FPL.

L-2011-105
10 CFR 52.3

March 22, 2011

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

Re: Florida Power & Light Company
Proposed Turkey Point Units 6 and 7
Docket Nos. 52-040 and 52-041
Response to Request for Additional Information 02.04.05-1, Letter No. 010 (eRAI 5233) Standard Review Plan Section 02.04.05 - Probable Maximum Surge and Seiche Flooding

Reference:

1. NRC Letter to FPL dated December 2, 2010, Request for Additional Information Letter No. 010 Related to SRP Section 02.04.05 - Probable Maximum Surge and Seiche Flooding for the Turkey Point Nuclear Plant Units 6 and 7 Combined License Application

2. FPL Letter to NRC dated January 12, 2011, Schedule for Response to NRC Request for Additional Information Letter No. 010 (eRAI 5233) - Standard Review Plan Section 02.04.05 Probable Maximum Surge and Seiche Flooding

Florida Power & Light Company (FPL) letter dated January 12, 2011 (Reference 2), indicated that the response to RAI 02.04.05-2 was scheduled to be provided by February 28, 2011, and the responses to RAI 02.04.05-1 and RAI 02.04.05-3 were scheduled to be provided by March 25, 2011.

FPL provides, as an attachment to this letter, its response to the Nuclear Regulatory Commission's (NRC) request for additional information RAI 02.04.05-1(Reference 1). The attachment identifies changes that will be made in a future revision of the Turkey Point Units 6 and 7 Combined License Application (if applicable).

FPL has revised the submittal schedule for the response to RAI 02.04.05-3. The response to RAI 02.04.05-3 is now scheduled to be provided in April 2011.

If you have any questions, or need additional information, please contact me at 561-691-7490.

D097
NRO

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

Executed on March 22, 2011

Sincerely,

William Maher
Senior Licensing Director – New Nuclear Projects

WDM/RFB

Attachment: FPL Response to NRC RAI No. 02.04.05-1 (eRAI 5233)

cc:
PTN 6 & 7 Project Manager, AP1000 Projects Branch 1, USNRC DNRL/NRO
Regional Administrator, Region II, USNRC
Senior Resident Inspector, USNRC, Turkey Point Plant 3 & 4

NRC RAI Letter No. PTN-RAI-LTR-010

SRP Section: 02.04.05 - Probable Maximum Surge and Seiche Flooding

QUESTIONS from Hydrologic Engineering Branch (RHEB)

NRC RAI Number: 02.04.05-1 (eRAI 5233)

The NRC staff reviewed the applicant's reasoning regarding the potential for natural oscillations within the Biscayne Bay to produce a resonance. The application discusses seismic forcing and acknowledges the possibility of atmospheric forcing as a contributor to seiche oscillation; please discuss the possible role of ocean currents (such as the Florida Current) in contributing to oscillations (see Soloviev et al. 2003 and Davis et al.2008).

Provide sufficient reasoning and analysis to demonstrate that natural oscillations in the Biscayne Bay would not coincide with other phenomena to produce flooding that could adversely affect the safety-related facilities of Units 6 and 7. Demonstrate that all potential natural causes of oscillation are accounted for, and provide details for any quantitative analyses, calculations, and comparisons.

References

Davis, K. A., J. J. Leichter, J. L. Hench, and S. G. Monismith (2008), Effects of western boundary current dynamics on the internal wave field of the Southeast Florida shelf, *J. Geophys. Res.*, 113, C09010, doi:10.1029/2007JC004699.

Soloviev, Alexander V., Mark E. Luther and Robert H. Weisberg. 2003. Energetic baroclinic super-tidal oscillations on the southeast Florida shelf. *Geophysical Research Letters*, v. 30, no. 9, 1463, doi:10.1029/2002GL016603

FPL RESPONSE:

FSAR Subsection 2.4.5.4, Revision 2 discusses the resonance potential at Biscayne Bay due to seismic forcing and evaluates seiche oscillation induced by a probable maximum storm surge (PMSS) event and concludes that they do not represent a flooding risk to the safety-related facilities at the Turkey Point Units 6 & 7 site. In response to this RAI, additional assessments were conducted to examine other natural phenomena which might generate oscillations with periods close to the natural oscillation periods of the Biscayne Bay. In addition to seismic forcing and seiche oscillation induced by a PMSS, Florida Current and sea breeze forcing are the only phenomena identified to be capable of generating high frequency oscillations. As described below, the evaluations conclude that the Florida Current and sea breeze will not produce resonance responses in the Biscayne Bay and will have no safety-related flooding impact on the site.

