Florida Power & Light Company, P.O. Box 128, Fort Pierce, FL 34954-0128

FPL

February 12, 1996

L-96-28
10 CFR 50.4

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, D. C. 20555

RE: St. Lucie Units 1 and 2
Docket Nos. 50-335 and 50-389
Response to Request for Additional
Information Generic Letter 92-08

Our response to the additional information you requested from Florida Power and Light Company (FPL) on October 6, 1995, concerning the ampacity derating of circuits protected by Thermo-Lag 330-1 at St. Lucie is attached. Attachment 2 provides a review of the FPL responses to this issue. The original St. Lucie response to Generic Letter (GL) 92-08, *Thermo-Lag 330-1 Fire Barriers*, was submitted by FPL letter, L-93-96 on April 16, 1993, and supplemented in response to your requests for additional information (RAI) dated December 20, 1993, August 9, 1994 and December 28, 1994, by FPL letters, L-94-33 dated February 11, 1994, L-94-104 dated April 29, 94, L-94-275 dated November 4, 1994, L-95-101 dated March 28, 1995, and L-95-286 dated October 27, 1995.

On October 16, 1995, NRC provided FPL a copy of a letter to the Nuclear Energy Institute (NEI) which discussed the NRC position on ampacity derating test parameters. Further FPL progress on resolving the ampacity derating issues will be included in our August 30, 1996 update to the NRC on Thermo-Lag.

Please contact us if there are any questions about this submittal.

Very truly yours,

W. H. Bohlke
Vice President
St. Lucie Plant

WHB/GRM

Attachments

cc: Stewart D. Ebneter, Regional Administrator, Region II, USNRC
Senior Resident Inspector, USNRC, St. Lucie Plant

A029

Attachment 1

NRC Request for Additional Information dated October 6, 1995

NRC REQUEST:

Please submit the anticipated test procedures or alternatively, a description of the analytical methodology including typical calculations which will be used to determine the ampacity derating parameters for the Thermo-Lag fire barriers that are installed at St. Lucie Units 1 and 2.

FPL RESPONSE:

Original Design For the original installation of Thermo-Lag on conduits, calculations were performed to ensure that adequate cable ampacity was available for the expected cable loading. One such calculation[1] prepared for Unit 1 in April 1984, used the following:

CA × DF > LA,

where:

CA = cable rated ampacity for given cable size,
DF = derating factor 3 hour fire wrap, and,
LA = load amperes,

and included these assumptions,

- Cable rated ampacity is based on 3 conductors routed in conduit in free air.
- Battery main cables are sized using battery profile, one hour current plus battery capacity margin.
- Cable ampacity is based on 90°C conductor temperature.
- The vendor published ampacity derating factor is 11%. A heat transfer calculation found 10% to be acceptable. A derating factor of 15% was used for conservatism.

For the cables analyzed in the above calculation, the calculated ampacity was always determined to be in excess of the cable loadings.

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[1] Calculation 6000.100, "Fire Wrapped Conduits Cable Ampacity", PCM 268-183, April 1984.

The heat transfer calculation[2], used as the basis for the 15% ampacity derating factor in the above described calculation, was intended to provide one ampacity derating factor that would bound the range of conduit/cable configurations wrapped with Thermo-Lag. The calculation includes heat transfer analyses of five conduit/cable configurations using conduit sizes from 1.5"-4.0" containing varying number of cables, cable sizes, cable insulation thicknesses and cable loadings. For each conduit/cable configuration, three cases were analyzed using maximum conductor surface temperature as the figure of merit:

1) The first case determined the conductor temperature without fire protection wrap. Using ambient temperature (40°C) and published cable ampacity as input, the temperature profile of the conduit/cable configuration was calculated. (Note that published cable ampacity includes a derate to account for the cable's presence in conduit.)

2) The second case determined the conductor temperature with a 1" Thermo-Lag conduit wrap. Similar to the first case, using ambient temperature (40°C) and published cable ampacity as input, the temperature profile of the cable/conduit configuration, which includes Thermo-Lag, was calculated.

