Florida Power & Light, 9760 S.W. 344 St. Homestead, FL 33035

FPL.

SEP 14 2011
L-2011-350
10 CFR 50.90

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, D. C. 20555-0001

Re: Turkey Point Units 3 and 4
Docket Nos. 50-250 and 50-251
Response to NRC Request for Additional Information Regarding Extended Power Uprate License Amendment Request No. 205 and Nuclear Performance and Code Review (SNPB) Issues

References:

(1) M. Kiley (FPL) to U.S. Nuclear Regulatory Commission (NRC) (L-2010-113), "License Amendment Request for Extended Power Uprate (LAR-205)," Accession No. ML103560169, October 21, 2010.

(2) Email from J. Paige (NRC) to T. Abbatiello (FPL), "Turkey Point EPU - Nuclear Performance and Code Review (SNPB) Request for Additional Information - Round 1.2 (Part 2)," Accession No. ML11111A150, April 19, 2011.

(3) M. Kiley (FPL) to U.S. Nuclear Regulatory Commission (L-2011-170), "Response to NRC Request for Additional Information Regarding Extended Power Uprate License Amendment Request No. 205 and Nuclear Performance and Code Review Issues," Accession No. ML11143A010, May 19, 2011.

(4) Email from J. Paige (NRC) to S. Hale (FPL) "Turkey Point EPU - Nuclear Performance and Code Review (SNPB) Request for Additional Information - Round 2.2 (Part 2)," Accession No. ML11236A286, August 24, 2011.

(5) M. Kiley (FPL) to U.S. Nuclear Regulatory Commission (L-2011-278), "Response to NRC Request for Additional Information Regarding Extended Power Uprate License Amendment Request No. 205 and Nuclear Performance and Code Review Issues," Accession No. ML11214A103, July 29, 2011.

By letter L-2010-113 dated October 21, 2010 [Reference 1], Florida Power and Light Company (FPL) requested to amend Renewed Facility Operating Licenses DPR-31 and DPR-41 and revise Turkey Point Units 3 and 4 Technical Specifications (TS). The proposed amendment will increase each unit's licensed core power level from 2300 megawatts thermal (MWt) to 2644 MWt and revise the Renewed Facility Operating Licenses and TS to support operation at this increased core thermal power level. This represents an approximate increase of 15% and is therefore considered an extended power uprate (EPU).

By email dated April 19, 2011 [Reference 2], the NRC Project Manager (PM) requested additional information to support the continued review of the EPU LAR by NRC staff in the Nuclear Performance and Code Review Branch (SNPB). The RAI consisted of five questions regarding detailed technical inputs and design information related to the EPU boron precipitation analysis. FPL responded to the NRC requests via letter L-2011-170, dated May 19, 2011 [Reference 3].

By email dated August 24, 2011 [Reference 4], the NRC PM provided a follow-up RAI to FPL's response in Reference 3. The RAI consisted of one question with five parts, pertaining to

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redundancies available in PTN's safety injection system and to probabilistic risk assessment (PRA) modeling details of long term core cooling with repeated transitions between hot leg and cold leg recirculation. Responses to these questions are presented in Attachment 1 of this letter.

During an NRC audit of the calculations for the PTN boric acid precipitation analyses held on July 11, 2011, the NRC requested additional information pertaining to assumptions and modeling techniques. FPL provided the requested information in letter L-2011-278, dated July 29, 2011 [Reference 5]. As a supplement to the information provided in Reference 5, FPL is also including responses to additional NRC questions on analysis conservatisms, precipitation during small break loss of coolant accidents (SBLOCA), and cooldown-induced precipitation. The supplemental questions, which are based on information requests issued to the Point Beach EPU project, are presented in Attachment 2 of this letter.

As documented in the response to RAI question SNPB-2.2.1.a in Attachment 1, FPL has included one commitment to implement a planned modification to the PTN safety injection flowpath. No existing commitments are affected by this submittal.

In accordance with 10 CFR 50.91(b)(1), a copy of this letter is being forwarded to the State Designee of Florida.

This submittal does not alter the significant hazards consideration or environmental assessment previously submitted by FPL letter L-2010-113 [Reference 1].

