Storm Surge
Technical Evaluation Report
Seabrook Station
Hazard Reevaluation Review

Prepared for

U.S.NRC

By

TAYLOR ENGINEERING, INC.

March 2017

TECHNICAL EVALUATION REPORT: SEABROOK STATION

STORM SURGE

NextEra reported in the Flood Hazard Reevaluation Report (FHRR; October 2016 Revision) that the reevaluated hazard, including associated effects, for site flooding due to storm surge is 23.35 ft-NAVD88 (North American Vertical Datum of 1988) at the seawall away from site structures with maximum flow depths that exceed 20.23 ft-NAVD88 near site structures. This flood-causing mechanism is described in NextEra's current design basis. The current design basis hazard for site flooding due to the Combined Effect scenario of a probable maximum hurricane (PMH) induced probable maximum storm surge (PMSS) at the site is 21.03 ft-NAVD88 for peak water surface elevation due to runup with maximum flow depths of 20.23 ft-NAVD88 at site structure walls.

NextEra submitted a FHRR on September 25, 2015. A revised FHRR was submitted by NextEra dated October 26, 2016. The revised FHRR contains introductory sections that describe the changes to the FHRR. Specific to storm surge, the changes to the FHRR relate to an additional flooding case for the PMSS event that featured higher storm-generated stillwater levels, a larger wave height near the site, and a lower wave period. The revised FHRR and additional PMSS analysis stems from NextEra and audits conducted between the original and revised FHRR submittals. Specific to storm surge, the audits discussed the Delft3D grid setup, the Taylor Engineering staff independent storm surge simulations, and comparisons of the water levels developed by different model setups and storms simulations.

The Taylor Engineering staff describes its evaluation of site flooding from storm surge, including associated effects, against the relevant regulatory criteria based on present-day methodologies and regulatory guidance below.

1.0 Historical Storm Surge Data

Information Submitted by NextEra
NextEra reviewed the historical hurricane tracks within a 100 mile radius (see Figure 1) of the Seabrook station and found that from 1854 to present, "most historical hurricanes move in a northerly direction, and there are no recorded landfalling hurricanes at the latitude of Seabrook station that come from the east or southeast."

NextEra also performed a site-specific climatological study to expand the search for storm data. To support a site-specific climatological study, NextEra conducted "online searches, reviews of numerous research papers, queries of National Weather Service (NWS) reports and databases, and examination of non-tropical storm related storm surges along the Atlantic coastline" to "develop the list of storms used" in the climatological study. NextEra searched sources that included "the NWS forecast offices in the region, National Center for Environmental Prediction (NCEP) (2014), National Oceanic and Atmospheric Administration's (NOAA) Earth System Research Laboratory (ESRL) 3/6 Hourly 20th century reanalysis data composites website (NOAA, 2014l), the NOAA ESRL 6-Hourly NCEP/National Center for Atmospheric Research (NCAR) reanalysis data composites (NOAA, 2014q), NOAA ESRL 3-Hourly NCEP North American Regional Reanalysis (NARR) (NOAA, 2014n), National Climatic Data Center (NCDC) storm archives (NCDC, 2014), and the Storm Prediction Center (SPC) severe storm reports (NOAA, 2014o). Additional storm cases are recorded by numerous refereed journal articles and research papers (e.g., Armstrong, 2013; Blake et al., 2012; Burt, 2012; Cooperman and Rosendal, 1963; Halverson and Rabenhorst, 2013; Hayden, 1889; McQueen et al., 1956)". Table 1 lists squall line

storms identified in the storm search analysis and Table 2 lists storms that "produced the highest wind speeds and lowest pressures at one or more analysis periods for a given direction" (FHRR, Sec. 4.4.9.1).

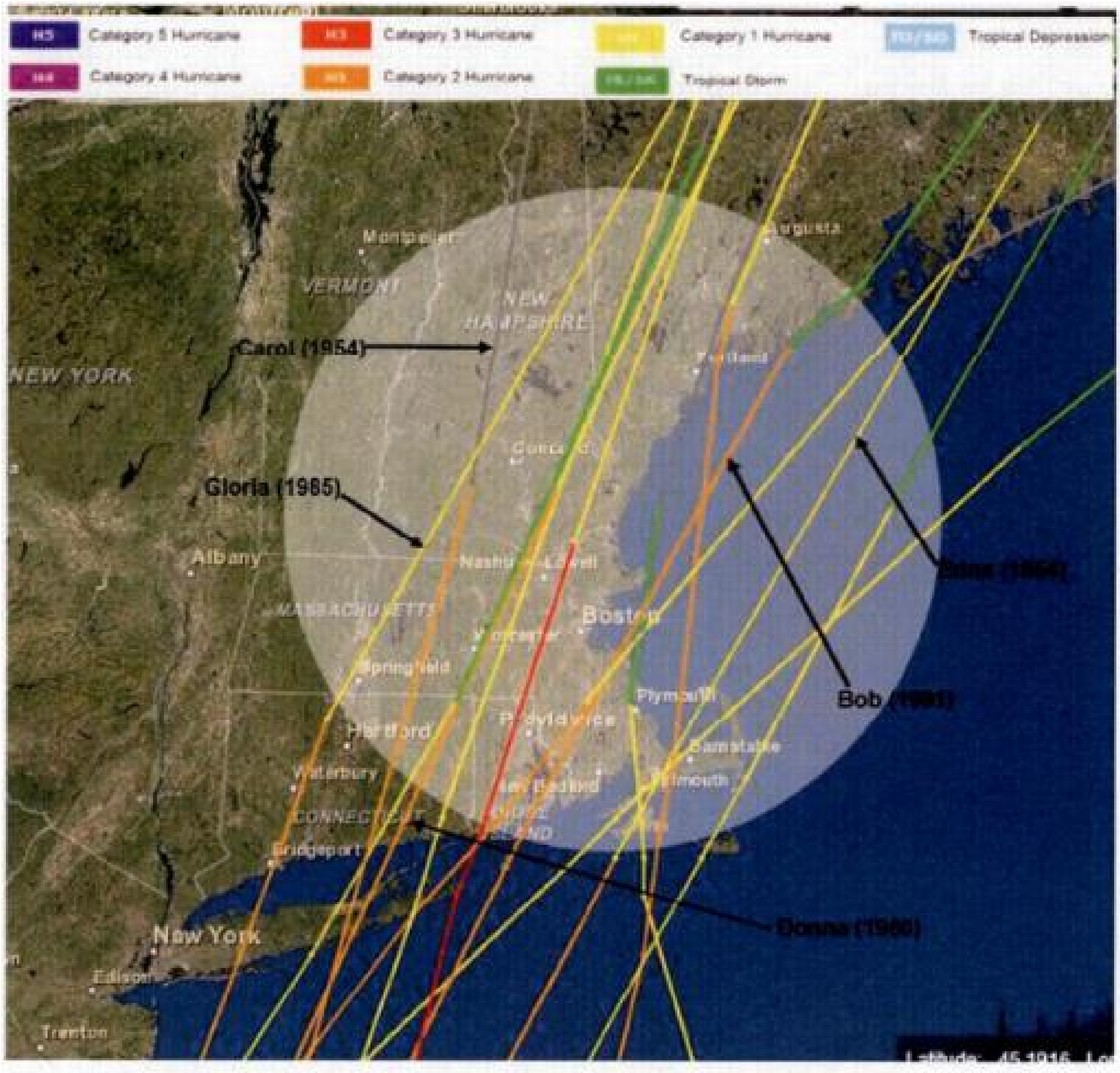

Figure 1 Historical Hurricane Tracks within 100 mile Radius of Seabrook
(Source: FHRR, Figure 4-24)

Table 1 List of Squall Line Storms Identified in the Storm Search Analysis
(Source: FHRR, Table 4-30)

Year	Month	Lowest Pressure (mb)	Observed Storm Surge (feet)	Peak Gusts Direction	Peak Gusts Speed (mph)
2013	2	968	4.21		89
2012	10	945.5	9.45	E	90
2011	10	971		NW	69
2010	3	993		N	75
2009	11	992	7.70	NE	74
2007	4	969	5.00	E	156
2006	11	944	9.87		80
2006	10	992	3.76		
2002	12	975		NW	45
1998	2	983.4	4.90		81/74
1997	3	979		NE	73
1996	1	980		NE	81
1996	10				81
1994	12	970			88/100
1993	3	961	12.00	E	144/109/101
1992	12	985	7.20	E	67/80
1991	10	972	5.11	NE	78
1987	3	980		NE	63
1987	2	964			
1984	3	963	7.00		97/108
1983	2	996			25
1978	2	984	4.34		93
1969	12	976		SE	100/80
1964	1	982			
1962	3	990	7.00	NE	70
1961	1	964	4.50	NW	131
1960	3	960		E	94
1956	4		4.60	N	70
1956	1	980	4.00	SE	123
1950	11	978		E	160/140
1940	2	974.9	3.69	N	96
1940	2		3.69		
1932	3	970.2			
1909	12				72
1888	3	980		NW	85

Table 2 List of Synoptic Storms Used for Delft3D Model Input (Source: FHRR, Table 4-31)

Storm	Date	Time (3hr)	Direction	Longitude	Latitude	Pressure MSL (Pa)
Feb 13-15, 1940	15-Feb	0z	E	-70.95	42.95	983.936
Jan 8-12, 1956	9-Jan	18z	E	-58.35	45.05	1022.14
Feb 4-8, 1978	7-Feb	18z	E	-55.65	43.85	1010.97
Feb 6-10, 2013	8-Feb	21z	E	-67.95	40.55	1010.89
Mar 5-9, 1962	7-Mar	6z	ENE	-67.05	40.25	1002.29
Nov 21-25, 2006	21-Nov	21z	ENE	-74.85	36.35	1020.39
Feb 6-10, 2013	9-Feb	0z	ENE	-68.25	42.65	1013.02
Nov 25-29, 1950	26-Nov	0z	ESE	-67.65	40.25	1015.57
Dec 25-29, 1969	28-Dec	0z	ESE	-61.05	45.05	1003.05
Mar 30-Apr 2, 1987	2-Apr	0z	ESE	-58.95	47.15	1024.4
Oct 28-Nov 1, 1991	30-Oct	0z	N	-64.35	40.25	1007.27
Mar 30-Apr 2, 1997	2-Apr	6z	N	-69.45	38.18	1006.55
Mar 5-9, 1962	8-Mar	12z	NE	-64.65	39.35	1002.12
Oct 28-Nov 1, 1991	29-Oct	12z	NE	-60.45	43.85	1011.22
Mar 30-Apr 2, 1997	1-Apr	0z	NE	-70.95	42.95	1000.09
Nov 21-25, 2006	22-Nov	0z	NE	-75.75	36.95	1021.02
Nov 21-25, 2006	21-Nov	12z	NNE	-78.75	33.05	1017.23
Feb 6-10, 2013	9-Feb	12z	NNE	-69.15	43.25	996.899
Feb 6-10, 2013	10-Feb	0z	NNW	-68.25	42.05	1005.93
Feb 13-15, 1940	15-Feb	12z	NW	-68.25	35.75	988.201
Jan 6-9, 1996	6-Jan	9z	NW	-61.95	38.75	1010.86
Mar 12-15, 1993	14-Mar	9z	S	-56.25	41.45	1009.15
Dec 25-29, 1969	27-Dec	12z	SE	-62.25	41.15	1002.89
Dec 22-26, 1994	23-Dec	12z	SE	-64.35	37.25	1008.51
Apr 14-18, 2007	16-Apr	12z	SE	-66.45	40.25	993.673
Mar 30-Apr 2, 1987	31-Mar	15z	SSE	-66.75	42.68	1015.86
Apr 14-18, 2007	16-Apr	6z	SSE	-68.55	37.55	992.539
Feb 6-10, 2013	8-Feb	15z	SSE	-72.15	35.15	1005.99
Mar 30-Apr 2, 1997	30-Mar	15z	SSW	-60.45	38.45	1009.73
Feb 13-15, 1940	15-Feb	6z	SW	-65.25	37.85	978.685
Mar 12-15, 1993	13-Mar	18z	SW	-78.75	30.95	988.817
Feb 13-15, 1940	15-Feb	0z	W	-70.05	36.05	983.782
Dec 25-29, 1969	29-Dec	0z	WNW	-67.35	36.05	1005.34
Feb 6-10, 2013	8-Feb	0z	WNW	-59.55	47.15	1021.31

Taylor Engineering Staff Technical Evaluation

NextEra performed a wide and exhaustive search of historical storm and surge data. NextEra identified and adequately described all relevant storms and surges.

2.0 Probable Maximum Hurricane

Information Submitted by NextEra

NextEra performed a hurricane climatology study for the area near Seabrook station; applied WindRiskTech (2014) technique to generate large numbers of synthetic hurricane tracks; and applied deterministic, coupled numerical modeling to simulate storm intensity along each track. Figure 2 shows the hurricane climatology study methodology flow diagram. Using the SLOSH model, NextEra generated 20,400 tropical cyclone events to represent "the tropical cyclone events that may take place at Seabrook over an extended time period" and applied the Delft3D-FLOW and Delft3D-WAVE models on select 27 storm tracks (see Table 3, Figure 3, and Figure 4) "to determine how the detailed nearshore bathymetry, more accurate representation of the hurricane and detailed hydrodynamics would affect the predicted storm surge". NextEra used the below criteria to select the 27 storm tracks (FHRR, Sec. 4.4.9.2.5).

1) 10 tracks with maximum wind velocity near the site,
2) 10 tracks with maximum storm surge from the SLOSH simulations, and
3) 10 tracks to map the entire range of the relationship between the SLOSH simulated surge and the Delft3D simulations.

NextEra stated that the above study provides high water level values with a probability of exceedance of the order of 10^{-5} per year.

Taylor Engineering Staff Technical Evaluation

NextEra provided the details of the site and region-specific climatological study and estimations of the ranges of PMH parameters. Taylor Engineering staff concludes NextEra has identified and described acceptable PMH parameters. However, NextEra did not provide the specific parameters values of the PMH or how it estimated the hypothetical PMH.

