March 23, 1998

Mr. T. F. Plunkett
President - Nuclear Division
Florida Power and Light Company
P.O. Box 14000
Juno Beach, Florida 33408-0420

SUBJECT: TURKEY POINT UNITS 3 AND 4 - REQUEST FOR ADDITIONAL INFORMATION RELATED TO FLORIDA POWER AND LIGHT'S EXEMPTION REQUEST FROM SECTION III.G.2 OF APPENDIX R TO 10 CFR PART 50, FIRE RATING FOR ELECTRICAL RACEWAY FIRE BARRIER SYSTEMS USED IN THE TURBINE BUILDING AREAS (TAC NOS. M99324 AND M99325)

Dear Mr. Plunkett:

By letter dated July 31, 1997, Florida Power and Light requested an exemption, for Turkey Point 3 and 4, from the requirements of Section III.G.2.a of Appendix R to 10 CFR Part 50 for raceway fire barriers in the turbine building.

The NRC staff has reviewed your exemption request and concluded that additional information, as outlined in the enclosure, is needed before we can complete our review. A timely response to this request to accommodate your planned implementation date is appreciated. If you have any questions regarding this matter, please contact me at (301)415-1496.

Sincerely,

/s/

Kahtan N. Jabbour, Senior Project Manager
Project Directorate II-3
Division of Reactor Projects - I/II
Office of Nuclear Reactor Regulation

Docket Nos. 50-250
and 50-251

Enclosure: As stated

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

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FLORIDA POWER AND LIGHT
TURKEY POINT UNITS 3 AND 4
REQUEST FOR EXEMPTION TO SECTION III.G.2.a OF APPENDIX R
THERMO-LAG FIRE BARRIERS IN TURBINE BUILDING AREAS
REQUEST FOR ADDITIONAL INFORMATION
(DOCKET NOS. 50-250 AND 50-251)

1.0 INTRODUCTION

By letter dated July 31, 1997, Florida Power and Light (FPL), the licensee for Turkey Point Units 3 and 4, requested an exemption from the requirements of Section III.G.2.a of Appendix R to 10 CFR Part 50 for raceway fire barriers in the turbine building.

FPL, in this exemption request has requested the Nuclear Regulatory Commission to approve the use of the following fire protection schemes in lieu of the fire protection features required by Section III.G.2.a of Appendix R to 10 CFR Part 50:

a. Separation of cables and equipment and associated non-safety circuits of redundant trains within the turbine building between column lines A and E by a fire barrier having a 1-hour rating. Automatic fixed water spray fire suppression systems are provided for the major combustible sources and turbine lube oil equipment and automatic wet pipe sprinklers are provided for area coverage including turbine lube oil distribution piping. However, no automatic fire detection is provided for this area.

b. Separation of cables and equipment and associated non-safety circuits of redundant trains within the turbine building and adjoining areas between column lines E and J_c by a fire barrier having a 25-minute rating. Automatic wet pipe sprinkler coverage is provided between column line E and J. However, no fire detection is provided for the area between column lines E and J_c.

c. Separation of cables and equipment and associated non-safety circuits of redundant trains within the turbine building and adjoining areas between column lines E and J_c by a horizontal distance of more than 20 feet with no significant intervening combustibles. Automatic wet pipe sprinkler coverage is provided between column line E and J. However, no fire detection is provided for the area between column lines E and J_c.

This request for additional information is concerned with the above separation schemes and the scope of their use.

2.0 REQUEST FOR ADDITIONAL INFORMATION

In order to support the staff's review of the requested exemption, the following additional information is requested:

a. FPL, in their letters L-94-146 dated June 15, 1994, and L-96-318 dated December 12, 1996, specified that for the major-in-situ combustibles in outside areas such as the turbine lube oil system, turbine lube oil reservoirs, and transformers (which are

protected by automatic suppression systems), 25-minute fire barriers would not be allowed within 50 feet of these major sources. In addition FPL, in their letter L-96-318, claimed that maintaining a 50-foot separation from major combustible provides additional assurance that a fire will not challenge a 25-minute fire barrier. Imposing their 50-foot separation logic, FPL committed to provide 1-hour fire barriers for one train of redundant post-fire safe shutdown trains that pass through these designated 50-foot separation zones.

In its letter L97-181 dated July 31, 1997, FPL acknowledged that in the event of a low-pressure turbine and/or generator lube oil leak as a result of a gross bearing seal failure, the fire loading in the turbine building could be significant. In addition, FPL acknowledged that leaking lube oil from the generator, exciter, and /or low pressure turbine bearings would fall directly into the condenser pit and bearing oil leakage would flow to the drains or to the condenser sump on the east side of the turbine. FPL, in this letter, also committed to install automatic wet pipe sprinkler coverage on the east side of the turbines between column lines E and J in the turbine building.

In reviewing the layout of the turbine, the condenser pit, and the location of the condenser pit sump and applying the FPL 50-foot separation zone criteria to the east side of the turbine, the 50-foot zone would extend out from the side of the turbine condenser to the turbine building J_c column line.

