NEXTera® ENERGY SEABROOK

June 28, 2017
SBK-L-17099
Docket No. 50-443

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555-0001

Seabrook Station

Flooding Focused Evaluation for Impact of New Flooding Hazard Information

References:

1. NRC Letter, "Request for Information Pursuant to Title 10 of the Code of Federal Regulations 50.54(f) Regarding Recommendations 2.1, 2.3, and 9.3, of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident," March 12, 2012 (ML12053A340)

2. U.S. Nuclear Regulatory Commission (NRC), Order EA-12-049, "Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events," March 12, 2012 (ML12054A736 (package))

3. NextEra Energy Seabrook letter SBK-L-15181 to U.S. Nuclear Regulatory Commission, "Response to NRC 10 CFR 50.54(f) Request for Information Regarding Near-Term Task Force Recommendation 2.1, Flooding - Submittal of Flooding Hazards Reevaluation Report," September 25, 2015, (ML15274A210)

4. NextEra Energy Seabrook letter SBK-L-16175 to U.S. Nuclear Regulatory Commission, "Response to NRC 10 CFR 50.54(f) Request for Information Regarding Near-Term Task Force Recommendation 2.1, Flooding - Submittal of Flooding Hazards Reevaluation Report," November 7, 2016 (ML16314D429)

5. U.S. Nuclear Regulatory Commission (NRC), Interim Staff Response to Reevaluated Flood Hazards Submitted in Response to 10 CFR 50.54(f) Information Request – Flood-Causing Mechanism Reevaluation (ML16356A468)

6. U.S. Nuclear Regulatory Commission (NRC), Staff Requirements Memo to COMSECY-14-0037, "Integration of Mitigating Strategies for Beyond-Design-Basis External Events and the Reevaluation of Flooding Hazards," March 30, 2015, (ML15089A236)

7. U.S. Nuclear Regulatory Commission (NRC), "Coordination Of Requests for Information Regarding Flooding Hazard Reevaluations and Mitigating Strategies for Beyond-Design-Basis External Events," September 1, 2015, (ML15174A257)

8. Nuclear Energy Institute (NEI), NEI 16-05, External Flooding Assessment Guidelines, Revision 1, June 2016 (ML16165A178)

9. U.S. Nuclear Regulatory Commission, JLD-ISG-2016-01, Guidance for Activities Related to Near-Term Task Force Recommendation 2.1, Flooding Hazard Reevaluation; Focused Evaluation and Integrated Assessment, Revision 0, December21, 2017 (ML16162A301)

On March 12, 2012, the Nuclear Regulatory Commission (NRC) staff issued a request for information pursuant to 10CFR50.54(f) to all NRC power reactor licensees and holders of construction permits in active or deferred status (Reference 1). Enclosure 2 of Reference 1 contains specific requested actions, requested information, and required responses associated with Near-Term Task Force (NTTF) Recommendation 2.1 for flooding hazards. Enclosure 2 of Reference 1 directed reevaluation of flooding hazards at sites and indicated that a Flooding Hazards Reevaluation Report (FHRR) would be due within one to three years from the date of the Reference 1 letter. Revision 0 of the Seabrook FHRR was submitted to the NRC in Reference 3.

During subsequent discussions with NRC Staff on the contents of the FHRR, Seabrook agreed to perform an additional flooding case for the Probable Maximum Storm Surge (PMSS) event to see the effects that additional standing water, an increase in significant wave height, and a shorter wave period would have on wave overtopping. Since these resultant PMSS flooding elevations were greater than those presented in the original Seabrook FHRR (Reference 3), a revision to the FHRR was submitted to the NRC in Reference 4. The NRC Staff completed its review of the FHRR, as documented in Reference 5, and concluded that the reevaluated flood hazard information for Seabrook is suitable input for flooding assessments associated with the 10CFR50.54(f) request for information.

The enclosure to this letter provides the Flooding Focused Evaluation for the reevaluated flood hazard required to complete Seabrook's response to the information requested by Enclosure 2 of the 50.54(f) letter with regard to flooding. The Focused Evaluation was prepared in accordance with References 8 & 9.

This letter contains no new regulatory commitments. The required plant modifications and program/procedure changes summarized in the Focused Evaluation are consistent with those committed to in the Mitigating Strategies Assessment submittal.

Should you have any questions concerning this submittal, please contact Mr. Kenneth Browne, Licensing Manager, at (603) 773-7932.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on June 28, 2017.

Sincerely,

NextEra Energy Seabrook, LLC

Eric McCartney
Regional Vice President – Northern Region

Enclosure

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Enclosure to SBK-L-17099

Seabrook Station
Flooding Focused Evaluation for Impact of New Flooding Hazard Information

SEABROOK STATION FLOODING FOCUSED EVALUATION SUMMARY

1. EXECUTIVE SUMMARY

Seabrook Station has reevaluated its flooding hazard in accordance with the NRC's March 12, 2012, 10 CFR 50.54(f) request for information (RFI) (Ref. 8.1). The RFI was issued as part of implementing lessons learned from the Fukushima Dai-ichi accident; specifically, to address Recommendation 2.1 of the NRC's Near-Term Task Force (NTTF) report. This information was submitted to NRC in a flood hazard reevaluation report (FHRR) on November 7, 2016 (Ref. 8.2) and is provided in the Mitigating Strategies Flood Hazard Information (MSFHI) documented in NRC's "Interim Staff Response to Reevaluated Flood Hazards" letter dated December 21, 2016 (Ref. 8.3). No changes to the flooding analysis have been performed since the issuance of the MSFHI letter. The FHRR will therefore serve as input to this Focused Evaluation (FE). There are two mechanisms that were found to exceed the design basis flood level at Seabrook. These mechanisms are listed below and discussed in this FE:

1. Local Intense Precipitation (LIP)
2. Probable Maximum Storm Surge (PMSS)

Associated effects (AE) and flood event duration (FED) parameters were assessed and submitted as a part of the Mitigating Strategies Assessment (MSA, Ref. 8.8). The FE concludes that the strategy for maintaining key safety functions (KSFs) during LIP and PMSS events has effective flood protection through the demonstration of adequate Available Physical Margin (APM) and reliable flood protection features. Overall site response is also determined to be adequate. This FE followed Path 2 of NEI 16-05 (Ref. 8.4) and utilized Appendices B & C for guidance on evaluating the site strategy. This submittal completes the actions related to External Flooding required by the March 12, 2012 10 CFR 50.54(f) request.

