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

May 19, 2017

Mr. Robert Coffey
Site Vice President
NextEra Energy Point Beach, LLC
6610 Nuclear Road
Two Rivers, WI 54241-9516

SUBJECT: POINT BEACH NUCLEAR PLANT, UNITS 1 AND 2– STAFF ASSESSMENT OF RESPONSE TO 10 CFR 50.54(f) INFORMATION REQUEST – FLOOD-CAUSING MECHANISM REEVALUATION (CAC NOS. MF6100 AND MF6101)

Dear Mr. Coffey:

By letter dated March 12, 2012, the U.S. Nuclear Regulatory Commission (NRC) issued a request for information pursuant to Title 10 of the *Code of Federal Regulations*, Section 50.54(f) (hereafter referred to as the 50.54(f) letter). The request was issued as part of implementing lessons learned from the accident at the Fukushima Dai-ichi nuclear power plant. Enclosure 2 to the 50.54(f) letter requested that licensees reevaluate flood-causing mechanisms using present-day methodologies and guidance. By letter dated March 12, 2015 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML15071A413), NextEra Energy Point Beach, LLC (NextEra, the licensee) responded to this request for Point Beach Nuclear Plant, Units 1 and 2 (Point Beach).

By letter dated December 10, 2015 (ADAMS Accession No. ML15321A063), the NRC staff sent the licensee a summary of the staff's review of Point Beach's reevaluated flood-causing mechanisms. The enclosed staff assessment provides the documentation supporting the NRC staff's conclusions summarized in the letter. As stated in the letter, the reevaluated flood hazard results for the local intense precipitation (LIP) flood-causing mechanism was not bounded by its current design basis. In order to complete its response to Enclosure 2 to the 50.54(f) letter, the licensee is expected to submit a focused evaluation for LIP to address this reevaluated flood hazard, as discussed in COMSECY-15-0019, "Closure Plan for the Reevaluation of Flooding Hazard for Operating Nuclear Power Plants," and 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, Flooding Hazard Reevaluation; Focused Evaluation and Integrated Assessment." This closes out the NRC's efforts associated with CAC Nos. MF6100 and MF6101.

If you have any questions, please contact me at (301) 415-1617 or e-mail at Frankie.Vega@nrc.gov.

Sincerely,

Frankie Vega, Project Manager
Hazards Management Branch
Japan Lessons-Learned Division
Office of Nuclear Reactor Regulation

Docket Nos. 50-266 and 50-301

Enclosure:
Staff Assessment of Flood Hazard
Reevaluation Report for Point Beach

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STAFF ASSESSMENT BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO FLOOD HAZARD REEVALUATION REPORT

NEAR-TERM TASK FORCE RECOMMENDATION 2.1

POINT BEACH NUCLEAR PLANT, UNITS 1 AND 2

DOCKET NOS. 50-266 AND 50-301

1.0 INTRODUCTION

By letter dated March 12, 2012 (NRC, 2012a), 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 Near-Term Task Force (NTFF) report (NRC, 2011b). Recommendation 2.1 in that document recommended that the NRC staff issue orders to all licensees to reevaluate seismic and flooding hazards for their sites against current NRC requirements and guidance. Subsequent staff requirements memoranda associated with SECY-11-0124 (NRC, 2011c) and SECY-11-0137 (NRC, 2011d) directed the NRC staff to issue requests for information to licensees pursuant to 10 CFR 50.54(f) to address this recommendation.

Enclosure 2 to the 50.54(f) letter (NRC, 2012a) 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 (ESPs) and combined licenses (COLs). The required response section of Enclosure 2 specified that NRC staff would provide a prioritization plan indicating the Flooding Hazard Reevaluation Report (FHRR) deadlines for each plant. On May 11, 2012, the NRC staff issued its prioritization of the FHRRs (NRC, 2012b). By letter dated March 12, 2015, NextEra Energy Point Beach, LLC (NextEra, the licensee) provided its FHRR for Point Beach Nuclear Plant (Point Beach), Units 1 and 2 (NextEra, 2015a).

On December 10, 2015, the NRC issued an interim staff response (ISR) letter to the licensee (NRC, 2015b). The purpose of the ISR letter is to provide the flood hazard information suitable for the assessment of mitigating strategies developed in response to Order EA-12-049 (NRC, 2012b) and the additional assessments associated with NTTF Recommendation 2.1: Flooding. The ISR letter also made reference to this staff assessment, which documents NRC staff's basis and conclusions. The flood hazard mechanism values presented in the letter's enclosures match the values in this staff assessment without change or alteration.

As mentioned in the ISR letter (NRC, 2015b), the reevaluated flood hazard result for the local intense precipitation (LIP) flood-causing mechanism is not bounded by the plant's current design basis (CDB). Consistent with the 50.54(f) letter and amended by the process outlined in COMSECY-15-0019 and Japan Lessons-Learned Division (JLD) Interim Staff Guidance (ISG) JLD-ISG-2016-01, Revision 0 (NRC, 2015b; NRC, 2016b), the NRC staff anticipates that the licensee will perform and document a focused evaluation for LIP that assesses the impact of the

LIP hazard on the site, and evaluates and implements any necessary programmatic, procedural, or plant modifications to address this hazard exceedance.

Additionally, for any reevaluated flood hazards that are not bounded by the plant's CDB hazard, the licensee is expected to develop flood event duration (FED) and associated effects (AE) parameters. These parameters will be used to conduct the mitigating strategies assessment (MSA) and focused evaluation or revised integrated assessment.

2.0 REGULATORY BACKGROUND

2.1 Applicable Regulatory Requirements

As stated above, Enclosure 2 to the 50.54(f) letter (NRC, 2012a) 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 ESPs and COLs. This section of the staff assessment describes present-day regulatory requirements that are applicable to the FHRR.

Sections 50.34(a)(1), (a)(3), (a)(4), (b)(1), (b)(2), and (b)(4), of 10 CFR, describes the required content of the preliminary and final safety analysis reports, including a discussion of the facility site with a particular emphasis on the site evaluation factors identified in 10 CFR Part 100. The licensee should provide any pertinent information identified or developed since the submittal of the preliminary safety analysis report in the final safety analysis report.

General Design Criterion 2 in Appendix A of 10 CFR Part 50 states that structures, systems, and components (SSCs) important to safety at nuclear power plants must be designed to withstand the effects of natural phenomena such as earthquakes, tornados, hurricanes, floods, tsunamis, and seiches without loss of capability to perform their intended safety functions. The design bases for these SSCs are to reflect appropriate consideration of the most severe of the natural phenomena that have been historically reported for the site and surrounding area. The design bases are also to have sufficient margin to account for the limited accuracy, quantity, and period of time in which the historical data have been accumulated.

Section 50.2 of 10 CFR defines the design bases as the information which identifies the specific functions that an SSC of a facility must perform, and the specific values or ranges of values chosen for controlling parameters as reference bounds for design which each licensee is required to develop and maintain. These values may be: (a) restraints derived from generally accepted "state of the art" practices for achieving functional goals; or (b) requirements derived from analysis (based on calculation, experiments, or both) of the effects of a postulated accident for which an SSC must meet its functional goals.

Section 54.3 of 10 CFR defines the "current licensing basis" (CLB) as "the set of NRC requirements applicable to a specific plant and a licensee's written commitments for ensuring compliance with and operation within applicable NRC requirements and the plant-specific design basis (including all modifications and additions to such commitments over the life of the license) that are docketed and in effect." This includes: 10 CFR Parts 2, 19, 20, 21, 26, 30, 40, 50, 51, 52, 54, 55, 70, 72, 73, 100 and appendices thereto; orders; license conditions; exemptions; and technical specifications as well as the plant-specific design-basis information as documented in the most recent final safety analysis report. The licensee's commitments made in docketed licensing correspondence that remains in effect are also considered part of the CLB.

Present-day regulations for reactor site criteria (Subpart B to 10 CFR Part 100 for site applications on or after January 10, 1997) state, in part, that the physical characteristics of the site must be evaluated and site parameters established such that potential threats from such physical characteristics will pose no undue risk to the type of facility proposed to be located at the site. Factors to be considered when evaluating sites include the nature and proximity of dams and other man-related hazards (10 CFR 100.20(b)) and the physical characteristics of the site, including the hydrology (10 CFR 100.21(d)).

