



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

December 15, 2017

Mr. Mano Nazar  
President and Chief Nuclear Officer  
Nuclear Division  
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**SUBJECT: ST. LUCIE PLANT UNITS 1 AND 2– STAFF ASSESSMENT OF FLOODING  
FOCUSED EVALUATION (CAC NOS. MF9914 AND MF9915;  
EPIDS L-2017-JLD-0021 AND L-2017-JLD-0029)**

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). By letter dated March 10, 2015 (ADAMS Accession No. ML15083A306), Florida Power and Light Company (FPL, the licensee) responded to this request for St. Lucie Plant Units 1 and 2 (St. Lucie).

After its review of the licensee's response, 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 parameters that are suitable for other assessments associated with NTTF Recommendation 2.1 "Flooding". As stated in the letter, because the local intense precipitation (LIP) flood-causing mechanism at St. Lucie is not bounded by the plant's CDB, additional assessments of the flood hazard mechanisms are necessary.

By letter dated June 29, 2017 (ADAMS Accession No. ML17180A090), the licensee submitted the focused evaluation (FE) for St. Lucie. The FEs are intended to confirm that licensees have adequately demonstrated, for unbounded mechanisms identified in the ISR letter, that: 1) a flood mechanism is bounded based on further reevaluation of flood mechanism parameters; 2) effective flood protection is provided for the unbounded mechanism; or 3) a feasible response is provided if the unbounded mechanism is local intense precipitation. The purpose of this letter is to provide the NRC's assessment of the St. Lucie FE.

As set forth in the attached staff assessment, the NRC staff has concluded that the St. Lucie FE was performed consistent with the guidance described in Nuclear Energy Institute (NEI) 16-05, Revision 1, "External Flooding Assessment Guidelines" (ADAMS Accession No. ML16165A178). Guidance document NEI 16-05, Revision 1, has been endorsed by Japan Lessons-Learned Division (JLD) interim staff guidance (ISG) JLD-ISG-2016-01, "Guidance for Activities Related to Near-Term Task Force Recommendation 2.1, Flood Hazard Reevaluation" (ADAMS Accession No. ML16162A301). The NRC staff has further concluded that the licensee has demonstrated that effective flood protection, if appropriately implemented, exists for the LIP flood mechanism during a beyond-design-basis external flooding event at St. Lucie. This closes out the licensee's response for St. Lucie for the reevaluated flooding hazard portion of the 50.54(f) letter and the NRC's efforts associated with CAC Nos. MF9914 and MF9915.

If you have any questions, please contact me at 301-415-1617 or via electronic mail at [Frankie.Vega@nrc.gov](mailto:Frankie.Vega@nrc.gov).

Sincerely,



Frankie Vega, Project Manager  
Beyond-Design-Basis Management Branch  
Division of Licensing Projects  
Office of Nuclear Reactor Regulation

Enclosure:  
Staff Assessment Related to the  
Flooding Focused Evaluation for St. Lucie

Docket Nos. 50-335 and 50-389

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STAFF ASSESSMENT BY THE OFFICE OF NUCLEAR REACTOR REGULATION  
RELATED TO THE FOCUSED EVALUATION 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. MF9914 AND MF9915; EPID L-2017-JLD-0021 AND L-2017-JLD-0029)

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) (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 of the 50.54(f) letter requested that licensees reevaluate flood hazards for their respective 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). If the reevaluated hazard for any flood-causing mechanism is not bounded by the plant's current design basis (CDB) flood hazard, an additional assessment of plant response would be necessary. Specifically, the 50.54(f) letter stated that an integrated assessment should be submitted, and described the information that the integrated assessment should contain. By letter dated November 30, 2012 (ADAMS Accession No. ML12311A214), the NRC staff issued Japan Lessons-Learned Division (JLD) interim staff guidance (ISG) JLD-ISG-2012-05, "Guidance for Performing the Integrated Assessment for External Flooding."

On June 30, 2015 (ADAMS Accession No. ML15153A104), the NRC staff issued COMSECY-15-0019, describing the closure plan for the reevaluation of flooding hazards for operating nuclear power plants. The Commission approved the closure plan on July 28, 2015 (ADAMS Accession No. ML15209A682). COMSECY-15-0019 outlines a revised process for addressing cases in which the reevaluated flood hazard is not bounded by the plant's CDB. The revised process describes a graded approach in which licensees with hazards exceeding their CDB flood will not be required to complete an integrated assessment, but instead will perform a focused evaluation (FE). As part of the FE, licensees will assess the impact of the hazard(s) on their site and then evaluate and implement any necessary programmatic, procedural, or plant modifications to address the hazard exceedance.