2. BACKGROUND

On March 12, 2012, the NRC issued Reference 8.1 to request information associated with Near-Term Task Force (NTTF) Recommendation 2.1 for Flooding. One of the Required Responses in Reference 8.1 directed licensees to submit a Flood Hazard Reevaluation Report (FHRR). For Seabrook, the FHRR was submitted on November 7, 2016 (Ref. 8.2).

Following the Commission's directive to NRC Staff in Reference 8.6, the NRC issued a letter to industry (Ref. 8.7) indicating development of new guidance for a "graded approach to flooding reevaluations" and "more focused evaluations of local intense precipitation and available physical margin in lieu of proceeding to an integrated assessment." NEI prepared the new "External Flooding Assessment Guidelines" in NEI 16-05 (Reference 8.4), which was endorsed by the NRC in Reference 8.5. NEI 16-05 indicates that each flood-causing mechanism not bounded by the design basis flood (using only stillwater and/or wind-wave runup level) should follow one of five assessment paths:

- Path 1: Demonstrate Flood Mechanism is Bounded
- Path 2: Demonstrate Effective Flood Protection
- Path 3: Demonstrate a Feasible Response to LIP
- Path 4: Demonstrate Effective Mitigation
- Path 5: Scenario Based Approach

Non-bounded flood-causing mechanisms in Paths 1, 2, or 3 only require a Focused Evaluation to complete the actions related to External Flooding required by the March 12, 2012 10 CFR 50.54(f) letter without the need for the NRC staff to perform Phase 2 decision making per JLD-ISG-2016-01 and NEI 16-05. Mechanisms in Paths 4 or 5 require an Integrated Assessment.

3. TERMS AND DEFINITIONS

AIMs – Assumptions, Inputs, and Methods
APM – Available Physical Margin
EC – Engineering Change
ELAP – Extended Loss of A/C Power
FE – Focused Evaluation
FIAP – Flooding Impact Assessment Process
FHRR – Flood Hazard Reevaluation Report
FLEX – Diverse and Flexible Coping Strategies, covered by NRC Order EA-12-049 and NEI 12-06
KSF – Key Safety Function, i.e. core cooling, spent fuel pool cooling, or containment function
Key SSC – A System Structure or Component relied upon to fulfill a Key Safety Function
LIP – Local Intense Precipitation
MSA – Mitigating Strategies Assessment as described in NEI 12-06 App. G
MSFHI – Mitigating Strategy Flood Hazard Information
NEI – Nuclear Energy Institute
PMF – Probable Maximum Flood
PMH – Probable Maximum Hurricane
PMP – Probable Maximum Precipitation
PMSS – Probable Maximum Storm Surge
SSC – Structures, Systems, and Components
TSA – Time Sensitive Action as described in NEI 12-06 App. E and NEI 16-05 App. C
WSEL – Water Surface Elevation

Seabrook Buildings/Rooms:

CB – Control Building
CT – Service Water Cooling Tower
DGB – Diesel Generator Building
EFW Pump House – Emergency Feedwater Pump House
ESWGR – Essential Switchgear
FSB – Fuel Storage Building
MSFW Pipe Chases – Main Steam & Feedwater Pipe Chases
PAB – Primary Auxiliary Building
RCA Tunnel – Radiologically Controlled Area Tunnel (lower level access to PAB, RHR Vaults, WPB)
RHR Vault – Residual Heat Removal Vault
SEPS – Supplemental Emergency Power System
SWPH – Service Water Pump House
WPB – Waste Processing Building

Vertical Datums

MSL – Mean Sea Level
NGVD29 - National Geodetic Vertical Datum of 1929
NAVD88 - North American Vertical Datum of 1988
Seabrook Plant Datum, equivalent to NGVD29 - Elevations in the Updated Final Safety Analysis Report (UFSAR) infer that NGVD29 and MSL are interchangeable (Ref. 8.8). Site datum is 0.77 ft. below NAVD88 datum (Site Datum elevation, ft. = NAVD88 elevation, ft. + 0.77).

4. FLOOD HAZARD PARAMETERS FOR UNBOUNDED MECHANISMS

NRC has completed the "Interim Staff Response to Reevaluated Flood Hazards" (Ref. 8.3) related to Seabrook's Flood Hazard Reevaluation Report (FHRR, Ref. 8.2). In Reference 8.3, the NRC states:

"The NRC staff has concluded that the licensee's reevaluated flood hazards information is suitable for the assessment of mitigation strategies developed in response to Order EA-12-049 (i.e., defines the mitigating strategies flood hazard information described in Nuclear Energy Institute (NEI) guidance document NEI 12-06, Diverse and Flexible Coping Strategies (FLEX) Implementation Guide) for Seabrook. Further, the NRC staff has concluded that the licensee's reevaluated flood hazard information is suitable input for other flooding assessments associated with the 50.54(f) letter."