Should you have any questions regarding this submittal, please contact Mr. Robert J. Tomonto, Licensing Manager, at (305) 246-7327.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on September 14, 2011.

Very truly yours,

Michael Kiley
Site Vice President
Turkey Point Nuclear Plant

Attachments (2)

cc:
USNRC Regional Administrator, Region II
USNRC Project Manager, Turkey Point Nuclear Plant
USNRC Resident Inspector, Turkey Point Nuclear Plant
Mr. W. A. Passetti, Florida Department of Health

Turkey Point Units 3 and 4

RESPONSE TO NRC RAI REGARDING EPU LAR NO. 205 AND SNPB NUCLEAR PERFORMANCE AND CODE REVIEW ISSUES

ATTACHMENT 1

RAI RESPONSE

Response to Request for Additional Information

The following information is provided by Florida Power and Light Company (FPL) in response to the U. S. Nuclear Regulatory Commission's (NRC) Request for Additional Information (RAI). This information was requested to support License Amendment Request (LAR) 205, Extended Power Uprate (EPU), for Turkey Point Nuclear Plant (PTN) Units 3 and 4 that was submitted to the NRC by FPL via letter (L-2010-113) dated October 21, 2010 [Reference 1].

By email dated April 19, 2011 [Reference 2], the U.S. Nuclear Regulatory Commission (NRC) Project Manager (PM) requested additional information to support the continued review of the EPU LAR by NRC staff in the Nuclear Performance and Code Review Branch (SNPB). The RAI consisted of five questions regarding detailed technical inputs and design information related to the EPU boron precipitation analysis. FPL responded to the NRC requests via letter L-2011-170, dated May 19, 2011 [Reference 3].

By email dated August 24, 2011 [Reference 4], the NRC PM provided a follow-up RAI to FPL's response in Reference 3. The RAI consisted of one question with five parts, pertaining to redundancies available in PTN's safety injection system and to probabilistic risk assessment (PRA) modeling details of long term core cooling with repeated transitions between hot leg and cold leg recirculation. The Reference 4 RAI questions and FPL's responses are documented below.

SNPB-2.2.1 To control boric acid precipitation following a loss-of-coolant accident (LOCA), the high pressure safety injection (HPSI) pumped flow is cycled from all cold side injection to hot leg injection to control the boric acid build-up in the vessel. At about 5 hrs post-LOCA, the HPSI flow is switched from the cold side to the hot side piping for boric acid control, particularly since the break location is not known. Thereafter, in 17 hr intervals the HPSI flow is switched back and forth between the hot and cold side for continued boric acid build-up control to preclude precipitation during the long term. During each realignment, the HPSI pump flow is also terminated and the valve alignments are then made to facilitate the switch in injection, followed by re-activation of the HPSI pumped flow. Provide the following information regarding this method for boric acid control following a LOCA:

a. **Describe and justify the use of the site HPSI pumps to address pump failure as it was stated that all four site HPSI pumps are available for mitigating the LOCA consequences. Also, describe how failures of the hot and cold side injection valves to open or close are addressed. What provisions are available if the cycling process results in additional long term valve failures?**

As described in UFSAR Appendix A, the four high head safety injection (HHSI) pumps are shared between Unit 3 and Unit 4. Two pumps (3A and 3B) normally draw suction from the Unit 3 refuel water storage tank (RWST); the other two (4A and 4B) draw suction from the Unit 4 RWST. Cross-connects between the two HHSI suction headers are normally closed, while the discharge cross-connects are normally open. All four pumps start automatically on receipt of a safety injection (SI) signal from either unit, but only the affected unit's motor-operated cold leg isolation valves open in automatic response to the SI signal. Therefore, borated water from all four pumps is initially supplied to the accident unit's reactor coolant system (RCS) – two drawing from the affected unit's RWST, and two from the unaffected unit's RWST. Emergency Operating Procedures (EOPs) direct the unaffected unit's HHSI pumps to be manually stopped early in the event, provided both of the affected unit's HHSI pumps are running normally. In the event of an affected unit HHSI pump failure, the unaffected unit's HHSI pump suction header is manually realigned to draw from the affected unit's RWST. (As discussed in the FPL response to NRC RAI question SRXB-1.3.14.a, documented in Reference 5, the HHSI pumps are not required for the safe shutdown of the unaffected unit, so all four are considered to be available for the accident unit.)