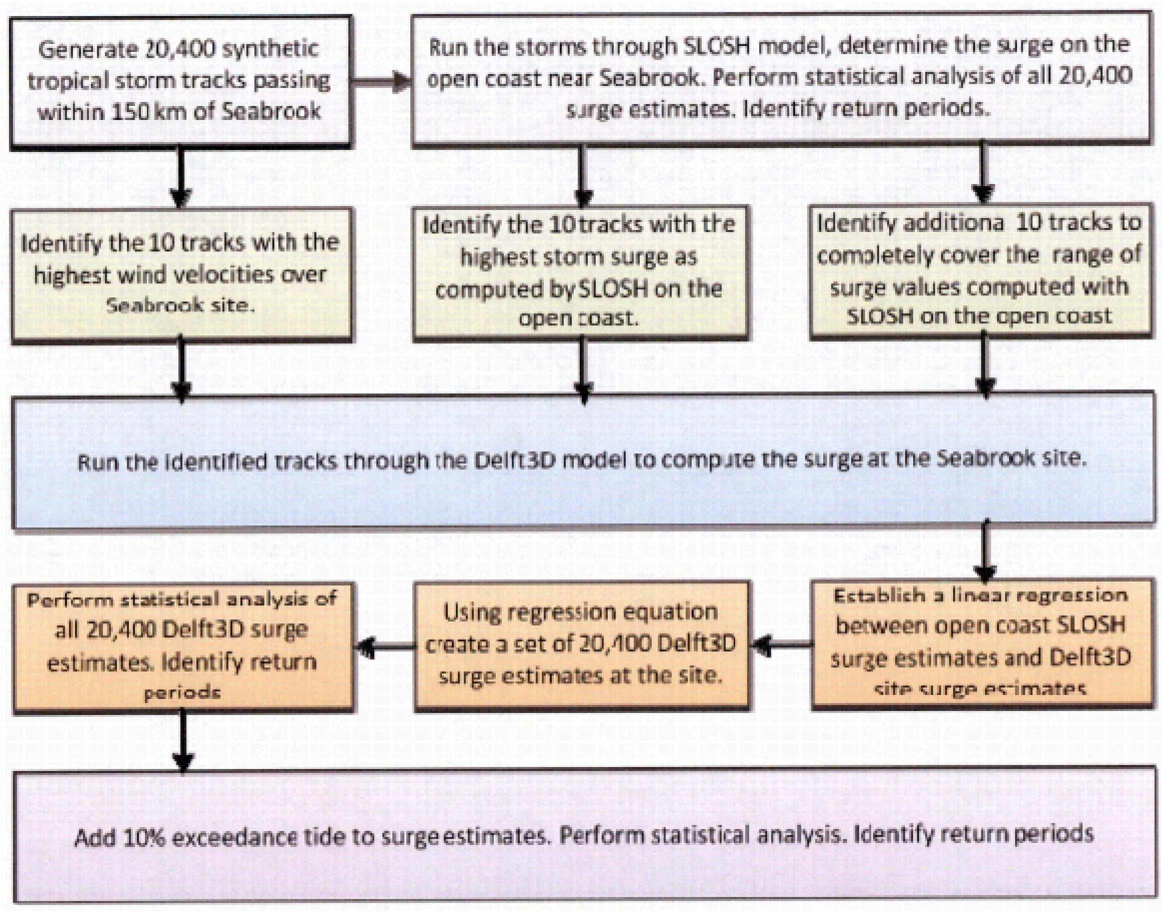

Figure 2 Hurricane Climatology Methodology Flow Diagram (Source: FHRR, Figure 4-36)

Table 3 Surge and Wind Speed for Identified Track Subset (Source: FHRR, Table 4-40)

Track	Delft3D Surge Level at Searbook (ft-NAVD88)	Delft3D Open Coast Surge Level (ft-NAVD88)	SLOSH Surge Level (ft-NAVD88)	Track direction (degrees, clockwise from north, 0 degrees)[1]	Wind Speed WRT (mph)[2]	Wind Speed NWS23 (mph)[3]
6674	5.81	12.07	17.59	152.79	66.17	52.57
6438	4.69	11.25	13.16	150.67	69.97	90.15
13210	5.87	7.97	11.98	157.44	91.16	70.02
16686	9.25	7.97	11.39	152.84	58.36	89.25
16838	8.10	7.97	10.96	142.76	54.09	80.31
10078	5.12	7.97	10.67	144.27	48.61	59.06
20010	4.63	4.69	10.67	143.04	57.49	78.96
5302	4.63	4.69	10.47	175.03	88.96	89.48
12535	4.59	9.61	2.07	215.62	57.02	90.82
14577	8.92	12.07	9.39	145.60	94.06	96.64
14937	1.91	3.05	3.38	201.07	60.60	48.32
2587	9.02	12.07	10.08	161.01	77.82	93.50
15251	3.38	4.69	10.08	117.19	59.64	61.74
2920	8.14	7.97	5.88	140.92	66.64	90.15
2571	7.74	8.79	6.86	153.54	64.24	85.23
16507	9.51	11.25	12.86	155.71	91.11	87.46
19564	9.74	10.43	13.78	166.40	90.80	90.37
8683	0.49	3.05	0.27	102.34	35.99	28.19
16865	1.28	3.87	0.36	139.52	36.93	55.25
15210	2.53	3.87	0.89	102.34	43.51	57.49
10252	2.43	4.69	0.36	212.04	28.39	67.33
15435	2.43	4.69	1.48	214.07	32.99	68.23
6625	4.10	7.15	2.07	200.88	45.07	77.62
11294	5.61	8.79	6.96	168.74	76.82	73.37
19667	3.28	4.69	4.07	169.75	40.00	49.88
19930	5.02	3.87	5.09	132.72	35.59	69.35
13445	5.74	7.97	8.67	165.69	53.98	62.63

[1]Track direction at closest 2-hour track position to Seabrook.
[2]Wind Risk Tech (WRT) maximum 1-minute wind speed at closest 2-hour track position to Seabrook, does include translational velocity.
[3]NOAA Technical Report NWS23 maximum 10-minute wind speed at Seabrook interpolated to a 15 minute time step, does include translational velocity.

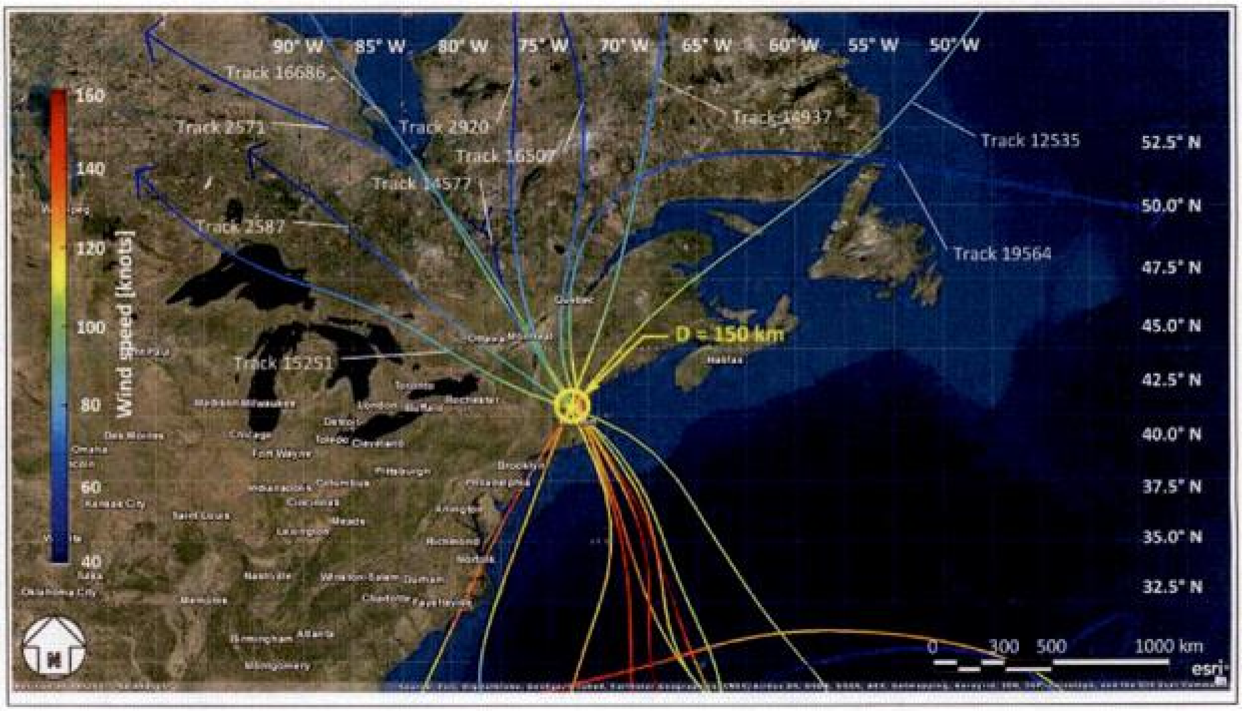

Figure 3 Track Set with Maximum Wind Speeds Near Seabrook (Source: FHRR, Figure 4-42)

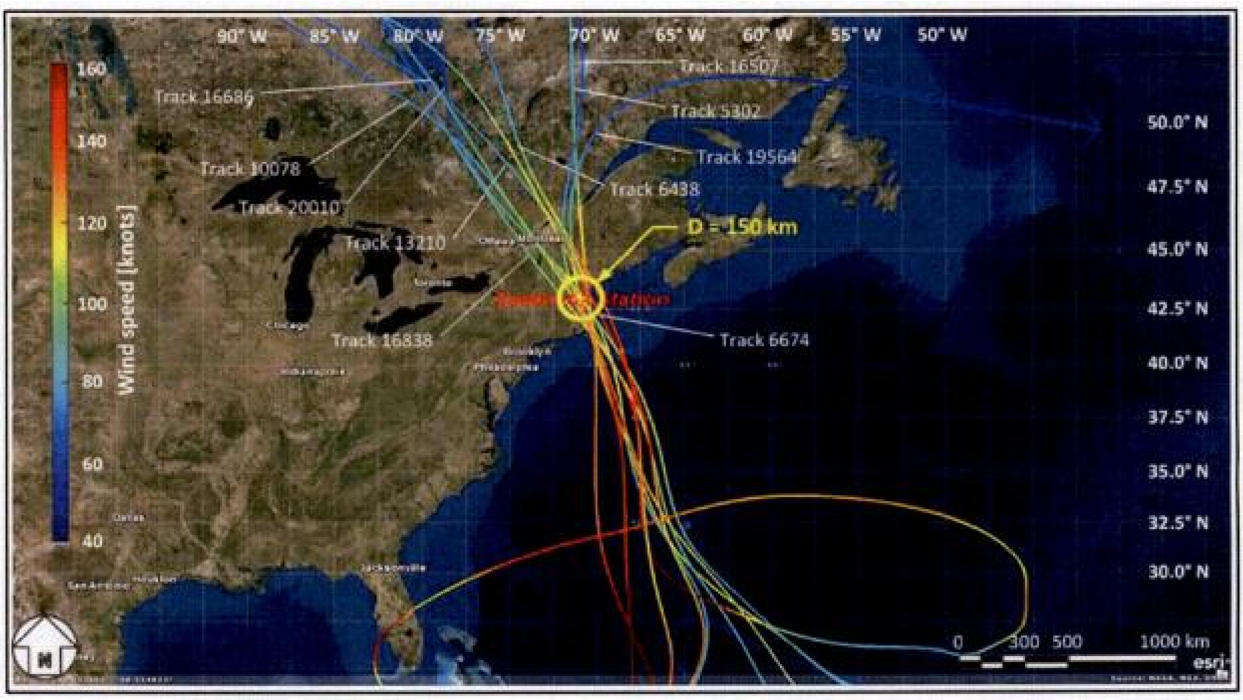

Figure 4 Tracks Set Producing Maximum Storm Surge with SLOSH model at Seabrook (Source: FHRR, Figure 4-43)

3.0 Probable Maximum Wind Storm.

Information Submitted by NextEra

NextEra cited Nuclear Regulatory Commission (NRC) guidelines "ANSI/ANS (1992) Section 7.2.2.1 and NRC (2013a) Section 3.2.2 for the area in the vicinity of the site" that states "the PMSS and seiche are calculated from the PMWS [probable maximum wind storm]." NextEra also cited that "ANSI/ANS (1992) Section 7.2.2.3.1 further indicates that parameters of the PMWS should be determined by a meteorological study." Following these guidelines, NextEra conducted a site-specific northeaster climatological study for Seabrook including an extensive data search. The northeaster climatological study results provided Seabrook site's PMWS wind speed, wind direction, and pressure values. NextEra described the data search as follows (FHRR, Sec. 4.4.9.1.1):

> A comprehensive search was conducted to identify significant synoptic storms, generally referred to as Nor'easters in the region, some of which combine with remnant tropical systems that impacted the region around Seabrook. Among the sources used in this search are the NWS forecast offices in the region, National Center for Environmental Prediction (NCEP) (2014), NOAA's Earth System Research Laboratory (ESRL) 3/6 Hourly 20th century reanalysis data composites website (NOAA, 2014l), the NOAA ESRL 6-Hourly NCEP/ National Center for Atmospheric Research (NCAR) reanalysis data composites (NOAA, 2014q), NOAA ESRL 3-Hourly NCEP North American Regional Reanalysis (NARR) (NOAA, 2014n), National Climatic Data Center (NCDC) storm archives (NCDC, 2014), and the Storm Prediction Center (SPC) severe storm reports (NOAA, 2014o). Additional storm cases are recorded by numerous refereed journal articles and research papers (e.g., Armstrong, 2013; Blake et al., 2012; Burt, 2012; Cooperman and Rosendal, 1963; Halverson and Rabenhorst, 2013; Hayden, 1889; McQueen et al., 1956). These storms are selected because of their historic impacts in the region, as well as their meteorological significance, including record-breaking high winds and/or low pressure readings.

Table 4 shows the 35 potential northeaster storms that the above-described storm search produced. After gridded data analysis, Table 5 shows a subset of the storms listed in Table 4 that "produced the highest wind speeds and lowest pressures at one or more analysis periods for a given direction" and thus were used for Delft3D model input. "The latitude and longitude listed in the tables represent the location of the grid with the highest wind speed from a given direction" (FHRR, Sec. 4.4.9.1.1).

Table 6 to Table 9 show the highest wind speeds and the pressures generated in the northeaster climatology study. NextEra evaluated "extreme wind events which produced the highest wind speeds and greatest pressure gradients over the entire period of record of a large region" that were considered "transpositionable" to the Seabrook site. So "all wind and pressure data associated with each event were shifted so that the theoretical storm occurred directly over the Seabrook site or in a location which would produce the worst case-yet physically possible scenario and therefore maximizes potential storm surge." NextEra assumed "the combination of extremely rare wind and pressure events over a large region of transpositionability to the site" produced representative PMWS data.