2.2 Enclosure 2 to the 50.54(f) Letter

Section 50.54(f) of 10 CFR states that a licensee shall at any time before expiration of its license, upon request of the Commission, submit written statements, signed under oath or affirmation, to enable the Commission to determine whether or not the license should be modified, suspended, or revoked. The 50.54(f) letter (NRC, 2012a) requested, in part, that licensees reevaluate the flood-causing mechanisms for their respective sites using present-day methodologies and regulatory guidance used by the NRC for the ESP and COL reviews.

2.2.1 Flood-Causing Mechanisms

Attachment 1 to Enclosure 2 of the 50.54(f) letter discusses flood-causing mechanisms for the licensee to address in its FHRR (NRC, 2012a). Table 2.2-1 lists the flood-causing mechanisms that the licensee should consider, and the corresponding Standard Review Plan (SRP) (NRC, 2007) sections and applicable ISG documents containing acceptance criteria and review procedures.

2.2.2 Associated Effects

In reevaluating the flood-causing mechanisms, the “flood height and associated effects” should be considered. JLD-ISG-2012-05 (NRC, 2012e) defines “flood height and associated effects” as the maximum stillwater surface elevation plus:

- Wind waves and runup effects;
- Hydrodynamic loading, including debris;
- Effects caused by sediment deposition and erosion;
- Concurrent site conditions, including adverse weather conditions;
- Groundwater ingress; and
- Other pertinent factors

2.2.3 Combined Effects Flood

The worst flooding at a site that may result from a reasonable combination of individual flood mechanisms is sometimes referred to as a “combined effects flood.” Even if some or all of these individual flood-causing mechanisms are less severe than their worst-case occurrence, their combination may still exceed the most severe flooding effects from the worst-case occurrence of any single mechanism described in the 50.54(f) letter (see SRP Section 2.4.2, “Areas of Review” (NRC, 2007)). Attachment 1 of the 50.54(f) letter) describes the “combined effect flood” as defined in American National Standards Institute/American Nuclear Society (ANSI/ANS) 2.8-1992 (ANSI/ANS, 1992), as follows:

> For flood hazard associated with combined events, American Nuclear Society (ANS) 2.8-1992 provides guidance for combination of flood causing mechanisms for flood hazard at nuclear power reactor sites. In addition to those listed in the ANS guidance, additional plausible combined events should be considered on a site specific basis and should be based on the impacts of other flood causing mechanisms and the location of the site.

If two less severe mechanisms are plausibly combined per ANSI/ANS-2.8-1992 (ANSI/ANS, 1992), then the NRC staff will document and report the result as part of one of the hazard sections. It should also be noted that for the purposes of this staff assessment, the terms "combined effects" and "combined events" are synonyms. An example of a situation where this may occur is flooding at a riverine site located where the river enters the ocean. For this site, storm surge and river flooding are plausible combined events and should be considered.

2.2.4 Flood Event Duration

Flood event duration was defined in JLD-ISG-2012-05 (NRC, 2012c) as the length of time during which the flood event affects the site. It begins when conditions are met for entry into a flood procedure, or with notification of an impending flood (e.g., a flood forecast or notification of dam failure), and includes preparation for the flood. It continues during the period of inundation, and ends when water recedes from the site and the plant reaches a safe and stable state that can be maintained indefinitely. Figure 2.2-1 of this assessment illustrates flood event duration.

2.2.5 Actions Following the FHRR

For the sites where the reevaluated flood hazard is not bounded by the CDB flood hazard elevation for any flood-causing mechanisms, the 50.54(f) letter requests licensees and construction permit holders to:

- Submit an interim action plan with the FHRR documenting actions planned or already taken to address the reevaluated hazard; and

- Perform an integrated assessment to: (a) evaluate the effectiveness of the CDB (i.e., flood protection and mitigation systems); (b) identify plant-specific vulnerabilities; and (c) assess the effectiveness of existing or planned systems and procedures for protecting against and mitigating consequences of flooding for the flood event duration.

If the reevaluated flood hazard is bounded by the CDB flood hazard for all flood-causing mechanisms at the site, licensees were not required to perform an integrated assessment.

COMSECY-15-0019 (NRC, 2015a) 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 an approach in which licensees with LIP hazards exceeding their CDB flood will not be required to complete an integrated assessment, but instead will perform a focused evaluation. As part of the focused evaluation, licensees will assess the impact of the LIP hazard on their sites and then evaluate and implement any necessary programmatic, procedural or plant modifications to address the hazard exceedance. For other flood hazard mechanisms that exceed the CDB, licensees can assess the impact of these reevaluated hazards on their site by performing either a focused evaluation or an integrated assessment (NRC, 2015a).

3.0 TECHNICAL EVALUATION

The NRC staff reviewed the information provided for the flood hazard reevaluation of Point Beach (NextEra, 2015a). The licensee conducted the hazard reevaluation using present-day methodologies and regulatory guidance used by the NRC staff in connection with ESP and COL reviews.

To provide additional information in support of the summaries and conclusions in the Point Beach FHRR, the licensee made calculation packages available to the NRC staff via an electronic reading room. The NRC staff did not rely directly on these calculation packages in its review; they were found only to expand upon and clarify the information provided in the Point Beach FHRR, and so those calculation packages were not docketed or cited.

3.1 Site Information

The 50.54(f) letter (NRC, 2012a) includes the SSCs important to safety in the scope of the hazard reevaluation. The licensee included pertinent data concerning these SSCs in the Point Beach FHRR. The NRC staff reviewed and summarized this information as follows in the sections below.

3.1.1 Detailed Site Information

In its FHRR, the licensee reported that Point Beach is located in Manitowoc County in east-central Wisconsin on the western shore of Lake Michigan, approximately 30 mi southeast of Green Bay and about 90 mi north-northeast of Milwaukee. The licensee also reported that site topographic and bathymetric surveys were performed in 2013 and 2014. In relation to Lake Michigan, a majority of the plant grounds are located at 607.3 ft North American Vertical Datum of 1988 (NAVD88). Additional details of the site are provided in the FHRR.

In its FHRR, the licensee reported that the ground surface elevation at the Point Beach site varies from 584.3 to 639.3 ft NAVD88. All elevations in this staff assessment are given with respect to NAVD88.

The Circulating Water Pump House (CWPH), where the plant draws its circulating water from Lake Michigan, has a ground floor elevation of 588.3 ft NAVD88. The licensee also reported that the ground floor elevation of the Turbine Building (TB) is 589.3 ft NAVD88. Table 3.1-1 of this assessment provides the summary of controlling reevaluated flood-causing mechanisms, including associated effects, that the licensee computed to be higher than the powerblock elevation.

3.1.2 Design-Basis Flood Hazards

The CDB flood levels are summarized by flood-causing mechanism in Table 3.1-2 of this assessment. The NRC staff reviewed the information provided in the Point Beach FHRR (NextEra, 2015a) and determined that sufficient information was provided to be responsive to Enclosure 2 of the 50.54(f) letter (NRC, 2012a).

3.1.3 Flood-Related Changes to the Licensing Basis

In its FHRR, the licensee reported that there have been many changes made to the barriers and to the administrative protections for postulated floods. These changes primarily represent changes to the protection strategy for wave runup. Additional details including the CLB are documented in the Flooding Walkdown Report. The NRC staff reviewed the information provided in the Point Beach FHRR (NextEra, 2015a) and determined that sufficient information was provided to be responsive to Enclosure 2 of the 50.54(f) letter (NRC, 2012a).

3.1.4 Changes to the Watershed and Local Area

The licensee indicated in its FHRR that there have been changes to the watershed, primarily in the immediate vicinity of the drainage at the site. It is reported that the changes were mainly to the barriers and the administrative protections for the postulated floods. The NRC staff also examined the Walkdown Report (NextEra, 2012) and the associated Walkdown Staff Assessment (NRC, 2014a) and determined that changes have occurred at the site since the original licensing. Inspections conducted during the site walkdown showed that no changes in land use or topography were observed that would adversely impact the site drainage. It is reported that the natural drainage of the topography designed to provide flow paths in the event of the probable maximum precipitation (PMP) and snowmelt was found to be unchanged except for where newer buildings had been constructed. The changes in these areas are supplemented with a drain system and were deemed to be acceptable.