Nuclear Energy Institute (NEI) 16-05, Revision 1, "External Flooding Assessment Guidelines" (ADAMS Accession No. ML16165A178), has been endorsed by the NRC as an appropriate methodology for licensees to perform the focused evaluation in response to the 50.54(f) letter. The NRC's endorsement of NEI 16-05, including exceptions, clarifications, and additions, is described in NRC JLD-ISG-2016-01, "Guidance for Activities Related to Near-Term Task Force

Recommendation 2.1, Flood Hazard Reevaluation" (ADAMS Accession No. ML16162A301). Therefore, NEI 16-05, Revision 1, describes acceptable methods for demonstrating that St. Lucie Plant Units 1 and 2 (St. Lucie) has effective flood protection.

## 2.0 BACKGROUND

This provides the final NRC staff assessment associated with the information that the licensee provided in response to the reevaluated flooding hazard portion of the 50.54(f) letter.

Therefore, this background section includes a summary description of the reevaluated flood information provided by the licensee and the associated assessments performed by the NRC staff. The reevaluated flood information includes: 1) the flood hazard reevaluation report (FHRR); 2) the mitigation strategies assessment (MSA); and 3) the focused evaluation.

### Flood Hazard Reevaluation Report

By letter dated March 10, 2015 (ADAMS Accession No. ML15083A306), Florida Power and Light Company (FPL, the licensee) submitted the flood hazard reevaluation report (FHRR) for St. Lucie. After reviewing the licensee's response, 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 discusses the reevaluated flood hazard mechanisms that exceeded the CDB for St. Lucie and parameters that are a suitable input for the MSA and the FE. As stated in the ISR letter, because the local intense precipitation (LIP) flood-causing mechanism at St. Lucie is not bounded by the plant's CDB, additional assessments of the flood hazard mechanism are necessary. The NRC staff issued a final staff assessment of the FHRR in a letter dated October 17, 2017 (ADAMS Accession No. ML17286A084). The NRC staff's conclusions regarding LIP exceeding the St. Lucie CDB remained unchanged from the information provided in the ISR letter.

### Mitigation Strategies Assessment

By letter dated December 19, 2016 (ADAMS Accession No. ML16365A005), FPL submitted the MSA for St. Lucie for review by the NRC staff. The MSAs are intended to confirm that licensees have adequately addressed the reevaluated flooding hazards within their mitigation strategies for beyond-design-basis external events. By letter dated May 2, 2017 (ADAMS Accession No. ML17094A811), the NRC issued its assessment of the St. Lucie MSA. The NRC staff concluded that the St. Lucie MSA was performed consistent with the guidance described in Appendix G of NEI 12-06, Revision 2, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide" (ADAMS Accession No. ML16005A625). The NRC's endorsement of NEI 12-06, Revision 2, is described in 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). The NRC staff further concluded that the licensee has demonstrated that the mitigation strategies, if appropriately implemented, are reasonably protected from reevaluated flood hazards conditions for beyond-design-basis external events.

### Focused Evaluation

By letter dated June 29, 2017 (ADAMS Accession No. ML17180A090), the licensee submitted the FE for St. Lucie. The FEs are intended to confirm that licensees have adequately demonstrated, for unbounded mechanisms identified in the ISR letter, that: 1) a flood

mechanism is bounded based on further reevaluation of flood mechanism parameters; 2) effective flood protection is provided for the unbounded mechanism; or 3) a feasible response is provided if the unbounded mechanism is local intense precipitation. These 3 options associated with performing an FE are referred to as Path 1, 2, or 3, as described in NEI 16-05, Revision 1. The purpose of this staff assessment is to provide the results of the NRC's evaluation of the St. Lucie FE.

### 3.0 TECHNICAL EVALUATION

The licensee stated that its FE followed Path 2 of NEI 16-05, Revision 1 and utilized Appendix B for guidance on evaluating the site strategy. The St. Lucie FE addresses the LIP flooding mechanism, which was found to exceed the plant's CDB as described in the FHRR and ISR letter. This technical evaluation will address the following topics: characterization of flood parameters; evaluation of flood impact assessments; evaluation of available physical margin; reliability of flood protection features; and overall site response.