Table 4 Summary of Squall Line Storms Identified in the Storm Search Analysis
(Source: FHRR, Table 4-30)

Year	Month	Lowest Pressure (mb)	Observed Storm Surge (feet)	Peak Gusts Direction	Peak Gusts Speed (mph)
2013	2	968	4.21		89
2012	10	945.5	9.45	E	90
2011	10	971		NW	69
2010	3	993		N	75
2009	11	992	7.70	NE	74
2007	4	969	5.00	E	156
2006	11	944	9.87		80
2006	10	992	3.76		
2002	12	975		NW	45
1998	2	983.4	4.90		81/74
1997	3	979		NE	73
1996	1	980		NE	81
1996	10				81
1994	12	970			88/100
1993	3	961	12.00	E	144/109/101
1992	12	985	7.20	E	67/80
1991	10	972	5.11	NE	78
1987	3	980		NE	63
1987	2	964			
1984	3	963	7.00		97/108
1983	2	996			25
1978	2	984	4.34		93
1969	12	976		SE	100/80
1964	1	982			
1962	3	990	7.00	NE	70
1961	1	964	4.50	NW	131
1960	3	960		E	94
1956	4		4.60	N	70
1956	1	980	4.00	SE	123
1950	11	978		E	160/140
1940	2	974.9	3.69	N	96
1940	2		3.69		
1932	3	970.2			
1909	12				72
1888	3	980		NW	85

Table 5 Summary of Synoptic Storms Used for Delft3D Model Input
(Source: FHRR, Table 4-31)

Storm	Date	Time (3hr)	Direction	Longitude	Latitude	Pressure MSL (Pa)
Feb 13-15, 1940	15-Feb	0z	E	-70.95	42.95	983.936
Jan 8-12, 1956	9-Jan	18z	E	-58.35	45.05	1022.14
Feb 4-8, 1978	7-Feb	18z	E	-55.65	43.85	1010.97
Feb 6-10, 2013	8-Feb	21z	E	-67.95	40.55	1010.89
Mar 5-9, 1962	7-Mar	6z	ENE	-67.05	40.25	1002.29
Nov 21-25, 2006	21-Nov	21z	ENE	-74.85	36.35	1020.39
Feb 6-10, 2013	9-Feb	0z	ENE	-68.25	42.65	1013.02
Nov 25-29, 1950	26-Nov	0z	ESE	-67.65	40.25	1015.57
Dec 25-29, 1969	28-Dec	0z	ESE	-61.05	45.05	1003.05
Mar 30-Apr 2, 1987	2-Apr	0z	ESE	-58.95	47.15	1024.4
Oct 28-Nov 1, 1991	30-Oct	0z	N	-64.35	40.25	1007.27
Mar 30-Apr 2, 1997	2-Apr	6z	N	-69.45	38.18	1006.55
Mar 5-9, 1962	8-Mar	12z	NE	-64.65	39.35	1002.12
Oct 28-Nov 1, 1991	29-Oct	12z	NE	-60.45	43.85	1011.22
Mar 30-Apr 2, 1997	1-Apr	0z	NE	-70.95	42.95	1000.09
Nov 21-25, 2006	22-Nov	0z	NE	-75.75	36.95	1021.02
Nov 21-25, 2006	21-Nov	12z	NNE	-78.75	33.05	1017.23
Feb 6-10, 2013	9-Feb	12z	NNE	-69.15	43.25	996.899
Feb 6-10, 2013	10-Feb	0z	NNW	-68.25	42.05	1005.93
Feb 13-15, 1940	15-Feb	12z	NW	-68.25	35.75	988.201
Jan 6-9, 1996	6-Jan	9z	NW	-61.95	38.75	1010.86
Mar 12-15, 1993	14-Mar	9z	S	-56.25	41.45	1009.15
Dec 25-29, 1969	27-Dec	12z	SE	-62.25	41.15	1002.89
Dec 22-26, 1994	23-Dec	12z	SE	-64.35	37.25	1008.51
Apr 14-18, 2007	16-Apr	12z	SE	-66.45	40.25	993.673
Mar 30-Apr 2, 1987	31-Mar	15z	SSE	-66.75	42.68	1015.86
Apr 14-18, 2007	16-Apr	6z	SSE	-68.55	37.55	992.539
Feb 6-10, 2013	8-Feb	15z	SSE	-72.15	35.15	1005.99
Mar 30-Apr 2, 1997	30-Mar	15z	SSW	-60.45	38.45	1009.73
Feb 13-15, 1940	15-Feb	6z	SW	-65.25	37.85	978.685
Mar 12-15, 1993	13-Mar	18z	SW	-78.75	30.95	988.817
Feb 13-15, 1940	15-Feb	0z	W	-70.05	36.05	983.782
Dec 25-29, 1969	29-Dec	0z	WNW	-67.35	36.05	1005.34
Feb 6-10, 2013	8-Feb	0z	WNW	-59.55	47.15	1021.31

Table 6 Highest 3-Hour Average Wind Speeds from 0° to 180° Compared to the Return Frequency 3-Hour Average Wind Speed Climatology at Portland (Source: FHRR, Table 4-34)

Storm Date	Date of Occurrence	UTC Time of Observation	Direction	3-Hr Average Wind Speed (m/s)	Equivalent Return Frequency
Oct 28-Nov 1, 1991	30-Oct	0000	North	29.9	1000 year
Oct 28-Nov 1, 1991	29-Oct	1200	Northeast	33.2	> 1000 year
Feb 6-10, 2013	8-Feb	2100	East	25.3	200 year
Apr 14-18, 2007	16-Apr	1200	Southeast	27.4	500 year
Mar 12-15, 1993	14-Mar	900	South	30.2	> 1000 year

Table 7 Highest 6-Hour Average Wind Speeds from 0° to 180° Compared to the Return Frequency 6-Hour Average Wind Speed Climatology at Portland (Source: FHRR, Table 4-35)

Storm Date	Date of Occurrence	UTC Time of Observation	Direction	6-Hr Average Wind Speed (m/s)	Equivalent Return Frequency
Mar 5-9, 1962	7-Mar	0600	Northeast	29.2	> 1000 year
Dec 25-29, 1969	28-Dec	0000	East	29.9	200 year
Dec 25-29, 1969	27-Dec	1200	Southeast	31.3	> 1000 year

Table 8 Highest 3-Hour Average Wind Speeds from 180° to 360° Compared to the Return Frequency 3-Hour Average Wind Speed Climatology at Portland (Source: FHRR, Table 4-36)

Storm Date	Date of Occurrence	UTC Time of Observation	Direction	3-Hr Average Wind Speed (m/s)	Equivalent Return Frequency
Mar 12-15, 1993	13-Mar	1800	Southwest	28.3	>1000 year
Feb 6-10, 2013	8-Feb	0000	West	22.8	500 year
Jan 6-9, 1996	6-Jan	0900	Northwest	24.6	>1000 year

Table 9 Highest 6-Hour Average Wind Speeds from 180° to 360° Compared to the Return Frequency 6-Hour Average Wind Speed Climatology at Portland
(Source: FHRR, Table 4-37)

Storm Date	Date of Occurrence	UTC Time of Observation	Direction	6-Hr Average Wind Speed (m/s)	Equivalent Return Frequency
Feb 13-15, 1940	15-Feb	0600	Southwest	32.4	>1000 year
Feb 13-15, 1940	15-Feb	0000	West	32.1	>1000 year
Feb 13-15, 1940	15-Feb	1200	Northwest	30.1	>1000 year

Taylor Engineering Staff Technical Evaluation
NextEra provided sufficient detail about the development of the PMWS. NextEra has identified and described an acceptable PMWS.

4.0 Antecedent Water Levels.

Information Submitted by NextEra
NextEra used recorded maximum monthly tide elevations from NOAA's Portland, Maine (NOAA 8418150) tidal station to calculate the 10% exceedance high tide for the antecedent water levels. NextEra applied the Weibull plotting position to estimate a 10% exceedance high tide of 7.38 ft-NAVD88 (7.61 ft-MSL) and a normal distribution to estimate a 95 percent confidence interval of 7.26 to 7.49 ft-NAVD88 for the 10% exceedance high tide (see Table 10) (FHRR, Sec. 4.4.6.1).

Table 10 Select Stations Results for 10% Exceedance High and Low Confidence Tide Values
(Source: FHRR, Table 4-23)

Station ID	Station Name	Lower Limit 10% Exceedance High Tide (feet, NAVD88)	10% Exceedance High Tide (feet, NAVD88)	Upper Limit 10% Exceedance High Tide (feet, NAVD88)	Lower Limit 10% Exceedance Low Tide (feet, NAVD88)	10% Exceedance Low Tide (feet, NAVD88)	Upper Limit 10% Exceedance Low Tide (feet, NAVD88)
8418150	Portland, ME	7.260	7.375	7.490	-7.259	-7.141	-7.023
8443970	Boston, MA	7.201	7.323	7.444	-7.926	-7.806	-7.685

NextEra presented estimates of the sea level rise from many nearby stations between the end of 2013 and years 2030, 2050, and 2113 (see Table 11). NextEra selected the sea level rise rate at Boston, MA for the antecedent water level (AWL) estimation. Based on the estimated sea level rise rate at Boston station, NextEra estimates the sea level rise between the end of 2013 and 2030 at 0.16 ft, the end of 2013 and March of 2050 at 0.35 ft, and between the end of 2013 and 2113 at 0.96 ft (see Table 11) (FHRR, Sec. 4.4.6.2).

Table 11 Estimated Sea Level Rise (Source: FHRR, Table 4-24)

Station ID	Station Name	Record Period (years)	Approximate Distance to Seabrook (miles)	Sea Level Rise in 2030 (feet)	Sea Level Rise in 2050 (feet)	Sea Level Rise in 2113 (feet)
8443970	Boston, MA	1921 – 2012	38.9	0.16	0.35	0.96
8418150	Portland, ME	1912 – 2013	60.6	0.10	0.22	0.60
8454000	Providence, RI	1939 – 2013	80.4	0.16	0.35	0.96
8410140	Eastport, ME	1929 – 2013	237.8	0.12	0.26	0.72

Taylor Engineering Staff Technical Evaluation

Taylor Engineering staff added NextEra's three sea level rise rates to the 10% exceedance high tide of 7.38 ft-NAVD88, to calculate a total AWL of 7.54 ft-NAVD88 for the short-term period between the end of 2013 and years 2030; 7.73 ft-NAVD88 "in the event an extension of the current license is granted" for the period between the end of 2013 and years 2030; and 8.34 ft-NAVD88 for the long-term period between the end of 2013 and 2113.

To independently confirm NextEra's AWL calculation, Taylor Engineering staff used the Portland, Maine (NOAA 8418150) tidal station data to calculate a 10% exceedance high tide of 6.72 ft-NAVD88, an expected 50-year sea level rise of 0.34 ft, and a total AWL of 7.06 ft-NAVD88. Thus, the Taylor Engineering staff verified that NextEra provided a more conservative calculation of antecedent water levels.
NextEra used an acceptable antecedent water level for its surge analysis.

Table 12 provides the Taylor Engineering staff-estimated tidal datums from NOAA tidal gage Station 8418150 (Portland, ME) data.

Table 122 NOAA Station 8418150, Portland, ME Tidal Data and Seabrook Plant Datum

Station Name	**NOAA 8418150 – Portland, ME**
Latitude	43° 39.4' N
Longitude	70° 14.8' W
Tide Datum	**Elevation (ft-NAVD88)**
Mean Higher High Water (MHHW)	4.65
Mean High Water (MHW)	4.22
Mean Sea Level (MSL)	-0.31
Mean Tide Level (MTL)	-0.35
Mean Low Water (MLW)	-4.91
Mean Lower Low Water (MLLW)	-5.25
NGVD29	-0.72
Plant Datum	*NGVD*
Plant Datum Elevation	*-0.72*

5.0 Storm Surge Models

5.1 Surge Propagation Models

Information Submitted by NextEra

NextEra applied the two-dimensional depth-averaged Delft3D Version 4.00.01 model software package to simulate the storm surge. "In Delft3D-FLOW, the hydrodynamics of storm surge conditions are simulated by solving the Navier-Stokes equations for incompressible free surface flow. The Navier-Stokes equations are reduced to two-dimensional, depth-averaged flow with Delft3D-FLOW (Deltares, 2011c). The Navier-Stokes equations for incompressible flow are solved under the shallow water and Boussinesq assumptions" (FHRR, Sec. 4.4.3.1).

NextEra developed five Delft3D rectangular model grids for storm surge modeling — (a) one sufficiently large coarse domain "to ensure all potentially significant regions and features that could affect the storm surge results were captured and appropriate boundary conditions analyzed"; and (b) four refined grids located close to the Seabrook site. Model simulations used domain decomposition so the model "conveys the information from the coarse grid to provide boundary conditions for the finer grids, which will vary with time during the evolution of the simulation" (FHRR, Sec. 4.4.2).

NextEra applied a roughness value of 0.02 and 0.04 for deep ocean and nearshore, respectively. NextEra also applied 538 ft^2/s (50 m^2/s) in the overall model domain for horizontal eddy viscosity and horizontal eddy diffusivity (FHRR, Sec. 4.4.4.1).

NextEra stated that the following guidelines were followed during model grid development (FHRR, Sec. 4.4.2):

- *Size between adjacent cells should vary less than 20%,*
- *Orthogonality should be less than 0.2 for offshore areas, but as close to zero as possible,*
- *Smoothness between adjacent grid cell lengths is generally preferred to be less than 1.2 in the area of interest, and*
- *aspect ratio should be less than 2.*
- *Courant number should be less than* $4\sqrt{2} = \sim$*5.66.*

NextEra applied astronomical tidal components to describe a water level forcing at the model boundary during the storm surge model calibration phase.

Taylor Engineering Staff Technical Evaluation

After submittal of the original FHRR (September 2015), Taylor Engineering staff reviewed NextEra's Delft3D_FLOW model, and the parameters, data, and conditions used in the model. Review of the initial Delft3D_FLOW nested grid system indicated inconsistency in the most refined grid (site grid) location and bathymetry and topography features. Through the audit process and discussions with NextEra, the final Delft3D_FLOW simulations, within the revised FHRR (October 2016) applied a nested grid system with correction features for the most refined grid (site grid).

5.2 Wave Models

Information Submitted by NextEra

NextEra applied the Delft3D-WAVE Simulating WAVEs Nearshore (SWAN) model software package to simulate wave transformation. NextEra describes the SWAN model as "a spectral wave model that evaluates the refracted wave height and wave angle based on a spectrum of waves using linear wave theory (Booij et al., 1999; Deltares, 2011c). The SWAN model accounts for (refractive) wave propagation due to current and water depth and represents the physical processes of wave generation by wind, dissipation due to whitecapping, bottom friction, depth-induced wave breaking, and nonlinear wave-wave interactions (both quadruplets and triads) explicitly with state-of-the-art formulations. Wave blocking by currents is also explicitly represented in the model. The SWAN model is based on the discrete spectral action balance equation and is fully spectral (across all directions and frequencies). The latter implies that short-crested random wave fields propagating simultaneously from widely different directions can be accommodated (e.g., a wind sea with superimposed swell). SWAN computes the evolution of random, short-crested waves in coastal regions with deep, intermediate, and shallow water depths and ambient currents" (FHRR, Sec. 4.4.1).

