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

December 19, 2008

Mr. J. A. Stall
Senior Vice President, Nuclear and
Chief Nuclear Officer
Florida Power and Light Company
P.O. Box 14000
Juno Beach, Florida 33408-0420

SUBJECT: TURKEY POINT NUCLEAR PLANT, UNIT 4 - GENERIC LETTER 2004-02, "POTENTIAL IMPACT OF DEBRIS BLOCKAGE ON EMERGENCY RECIRCULATION DURING DESIGN BASIS ACCIDENTS AT PRESSURIZED WATER REACTORS," REQUEST FOR ADDITIONAL INFORMATION (TAC NO. MC4726)

Dear Mr. Stall:

By letters dated February 28, 2008 and August 11, 2008 (Agencywide Documents Access and Management System (ADAMS) Accession Nos. ML080710429 and ML082310488), Florida Power and Light (the licensee) submitted a supplemental response to Generic Letter (GL) 2004-02, "Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized Water Reactors," for Turkey Point, Unit 4.

The U.S. Nuclear Regulatory Commission (NRC) staff has reviewed the licensee's submittals. The process involved detailed review by a team of approximately 10 subject matter experts, with a focus on the review areas described in the NRC's "Content Guide for Generic Letter 2004-02 Supplemental Responses" (ADAMS Accession No. ML073110389). Based on these reviews, the NRC staff has determined that additional information is needed in order to conclude there is reasonable assurance that GL 2004-02 has been satisfactorily addressed for Turkey Point, Unit 4. The enclosed document describes these requests for additional information (RAIs).

The NRC requests that the licensee respond to these RAIs within 90 days of the date of this letter. If the licensee concludes that more than 90 days are required to respond to the RAIs that are being addressed by new testing, the licensee should request additional time, including a basis for why the extension is needed.

The exception to the above response timeline is RAI 31 in the enclosure. The NRC staff considers in-vessel downstream effects to not be fully addressed at Turkey Point, Unit 4, as well as at other pressurized water reactors. The licensee's submittal refers to draft WCAP-16793-NP, "Evaluation of Long-Term Cooling Considering Particulate, Fibrous, and Chemical Debris in the Recirculating Fluid." At this time, the NRC staff has not issued a final safety evaluation (SE) for WCAP-16793.

The licensee may demonstrate that in-vessel downstream effects issues are resolved for Turkey Point, Unit 4, by showing that the licensee's plant conditions are bounded by the final WCAP-16793 and the corresponding final NRC staff SE, and by addressing the conditions and limitations in the final SE. The licensee may also resolve RAI 31 by demonstrating, without reference to WCAP-16793 or the NRC staff SE, that in-vessel downstream effects have been addressed at Turkey Point, Unit 4. The specific issues raised in RAI 31 should be addressed regardless of the approach the licensee chooses to take.

The licensee should report how it has addressed the in-vessel downstream effects issue and the associated RAI referenced above within 90 days of issuance of the final NRC staff SE on WCAP-16793. The NRC staff is currently developing a Regulatory Issue Summary to inform licensees of the staff's expectations and plans regarding resolution of this remaining aspect of Generic Safety Issue 191, "Assessment of Debris Accumulation on PWR Sump Performance."

Sincerely,

Brenda T Mozafari

Brenda L. Mozafari, Senior Project Manager
Plant Licensing Branch II-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-251

Enclosure: As stated

cc w/encl: Distribution via ListServ

TURKEY POINT NUCLEAR PLANT 4

REQUEST FOR ADDITIONAL INFORMATION

SUPPLEMENTAL RESPONSES TO GENERIC LETTER (GL) 2004-02

DOCKET NO. 50-251

DATED FEBRUARY 28 AND AUGUST 11, 2008

1. Please provide clarification of whether the containment spray system (CSS) is required to operate in recirculation mode for a secondary system high energy line break (HELB). If the CSS is required to operate in recirculation mode following a secondary system HELB, please describe your evaluation of this event including the performance of the new sump strainer.

2. Please provide your evaluation that establishes that breaks at or near the reactor nozzle will not result in a more limiting debris generation condition than the breaks presented in the supplemental response. Please describe the insulating material(s) for the reactor vessel.