The enclosure to Reference 8.3 includes a summary of the current design basis and reevaluated flood hazard parameters, respectively. In Table 1 of the enclosure to Reference 8.3, the NRC lists the following flood-causing mechanisms for the design basis flood:

- Local Intense Precipitation
- Streams and Rivers
- Failure of Dams and Onsite Water Control/Storage Structures
- Storm Surge
- Seiche
- Tsunami
- Ice Induced Flooding
- Channel Migrations/Diversions

In Table 2 of the enclosure to Reference 8.3, the NRC lists flood hazard information (specifically stillwater elevation and wind-wave runup elevation) for the following flood-causing mechanisms that are not bounded by the design basis hazard flood level:

- Local Intense Precipitation (LIP)
- Probable Maximum Storm Surge (PMSS)

It should be noted that the PMSS flood-causing mechanism for Seabrook represents the NUREG/CR-7046, Section H, 3.2, Combined-Effects Flood (Floods along Shores of Open and Semi-Enclosed Bodies of Water (Streamside Location)). For additional conservatism, the Probable Maximum Hurricane (PMH) was considered coincident with the Probable Maximum Flood (PMF) and antecedent 10 percent exceedance high tide, which demonstrated that the PMF in Hampton Harbor had a negligible effect on the maximum PMSS water levels (Reference 8.14).

LIP and PMSS are the reevaluated flood-causing mechanisms that will be addressed in the external flooding assessment (FE). The two unbounded flood mechanisms for Seabrook are described in detail the FHRR (Ref. 8.2) and summarized in the Mitigating Strategy Assessment (MSA, Ref. 8.8). The impacts of LIP and PMSS flooding including associated effects (AE) and flood event duration (FED) parameters were assessed and submitted as a part of Seabrook's flooding MSA. Parameters are not being revised as part of the Flooding Impact Assessment Process (FIAP) for either mechanism. The following summarizes how each of these unbounded mechanisms was addressed in this external flooding assessment:

	Flood Mechanism	Summary of Assessment
1.	Local Intense Precipitation (LIP)	Assessment for LIP will follow FIAP Path 2, as described in Table 6.3 of NEI 16-05, since permanent passive protection features are solely relied upon to maintain KSFs.
2.	Hurricane Storm Surge (PMSS)	PMSS assessment will also follow Path 2. A bounding set of parameters was not developed due to different warning times and the need for anticipatory installation of temporary flood protection features for PMSS.
		Adequate APM, reliability of passive and temporary flood protection features, and adequate site response are all demonstrated for both mechanisms.

5. OVERALL SITE FLOODING RESPONSE

5.1 Description of Overall Site Flooding Response

The site response for LIP is as follows:

An extreme LIP event results in limited internal flooding. The large majority of internal flooding is restricted to non-critical areas (RCA Tunnel, Unit 2 Tunnel, WPB). A minor amount of water enters the A ESWGR Room, A RHR Vault, and West MSFW Pipe Chase. The amounts were calculated in Reference 8.8 and determined to not impact any safety related equipment. No anticipatory actions are required for LIP. Permanently installed passive features (doors) prevent significant water ingress directly to critical areas. Modifications identified in Section 5.2 will be required to support this assessment.

The site response for PMSS is as follows:

Seabrook will require the following temporary flood barriers to be deployed to maintain KSFs during major (Category 3) hurricane induced PMSS flooding:

- Temporary sandbag dikes in twelve doorways
- Installation of a flood gate in one doorway
- Sealing of floor drains

Anticipatory installation of temporary flood barriers is performed when the entry conditions for Procedures OS1200.03 and ON1090.13 (Ref. 8.9. 8.10) are met. These actions were added to the procedures as interim actions when the FHRR was submitted for NRC approval. An informal evaluation was performed estimating the time to complete installation of temporary flood barriers and determined sufficient time was available based on greater than 48 hours of warning time. Anticipatory installation of temporary flood barriers will be formally validated as TSAs in accordance with NEI 12-06 App. E (Ref. 8.11) to satisfy the requirements of NEI 16-05 (Ref. 8.4).

With the deployment of the temporary flood barriers, all KSFs and SSCs important to safety will remain available during the PMSS event.

Though not credited in this evaluation, additional defense-in-depth is provided by FLEX (as confirmed in the MSA, Ref. 8.8).

5.2 Summary of Plant Modifications and Changes

- Modify Doors A134 (Admin. Bldg.), C102 (A ESWGR Room), EM401/402/414 (Containment Personnel Hatch area) with improved seals to reduce gaps (required for LIP response).
- Add flood protection feature to the RHR Vault hallway off the RCA Tunnel walkway to ensure flooding is routed to the Unit 2 Tunnel or Waste Processing Building (required for LIP response).
- Seal floor drain in Alternate RCA Checkpoint and metal siding around Door EM414 and above adjacent stairway to RCA Tunnel (required for LIP response).

- Revise Procedure OP-AA-102-1002 (Ref. 8.12), to include 1/8" maximum allowable door gaps for Doors A134, C102, P901 (RHR Vault), and EM401/402/414 (required for LIP response).
- Revise the FLEX Program (DFCS, Ref. 8.18) to document TSAs for hurricane anticipatory actions (required for PMSS response).
- Revise Procedure ON1090.13 as follows (required for PMSS response):
  - Add installation of sandbags at Cooling Tower Doors CT102 and CT103 and East MSFW Pipe Chase Door EM408.
  - Revise heights and specific installation instructions for all other sandbagged doorways based on the results of this evaluation and the MSA (Ref. 8.8, 8.9). See Table 2 for complete list of sandbag dike locations.
  - Close valve DCW-V-2 in the RCA Hot Shop sump or seal the sump.
  - Enhance sandbag installation instructions to include additional USACE guidance (Ref. 8.16, 8.17).