3) The third case determined the conductor temperature with a 1" Thermo-Lag conduit wrap and a 10% derated ampacity to account for the Thermo-Lag wrap on the conduit. Similar to the second case, using ambient temperature (40°C) and published cable ampacity as input, the temperature profile of the cable/conduit configuration, which includes Thermo-Lag and 10% derating, was calculated.

Results show that for each of the five conduit/cable configurations analyzed, the conductor temperature for the first case (without Thermo-Lag wrap) was less than the second case (Thermo-Lag wrap). This is expected since the heat source within the conductor is the same and the thermal resistance of the conduit/cable configuration has been increased.

Results also show that the conductor temperature for the second case (Thermo-Lag wrap) is greater than the third case (Thermo-Lag wrap and 10% ampacity derating). This is also expected since the heat source has been reduced.

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[2] Calculation 2800.612, "Calculations to Determine the Derating Factor for Cables with Fire Barriers", April 1984.

Finally, results show that the conductor temperature for the third case (Thermo-Lag wrap and 10% ampacity derating) is less than the first case (w/o Thermo-Lag wrap). This comparison shows that a 10% ampacity derating to account for Thermo-Lag is reasonable since it results in a lower conductor temperature when compared to conduit/cable configurations without Thermo-Lag.

GL 92-08 Actions In early 1993, ampacity derating calculations[3] were performed in response to the information requests of GL 92-08. The calculations involved determining the available margin between the expected cable loading and cable ampacity. A review was performed of all power cables (except for motor operated valves since their time at power is very small) wrapped with Thermo-Lag for St. Lucie Units 1 and 2. This review included conduit wrapped for the purposes of fire protection or electrical separation. Both the expected cable loading and ampacity rating (with and without Thermo-Lag) were investigated. Relevant calculations from original installation of Thermo-Lag were used as appropriate. After applying a 15% derating factor consistent with previous heat transfer analyses, ampacity margin for the limiting cables on Unit 1 and Unit 2 were determined to be 29% and 43%, respectively. The 15% ampacity derating factor was also supported by industry test results involving three hour Thermo-Lag wrapped conduit which showed a maximum derating factor of about 10%[4,5,6].

Future Activities In addition to the activities completed as described above, FPL has activities planned to resolve ampacity derating for St. Lucie Units 1 and 2. These activities, which are scheduled to be completed by the end of the third quarter of 1996, are outlined below:

1) Calculations and evaluations performed to date to address ampacity derating associated with Thermo-Lag wrapped conduits will be re-verified and re-documented to confirm that methods and assumptions remain valid when considering new information.

2) An evaluation will be performed which will compare the St. Lucie Units 1 and 2 installed Thermo-Lag to the Texas

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[3] Calculation PSL-BFJE-93-002, "Ampacity Derating Response to NRC GL 92-08 for Cable Routed in Conduits with Thermo-lag 330-1 Fire Barrier System Coating", March 1993.

[4] TSI/ITL Test 11781, "Ampacity Tests on 2 inch Conduits with Thermo-Lag 330-1", October 24, 1981.

[5] TSI/ITL Test 84-10-5, "Ampacity Tests on 2 inch Conduits with Thermo-Lag 330-1", October 1984.

[6] UL Tests, 86NK23826, "Ampacity in Trays & Conduit with Thermo-Lag 330-1", January 21, 1987.

Utilities tested configurations[7] to determine if the testing bounds the St. Lucie configurations. If not, FPL will identify and address the differences. Where credible analytical methods can be applied to differences, adjustments will be made to derating calculations and analyses to ensure that ampacity derating factors remain conservative. If analytical methods are not applicable, further testing may be required.

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[7] NRC Safety Evaluation: "Safety Evaluation of Ampacity Issues Related to Thermo-Lag Fire Barriers at Comanche Peak Steam Electric Station, Unit 2", June 14, 1995.