3. Please provide a description of the jacketing/banding systems used to encapsulate steam generator Nukon insulation at Turkey Point 4 and during the applicable jacketing/banding system qualification testing. The information should include the jacket materials used in the testing, geometries and sizes of the targets and jet nozzle, and materials used for jackets installed on the steam generators. Please provide information that compares the mechanical configuration and sizes of the test targets and jets, and the potential targets and two-phase jets in the plant. Please evaluate how any differences in jet/target sizing and jet impingement angle affect the ability of the insulation system or systems to resist damage from jet impingement. In doing so, please provide a justification for applying debris generation test data obtained for the insulation jacketing systems employed at the Wolf Creek and Callaway reactor plants to the jacketing systems used at Turkey Point 4, demonstrating that the Turkey Point 4 jacketing systems are as resistant to destruction as the jacketing systems tested.

4. For Nukon and calcium silicate debris, please describe what percentage of the small fines category was divided into individual fines and small pieces for the head loss flume testing that was conducted for the replacement strainer, and provide a technical basis that the quantity of individual fines was prototypical for plant conditions. Please provide the characteristic size of the fine debris of each type of debris (Nukon and calcium silicate). In particular, for fiberglass insulation, the debris size distribution should account for the reduction in the assumed zone of influence from 17D to 7D, which exposes the destroyed debris to a higher destruction pressure.

5. Please provide a contour plot of the containment pool velocities that includes both the velocities inside the bioshield wall and in the outer annulus. Please also provide a close-up plot of the velocity and turbulence contours in the region of the strainer and its immediate surroundings. Please also provide a table of the head loss test flume

(average) velocity as a function of distance from the test strainer and identify the turbulence level simulated in the test flume.

6. Please discuss how erosion of fibrous and calcium silicate debris in the containment pool was addressed and provide technical justification. If testing was used to justify any assumptions made concerning erosion, please provide the following additional information:

    a. A comparison of the flow conditions (velocity and turbulence), chemical conditions, and fiberglass material present in the erosion tests to the analogous conditions for Turkey Point 4.
    b. The duration of the erosion tests and how the results were extrapolated to the sump mission time.

7. Please describe how the kinetic energy of the containment sprays entering the containment pool was modeled. Spray flow splashing into the containment pool can have a significant impact on the velocity and turbulence distributions in the containment pool. Furthermore, the drainage from the containment sprays frequently is not uniform (as is assumed for Turkey Point 4) at the containment pool elevation due to non-uniformities in the structures at higher elevations that can result in concentrated drainage (e.g., refueling canal drains, hatch openings, gaps in curbs, etc.). Please provide the justification for using a uniform spray drainage model.

8. The August 11, 2008, supplemental response states on page 16 that streamline plots were used to identify isolated eddies that had velocities higher than the incipient tumbling velocity but did not contribute to debris transport from the zone. Please provide the basis for considering debris assumed to be present in this area at the switchover to recirculation to not transport to the strainers, considering the following points:

    a. Even in steady-state turbulent flow problems, chaotic perturbations result in variance in the solution that will alter the flow pattern in isolated eddies and allow fluid and debris elements in these eddies to escape as time or the number of computational iterations increases. Sophisticated turbulence models are expected to be necessary to accurately predict the behavior of eddies if they are credited with retention of debris. Please discuss the fidelity of the turbulence model used in the computational fluid dynamics code and discuss whether the converged solution was run further and checked at various intervals after convergence was reached to demonstrate evidence of the stability of any eddies credited with debris hold up.
    b. Suspended debris and floor-transporting debris do not precisely follow streamlines of fluid flow. This phenomenon (phase slip) can be particularly significant when the streamlines exhibit significant curvature, such as in an eddy.
    c. There are significant uncertainties associated with modeling blowdown, washdown, and pool fill transport mechanisms. As a result, the initial debris distribution at switchover can vary significantly.

9. Please provide the methodology and technical basis for the conclusion that 38 percent of the calcium silicate debris settles in the containment pool. Please state the size distribution of the calcium silicate that is assumed to settle in the containment pool.

10. The transport assumptions for blowdown, washdown, and pool fill up can significantly affect the debris transport fractions for Turkey Point 4 due to the installation of the debris interceptors at the exits to the bioshield wall. Little information was provided in these areas in the supplemental responses. Please summarize the transport analysis methodology and results for the blowdown, washdown and pool fill up transport processes for all types of debris, and identify the resulting debris distribution in the containment pool assumed at the initiation of sump recirculation.

11. The supplemental response did not provide sufficient information concerning the debris interceptors to justify the credit apparently assumed for fibrous debris capture at the interceptors. Please provide the following information concerning the debris interceptors:

    a. The assumed capture efficiency for fibrous debris.
    b. The interceptor screen perforation size.
    c. The interceptor height.
    d. The dimensions of the interceptor roof.
    e. The total surface area of the interceptors.
    f. The characteristic size and size distribution of all debris used for the testing of the interceptors.
    g. A summary of any analysis done to assess debris floatation over the interceptors.
    h. A description of any flowpaths by which fluid in the containment pool inside the bioshield may bypass the debris interceptors.
    i. A summary of any scaling that was done to apply interceptor test results to plant conditions.