Required modifications and procedure changes are being tracked in the station's Action Tracking System. NextEra Energy Seabrook, LLC, will develop and implement the required modifications and process the program/procedure changes once the FE has been accepted by the NRC.

6. FLOOD IMPACT ASSESSMENT

6.1 Local Intense Precipitation (LIP) – Path 2, Reliance on Permanent Flood Protection Features

6.1.1 Description of Flood Impact

The major impact of a LIP event would be flooding through door gaps and floor drains into critical areas. Although Procedures OS1200.03 and ON1090.13 (Ref. 8.9, 8.10) have entry conditions if predicted rainfall intensity is greater than 4 inches in one hour; no credit is taken for warning time or anticipatory actions. The following safety related structures are affected:

- Fuel Storage Building (FSB)
- Diesel Generator Building (DGB)
- Control Building (Essential Switchgear (ESWGR) Rooms)
- Residual Heat Removal (RHR) Vaults
- West Main Steam and Feedwater (MSFW) Pipe Chase
- Service Water Pump House (SWPH).

Affected areas with associated exterior LIP flood depths and height above door thresholds / floor elevations from the FHRR are listed in Attachment A.

Calculations and evaluation of flood water ingress into the areas listed above were performed to determine the impact of a LIP event (Ref. 8.8). Flooding through doorways directly into the A ESWGR Room, B Electrical Tunnel, A RHR Vault, West MSFW Pipe Chase, and SWPH will not result in water levels that affect or prevent access to necessary equipment. Flood levels in the FSB will be limited to the truck bay, which does not contain any safety related equipment. Any potential flooding in the DGB would be extremely minor and limited to the A Fuel Oil Storage Tank Room with no impact to fuel transfer equipment. Limited duration LIP flooding from the Administration (Admin.) Building into lower levels through the stairwell and floor drains will not exceed the holding capacity of the Unit 2 Tunnel or Waste Processing Building (WPB) prior to reaching a level that could introduce water into critical areas. Internal flooding from a LIP event will therefore not affect any KSFs.

Modifications are required to support this assessment. A flood protection feature in the RHR Vault hallway off the lower level walkway (RCA Tunnel) will be necessary to ensure flood water in the RCA Tunnel is directed to the Unit 2 Tunnel or WPB. Minor modifications consisting of improved door seals are also required for several doors to limit flood water ingress. All critical doors are currently inspected annually (Ref. 8.10). Gap measurements will be added to annual inspections for doors where inflows were calculated and assumed a maximum gap.

6.1.2 Adequate Available Physical Margin (APM) Justification and Reliability of Flood Protection

Existing design basis for the A ESWGR Room, A RHR Vault, West MSFW Pipe Chase, FSB, and SWPH relies on floor elevations being above the flood level to provide flood protection. Reevaluated LIP flood levels are above the floor elevations and water enters these rooms. Water subsequently enters the B Electrical Tunnel from the A ESWGR Room. Doorways become the credited flood protection features for the reevaluated LIP flood hazard. Doorway leakage was only evaluated up the maximum flood level; therefore APM is considered negligible in accordance with NEI 16-05. The parameter used to judge APM adequacy is the calculated internal flood level from Reference 8.8 compared to depth that could potentially cause failure of key SSCs. An APM summary for each of these areas is provided in Table 1 below. A more detailed discussion of APM for each area may be found in Reference 8.9.

Table 1 – LIP APM

Location	Internal Flood Depth	Critical Depth	APM	APM Discussion
A ESWGR Room	1.3 in.	4 in.	2.7 in.	Critical depth is height of water that could affect switchgear.
B Electrical Tunnel	2.7 in.	6 in.	3.3 in.	Critical equipment in this area is greater than 6 in. above the floor.
A RHR Vault	12 in.	17 in.	5 in.	Critical depth is the bottom of Containment Building Spray pump motor (CBS-P-9-A).
W MSFW Pipe Chase	34 in.	36 in.	2 in.	At 36 in. flood depth water overtops a flood barrier and potentially affects MS & FW instrumentation in an adjacent room.
FSB	9 in.	12 in.	3 in.	Critical depth is the ramp height to reach the floor level that could impact safety related equipment.
SWPH	6 in.	30 in.	24 in.	Critical depth is based on of the SW pump discharge centerline No equipment that could be affected by flooding is located below this elevation.

The internal flood depths above are the result of water entering directly through exterior doors. Another potential source of flooding into the A RHR Vault is from RCA Tunnel flooding from various sources. Flood water volume from these sources of approximately 140,000 gallons was shown to not exceed the available holding volume in the RCA Tunnel / Unit 2 Tunnel of approximately 160,000 gallons (Ref. 8.8).

APM is shown to be greater than zero, but is considered negligible as discussed above since flood depth that would result in zero APM was not evaluated. Per NEI 16-05 Appendix B Section B.1, "Negligible or zero APM can be justified as acceptable if the use of conservative inputs, assumptions, and/or methods in the flood hazard reevaluation can be established." Since the AIMs used in LIP analysis and internal flood depth calculations are conservative, APM is adequate. The following are examples of conservatisms used in the LIP flood analysis (Reference 8.13):

- All active and passive drainage components were considered nonfunctional
- Zero ground infiltration capacity credited
- Most Manning roughness coefficients selected were at the most conservative end of the given range for that surface type
- Volumes of east and west pipe chase pits conservatively estimated in FLO-2D model

Internal flooding calculations performed in support of the MSA (Ref. 8.8) also contain conservatisms:

