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

May 2, 2017

Mr. Mano Nazar
President and Chief Nuclear Officer
Nuclear Division
Florida Power & Light Company
Mail Stop NT3/JW
15430 Endeavor Drive
Jupiter, FL 33478

SUBJECT: ST. LUCIE PLANT, UNITS 1 AND 2 – FLOOD HAZARD MITIGATION STRATEGIES ASSESSMENT (CAC NOS. MF7970 AND MF7971)

Dear Mr. Nazar:

By letter dated March 12, 2012 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML12053A340), the U.S. Nuclear Regulatory Commission (NRC) issued a request for information to all power reactor licensees and holders of construction permits in active or deferred status, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR), Section 50.54(f), "Conditions of Licenses" (hereafter referred to as the "50.54(f) letter"). The request was issued in connection with implementing lessons learned from the 2011 accident at the Fukushima Dai-ichi nuclear power plant, as documented in the NRC's Near-Term Task Force (NTTF) report (ADAMS Accession No. ML111861807).

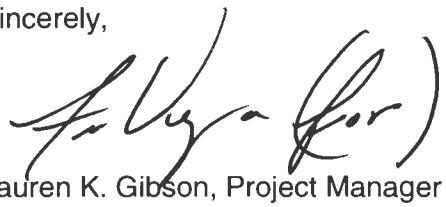
Enclosure 2 to the 50.54(f) letter requested that licensees reevaluate flood hazards for their sites using present-day methods and regulatory guidance used by the NRC staff when reviewing applications for early site permits and combined licenses (ADAMS Accession No. ML12056A046). Concurrent with the reevaluation of flood hazards, licensees were required to develop and implement mitigating strategies in accordance with NRC Order EA-12-049, "Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events" (ADAMS Accession No. ML12054A735). In order to proceed with implementation of Order EA-12-049, licensees used the current licensing basis flood hazard or the most recent flood hazard information, which may not be based on present-day methodologies and guidance, in the development of their mitigating strategies.

By letter dated December 19, 2016 (ADAMS Accession No. ML16365A005), Florida Power and Light Company (FPL, the licensee) submitted the mitigation strategies assessment (MSA) for St. Lucie Plant, Units 1 and 2 (St. Lucie). The MSAs are intended to confirm that licensees have adequately addressed the reevaluated flooding hazards within their mitigating strategies for beyond-design-basis external events. The purpose of this letter is to provide the NRC's assessment of the St. Lucie MSA.

The NRC staff has concluded that the St. Lucie MSA was performed consistent with the guidance described in Appendix G of Nuclear Energy Institute 12-06, Revision 2, as endorsed by Japan Lessons-Learned Division (JLD) interim staff guidance (ISG) JLD-ISG-2012-01, Revision 1, and that the licensee has demonstrated that the mitigation strategies are reasonably protected from reevaluated flood hazards conditions for beyond-design-basis external events. This closes out the NRC's efforts associated with CAC No. MF7992.

If you have any questions, please contact me at 301-415-1056 or at Lauren.Gibson@nrc.gov.

Sincerely,



Lauren K. Gibson, Project Manager
Hazards Management Branch
Japan Lessons-Learned Division
Office of Nuclear Reactor Regulation

Enclosure:
Staff Assessment Related to
the Mitigating Strategies for St. Lucie

Docket Nos. 50-335 and 50-389

cc w/encl: Distribution via Listserv

STAFF ASSESSMENT BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO MITIGATION STRATEGIES FOR St. LUCIE PLANT, UNITS 1 AND 2,

AS A RESULT OF THE REEVALUATED FLOODING HAZARD NEAR-TERM

TASK FORCE RECOMMENDATION 2.1- FLOODING CAC NOS. MF7970 AND MF7971

1.0 INTRODUCTION

By letter dated March 12, 2012 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML12053A340), the U.S. Nuclear Regulatory Commission (NRC) issued a request for information to all power reactor licensees and holders of construction permits in active or deferred status, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR), Section 50.54(f), "Conditions of Licenses" (hereafter referred to as the "50.54(f) letter"). The request was issued in connection with implementing lessons learned from the 2011 accident at the Fukushima Dai-ichi nuclear power plant, as documented in the NRC's Near-Term Task Force (NTTF) report (ADAMS Accession No. ML111861807).