12. Given the credit for the debris interceptors, it is unclear that performing a computational fluid dynamic (CFD) simulation for only one break provides a sufficient basis to identify the limiting debris loading at the strainers. Please provide the basis for concluding that higher debris transport fractions associated with other postulated breaks would not ultimately result in a more limiting debris loading for the strainers. For example, breaks near the interceptors and/or outside the bioshield wall (if such breaks exist that could require sump recirculation for mitigation) could have much higher transport fractions than the single break analyzed with CFD.

13. Please provide the clean strainer head loss (CSHL) calculation methodology. Note that the Performance Contracting, Incorporated (PCI) correlation has not been accepted for application to the pressurized-water reactor (PWR) strainers. The staff is awaiting additional information from PCI after having reviewed certain PCI-provided CSHL test data.

14. Please provide verification that the vortex testing was conducted at prototypical or conservative flow rates and physical conditions for the limiting strainer module (e.g., test flume geometry versus plant sump geometry).

15. Please provide documentation of the testing methodology. In general, provide a description of each head loss test run that was instrumental in determining the limiting head loss for the Turkey Point 4 strainer. Please include the purpose of each such

salient test, and a description of the steps performed during the test or tests. Please include:

a. Debris introduction sequences for each debris type and size, including time between additions and quantities for each test.
b. The general procedure for conducting the tests.
c. Debris introduction locations in the test flume, and the amount of each debris surrogate added to each test.
d. The fibrous debris size distribution with a comparison to transport evaluation predictions of fibrous debris sizes showing that nonprototypical fiber sizes were not added to the test. [Please note that for head loss testing and transport evaluations the categories of small fines and large pieces may not provide sizing that will adequately predict behavior. In general, small fines should be divided further into small pieces and fines.]
e. A verification that the amount of fine fiber added to the test was plant specific considering that larger pieces of fiber are more likely to be trapped by the debris interceptors.
f. Particulate debris size distributions.
g. Test flow rates in gallons per minute.
h. A description of debris introduction including debris mixes and concentrations showing that nonprototypical agglomeration did not occur.
i. A flow velocity profile in feet per second in the flume as compared to plant flow velocities in the areas adjacent to the strainer.

16. Please provide a graph of head loss versus time for the duration of the chemical effects testing, including the initial nonchemical portions. Include information regarding events that would be expected to affect the head loss such as debris addition, large flow changes, flow sweeps, etc.

17. Please provide the amount of debris that settled in the test flume during each test.

18. The supplemental response stated that the head loss determined by testing was extrapolated to higher temperatures expected during recirculation. The supplemental response indicated that a fiber-only test resulted in significant clean strainer area. It was not stated whether there were clean strainer areas following testing with chemicals and particulates. Clean strainer can result in turbulent flow, which complicates attempts to viscosity correct head loss results to higher temperatures. It was not stated whether bore holes or other pressure driven phenomena occurred during testing. Flow sweeps should have been conducted to assure that a temperature extrapolation of head loss test data was valid. State the assumptions and their bases for the temperature extrapolation evaluation. Please state whether there was clean strainer area following the limiting chemical effects test. State whether there were bore holes or similar phenomena that occurred during testing.

19. Please provide the test data used to determine the extrapolation of head loss to the final mission time. Please provide the data set which was used to perform this extrapolation. Provide any assumptions used in this evaluation and their bases. Please note that the most recent NRC staff guidance recognizes linear extrapolation as a conservative extrapolation method (Enclosure 1 of NRC letter to Nuclear Energy Institute. See

Agencywide Documents Access and Management System Accession No. ML080230234).

20. Please verify that the head loss cases presented at 170 °F and 300 °F are the limiting cases for NPSH margin, and that other temperatures do not result in more limiting conditions. Please include the debris head loss and CSHL in this evaluation.

21. The flashing evaluation stated that accident pressure was not credited. However, the supplemental response stated that containment pressure was assumed to be the minimum allowable partial pressure of air at the start of the accident adjusted for temperature, plus the vapor pressure equivalent to the temperature of the sump water. The flashing analysis was conducted over a temperature range between 65 and 300 °F. No margin to flashing was provided. The methodology and assumptions for the evaluation were also not provided. Please provide an evaluation of flashing across the debris bed and screen. Please provide the head loss margin available to prevent flashing. Please provide the assumptions and bases for this evaluation.