"There are three generations of wave models available to compute the sea surface state in Delft3D-WAVE (i.e., SWAN) (Deltares, 2011e). First generation wave models do not consider nonlinear wave interactions. Second generation models parameterized these interactions and include the coupled hybrid and coupled discrete formulations. Third generation models explicitly represent all the physics relevant for the development of the sea state in two dimensions, without assumptions regarding the spectral space. Further, energy terms are described explicitly with the addition of bottom dissipation and reflection, diffraction, and refraction terms. For Seabrook, the model computes the sea state from the hurricane using the third-generation model.

The Delft3D-WAVE computations accounted for the following processes (Deltares, 2011e): depth-induced breaking, nonlinear triad interactions, bottom friction, wind growth, whitecapping, refraction and frequency shift" (FHRR, Sec. 4.4.3.2).

NextEra applied the Delft3D-FLOW and Delft3D-WAVE modules "to simulate the coupled effects of flow movement (i.e., storm surge) and wave propagation (i.e., wave spectra, height, period, and setup) through a water body when acted upon by external forcing functions (i.e., wind and atmospheric pressure fields)." The coupling allowed for the accounting of "the effect of flow on the waves (via setup, current refraction, and enhanced bottom friction) and the effect of waves on current (via forcing, enhanced turbulence, and enhanced bed shear stress)." The coupling of the Delft3D-FLOW and Delft3D-WAVE models occurred every 30 min throughout the simulation (FHRR, Sec. 4.4.3.3).

In the SWAN model, NextEra opted to apply (1) wave growth from wind field, white capping process of energy dissipation, and wave nonlinear interaction; (2) depth-induced shoaling and refraction in the model and current-induced shoaling; (3) a vegetation based roughness of 0.0628 m for use in wind-wave modeling "to most accurately represent wave growth within Hampton harbor"; and (4) a constant ratio of breaking wave height to breaking wave depth of 0.73 (FHRR, Sec. 4.4.4.2).

Taylor Engineering Staff Technical Evaluation

The Delft3D-WAVE model applied the same nested grids as the Delft3D-FLOW model so the comments in the Taylor Engineering staff technical evaluation comments in Section 5.1 also pertain to the Delft3D-WAVE model grids. Through the audit process and discussions with

NextEra, the final Delft3D_FLOW simulations applied a nested grid system with correction features for the most refined grid (site grid).

5.3 Topography and Bathymetry

Information Submitted by NextEra
NextEra obtained (1) the coastal bathymetry data from the Generalized Bathymetric Charts of the Ocean (GEBCO) project; (2) the 1/9 Arc Second (approximately 3 m) National Elevation Dataset (NED) from the U.S. Geological Survey (USGS) National Map Viewer; and (3) the local site bathymetry and topography from NOAA (1947, 1954, 1983) and USGS (2011b) (FHRR, Sec. 4.4.2).

Taylor Engineering Staff Technical Evaluation
As mentioned in the Taylor Engineering staff technical evaluation of Sections 5.1 and 5.2, the original FHRR submittal (September 2015) included bathymetry and topography features within the most refined nested grid (site grid) that did not align with existing bathymetry and topography features near the site. The revised FHRR (October 2016) contains Delft3D nested grids with bathymetry and topography features that align with existing features near the site.

6.0 Numerical Model Validation

Information Submitted by NextEra
NextEra selected Hurricane Bob (August 16 to 21, 1991) and Hurricane Donna (September 3 to 13, 1960) (see Figure 5) to provide data for calibration and verification of various Delft3D model parameters because (a) these hurricanes were both Category 2 on the Saffir-Simpson scale near Seabrook, (b) calibration data are available, and (c) the tracks of the storms are relevant to Seabrook (FHRR, Sec. 4.4.7.1.2).

NextEra reported the procedure for the Seabrook Delft3D-FLOW and Delft3D-WAVE model calibration and verification (FHRR, Sec. 4.4.7.1.3) "as follows:

- Selected a historical calibration event (Hurricane Bob) based on availability of observed storm surge data, the available resolution of the wind and pressure forcing data, and the magnitude of the event;
- Performed a series of sensitivity simulations of the wind drag coefficient for the calibration event;
- Performed a series of sensitivity simulations of the Manning's roughness coefficient for the calibration event.
- Ran the Hurricane Donna as validation to determine if the final calibration parameter values are acceptable for storm surge modeling."

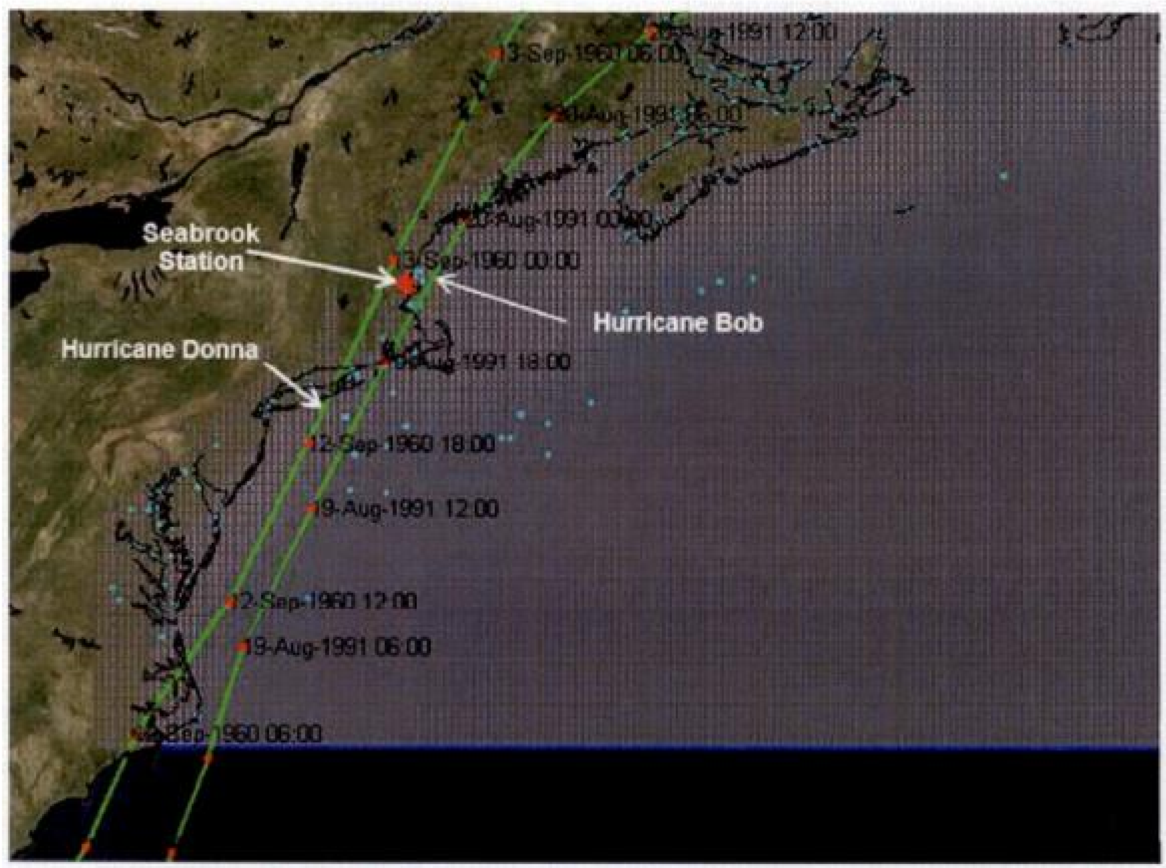

Figure 5 Tracks of Hurricane Bob and Hurricane Donna (Source: FHRR, Figure 4-25)

Based on the above procedure, NextEra judged model performance by comparing model simulated and observed values and computing for the Nash-Sutcliffe model quotient efficiency (NSE) and Root Mean Square Error (RMSE).

$$\boldsymbol{NSE = 1 - \sum_{t=1}^{n} \frac{\left(y_0^t - y_m^t\right)^2}{\left(y_0^t - y_{bar0}\right)^2}} \qquad \text{Equation 1}$$

$$\boldsymbol{RMSE = \sqrt{\frac{\sum_{t=1}^{n} \left(y_0^t - y_m^t\right)^2}{n}}} \qquad \text{Equation 2}$$

where t = time step;
n = total number of time steps;
y_0 = observed value;
y_m = simulated value; and
y_{bar0} = average of all observed values.

NextEra considered NSE values closer to 1 as indicative of better model performance and values closer to -∞ as indicative of poor model performance. “An NSE value of 0 suggests the model’s predictive power is equal to a model that simply reproduces the average of the observed time series. Numerical models producing an NSE value of 0 or less add no additional value. An NSE

value of 1 suggests an ideal model that has no error in reproduction of observed data. Values between 0 and 1 suggest that use of the model adds value to the prediction; however, the transformation is not ideal. The RMSE represents the sample standard deviation between simulated and observed values."

NextEra divided the model calibration into two parts — tide calibration (Figure 6) and surge (Figure 7) calibration. NextEra provided a tide calibration RMSE of 0.214 m and an NSE of 0.957 based on comparison with measured tides at the Portland Station. Comparisons of modeled and observed peak storm surge elevations show an R^2 (coefficient of determination) of 0.9081 (for Hurricane Bob) and 0.4694 (for Hurricane Donna). Notably, an $R^2 = 0$ indicates the modeled peak storm surge elevations do not fit the data and an $R^2 = 1$ indicates the modeled peak storm surge elevations perfectly fit the data. Tables 13, 14, and 15 provide summaries of the Delft3D-FLOW model tide and model surge calibration and Delft3D-Wave model surge calibration. Tables 16 and 17 show the comparison of model simulated and observed peak surge for model calibration (Hurricane Bob) and model verification (Hurricane Donna).

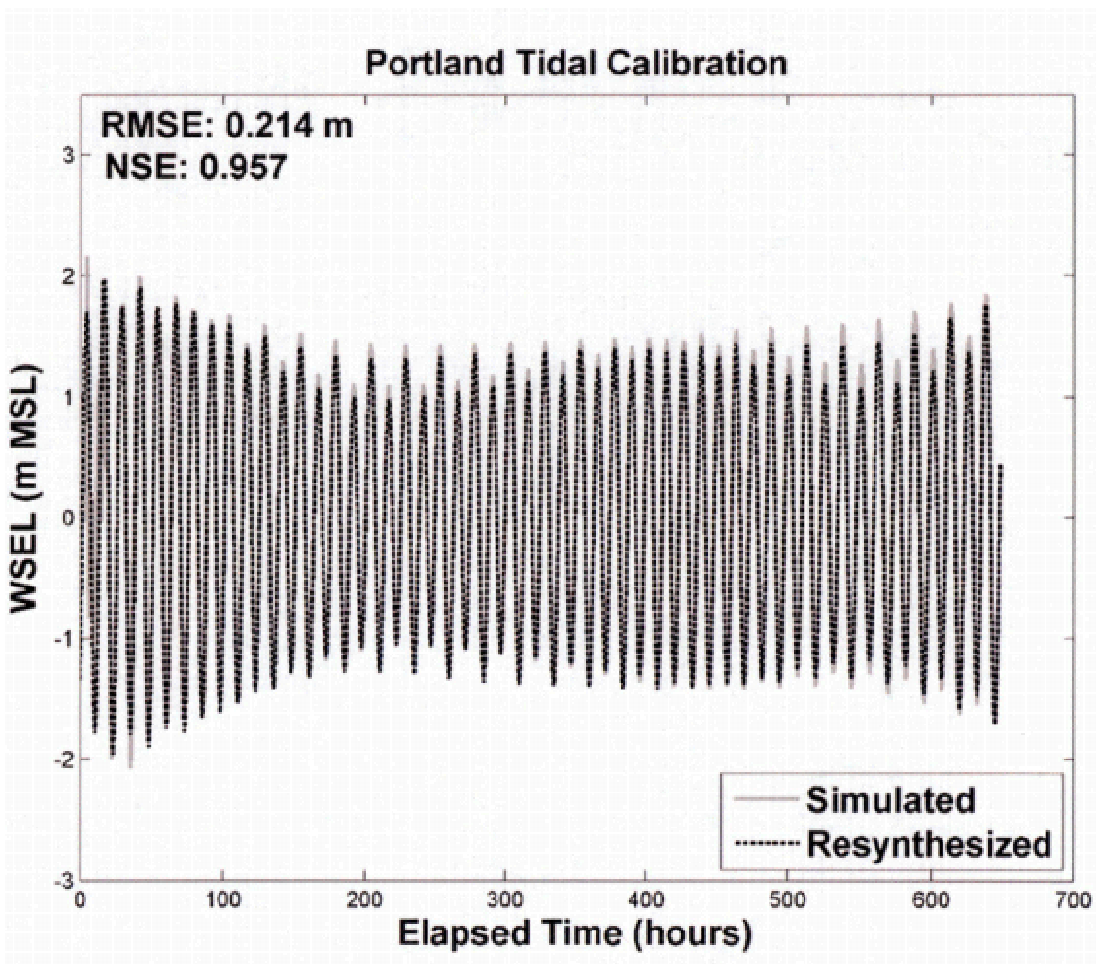

Figure 6 Resynthesized and Simulated Water Level Comparison, Portland, ME
(Source: FHRR, Figure 4-27)

