UNITED STATES
NUCLEAR REGULATORY COMMISSION
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November 29, 2017

Mr. Mano Nazar
President and Chief Nuclear Officer
Nuclear Division
NextEra Energy Seabrook, LLC
Mail Stop: EX/JB
700 Universe Blvd
Juno Beach, FL 33408

SUBJECT: SEABROOK STATION, UNIT 1 – FLOOD HAZARD MITIGATION STRATEGIES ASSESSMENT (CAC NO. MF7974; EPID L-2016-JLD-0006)

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 June 14, 2017 (ADAMS Accession No. ML17166A001), NextEra Energy Seabrook, LLC (the licensee) submitted the mitigating strategies assessment (MSA) for Seabrook Station, Unit 1 (Seabrook). 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 Seabrook MSA.

The NRC staff has concluded that the Seabrook MSA was performed consistent with the guidance described in Appendix G of Nuclear Energy Institute (NEI) NEI-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 hazard conditions for beyond-design-basis external events.

This letter closes out the NRC's efforts associated with CAC No. MF7974.

If you have any questions, please contact me at 301-415-1617 or at 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
Mitigating Strategies for Seabrook

Docket No. 50-443

cc w/encl: Distribution via Listserv

STAFF ASSESSMENT BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO MITIGATION STRATEGIES FOR

SEABROOK STATION, UNIT 1,

AS A RESULT OF THE REEVALUATED FLOODING HAZARD NEAR-TERM TASK FORCE

RECOMMENDATION 2.1- FLOODING

CAC NO. MF7974; EPID L-2016-JLD-0006

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 (FIP) 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 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 (SRM) 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 Seabrook Station, Unit 1 (Seabrook) mitigating strategies for beyond-design-basis external events.

2.0 BACKGROUND

By letter dated November 7, 2016 (ADAMS Accession No. ML16314D429, Non-Public), NextEra Energy Seabrook, LLC (NextEra, the licensee) submitted its flood hazard reevaluation report (FHRR) Revision 1 for Seabrook. By letter dated December 21, 2016 (ADAMS Accession No. ML16356A479), the NRC issued an interim staff response (ISR) letter for Seabrook. The ISR letter included the reevaluated flood hazard mechanisms that exceeded the current design basis (CDB) for Seabrook and parameters that are a suitable input for the mitigating strategies assessment (MSA). For Seabrook, the mechanisms listed as not bounded by the CDB in the ISR letter are local intense precipitation (LIP) and storm surge. The NRC staff review of the flood event duration (FED) and associated effects (AE) parameters associated with the flooding mechanisms not bounded by the CDB is provided below.

For the flood-causing mechanisms that are not bounded by respective current plant design-basis hazards, the ISR letter noted that in order to complete its response to the information requested by Enclosure 2 to the 50.54(f) letter, the licensee is expected to submit an integrated assessment or a focused evaluation, as appropriate, to address these reevaluated flood hazards, as described in NRC letter dated September 1, 2015, "Coordination of Requests for Information Regarding Flooding Hazard Reevaluations and Mitigating Strategies for Beyond-Design-Basis External Events" (ADAMS Accession No. ML15174A257). This letter describes the changes in the NRC's approach to the flood hazard reevaluations that were approved by the Commission in its SRM to COMSECY-15-0019 "Mitigating Strategies and Flooding Hazard Reevaluation Action Plan" (ADAMS Accession No. ML15153A104).

By letter dated June 14, 2017 (ADAMS Accession No. ML17166A001), the licensee submitted its MSA for Seabrook for review by the NRC staff. The MSA is intended to confirm that licensees have adequately addressed the reevaluated flooding hazards within their mitigating strategies for beyond-design-basis external events.

3.0 TECHNICAL EVALUATION

3.1 Mitigating Strategies under Order EA-12-049

The NRC staff evaluated the Seabrook strategies as developed and implemented under Order EA-12-049, as described in the licensee's FIP dated July 26, 2016 (ADAMS Accession No. ML16214A244). The NRC staff's safety evaluation (SE) for Seabrook is dated December 1, 2016 (ADAMS Accession No. ML16321A418). The Seabrook SE concluded that the licensee has developed guidance and proposed design that, if implemented appropriately, will adequately address the requirements of Order EA-12-049.

A brief summary of Seabrook's FLEX strategies, as described in the FIP, is listed below. Notably, Seabrook's Phase 2 strategy, as described in the FIP and evaluated by the corresponding staff safety evaluation, consists of a primary and an alternate strategy. The primary strategy relies on the availability of at least one of two installed supplemental emergency power system (SEPS) diesel generator sets, which are not fully protected from wind-borne missiles (as may be experienced during a hurricane) or flooding. Accordingly, the alternate FLEX strategy does not rely on SEPS.