- Internal flooding calculations assumed that external water level was maximum LIP depth for entire flooding duration with the exception of Door EM402. For Door EM402 the flooding depth and duration were broken down into two time segments to obtain a more accurate approximation. Flood depth for the duration of each segment was the maximum for that time period. Therefore the two segment calculations and thus the combined total water ingress calculation for Door EM402 is conservative.
- A ESWGR Room / B Electrical Tunnel:
  - LIP flood level used does not consider holding volume in Turbine Building or lower LIP flood depths at other Turbine Building entrances.
  - Floor drains and sumps are considered non-functional.
  - To maximize depth in the ESWGR Room, no water is assumed to pass through doorways into the electrical chase or stairwell to the lower level electrical tunnels.
- A RHR Vault:
  - No credit is taken for the four inch berm in the entrance way leading to the vault door.
  - Sump pumps are assumed to be non-functional.
- West MSFW Pipe Chase:
  - All the flood water ingress through Door EM402 is assumed to go into the pipe chase. No consideration is given for water that will flow through floor drains or the stairway into the RCA Tunnel
- SWPH:
  - No credit is taken for internal flood water that will drain into the forebay.
- Additional conservatisms for Admin. Building flood volume calculation:
  - Floor drain line flow calculation maximizes flow by ignoring many sources of head loss.
  - Holding volume does not include the considerable volume of the WPB below this elevation.

The following critical doors will be modified to reduce gaps as required to limit water ingress:

- A134, Admin. Building
- C102, A ESWGR Room
- EM401, EM402, & EM414, Alternate RCA Checkpoint / Containment Personnel Hatch area

Flood boundary doors are inspected annually (Ref. 8.12). The inspection procedure will be revised to include 1/8" maximum allowable door gaps for doors credited in water ingress calculations (Ref. 8.8). This would include the doors listed above plus Door P901 in the RHR Vault.

Hydrostatic and hydrodynamic forces were considered in the FHRR and determined to be generally low and not a concern. The FHRR determined that the LIP water surface elevation (WSEL) at Seabrook is not sufficient to convey waterborne projectiles of significant size; therefore, a waterborne projectile could not affect any SSCs. Increased static head (0.64 ft.) on the Admin. Building floor drain piping as a result of LIP flooding is insignificant. Therefore, given that conservative leakage rates through critical doors were calculated, periodic inspections are performed and required gaps maintained, and increased loading from floodwaters and debris is judged to be negligible due to the small flood heights, the flood protection features credited for LIP response meet the criteria for reliability per Appendix B of NEI 16-05.

6.1.3 Adequate Overall Site Response

Significant plant preparation is not credited or deemed necessary. The only plant action assumed is to ensure flood boundary doors are closed per Procedure ON1090.13 (Reference 8.10), which is not predicated on significant advanced warning. All flood boundary doors are Fire, Security, or RCA Boundary doors. Only one of these doors could potentially be left open unattended (Admin. Building Door A134) and would be closed per ON1090.13. Therefore, no time sensitive manual actions are required for this flood mechanism and further evaluation of the overall site response is not necessary.

6.2 Probable Maximum Storm Surge (PMSS) – Path 2, Installation of Temporary Flood Protection Features Required

6.2.1 Description of Flood Impact

Installation of temporary flood barriers is required to prevent flood water ingress from PMSS flooding into critical areas. PMSS flood depths and height above door thresholds / floor elevations from the FHRR for affected structures are listed in Attachment A. Protection height for flood barriers installed in doorways is summarized in Table 2 below. Table 2 reflects revised sandbag strategies based on the MSA and this FE. Procedure ON1090.13 (Ref. 8.10) will be revised to reflect the updated strategy. Floor Drains in the Admin. Building and Alternate RCA Checkpoint by the Containment Personnel Hatch are also sealed with plastic and tape and covered with sandbags. Water will enter the SWPH, but not to a level that impacts equipment in the structure (Ref. 8.8).

Table 2 – PMSS APM

Location	Door #	PMSS Flood Depth (in.)[1,2]	Protection Height (in.)[1]	APM (in.)[1]
ESWGR Rooms	C102	(-) 1	8	9
	C118	(-) 3	8	11
DG Bldg.	D300	7	12	5
	D305	4	12	8
	D306	(-) 1	8	9
A RHR Vault	P900	12	16	4
Cooling Tower	CT102	7[3]	12	5
	CT103	7[3]	12	5
East MSFW Pipe Chase	EM408	3[4]	8	5
Containment Personnel Hatch Area	EM401	6	12	6
	EM402	6	12	6
	EM414	6	12	6
Admin. Bldg.	A134	9	23[5]	14

1. Values rounded to nearest inch.
2. PMSS Flood Depth is depth above threshold.
3. PMSS WSEL (20.35 ft.-NAVD88) is below door threshold (21.23 ft.-NAVD88) with PMSS depth of 0.97 ft. An additional 1.5 ft. is added to WSEL to account for on-site generated wave action. Note that there is a concrete landing at the threshold elevation extending out from the door that will reduce the wave runup effect.
4. PMSS WSEL (20.45 ft.-NAVD88) is below door threshold (21.23 ft.-NAVD88) with PMSS depth of 0.58 ft. An additional 1 ft. is added to WSEL to account for on-site generated wave action. Note that there is a concrete landing at the threshold elevation extending out from the door that will reduce the wave runup effect.
5. Flood gate. All other protection heights are for sandbag dikes.