22. Please provide the assumptions and methods used to evaluate the maximum recirculation sump flow rates. Please specifically discuss the basis for the timing of 24 hours into the event for a change in sump flow from 2697 gallons per minute (gpm) to 3750 gpm, as well as the pump operating configurations, assumptions, and methodology to calculate the flows for both cases.

23. Please provide the method used for estimation of the suction side head losses in the suction lines. The hydraulics methodology, the source of pipe loss data, and the source of the loss coefficients should be discussed, as well as any codes used to calculate the results.

24. The supplemental response stated that the net positive suction head required (NPSHr) values for the emergency core cooling system (ECCS) and CSS pumps were based on pump test curves. While use of NPSHr data provided by the manufacturer may be acceptable, it is not clear whether the equivalent of the 3 percent criterion of Regulatory Guide 1.82, Revision 3 was used. Please provide the basis for the NPSHr values for the ECCS and CSS pumps.

25. The supplemental response does not discuss the distinction between cold-leg and hot-leg recirculation scenarios, in which the pump lineups and, therefore, the flow rates, may vary. If plant procedures address both scenarios, please provide the NPSH results for both scenarios or provide arguments that one or the other scenario is bounding.

26. Table 3.g-1 in the supplemental response dated August 11, 2008, lists the pressurizer relief tank as a source of water for the containment pool. This assumption appears to be the only difference between the water source assumptions betweens Units 3 and 4. However, the total volumes of water added to the containment pool are identical for both units. Please clarify the assumptions made for Unit 4 with respect to the pressurizer relief tank as a water source for the post-loss-of-coolant accident (LOCA) containment pool.

27. Please discuss any water holdup volumes in containment sumps, pits or cavities.

28. Please clarify whether the exchange of reactor coolant system water at operational temperature with cooler, denser, refueling water storage tank water was evaluated as a holdup mechanism.

29. For a LOCA caused by a leak at the top of the pressurizer, please clarify whether the filling of the steam space in the pressurizer was considered as a hold-up volume.

30. Please provide a basis for the assumption that the 6-inch diameter refueling canal drains cannot be blocked by debris. Large pieces of insulation or other debris can be this size or larger and some fraction of them could be blown into the upper containment and potentially reach the refueling canal drains. Please consider temporary floatation and transport over the drain due to refueling canal drain surface currents, absorption of water into the material, and subsequent sinking of the material to cover the drains.

31. The NRC staff considers in-vessel downstream effects to not be fully addressed at Turkey Point Unit 4 as well as at other PWRs. Turkey Point Unit 4's supplemental response refers to draft WCAP-16793-NP, "Evaluation of Long-Term Cooling Considering Particulate, Fibrous, and Chemical Debris in the Recirculating Fluid." The NRC staff has not issued a final safety evaluation (SE) for WCAP-16793-NP. The licensee may demonstrate that in-vessel downstream effects issues are resolved for Turkey Point Unit 4 by showing that the licensee's plant conditions are bounded by the final WCAP-16793-NP and the corresponding final NRC staff SE, and by addressing the conditions and limitations in the final SE. The licensee may alternatively resolve this item by demonstrating, without reference to WCAP-16793 or the staff SE, that in-vessel downstream effects have been addressed at Turkey Point Unit 4. In any event, the licensee should report how it has addressed the in-vessel downstream effects issue within 90 days of issuance of the final NRC staff SE on WCAP-16793. The NRC staff is developing a Regulatory Issue Summary to inform the industry of the staff's expectations and plans regarding resolution of this remaining aspect of Generic Safety Issue 191.

32. Your June 30, 2008, response to GL 2004-02 states that the final sump fluid pH is achieved by manual addition of sodium tetraborate (STB) following a LOCA rather than by dissolution of STB already stored in the lowest elevation of the reactor building. Please provide the procedure for addition of STB following a LOCA. Where is the STB stored during normal plant operation? How is the STB transported to the containment building and how is it physically added to the sump?

33. What surveillance requirements are in place to ensure that the required quantity of STB is available to provide adequate sump buffering?

34. What surveillance requirements are in place to ensure that the STB's chemical and physical properties are maintained in a manner that allows for timely addition, dissolution, and adequate pH control? Are chemical tests performed periodically to ensure the buffer capacity of the stored STB? Are physical tests performed to ensure that densification of the STB has not occurred over time? If the STB is exposed to humid conditions in the storage facility, the pellets/granules may solidify, which would

impede both dissolution and addition to the sump. How is this potential phenomenon addressed at Turkey Point?