- For Phase 1, immediately following the occurrence of an extended loss of alternating current power/loss of ultimate heat sink (ELAP/LUHS) event, 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 from the steam generators (SGs) to the atmosphere through atmospheric steam dump valves (ASDVs) or SG safety valves. The turbine driven emergency feedwater (TDEFW) pump will provide flow to the SGs to make up for steam release, with suction from the condensate storage tank (CST). Under ELAP conditions, RCS inventory will diminish gradually due to leakage through reactor coolant pump seals and other leakage points. Some passive injection from the nitrogen-pressurized accumulators would occur as the RCS is depressurized below the accumulator cover gas pressure. The licensee determined that sufficient reactor coolant inventory is available throughout Phase 1 without crediting the active injection of RCS makeup.

  If SEPS is unavailable, load stripping of non-essential loads will begin within 2 hours after the occurrence of an ELAP/LUHS. This extended load shedding will extend the battery-powered monitoring function up to 12 hours. If SEPS is available, the SEPS generators will automatically start upon initiation of the ELAP. Operators will align one train of electrical distribution (including battery chargers) to be supported by SEPS. Load shedding from the nonenergized vital direct current (dc) buses would not be considered a time-sensitive action with SEPS available; however, operators would still complete load shedding within 2 hours of ELAP initiation, and swap the supply of the more loaded vital dc bus to the more lightly loaded battery in the same train, so as to extend coping time to 12 hours for the bus which does not have its battery charger powered by SEPS.

- For Phase 2, the strategy for core cooling would be to continue using the SGs as a heat sink, with makeup water supplied by the TDEFW pump. Operators will also deploy a portable diesel-driven FLEX low pressure pump (FLPP), drawing from the CST or Unit 2 circulating water piping cistern, to provide makeup to the SGs in the event of TDEFW pump failure. If SEPS is available, an emergency ac bus will be energized, supported by SEPS, and a motor-driven emergency feedwater (EFW) pump can be energized to serve as a backup to the TDEFW pump. The primary FLEX strategy (using SEPS) would be to initiate a cooldown within 2 hours of ELAP initiation, and reach the criteria for long-term cooldown using the residual heat removal (RHR) system within 9 hours. If SEPS is not available, the licensee's FLEX strategy entails refilling the CST from the circulating water pump cistern using a portable submersible low pressure FLEX pump. Without SEPS, the RHR system could not be energized within 9 hours.

In order to maintain sufficient borated RCS inventory in Phase 2, the licensee's primary strategy relies on energizing an installed charging pump using SEPS, which would enable rapid boration of the RCS from either the boric acid tanks (BATs) or the refueling water storage tank (RWST). If SEPS cannot be used, operators will deploy a portable FLEX high pressure pump (FHPP) to inject borated makeup water from the BATs or RWST. A portable FLEX diesel generator (DG) (480 volts alternating current (Vac)) will be deployed from the FLEX equipment storage building to a location between the diesel generator building (DGB) and the waste processing building, or between the DGB and the administration building (as a backup location). The FLEX DG will be placed into service to supply power to a portable battery charger, dc control power, and instrumentation prior to battery depletion.

- For Phase 3, the long-term core cooling strategy will be to establish shutdown cooling (SDC) using the primary component cooling water (PCCW) and RHR systems. Per the licensee's primary strategy, SDC will already have been established using SEPS when support equipment from a National SAFER [Strategic Alliance for FLEX Emergency Response] Response Center (NSRC) arrives onsite. In this case, NSRC equipment would serve as a backup to SEPS. If SEPS is not available, NSRC pumps, generators, and other associated equipment will be necessary to restore the PCCW and RHR systems, and establish SDC. The primary onsite staging area for NSRC-supplied equipment would the southeast corner of the general office building parking lot; the alternate staging area is the western side of the "B" employee parking lot.

3.2 Reevaluated Flooding Hazards and Modified FLEX Strategies

By letter dated June 14, 2017 (ADAMS Accession No. ML17166A001), the licensee submitted its MSA for Seabrook. The MSA is intended to confirm that licensees have adequately addressed the reevaluated flooding hazard(s) within their mitigating strategies for beyond-design-basis external events. As in the MSA, all elevations and flood depths are given in feet (ft.) per the North American Vertical Datum of 1988 (NAVD88) unless otherwise noted.

