December 29, 1995

Mr. Percy M. Beard, Jr.
Senior Vice President,
Nuclear Operations (NA2I)
Florida Power Corporation
ATTN: Manager, Nuclear
Licensing
15760 W Power Line Street
Crystal River, Florida 34428-6708

SUBJECT: REVIEW OF EPRI TC TOOLS FIRE MODEL - (TAC NO. M85541)

By letter dated August 8, 1995, you submitted information on the development and use of the EPRI Tailored Collaboration Fire Modeling Tools methodology. The staff has completed its review of the submittal. Our comments are attached.

At a public meeting on October 19, 1995, you indicated that the EPRI methodology would not be used as the basis for evaluating the performance of Thermo-Lag barriers installed to meet NRC fire protection requirements at Crystal River; therefore, unless you change your position on the use of the EPRI methodology you need not respond to the attached comments. Since Crystal River is a Nuclear Energy Institute application guide lead plant, however, it is appropriate to forward our comments to you. We request that you forward these comments to your contact at EPRI.

If Florida Power Corporation chooses to use this methodology as the basis for evaluating Thermo-Lag fire barriers in the future, the staff will conduct a through review of the development and application of the methodology and its supporting technical bases. If you have any questions regarding this matter, please contact me at (301) 415-1494.

Sincerely,

(Original Signed By)

George Wunder, Project Manager
Project Directorate II-1
Division of Reactor Projects - I/II
Office of Nuclear Reactor Regulation

Docket No. 50-302

Enclosure: As stated

cc w/enclosure: See next page

Distribution
Docket File ACRS
PUBLIC
PDII-1 RF
SVarga
JZwolinski
OGC

FILENAME - G:\CRYSTAL\85541.AI2

OFFICE	LA:PDII-1	PM:PDII-1	D:PDII-1		
NAME	EDunnington	GWunder	DMatthews		
DATE	12/29/95	12/29/95	12/29/95		
COPY	Yes/No	Yes/No	Yes/No		

9601040319 951229
PDR ADOCK 05000302
F PDR

DF01

040053

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

December 29, 1995

Mr. Percy M. Beard, Jr.
Senior Vice President,
Nuclear Operations (NA2I)
Florida Power Corporation
ATTN: Manager, Nuclear
Licensing
15760 W Power Line Street
Crystal River, Florida 34428-6708

SUBJECT: REVIEW OF EPRI TC TOOLS FIRE MODEL - (TAC NO. M85541)

By letter dated August 8, 1995, you submitted information on the development and use of the EPRI Tailored Collaboration Fire Modeling Tools methodology. The staff has completed its review of the submittal. Our comments are attached.

At a public meeting on October 19, 1995, you indicated that the EPRI methodology would not be used as the basis for evaluating the performance of Thermo-Lag barriers installed to meet NRC fire protection requirements at Crystal River; therefore, unless you change your position on the use of the EPRI methodology you need not respond to the attached comments. Since Crystal River is a Nuclear Energy Institute application guide lead plant, however, it is appropriate to forward our comments to you. We request that you forward these comments to your contact at EPRI.

If Florida Power Corporation chooses to use this methodology as the basis for evaluating Thermo-Lag fire barriers in the future, the staff will conduct a through review of the development and application of the methodology and its supporting technical bases. If you have any questions regarding this matter, please contact me at (301) 415-1494.

Sincerely,

George F. Wunder

George Wunder, Project Manager
Project Directorate II-1
Division of Reactor Projects - I/II
Office of Nuclear Reactor Regulation

Docket No. 50-302

Enclosure: As stated

cc w/enclosure: See next page

Mr. Percy M. Beard, Jr.
Florida Power Corporation

Crystal River Unit No. 3
Generating Plant

cc:
Mr. Rodney E. Gaddy
Corporate Counsel
Florida Power Corporation
MAC-A5A
P.O. Box 14042
St. Petersburg, Florida 33733

Mr. Bruce J. Hickle, Director
Nuclear Plant Operations (NA2C)
Florida Power Corporation
Crystal River Energy Complex
15760 W. Power Line Street
Crystal River, Florida 34428-6708

Mr. Robert B. Borsum
B&W Nuclear Technologies
1700 Rockville Pike, Suite 525
Rockville, Maryland 20852

Mr. Bill Passetti
Office of Radiation Control
Department of Health and
Rehabilitative Services
1317 Winewood Blvd.
Tallahassee, Florida 32399-0700

Attorney General
Department of Legal Affairs
The Capitol
Tallahassee, Florida 32304

Mr. Joe Myers, Director
Division of Emergency Preparedness
Department of Community Affairs
2740 Centerview Drive
Tallahassee, Florida 32399-2100

Mr. Robert G. Byram
Senior Vice President Nuclear
Pennsylvania Power and Light Company
2 North Ninth Street
Allentown, Pennsylvania, 18101