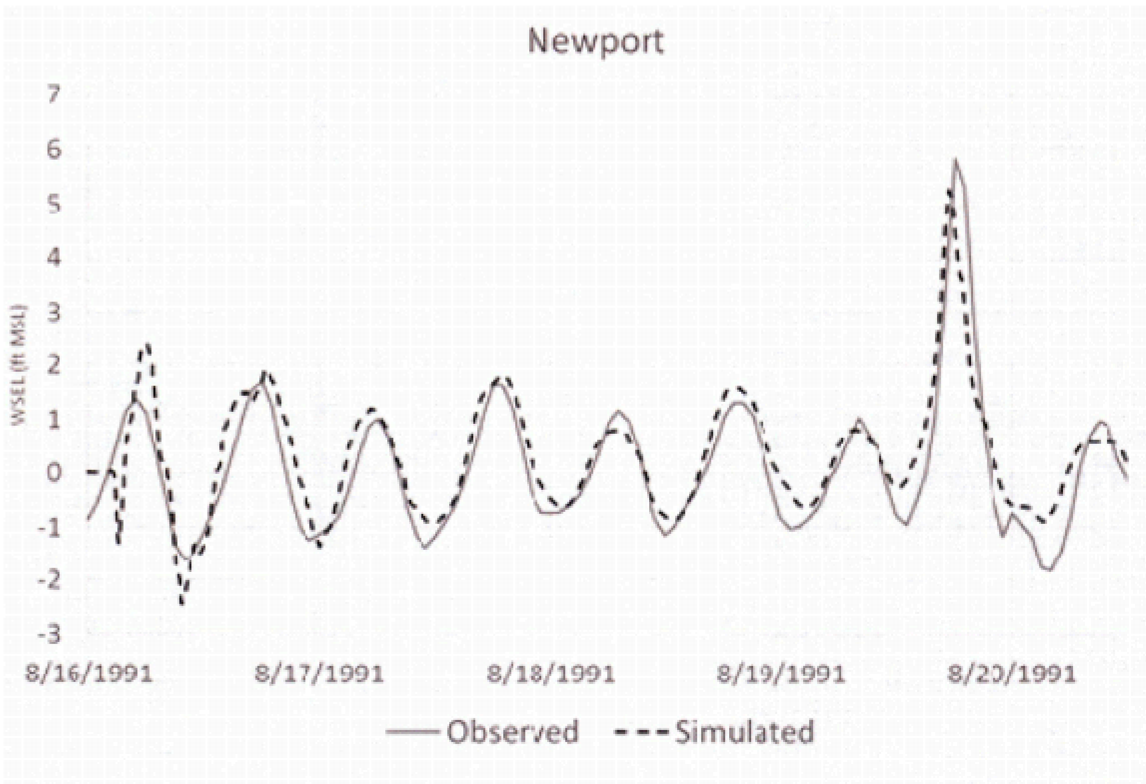

Figure 7 Delft3D Simulated and Observed Time Series Storm Surge Comparison at Newport (RI) during Hurricane Bob (Source: FHRR, Figure 4-27)

Table 13 Summary of Parameters for Delft3D-FLOW Model Tide Calibration
(Source: FHRR, Table 4-25)

Grid Parmeters	Grid 1 (Overall Grid): Initial Parameters	Grid 1 (Overall Grid): Final Parameters
Grid Type	Rectangular	Rectangular
Grid Cell Size	5 km	5 km
Grid Cells M Direction	543	543
Grid Cells N Direction	353	353
Reference Datum	Mean Sea Level (MSL)	Mean Sea Level (MSL)
Coordinate System	Spherical - Projected WGS 1984	Spherical - Projected WGS 1984
Number of Layers	One Layer for Depth-Averaged Computations	One Layer for Depth-Averaged Computations
Thin Dams	None Specified	None Specified
Dry Points	None Specified	None Specified
Time Step	0.2 Minute (12 seconds)	0.2 Minute (12 seconds)
Physical Processes Modelled	Tidal Forces	Tidal Forces
Initial Condition Water Level	Uniform at 0 meters	Uniform at 0 meters
Open Boundary Conditions	Water Levels	Water Levels
Boundary Conditions Type	Atmospheric Forcing using Tidal Constituents	Atmospheric Forcing using Tidal Constituents
Number of Boundary Conditions	10 on the North Boundary 35 on the East Boundary 52 on the South Boundary	10 on the North Boundary 35 on the East Boundary 52 on the South Boundary
Open Boundary Condition Reflection Coefficient	0 s^2	0 s^2
Gravitational Acceleration	9.81 m/s^2	9.81 m/s^2
Water Density	1025 kg/m^3	1025 kg/m^3
Air Density	N/A	N/A
Wind Drag Coefficient Break Points	N/A	N/A
Bottom Roughness	Spatially Uniform Manning's (0.02)	Spatially distributed [0.02, 0.04]
Stress formulation due to wave forces	N/A	N/A
Wall Roughness Slip Condition	Free Slip	Free Slip
Eddy Viscosity/Diffusivity	Uniform at 50 m^2/s	Uniform at 50 m^2/s
Drying and Flooding Check at	Grid Cell Centers and Faces	Grid Cell Centers and Faces
Depth Specified at	Grid Cell Corners	Grid Cell Corners
Depth at Grid Cell Centers	Max	Max
Depth at Grid Cell Faces	Mean	Mean
Advection Scheme for Momentum	Cyclic	Cyclic
Threshold Depth	0.0126 meters	0.0126 meters
Marginal Depth	None	None
Smoothing Time	60 minutes	60 minutes
Threshold Depth for Critical Flow Limiter	N/A	N/A

Table 14 Summary of Parameters for Delft3D-FLOW Model Storm Surge Calibration (Source: FHRR, Table 4-26)

Grid Parmeters	Grid 1 (Overall Grid): Initial Parameters	Grid 1 (Overall Grid): Final Parameters
Grid Type	Rectangular	Rectangular
Grid Cell Size	10.5 km	10.5 km
Grid Cells M Direction	543	543
Grid Cells N Direction	353	353
Reference Datum	Mean Sea Level (MSL)	Mean Sea Level (MSL)
Coordinate System	Spherical - Projected WGS 1984	Spherical - Projected WGS 1984
Number of Layers	One Layer for Depth-Averaged Computations	One Layer for Depth-Averaged Computations
Thin Dams	None Specified	None Specified
Dry Points	None Specified	None Specified
Time Step	1 Minute (60 seconds)	1 Minute (60 seconds)
Physical Processes Modelled	Wind, Tidal Forces	Wind, Tidal Forces
Initial Condition Water Level	Uniform at 0 meters	Uniform at 0 meters
Open Boundary Conditions	Astronomic Water Levels	Astronomic Water Levels
Boundary Conditions Type	Atmospheric Forcing using Tidal Constituents	Atmospheric Forcing using Tidal Constituents
Number of Boundary Conditions	10 on the North Boundary 35 on the East Boundary 52 on the South Boundary	10 on the North Boundary 35 on the East Boundary 52 on the South Boundary
Open Boundary Condition Reflection Coefficient	0 s^2	0 s^2
Gravitational Acceleration	9.81 m/s^2	9.81 m/s^2
Water Density	1025 kg/m^3	1025 kg/m^3
Air Density	1.229 kg/m^3	1.229 kg/m^3
Wind Drag Coefficient Break Points	A – 0.00063 at 0 m/s B – 0.00327 at 40 m/s C – 0.00327 at 100 m/s	A – 0.00063 at 0 m/s B – 0.00403 at 40 m/s C – 0.00403 at 100 m/s
Wind Speed Averaging Interval	1 minute	10 minutes
Bottom Roughness	Spatially distributed [0.02, 0.04]	Spatially distributed [0.02, 0.04]
Stress formulation due to wave forces	Fredsoe	Fredsoe
Wall Roughness Slip Condition	Free Slip	Free Slip
Eddy Viscosity/Diffusivity	Uniform at 50 m^2/s	Uniform at 50 m^2/s
Wind	Space Varying Wind and Pressure	Space Varying Wind and Pressure
Drying and Flooding Check at	Grid Cell Centers and Faces	Grid Cell Centers and Faces
Depth Specified at	Grid Cell Corners	Grid Cell Corners
Depth at Grid Cell Centers	Max	Max
Depth at Grid Cell Faces	Mean	Mean
Advection Scheme for Momentum	Cyclic	Cyclic
Threshold Depth	0.0126 meters	0.0126 meters
Marginal Depth	None	None
Smoothing Time	60 minutes	60 minutes
Threshold Depth for Critical Flow Limiter	N/A	N/A

Table 15 Summary of Parameters for Delft3D-WAVE Model Surge Calibration
(Source: FHRR, Table 4-27)

Grid Parmeters	Grid 1 (Overall Grid): Initial Parameters	Grid 1 (Overall Grid): Final Parameters
Grid Type	Rectangular	Rectangular
Grid Cell Size	10.5 km	10.5 km
Grid Cells M Direction	543	543
Grid Cells N Direction	353	353
Reference Datum	Mean Sea Level (MSL)	Mean Sea Level (MSL)
Coordinate System	Spherical - Projected WGS 1984	Spherical - Projected WGS 1984
Spec. Res. N Directions	36	36
Lowest Freq.	0.05 Hz	0.05 Hz
Highest Freq.	1 Hz	1 Hz
N bins	24	24
Boundary – sig. wave height	1 m	n/a
Boundary – Peak period	2 s	n/a
Boundary (nautical)	East (90 degree), North (0 degree), South (180 degree)	n/a
Boundary - Directional Spreading	4	n/a
Gravity	9.81 m/s^2	9.81 m/s^2
Water density	1025 kg/m^3	1025 kg/m^3
North with respect to x-axis	90 (deg)	90 (deg)
Minimum depth	0.05 (m)	0.05 (m)
Generation Model	3rd generation	3rd generation
Depth-induced breaking alpha	1	1
Depth-induced breaking gamma	0.73	0.73
Nonlinear triad interactions alpha	0.1	0.1
Nonlinear triad interactions beta	2.2	2.2
Bottom friction type	JONSWAP	Madsen
JONSWAP Coefficient	0.067 m^2/s^3	0.0628 m[(1)]
Wind Growth	Activated	Activated
Whitecapping	Komen et al.	Komen et al.
Wave Propagation – Refraction	Activated	Activated
Wave Propagation – Frequency Shift	Activated	Activated
Computional mode	Stationary with 30 min coupling interval	Stationary with 30 min coupling interval
Directional space scheme	0.5	0.5
Frequency space scheme	0.5	0.5
Relative Change Hs-Tm01	0.02	0.02
Percentage wet criteria	98%	98%
Relative Change Hs	0.02	0.02
Relative Change TM01	0.02	0.02
N Iterations	10	30

[1] Model files (Bob and Donna) were run using the JONSWAP parameterization, final bottom friction type and coefficient based on the literature review for Hampton Harbor and seagrass roughness.

Table 16 Comparison of Observed and Simulated Peak Storm Surge Elevations for Hurricane Bob (Source: FHRR, Table 4-28)

Location	Observed Peak Surge (ft-MSL)	Simulated Peak Surge (ft-MSL)	Bias (ft)
Sandy Hook	3.54	4.11	0.57
Atlantic City	2.75	2.48	-0.27
Newport	5.85	5.29	-0.56
Bar Harbor	5.57	5.54	-0.03
Woods Hole	5.8	5.33	-0.47

Table 17 Comparison of Observed and Simulated Peak Storm Surge Elevations for Hurricane Donna (Source: FHRR, Table 4-29)

Location	NOAA Station ID	Observed Peak Surge (ft-MSL)	Simulated Peak Surge (ft-MSL)	Bias (ft)
Boston	8443970	5.99	6.83	+0.84
Sandy Hook	8531680	7.31	8.15	+0.84
Atlantic City	8534720	4.63	6.34	+1.71
Newport	8452660	4.77	5.58	+0.81
Woods Hole	8447930	4.70	4.28	-0.42
Portland	8418150	6.00	4.87	-1.13

Taylor Engineering Staff Technical Evaluation
NextEra's model-predicted high water levels reasonably approximated observed levels and present an acceptable validation of the models at select locations. NextEra did not provide indications on model performance near the Seabrook site; due to a lack of measured high storm surge levels near the site during historical tropical or extra-tropical storms.

7.0 Numerical Model Error and Uncertainty

Information Submitted by NextEra
For numerical model error, NextEra provided a tidal calibration RMSE of 0.214 m and an NSE of 0.957 based on comparison with measured tides at the Portland Station. Comparisons of modeled and observed peak storm surge elevations show an R^2 (coefficient of determination) of 0.9081 (for Hurricane Bob) and 0.4694 (for Hurricane Donna). Notably, an $R^2 = 0$ indicates the modeled peak storm surge elevations do not fit the data and an $R^2 = 1$ indicates the modeled peak storm surge elevations perfectly fit the data.

For model uncertainty, NextEra performed a series of sensitivity simulations for the model wind drag coefficient and Manning's roughness coefficient during the model calibration. However, the FHRR did not present the results of the sensitivity simulations and did not indicate how these model parameters change water elevations at the Seabrook site.

Taylor Engineering Staff Technical Evaluation
NextEra provided information on the error associated with the tide analysis and provided comparisons of measured water levels for locations relatively near to the site during strong

storms. NextEra did not present detailed and specific information on how modeling error and uncertainty was incorporated in the modeling processes.

8.0 Storm Surge Water Levels.

8.1 Deterministic Storm Surge Water Levels.

Information Submitted by NextEra
Table 5-1 in the revised FHRR (October 2016) contains the summary water levels for the PMSS analysis that applied the Delft3D-FLOW and 3D-WAVE model. The table contains maximum stillwater level for the combined events analysis (17.75 ft-NAVD88) and the maximum total water level including wave runup (23.35 ft-NAVD88). Revised FHRR Section 4.4.9.4 discusses the 17.75 ft-NAVD88 maximum stillwater level and documents the inclusion of a 4.0 ft sensitivity margin within the 17.75 ft-NAVD88 level. The FHRR states the 23.35 ft-NAVD88 total water level including wave runup occurs at the site seawall “away from site structures”. NextEra also provided the Seabrook site elevation of the top of the revetment (flood barrier) at 19.23 ft-NAVD88 (20.00 ft-Plant Datum) (FHRR, Sec. 4.4.9.4). Based on the simulated water levels and wave conditions, and knowing the site elevation, NextEra developed wave overtopping estimates summarized in revised FHRR Table 4-41 and Figure 4-46 that estimates an overtopping duration of approximately 4.5 hours under PMSS conditions.

Taylor Engineering Staff Technical Evaluation
The discussion below shows the results of Taylor Engineering staff independent storm surge simulations conducted to provide additional estimates of the deterministic PMH storm surge water levels near Seabrook. The independent simulations for Seabrook applied the SWAN+ADCIRC model to develop the water level and waves conditions near the Seabrook site. The simulations applied the SWAN+ADCIRC mesh developed for the New England region with detailed mesh areas for the Seabrook and Pilgrim nuclear sites. Taylor Engineering staff applied the mesh in a test simulation on Taylor Engineering’s high performance computer, “Merlin,” with Hurricane Sandy (2012) forcing that demonstrated the ability to reasonably reproduce measured values in the New England region.

The independent simulations applied time-varying, two-dimensional wind and pressure fields for tropical storms with varying parameters. Taylor Engineering staff developed the tropical storm parameter combinations to produce the Probable Maximum Intensity (PMI) storm conditions at PNPS. Table 18 presents the range of parameters tested in the initial sensitivity simulations. The site location, north of Cape Cod and interior of an inlet to the east of the site created a complex storm surge response at the site, which required examination of many storm track angles and landfall locations.