3.2.1 Local Intense Precipitation (LIP)

For LIP, the maximum reevaluated flood elevations are not bounded by the CDB elevation of 19.9 ft. NAVD88 at multiple locations throughout the site. For a set of eight points of interest (POIs) that were identified in Table 2 of the staff ISR letter as having reevaluated hazard elevation values that were representative of eight buildings (e.g. outside of containment Unit 1, the turbine building, the administration building), the reevaluated flood levels range from 20.3 to 25.1 ft. NAVD88.

In its MSA, the licensee stated that flood water ingress from a LIP hazard could affect the following spaces which are important to the Seabrook FLEX strategy:

- the service water pump house (SWPH);
- the fuel storage building (FSB);
- the diesel generator building (DGB);
- the "A" essential switchgear room (ESWGR) in the control building;
- the "A" RHR vault; and
- the west main steam and feedwater (MSFW) pipe chase.

The licensee evaluated the impact of flood water ingress into these spaces on the implementation of the primary FLEX strategy, which relies on the availability of SEPS generators as discussed in the previous section of this staff assessment. The licensee's analysis, Engineering Evaluation EE-17-005, "Beyond Design Basis Flooding Mitigating Strategy Assessment", Revision 0 (EC288388), demonstrated that flood levels in the "A" essential switchgear room, "B" electrical tunnel, "A" RHR vault, and west MSFW pipe chase would not affect or prevent operator access to any necessary equipment.

The licensee stated that the maximum resulting flood depth in the SWPH would not impact FLEX equipment stored in that space. For the FSB, the licensee's analysis indicated that flood waters would be contained to the truck bay, which would not affect FLEX implementation. The licensee stated that the stillwater flood elevation from the reevaluated LIP hazard would not exceed the floor/threshold elevation of the DGB; if any flooding in the DGB did occur, it would be minor and limited to the "A" fuel oil storage tank room, which would also not affect FLEX implementation. The LIP flooding from the administration building into lower levels would not exceed the combined holding capacity of the Unit 2 tunnel and waste processing building, and so would not cause subsequent flooding of critical areas. The licensee concludes that their flooding analysis demonstrates that the primary (SEPS available) FLEX strategy can be implemented as planned for an ELAP event concurrent with a reevaluated LIP flood hazard.

The licensee does note that some physical and procedural modifications are required to support this conclusion. These modifications are identified in the MSA:

- a flood protection feature in the RHR vault hallway off the lower level walkway to ensure that flood water is routed to the Unit 2 tunnel or waste processing building, and so will not accumulate in the "A" RHR vault;

- sealing of a floor drain and portions of the metal-sided structure in the alternate radiation protection (RP) checkpoint area to prevent flood water ingress;

- modifications to reduce gaps at the following doors:
    - A134, administration building stairwell entrance to radiologically controlled area (RCA) tunnel;
    - C102, "A" ESWGR doorway into the turbine building;
    - EM401, EM402, and EM414, alternate RP checkpoint / containment personnel hatch areas

- adding gap measurements to the existing annual inspections for those doors where inflows were calculated and a maximum door gap was assumed.

The staff concludes that the licensee's analysis of the reevaluated LIP hazard is reasonable provided that these modifications are put in place by the licensee. The staff notes that the procedural revisions and flood protection modifications that the licensee describes in its MSA are subject to future NRC inspection.

As for Phase 2 deployment of portable equipment from protected storage, the licensee notes that the reevaluated LIP hazard would be of sufficiently short duration, and that the topography at Seabrook would promote sufficiently rapid drainage of flood water, that these FLEX actions would not be threatened, with one minor exception. In Phase 2, the licensee would deploy a portable diesel-driven pump (the FLPP, mentioned in Section 3.1 of this staff assessment) as a backup to the TDEFW pump, to provide SG makeup in the event that the TDEFW pump fails. The FLPP can be aligned to discharge to either the TDEFW pump discharge header, or to drain connections on the main feedwater headers located in the east and west MSFW pipe chases. As noted above, the west MSFW pipe chase is susceptible to flooding from the reevaluated LIP hazard; therefore, this method of supplying SG makeup may not be feasible. However, FLPP discharge to the TDEFW pump discharge header would still be possible. Moreover, the TDEFW pump is expected to be available throughout Phase 2 and use of the FLPP would only be required in the event of an unforeseen equipment failure. Finally, if SEPS is available, then the re-powered motor-driven EFW pump (with pre-existing connections to the SGs) would represent another backup to the TDEFW pump. The staff concludes that the potential unavailability of the SG makeup connections in the west MSFW pipe chase would not threaten the viability of the licensee's FLEX strategy.