The NRC staff reviewed the information provided in the Point Beach FHRR (NextEra, 2015a) and determined that sufficient information was provided to be responsive to Enclosure 2 of the 50.54(f) letter (NRC, 2012a).

3.1.5 Current Licensing Basis Flood Protection and Pertinent Flood Mitigation Features

The Point Beach FHRR (NextEra, 2015a) reports precipitation induced flooding and Lake Michigan flooding as the two flooding hazards evaluated in the CLB. The FHRR states that the CLB precipitation event for Point Beach is combination of a 6-hour rainfall with a 50-year recurrence interval and water content of snow in late March with a 50-year recurrence frequency. This combined volume of water is equivalent to 4.90 inches (in.) over the 6-hour duration.

The probable maximum storm surge (PMSS) on Lake Michigan was also considered as part of the CLB. The PMSS CLB is a lake flood level of 589.72 ft NAVD88 resulting from a combination of the historical maximum Lake Michigan elevation of 583.0 ft NAVD88 coincident with 0.17 ft wind setup and 6.55 ft wave runup on a vertical surface. The NRC staff reviewed the information provided in the Point Beach FHRR (NextEra, 2015a) and determined that sufficient information was provided to be responsive to Enclosure 2 of the 50.54(f) letter (NRC, 2012a).

3.1.6 Additional Site Details to Assess the Flood Hazard

The licensee provided model input and output files and associated hydrologic and bathymetric data for NRC staff's review.

3.1.7 Plant Walkdown Activities

The 50.54(f) letter requested that licensees plan and perform plant walkdown activities to verify that current flood protection systems were available, functional, and implementable. Other requests described in the 50.54(f) letter asked the licensee to report any relevant information from the results of the plant walkdown activities.

By letter dated November 20, 2012, NextEra provided the requisite flood walkdown report for the Point Beach site (NextEra, 2012). The NRC staff prepared a staff assessment report, dated June 20, 2014 (NRC, 2014a), to document its review of that report. The NRC staff concluded that the licensee's implementation of the flooding walkdown methodology met the intent of the 50.54(f) letter.

3.2 Local Intense Precipitation and Associated Site Drainage

The licensee reported in the Point Beach FHRR that the reevaluated flood hazard for local intense precipitation and associated site drainage is based on a stillwater surface elevation of 609.6 ft NAVD88. This flood-causing mechanism is discussed in the licensee's CDB. The CDB probable maximum flood elevation for LIP and associated site drainage is based on a stillwater surface elevation of 608.9 ft NAVD88. In response to NRC staff's questions raised during the audit, the licensee stated that the flood-related elevations of the CDB and CLB for Point Beach are the same (NRC, 2015a).

Section 3.1 of the Point Beach FHRR states that the CLB precipitation event for Point Beach is the combination of a 6-hour rainfall with 50-year recurrence frequency combined with the water equivalent of snow in late March with also a 50-year frequency. The licensee stated the combined rainfall-snowmelt CLB/CDB event to be 4.90 in. over a period of 6-hours. Maximum water surface elevations (WSEs) of the CLB at select points of interest (POIs) are presented in Table 3.1 of the FHRR. Based on information in the FHRR, the CDB PMF elevation for LIP and associated site drainage is a stillwater surface elevation of 608.9 ft NAVD88.

The NRC staff requested additional information from the licensee in order to supplement the information provided in the Point Beach FHRR. The licensee provided this additional information in an audit conducted on October 29, 2015 (NRC, 2016), which is discussed in the appropriate sections below.

3.2.1 Model Input

3.2.1.1 LIP Intensity and Distribution

The licensee performed a site-specific LIP evaluation using the recommendations for a storm-based approach described in (ANSI/ANS, 1992; World Meteorological Organization, 2009; and NRC, 2011). The licensee stated that the storm-based approach is based on historical data that were then maximized and transpositioned to have the event occurring at the Point Beach site. The storm-based approach is described in Hydrometeorological Report (HMR) 33 (National Oceanic and Atmospheric Administration (NOAA), 1956) and HMR 51 (NOAA, 1978).

In order to apply the storm-based approach the licensee identified a set of storms which represent extreme precipitation events. Such storm types included thunderstorms and intense rainfall events associated with Mesoscale Convective Complexes. This procedure is similar to the process described in Section 6 of HMR 52 (NOAA, 1982). The licensee selected 21 large historical storms for further evaluation of LIP at the Point Beach site from storms with similar meteorological and topographic setting. The licensee stated that thirteen of the storms were previously analyzed in HMR 33 and HMR 51 by the National Weather Service (NWS) and the U.S. Army Corps of Engineers (USACE). Each historical storm was modified by an algorithm that performed transpositioning adjustment using a combination of atmospheric moisture and terrain influences. The storms were maximized and transpositioned to the Point Beach site.

The resulting rainfall was the total volume of rainfall to be expected at the Point Beach site with all contributing factors maximized and occurring simultaneously. The May 1943 Mounds, Oklahoma storm event resulted in the largest 1-h rainfall after performing storm maximization and transpositioning. The licensee estimated a 1-h, 1-mi^2 PMP depth of 12.8 in. The total precipitation depth estimates were applied into four hyetographs which the licensee named the first, second, third, and fourth quartiles. The first quartile had the most intense precipitation in the beginning of the event and the fourth quartile having the most intense precipitation in the end of the event.

The licensee stated that lack of sub-hourly PMP-type storm data prevented the development of an updated evaluation; therefore, the ratios derived from HMR 52, Figures 36 and 38 (NOAA, 1982) were used for sub-hourly precipitation estimates at the Point Beach site. The site-specific 5-minute, 15-minute, 30-minute, and 1-hour LIP intensities are shown in Table 3.2-1 of this assessment.

In order to determine the appropriateness of the site-specific PMP (ssPMP) values used by the licensee and the resulting LIP flood WSEs at Point Beach, the NRC staff independently evaluated the sensitivity of the licensee's FLO-2D model. The staff compared WSEs from the ssPMP with the WSEs modeled using precipitation values from HMR-52. The 1-hour, 1-mi^2 PMP value at the Point Beach site estimated using the HMR-52 method was 16.6 in., compared to the 12.8 in. estimated using the ssPMP; this is a 23 percent difference in total rainfall depth. The sensitivity analysis resulted in a WSE difference of about 0.44 ft (14 percent) at Units 1 and 2, Door 232, and 0.63 ft (22 percent) at TB Door 11. The results of the staff's sensitivity analysis indicated that the WSEs estimated using the HMR-based event were not significantly higher than the WSEs estimated using the licensee's ssPMP-based event. More importantly, the differences were insignificant at the safety-related structures of Point Beach. Considering the level of conservatism incorporated in the modeling assumptions and in light of the small differences in estimated WSEs, the staff determined that it was not necessary to review the manner in which the licensee's ssPMP estimate was derived. Correspondingly, the staff concluded that the licensee's ssPMP values were reasonable to use in the LIP runoff analysis discussed below.

3.2.1.2 Runoff Model Development

The licensee developed the LIP flood model following guidance in NUREG/CR-7046 (NRC, 2011). The licensee used FLO-2D® Pro software (FLO-2D, 2013) to determine the maximum WSE and maximum flood depths for the LIP event at critical door locations of Point Beach (NextEra, 2015b). The primary input to this model was a digital terrain model (DTM), which was generated in ArcGIS® by processing a 2014 topographic survey of the Point Beach site (NRC, 2016). The topographical survey data has a ±0.1 ft accuracy vertically and ±0.05 ft accuracy horizontally (NRC, 2016). The data was used by the licensee in ArcGIS® to create a DTM with elevation points positioned at the centers of 5-ft by 5-ft cells. As shown on Figure 3.2-1 of this assessment, all features and obstructions such as permanent structures, temporary structures, and barriers were represented in the DTM by defining them as raised, flat surfaces from which rooftop runoff discharges directly to the ground surface (NextEra, 2014a). The flow is routed around obstructions without applying FLO-2D flow reduction factors to the corresponding grid cells. The NRC staff reviewed the methodology and determined that because the surface detention is set at a reasonably low value of 0.04 ft, storage on the cells representing obstructions (rooftops) will not significantly reduce runoff discharging from the roof and is therefore considered an acceptable modification to the FLO-2D model approach.

