Florida Power & Light Company, 6501 S. Ocean Drive, Jensen Beach, FL 34957

FPL

August 18, 2011

L-2011-326
10 CFR 50.90

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555

Re: St. Lucie Plant Unit 2
Docket No. 50-389
Renewed Facility Operating License No. NPF-16

Information Requested by NRC Reactor Systems Branch Regarding a Sample Case Study for Boron Dilution Event in Support of the Extended Power Uprate License Amendment Request

References:

(1) R. L. Anderson (FPL) to U.S. Nuclear Regulatory Commission (L-2011-021), "License Amendment Request (LAR) for Extended Power Uprate," February 25, 2011, Accession No. ML110730116.

By letter L-2011-021 dated February 25, 2011 [Reference 1], Florida Power & Light Company (FPL) requested to amend Renewed Facility Operating License No. NPF-16 and revise the St. Lucie Unit 2 Technical Specifications (TS). The proposed amendment will increase the unit's licensed core thermal power level from 2700 megawatts thermal (MWt) to 3020 MWt and revise the Renewed Facility Operating License and TS to support operation at this increased core thermal power level. This represents an approximate increase of 11.85%, and is therefore considered an Extended Power Uprate (EPU).

The NRC Project Manager, during a conference call on July 15, 2011, identified a request from the Reactor Systems Branch (SRXB) for copies of the calculations related to the development of tables in the St. Lucie Unit 2 EPU LAR associated with the evaluation of boron dilution events. In a subsequent phone call on July 25, 2011, the subject was discussed with the SRXB reviewer and the NRC request was modified to a request for a sample case that demonstrates how the boron dilution analyses are performed. The requested information is documented in Attachment 1 to this letter.

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

A001
NRR

This submittal does not alter the significant hazards consideration or environmental assessment previously submitted by FPL letter L-2011-021 [Reference 1].

This submittal contains no new commitments and no revisions to existing commitments.

Should you have any questions regarding this submittal, please contact Mr. Christopher Wasik, St. Lucie Extended Power Uprate LAR Project Manager, at 772-467-7138.

I declare under penalty of perjury that the foregoing is true and correct to the best of my knowledge.

Executed on

Very truly yours, Aug. 18, 2011

Richard L. Anderson
Site Vice President
St. Lucie Plant

Attachment (1)

cc: Mr. William Passetti, Florida Department of Health

Response to Request for Additional Information

The following information is provided by Florida Power & Light in response to the U. S. Nuclear Regulatory Commission's (NRC) Request for Additional Information (RAI). This information was requested to support Extended Power Uprate (EPU) License Amendment Request (LAR) for St. Lucie Nuclear Plant Unit 1 that was submitted to the NRC by FPL via letter (L-2011-021), dated February 25, 2011, Accession Number ML110730116.

During a conference call on July 15, 2011, the Reactor Systems Branch (SRXB) reviewer requested copies of the calculations related to the development of tables in the St. Lucie Unit 2 EPU LAR associated with the evaluation of boron dilution events. In a subsequent phone call on July 25, 2011, the subject was discussed with the SRXB reviewer and the request was modified to a request for a sample case that demonstrates how the boron dilution analyses are performed. The requested information and FPL response is documented below.

NRC Request (verbal request paraphrased by FPL)

Provide a sample case that demonstrates how the boron dilution analyses are performed.

Response

Tables 2.8.5.4.5-3 through 2.8.5.4.5-5 of LAR Attachment 5 provide various combinations of the minimum initial boron concentration (Cbi) and the maximum critical boron concentration (Cbc) values to satisfy the acceptance criterion on the maximum allowed time for operator action during Modes 4, 5, and 6, respectively. The acceptance criterion is 15 minutes for Modes 4 and 5 and 30 minutes for Mode 6. The ranges of Cbi values selected for these tables bound the values allowed during plant operation in these Modes.