ATTACHMENT 2

Review of Previous Ampacity Derating Responses

I. FPL first provided technical information related to cable ampacity derating in a letter to the NRC dated April 16, 1993 [1] responding to the NRC Generic Letter 92-08 dated December 17, 1992[2].

NRC Requested Action

2.(c) State

(1) whether or not the as-built Thermo-Lag 330-1 barrier configurations are consistent with the barrier configurations used during the ampacity derating tests relied upon by the licensee for the ampacity derating factors used for all raceways protected by Thermo-Lag 330-1 (for fire protection of safe shutdown capability or to achieve physical independence of electrical systems) and

(2) whether or not the ampacity derating results relied upon by the licensee are correct and applicable to the plant design.

FPL Response

2.(c)(1)

St. Lucie Units 1 and 2 protect conduits (not trays), with regard to raceway protection. The following ampacity derating tests for conduits are applicable to the St. Lucie design:

TSI/ITL Tests:

(a) Test 11781, dated October 1981, on a 2 inch steel conduit with a one hour fire barrier, determined a 7.47% derating due to Thermo-Lag 330-1.

(b) Test 84-10-5, dated October 1981, on a 2 inch steel conduit with a three hour fire barrier, determined a 9.72% derating due to Thermo-Lag 330-1.

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[1] FPL Letter to NRC, "Generic Letter 92-08 Response", L-93-96, April 16, 1993.

[2] NRC Generic Letter 92-08, "Thermo-Lag 330-1 Fire Barriers", December 17, 1992.

Underwriters Laboratory (UL) Tests:

(a) Test 86NK23826, dated January 1987, on a 4 inch steel conduit with a one hour Thermo-Lag 330-1 fire barrier, determined a 0.0% ampacity derating (ie: within the accuracy of the test).

(b) Test 86NK23826, dated January 1987, on a 4 inch steel conduit with a three hour Thermo-Lag 330-1 fire barrier, determined a 9.4% ampacity derating (ie: within the accuracy of the test).

The UL tests were performed after the St. Lucie design, but the results are bounded by the TSI/ITL test results. All the power circuits routed in conduits protected with Thermo-Lag 330-1 at the St. Lucie Units 1 and 2 have been evaluated. After applying a 15% derating factor for all the cables in Thermo-Lag enclosed conduits, the worst case ampacity margin is 29% for Unit 1 and 43% for Unit 2. This provides for a substantial margin over the circuit ampacity requirements.

2.(c)(2)

FPL is aware of the NRC concern regarding the apparent inconsistent ampacity derating results on cable trays. One of the NEI Thermo-Lag tasks is to perform additional ampacity derating tests (on conduit and cable trays) to resolve this issue. NEI is working with the NRC on an acceptable test methodology. When the testing is complete and accepted by the NRC, FPL will ensure that the results remain within design parameters.

II. FPL next provided technical information related to ampacity derating in a letter to the NRC dated February 11, 1994 [3], responding to an RAI from the NRC dated December 20, 1993 [4].

NRC REQUEST (IV.B.1)

For the barriers described under Item I.B.1, describe those that you have determined will fall within the scope of the NUMARC [NEI] program for ampacity derating, those that will not be bounded by the NUMARC [NEI] program, and those for which ampacity derating does not apply.

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[3] FPL letter to NRC, "Generic Letter 92-08 Response", L-94-33, February 11, 1994.

[4] NRC letter and enclosure, "Request for Additional Information", December 20, 1993.

FPL Response (IV.B.1.)

St. Lucie raceways containing power cables protected by Thermo-Lag barriers fall within the scope of the NEI program for ampacity derating. Conduits requiring protection with Thermo-Lag 330-1 have been evaluated. After applying a 15% derating factor (based on TSI/ITL ampacity derating tests, as discussed in our April 16, 1993 response to GL 92-08) for all Thermo-Lag enclosed conduits, the remaining worst case ampacity derating margin is 29%. This provides a substantial margin over the circuit's ampacity requirements.