The NRC staff reviewed the location of obstructions using aerial imagery of the Point Beach site (see Figure 3.2-2). Some of the locations identified in the licensee's model as temporary structures (including non-permanent structures and potential future laydown areas) were not readily apparent to the NRC staff from the imagery. During the October 29, 2015, audit, the licensee confirmed that the locations of the temporary structures and areas defined in the FLO-2D model. The licensee provided a sensitivity report for the LIP model (NextEra, 2014), which confirmed the reasonableness of the model. The difference in maximum WSE due to the temporary structures at the three door locations (Doors 209, 310, and 311), which are doors to the Service Building, was less than or equal to 0.12 ft.

The roughness coefficients for the model were assigned according to the land cover type (NextEra, 2015b) and licensee-selected values were confirmed by NRC staff to be consistent with the suggested values in the FLO-2D Pro user manual (FLO-2D, 2013). The licensee selected Manning's roughness coefficient n values of 0.02 for asphalt, 0.2 for open ground, and 0.4 for forest litter and/or pasture land cover types, respectively. The licensee provided a graphical representation that shows the spatial distribution of the Manning's roughness coefficient values across the site. Based on the site land cover information, the NRC staff determines that the values used are reasonable and appropriate.

The licensee also assumed no runoff losses and complete blockage of the site's surface-water drainage system based on the recommendations of NUREG/CR-7046. The licensee used a DTM, which accounted for obstructions and surface flow impediments such as buildings, temporary structures, wave barriers, and other topographic features.

3.2.2 Model Simulation

The licensee considered two scenarios for the LIP flooding analysis. Scenario A considers the temporary laydown areas completely occupied with equipment/containers. Scenario B is similar to Scenario A, but with additional temporary wave barriers installed adjacent to the CWPH. When the water level of Lake Michigan exceeds an administratively controlled limit, temporary wave barriers will be installed at the Point Beach site along the roll up doors on the north and south side of the CWPH, as shown on Figure 3.2-3 of this assessment. The licensee created Scenario B to assess the impact of these wave barriers, also referred to as door barriers. The plan for the installation of barriers was updated following a 2014 walkdown, and six barriers of 8 feet (ft) by 25 ft with a height of 3.5 ft were represented in the model as a wider structure of 15 ft by 25 ft (NextEra, 2015a).

In the FHRR, it is stated that during high lake level conditions, 3.5 ft high wave barriers are installed outside the CWPH rollup doors and sandbags are placed to seal the rollup doors. When the barriers are installed, the maximum LIP flood heights near the CWPH doors are projected to increase to 3.4 ft. The licensee stated during the audit (NRC, 2016) that the 100-yearr high lake level of 1.8 ft-Plant Datum for Lake Michigan was not used in the FL0-2D runoff model since site grade and associated features are at least 3 ft higher than the high lake level.

Accordingly, the elevated lake level would have no appreciable effect on site runoff, as the runoff from the site grade would flow freely down to the beach and into the Lake.

The licensee performed four sensitivity runs for each scenario to test the sensitivity of the models to inclusion of surface depressions, inclusion (unblockage) of the site's surface-water drainage system, a reduction in the area of four temporary structures, and a combination of all three. Each sensitivity test run was performed without wave barrier protection to be comparable to Scenario A results and run with wave barrier protection to be comparable to Scenario B results. The following were the various sensitivity tests:

- Test 1 - FLO-2D model that accounts for surface depressions;
- Test 2 - FLO-2D model that accounts for surface depressions and the Point Beach yard drainage network;
- Test 3 - FLO-2D model that uses the same topography from Scenario A and Scenario B but has a reduced temporary structure layout; and
- Test 4 - FLO-2D model that accounts for surface depressions, the Point Beach yard drainage network, and the reduced temporary structure layout.

The final model with all three (primarily) non-conservative assumptions had a maximum WSE that was up to 1.5 ft lower than the original model at the TB. The sensitivity analysis demonstrates the effect of the conservative assumptions used in the original model.

The NRC staff reviewed the FLO-2D simulation model and found that the volume conservation error was less than 0.001 percent, which demonstrates that the model conserves volume and the flood simulation is executed successfully. The licensee noted that coefficients controlling time step and percent change in flow depth within the model were modified as suggested in the FLO-2D Pro Reference Manual to address numerical surging (model numerical instability) which was occurring with default values. The NRC staff confirmed that the final models of the two primary scenarios provided by the licensee did not exhibit numerical surging.

The licensee evaluated 33 doors at 6 onsite buildings as POIs for the Point Beach site. The majority of the doors were identified in the CLB and confirmed as POIs during a site walkdown conducted by Point Beach staff. The maximum WSE of 609.6 ft NAVD88 occurred at Units 1 and 2, Door 159 during the fourth quartile storm for both of the licensee's LIP scenarios (with and without wave barriers). Maximum WSEs at most buildings exhibit very small differences (±0.1 ft) between the two scenarios. However, because the temporary wave barriers included in Scenario B partially obstruct the normal flow away from the powerblock area toward the CWPH and the lake, the maximum WSEs at the CWPH and the nearby TB doors are greater than the WSEs of Scenario A by 0.3 to 0.7 ft. The simulation results indicate that Scenario B is the controlling LIP event and has a maximum WSE of 609.6 ft NAVD88 at Door 159 of the Units 1 and 2 Building. The reevaluated maximum flow depths exceed the CDB at all POIs except Door 601, which remained the same (NextEra, 2015a; NextEra, 2015b; NextEra, 2015c). Hydrographs at POIs of the LIP simulation show that that durations for water ponding with depths greater than 0.05 ft range from an hour or less at some locations to more than 10 hours at other locations. Flow depths around the switchgear are calculated relative to 26.5 ft Plant Datum (equivalent to 607.8 ft NAVD88), the finished building elevation (NRC, 2016), rather than the ground surface elevation.

The NRC staff notes that the maximum water depth of all the POI locations for Scenario B is 3.4 ft at Door 338 of the CWPH, which is a different location than the maximum WSE. The maximum hydrodynamic force is also at a different location than the maximum WSE at Door 340 of the CWPH, with a maximum force of 205.2 lb/ft (NextEra, 2015b). Comparisons of the WSEs provided by the licensee and a separate confirmatory analysis performed by NRC staff using different builds of the FLO-2D model are presented in Table 3.2-2 of this assessment.

The NRC staff confirmed the licensee's conclusion that the reevaluated flood hazard for LIP and associated site drainage is not bounded by the CDB flood hazard. Therefore, the NRC staff expects that the licensee will submit a focused evaluation for LIP and associated site drainage for the Point Beach site.

3.3 Streams and Rivers

The licensee reported in the Point Beach FHRR that the reevaluated flood hazard for streams and rivers does not inundate the plant site, but did not report a probable maximum flood elevation. This flood-causing mechanism is discussed in the licensee's CDB, but no PMF elevation was reported. The FHRR states that there are no significant streams that flow near the Point Beach site with the exception of two small creeks that drain to the north and to the south; as a result, the licensee did not perform a PMF analysis for streams and rivers for the CLB/CDB.

In its FHRR, the licensee reported that the Point Beach site is located on Lake Michigan and there are no major streams or rivers that could result in flooding at the site. As a result, the licensee determined that the streams and rivers flood-causing mechanism is not applicable to the Point Beach site. The NRC staff reviewed available topographical and hydrological maps and information and confirmed the licensee's conclusion that there are no streams or rivers that could impact the Point Beach site.

The NRC staff confirmed the licensee's conclusion that the streams and rivers flood-causing mechanism could not inundate the Point Beach site. Therefore, this potential flood-causing mechanism does not need to be analyzed in a focused evaluation or an additional assessment.

3.4 Failure of Dams and Onsite Water Control/Storage Structures

The licensee reported in the Point Beach FHRR that the reevaluated hazard for failure of dams and onsite water control or storage structures does not inundate the plant site, but did not report a probable maximum flood elevation. This flood-causing mechanism is discussed in the licensee's CDB, but no probable maximum flood elevation was reported.

In its FHRR, the licensee reported that there are no dams located upstream or downstream of the Point Beach site. As a result, the licensee concluded that there is no potential for dam breach related flooding at the site.

The NRC staff reviewed available topographical and hydrological maps and information and including the USACE National Inventory of Dams database (USACE, n.d.) and verified that there are no dams in the contributing watershed that would cause a flooding hazard at the Point Beach site. Therefore, the NRC staff confirmed the licensee's conclusion that there are no dams or onsite water storage structures that would affect the site area.