Enclosure 2 to the 50.54(f) letter requested that licensees reevaluate flood hazards for their sites using present-day methods and regulatory guidance used by the NRC staff when reviewing applications for early site permits and combined licenses (ADAMS Accession No. ML12056A046). Concurrent with the reevaluation of flood hazards, licensees were required to develop and implement mitigating strategies in accordance with NRC Order EA-12-049, "Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events" (ADAMS Accession No. ML12054A735). That order requires holders of operating reactor licenses and construction permits issued under 10 CFR Part 50 to modify the plants to provide additional capabilities and defense-in-depth for responding to beyond-design-basis external events, and to submit to the NRC for review a final integrated plan that describes how compliance with the requirements of Attachment 2 of the order was achieved. In order to proceed with implementation of Order EA-12-049, licensees used the current licensing basis (CLB) flood hazard or the most recent flood hazard information, which may not be based on present-day methodologies and guidance, in the development of their mitigating strategies.

The NRC staff and industry recognized the difficulty in developing and implementing mitigating strategies before completing the reevaluation of flood hazards. The NRC staff described this issue and provided recommendations to the Commission on integrating these related activities in COMSECY-14-0037, "Integration of Mitigating Strategies for Beyond-Design-Basis External Events and the Reevaluation of Flood Hazards," dated November 21, 2014 (ADAMS Accession No. ML14309A256). The Commission issued a staff requirements memorandum on March 30, 2015 (ADAMS Accession No. ML15089A236), affirming that the Commission expects licensees for operating nuclear power plants to address the reevaluated flood hazards, which are considered beyond-design-basis external events, within their mitigating strategies.

Nuclear Energy Institute (NEI) 12-06, Revision 2, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide" (ADAMS Accession No. ML16005A625), has been endorsed by the NRC as an appropriate methodology for licensees to perform assessments of the mitigating strategies against the reevaluated flood hazards developed in response to the March 12, 2012,

50.54(f) letter. The guidance in NEI 12-06, Revision 2, and Appendix G in particular, supports the proposed Mitigation of Beyond-Design-Basis Events rulemaking. The NRC's endorsement of NEI 12-06, including exceptions, clarifications, and additions, is described in NRC Japan Lessons-Learned Division (JLD) interim staff guidance (ISG) JLD-ISG-2012-01, Revision 1, "Compliance with Order EA-12-049, Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events" (ADAMS Accession No. ML15357A163). Therefore, Appendix G of NEI 12-06, Revision 2, describes acceptable methods for demonstrating that the reevaluated flooding hazard is addressed within the St. Lucie Plant, Units 1 and 2 (St. Lucie) mitigating strategies for beyond-design-basis external events.

2.0 BACKGROUND

By letter dated March 10, 2015 (ADAMS Accession No. ML15083A264), Florida Power and Light Company (FPL, the licensee) submitted its flood hazard reevaluation report (FHRR) for St. Lucie. By letter dated September 3, 2015 (ADAMS Accession No. ML15224B449), the NRC issued an interim staff response (ISR) letter for St. Lucie. The ISR letter provided the reevaluated flood hazard mechanisms that exceeded the current design basis (CDB) for St. Lucie and flood parameters that are suitable input for the mitigating strategies assessment (MSA). For St. Lucie, the mechanisms listed as not bounded by the CDB in the ISR letter are local intense precipitation (LIP) and hurricane-induced probable maximum storm surge (PMSS). By letter dated December 19, 2016 (ADAMS Accession No. ML16365A005), FPL submitted the St. Lucie MSA for review by the NRC staff.

3.0 TECHNICAL EVALUATION

3.1 Mitigating Strategies under Order EA-12-049

The NRC staff evaluated the St. Lucie's strategies as developed and implemented under Order EA-12-049. This evaluation is documented in a safety evaluation issued by letter dated July 5, 2016 (ADAMS Accession No. ML16167A473).