As described in the EPU LAR [Reference 1], Licensing Report (LR) Section 2.8.5.6.3.4, two HHSI pumps are required to ensure adequate core cooling during cold leg recirculation, while hot leg recirculation requires two HHSI pumps to maintain adequate flow for both boric acid flushing and core cooling. If one of the affected unit's pumps fails to start in either mode, operators can start a HHSI pump on the unaffected unit. After 14 hours into the event, only one HHSI pump is required due to lower decay heat generation within the core, reducing the likelihood of operators needing to cross-connect the HHSI pumps during long term recovery.

When transitioning between cold leg and hot leg recirculation (and vice versa), operators first secure the operating HHSI pumps, then manipulate the hot leg and cold leg injection isolation valves, and then restart the HHSI pumps. The EPU long term cooling analysis shows that adequate flow is delivered even if one of the two parallel hot leg or one of the two parallel cold leg isolation valves fails to open. If one of these isolation valves fails to close when required, both the hot leg and cold leg injection flowpaths are equipped with backup valves that can isolate flow. EPU LAR LR Table 1.0-1, Item 13, identifies a modification to the cold leg injection flowpath that enables operators to isolate the flowpath remotely for EPU conditions.

As stated in the EPU LAR, LR Section 2.11.1.2.2, PTN EOPs will no longer include the "concurrent cold leg and hot leg recirculation" lineup. A planned modification to the hot leg injection flowpath will enable it to withstand any postulated single active failure, and the "concurrent injection" lineup will no longer be required. This modification was not identified in Table 1.0-1 of the EPU LAR. Thus, Turkey Point makes the following commitment, to be completed prior to MODE 4 operation at the EPU power level for Units 3 and 4:

> "PTN will implement a modification to ensure that no single active failure can prevent hot leg or cold leg safety injection flow during the injection or recirculation mode, consistent with Turkey Point's existing design and licensing basis."

Additional valve failures following a postulated single active failure are beyond the design basis of the PTN ECCS. Hot leg and cold leg isolation valves are designed and maintained for safety-related service, qualified for operation in the harshest environment to which they may be exposed, and subject to routine valve testing to ensure reliable operation. Nevertheless, the valve arrangement described above can accommodate a number of independent failures while still allowing the system to perform its design function. Further valve reliability considerations are discussed in the response to SNPB-2.2.1.c. below.

b. **Describe the short term and long term PRA evaluations and assumptions for the HPSI pump cycling/valve manipulations and how they support acceptable operation of the method to control boric acid precipitation.**

In the Turkey Point PRA, the initial transitions to cold leg recirculation and hot leg recirculation are modeled. Turkey Point's core damage frequency due to large-break LOCA is very low—approximately 1E-09 per year.

To assess the long-term impacts of cycling between hot and cold leg recirculation, a bounding assessment of the risk associated with a 30-day mission time for a large-break LOCA was performed by multiplying the large-break LOCA core damage frequency from the PRA model (with a 24-hour mission time) by a factor of 23 to approximate the number of realignments and the difference in mission times (30 days versus 24 hours). The core damage frequency for this bounding assessment remains low—less than 1E-07 per year.

It should be noted that this bounding assessment did not consider the new modifications to the hot leg and cold leg injection flowpaths discussed in the response to SNPB-2.2.1.a above. These new capabilities will reduce the large-break LOCA risk.

c. **Describe the reliability of the valves and pumps to operate during the recycling process during the long term.**

As mentioned in SNPB-2.2.1.b above, the realignments involve additional demand cycles on the relevant pumps and valves. As the number of demands and the mission or run time duration increases, the cumulative probability of failure increases. In the PRA model, the failure rates of the pumps and valves are calculated using a combination of plant-specific and industry data; and these rates are assumed to remain constant throughout the mission time. Several factors can affect the failure rates during an extended mission time including wear, environment and time since the last demand. The first two factors, wear and environment, will tend to increase the component failure rates. The third, time since the last demand, will tend to decrease the failure rates. However, these factors are expected to have a minimal effect on the reliability of the relevant components during the 30-day mission time. The relevant pumps and valves are classified safety-related, and are designed and maintained to assure overall high reliability commensurate with their safety significance. This is managed under the station's implementation of the