#### 3.1 Characterization of Flood Parameters

The LIP elevations, associated effects (AE) and flood event duration (FED) parameters that are used as inputs to the FE are the same as those that were used for the MSA. The licensee stated that in the powerblock area, the maximum external depth of accumulated water is 3.20 feet (ft.) and this LIP flood water will maintain a depth above critical door sills of the Unit 1 and 2 Reactor Auxiliary Buildings (RABs) for a maximum of 2.6 hours. Table 3.1 of this assessment provides a summary of LIP flood-causing mechanism at the St. Lucie site.

The FE credits passive permanent flooding protection features to demonstrate that key structures, systems, and components (SSCs) are protected from the LIP flooding mechanism. The licensee indicated that the site does not require additional manual actions by plant personnel to protect key SSCs; therefore, an evaluation of the overall site response was not necessary.

The NRC staff reviewed the LIP parameters listed in the licensee's FE and confirmed that they were consistent with the parameters that were presented in the MSA for the LIP event. Based on the review that was previously performed for the MSA, the staff concludes that the licensee's characterization of the LIP event in the FE is appropriate.

Table 3.1 Summary of Controlling Flood-Causing Mechanisms at the St. Lucie Site.

<b>Reevaluated Flood-Causing Mechanisms and Associated Effects That May Exceed The Powerblock Elevation (15.2 ft. NAVD88)</b>	<b>ELEVATION (NAVD88)</b>
Local Intense Precipitation and Associated Drainage	19.3 ft. <sup>(1)</sup>

<sup>(1)</sup> The LIP mechanism has multiple elevations, the most significant of which is this maximum water-surface elevation at critical door sills.

## 3.2 Evaluation of Flood Impact Assessment for LIP

### 3.2.1 Description of Impact of Unbounded Hazard

The St. Lucie FE identified the potential impacts on key SSCs as a result of water ingress due to LIP. The LIP event leads to flood water surface elevations above critical door sills at some locations. In order to assess the impacts of the unbounded flood levels, the licensee identified the maximum water surface elevations at the exterior door openings, maximum flood depths above the door threshold, and duration of when the flood levels are above the door threshold. With this information, the licensee assessed the impacts of water ingress and potential for accumulation into rooms housing key SSCs.

The licensee's evaluation indicated that water in-leakage from the LIP flood into the Unit 1 and 2 RABs would reach the height of 2.4 and 0.9 inches, respectively, inside the buildings. The licensee stated that the critical equipment inside Unit 1 and Unit 2 RABs have at least a minimum height of 6 inches from the building main floor. The licensee estimated that external flooding will reach amounts of 90,000 gallons (Unit 1 RAB) and 16,700 gallons (Unit 2 RAB) after the LIP flood. The licensee stated that the design basis maximum amount of flood water that can be accumulated in both RAB lower levels is 135,000 gallons. Therefore, the licensee concludes that: (1) the maximum flood volumes and associated elevations do not impact any key SSCs and (2) there is no need to make any further physical modifications to the station other than routine preventative maintenance to maintain exterior door seals.

The NRC staff reviewed the information provided by the licensee in order to assure that adequate flood parameters were used for the calculation of water ingress and water accumulation. Specifically, the NRC staff verified that the assumed duration of flooding above threshold elevation was consistent with previous information reviewed by the staff for the St. Lucie MSA. 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.

### 3.2.2 Evaluation of Available Physical Margin and Reliability of Flood Protection Features

The licensee relies on passive features and existing doors to justify that there is available margin. As stated above the licensee assessed the potential water in-leakage from LIP flood into Unit 1 and 2 RABs. The licensee calculated that LIP water would reach the height of 2.4 inches (inside Unit 1 RAB) and 0.9 inches (inside Unit 2 RAB) and compared these results to the locations of critical equipment inside these buildings. The licensee stated that the bottom height of the critical equipment is at least 6 inches above the building floors. Based on this information the licensee calculated the available physical margin for SSCs inside Unit 1 and Unit 2 RABs which resulted in approximately 3.6 and 5.1 inches, respectively. In addition, in order to demonstrate margin, the licensee compared the maximum amount of water that can safely accumulate in the buildings (135,000 gallons) to the expected accumulation of 90,000 and 16,700 gallons for RAB Unit 1 and Unit 2, respectively. The licensee's detailed evaluation is provided in NEE-131-PR-001, Rev. 1 "Effects of Local Intense Precipitation (LIP) on Plant Internal Flooding Report". The NRC staff audited the NEE-131-PR-001, Rev. 1. Specifically, the staff: reviewed the maximum external water depths and water surface elevations for points of interests; reviewed the licensee's assessment of the ability of exterior doors to withstand pressures associated with the higher flood elevations; confirmed elevation of key SSCs located inside Unit 1 and Unit 2 RABs; confirmed the maximum amount of water that can be safely