Table 18 Tropical Storm Parameters in ADCIRC Sensitivity Simulations

Central Pressure (mb)	920, 925
Radius to Maximum Winds (RMW) (nm)	30, 45
Forward Velocity (kt)	25, 40
Track Angle at Landfall (degrees counter-clockwise from north)	30, 10, 0, -10, -20, -30
Landfall Location (RMW from reference site; to west of point along Cape Cod south shoreline)	0, 0.25, 0.5, 1

The initial test simulations applied only the ADCIRC (hydrodynamic) model to expedite run times which allowed examination of storm surge sensitivity to the tropical storm parameters. Based on these results, the final simulations applied the SWAN+ADCIRC model, which couples the hydrodynamic model to a spectral wave model (SWAN) to include wave-induced water level effects near the site. Review of the refined simulation results showed angles at landfall of 0, 10, and 30 degrees counter-clockwise from north produced the highest water levels at the site. Due to the site location, several landfall location and storm track angle combinations created elevated storm surge levels at the site. The final simulations applied the parameter values and ranges listed in Table 19.

Table 19 Tropical Storm Parameters in SWAN+ADCIRC Final Simulations

Central Pressure (mb)	925
Radius to Maximum Winds (RMW) (nm)	45
Forward Velocity (kt)	25
Track Angle at Landfall (degrees counter-clockwise from north)	30, 10, 0
Distance from Site as Storm Track Passes (nm)	1, 7, 24

Review of FHRR Storm Surge Simulations

NextEra applied SLOSH and Delft3D models to estimate the PMSS at the site. Approximately 20,400 SLOSH storm surge simulations identified the combination of storm tracks and meteorological parameters that NextEra expects to cause the largest storm surge at Seabrook. NextEra completed more detailed simulations using 27 Delft3D-FLOW and Delft3D-WAVE models simulations to further evaluate the storms identified by the SLOSH model screening analysis that resulted in large surges at Seabrook. NextEra simulated PMWS and PMH storm conditions to calculate the PMSS. Table 5-1 in the revised FHRR (October 2016) contains the summary water levels for the PMSS analysis that applied the Delft3D-FLOW and 3D-WAVE model. The table contains maximum stillwater level for the combined events analysis (17.75 ft-NAVD88) and the maximum total water level including wave runup (23.35 ft-NAVD88). Revised FHRR Section 4.4.9.4 discusses the 17.75 ft-NAVD88 maximum stillwater level and documents

the inclusion of a 4.0 ft sensitivity margin within the 17.75 ft-NAVD88 level. The FHRR states the 23.35 ft-NAVD88 total water level including wave runup occurs at the site seawall “away from site structures”. Revised FHRR Section 2.2.9.5 states the runup at the seawall occurs approximately 20 m (66 ft) from any structures.

Comparison of FHRR and Independent Simulation Water Levels
The results from the independent simulations with the PMI forcing allow comparison of the FHRR PMSS water levels. Table 20 presents details of the final three independent simulations with comparisons to the FHRR PMSS water levels for the Seabrook site. Figure 8 shows the tracks for the final three independent simulations.

Table 20 contains a summary of the revised FHRR PMH water levels with information listed for antecedent water level, stillwater level, wave conditions, and total water level including wave runup. The FHRR PMH water levels show a stillwater level of 17.8 NAVD88-ft including the 4 ft sensitivity margin and a total water level of 23.4 ft-NAVD88 at the seawall away from the structures. The three right hand columns in Table 20 show results from the final three Taylor Engineering staff independent SWAN+ADCIRC simulations that applied PMH-level wind forcing at the site.[1] The Taylor Engineering independent simulations show stillwater levels near the site seawall that range from 17.8 to 20.6 ft-NAVD88; near the revised FHRR stillwater levels. The Taylor Engineering independent simulation results show total water levels, including wave runup, near the site that range from 19.6 to 21.3 ft-NAVD88. Notably, the revised FHRR Table 5-1 provides a total water level of 23.4 ft-NAVD88, but states this value occurs near the seawall and should not be deemed equal to the total water level near site structures.

With consideration of all information provided by NextEra in the original and revised FHRR documents, NextEra provided an acceptable PMSS within the revised FHRR.

[1] Note: Mentions of staff in this table refer to Taylor Engineering staff.

Table 20 **Summary of Water Levels at Site based on FHRR and** Taylor Engineering **Independent Simulations**

Parameter	Seabrook FHRR PMH (rev. FHRR, 10/2016)	Staff SWAN+ADCIRC Independent Run#1	Staff SWAN+ADCIRC Independent Run#2	Staff SWAN+ADCIRC Independent Run#3
Peripheral Pressure (mb)	Probabilistic Evaluation of Water Level, no specific PMH hurricane	1013	1013	1013
Central Pressure (mb)		925	925	925
Radius of Maximum Winds (NM)		45	45	45
Forward Speed (kt)		25	25	25
Angle at Landfall (deg CCW from N)		30	10	0
Landfall Location (first land)		70.51 W, 41.35 N	70.73 W, 41.34 N	70.83 W, 41.33 N
Distance as Track Passes Site		24.3 NM West of Site	6.6 NM West of Site	0.9 NM East of Site
10% Astronomical High Tide (ft-NAVD88)	7.38	6.71	6.71	6.71
Sea Level Rise (ft)[1]	0.2	0.34	0.34	0.34
Location	N/A	Marsh NE of Site	Marsh NE of Site	Marsh NE of Site
Revaluated Stillwater (ft-NAVD88) [FHRR Table 5-1]	17.8	20.6	18.9	17.8
FHRR Table 5-1 CDB Stillwater (ft-NAVD88)	14.8	14.8	14.8	14.8
Top of Revetment (Flood Protection) (ft-NAVD88) [FHRR Section 4.4.9.4]	19.23 top of revetment (flood barrier)	19.23 top of revetment (flood barrier)	19.23 top of revetment (flood barrier)	19.23 top of revetment (flood barrier)
Location	Seawall	Marsh NE of Site	Marsh NE of Site	Marsh NE of Site
Revaluated PMH SWAN Hs/Tm (ft/sec) [FHRR Section 4.4.9.4]	4.0/4.0	5.9/4.7	5.1/4.3	4.6/4.3
Location	Seawall/Site	Seawall/Site	Seawall/Site	Seawall/Site
Reevaluated Total Water Level (ft-NAVD88) [FHRR Table 5-1][2,3]	23.4 (at seawall)	21.3	19.9	19.6
FHRR Table 5-1 CDB Total Water Level (ft-NAVD88)	21.03 at site structure walls	21.03 at site structure walls	21.03 at site structure walls	21.03 at site structure walls

1) Apply projection for 50 years (remaining operating life of plant) for staff assessment of SLR

2) Staff total water level applies an average slope method (USACE CEM; small berm width structure) for Indep. Run #1 (negative freeboard)

3) Staff total water level applies an overtopping method (Van der Meer & Bruce (2014); volumetric based) for Indep. Runs #2/#3 (positive freeboard)

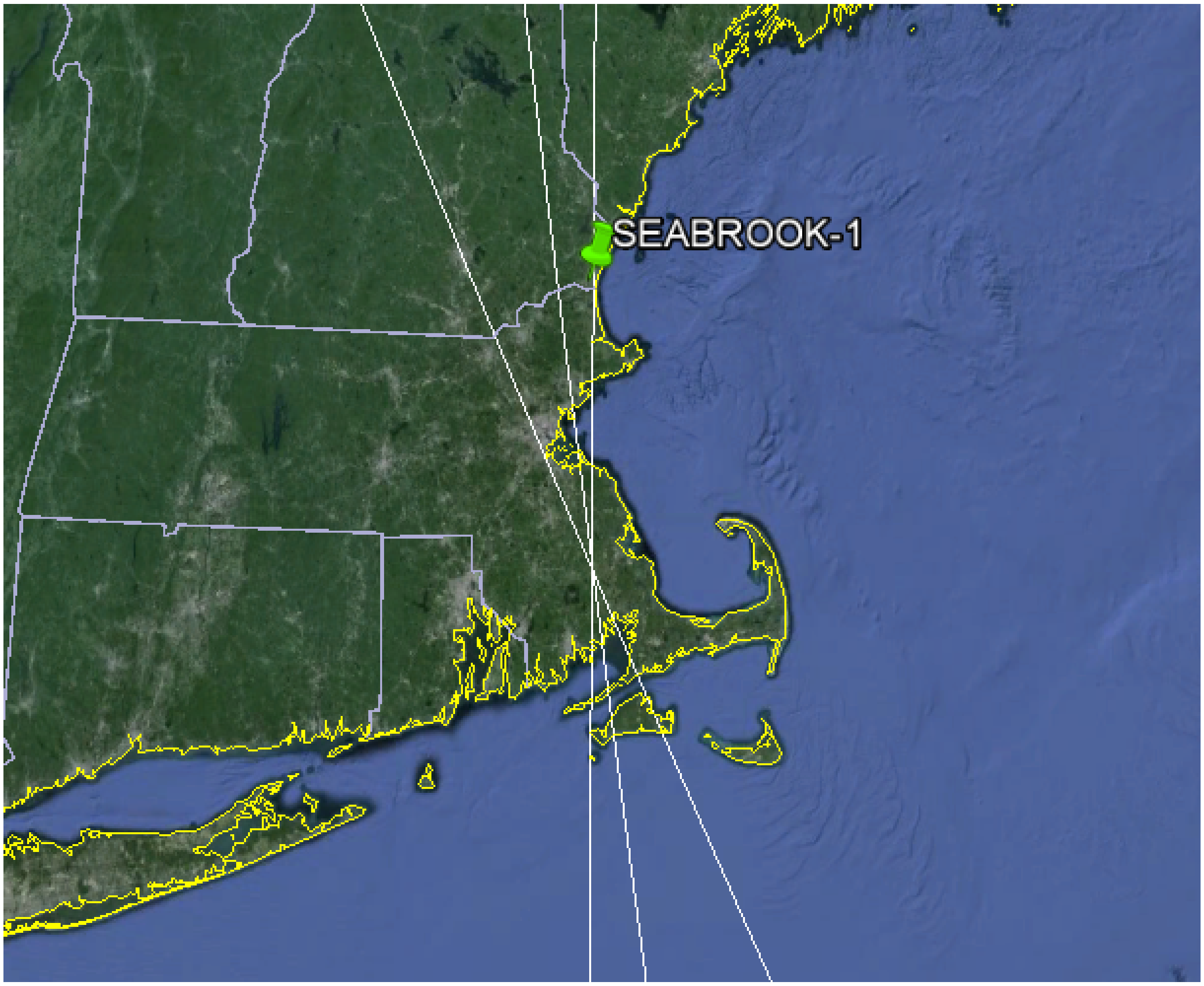

Figure 8 Storm Tracks for Top Three Storms in the Independent Analysis Water Levels

8.2 Probabilistic Storm Surge Water Levels.

Information Submitted by NextEra

NextEra's storm surge evaluation for the Seabrook site involved components that were probabilistically informed. The probabilistically-informed components of the approach focused on development and statistical analysis of synthetically derived data. Specifically, NextEra generated 20,400 synthetic storm tracks and used SLOSH to estimate surge heights for each storm track. Next, NextEra used Delft3D to generate refined surge heights for 27 of the 20,400 synthetic storm tracks. A statistical analysis (linear regression model) was used to define a relationship between SLOSH and Delft3D surge heights using the 27 synthetic results. The linear model was used to estimate "refined surge heights" for the remaining synthetic data points. Finally, NextEra performed a statistical analysis to fit a distribution to the synthetically derived surge data and to select the PMSS. Figure 2 provides an overview of NextEra's approach.

Taylor Engineering Staff Technical Evaluation

The Taylor Engineering staff performed an initial review of NextEra's probabilistically-informed approach, including performance of several initial sensitivity studies. As part of its initial review, Taylor Engineering staff identified several topics for which additional review or information was required. These topics related to NextEra's methodological approach for development of the aleatory model as well as consideration of epistemic uncertainties (including sensitivity of results to modeling decisions and assumptions). For example, topics included treatment of tides and sea level rise, storm parameter ranges and discretization used in generation of synthetic storm parameter sets, the approach used to assign return periods to wind speeds, the sufficiency of sample size for large surge events, the assumed linear relationship between SLOSH and Delft3D results, and the non-parametric approach used to fit a distribution to synthetic surge data.

In recognition of the uncertainty associated with the probabilistically-informed assessment as well as the sensitivity of results to various modeling decisions and assumptions, NextEra adjusted their probabilistically-informed PMSS elevation by adding a 4.00 ft "sensitivity factor." The resultant stillwater elevation was 17.8 ft-NAVD88. This stillwater elevation is generally consistent with the results of independent, deterministic assessments performed by the Taylor Engineering staff. As a result, the Taylor Engineering staff was able to conclude that the results of the assessment were reasonable and the Taylor Engineering staff did not perform detailed, further review of the probabilistically-informed assessment methodology.

9.0 Wave Runup, Inundation, and Drawdown.

Information Submitted by NextEra

As the PMH event produced a water surface elevation (WSEL) of 17.75 ft-NAVD88 and as the top of the revetment (flood barrier) elevation is at 19.23 ft-NAVD88, NextEra estimated the water depth, wave height, and wave period and applied the USACE Coastal Engineering Manual (USACE, 2011) to estimate a wave runup height of 5.6 ft (Figure 9). Adding the PMH-generated WSEL and wave runup height, NextEra provided the peak water surface elevation at 23.35 ft-NAVD88. NextEra stated that this "runup occurs at the vertical seawall section, approximately 20 m from any structures" (FHRR, Sec. 4.4.9.4).

Table 21 provides NextEra's estimated maximum flow depths and related velocities at select points of interest (POI) (see POIs in Figure 10 and Figure 11) resulting from overtopping waves. (FHRR, Sec. 4.4.9.6).

NextEra used the PMSS model and selected an observation point located "1 km past the Seabrook inlet, in the general area of the intake structures to ensure an accurate low water elevation" to estimate the drawdown from a PMSS. NextEra used the 10% exceedance low tide (see Table 10) and a constant 100 miles per hour wind at a constant direction of 270 degrees (nautical convention) to estimate a low water elevation of -21.42 ft-NAVD88 (-20.65 ft-Plant Datum) (FHRR, Sec. 4.13.2).