The safety evaluation concluded that St. Lucie has developed guidance and proposed designs which, if implemented appropriately, will adequately address the requirements of Orders EA-12-049 and EA-12-051.

3.2 Evaluation of Current FLEX Strategies

The licensee stated in its MSA that St. Lucie's FLEX strategy is described in the document PSL-ENG-SEMS-14-005, Rev. 3, "St. Lucie FLEX Final Integrated Plan Document." The licensee's flood evaluation for FLEX strategies accounted for all flood hazards, with the exception of the LIP flood event and the Probable Maximum Storm Surge due to hurricane as discussed in the St. Lucie MSA document.

A brief summary of the licensee's FLEX strategies is as follows:

- For Phase 1, immediately following the loss of power, the reactor will trip and the plant will initially stabilize at no-load reactor coolant system (RCS) temperature and pressure conditions, with reactor decay heat removal via steam release to the atmosphere through the steam generator (SG) safety valves and/or SG atmospheric dump valves (ADVs). Natural circulation of the RCS will develop to provide core cooling and the

steam turbine driven auxiliary feedwater pump (TDAFW) pump will provide flow from the condensate storage tank (CST) to the SGs to make-up for steam release. Load stripping of all non-essential loads would begin at the declaration of an extended loss of alternating current (ELAP)/LUHS (approximately 1 hour after loss of power) and be completed within the next 30 minutes. With load stripping, the useable Class 1E battery life is calculated to be 21.5 hours for Unit 1 and 14.9 hours for Unit 2.

- For Phase 2, two FLEX 480V Diesel Generators (DG) will be deployed to repower the station 480 volts alternating current (VAC) bus in each Unit to ensure power is available to the battery chargers prior to depletion of the station batteries within 5 hours after ELAP is declared. The FLEX 480 VAC DGs will begin to operate around the 8 hour mark after declaration of ELAP to recharge the batteries. For RCS makeup, a permanent installed charging pump (in both Units) will be available once repowered from the FLEX 480 VAC DGs around the 9 hour mark after initiation of ELAP. The portable diesel driven pump (FLEX SG pump) will be deployed for core cooling at a location near the CST within 10 hours after ELAP. A portable FLEX CST pump will be staged at available from water sources by the 11 hour mark and will be in operation around the 17 hour mark to refill the CST. Spent Fuel Pump (SFP) makeup with the FLEX SFP pump is staged and aligned around the 16 hour mark and is placed into service around the 26 hour mark.

- For Phase 3, the FLEX strategy (within 72 hours after initiation of ELAP) will establish Shutdown Cooling (SDC) using equipment from the National Strategic Alliance of FLEX Emergency Response Center (NSRC), which will include a NSRC pumping system capable of cooling the CCW Heat Exchanger and a NSRC 4.16 KVAC generator to power Component Cooling Water (CCW) and Low Pressure Safety Injection (LPSI) pumps. Temporary power cables will be supplied with the NSRC 4.16kV generators for connection to the Class 1E 4.16kV Buses through switchgear located in the Electrical Equipment Rooms of each unit.

3.2.1 Confirmation of the Flood Hazard Elevations in the MSA

The NRC staff reviewed the flood hazard elevations in the MSA and confirmed the flood depths for LIP flood-causing mechanisms are consistent with the values in the FHRR.

3.2.2 Evaluation of Associated Effects

The staff reviewed information provided by FPL in the FHRR and MSA regarding associated effects (AE) parameters for flood hazards not bounded by the CDB. The AE parameters related to water surface elevation (i.e., stillwater elevation with wind waves and runup effects) were previously reviewed by staff, and were transmitted to the licensee via the ISR. The AE parameters not directly associated with water surface elevation are discussed below and are summarized in Table 3.2.2-1.