In its MSA, the licensee indicated that they would not credit any warning time in advance of a reevaluated LIP event. The only operator action that the licensee did credit for preparation for a potential LIP event was ensuring the closure of flood barrier doors, which would not require significant advance warning time.

The NRC staff concludes that it is reasonable that the FLEX strategy, using existing FLEX procedures, equipment, and personnel, can be implemented as intended provided that physical and procedural flood protection modifications are put in place as discussed above.

3.2.2 Probable Maximum Storm Surge (PMSS)

For storm surge, the bounding case was determined to be the probable maximum hurricane (PMH) in the licensee's FHRR, with a reevaluated stillwater elevation of 17.75 ft. NAVD88, compared to a reevaluated stillwater elevation of 13.16 ft. NAVD88 for the probable maximum nor'easter storm event. As documented in the licensee's FHRR, wave run-up against the vertical seawall represents an additional 5.60 ft. Therefore, the maximum water surface elevation as a result of wave run-up is 23.35 ft. NAVD88 at the seawall. This exceeds the CDB flood elevation of 14.8 ft. NAVD88. As a result of the reevaluated storm surge waves overtopping the seawall, flood water would flow across the site. The resulting ponding levels (i.e., the wave-overtopping stillwater elevations) at multiple points of interest across the site exceed the CDB stillwater elevation of 20.2 ft. NAVD88.

In its MSA, the licensee stated that flood water ingress from a PMSS hazard could affect the following spaces which are important to the Seabrook FLEX strategy:

- the SWPH;
- the DGB;
- the "A" RHR vault;
- the east and west MSFW pipe chases;
- the service water cooling tower (SWCT); and
- SEPS switchgear and electrical vault.

In contrast to the reevaluated LIP flood mechanism, for which no warning time is assumed, the licensee credits sufficient warning time (approximately 48 hours) to perform anticipatory actions prior to the onset of hurricane-force winds, including placing the reactor in hot standby (Mode 3) and establishing augmented staffing through the event. Seabrook procedure ON1090.13, "Response to Natural Phenomena Affecting Plant Operations", Revision 13, also directs operators to install sandbags, seal floor drains, and install a flood gate to prevent ingress of flood water into critical areas. The licensee has completed an informal validation that all required actions can be performed within the warning period, and states that a formal validation (Level B) in accordance with Appendix E of NEI 12-06 will be performed.

As with the reevaluated LIP hazard, the licensee relies on some physical and procedural modifications to ensure that the primary (SEPS available) FLEX strategy can be implemented during an ELAP/LUHS event concurrent with PMSS. Based on the results of the licensee's aforementioned flooding analysis, EE-17-005, the licensee will enhance its sandbagging strategies to conform to U.S. Army Corps of Engineers (USACE) guidance. In its MSA, the licensee states that sandbags and temporary flood barriers will prevent flooding of the DGB, "A" RHR vault, the SWCT, and the MSFW pipe chases. The maximum flood depth in the SWPH would not be sufficient to impact FLEX equipment stored in that building, as openings in the SWPH would drain flood water to the service water forebay.

Physical modifications (i.e., permanent flood protection features) are necessary to protect the SEPS switchgear and electrical vault areas. In its MSA, the licensee commits to installing these flood protection features no later than December 31, 2018. With this modification installed, the licensee states that the primary FLEX strategy (which requires SEPS availability) is still viable during a reevaluated PMSS hazard.

The licensee's alternate FLEX strategy, which requires operators to deploy portable FLEX equipment, requires revision in light of the impact of the reevaluated PMSS flood hazard. In its FHRR, the licensee calculated that the duration of significant flooding resulting from PMSS would be approximately 4 hours, with 2 hours on either side of a peak. The licensee proposed that a reasonable assumption for the timing of the ELAP would be that the ELAP event begins at the time when flood depths exceed FLEX design-basis levels, which is about 1 hour before peak PMSS flooding. Based on the flooding analysis documented in EE-17-005, with conservative estimates for the time at which the site could be safely accessed and the time duration necessary for debris removal, the licensee concludes that deployment of portable FLEX equipment could begin no earlier than 8 hours after the start of the ELAP. The licensee notes that the alternate (without SEPS) FLEX strategy as described in the FIP lists deployment of the 480 Vac FLEX DG as a time sensitive action (TSA), which is to begin no later than 6 hours after the start of the ELAP. Therefore, a hurricane-specific modified timeline for this FLEX strategy is required.