Maintenance Rule per 10CFR50.65.

d. **Since sump debris will be contained in the HPSI injection lines and HPSI pumps, how does the accumulation of sump debris affect subsequent valve and pump performance, including stopping and restarting pumps and opening and closing injection line valves? After the HPSI pump flow is terminated, debris in the lines will tend to settle and accumulate in the piping. Restarting the pumps could cause slugs of local debris concentration to clog or hinder valve operation and/or pump restart. Discuss the impact of the debris on valve and pump performance during the long term alignments and pump restarts.**

   EPU has minimal effect on the issues that will be addressed to resolve NRC concerns on the resolution of GSI-191 for Turkey Point. As a result, all future evaluations related to the resolution of GSI- 191 will consider both the current and EPU conditions, and the review and approval of the Turkey Point EPU LAR should be considered to be independent of the resolution of GSI-191.

   The impact of recirculating sump fluid debris on ECCS components downstream of the sump strainers was evaluated in FPL's supplemental response to Generic Safety Issue (GSI) 191 issued June 30, 2008 (Reference 6). The evaluation used the methodology prescribed in WCAP-16406-P, Revision 1 (Reference 7), "Evaluation of Downstream Sump Debris Effects in Support of GSI-191," addressing each of the limitations and conditions specified in the associated NRC Safety Evaluation dated December 20, 2007 (Reference 8). FPL's response evaluated clogging and wear on ECCS pumps and valves, concluding that there was no potential for sump debris to prevent these components from performing their required functions.

e. **Describe how operator errors are addressed should an improper alignment be made following one of the cycling operations.**

   As mentioned in the response to SNPB-2.2.1.b above, in the Turkey Point PRA, the initial transitions to cold leg recirculation and hot leg recirculation are modeled. In the cold leg recirculation model, failure of the operators to implement cold leg recirculation is included. Similarly, in the hot leg recirculation model, failure of the operators to implement hot leg recirculation is included.

   Control room indication is available for each of the major components manipulated in the transition between hot and cold leg recirculation. Upon restarting flow in hot leg or cold leg recirculation, operators are immediately directed to monitor ECCS performance indications such as flow measurement and ECCS pump motor current. These indications will notify operators of a potential system alignment error.

References

1. M. Kiley (FPL) to U.S. Nuclear Regulatory Commission (L-2010-113), "License Amendment Request for Extended Power Uprate (LAR 205)," Accession No. ML103560169, October 21, 2010.

2. Email from Jason Paige (NRC) to Tom Abbatiello (FPL), "Turkey Point EPU - Nuclear Performance and Code Review (SNPB) Request for Additional Information - Round 2.2 (Part 2)," Accession No. ML1111A150, April 19, 2011.
3. M. Kiley (FPL) to U.S. Nuclear Regulatory Commission (L-2011-170), "Response to NRC Request for Additional Information Regarding Extended Power Uprate License Amendment Request No. 205 and Nuclear Performance and Code Review Issues," Accession No. ML11143A010, May 19, 2011.
4. Email from Jason Paige (NRC) to Steve Hale (FPL) "Turkey Point EPU - Nuclear Performance and Code Review (SNPB) Request for Additional Information - Round 2.2 (Part 2)," Accession No. ML11236A286, August 24, 2011.
5. M. Kiley (FPL) to U.S. Nuclear Regulatory Commission (L-2011-305), "Response to NRC Request for Additional Information Regarding Extended Power Uprate License Amendment Request No. 205 and Reactor Systems Issues," Accession No. ML11234A178, August 19, 2011.
6. W. Jefferson, Jr. (FPL) to U.S. Nuclear Regulatory Commission (L-2008-138), "Supplemental Response to NRC Generic Letter 2004-02, 'Potential Impact of Debris Blockage on Emergency Recirculation during Design Basis Accidents at Pressurized-Water Reactors'," Accession No. ML081960386, June 30, 2008.
7. Westinghouse Topical Report WCAP-16406-P, Revision 1, "Evaluation of Downstream Sump Debris Effects in Support of GSI-191," August 2007.
8. J. Gresham (NRC) to G. Bischoff (Pressurized Water Reactor Owners Group), "Final Safety Evaluation for Pressurized Water Reactor Owners Group (PWROG) Topical Report (TR) WCAP-16406-P, Evaluation of Downstream Sump Debris Effects in Support of GSI-191, Revision 1 (TAC No. MD2189)," December 20, 2007.