The fire protection schemes proposed by the FPL (see Section 1.0 above) utilize electrical raceway fire barriers system (ERFBS) for the protection of post-fire safe capability. An ERFBS with a 1-hour fire resistive rating will be used in the turbine building for the protection of one train of redundant shutdown trains located between column lines A and E and a 25-minute fire resistive rating in the turbine building between column line E and J_c. Where more than 20 feet of horizontal distance exists between redundant post-fire safe shutdown trains, without significant intervening combustibles, a fire resistive barrier will not be provided.

The protection schemes proposed by FPL in its exemption request (refer to FPL letter L-97-181, dated July 31, 1997) is contrary to the protection scheme it committed to for major-in-situ combustibles (refer to FPL L-94-146 and L-96-318) and does not appear to provide an equivalent level of fire safety. The staff considers the potential fire threat to plant safety from a fire involving one of the major-in-situ combustibles (e.g., main transformer, turbine lube oil reservoir) to be less than the plant challenges that could result from a major turbine fire event. Based on the potential fire conditions associated with the major-in-situ fire hazards and the turbine fire hazards address the following:

(1) Describe the fire threat posed by a challenging fire involving the turbine building related to each major-in-situ combustible and what adverse affects these fires would have operationally on the plant. In addition, describe the post-fire safe shutdown functions that are in the 50-foot zones associated with each of these major-in-situ combustibles and, for cases where redundant post-fire safe shutdown functions are in the zone, describe which function will be protected by 1-hour fire barrier system. On a drawing, show the general location and routings of each shutdown function in each of these zones of concern.

(2) Describe the fire threat posed by a challenging fire involving a turbine failure and resulting fire event and what adverse affects this fire would have operationally on the plant. In addition, describe the post-fire safe shutdown functions that are located between column lines A and E and between column lines E and J_c. For the turbine building area between column lines A and E, if redundant post-fire safe shutdown functions are located in this area describe which function will be protected by 1-hour fire barrier system and on a drawing show their general locations and routings within the area. For the turbine building area between column lines E and J_c, if redundant safe shutdown factions or trains are located in this area describe the functions protected by 25-minute fire rated barriers and on a drawing show their general locations and routings within the area. With respect to the proposed 20-foot separation scheme, for the turbine building area between column lines E and J_c, describe the functions afforded the proposed spacial separation and on a drawing show their general locations and routings within the area.

(3) For a turbine fire event, certain areas between column lines A and E could be significantly challenged by a lube oil fire and within this area. Post-fire safe shutdown functions will be protected by 1-hour rated ERFBSs and could be subject to direct flame impingement and engulfment. Within the area of concern identify the raceway protected by a 1-hour rated ERFBS which could potentially be engulfed or impinged by the fire. In addition, it is the staff's understanding that the current ERFBSs in this area of concern will be upgraded to 1-hour designs which were subjected to ASTM E-119 standard time-temperature curve conditions for 1 hour. The fire exposure represented by the ASTM E-119 time temperature curve does not bound the potential fire exposure conditions resulting from flammable/combustible liquid fires. ASTM E-1529 time temperature curve is generally used to bound these types of fire exposures. In the area of concern, i.e.,where the potential exists for an ERFBS to be subject to fire engulfment or flame impingement, provide an evaluation which assesses the fire resistive performance of the proposed fire barrier design when exposed to the ASTM E-1529 time-temperature environmental conditions.

b. National Fire Protection Association (NFPA) Standard 850, "Fire Protection for Fossil Fueled Steam and Combustion Turbine Electric Generating Plants," 1992, recommends a minimum level of fire protection for turbines-generators and its systems. Specifically this standard recommends the use of water suppression systems, specifies the level of protection needed for the hazards and the building and specifies suppression system performance criteria. Using this standard, perform an evaluation which compares the Turkey Point Units 3 and 4 turbine fire protection features (provided and proposed) against those recommended by NFPA 850. This evaluation should identify and describe where the Turkey Point Units 3 and 4 turbine fire protection features deviate from the criteria specified by the standard and the appropriate justification for these deviations.

c. Generally, sprinkler systems are used for fire control and are not normally designed for the extinguishment of oil fires. In order to extinguish a fully developed

oil fire with water, a properly designed water spray system with open head nozzles, is needed. The system design needs to consider energy output from the burning fuel and its configuration when burning. The burning characteristics dictate the distance the nozzle can be located from the hazard, the spacing between the nozzles, the required velocity of the water spray and rate of discharge from each systems nozzle. FPL in their supporting analysis for the exemption references a Factory Mutual Research Corporation Report, "Fire Tests of Automatic Sprinkler Protection for Oil Spill Fires," dated September 9, 1957, and summarized the observations made by this report. This summary suggests that sprinklers would be effective at controlling the hot gas layer of an oil spill fire. The staff would like to review this report in detail in order to understand the insights and its applicability to fire conditions resulting from a turbine failure event. The NRC staff requests that the referenced report and other referenced reports (e.g., V. Babrauskas, "Temperatures in Flames and Fires," May 1997) be provided to support its for review of the exemption request.