The NRC staff confirmed the licensee's conclusion that the flooding from failure of dams and onsite water control or storage structures flood-causing mechanism could not inundate the Point

Beach site. Therefore, this potential flood-causing mechanism does not need to be analyzed in a focused evaluation or an additional assessment.

3.5 Storm Surge

The licensee reported in the Point Beach FHRR that the reevaluated flood hazard for storm surge is based on a stillwater surface elevation of 585.8 ft NAVD88. Including wind waves and runup results in an elevation of 589.7 ft NAVD88.

This flood-causing mechanism is discussed in the licensee's CDB. The CDB PMF elevation for storm surge is based on a stillwater surface elevation of 583.2 ft NAVD88. Including wind waves and runup results in an elevation of 589.7 ft NAVD88.

The licensee reviewed the historical record and concluded that most of the historical instances of sustained winds over 50 mph in the Great Lakes region are associated with deep low extratropical cyclones which move through the region from the southwest to the northeast. Due to these preferred track directions, the licensee concluded that the vast majority of the strongest sustained winds would occur from the south or southwest. In its review of these storms, the licensee discovered that pressure centers as low as 955 mbar (equivalent to a Category 3 hurricane) have occurred near Point Beach. The licensee also stated that tropical systems making landfall along the Gulf of Mexico coast or U.S. east coast and move inland (e.g., Hurricane Hazel in 1954, Hurricane Sandy in 2012) have reached the Great Lakes region, but transitioned into extratropical cyclones.

The licensee used the Delft3D Version 4.00.01 software package (Deltares, 2011) to estimate the PMSS and associated wave effects from a suite of theoretical design storms. The licensee's Wave transformation in Delft3D-WAVE was performed using Simulating WAves Nearshore (SWAN) (Booij et al., 1999; Deltares, 2014; TUDelft, n.d). The licensee calibrated and validated both models to observed historical windstorms (December 1, 1985; December 2, 1990; and October 25, 2010). The licensee stated that the antecedent lake level (e.g., 100-year high lake level) of 575.6 ft was included in the numerical model simulations.

The licensee used observed storm surge time series recorded at NOAA tide stations to calibrate the simulated storm surges (FHRR Table 4.5; FHRR Figure 4.12). The licensee calibrated the simulated wave fields using the observed wave characteristics time series recorded at NOAA buoy stations (FHRR Tables 4.6; FHRR Figure 4.13). The licensee stated that the October 25, 2010, storm was selected as the calibration event due to the finer temporal resolution of the atmospheric wind and pressure data as well as the availability of observed storm surge and wave characteristics (FHRR Tables 4.5 and 4.6). The licensee used the remaining historical storms discussed above for model validation.

Due to the size, bathymetry, and geometry of the Great Lakes, the licensee used six Delft3D-FLOW domains with the coarsest grids representing conditions over Lake Michigan and Lake Huron. The extents of the domains were chosen to include the surrounding coast up to approximately 66 ft above the 100-year lake level of 583.4 ft. The licensee selected a horizontal resolution of 6,562 ft to represent the bathymetric contours of Lake Michigan and Lake Huron away from Point Beach (FHRR Figure 4.10). Near Point Beach, the licensee selected a grid resolution of 19.0 ft to represent Point Beach's coastline and nearshore bathymetry (FHRR Figure 4.11).

The licensee developed the synthetic probable maximum synoptic events in accordance with applicable guidance documents (ANSI/ANS, 1992; NRC, 2011), which provided the basis for the site-specific storm methodology. The licensee evaluated 3-hour or 6-hour wind and pressure data for 31 historical synoptic events from 1907 to 2012 which produced 45 maximized, potential synoptic PMWS scenarios (FHRR Table 4.4). The licensee then maximized and transposed each scenario to occur directly over the Point Beach site. Finally, the licensee applied the overwater wind adjustments and sampling interval adjustments described in FHRR Section 4.4.9.5 and FHRR Section 4.4.9.6, respectively, to the bounding PMWS synoptic event (i.e. Scenario 13) to determine the PMSS and peak water level at the Point Beach site.

The licensee's PMSS results are presented in FHRR Table 4.12 and FHRR Figure 4.25, where the wave runup on a gently-sloping impermeable surface reached a maximum of 589.7 ft (FHRR Figure 4.26). The licensee stated that the majority of the plant elevations are located at an elevation of 607.3 ft. The licensee stated that the only exception to this is the area near the CWPH where the plant draws its circulating water from Lake Michigan and has a ground floor elevation of 588.3 ft. In addition, the CLB requires the installation of concrete barriers and sandbags to provide a flooding barrier at the CWPH that would protect equipment in the CWPH and TB from the flood waters up to 590.3 ft. Thus, the licensee concluded that no interim measures are required for this hazard since reevaluated PMSS levels would not adversely affect critical structures because the reevaluated PMSS levels do not inundate the site.

The NRC staff reviewed the NOAA databases cited by the licensee, including the climatology of Lake Michigan (USACE, 2012a), and confirmed that the controlling storm for PMSS calculations is an extratropical storm. The NRC staff concluded that the licensee applied the appropriate storm parameters per ANSI/ANS-2.8-1992 consistent with NUREG/CR-7046 (NRC, 2011), ANSI/ANS-2.8-1992 (ANSI/ANS, 1992) and JLD-ISG-2012-06 (NRC, 2013), the licensee determined based on the performance of a statistical analysis of NOAA-observed water level data (NOAA, 2016a, and 2016b; Canada, 2016; USACE 2016a and 2016b).

The NRC staff independently ran the NOAA Great Lakes Storm Surge Planning Program (SSPP) model for a sustained wind speed of 100 miles per hour (mph) and varied the wind direction in 10 degree increments between 10 and 360 degrees to determine the wind direction which results in the greatest surge elevation at the site (Schwab et al, 1981; 1987). The resulting SSPP predicted a PMSS maximum still water level of 586.6 ft compared to the licensee's 585.8 ft using Delft3D (Deltares, 2011). The FHRR maximum PMSS stillwater level was below the grade elevation at the CWPH and TB POIs, therefore Point Beach would not be inundated from the PMSS event.

Thus, the NRC staff confirmed the licensee's conclusion that the PMF from reevaluated hazard for flooding from storm surge is bounded by the CDB flood hazard for the Point Beach site. The NRC staff also confirmed the licensee's conclusion that the flood hazard from storm surge alone would not inundate the site. Therefore, flooding from storm surge does not need to be analyzed in a focused evaluation or an additional assessment.

3.6 Seiche

The licensee reported in the Point Beach FHRR that the reevaluated flood hazard for seiche is based on a stillwater surface elevation of 583.1 ft NAVD88, including wind waves and runup results in an elevation of 584.1 ft NAVD88. This flood-causing mechanism is discussed in the licensee's CDB, but no PMF elevation was reported.

The numerical model (Delft3D) (Deltares, 2011) used by the licensee in the PMSS evaluation (FHRR Section 4.4) was also used to estimate the maximum seiche from a suite of theoretical design storms. Synthetic squall line (derecho) events were developed in accordance with applicable guidance documents (e.g., ANSI/ANS, 1992; NRC, 2011; NRC, 2013), which provide the basis for the site-specific storm methodology. The licensee evaluated the peak seiche stillwater level at Point Beach from a combination of the maximum seiche with wind-wave activity and lesser of the 100-year or maximum controlled water level.

The Point Beach FHRR states that historical squall lines (or derechos) can produce some of the highest instantaneous recorded wind gusts, but last only for a limited time (i.e., less than 30 minutes) at a given location. The licensee analyzed seventeen historical squall lines between 1909 and 2012 to develop maximized, transposed squall lines (derechos). These synthetic storms were then evaluated or potential seiches independent of the PMSS. The licensee stated that this result is for a single squall line event. In order to amplify the initial seiche amplitude, forcing would need to be applied to the lake at a resonant frequency to the basin geometry. Therefore, the licensee performed a fast Fourier transform to establish Lake Michigan's natural periods of oscillations. The dominant natural frequencies were found to be 40, 90, and 110 minutes. Based on a 30 minute squall line duration, the licensee concluded that strong squall lines would require a spacing of at least 12 hours in order for the necessary meteorological conditions to recharge. Thus, a series of squall line or derecho events occurring at the lake's characteristic resonant frequencies are physically impossible and seiche amplification above the +1.0 ft produced in the model simulations is implausible at Point Beach.