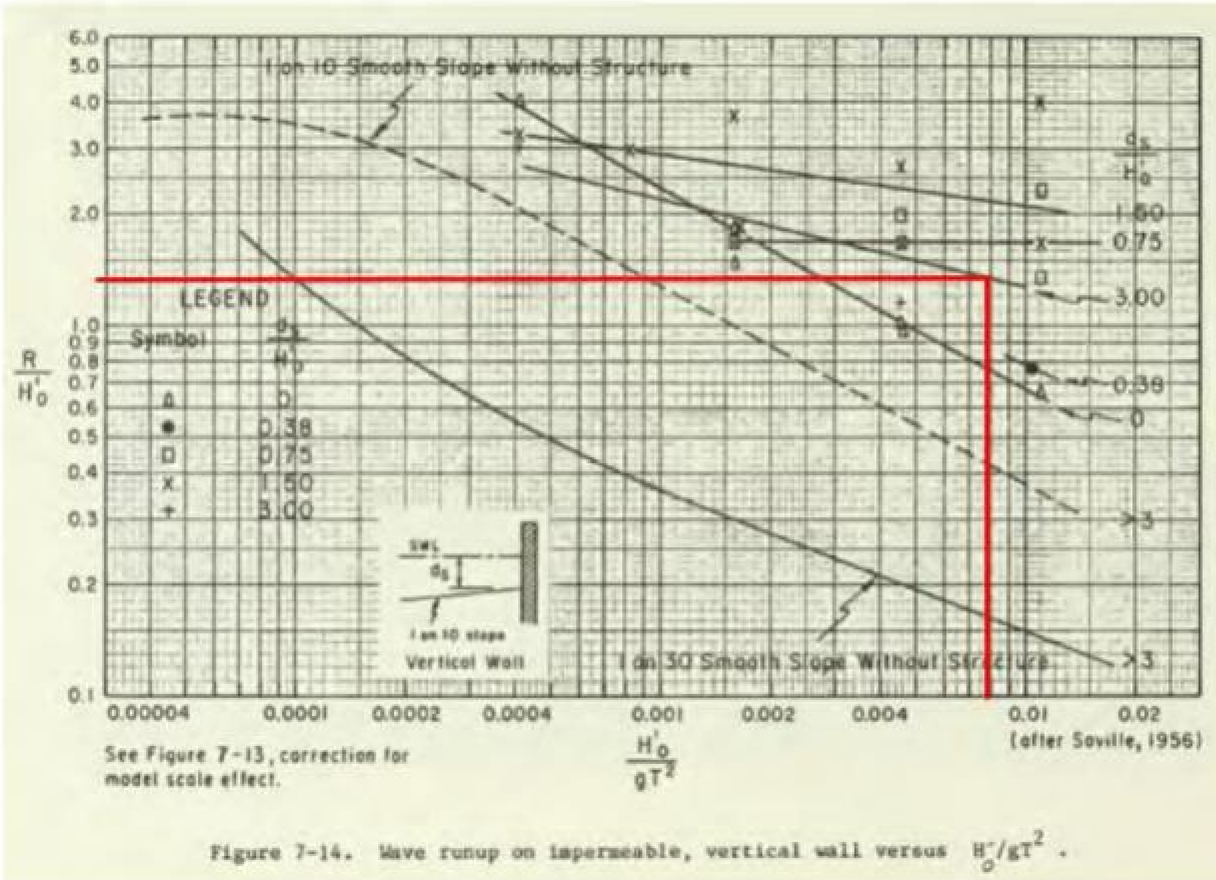

Figure 9 Wave Runup on Impermeable Vertical Wall (Source: FHRR, Figure 4-45, from USACE CEM)

Table 21 Wave Overtopping Maximum Flow Depths and Velocities (Source: FHRR, Table 4-41)

POI	North		South		Bounding	
	Depth(1) (ft)	Velocity (ft/s)	Depth(1) (ft)	Velocity (ft/s)	Depth(1) (ft)	Velocity (ft/s)
1	0.00	0.00	0.21	0.24	0.21	0.24
2	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.38	0.65	0.38	0.65
4	0.00	0.00	0.77	0.52	0.77	0.52
5	0.00	0.00	0.75	0.48	0.75	0.48
6	0.00	0.00	0.60	1.41	0.60	1.41
7	0.00	0.00	0.67	0.77	0.67	0.77
8	0.00	0.00	0.32	0.40	0.32	0.40
9	0.00	0.00	0.10	0.70	0.10	0.70
10	0.00	0.00	0.29	0.49	0.29	0.49
11	0.00	0.00	0.09	0.33	0.09	0.33
12	0.00	0.00	0.27	0.59	0.27	0.59
13	0.00	0.00	0.27	0.71	0.27	0.71
14	0.00	0.00	0.75	0.92	0.75	0.92
15	0.00	0.00	0.19	0.23	0.19	0.23
16	0.00	0.00	0.57	0.68	0.57	0.68
17	0.00	0.00	0.58	0.34	0.58	0.34
18	0.00	0.00	0.64	1.01	0.64	1.01
19	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.00	0.00
21	0.12	0.23	0.49	1.57	0.49	1.57
22	0.20	0.72	0.94	2.04	0.94	2.04
23	0.07	0.18	1.01	1.91	1.01	1.91
24	0.91	0.99	1.77	1.83	1.77	1.83
25	0.20	0.48	0.96	0.61	0.96	0.61
26	0.21	0.41	0.97	0.50	0.97	0.50
27	0.35	0.56	1.08	0.43	1.08	0.56
28	0.32	0.78	0.98	0.91	0.98	0.91
29(2)	0.00	0.00	0.00	0.00	0.00	0.00
30	0.00	0.00	0.99	1.34	0.99	1.34
31	0.11	0.21	0.76	0.47	0.76	0.47
32	0.70	0.57	1.35	0.52	1.35	0.57
33	0.11	0.52	0.77	0.68	0.77	0.68
34	0.34	0.76	0.89	0.70	0.89	0.76
35	0.28	0.63	0.81	0.63	0.81	0.63
36	0.19	0.39	0.72	0.49	0.72	0.49

POI	North		South		Bounding	
	Depth[1] (ft)	Velocity (ft/s)	Depth[1] (ft)	Velocity (ft/s)	Depth[1] (ft)	Velocity (ft/s)
37	0.20	0.32	0.72	0.45	0.72	0.45
38	0.40	0.50	0.92	0.54	0.92	0.54
39	0.68	1.32	1.20	1.42	1.20	1.42
40	0.68	1.50	1.20	1.61	1.20	1.61
41	0.37	1.12	0.90	1.22	0.90	1.22
42	0.27	0.93	0.80	0.98	0.80	0.98
43	0.40	0.86	0.90	0.78	0.90	0.86
44	0.25	0.62	0.66	0.76	0.66	0.76
45	0.40	0.38	0.79	0.65	0.79	0.65
46	0.32	0.39	0.67	0.68	0.67	0.68
47	0.36	0.30	0.70	0.69	0.70	0.69
48	0.15	0.22	0.48	0.53	0.48	0.53
49	0.18	0.37	0.41	1.12	0.41	1.12
50	0.41	1.36	0.65	1.59	0.65	1.59
51	0.58	1.33	0.83	1.48	0.83	1.48
52	0.13	0.22	0.46	0.26	0.46	0.26
53	0.00	0.00	0.52	1.07	0.52	1.07
54	0.00	0.00	0.00	0.00	0.00	0.00
55	0.00	0.00	0.00	0.00	0.00	0.00
56	0.00	0.00	0.00	0.00	0.00	0.00
57	0.00	0.00	0.00	0.00	0.00	0.00
58	0.00	0.00	0.63	0.48	0.63	0.48
59[3]	0.00	0.00	0.63	0.39	0.63	0.39
61	0.00	0.00	0.63	0.43	0.63	0.43
62	0.00	0.00	0.63	0.51	0.63	0.51
63	0.00	0.00	0.63	0.54	0.63	0.54
64	0.18	0.47	0.97	0.82	0.97	0.82
65	0.16	0.39	0.97	0.67	0.97	0.67
66	0.15	0.35	0.96	1.13	0.96	1.13
67	0.15	0.30	0.99	1.97	0.99	1.97
68	0.15	0.26	1.03	1.22	1.03	1.22
69	0.15	0.28	1.03	2.08	1.03	2.08
70	0.15	0.24	1.04	1.46	1.04	1.46
71	0.15	0.29	1.05	0.88	1.05	0.88
72	0.15	0.29	1.05	1.44	1.05	1.44
73	0.15	0.34	1.06	1.16	1.06	1.16

POI	North		South		Bounding	
	Depth[1] (ft)	Velocity (ft/s)	Depth[1] (ft)	Velocity (ft/s)	Depth[1] (ft)	Velocity (ft/s)
74	0.15	0.32	1.07	1.26	1.07	1.26
75	0.16	0.34	1.08	0.86	1.08	0.86
76	0.00	0.00	0.00	0.00	0.00	0.00
77	0.00	0.00	0.00	0.00	0.00	0.00
78	0.00	0.00	0.00	0.00	0.00	0.00
79	0.00	0.00	0.00	0.00	0.00	0.00
80	0.00	0.00	0.00	0.00	0.00	0.00
81	0.00	0.00	0.00	0.00	0.00	0.00
82	0.00	0.00	0.00	0.00	0.00	0.00
83	0.00	0.00	0.00	0.00	0.00	0.00

[1] Depths are representative of average depths over a 10.1 m^2 area. Significant discontinuities in local surface levels can affect local results. Where depth at given point differs markedly from that of nearby points, direction of flooding, local topography, and nearby POIs should be referenced to determine a reasonable, conservative flooding level for these points.

[2] POI 29 is located on top of the RHR vault roof; therefore, flood depths do not accumulate because the RHR Vault roof is higher than the maximum flood water levels in the area.

[3] POI 59 and 60 are the same point in the PMSS model. The resolution of this model is comparatively coarse since the grid cell size is of the same order as the distances between some of the buildings on site.

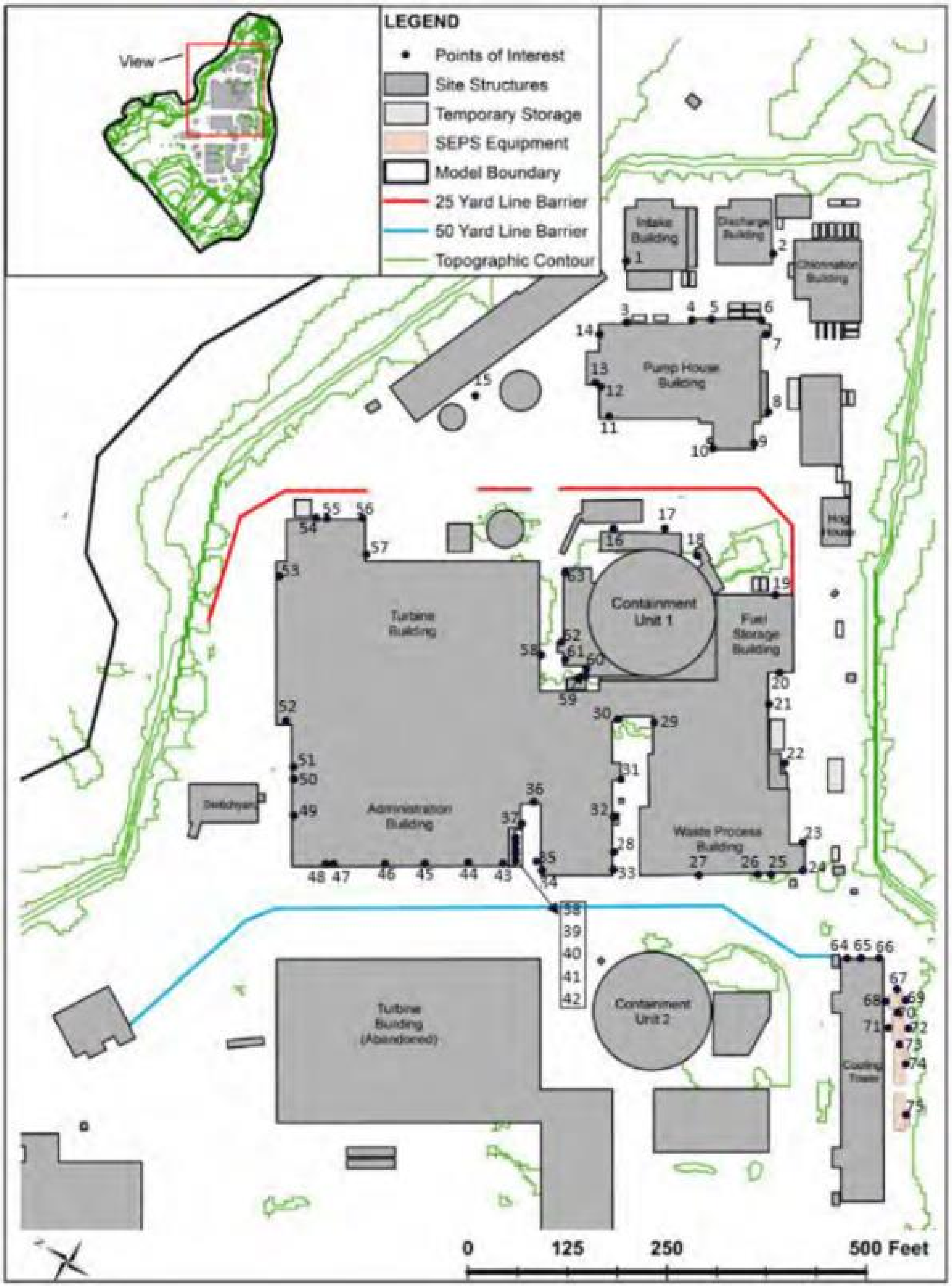

Figure 10 Seabrook Points of Interest (POI), East (Source: FHRR, Figure 4-9)