accommodated within the lower levels of the RABs, and reviewed the assumptions taken when calculating water in-leakage from the LIP flood.

In Section 6.2 of its FE the licensee committed to repair / replace the Unit 1 and 2 RAB drumming room doors in order to minimize the in leakage caused during an LIP event. Work Orders 40375255-02 and 40288725-01 have been put in place to ensure that these doors will be replaced. The staff reviewed these work orders and noted that these were completed and the doors have been replaced. Therefore, the commitments as described in Section 6.2 of the FE, have been completed.

Because increased focus has been placed on flood protection since the accident at Fukushima, licensees and NRC inspectors have identified deficiencies with equipment, procedures, and analyses relied on to either prevent or mitigate the effects of external flooding at a number of licensed facilities. Recent examples include those found in Information Notice 2015-01, "Degraded Ability to Mitigate Flooding Events" (ADAMS Accession No. ML14279A268). In addition, the NRC is cooperatively performing research with the Electric Power Research Institute to develop flood protection systems guidance that focuses on flood protection feature descriptions, design criteria, inspections, and available testing methods in accordance with a memorandum of understanding dated September 28, 2016 (ADAMS Accession No. ML16223A495). The NRC staff expects that licensees will continue to maintain flood protection features in accordance with their current licensing basis. The NRC staff further expects that continued research involving flood protection systems will be performed and shared with licensees in accordance with the guidance provided in Management Directive 8.7, "Reactor Operating Experience Program" (ADAMS Accession No. ML122750292), as appropriate.

The NRC staff concludes, based on the information provided by FPL, that adequate margin exists for the reevaluated LIP mechanism. The NRC staff agrees that the licensee's estimation of water accumulation is conservative. The staff also finds that the hydrostatic and hydrodynamic loading analysis performed on power block structures was done using appropriate engineering codes and standards and the resultant loads are relatively low and are not expected to negatively impact such structures. Therefore, the NRC staff concludes that the licensee has demonstrated that adequate and reliable passive features exist to provide flood protection of key SSCs and maintain key safety functions as defined in Appendix B of NEI 16-05, Rev 1.

### 3.2.3 Overall Site Response

The licensee does not rely on any personnel actions or new modifications to the plant in order to respond to the LIP event. As described above, the licensee's evaluation relied on passive existing flood protection features to demonstrate adequate flood protection; therefore, there is no need to review overall site response.

## 4.0 AUDIT REPORT

The July 18, 2017, generic audit plan describes the NRC staff's intention to issue an audit report that summarizes and documents the NRC's regulatory audit of the licensee's FE. The NRC staff's St. Lucie audit was limited to the review of the calculations and procedures described above. Because this staff assessment appropriately summarizes the results of the audit, the NRC staff concludes a separate audit report is not necessary, and that this document serves as the audit report described in the staff's July 18, 2017, letter.

## 5.0 CONCLUSION

The NRC staff concludes that FPL performed the St. Lucie FE in accordance with the guidance described in NEI 16-05, Revision 1, as endorsed by JLD-ISG-2016-01, and that the licensee has demonstrated that effective flood protection, if appropriately implemented, exists from the reevaluated flood hazards. Furthermore, the NRC staff concludes that St. Lucie screens out of performing an integrated assessment based on the guidance found in JLD-ISG-2016-01. As such, in accordance with Phase 2 of the process outlined in the 50.54(f) letter, additional regulatory actions associated with the reevaluated flood hazard are not warranted. The licensee has satisfactorily completed providing responses to the 50.54(f) activities associated with the reevaluated flood hazards.



SUBJECT: ST. LUCIE PLANT UNITS 1 AND 2- STAFF ASSESSMENT OF FLOODING  
FOCUSED EVALUATION DATED December 15, 2017

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