Turkey Point Units 3 and 4

RESPONSE TO NRC RAI REGARDING EPU LAR NO. 205
AND SNPB NUCLEAR PERFORMANCE AND CODE REVIEW ISSUES

ATTACHMENT 2

SUPPLEMENTAL INFORMATION FOR TURKEY POINT BORIC ACID PRECIPITATION ANSLYSIS

Supplemental Information for Turkey Point Boric Acid Precipitation

The following information is provided by Florida Power and Light Company (FPL) to assist the U.S. Nuclear Regulatory Commission (NRC) in reviewing License Amendment Request (LAR) 205, Extended Power Uprate (EPU), for Turkey Point Nuclear Plant (PTN) Units 3 and 4, submitted to the NRC by FPL via letter (L-2010-113) dated October 21, 2010 [Reference 1].

During an NRC audit of the calculations for the PTN boric acid precipitation analyses held on July 11, 2011, the NRC requested additional information pertaining to assumptions and modeling techniques. FPL provided the requested information in letter L-2011-278, dated July 29, 2011 [Reference 2]. As a supplement to the information in Reference 2, FPL is also providing responses to additional questions on analysis conservatisms, precipitation during small break loss of coolant accidents (SBLOCA), and cooldown-induced precipitation. The supplemental questions, which are based on information requests issued to the Point Beach EPU project, are presented below with FPL's updated responses:

Question 1 **Please list all of the major conservatisms and margins inherent in the methods utilized to determine the boric acid build-up in the vessel and the timing for precipitation.**

Listed below are the conservatisms inherent in the methods utilized to determine the boric acid build-up in the vessel and the timing for precipitation. They are broken up into two categories: methodology conservatisms and analysis assumption conservatisms.

Methodology Conservatisms

Containment Pressure

The solubility limit used to determine an appropriate hot leg switchover time is based upon the saturation temperature of boric acid at atmospheric pressure conditions (29.27 wt%). Licensing Report (LR) Figure 2.8.5.6.3.4-2 and Table 2.8.5.6.3.4-4 of the EPU LAR [Reference 1] captures the effect of increased pressure on the solubility limit of boric acid at saturation temperature. It can be seen that the solubility limit increases with increased pressure. The analysis takes no credit for any pressure above atmospheric conditions when determining the solubility limit of boric acid and is a source of conservatism.

Containment Sump Buffering Agents

It has been experimentally shown that sump buffering agents increase the solubility of boric acid. PTN will utilize a passive pH control system by installing a series of stainless steel baskets containing sodium tetraborate decahydrate (NaTB) in the lower levels of containment. No credit is taken for the increase in the boric acid solubility limit due to the presence of sump buffering agents.

Subcooling

The coolant that enters the core during the recirculation phase would be at a temperature below that of the saturation temperature at atmospheric conditions due to cooling in the residual heat removal system heat exchanger. No credit is taken for this subcooling of the coolant that enters the inner vessel region. Credit for subcooling would decrease the amount of boil-off for a given decay heat and slow down the concentration of boric acid.

Analysis Assumption Conservatisms

Source Boron Concentrations

Source boron concentrations of the contributors to the containment sump (RWST, accumulators, RCS, etc.) are conservatively maximized in accordance with Technical Specification values or limits generated for each reload cycle. Margin would be gained if surveillance data was used to determine operating boron concentrations of the contributors to the containment sump.