This modified timeline appropriately falls under Section G.4.2 (modified FLEX strategies) of NEI 12-06, and does not represent an alternate mitigating strategy (AMS) as outlined in Section G.4.3. The licensee's modified timeline delays the start of portable FLEX equipment deployment, including the 480 Vac DG, from 6 hours to 8 hours after the start of the ELAP. In justifying the validity of this modified timeline, the licensee appeals to the existence of sufficient margin in the existing FLEX timelines, as well as the significant warning time and preparatory actions (e.g. placing the unit in hot standby and establishing augmented staffing) associated with a hurricane or nor'easter storm. For some TSAs, certain supporting actions do not require outdoor access and can be performed during the PMSS flooding duration, thus decreasing the time required for operators to complete the overall TSA. Four items in the licensee's alternate (non SEPS) FLEX strategy timeline (see Table 2 of the Seabrook FIP) will have adjusted time constraints:

- Restore power to motor control centers (MCCs) 111 and 231
- Restore power to vital battery charger

- Commence RCS boration
- Commence CST makeup

Restoration of power to MCC-111, MCC-231, and a vital battery charger are performed concurrently, using the same 480 Vac DG. The current FLEX timeline has these actions commencing at approximately 6 hours after the start of the ELAP, and completed no later than 8 hours after the start of the ELAP. The licensee notes that early in the FLEX response, operators complete a dc load shed which extends maximum battery life to 12 hours; therefore, a margin of 4 hours currently exists in the FLEX timeline for powering a vital battery charger. With the reevaluated PMSS flood hazard, the licensee assumes that operators would not be able to begin these actions until 8 hours into the ELAP, a delay of 2 hours with respect to the existing timeline. During the time of PMSS on-site flooding, before outdoor access is possible, operators would be able to deploy local power distribution equipment stored in the ESWGRs. Also, the licensee notes that an activity duration of 2 hours is assumed for both the dc load shed and repowering the battery charger; in performing its FLEX validation, the licensee demonstrated that both of these activities could be performed in less than 1 hour. As for the MCCs, calculation EE-17-005 indicates that establishing ventilation to the control room and the MSFW pipe chases (which depends on repowering MCC-111 and MCC-231) can be performed at 12 hours after the start of the ELAP, a 4-hour extension from the existing time constraint. Therefore, the licensee states that the modified FLEX timeline for hurricane events can adjust the start times for restoring power to a vital battery charger and MCCs 111 and 231 from 6 hours to 8 hours after ELAP initiation.

The existing FLEX strategy timeline (Table 2 of the Seabrook FIP) gives 7 hours after ELAP initiation as the estimated start time for deploying the portable FHPP for RCS boration, with 10 hours after ELAP initiation as the time constraint for commencing boration. Significant margin exists between this time constraint and the calculated time (20 hours after ELAP initiation) that RCS boration is required to begin, as recorded in Westinghouse calculation CN-SEE-11-15-3 (FP100957), Revision 1, "NextEra Energy Seabrook Station Reactor Coolant System FLEX Evaluation With Low-Leakage Reactor Coolant Pump Seal Packages," dated July 16, 2015. This calculation and its conclusions were approved by the staff in its SE of the licensee's mitigating strategies. Moreover, in its MSA the licensee states that the FHPP would be pre-deployed to the primary auxiliary building (PAB) as part of hurricane preparations, which would reduce the time required to perform the overall TSA from 3 hours to 1 hour. In its MSA, the licensee commits to performing a time validation of this revised action, and states that its storm preparation procedures will be revised to include pre-staging the FHPP in the PAB. Therefore, the licensee proposes that the modified FLEX timeline for commencing RCS boration can adjust the estimated start time from 7 hours to 9 hours after ELAP initiation, and adjust the time constraint from 10 hours to 11 hours after ELAP initiation.

The final TSA impacted by flooding resulting from the reevaluated PMSS hazard is commencing makeup to the CST. Since the RCS cooldown is delayed in the alternate (non-SEPS) FLEX strategy, the CST must provide decay heat removal for a longer duration and would have a minimum coping time of 15 hours as a source of SG makeup. A time constraint of 11 hours was assigned to this action in order to provide margin. Therefore, operators must begin refilling the CST no later than 9 hours after event initiation, per the existing FLEX timeline. As noted above, during the significant advance warning time associated with a hurricane or nor'easter storm, Seabrook procedure OS1200.03, "Severe Weather Conditions," directs operators to place the unit in hot standby no later than 2 hours prior to the projected onset of hurricane-force winds. With the reactor shut down in advance of the ELAP event, coping time for the CST to provide suction to the TDEFW pump is extended; Attachment E of calculation EE-17-005 demonstrates that two hours is an acceptable conservative extension of this coping time. Consequently, the start time for this TSA may be adjusted from 9 hours to 11 hours after ELAP initiation, and the time constraint may be adjusted from 11 hours to 13 hours after ELAP initiation.