Florida Current is a major influence on the coastal circulation and current dynamics in the southeast Florida shelf. The Florida Current generates internal wave field and coastal ocean current oscillations with a dominant periodicity of about 10 hours

(References 1, 2 and 3). Soloviev et al. 2003 (Reference 1) also illustrate that the presence of the Florida Current has no apparent effect on the sea level and its oscillations near the shore, which still follows the tidal constituents with dominant periods near 12 and 24 hours. Therefore, there is no evidence to support a hypothesis that the Florida Current has any impact on the sea level oscillations near the site, despite its influence on the velocity and density fields.

The estimation of the natural period of Biscayne Bay, which has an average depth of approximately 6 feet (FSAR Subsection 2.4.1, Reference 217) and is approximately 25 miles long from north to south and 8 miles wide from east to west, follows the methodology from Section II-5-6 of the USACE Coastal Engineering Manual (Reference 4) for open and closed basins as shown in Equations 1 and 2 below. In the north-south direction, the bay is postulated to be a closed basin, and an open basin in the east-west direction. The natural oscillation periods of Biscayne Bay during a normal sea condition are estimated to be approximately 3.4 to 5.3 hours, which are much smaller than the observed oscillation period of 10 hours in the current and density fields. Therefore, the potential for resonance in Biscayne Bay as affected by the Florida Current can further be precluded.

$$T_{north-south} = \frac{2\,l_{north-south}}{n\sqrt{g\,h}}$$ (Equation 1 for Closed Basin)

$$T_{east-west} = \frac{4\,l_{east-west}}{(1+2n)\sqrt{g\,h}}$$ (Equation 2 for Open Basin)

where,

T is the natural period of the basin

l is the length of the basin (25 miles in the north-south direction; 8 miles in the east-west direction)

n is the number of nodes (fundamental mode corresponds to $n=1$ for closed basin and $n=0$ for open basin)

g is the gravitational acceleration (32.2 feet/second^2)

h is the average depth of the basin (6 feet)

The potential of resonance within the Biscayne Bay from the forcing from sea breeze, which is caused by the diurnal (24-hour period) heating and cooling of the land and sea was also evaluated. This 24-hour period is much greater than the natural oscillation periods of the Biscayne Bay which are estimated to be approximately 3.4 to 5.3 hours.

According to Militello and Kraus 2001 (Reference 5), sea breeze can introduce diurnal oscillations and generate higher harmonic motions into water bodies. Through the analytical solution and numerical modeling developed for a simplified one-dimensional idealized basin, their study illustrates that (i) the amplitudes of wind-forced motions at the higher harmonics are orders of magnitude smaller than that at the fundamental period, and (ii) the wind-forced motions near the resonant modes can be almost completely damped by relatively small bottom friction in the water body. Consequently, flooding from resonance within the Biscayne Bay due to sea breeze is not expected.

The design plant grade elevation for the safety-related facilities at the Turkey Point Units 6 & 7 site is more than 26 feet above the mean sea level of -0.9 feet NAVD 88 (FSAR Subsection 2.4.1, Reference 218) of the Bay. The flooding of the safety-related facilities at the Turkey Point Units 6 & 7 site due to resonance in Biscayne Bay produced by Florida Current and sea breeze is therefore precluded.

This response is PLANT SPECIFIC.

References:

1) Soloviev, A. V., Luther, M. E. and Weisberg, R. H. (2003), "Energetic baroclinic super-tidal oscillations on the southeast Florida shelf", Geophysical Research Letters, v. 30, no. 9, 1463, doi:10.1029/2002GL016603.
2) Peters, H., Shay, L. K., Mariano, A. J., Cook, T. M. (2002), "Current variability on a narrow shelf with large ambient vorticity", J. Geophys. Res., 107, C8, 3087, doi:10.1029/2001JC000813.
3) Davis, K. A., Leichter, J. J., Hench, J. L., and Monismith, S. G. (2008), "Effects of western boundary current dynamics on the internal wave field of the Southeast Florida shelf", J. Geophys. Res., 113, C09010, doi:10.1029/2007JC004699.
4) U.S. Army Corps of Engineers, *Coastal Engineering Manual*, Part II, Chapter 5, 2008.
5) Militello, A., Kraus, N.C. (2001), "Generation of harmonics by sea breeze in nontidal water bodies", J. Physical Oce., 31(6), 1639.