Mr. C. Randy Hutchinson
Vice President, Operations GGNS
Entergy Operations, Inc.
P.O. Box 756
Port Gibson, MS, 39150

Chairman
Board of County Commissioners
Citrus County
110 North Apopka Avenue
Iverness, Florida 34450-4245

Mr. Larry C. Kelley, Director
Nuclear Operations Site Support
(SA2A)
Florida Power Corporation
Crystal River Energy Complex
15760 W. Power Line Street
Crystal River, Florida 34428-6708

Senior Resident Inspector
Crystal River Unit 3
U.S. Nuclear Regulatory Commission
6745 N. Tallahassee Road
Crystal River, Florida 34428

Mr. Gary Boldt
Vice President - Nuclear Production
Florida Power Corporation
Crystal River Energy Complex
15760 W. Power Line Street
Crystal River, Florida 34428-6708

Regional Administrator, Region II
U.S. Nuclear Regulatory Commission
101 Marietta Street N.W., Suite 2900
Atlanta, Georgia 30323

Mr. Kerry Landis
U.S. Nuclear Regulatory Commission
101 Marietta Street, N.W. Suite 2900
Atlanta, Georgia 30323-0199

Mr. George A. Hunger, Jr.
Director, Licensing, MC62A-1
PECO Energy Company
Nuclear Group Headquarters
Correspondence Control Desk
P.O.Box 195
Wayne, Pennsylvania, 19087-0195

Mr. Alex Marion
Director, Engineering
Nuclear Energy Institute
1776 EYE St. N.W.
Washington, D.C., 20006-3708

Enclosure

COMMENTS BY THE OFFICE OF NUCLEAR REACTOR REGULATION
EPRI TC TOOLS METHODOLOGY FOR EVALUATING THERMO-LAG FIRE BARRIERS

I. Introduction

By letter dated August 8, 1995, Florida Power Corporation (FPC) submitted a non-proprietary version of information regarding the development and use of the EPRI Tailored Collaboration (TC) Fire Modeling Tools at Crystal River, Unit 3, in response to questions raised by the NRC staff during an April 25, 1995, public meeting on the subject, and a request for additional information dated July 6, 1995. The following questions and comments are based on NRC staff review of the submittal of August 8, 1995.

II. Total Heat Load Concept

1. The EPRI methodology assumes that the fire barrier material's thermal properties remain constant throughout the fire exposure. Thermo-Lag undergoes sublimation, chemical decomposition, and charring throughout the fire exposure. Therefore, it is not reasonable to assume that the thermal properties are constant.

2. The radiative heat transfer equations used by EPRI are based upon the furnace gas temperatures and the exposed surface temperatures of the barrier only ($q \sim T^4$). The exposed surface temperature is generally not of interest when evaluating fire barrier performance, only the unexposed surface temperature is of value. The heat transfer from the exposed surface to the unexposed surface of the barrier is primarily through conduction. Since instrumentation is generally not provided on either the exposed or unexposed surface of the barrier (instrumentation is provided on the raceway), no test data is available to validate the EPRI methodology. The methodology does not account for radiation from the furnace enclosure and the emissivity of materials/gases and shape factors that affect radiative heat transfer. Provide a technical basis for the assertion that radiative heat transfer estimates calculated solely on the basis of recorded average furnace gas temperatures are correct and bounding of all heat transfer between the furnace environment and the barrier assembly.

3. The total heat load concept assumes that fire exposures with an equal area under the incident heat-flux-time curve (BTU/ft^2 over time) equates to equal fire severity, and therefore, equal fire barrier performance. This assumption may be nonconservative for fires that develop more rapidly than the ASTM E-119 exposure. This assumption does not consider the different heat release/exposure rates and the corresponding effect that thermal shock and uneven heating due to a rapidly increasing fire would have on the performance of the fire barrier assembly. Provide a technical basis for the assumption that the total heat load concept is bounding for fires that develop more rapidly than the ASTM E-119 exposure.

4. Based on observations of several fire tests conducted by the NRC and industry involving Thermo-Lag fire barriers, it is apparent that the primary failure mechanism of Thermo-Lag barriers is the opening of the assembly due to structural failure at joints or burnthrough of the material. The opening of the barrier results in temperatures (either single point or average) inside the assembly exceeding the maximum specified by Supplement 1 to Generic Letter 86-10. Provide a discussion how the EPRI methodology addresses structural failures and barrier burnthrough.