For the LIP flood-causing mechanism, the licensee stated in the MSA that the associated effects would not affect the safety of the plant due to relatively low flow velocities and small inundation depths. The licensee specifically noted that the flow velocities within the powerblock area are low, minimizing the ability for waterborne projectiles (debris) to adversely affect the plant facilities. The licensee also stated that scouring or erosion of the surface soils from an LIP event is insignificant due to low flow velocities. The staff confirmed this statement by reviewing

the licensee-provided LIP model input and output files. The staff identified that the estimated inundation depths and flow velocities are low and that the modeling is reasonable for use in the MSA. Therefore, the staff agrees with the licensee's conclusion that the AE parameters for LIP are minimal.

3.2.3 Evaluation of Flood Event Duration

The staff reviewed information provided by the licensee regarding the flood event duration (FED) parameters needed to perform the MSA for flood hazards not bounded by the CDB at St. Lucie. The FED parameters for the flood-causing mechanisms not bounded by the CDB are summarized in Table 3.2.3-1.

The licensee reported a warning time of zero hours for the LIP flood-causing mechanism in the MSA. However, the staff notes that NEI 15-05, 2015, "Warning Time for Local Intense Precipitation Events," Revision 6 (ADAMS Accession No. ML15104A158), could be used to establish LIP warning time for the purposes of future assessments of plant response, if needed. In its MSA, the licensee reported periods of inundation and recession of 2.6 hours and 1.3 hours, respectively. The licensee used the 2-dimensional numerical model described in the FHRR to determine these parameters. The staff confirmed the licensee's flood event duration parameters by reviewing the numerical model results for the LIP flood-causing mechanism. The staff concludes that the licensee's FED parameters are reasonable and acceptable for use in the MSA.

3.2.4 Evaluation of Flood Protection Features

LIP Flood

In the MSA, Section 2 describes the reevaluated LIP effect upon FLEX deployment strategy and water in-leakage into the door sills of the Unit 1 and 2 Reactor Auxiliary Buildings (RABs). The licensee indicated that the LIP flood water will maintain a depth above critical door sills for a maximum of 2.6 hours. The 2.6 hours includes about 1.3 hours of water recession away from the power block. In developing the FLEX strategies accounting for flood scenarios, the licensee did not consider the impact of the 2.6 hour LIP flood duration in regards to FLEX equipment deployment to areas inside the power block, including the RABs. The water in-leakage from the LIP flood into the Unit 1 RAB was determined in the MSA to reach the height of 2.4 inches inside the building. The critical equipment inside the Unit 1 RAB have at least a minimum height of 6 inches from the building main floor. As for the flood height for Unit 2 RAB, the LIP flood water in-leakage was determined by the licensee to reach 0.9 inches. The critical equipment inside of Unit 2 RAB also sits at least 6 inches above the building main floor (19.5 ft PSL-datum). Both RABs are described in the MSA to have lower levels (-0.5 ft PSL-datum) of the building, in which the water accumulated from external flooding will reach amounts of 90,000 gallons (Unit 1 RAB) and 16,700 gallons (Unit 2 RAB) after the LIP flood. The maximum amount of flood water that can be accumulated in both RAB lower levels is 135,000 gallons. The licensee concluded in its evaluation of the LIP flood that the 2.6 hour duration would mainly impact the amount of water seepage into the RABs and exceed the critical door sills and pathways for FLEX equipment deployment. The 2.6 hours would be considered to impact potential FLEX equipment deployment after the initiating ELAP event. The licensee stated in its MSA that physical modifications were made to the door sills and penetrations throughout the power block to allow for delayed deployment of the FLEX 480 VAC DGs around the 5 hour mark.

The NRC staff reviewed the licensee's assessment of the LIP event as compared to existing FLEX strategies in St. Lucie FIP. The NRC staff finds that the existing locations of the critical equipment inside the RABs would not be affected by the water in-leakage from the door sills since the LIP flood water elevation is much lower. The NRC staff also finds that the current FLEX strategies would allow for delayed deployment of FLEX equipment due to the physical modifications to the RAB door sills and power block penetrations to limit the amount of water that affect the deployment paths and staging locations. The 2.6 hour duration taking place after the initiating ELAP event will allow FLEX deployment strategies to remain unaffected since the first FLEX equipment is deployed around the 5 hour mark. Based on the existing location of critical equipment inside of the RABs and the modifications made to the RABs door sills and penetrations around the power block, the NRC staff finds that the licensee has adequately assessed the Mitigating Strategies Flood Hazard Information (MSFHI) for the LIP flood event and that the applicable FLEX strategies can be implemented.