35. Because addition of the STB is performed manually (as opposed to a passive system in the containment) the amount of time needed to add the required amount to buffer the sump pool may be longer than for the passive addition case. Please provide the amount of time needed to manually add the required amount of STB. Has the dose for personnel associated with the manual addition process been estimated, and if so, what is that dose per person? Does the time dependant sump pH profile used to determine material dissolution (e.g., aluminum, calcium, silica) account for the time required to manually add the STB?

36. The June 30, 2008, supplemental response states that buffer addition occurs until a pH of 7.2 is achieved. How is the sump fluid pH monitored following a LOCA to ensure that an adequate quantity of STB has been added to achieve a pH of no lower than 7.2?

37. Please clarify your intention to update the Turkey Point Unit 4 Final Safety Analysis Report, in accordance with Title 10, *Code of Federal Regulations*, Section 50.71(e), to include a description of the new sump strainer, its design basis, and the analyses performed that were associated with the post accident debris evaluation.

38. The supplemental responses for Turkey Point Unit 3 stated that the original sump design and replacement strainer design did not include trash racks. However, the staff noted that existing TS 4.5.2.e.3, which is identical for Units 3 and 4, refers to trash racks being present. Based upon the supplemental responses for Turkey Point Unit 4, it is not clear whether the replacement strainer design includes trash racks. Please identify whether the Turkey Point Unit 4 replacement strainer design includes a trash rack. If no trash rack is present, then please discuss whether TS 4.5.2.e.3 will be revised to remove the reference to a trash rack being present to be consistent with the current design of the Turkey Point Unit 4 sump.

39. Page 30 of the August 11, 2008, supplemental response indicates that the replacement ECCS strainer design is a common, non-independent strainer assembly shared by both trains. The response indicates that this design is not a departure from the current licensing basis because the original ECCS sump intake design included a permanent cross-connection between trains that was located outside of containment. Please provide the following additional information concerning the original ECCS sump intake design:

    a. A piping system diagram that includes the cross-connection line between the ECCS sump suction lines.
    b. A determination of whether the original ECCS sump suction lines were normally isolated, independent lines during sump recirculation mode that could be cross-connected by operator action, or whether the cross-connect was normally open in recirculation mode.
    c. The type of valves installed on the cross-connect line (if any), and whether remote or manual operation would be necessary to operate the valves.
    d. A justification of any change to the plant licensing basis that would be necessary if the independence of the original sump screens was reduced. Please note that

if the cross-connection line was a normally isolated line during recirculation, then this would indicate that the original ECCS sump screens were independent screens that could be shared, if desired, during an event, which is a different configuration than the current replacement strainer design that does not have independence.

The licensee may demonstrate that in-vessel downstream effects issues are resolved for Turkey Point, Unit 4, by showing that the licensee's plant conditions are bounded by the final WCAP-16793 and the corresponding final NRC staff SE, and by addressing the conditions and limitations in the final SE. The licensee may also resolve RAI 31 by demonstrating, without reference to WCAP-16793 or the NRC staff SE, that in-vessel downstream effects have been addressed at Turkey Point, Unit 4. The specific issues raised in RAI 31 should be addressed regardless of the approach the licensee chooses to take.

The licensee should report how it has addressed the in-vessel downstream effects issue and the associated RAI referenced above within 90 days of issuance of the final NRC staff SE on WCAP-16793. The NRC staff is currently developing a Regulatory Issue Summary to inform licensees of the staff's expectations and plans regarding resolution of this remaining aspect of Generic Safety Issue 191, "Assessment of Debris Accumulation on PWR Sump Performance."

Sincerely,

/RA/

Brenda L. Mozafari, Senior Project Manager
Plant Licensing Branch II-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-251

Enclosure: As stated

cc w/encl: Distribution via ListServ

DISTRIBUTION:

Public
RidsNrrLABClayton Resource
RidsOgcRp Resource
RidsNrrDciCsgb
LPL2-2 R/F
RidsNrrDorlLpl2-2 Resource
RidsNrrDssSsib Resource
RidsNrrDeEmcb
RidsRgn2MailCenter Resource
RidsAcrsAcnwMailCtr Resource
RidsNrrPMBMozafari Resource
JPaige

ADAMS Accession No. ML083440078

OFFICE	LPL2-2/PE	LPL2-2/PM	NRR/LPL2-2/LA	NRR/DSS/SSIB	NRR/DCI/CSGB	LPL2-2/BC
NAME	JPaige	BMozafari	BClayton	MScott	AHiser	TBoyce
DATE	12/12/08	12/19/08	12/12/08	12/12/08	12/19/08	12/19/08

OFFICIAL RECORD COPY