The NRC staff reviewed the licensee's results and confirmed the licensee's statements regarding wind effects on seiche resonance. The NRC staff concurs with the licensee's conclusion that squall lines initially move offshore at Point Beach and the potential flooding impact from seiche would be indirect. The primary storm surge will occur along the eastern and/or southern shorelines of Lake Michigan with potential seiches propagating to the west and/or north after the squall line has passed completely over Lake Michigan. For Lake Michigan, the mean seiche period for primary mode oscillation along the long axis should be about 9 hours while the cross-lake primary mode period should be roughly 2 hours with typical seiche events lasting for 1 to 3 days with amplitudes of 1 to 5 ft (USACE, 2012b). Therefore, the Point Beach site could not be inundated from these types of events.

The NRC staff confirmed the licensee's conclusion that the seiche flood-causing mechanism could not inundate the Point Beach site. Therefore, this potential flood-causing mechanism does not need to be analyzed in a focused evaluation or an additional assessment.

3.7 Tsunami

The licensee reported in the Point Beach FHRR that the reevaluated flood hazard for tsunami does not inundate the plant site, but did not report a PMF elevation. This flood-causing mechanism is not discussed in the licensee's CDB.

In its FHRR, the licensee reported that tsunami was not considered a plausible flood-causing mechanism at the Point Beach site, as indicated in the CLB. The Point Beach FHRR also states that there were no earthquakes, landslides, or volcanic eruptions that would generate a tsunami in Lake Michigan near the Point Beach site. Therefore, the licensee concluded that Point Beach is not affected by flooding from tsunamis.

The licensee analyzed observational records and current scientific literature to evaluate the potential sources of a tsunami for the Point Beach site. In addition, the FHRR stated that queries were performed in the National Geophysical Data Center tsunami, earthquake, and volcano databases to determine whether any historical events were reported regionally or near Point Beach (NOAA, 2014). The United States Geological Survey (USGS) database was queried for possible tsunamigenic landslide activities in the Great Lakes, specifically Lake Michigan (USGS, 2014a; USGS, 2014b). The licensee found no historical evidence of a potential tsunami occurring at or near Point Beach due to earthquake, landslide, or volcanic activity (Lockridge et al., 2002). The Point Beach FHRR states that the only historical "tsunami runup" events located in the databases were related to meteorological events which were not classified as true tsunami events but rather seiches.

The NRC staff reviewed the methodologies and references used by the licensee to determine the severity of the tsunami phenomena reflected in this analysis and noted that they are consistent with present-day methodologies and guidance. In the context of the above discussion, the NRC staff finds the licensee's analysis and use of these methodologies acceptable. In summary, the NRC staff confirmed the licensee's conclusion that flooding from tsunami could not inundate the site.

The NRC staff confirmed the licensee's conclusion that the tsunami flood-causing mechanism could not inundate the Point Beach site. Therefore, this potential flood-causing mechanism does not need to be analyzed in a focused evaluation or an additional assessment.

3.8 Ice-Induced Flooding

The licensee reported in the Point Beach FHRR that the reevaluated hazard for ice-induced flooding does not inundate the plant site, but did not report a PMF elevation. This flood-causing mechanism is not discussed in the licensee's CDB.

The licensee reported in the Point Beach FHRR that the licensee queried the USACE Ice Jam Database (USACE, 2014) to obtain information on historical ice events recorded in the Manitowoc-Sheboygan Watershed. The query results indicated that no ice jams were recorded; therefore, the licensee determined no further analysis was necessary to determine flooding from ice.

The licensee obtained ice cover data for the lake from the U.S. National Ice Center (USNIC) website (USNIC, 2014). The record consisted of daily ice analysis charts which are digitally available from 1995 to present. Based on the results of the query, the licensee determined that further consideration of ice-induced flooding (including the effects of frazil ice) was not required. The NRC staff reviewed the available information including the databases of the USACE National Ice Jam Database (USACE, 2015) and the USNIC and verified that there are no significant ice events of record that could potentially result in ice-induced flooding at the Point Beach site. The NRC staff also did not find documented accounts of flooding from ice in the area surrounding the Point Beach site. Therefore, the NRC staff confirmed that the licensee's conclusion about flood hazard from ice-induced flooding events is appropriate.

The NRC staff confirmed the licensee's conclusion that the ice-induced flood-causing mechanism could not inundate the Point Beach site. Therefore, this potential flood-causing mechanism does not need to be analyzed in a focused evaluation or an additional assessment.

3.9 Channel Migrations or Diversions

The licensee reported in the Point Beach FHRR that the reevaluated flood hazard for channel migrations or diversions does not inundate the plant site, but did not report a probable maximum flood elevation. This flood-causing mechanism is not discussed in the licensee's CDB.

In its FHRR, the licensee reported that the Point Beach site is located on Lake Michigan and that no major streams exist in the surrounding area, therefore channel migration is not a plausible flood-causing mechanism. The NRC staff reviewed available topographical and hydrological maps and information and confirmed that the licensee's conclusion about the flood hazard from channel migration is appropriate.

The NRC staff confirmed the licensee's conclusion that the channel migrations or diversions flood-causing mechanism could not inundate the Point Beach site. Therefore, this potential flood-causing mechanism does not need to be analyzed in a focused evaluation or an additional assessment.

4.0 REEVALUATED FLOOD ELEVATION, EVENT DURATION AND ASSOCIATED EFFECTS FOR HAZARDS NOT BOUNDED BY THE CDB

4.1 Reevaluated Flood Elevation for Hazards Not Bounded by the CDB

Section 3 of this staff assessment documents the NRC staff review of the licensee's flood hazard water height results. Table 4.1-1 of this assessment contains the maximum results, including waves and runup, for flood mechanisms not bounded by the CDB presented in Table 3.1-1. The NRC staff agrees with the licensee's conclusion that the LIP mechanism is not bounded by the CDB. The NRC staff anticipates the licensee will submit a focused evaluation for LIP and associated site drainage.

4.2 Flood Event Duration for Hazards Not Bounded by the CDB

The NRC staff reviewed the information provided in the Point Beach FHRR (NextEra, 2015a) regarding the FED parameters needed to perform the additional assessment of plant response for flood hazards not bounded by the CDB. The FED parameters for flood-causing mechanisms not bounded by the CDB are summarized in Table 4.2-1 of this assessment and the NRC staff considers the values reported to be reasonable.

The licensee provided FED parameter values for the LIP flood-causing mechanism, but it did not provide the flood warning time in the FHRR (NextEra, 2015a).

The NRC staff determined that the licensee could use guidance provided in Nuclear Energy Institute (NEI) 15-05 (NEI, 2015) to estimate the LIP warning time for future analyses, if needed. Periods of inundation and recession were not provided in the FHRR; however, duration values were contained in the calculation packages discussed with staff as part of the audit. The staff reviewed the duration values, including the model simulation results, and found the duration results to be reasonable. The NRC staff documented the periods of inundation and recession in the Audit Summary Report (NRC, 2016). The period of inundation for significant water depth ponding is approximately 1 hour at critical POIs, and the model-simluated period of recession is 4.25 hours.

The NRC staff reviewed the FED parameters provided in the licensee's FHRR (NextEra, 2015a) and determined that they are reasonable for use in future assessments of plant response.

4.3 Associated Effects for Hazards Not Bounded by the CDB

The NRC staff reviewed information provided in the Point Beach FHRR (NextEra, 2015a) regarding AE parameters needed to perform future additional assessments of plant response for flood hazards not bounded by the CDB. The AE parameters not directly associated with a maximum WSE are listed in Table 4.3-1 of this assessment.

The licensee provided estimates of hydrostatic and hydrodynamic loads for the LIP event. The hydrostatic loads were computed based on the modeled WSEL at each POI. The hydrodynamic loads were estimated from the modeled velocity time series at each POI. The total waterborne load was estimated as the summation of the two loads as presented in Table 3.2-3 of this assessment. As stated in the FHRR, the reevaluated combined hydrostatic and hydrodynamic loads at the POIs were bounded by the maximum tornado impact pressure by a significant margin for Class I structures. The staff reviewed the simulated water surface elevations and velocities and determined that the information provided by the licensee is appropriate and reasonable for the FHRR review.