PMSS Event

In the MSA, Section 2 described the reevaluated PMSS analysis for the MSFHI hurricane storm surge. The power block is protected from wave run-up from the hurricane storm surge by the discharge canal steel sheet-piling barrier. The FLEX storage building is elevated above the projected flood height and protected from the storm surge. The hurricane storm surge floods the redundant pathways between the FLEX storage building and the power block for longer than the original time estimate of 5 hours (including recession of the flood water). The licensee estimated that the increased duration of the PMSS flood will delay the transport of the portable FLEX equipment for up to 6 hours. The licensee indicated in its MSA that the most time critical function of deploying the FLEX 480 VAC DGs would be the most limiting time constraint. The licensee stated that the FLEX equipment deployment strategies can support the 6 hour delay due to PMSS due to the existing extension capabilities of the batteries for Unit 1 and Unit 2. Unit 1 batteries can be extended to 21 hours and Unit 2 can be extended to 14 hours. The 6 hour delay would allow storm surge flood water to recede from the deployment pathways, leaving 2 hours to deploy the FLEX 480 VAC DGs and align to the 480 VAC busses. The licensee determined that the remaining FLEX equipment will remain unaffected by the 6 hour delay due to later deployment and alignment times associated with the portable pumps, specifically for core cooling and CST makeup, which will be needed around the 10 hour mark and RCS makeup with the charging pumps needed around the 8 hour mark after ELAP declaration. Current site hurricane procedures provide warning time between 12 to 72 hours to bring the plant into Shutdown to Mode 3, 4, or 5 at least 2 hours before projected onset of hurricane winds. The licensee stated in its MSA that the revision to the deployment timeline was made in the PSL program document ADM-17.34, Rev. 7, "Diverse and Flexible Coping Strategies (FLEX) Program."

The NRC staff reviewed the licensee's assessment of the reevaluated PMSS in the MSA. The NRC staff concurred that the overall FLEX deployment strategy regarding portable FLEX pumps would not be affected by the 6 hour delay since the FLEX equipment is expected to be deployed and aligned around the 8 hour mark or later after declaration of ELAP. The NRC staff reviewed the licensee's updated FLEX Strategy Program to ensure that the licensee's deployment strategy for the FLEX 480 VAC DGs was consistent with the assumptions made in the MSA. The licensee's timelines in the program document indicated that the safety-related battery chargers should be energized by the FLEX 480 VAC DGs approximately 9 hours from event initiation. NRC staff also reviewed calculations FPL064-CALC-004, "Unit 1 Battery Load Shedding Strategy," Revision 3, and FPL064-CALC-005, "Unit 2 Battery Load Shedding," Revision 3. The NRC staff verified that the licensee's calculations for the Unit 1 and Unit 2

Class 1E station batteries could be extended up to 21.5 hours (Unit 1) and 14.9 hours (Unit 2). The licensee's current strategy also includes the energization of the safety-related battery chargers prior to the Class 1E batteries being fully discharged. Based upon the batteries' capability to operate beyond the 6 hour delay and the availability of battery chargers, the NRC staff finds that the 6 hour delay would still allow implementation of the overall FLEX strategy.

3.2.5 Conclusion

The NRC staff has reviewed the information provided in the St. Lucie MSA related to the original FLEX strategies, as evaluated against the reevaluated hazard(s) described in Section 3.2.3 of this staff sssessment, and concluded that the licensee has adequately assessed the MSFHI for the LIP flood event and PMSS flood event to determine that the FLEX Strategy should be able to be implemented as currently designed. The NRC staff made its determination based upon:

- Modifications were made to the RAB door sills and power block to limit the water intrusion and allow for the 2.6 hour duration to complete before FLEX equipment deployment;

- The location of critical equipment inside the RABs at a higher elevation of the projected water in-leakage from the LIP flood;

- Capability of the Unit 1 and 2 station batteries to operate beyond the 6 hour delay prior to needing the FLEX 480 VAC DGs; and

- The availability of battery chargers prior to the station batteries being depleted.