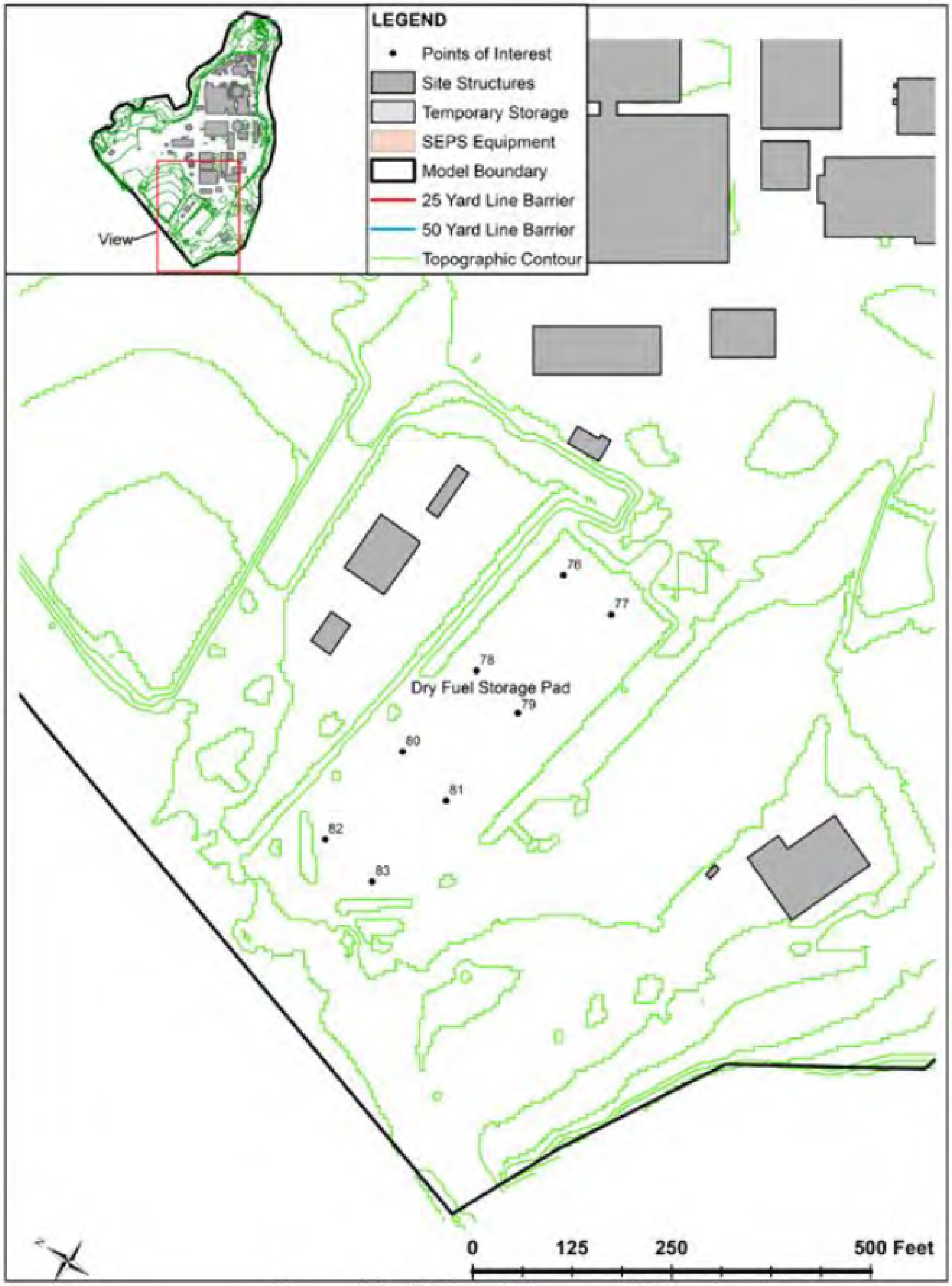

Figure 11 Seabrook Points of Interest (POI), West (Source: FHRR, Figure 4-10)

Taylor Engineering Staff Technical Evaluation
NextEra's estimation of surge-induced flood wave runup, inundation, and drawdown are acceptable.

10.0 Flood Event Duration

Information Submitted by NextEra
NextEra estimated the duration of surge-induced flood duration from overtopping waves at approximately 4.5 hours (Figure 12).

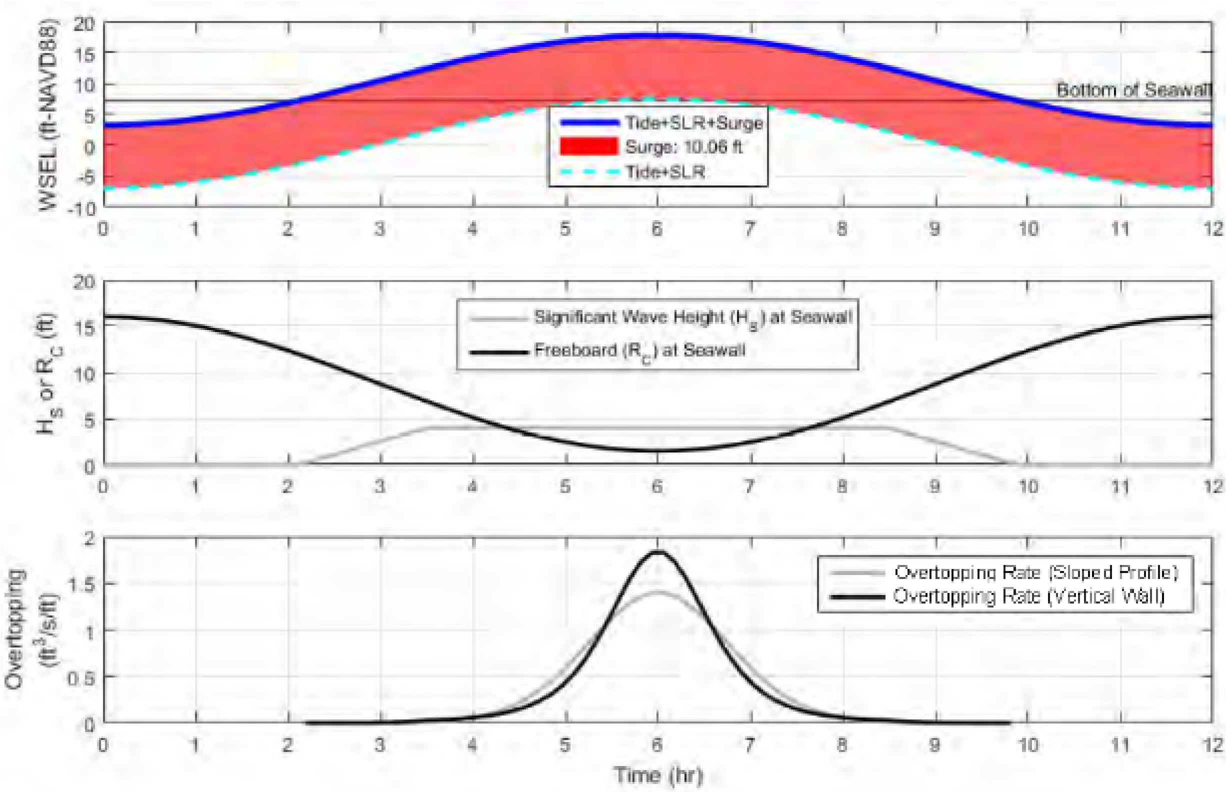

Figure 12 Time Series of Wave Overtopping (Source: FHRR, Figure 4-46)

Taylor Engineering Staff Technical Evaluation
Based on review of NextEra's Delft3d and overtopping results and the Taylor Engineering's independent simulations, NextEra's estimate of the duration of the flood event is acceptable.

11.0 Hydrostatic and Hydrodynamic Forces.

Information Submitted by NextEra
NextEra applied "methods presented in the USACE Coastal Engineering Manual (CEM) (USACE, 2011) and Federal Emergency Management Agency (FEMA) P-259 (FEMA, 2012)" to calculate hydrostatic and hydrodynamic forces generated by flood water waves during the PMSS. Table 22 provides NextEra's estimated hydrostatic and hydrodynamic forces from a PMSS at the points of interest (see Figure 10 and Figure 11) (FHRR, Sec 4.11.2).

Table 22 Calculated Hydrostatic and Hydrodynamic Forces at Points of Interest (Source: FHRR, Table 4-52)

POI	LIP		PMSS		Maximum Total Force (lb/ft)
	Hydrostatic Force (lb/ft)	Hydrodynamic Force (lb/ft)	Hydrostatic Force (lb/ft)	Hydrodynamic Force (lb/ft)	
1	3.00	0.33	0.00	0.00	3.3
2	3.00	0.13	0.00	0.00	3.1
3	7.49	0.02	1.10	0.16	7.5
4	3.61	0.01	5.61	0.23	5.8
5	6.60	0.02	5.99	0.20	6.6
6	4.51	0.01	0.63	0.55	4.5
7	1.13	0.01	1.06	0.21	1.3
8	1.65	0.03	3.44	0.10	3.5
9	0.00	0.00	0.00	0.00	0.0
10	0.00	0.00	0.00	0.00	0.0
11	6.60	0.09	0.00	0.00	6.7
12	5.77	0.01	0.00	0.00	5.8
13	5.50	0.01	0.00	0.00	5.5
14	1.95	0.01	1.76	0.40	2.2
15	11.99	0.17	1.14	0.02	12.2
16	0.00	0.00	0.00	0.00	0.0
17	0.00	0.00	0.00	0.00	0.0
18	0.00	0.00	0.00	0.00	0.0
19	34.40	0.43	2.69	0.00	34.8
20	6.60	0.06	0.00	0.00	6.7
21	0.00	0.00	0.00	0.00	0.0
22	0.00	0.00	0.00	0.00	0.0
23	0.00	0.00	0.00	0.00	0.0
24	0.00	0.00	0.00	0.00	0.0
25	0.00	0.00	0.00	0.00	0.0
26	0.00	0.00	0.00	0.00	0.0
27	0.00	0.00	0.00	0.00	0.0
28	24.71	0.26	30.46	1.59	32.1
29	0.00	0.00	0.00	0.00	0.0
30	7.49	0.10	10.86	2.08	12.9
31	0.00	0.00	0.00	0.00	0.0
32	0.00	0.00	0.00	0.00	0.0
33	0.00	0.00	3.43	0.30	3.7
34	0.00	0.00	11.65	0.70	12.4
35	19.97	1.61	21.23	0.65	21.9
36	0.53	0.41	0.00	0.00	0.9
37	10.50	1.08	2.40	0.11	11.6
38	6.60	0.64	4.99	0.23	7.2
39	6.89	0.71	8.73	2.08	10.8
40	6.60	0.95	24.37	4.47	28.8

POI	LIP		PMSS		Maximum Total Force (lb/ft)
	Hydrostatic Force (lb/ft)	Hydrodynamic Force (lb/ft)	Hydrostatic Force (lb/ft)	Hydrodynamic Force (lb/ft)	
41	7.80	1.09	19.24	2.28	21.5
42	9.10	1.20	11.08	1.12	12.2
43	5.24	0.35	12.90	0.94	13.8
44	7.19	0.50	8.49	0.59	9.1
45	5.24	0.44	6.25	0.37	6.6
46	6.89	0.54	9.92	0.51	10.4
47	3.82	0.39	10.43	0.54	11.0
48	4.51	0.43	4.07	0.20	4.9
49	0.15	0.08	0.97	0.43	1.4
50	0.03	0.05	0.00	0.04	0.1
51	0.05	0.05	5.81	1.85	7.7
52	0.20	0.01	5.93	0.06	6.0
53	0.00	0.00	2.10	0.58	2.7
54	0.61	0.08	0.00	0.00	0.7
55	0.80	0.02	0.00	0.00	0.8
56	0.70	0.03	0.00	0.00	0.7
57	1.95	0.00	0.00	0.00	2.0
58	27.57	0.59	0.30	0.04	28.2
59	15.73	3.75	0.00	0.00	19.5
60	56.86	5.50	8.91	0.19	62.4
61	34.40	1.11	0.00	0.00	35.5
62	0.00	0.00	0.00	0.00	0.0
63	0.00	0.00	0.00	0.00	0.0
64	0.00	0.00	30.19	0.87	31.1
65	11.99	2.00	0.00	0.00	14.0
66	0.00	0.00	4.30	2.82	7.1
67	0.00	0.00	5.00	1.17	6.2
68	0.00	0.00	14.42	5.77	20.2
69	0.00	0.00	5.84	1.81	7.7
70	0.00	0.00	34.21	1.58	35.8
71	6.32	0.23	13.72	2.70	16.4
72	0.38	0.03	21.52	2.21	23.7
73	1.51	0.47	32.53	3.19	35.7
74	0.70	0.02	33.72	1.50	35.2
75	1.38	0.04	0.00	0.00	1.4
76	2.11	0.01	0.00	0.00	2.1
77	2.81	0.01	0.00	0.00	2.8
78	20.47	0.04	0.00	0.00	20.5
79	14.85	0.05	0.00	0.00	14.9
80	24.71	0.06	0.00	0.00	24.8

POI	LIP		PMSS		Maximum Total Force (lb/ft)
	Hydrostatic Force (lb/ft)	Hydrodynamic Force (lb/ft)	Hydrostatic Force (lb/ft)	Hydrodynamic Force (lb/ft)	
81	13.18	0.09	0.00	0.00	13.3
82	19.97	0.03	0.00	0.00	20.0
83	24.71	0.04	0.00	0.00	24.7

[1]Forces are calculated based on the height above the door threshold, floor elevation, pad elevation, or ground elevation as appropriate.
[2]POI 59 and 60 are the same point in the PMSS model. The resolution of this model is comparatively coarse since the grid cell size is of the same order as the distances between some of the buildings on site.

Taylor Engineering Staff Technical Evaluation
Taylor Engineering staff independently verified hydrostatic and hydrodynamic force calculations based on water surface and ground elevations and depth and flow velocities found in "FPL-081-CALC-021_Hydrostatic and Hydrodynamic Loading Calculation Rev 1.pdf" document. Taylor Engineering staff calculations substantially agreed with force values listed in FHRR Table 4-52.

12.0 Debris and Water-Borne Projectiles.

Information Submitted by NextEra
NextEra did not provide an analysis of debris and water-borne loadings because of NextEra's opinion that "maximum water depths on site due to local intense precipitation (LIP) or PMSS flooding are on the order of 1 – 2 feet and are transient in nature. The low levels and short durations will not support transport of debris of significant size, so no further evaluation of water-borne projectiles and debris loading is warranted" (FHRR, Sec. 4.12).

Taylor Engineering Staff Technical Evaluation
NextEra's estimated depths do not exceed 1.5 ft at any FHRR Point of Interest. Taylor Engineering staff agrees that this depth would not support transportation of any debris of significant size.

13.0 Effects of Sediment Erosion and Deposition.

Information Submitted by NextEra
NextEra did not provide an analysis of sediment erosion and deposition because of NextEra's opinion that the "drainage area for Seabrook consists mostly of concrete and paved surfaces which contain none or very few unconsolidated particles. Therefore, Seabrook cannot provide the amount of sediment necessary to lead to any accumulation at the points of interest" (FHRR, Sec. 4.11).

Taylor Engineering Staff Technical Evaluation
Taylor Engineering staff agrees with NextEra's opinion that as "Seabrook consists mostly of concrete and paved surfaces", significant sediment erosion is not likely and thus Seabrook cannot provide enough sediment to result in deposition at the points of interest.

14.0 Consideration of Other Site-Related Evaluation Criteria.

Information Submitted by NextEra

NextEra did not provide discussion of how seismic and non-seismic information was used in the postulation of worst-case storm surge scenarios.

Taylor Engineering Staff Technical Evaluation
NextEra did not discuss how seismic and non-seismic information was used in the postulation of worst-case storm surge scenarios.

15.0 Conclusion
The information on flooding from storm surge that is specific to the data needs of the Integrated Assessment is described in Section 5 of the FHRR.

The Taylor Engineering staff confirmed NextEra's conclusion that the reevaluated hazard for flooding from storm surge is not bounded by the current design basis flood hazard; therefore, NextEra should include flooding from storm surge within the scope of the Integrated Assessment.

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