III. Impact of Room Characteristics

1. The EPRI methodology asserts that the room configurations used to develop and test correlations used by FIVE can be shown to be conservative when applied to typical power plant compartments. However, this does not appear to be correct for at least the two following configurations:

a. The EPRI methodology assumes that the presence of intervening objects near the ceiling level will decrease the temperatures associated with the plume and ceiling jet and potentially shield the component of interest. This assumption may be nonconservative. The restriction to fluid flow due to an intervening object can result in higher localized temperatures in the hot gas layer (pseudo room concept). If the fire barrier is located in this area it may see a more severe exposure than that predicted by the EPRI methodology. Provide a description of how the methodology addresses localized "hot spots" due to obstructions.

b. The methodology assumes that the presence of a corner in the room will diffuse and distort the ceiling jet causing it to mix more quickly with the hot gas layer, thereby reducing the overall room temperature. This appears to conflict with the conclusions presented by Zukowski (1981) and Hasemi/Tolunga (1984), that for a plume near a wall or corner the entrained air flow is reduced and the temperature is increased. Please resolve the apparent conflict.

2. Identify any differences between laboratory experiments and typical room configurations that may not be conservative, such as the use of heat release rate data from bench-scale tests which do not account for the radiation of energy to the fuel from the compartment boundaries and the sensitivity of the EPRI method to this data. The use of heat release rate data from bench-scale tests, such as the cone calorimeter (ASTM E-1354), is generally limited to comparing the flammability properties of different materials used in a similar application, where the consideration of compartment effects is excluded from the analysis, such as different fabric coverings on furniture. Provide a discussion on the applicability of bench scale data to predicting full-scale fire performance in an actual nuclear power plant compartment.

IV. Effects of Forced Ventilation

1. The methodology does not account for the increase in mass flow into the plume as a result of an increase in the deflection angle of the plume which results in an effectively "taller" plume which corresponds to more rapid fire development, higher room temperatures, and quicker fuel exhaustion. Air entrainment is dependent upon flame height. Provide a technical basis that demonstrates the methodology is conservative and bounding to address flame deflection angle.

2. The cable flammability data referenced from the projects completed by Factory Mutual for EPRI may be in error (Ref.: Ltr. to EPRI from A. Tewarson, FMRC dated 5/10/95). Provide a discussion how this data is used in the methodology and the sensitivity of the methodology to cable flammability data.

3. Plume generated wind velocity is not discussed in the EPRI methodology. This phenomenon was present at the HDR fire tests conducted in Germany where the actual recorded compartment temperatures significantly exceeded those predicted by the fire models. The increase in the deflection angle of the plume resulted in higher room temperatures due to increased air entrainment. Provide a description of how plume generated wind velocity and its corresponding effects of fire severity are addressed by the methodology.

V. Fire Propagation of Cable Trays

1. The EPRI methodology assumes an ignition temperature of 932° F for IEEE 383 rated cables. Sandia National Laboratory reported a piloted ignition temperature of less than 617° F for IEEE 383 rated cables in NUREG/CR 5546. Provide a sensitivity analysis for the methodology using the more conservative flammability data reported by Sandia.

VI. Combustibility and Flame Spread of Thermo-Lag in Hazard Tool

1. No technical basis is provided for the assumption that a burning efficiency of 0.5 to 0.7 is appropriate for Thermo-Lag. It is not clear how observed fire tests of Thermo-Lag barriers support this assumption. Provide a technical basis for this assumption.

2. The methodology states that in furnace tests the Thermo-Lag is burning if it is in an environment above 1000° F. In the fire endurance tests of Thermo-Lag barriers witnessed by the staff, the material ignited in less than 2 minutes, at this point the average furnace temperature is less than 500° F. Provide a sensitivity analysis for the methodology using a more conservative ignition temperature of 500° F.

VII. Overview of the Development of the Tool

1. The EPRI Tool focuses on the behavior of individual barrier segments to determine the fire rating of an entire assembly. The staff believes that the interface points between segments and the thermal mass enclosed

within the barrier are also important in establishing the fire rating of an assembly. These factors do not appear to be addressed by the EPRI Tool. Provide a discussion of how the methodology addresses interfaces between segments and the thermal mass enclosed within the barrier assembly.

2. The EPRI Tool implies that the configurations tested by NEI, TVA and TU Electric were similar. Although similar raceway configurations (e.g., 2-inch diameter conduit with LBDs in a U-shape) were tested, the test assemblies were significantly different. This was due largely to the different methods of fire barrier assembly. Provide a discussion of how the different methods of assembly that affect fire endurance performance and the structural integrity of the assembly are addressed by the EPRI methodology.

3. The staff position on important installation parameters is documented in the request for additional information of December 1993. These parameters were agreed to with NEI during the industry test program of Thermo-Lag fire barrier assemblies. The limited set of parameters identified in the EPRI methodology are not adequate to evaluate barrier performance.

4. The figures regarding postulated fire ratings for various fire barrier segments and configurations, which were discussed during the April 25, 1995 meeting, were not included in the non-proprietary version of the EPRI methodology. However, as discussed during the meeting, it does not appear that the limited test data, from dissimilar test assemblies and segments is adequate for deriving the figures. This staff concern was not addressed in the submittal of August 8, 1995.