In order to estimate the debris load, the licensee used guidance provided in ASCE 7-10 (ASCE, 2010). The analysis considered a conservative waterborne debris load and a range of potential flow velocities consistent with the guidance. The reevaluated waterborne projectile impact pressures were compared to the CLB/CDB tornado missiles, and found that sufficient margin existed for Class I structures, even at the highest range of expected flood velocities. Furthermore, the surface water elevation resulting from the PMSS event does not reach the CWPH POIs or further inland. Therefore, it was determined that waterborne projectiles will not impact any POI considered in the flood hazard reevaluation resulting from PMSS. The staff reviewed the maximum velocities from the model outputs, consistent with the guidance provided in ASCE 7-10 (ASCE, 2010) and determined that the approach is acceptable for the purpose of the FHRR review.

The NRC staff reviewed the AE parameters provided by the licensee and the NRC staff confirms the licensee's AE parameter results are reasonable for use in future assessments of plant response.

4.4 Conclusion

Based on the preceding analysis, NRC staff confirmed that the reevaluated flood hazard information discussed in Section 4 of this assessment is an appropriate input to the additional assessments of plant response as described in the 50.54(f) letter (NRC, 2012a), COMSECY-15-0019 (NRC, 2015a) and associated guidance.

5.0 CONCLUSION

The NRC staff reviewed the information provided for the reevaluated flood-causing mechanisms for Point Beach. Based on its review of available information provided in NextEra's 50.54(f) response (NextEra, 2015a), the NRC staff concludes that the licensee conducted the hazard reevaluation using present-day methodologies and regulatory guidance used by the NRC staff in connection with ESP and COL reviews.

Based upon the preceding analysis, the NRC staff confirmed that the licensee responded appropriately to Enclosure 2, Required Response 2, of the 50.54(f) letter, dated March 12, 2012. In reaching this determination, NRC staff confirmed the licensee's conclusions that: (1) the reevaluated flood hazard results for LIP is not bounded by the CDB flood hazard; (2) additional assessments of plant response will be performed for the LIP flood-causing mechanism; and (3) the reevaluated flood-causing mechanism information is appropriate input to the additional assessments of plant response as described in the 50.54(f) letter and COMSECY-15-0019 (NRC, 2015a) and associated guidance. The NRC staff has no additional information needs with respect to NextEra's 50.54(f) response (NextEra, 2015a).

6.0 REFERENCES

Note: ADAMS Accession No. refers to documents available through NRC's Agencywide Documents Access and Management System (ADAMS). Publicly-available ADAMS documents may be accessed through http://www.nrc.gov/reading-rm/adams.html.

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Table 2.2-1. Flood-Causing Mechanisms and Corresponding Guidance

Flood-Causing Mechanism	Standard Review Plan Section(s) and JLD-ISG
Local Intense Precipitation and Associated Drainage	SRP 2.4.2 SRP 2.4.3
Streams and Rivers	SRP 2.4.2 SRP 2.4.3
Failure of Dams and Onsite Water Control/Storage Structures	SRP 2.4.4 JLD-ISG-2013-01
Storm Surge	SRP 2.4.5 JLD-ISG-2012-06
Seiche	SRP 2.4.5 JLD-ISG-2012-06
Tsunami	SRP 2.4.6 JLD-ISG-2012-06
Ice-Induced	SRP 2.4.7
Channel Migrations or Diversions	SRP 2.4.9

SRP is the Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition (NRC, 2007)

JLD-ISG-2012-06 is the "Guidance for Performing a Tsunami, Surge, or Seiche Hazard Assessment" (NRC, 2013a)

JLD-ISFG-2013-01 is the "Guidance for Assessment of Flooding Hazards Due to Dam Failure" (NRC, 2013b)

Table 3.0-1. Summary of Controlling Flood-Causing Mechanisms at the Point Beach site

Reevaluated Flood-Causing Mechanisms and Associated Effects that May Exceed the Powerblock Elevation 589.3 ft [1]	ELEVATION [NAVD88]
Local Intense Precipitation and Associated Drainage	609.6 ft

[1]Flood height and associated effects as defined in JLD-ISG-2012-05 (NRC, 2012c).

Table 3.1-1. Current Design Basis Flood Hazards for the Point Beach Site (NextEra, 2015a)

Flood Mechanism	Stillwater Elevation [NAVD88]	Waves/Runup	Current Design Basis Elevation [NAVD88]	Reference
Local Intense Precipitation and Associated Drainage	608.9 ft	Minimal	608.9 ft	FHRR Table 3.1
Streams and Rivers	Not discussed in CDB	Not discussed in CDB	Not discussed in CDB	FHRR Section 3.3
Failure of Dams and Onsite Water Control/Storage Structures	Not discussed in CDB	Not discussed in CDB	Not discussed in CDB	
Storm Surge	583.2 ft, including tides	6.6 ft due to wave runup	589.7 ft	FHRR Section 3.4
Seiche	No impact on site identified	No impact on site identified	No impact on site identified	
Tsunami	Not discussed in CDB	Not discussed in CDB	Not discussed in CDB	
Ice-Induced	Not discussed in CDB	Not discussed in CDB	Not discussed in CDB	
Channel Migrations or Diversions	Not discussed in CDB	Not discussed in CDB	Not discussed in CDB	

Table 3.2-1 Site-Specific Sub-hourly Point Beach LIP Precipitation Depths

Time (min)	Precipitation Depths (in.)
5	4.4
15	6.9
30	9.9
60	12.8

Table 3.2-2. Comparison of Maximum Water Surface Elevations and Durations of Inundation (Using different FLO-2D builds of the Point Beach LIP flooding model)

Scenario			CDB	OQ4 (Scenario A)				OWBQ4 (Scenario B)			
Building	Door Nam e	FLO-2D Cell	Maximum Water Surface Elevation, ft NAVD88	Licensee Maximum Water Surface Elevation, ft NAVD88	NRC staff Maximum Water Surface Elevation, ft NAVD88	Peak flood dept h (ft)	Duration of flood depth >0.05 ft (hr)	Licensee Maximum Water Surface Elevation ft NAVD88	NRC staff Maximum Water Surface Elevation, ft NAVD88 (NRC staff)	Peak flood dept h (ft)	Duratio n of flood depth >0.05 ft (hr)
Flo-2D Build Version			-	13.11.06	14.08.09			13.11.06	14.08.09		
Turbine Building	1	73814	589.4	591.2	591.2	1.9	3	591.8	591.8	2.5	2.5
	2	73820	589.4	591.2	591.2	1.9	2	591.8	591.8	2.5	2
	4	73817	589.4	591.2	591.2	1.9	2	591.8	591.8	2.5	2
	11	73840	589.5	591.4	591.4	2.0	3	591.9	591.9	2.6	3
	13	73842	589.5	591.4	591.4	2.0	3	591.9	591.9	2.6	3
Diesel Generato r	101	73220	608.2	607.7	607.7	0.17	1	607.7	607.7	0.17	1
	102	72901	608.5	609.3	609.3	0.09	1	609.3	609.3	0.09	1
	108	69785	608.9	609.3	609.3	0.45	1	609.3	609.3	0.45	1
	603	69782	608.6	609.1	609.1	0.25	1	609.1	609.1	0.25	1
	604	69789	608.9	609.3	609.3	0.65	1.5	609.3	609.3	0.65	1
Unit 1 & Unit 2	151	49324	607.4	609.0	609.0	1.8	2.5	609.0	609.0	1.8	2.5
	152	47609	607.5	609.3	609.3	2.1	4	609.3	609.3	2.1	4
	154	49342	607.6	609.5	609.5	2.3	9	609.5	609.5	2.3	9
	159	63856	----	609.6	609.6	2.4	9	609.6	609.6	2.4	9
	167	61096	----	609.5	609.5	2.2	5	609.5	609.5	2.2	5
	209	57578	607.2	608.4	608.3	1.0	1.5	608.3	608.4	1.0	1.5
	210	50358	607.4	609.0	609.0	1.8	3	609.1	609.0	1.8	3