Therefore, the NRC staff concludes that the licensee appears to have demonstrated the capability to deploy FLEX strategies, as modified, against a postulated beyond-design-basis event for the LIP and PMSS flood events, as described in NEI 12-06, Revision 2 and ISG-2012-01, Revision 1.

4 CONCLUSION

The NRC staff has reviewed the information provided in the St. Lucie MSA related to the FLEX strategies, as evaluated against the reevaluated hazard(s) described in Section 2 of this staff assessment, and found that:

- The FLEX strategies appear to not be affected by the impacts of the ISR flood levels (including impacts due to the environmental conditions created by the ISR flood levels);

- The deployment of the FLEX strategies appears to not be affected by the impacts of the ISR flood levels; and

- Associated effects and FED are reasonable and acceptable for use in the St. Lucie MSA, and have been appropriately considered in the MSA.

Therefore, the NRC staff concludes that the licensee appears to have followed the guidance in Appendix G of NEI 12-06, Revision 2, and should be able to deploy the original FLEX strategies, as designed, against a postulated beyond-design-basis event for LIP, including associated effects and flood event duration.

TABLE 3.2.2-1. ASSOCIATED EFFECTS PARAMETERS NOT DIRECTLY ASSOCIATED WITH TOTAL WATER HEIGHT FOR FLOOD-CAUSING MECHANISMS NOT BOUNDED BY THE CDB

	FLOOD-CAUSING MECHANISM
Associated Effects Parameter	**LOCAL INTENSE PRECIPITATION**
Hydrodynamic loading at plant grade	Minimal
Debris loading at plant grade	Minimal
Sediment loading at plant grade	Minimal
Sediment deposition and erosion	Minimal
Concurrent conditions, including adverse weather	Minimal
Groundwater ingress	Minimal
Other pertinent factors (e.g., waterborne projectiles)	Minimal

Source: FHRR

Table 3.2.3-1. Flood Event Durations for Flood-Causing Mechanisms Not Bounded by the CDB

FLOOD-CAUSING MECHANISM	TIME AVAILABLE FOR PREPARATION FOR FLOOD EVENT	DURATION OF INUNDATION OF SITE	TIME FOR WATER TO RECEDE FROM SITE
Local Intense Precipitation and Associated Drainage	Use NEI 15-05 (NEI, 2015)	2.6 hours	1.3 hours

Source: MSA

ST. LUCIE PLANT, UNITS 1 AND 2 – FLOOD HAZARD MITIGATION STRATEGIES ASSESSMENT DATED May 2, 2017

DISTRIBUTION:

Public
JLD R/F
RidsNRRJLD Resource
RidsNrrDorllpl2-2 Resource
RidsNrrDorl Resource
RidsNrrPMStLucie Resource
RidsRgn2MailCenter Resource
RidsNrrlaSLent Resource
RidsOgcMailCenter Resource
RidsOpaMail Resource
RidsAcrsAcnw MailCtr Resource
RidsNroDsea Resource
SBailey, NRR
JBoska, NRR
NSanfilippo, NRR
LGibson, NRR
CWolf, OCA

ADAMS Accession No. ML17094A811 *by e-mail dated

OFFICE	NRR/JLD/JHMB/PM	NRR/JLD/LA	NRR/JLD/JOMB/PM	NRO/DSEA/RHM1	NRR/JLD/JERB/BC
NAME	LKGibson	SLent	JPaige	CCook*	SBailey*
DATE	04/06/2017	04/06/2017	04/12/2017	03/29/2017	03/15/2017
OFFICE	NRR/JLD/JHMB/BC	NRR/JLD/JHMB /PM			
NAME	NSanfilippo	LKGibson (FVega for)			
DATE	04/14/2017	05/02/2017			

OFFICIAL RECORD COPY