6.2.2 Adequate APM Justification and Reliability of Flood Protection

APM for temporary flood protection barriers (sandbags) in doorways is listed in Table 2. APM is greater than zero, but minimal and considered negligible with regard to evaluation per NEI 16-05 requirements. The sealing method for floor drains is intended for the minimal flood depth in those locations and not evaluated for depths greater than PMSS flood height, therefore APM is considered negligible as well. Per NEI 16-05 Appendix B, Section B.1, "Negligible or zero APM can be justified as acceptable if the use of conservative inputs, assumptions, and/or methods in the flood hazard reevaluation can be established." Since the AIMs used in PMSS analysis are conservative, APM is considered adequate. This will also encompass other areas considered not affected and protected solely by elevation above the flood level. Those areas are not specifically discussed in this FE, but have less than design basis margin to the reevaluated PMSS flood level. The following are examples of conservatisms used in the PMSS flood analysis (Reference 8.14 except where noted):

- The 10% exceedance high tide conservatively assumed with a 10-year return period independent of storm surge level (Ref. 8.15).
- Breaking depth at the riprap slope and seawall was conservatively assumed. Larger assumed breaking depths will yield larger breaking waves and overtopping flows.
- Active and passive drainage components considered nonfunctional.
- Peak wave period used instead of mean wave period in overtopping computation.
- No credit taken for post-overtopping backflow off of the Seabrook site into Hampton Harbor, which could potentially reduce the rate of wave overtopping.
- Waves approaching Seabrook site are assumed Rayleigh distributed.
- Overtopping discharge rate included as constant flow rate.

Note that leakage past sealed floor drains will flow into the RCA Tunnel, Unit 2 Tunnel, and WPB. The RCA and Unit 2 Tunnels alone have a greater than 160,000 gallon holding capacity without including the WPB (Ref. 8.8). This provides margin in addition to the discussion above for this flood barrier.

PMSS flood waters will enter the Service Water Pump House, but not to a depth that affects Key SSCs. Depth is limited by openings that drain water into the forebay. With ocean water intakes far removed from shore, forebay level will be significantly lower than the storm surge level in Hampton Harbor. The stop log openings are flush with the SWPH floor and the larger forebay access opening has a six inch berm around it. Conservatively ignoring water that drains into the forebay, the maximum water level in the SWPH is El. 20.77 ft.-NAVD88. No active equipment is located below the centerline of the SW pump discharge lines at El. 22.73 ft.-NAVD88 (23.5 ft.-plant Datum). The 23 inch difference in elevation between the maximum flood level and the centerline of the SW pump discharge line provides adequate APM.

Procedure ON1090.13 (Ref. 8.10) provides explicit instructions on sandbag stacking configuration required for each door. These configurations follow the US Army Corps of Engineers (USACE) guidance (Ref. 8.16, 8.17), which is considered an accepted engineering practice. Installation steps will be revised to include additional instructions from the USACE guidance. Plastic sheeting used to seal the sandbag dikes is reinforced and exceeds the 6 mil thickness poly sheeting specified in USACE guidance. Note that the sandbag berms are inside the doors and thus not subject to hydrodynamic forces or waterborne projectiles. The FHRR determined that the PMSS WSEL at Seabrook is not sufficient to convey projectiles of significant size; therefore, a waterborne projectile will not affect the doors themselves. Sandbag dikes used to protect Seabrook from PMSS flooding are therefore considered reliable based on configuration and location inside doorways.

The flood gate for Door A134 in the Admin. Building is a commercial off the shelf item commonly used for this application. It is designed for a 23 inch flood height and will see less than nine inches and is also judged to be reliable based on guidance in NEI 16-05, Appendix B.

Methodology for sealing floor drains is limited to the locations described above where PMSS flood depth is less than nine inches. Placement of sandbags on top of reinforced plastic on the floor drains prevents any significant open area of plastic from being subject to the minimal differential pressure associated with the PMSS flood height. The hydrostatic forces and leakage paths would be similar to sandbag dikes, only in a vertical direction versus horizontal. Sealing floor drains in this manner is comparable to sandbag dikes and is therefore considered reliable.

6.2.3 Adequate Overall Site Response

This evaluation, performed in accordance with NEI 16-05, Appendix C, has demonstrated the overall site response to a PMSS event is adequate. Anticipatory installation of temporary flood protection features as identified in the FHRR were incorporated in ON1090.13 (Ref. 8.10) and will be updated as a result of this evaluation and the MSA (Ref. 8.8, 8.9). Installation of the temporary barriers (as updated) will prevent water ingress into areas that could potentially affect Key SSCs. The following sections outline the results of evaluating the criteria in NEI 16-05, Appendix C.

6.2.3.1 Defining Critical Path and Identifying Time Sensitive Actions (TSAs)

The overall strategy for protecting Seabrook from a PMSS event contains relatively simple and straight forward actions as identified in ON1090.13 (Ref. 8.10). The critical path and TSAs are as follows:

- Identify the potential for a Major Hurricane (Category 3 or greater) and enter Abnormal Operating Procedure OS1200.03, Severe Weather Conditions (Ref. 8.9). OS1200.03 implements ON1090.13 and NM11800 (Ref. 8.10, 8.19).
- Install temporary flood protection features as identified in ON1090.13:
  - sandbags at 12 doors (see Table 2)
  - flood gate in Door A134
  - seal floor drains in the Admin. Building

Anticipatory installation of temporary flood barriers described above are considered TSAs requiring Level B validation in accordance with NEI 12-06, Appendix E.

6.2.3.2 Demonstration all TSAs are Feasible

Anticipatory actions for a major hurricane were put in place as interim measures after the FHRR was submitted. An informal evaluation was completed to validate that the required actions could be performed in the allotted time frame. The estimated time to complete installation of temporary flood barriers is 12 hours with a crew of 20 people. Warning time is 36 hours or greater (Hurricane Warnings are issued 36 hours in advance, Ref. 8.20). The number of sandbags to be installed has been reduced by changes to the sandbagging strategies resulting from the MSA and this FE, thereby increasing the margin in the time estimate. All TSAs are therefore judged to be feasible. Formal validation in accordance with NEI 12-06, Appendix E will be required for anticipatory actions to satisfy NEI 12-06 and NEI 16-05 requirements. TSAs for installation of temporary flood barriers will be incorporated into the DFCS Manual (FLEX Program, Ref. 8.18).