ASSOCIATED COLA REVISIONS:

FSAR Subsection 2.4.5.4 will be revised as follows:

Units 6 & 7 are located adjacent to the west shore of the Biscayne Bay approximately 8 miles west of the Elliott Key Barrier Island. There are no records of seismic seiches within the bay. However, because the bay is a semi-enclosed body of water, seiche oscillation may occur due to atmospheric forcing. It is likely that such oscillations would occur along the principal axis of the bay in the north-south direction. Assuming that the bay is approximately 25 miles long, the natural period of oscillation for the bay, **during a PMH event,** is estimated to be approximately 36.8 minutes **(based on PMH still water depth of approximately 27.7 feet). This period is calculated conservatively using the half length of the bay and second mode of oscillation which gives a smaller period closer to the period of wind-waves**. During a PMH event, storm surge elevation inundates the Elliott Key Barrier Island. Under such conditions, it is unlikely that seiches occur. In addition, the natural period of oscillation is much greater than the period of wind-waves and shorter than the period of storm surge waves. Therefore, natural oscillations within the bay do not result in a resonance and flooding of the plant area due to a seiche event in the Biscayne Bay is precluded.

Florida Current is a major influence on the coastal circulation and current dynamics in the southeast Florida shelf. The Florida Current generates internal wave field and coastal ocean current oscillations with a dominant periodicity of about 10 hours (Subsection 2.4.5, References 212, 213 and 214). Soloviev et al. 2003 (Subsection 2.4.5, Reference 212) also illustrate that the presence of the Florida Current has no apparent effect on the sea level and its oscillations near the shore, which still follows the tidal constituents with dominant periods near 12 and 24 hours. Therefore, there is no evidence to support a hypothesis that the Florida Current has any impact on the sea level oscillations near the site, despite its influence on the velocity and density fields.

The natural oscillation periods of Biscayne Bay during a normal sea condition are estimated to be approximately 3.4 to 5.3 hours calculated using the methodology from Section II-5-6 of the USACE Coastal Engineering Manual (Subsection 2.4.5, Reference 210), which are much smaller than the observed oscillation period of 10 hours in the current and density fields. Therefore, the potential for resonance in Biscayne Bay as affected by the Florida Current can further be precluded.

The potential of resonance within the Biscayne Bay from the forcing from sea breeze, which is caused by the diurnal (24-hour period) heating and cooling of the land and sea was also evaluated. This 24-hour period is much greater than the natural oscillation periods of the Biscayne Bay which are estimated to be approximately 3.4 to 5.3 hours. According to Militello and Kraus 2001 (Subsection 2.4.5, Reference 215), sea breeze can introduce diurnal oscillations and generate higher harmonic motions into water bodies. Through the analytical solution and numerical modeling developed for a simplified one-dimensional idealized basin, their study illustrates that (i) the amplitudes of wind-forced motions at the higher harmonics are orders of magnitude smaller than that at the fundamental period, and (ii) the wind-forced motions near the resonant modes can be almost completely damped by relatively small bottom friction in the water body. Consequently, flooding from resonance within the Biscayne Bay due to sea breeze is not expected.

FSAR Subsection 2.4.5.6 will be revised by adding the following references:

212. Soloviev, A. V., et al., *Energetic baroclinic super-tidal oscillations on the southeast Florida shelf*, Geophysical Research Letters, Vol. 30, No. 9, 1463, May 2003.

213. Peters, H., et al., *Current variability on a narrow shelf with large ambient vorticity*, J. Geophys. Res., 107, C8, 3087, August 2002.

214. Davis, K. A., et al., *Effects of western boundary current dynamics on the internal wave field of the Southeast Florida shelf*, J. Geophys. Res.,Vol. 113, C09010, September 2008.

215. Militello, A., Kraus, N.C., *Generation of harmonics by sea breeze in nontidal water bodies*, J. Physical Oce., Vol. 31(6), 1639, June 2001.

ASSOCIATED ENCLOSURES:

None