d. In a letter dated August 11, 1994, the NRC advised FPL that performance based approaches would not be considered by the staff as means to resolve the Thermo-Lag fire barrier issues. Nevertheless, FPL used fire modeling calculations to support its exemption request. These calculations were based on a limited postulated fire condition resulting from the failure the hydrogen oil seals on the generator and that the resulting lube oil fire is confined initially to the area under the generator between column lines B and D. The fire modeling calculation bases are limited in that they did not recognize other contributing factors such as the hydrogen burn from the seal failure but also from the hydrogen gas cylinders installed in the area of fire influence and from the potentially broken insulators on the generator end of the isophase bus duct. In addition, it needs to be recognized that some level of fire damage will result to the energized electrical equipment (MCC 3A, neutral cell, isophase bus, potential transformer 3G07) and fire and electrical contribution added by these electrical hazards are uncertain. The staff is also concerned that FPL's postulated fire did not consider other oil leakage sites (e.g., bearing assemblies at the low pressure to low pressure turbine interface and low pressure turbine to generator interface) and the potential for fires occurring at these sites.

   FPL's fire predictions were based on theoretical calculations for heat release, ceiling jet at 12'-0" and 18'-0" ceiling elevations, ceiling jet velocity, and flame height. The overall fire prediction is based on a 28-minute duration, which is based on the assumption that the oil leak will not exceed 450 gallons per minute and that during generator coast down the 10,000 gallon oil reservoir would be depleted in 23 minutes. FPL also assumed that manual fire control would be implemented within 5 minutes and that hose stream flow would provide additional heat removal from the fire.

   In the fire prediction, from 6 minutes to 23 minutes, FPL limits the amount of lube oil available for combustion at a constant 1667 gallons. FPL assumed this constant rate on the basis of that additional leakage flows into to the condenser and

69 MW[1] and is controlled at a constant 34 MW after sprinkler activation. Within 2 minutes of the start of the fire FPL, predicts that the ceiling jet temperatures at the 12'-0" high ceiling under the turbine generator will be 4546 °F at 3' from the centerline of the fire and 1306 °F at 22' away (D column line). The ceiling jet temperatures on the other side of D column line, where the ceiling transitions from 12'-0" to 24'-0", is predicted by FPL to be 1200 °F and 750 °F at the J column line (57 feet from the centerline of the fire). After sprinkler actuation (4 minutes after the start of the fire) FPL predicts that the temperature will be reduced to 2895 °F at 3' from the centerline of the fire, 854 °F at the D column line, 369 °F near the ceiling transition to 24'-0", and 293 °F at the J column line.

In order to evaluate this prediction and the area of influence made by this prediction, the staff requests the following:

(1) From its review, the NRC staff is concerned that the fire predictions made by FPL may not be conservative and that the general reduction of heat release from a fire by the combination of factors noted in the submittal is not a recognized fire modeling practice. In order to understand the fire conditions bounded by the FPL fire predictions, provide the supporting assumptions and their technical basis, the fire prediction calculations, a summary of the uncertainties associated with these fire predictions, and any experimental data which would provided validation for these predictions. In addition, provide your technical basis for the assumption that a five man fire brigade is capable of applying sufficient water from manual hose lines (i.e., within 5 minutes) to be effective in the control and extinguishment of a significant turbine building fire.

(2) Based on the predicted ceiling jet temperatures predicted it appears that the area of sprinkler actuation may be underestimated and that the actual water demand may be greater than estimated. Provide the analysis supporting the 0.3 gpm/3000 square foot of floor area design for the general area sprinklers provided in the turbine building. In addition, based on FPL fire predictions, the fire could cause sprinkler actuation on multiple levels of the turbine building (elevation 30'-0", hydrogen seal oil unit, auxiliary transformer, condenser pit). Provide the water supply analysis which demonstrates that the fire water system has sufficient

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1 FPL assumed a 75% reduction in heat release rate of the fire due to full coverage of the sprinklers over the postulated oil pool, large area of the ceiling is open to the atmosphere, fire-induced vulnerability evaluation methodology allows a 70% reduction in heat release due to heat absorption in enclosures, large pool fires exhibit incomplete combustion, and burning fuel in the condenser pit is entrained into the condenser pit and aids in flame smothering and cooling. The staff considers the uncertainty with this reduction factor to be high.

capability and capacity to supply fire fighting water to the fire systems and to hose lines for manual fire fighting.

(3) The temperatures predicted may not be conservative and bounding. The uncertainties associated with these fire predictions and their predicted temperatures may have led to under estimations of the resulting conditions. These temperatures may not be conservatively bounding. The current predictions indicate a concern that temperatures may exceed the operability threshold of plant equipment in the area of fire concern. For those safe shutdown functions not protected by ERFBS between column lines E and J_c and that can be affected by direct and indirect fire damage (e.g., ceiling jet temperatures, radiant energy, and smoke), provide the engineering analysis that demonstrates sufficient fire protection defense-in-depth diversity is factored into the overall fire protection design such that one train of shutdown capability will remain functional.