The staff concludes that this adjusted FLEX timeline for hurricane and nor'easter storms is acceptable, and that it is reasonable that the FLEX strategy, using FLEX procedures and storm preparation procedures modified as described in the MSA, equipment, and personnel, can be implemented as intended for an ELAP scenario concurrent with a PMSS event. The staff notes the licensee's commitment in its MSA to perform and document time validation for hurricane anticipatory actions in accordance with NEI 12-06, and incorporate these actions as TSAs in its FLEX program.

The staff concludes that installing permanent flood protection for the SEPS electrical vault and switchgear areas is a reasonable approach to ensure the availability of SEPS for the ELAP response during a PMSS event. The staff notes that the procedural revisions and flood protection modifications described in the MSA are subject to future NRC inspection.

3.3 Evaluation of Flood Parameters in the MSA

3.3.1 Confirmation of the Flood Hazard Elevations in the MSA

The NRC staff reviewed the flood hazard elevations in the MSA, and confirmed the elevations match values in the ISR and associated ISR Tables. The ISR Tables include flood hazard elevations that are based on the NRC staff's association of the flooding POIs with specific site buildings as shown in the FHRR Revision 1; the MSA has precisely identified specific site buildings and doors for these flooding POIs. Aside from the different associations in the ISR and the MSA, the NRC staff have not identified any consequential differences in maximum flood hazard elevations in either of these documents, but the NRC staff does note some differences that are on the order of about 0.1 ft., which the NRC staff attribute to the reasons stated above.

The licensee submitted a revision to FHRR Table 6-1 and Table 6-2 (ADAMS Accession No. ML17093A636). The NRC staff compared the MSA report with these revisions. The revisions do not have a direct bearing on the FEDs or AEs. The first revision concerns the inclusion of the RHR Vault Door P900 and Door 901 as being locations impacted by the LIP and PMSS events due to the licensee correcting the door elevations. These corrected door thresholds are about 0.8 ft. lower than the values given in the FHRR. The doors at these locations were not previously identified by the licensee as being impacted by these flooding events. The NRC staff verified that these corrected door thresholds elevations are consistent with those presented in Attachment A of the MSA. Because the revisions do not include an update of flood hazard elevations, hazards described in the ISR remain consistent with the FHRR, revised FHRR tables, and the MSA for these locations.

The second revision is related to the revision of the threshold elevations of the DG Building Vents A and B as presented in FHRR Table 6-2 and subsequently corrected in the MSA. The corrected vent elevations are higher than those presented in the FHRR and therefore, after correction, still remain as areas that are not impacted by either the LIP or PMSS events.

3.3.2 Evaluation of Flood Event Duration

The NRC staff reviewed information provided by the licensee regarding the FED parameters needed to perform the MSA for flood hazards not bounded by the CDB. The NRC staff assumes that the MSA report, when referencing the FHRR, implies FHRR Revision 1 and the NRC staff will, in this report, imply FHRR Revision 1 unless explicitly stated otherwise.

Subsequent to the submittal of the MSA, NextEra and the NRC staff participated in a teleconference held on September 7, 2017, to clarify some aspects of the FED parameters as described in the MSA. NextEra followed-up this teleconference with an electronic mail dated September 11, 2017 (ADAMS Accession No. ML17256A775), that re-iterated those clarifications. The FED parameters for the flood-causing mechanisms not bounded by the CDB are summarized in Table 3.2.1-1 of this assessment.

For the LIP event, the licensee stated that no warning time was credited or was needed and that no period of site preparation was needed. The licensee states in its MSA that there may be little warning time for storms that can result in LIP events. The licensee also states that there is no credit taken for anticipation of a LIP event. The licensee further states that the only anticipatory action to be taken is to ensure the credited doors are closed which does not require significant warning time. The MSA identifies all credited doors, specific procedures for responding to natural phenomena such as an LIP event, and the specific affected buildings on the Seabrook site.