Further ampacity derating tests are planned as part of the NEI Thermo-lag program. NEI and the NRC are working on an acceptable test methodology. When the NEI sponsored testing is completed and accepted by the NRC, we will ensure that the results relative to each application of Thermo-Lag are acceptable. We are confident that the results will continue to demonstrate that substantial margin over requirements.

NRC REQUEST (IV.B.2)

For the barriers you have determined fall within the scope of the NUMARC [NEI] program, describe what additional testing or evaluation you will need to perform to derive valid ampacity derating factors.

FPL Response (IV.B.2.)

Due to the margin shown in FPL ampacity derating calculations on Thermo-Lag protected circuits, we are not anticipating any additional FPL evaluation or testing beyond the NEI sponsored testing program.

NRC REQUEST (IV.B.3)

For the barrier configurations that you have determined will not be bounded by the NUMARC [NEI] test program, describe your plan for evaluating whether or not the ampacity derating test relied upon for the ampacity derating factors used for those electrical components protected by Thermo-Lag 330-1 (for protecting the safe-shutdown capability from fire or to achieve physical independence of electrical systems) are correct and applicable to the plant design. Describe all corrective actions needed and submit the schedule for completing such actions.

FPL Response (IV.B.3.)

See response to IV.B.1.

NRC REQUEST (IV.B.4)

In the event that the NUMARC [NEI] fire barrier test indicate the need to upgrade existing in-plant barriers or to replace existing Thermo-Lag barriers with another fire barrier system, describe the alternative actions you will take (and the schedule for performing those actions) to confirm that the ampacity derating factors were derived by valid tests and are applicable to the modified plant design.

FPL Response (IV.B.4.)

We do not plan to replace the present raceway fire barrier material with another type. Ampacity derating testing is scheduled to be performed by NEI using additional thicknesses of Thermo-Lag. Due to the low thermal resistance of Thermo-Lag in non-fire application, a substantially different ampacity derating is not anticipated. However, as identified in the prior correspondence, ampacity margins at St. Lucie Unit 1, using design and construction criteria, are sufficiently large to encompass proposed ampacity derating well over that presently tested.

III. FPL last provided technical information related to cable ampacity derating in a letter to the NRC dated March 28, 1995 [5] responding to an RAI from the NRC dated December 28, 1994 [6].

NRC REQUEST 1: Thermo-Lag Materials

a. Describe the specific tests and analyses that will be performed to verify that the Thermo-Lag fire barrier materials that are currently installed at St. Lucie 1 and 2, or that will be installed in the future, are representative of the materials that were used to address the technical issues associated with Thermo-Lag barriers and to construct the fire endurance and ampacity derating test specimens. The tests and analyses shall address the material properties and attributes that were determined or controlled by TSI during the manufacturing process and the quality assurance program. The tests and analyses shall also address the material properties and attributes that contribute to conclusions that the Thermo-Lag materials and barriers conform to NRC regulations. These include:

(1) chemical composition

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[5] FPL letter to NRC, "Request for Additional Information, Generic Letter 92-08 Response", L-95-101, March 28, 1995.

[6] NRC letter and enclosure, "Request for Additional Information", December 28, 1994.

(2) material thickness
(3) material weight and density
(4) the presence of voids, cracks, and delaminations
(5) fire endurance capabilities
(6) combustibility
(7) flame spread rating
(8) ampacity derating
(9) mechanical properties such as tensile strength, compressive strength, shear strength, and flexural strength.

FPL Response 1.a

(8) Ampacity Derating

Ampacity derating has been addressed by FPL in existing calculations. FPL believes that there is sufficient margin in these calculations with regards to ampacity derating to bound any testing which may be performed. After an acceptable approach and test methodology has been agreed upon and testing has been performed, FPL will review these test results to determine if there is any impact on existing calculations.