6.2.3.3 Establishing Unambiguous Procedural Triggers

Procedure ON1090.13, Response to Natural Phenomena Affecting Plant Operations (Ref. 8.10), is entered for forecasted hurricane conditions and contains general site preparations for severe weather. Section 4.4 is entered at a minimum when a Hurricane Warning for a Category 3 or greater hurricane is received and executes installation of temporary flood barriers. OS1200.03, Severe Weather Conditions, (abnormal procedure, Ref. 8.9) has an entry condition of Hurricane Warning received for Category 3 or greater hurricane. OS1200.03 ensures that ON1090.13 and NM11800, Hazardous Condition Response and Recovery Plan (E-Plan procedure, Ref. 8.19) are in progress.

6.2.3.4 Proceduralized and Clear Organizational Response for a Flood

The Operations Director, Assistant Operations Manager, and Shift Manager are responsible for actions taken for a predicted hurricane in accordance with ON1090.13. Emergency Plan Procedure NM11800 (Ref. 8.19) is entered upon receipt of a Hurricane Warning for a major hurricane. NM11800 provides clear guidance that the Plant General Manager (or on-duty Site Emergency Director if the PGM is unavailable) directs response to hazardous conditions inside the Protected Area and directs the PGM to establish a command and control center for events requiring a prolonged response effort within the Protected Area. Plant General Manager Response Guidelines contained in NM11800 include the following actions for severe weather:

- In the event of approaching severe weather, establish a list of essential services and direct assignment of Station Staff to support these needs prior to the release of nonessential staff.
- If a hurricane may potentially affect the site within 72 hours, direct the Emergency Coordinator and Maintenance Services Representative to initiate storm preparations.
- Instructions regarding sequestration of essential personnel.

Organizational Response for potential PMSS flooding is therefore proceduralized and clear.

6.2.3.5 Detailed Flood Response Timeline

Although it is likely that hurricane preparations would have begun 48-72 hours in advance of the storm, the minimum response initiation timeframe would be at receipt of a Hurricane Warning for a major hurricane. The response timeline includes the following activities:

- Obtain materials
- Prepare sandbags and transport to required locations
- Deploy sandbags and install one flood gate.

These activities are estimated to take 12 hours with a crew of 20 people. Validation for these actions will be performed in accordance with NEI 12-06, Appendix E and TSAs incorporated in the FLEX program.

6.2.3.6 Accounting for the Expected Environmental Conditions

The environmental conditions expected during the deployment of the temporary flood barriers are not expected to be extreme. Advance warning of a major hurricane will provide sufficient time to have sandbags deployed to the required locations prior to the onset of severe weather. The flood barriers are installed indoors at that point. Given the amount of time expected to complete the action, it is highly unlikely that conditions will deteriorate enough to impede installing the flood protection.

6.2.3.7 Demonstration of Adequate Site Response

The site response to PMSS flooding has been demonstrated as adequate by meeting the guidelines in NEI 16-05, Appendix C. All TSAs have been identified and determined to be feasible per NEI 12-06 Appendix E & G. The time margin was calculated as 24 hours given the time available as 36 hours and the time required to execute as 12 hours. Anticipatory actions will be validated in accordance with NEI 12-06, Appendix E and incorporated into the Seabrook Flex Program as Level B TSAs. The organizational structure and command & control is clearly laid out in Procedures ON1090.13 and NM11800. Finally, the environmental conditions are not expected to be extreme during preparation activities even with the minimum warning time prior to the arrival of a major hurricane.

This evaluation demonstrates that the overall site response is adequate for PMSS per the NEI 16-05 guidance.

7. CONCLUSION

The FHRR showed that two flooding mechanisms were not bounded by the CLB and were required to be evaluated in this FE. A LIP was estimated to generate water levels exceeding door thresholds in multiple locations. There are no manual actions relied on and internal flooding levels were determined not to affect Key SSCs or KSFs. This FE demonstrated adequate APM for a LIP event.

The second mechanism not bounded by the CLB is PMSS. The FHRR estimated the PMSS would produce flooding elevations that could exceed door thresholds for some buildings that house Key SSCs. Key SSCs will be protected by installation of temporary flood barriers. The barriers have been shown to have adequate APM and are reliable. Therefore, no significant water intrusion or accumulation is anticipated in rooms with Key SSCs and Seabrook will be able to maintain all KSFs throughout the event. This FE demonstrated the site response is adequate given the required anticipatory actions have ample time margin to be completed.

Finally, for both mechanisms, the MSA has demonstrated that mitigating strategies (FLEX) will be available to maintain/restore KSFs as a defense-in-depth measure. Additional information can be found in the MSA (Ref. 8.8).

The FE submittal completes the actions related to External Flooding required by the March 12, 2012 10 CFR 50.54(f) letter. It is not anticipated that Phase 2 decision making will be necessary based on the information provided in this FE.