The LIP event creating the maximum water elevations and approximate durations above door thresholds for different POIs are listed in Table 4-3 of the FHRR. The licensee does not replicate this information in the MSA, but rather references the FHRR. The licensee used the two-dimensional numerical modeling described in the FHRR to determine these inundation duration parameters. The NRC staff noted from the FHRR table that the inundation periods range from 5 minutes to 60 minutes for most flooding POIs. The NRC staff also noted from the FHRR table that at some POIs, the door threshold was not inundated during the LIP event. The licensee's LIP model simulated a 4-hour period. Results at some POIs indicated persistent ponding over this modeling duration and this was noted in the FHRR as inundation periods in excess of 4 hours without further quantification. The flooding depths for POIs that have door threshold LIP flood elevations that persist for longer than 1 hour are shown in Table 3.2.1-2 of this assessment. The licensee states in Table 3-1 of its MSA that the duration of significant flooding and the period of recession was not considered in the FLEX design-basis flood hazard while the LIP flood hazard elevations are considered not bounded by the FLEX design-basis.

The licensee clarified with the NRC staff that their use of "duration of significant flooding" in the MSA is intended to describe durations of LIP flooding elevations above door thresholds or floor elevations in contrast to the duration of site flooding or ponding (ADAMS Accession No. ML17256A775). For the purposes of the MSA, duration of significant flooding is the same as period of inundation.

The NRC staff confirmed that the licensee's reevaluation of the inundation periods for LIP and associated drainage used present-day methodologies and regulatory guidance.
For storm surge, the licensee determined that the FED parameters were based on the National Hurricane Center (NHC) advisories, the licensee's requirement to monitor the NHC advisories, and the severe weather procedural requirements. The FLEX design-basis warning time was stated as between 12 and 72 hours while the mitigating strategies flood hazard information PMSS warning time was stated as being between 48 and 72 hours, which the licensee considered bounded by the FLEX design-basis. The licensee developed the warning time estimates based on NHC official advisory warning timing, which are required to be tracked. For the bounding PMSS event, the licensee provided the FED parameters in the MSA.

To determine the adequacy of the flood event duration parameters, the NRC staff reviewed the licensee's hydrologic and hydraulic models and resulting hydrographs as presented in its FHRR. Based on this review, the NRC staff determined that the licensee's FED parameters are reasonable and acceptable for use in the MSA.

3.3.3 Evaluation of Flood Associated Effects

The NRC staff reviewed information provided by the licensee regarding 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 the NRC staff, and were transmitted to the licensee via the ISR letter. After submittal of its MSA, NextEra and the NRC staff participated in a teleconference held on September 7, 2017, to clarify some aspects of the AE parameters as described in the MSA. NextEra followed-up this teleconference with an electronic mail dated September 11, 2017 (ADAMS Accession No. ML17256A775), that re-iterated those clarifications. The AE parameters not directly associated with water surface elevation are discussed below and are summarized in Table 3.2.2-1 of this assessment.

For the LIP event, the licensee stated that the hydrodynamic and waterborne debris loads were considered bounded by FLEX design-basis. The licensee stated in its MSA that the hydrostatic and hydrodynamic load values were reported in the FHRR and determined to be generally low and not a concern for the FLEX assessment. The licensee stated that the sediment and waterborne debris loads due to LIP were not calculated based on their assessment and because of the concrete and paved surface at the Seabrook site, these surfaces would not be appreciable sources of material for these types of loads. The licensee stated that the high winds were considered as concurrent conditions during the LIP event and that the time necessary for wind-generated debris removal was incorporated into the FLEX program timeline. The licensee stated that the groundwater ingress is not expected during a LIP event due to the impervious groundcover and short duration of the LIP event. The NRC staff found that the estimated LIP flood hazards are acceptable and that the modeling is reasonable for use in the MSA in terms of assessing AEs associated with the LIP event. The NRC staff agrees with the licensee's conclusion that the AE parameters for LIP are either minimal or no impact to the plant facilities.

For the PMSS event, the licensee discussed and provided AE parameters in its MSA. The licensee stated that the hydrostatic and hydrodynamic load values as presented in the FHRR are low and not of concern and therefore bounded by the FLEX design-basis. The licensee clarified in its September 7, 2017, electronic email (ADAMS Accession No. ML17256A775) that the effects of sediment deposition and erosion and waterborne debris loading are not considered to be a hazard within the protected areas of the site. The licensee considers the concrete and paved surfaces would not provide sufficient sources of these materials to create a hazard associated with sediment and waterborne debris loads. Section 4.11 in the FHRR discussed the estimation of hydrostatic and hydrodynamic loads were computed based on guidelines by USACE Coastal Engineering Manual ("Coastal Engineering Manual - Parts I-VI," EM 1110-2-1100, Change 3, September 2011) and FEMA (Engineering Principles and Practices for Retrofitting Flood-Prone Residential Structures (Fourth Edition)," FEMA-P-259, January 2012). The NRC staff found that the load analyses are reasonable for use as the basis for the licensee's conclusion of significance within the MSA. Therefore, the NRC staff concluded that the licensee's estimation of the AE parameters for the PMSS acceptable for use as part of the MSA review.