Source Mass

Source masses are conservatively maximized for boron sources and conservatively minimized for dilution sources when determining the assumed masses of the contributors to the sump. Margin would be gained if operating source masses were used in the analysis.

Appendix K Decay Heat

The decay heat used to determine boil-off is 1971 ANS + 20% for infinite operation (Reference 3). This increases the boil-off due to the conservative nature of the decay heat and increases the concentration rate of boric acid, causing the core region solubility limit to be reached much sooner than if a realistic decay heat model or reduced uncertainty (i.e., ANSYS decay heat of 10% beyond 1000 seconds) were used.

Question 2 **How are small cold leg breaks in the 2-6 inch range handled when RCS pressure remains above the shutoff head of the LHSI pump and HHSI is terminated when the RWST drains?**

How do the EOPs deal with this particular scenario? That is, if a SBLOCA occurs and RCS pressure remains above 134 psia, then the operators will need to immediately re-align HHSI to the sump to assure the time during the LOCA without any injection is minimized to limit the PCT. Please explain how this condition is handled.

The Post-LOCA analyses for the Turkey Point Unit 3 and Unit 4 EPU do not take credit for low head safety injection. Direct injection for all design basis accidents only credit flows provided by the HHSI pumps. As such, an elevated RCS pressure, as occurs during the SBLOCA scenario, would have minimal impact on the HHSI flow provided.

Question 3 **Background and additional clarification requested regarding the potential for injection for extended periods of time following SBLOCAs and a possible inadvertent rapid depression:**

There is the concern that should operators regain power or the ability to more rapidly depressurize the RCS, precipitation could be inadvertently produced. It would therefore be important for the EOPs to instruct or alert the operators not to exceed the maximum cooldown limit following a small

break LOCA. Staff calculations also show that the operators could also utilize the PORVs should only one of the ADVs fail to open. While the staff finds that one ADV may not depressurize the RCS to 12 psia for small breaks for many hours, the high RCS temperature will maintain the boric acid in solution. Potential modifications to the EOPs or guidance to stay within the limits of the permissible cooldown rates will prevent the operators from causing an inadvertent precipitation by limiting the depressurization rate during small breaks in the event boiling persists for extended periods of time with the RCS pressure above 120 psia (or that RCS pressure where LPSI injection can flush the core to control boric acid).

Please provide information as to how the EOPs and operating procedures instruct the operators to not exceed the permissible cooldown limits following a SBLOCA.

Per Turkey Point's Emergency Operating Procedures (EOP), the maximum allowable cool down rate of the RCS is 100°F/hr. If adequate depressurization of the system does not occur early in the transient, and the system pressure remains at, or above, 120 psia, boric acid precipitation in the event of a rapid cool down due to a late initiation of hot leg switchover (HLSO) will not occur. The long term cooling analysis performed for Turkey Point demonstrated that if HLSO were not to occur until 12 hours, sufficient hot leg injection dilution flow exists. It was demonstrated that the RCS did not cool down and depressurize faster than the hot leg injection was capable of diluting the core, mitigating boric acid precipitation.

The post-LOCA analyses for the Turkey Point Unit 3 and Unit 4 EPU do not take credit for low head safety injection (LHSI). Direct injection for all design basis accidents only credit flows provided by the HHSI pumps. As such, an elevated RCS pressure, as occurs during the SBLOCA scenario, would have minimal impact on the HHSI flow provided.

References

1. M. Kiley (FPL) to U.S. Nuclear Regulatory Commission (L-2010-113), "License Amendment Request for Extended Power Uprate (LAR 205)," Accession No. ML103560169, October 21, 2010.
2. M. Kiley (FPL) to U.S. Nuclear Regulatory Commission (L-2011-278), "Response to NRC Request for Additional Information Regarding Extended Power Uprate License Amendment Request No. 205 and Nuclear Performance and Code Review Issues," Accession No. ML11214A103, July 29, 2011.
3. Proposed American Nuclear Society Standards, "Decay Energy Release Rates Following Shutdown of Uranium-Fueled Thermal Reactors," Approved by Subcommittee ANS-5, ANS Standards Committee, October 1971 [as cited in Appendix K to 10 CFR Part 50, Section I.A.4].