The same method is used to calculate the values presented in the three LAR tables. This process has been automated through the ABORT code. To describe the process used, a sample case has been selected from Table 2.8.5.4.5-4. This case is number 13 for 2 charging pumps in operation, where Cbi = 1440 ppm and Cbc = 1151 ppm (rounded down from 1151.34 ppm for conservatism). The following data applies to the selected case:

- Flux ratio for the Boron Dilution Alarm System (BDAS) = 2.276
- Reactor Coolant System (RCS) volume (Vrcs) = 3410.1 ft^3
- Specific Volumes:
  - For RCS water (vrcs) = 0.0166332 ft^3/lbm at 14.7 psia, 200 °F (maximum for Mode 5)
  - For charging flow (vdil) = 0.0160189 ft^3/lbm at 14.7 psia, 40 °F
- Charging flow (Qdil) = 98 gpm for 2 pumps.

The ABORT code calculates, for a set of Cbi input values, the Cbc value that results in a time from the onset of the BDAS alarm until criticality is reached that matches the acceptance criterion. For conservatism and to allow for neutron flux averaging, the acceptance criterion is taken as 15.25 minutes for Modes 4 and 5 and 30.25 minutes for Mode 6. This calculation is performed in an iterative manner. That is, by assuming Cbc values and calculating the

corresponding time from alarm to criticality, until the acceptance criterion is satisfied. The discussion that follows applies to the final ABORT iteration case.

The time to reach criticality is calculated based on Equation 15.4.6-6 of UFSAR Section 15.4.6.2:

Time to criticality = (vdil x 7.481 gal/ ft^3 / Qdil) x (Vrcs / vrcs) x ln(Cbi / Cbc) = 56.08 minutes

The ABORT computer code models an inverse count rate ratio (ICRR) curve to predict the time when the source range detectors reach the BDAS setpoint (i.e., a flux ratio of 2.276). The portion of the ICRR curve developed for St. Lucie Unit 2 of relevance to the next step is shown below.

ΔCb (ppm)	ICRR
282	1.133961
332	1.260833

The Cbi – Cbc difference (ΔCb) is 1440 – 1151.34 = 288.66 ppm

The ICRR is linearly interpolated from the ICRR curve resulting in the following value: 1.150854.

Using the flux ratio setpoint, the ICRR value at the alarm time is 1.150854/2.276 = 0.505647.

The portion of the ICRR curve of relevance to the next step is shown below.

ΔCb (ppm)	ICRR
50	0.369438
100	0.608450

Using this portion of ICRR curve, the ΔCb at the alarm time is calculated using linear interpolation, resulting in 78.5 ppm.

The boron concentration at the alarm time is 1151.34 ppm + 78.50 ppm = 1229.84 ppm.

The time to dilute from the start of the event (1440 ppm) to the time when the BDAS alarm is reached (1229.84 ppm) is calculated next. For this calculation, UFSAR Equation 15.4.6-6 could be used. Instead, the ABORT code uses a more conservative approach which is based on the average dilution rate from the start of the event to the time when criticality is reached. This average dilution rate is calculated as follows for the selected sample case.

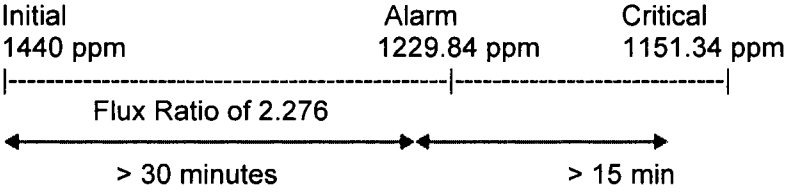
Average dilution rate = (1440-1151.34)/56.08 = 5.1472 ppm/min

The time to reach the BDAS alarm is calculated based on linear interpolation as follows:

Time to reach the BDAS alarm = (1440-1229.84)/5.1472 = 40.83 min (> 30 min was reported in the LAR).

The time for operator action becomes 56.08 – 40.83 = 15.25 min, which matches exactly the acceptance criterion (> 15 min was reported in the LAR).

If UFSAR Equation 15.4.6-6 had been used, the time to reach the BDAS alarm would have been 39.55 minutes and the time for operator action = 56.08 – 39.55 = 16.53 minutes. Hence, the approach used in the ABORT code is more conservative as it results in less time for operator action.



Therefore, the time for alarm (40.83 min > 30 min) and the time for operator action (15.25 min > 15 min) meet the values in LAR Table 2.8.5.4.5-1.