The licensee concluded that further development of the AE parameters for these flood mechanisms are not required.

In summary, the NRC staff determined that the licensee's methods were appropriate and the provided AE parameters are reasonable for use in the MSA.

4.0 CONCLUSION

The NRC staff has reviewed the information provided in the Seabrook MSA related to current FLEX strategies, as evaluated against the reevaluated hazard(s) described in Section 3 of this staff assessment, and found that:

- Impacts to the FLEX strategies have been adequately identified;
- required to account for the reevaluated LIP and PMSS flood hazards; and
- The licensee has provided an adequate description and justification of flood protection features necessary to implement the FLEX strategy to account for the reevaluated LIP flood hazard.

Therefore, the NRC staff concludes that the licensee's proposed modified FLEX strategies should be effective during a postulated beyond-design-basis event for the LIP and PMSS flood-causing mechanisms, including AEs and FED. The NRC staff confirmed that the Seabrook flood hazard MSA was performed consistent with the guidance in Appendix G of NEI 12-06, Revision 2, as endorsed by JLD-ISG-2012-01, Revision 1. Based on the licensee's appropriate hazard characterization, methodology used in the Seabrook MSA evaluation, and the description of its modified FLEX strategies, the NRC staff concludes that the licensee has demonstrated that these mitigation strategies, if appropriately implemented, are reasonably protected from the reevaluated flood hazard conditions.

Table 3.2.1-1. 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(1)	0	Less than 1 hour for most locations; some locations have residual ponding	Less than 1 hour for most locations; some locations have residual ponding
Storm Surge (2)	48-72 hours	1-2 hours	2 hours

Source: (FHRR, email dated April 3, 2017, ADAMS Accession No. ML17093A652, non-public)
Notes:
(1) LIP flood depth durations above plant door thresholds and floor levels were presented in the FHRR; duration of inundation for some locations extended beyond 4 hours due to persistent minor ponding. This information is not quantitatively re-expressed in the MSA.

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

	Flooding Mechanism	
Associated Effects Parameter	**Local Intense Precipitation**	**Storm Surge**
Hydrodynamic loading at plant grade(1)	Minimal	Minimal
Waterborne debris loading at plant grade (2)	Minimal	Minimal
Sediment loading at plant grade	Minimal	Minimal
Sediment deposition and erosion	Minimal	Minimal
Concurrent conditions, including adverse weather	High winds; wind-borne debris removal considered	High winds; wind-borne debris removal considered
Groundwater ingress	Minimal	Minimal
Other pertinent factors (e.g., waterborne projectiles)	None stated	None stated

Source: (MSA)
Notes:

(1) Hydrostatic and hydrodynamic loads are discussed quantitatively in the FHRR; the resultant loads are not carried into the MSA other than to state that they are low.

TABLE 3.2.1-2. FLOODING POINTS OF INTEREST (POIS) IDENTIFIED AS HAVING APPROXIMATE GREATER-THAN-ONE-HOUR LIP FLOOD DURATIONS ABOVE DOOR THRESHOLDS.

POI	Description(1)	Maximum Inundation Depth Relative to Ground (ft)(2)
8(3)	Service Water Pump house (SWPH) Roof Stair	0.2
19(3)	Fuel Storage Building (FSB)–Personnel Door	0.8
20(3)	FSB-Personnel Door	0.5
25(3)	Waste Processing Building (WPB)	0.1
30(3)	Residual Heat Removal (RHR) Vault	0.1
57(3)	Turbine Building	0.3
60(3)	RCA Ckpt/ Cont. Hatch	1.5
71	Supplemental Emergency Power System0(SEPS-SWGR)	0.5

(1) Source: MSA Attachment A.(2) Source: FHRR Rev 1 Table 4-3; staff rounded depths to nears tenth of a foot. Flow depths are relative to ground while inundation periods are relative to door thresholds.

(3) POIs that have periods of inundation greater than the LIP simulation period of 4 hours (FHRR Rev 1 Table 4-3).

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