	231	57303	607.9	609.5	609.5	2.2	6	609.5	609.5	2.2	6
	232	60063	607.9	609.5	609.5	2.5	>10	609.5	609.5	2.5	>10
Service Building	310	61353	607.0	607.7	607.7	1.0	4	607.7	607.7	1.0	4
	311	57911	607.0	608.0	608.0	1.0	4	608.0	608.0	1.0	2
	312	57912	607.1	608.1	608.1	1.0	4	608.1	608.0	1.0	2
	313	57921	607.2	608.3	608.3	1.0	4	608.3	608.3	1.0	2
	314	57923	607.2	608.4	608.3	1.0	4	608.3	608.4	1.0	1.8
CWPH	336	80021	588.9	590.5	590.5	n/a	n/a	591.1	591.1	2.5	8
	338	78305	589.0	591.1	591.1	1.0	4	591.8	591.8	3.4	8
	339	78322	589.1	591.3	591.3	1.0	4	591.8	591.8	3.3	9
	340	80401	588.9	590.9	590.9	n/a	n/a	591.2	591.1	2.6	9
G5 Building	G5-01	43119	----	609.2	609.2	2.0	3.5	609.2	609.2	2.0	3.5
	G5-02	43118	----	609.2	609.2	2.0	3.5	609.2	609.2	2.0	3.5
	G5-03	41392	----	609.3	609.3	2.2	8	609.3	609.3	2.2	8
	G5-04	41386	----	609.2	609.2	2.0	4	609.2	609.2	2.0	4
	G5-05	41377	----	609.0	609.0	1.8	3	609.0	609.0	1.8	3

The results presented as peak flood depth and approximate duration of flood depth of greater than 0.05 ft are compiled from NextEra (2014a).

Table 3.2-3 – Hydrostatic and Hydrodynamic Loads during LIP Event

	Door	Scenario A			Scenario B		
		Static Force, (lbs/ft)	Impact Force, (lbs/ft)	Total Force, (lbs/ft)	Static Force, (lbs/ft)	Impact Force, (lbs/ft)	Total Force, (lbs/ft)
Turbine Building	1	112.6	1.0	113.7	195.0	3.5	**198.5**
	2	112.6	1.9	114.5	195.0	6.7	**201.7**
	4	112.6	0.7	113.3	195.0	3.5	**198.5**
	11	137.6	2.7	140.2	210.9	7.4	**218.3**
	13	137.6	3.2	140.8	210.9	7.0	**217.9**
Diesel Generator	600	1.2	0.1	**1.3**	1.2	0.1	**1.3**
	601	0.3	0.0	0.3	0.3	0.0	**0.3**
	602	7.8	0.5	**8.3**	7.8	0.4	8.2
	603	2.8	0.7	**3.5**	2.8	0.7	**3.5**
	604	15.3	0.1	**15.4**	15.3	0.1	**15.4**
Unit 1 & Unit 2	151	112.6	1.3	113.9	112.6	1.4	**114.0**
	152	137.6	6.6	144.2	137.6	8.3	**145.9**
	154	165.0	6.0	**171.0**	165.0	3.4	168.4
	159	179.7	6.6	**186.3**	179.7	4.5	184.2
	167	151.0	5.4	**156.4**	151.0	3.5	154.5
	209	31.2	1.1	**32.3**	31.2	1.1	**32.3**
	210	112.6	0.7	113.4	112.6	1.0	**113.7**
	231	165.0	5.6	170.6	165.0	5.8	**170.9**
	232	195.0	8.2	203.2	195.0	8.7	**203.7**
Service Building	310	31.2	2.4	33.6	31.2	4.3	**35.5**
	311	25.3	27.5	**52.8**	25.3	26.7	52.0
	312	25.3	24.3	**49.6**	25.3	23.2	48.4
	313	44.9	11.2	**56.1**	44.9	9.1	54.1
	314	37.8	2.2	**39.9**	37.8	2.1	**39.9**
CWPH	336	137.6	140.6	**278.2**	195.0	70.3	265.3
	338	244.6	22.3	266.9	360.7	69.9	**430.5**
	339	244.6	21.2	265.8	339.8	29.4	**369.1**
	340	165.0	102.7	***267.7***	210.9	205.2	**416.2**
G5 Building	G501	137.6	2.2	139.8	137.6	2.9	**140.5**
	G502	137.6	1.1	138.7	137.6	1.2	**138.8**
	G503	151.0	0.4	151.4	151.0	0.7	**151.8**
	G504	124.8	6.7	**131.5**	124.8	4.1	128.9
	G505	101.1	38.2	**139.3**	101.1	31.2	132.3

Source: FHRR Table 4.1 (NextEra, 2015a)

Table 4.1-1. Reevaluated Flood Hazards for Flood-Causing Mechanisms Not Bounded by the CDB

Flood-Causing Mechanism	Stillwater Elevation, NAVD88	Associated Effects	Reevaluated Flood Hazard NAVD88	Reference
Local Intense Precipitation and Associated Drainage	609.6 ft	Minimal	609.6 ft	FHRR Table 4.2

Table 4.2-1. Flood Event Duration 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	NEI 15-05 (NEI, 2015)	~1 hour[1]	~4.25 hours[2]

Source: (NextEra, 2015a; NextEra, 2015b and NextEra, 2016)
Notes:
[1]Duration of inundation from the hydrograph presented in the FHRR (NextEra, 2015a) [FHRR Figure 4.9 LIP TB Door 13 Water Depth Time Series – Scenario B].
[2]Time of recession from the MSA document (NextEra, 2016).

Table 4.3-1 Associated Effects Inputs for Flood-Causing Mechanisms Not Bounded by the CDB

	Flood-Causing Mechanism
Associated Effects Parameter	**Local Intense Precipitation**
Hydrodynamic loading at plant grade	430.5 lb/ft at CWPH (includes 360.7 lb/ft hydrostatic and 69.9 lb/ft hydrodynamic)(2)
Debris loading at plant grade	Minimal
Sediment loading at plant grade	Minimal
Sediment deposition and erosion	Minimal
Concurrent conditions, including adverse weather	Minimal
Other pertinent factors (e.g., waterborne projectiles)	Minimal

Source: (NextEra, 2015a)
Notes:

(1) Lb/ft stands for pounds per linear feet of structure in length.
(2) Source: FHRR Table 4.15

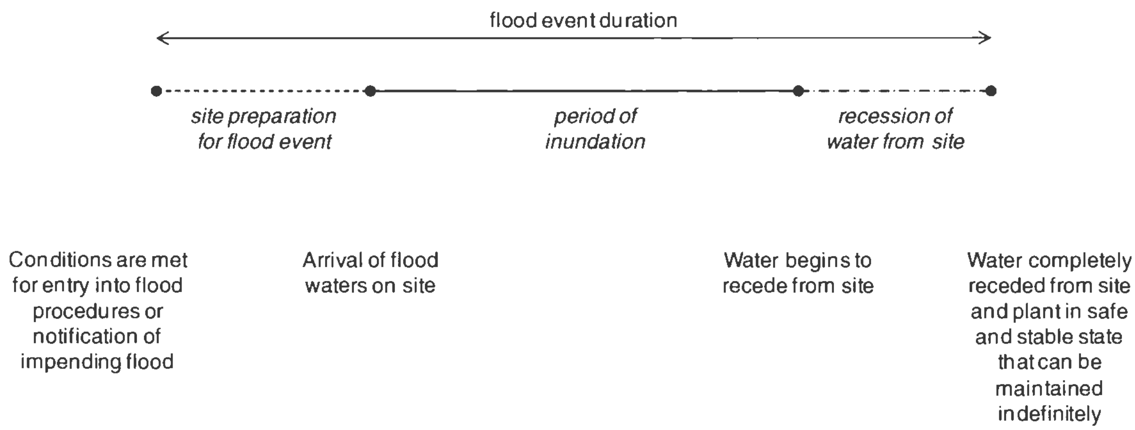

Figure 2.2-1 Flood Event Duration
Source: JLD-ISG-2012-05 (NRC, 2012c), Figure 6.

Figure 3.2-1. Permanent and Temporary Structures of the Point Beach Site, *TS1 and TS2 are the temporary structures referenced in the Scenario A section.* Source: FHRR Figure 4.5

Figure 3.2-2. Point Beach Imagery (Source: Google Earth, 2015)

Figure 3.2-3. Location of Temporary Wave Barriers as Described for Scenario B

Source: FHRR Figure 4.8

POINT BEACH NUCLEAR PLANT, UNITS 1 AND 2– STAFF ASSESSMENT OF RESPONSE TO 10 CFR 50.54(f) INFORMATION REQUEST – FLOOD-CAUSING MECHANISM REEVALUATION DATED May 19, 2017

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