8. REFERENCES

8.1 NRC Letter, Request for Information Pursuant to Title 10 of the Code of Federal Regulations 50.54(f) Regarding Recommendations 2.1, 2.3, and 9.3, of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident; dated March 12, 2012

8.2 NextEra Energy Seabrook Letter SBK-L-16175 to NRC, Response to NRC 10CFR50.54(f) Request for Information Regarding Near-Term Task Force Recommendation 2.1, Flooding – Submittal of Flooding Hazards Reevaluation Report, dated November 7, 2016 (ADAMS Accession No. ML 16314D429)

8.3 NRC Letter to Seabrook, Seabrook Station, Unit 1 – Interim Staff Response to Reevaluated Flood Hazards Submitted in Response to 10 CFR 50.54(f) Information Request – Flood-Causing Mechanism Reevaluation, dated December 21, 2016, (MSFHI Letter, ADAMS Accession Nos. ML16356A468 and ML16347A175)

8.4 NEI 16-05, External Flooding Assessment Guidelines, Rev. 1

8.5 U.S. Nuclear Regulatory Commission, JLD-ISG-2016-01, Guidance for Activities Related to Near-Term Task Force Recommendation 2.1, Flooding Hazard Reevaluation; Focused Evaluation and Integrated Assessment, Rev. 0

8.6 NRC Staff Requirements Memoranda to COMSECY-14-0037, "Integration of Mitigating Strategies for Beyond-Design-Basis External Events and the Reevaluation of Flooding Hazards", dated March 30, 2015

8.7 NRC Letter, Coordination of Requests for Information Regarding Flooding Hazard Reevaluations and Mitigating Strategies for Beyond-Design-Basis External Events, dated September 1, 2015

8.8 Engineering Evaluation EE-17-005, Beyond Design Basis Flooding Mitigating Strategy Assessment, Rev. 0 (EC288388 Rev. 0)

8.9 Engineering Evaluation EE-17-006, Focused Flooding Evaluation To Support Closure of NRC Fukushima Near Term Task Force Recommendation 2.1, Flooding, Rev. 0 (EC288390 Rev. 0)

8.9 OS1200.03, Severe Weather Conditions, Rev. 28

8.10 ON1090.13, Response to Natural Phenomena Affecting Plant Operations, Rev. 13

8.11 NEI 12-06, Diverse and Flexible Coping Strategies (FLEX) Implementation Guide, Rev. 2 [Note: Revision 2 was used in development of this MSA based on the MSFHI Letter (Ref. 8.4). Revision 4 has since been accepted by the NRC. Changes from Rev. 2 to Rev. 4 do not impact the content of this FE or supporting evaluations.]

8.12 OP-AA-102-1002, Seasonal Readiness, Rev. 18

8.13 FP26296, Enercon Calculation FPL-081-CALC-019, FLO-2D Evaluation of Local Intense Precipitation (LIP) Calculation, Rev. 0

8.14 FP26294, Enercon Calculation FPL-081-CALC-016, Probable Maximum Storm Surge (PMSS), Wave Runup, Combined Effects, and Low Water Calculation, Rev. 2

8.15 FP26298, Enercon Calculation FPL-081-CALC-024, Hurricane Climatology Calculation, Rev. 1

8.16 Flood Fight Handbook, US Army Corps of Engineers St. Paul District, 2016

8.17 Sandbagging Techniques, US Army Corps of Engineers, Northwestern Division, 2004

8.18 Diverse and Flexible Coping Strategies (FLEX) Program (DFCS), Rev. 1

8.19 NM 11800, Hazardous Condition Response and Recovery Plan, Rev. 30

8.20 National Oceanic and Atmospheric Administration (NOAA), NOAA National Weather Service (NWS), National Hurricane Center, available at: http://www.nhc.noaa.gov/

ENCLOSURES

Attachment A Critical Plant Areas Impacted By LIP or PMSS Flooding

SEABROOK STATION FLOODING FOCUSED EVALUATION SUMMARY

Attachment A Critical Plant Areas Impacted By LIP or PMSS Flooding

Critical SSC (Note 1)	Associated POIs / Door #'s (Note 7)	Floor/Threshold Elevation (ft. NAVD88) (Note 2)	LIP WSEL (ft. NAVD88) (Note 2)	PMSS WSEL (ft. NAVD88) (Note 2)	LIP Height Above Floor/Threshold (in.)	PMSS Height Above Floor/Threshold (in.)	Comments
Service Water Pump House (SWPH)	4-7 SW100/105	20.23	20.69	20.77	5.5	6.5	Flood depth will not impact equipment in SWPH.
Fuel Storage Building (FSB)	19, 20 F203/204	20.73	20.78	20.02 (Ground El.)	0 (Note 3)	0 (Note 4)	EL. 20.73 FT. NAVD88 is the SFP Hx area. The two doors in the truck bay are at El 19.73 ft.-NAVD88. There is no safety related equipment in the truck bay.
Diesel Generator Building (B FOST)	33 D305	20.76	20.52	21.09	N/A	4.0	Door is sandbagged in anticipation of a major hurricane.
Diesel Generator Building (A FOST)	34 D300	20.74	20.73	21.34	N/A	7.2	Door is sandbagged in anticipation of a major hurricane.
A Essential Switchgear Room	36, 58 C100/101/ 102	20.73	21.26	20.63	6.4	N/A	LIP flooding will not affect Key SSCs. Doors are sandbagged in anticipation of a major hurricane.
A RHR/CBS/SI Vault (Note 5)	30 P900/901	19.90	20.70 (Note 6)	20.89	9.6	11.9	LIP flooding will not affect Key SSCs. Door is sandbagged in anticipation of a major hurricane.
	37, 38 43-46 Admin Bldg	20.23	20.87	20.95	7.7	8.6	Modifications will be installed to mitigate the LIP flood hazard from these flow paths into the RHR Vault. Flood barriers are installed in anticipation of a major hurricane.
	59, 60, 61 EM401/402/ 414	20.39	21.77	20.92	16.6	6.4	Modifications will be installed to mitigate the LIP flood hazard from these flow paths into the RHR Vault. Flood barriers are installed in anticipation of a major hurricane.
West Main Steam & FW Pipe Chase	59, 60 EM402	20.39	21.77	20.92	16.6	6.4	The lower level of the west pipe chase will be flooded during LIP; however this will not affect Key SSCs. Door is sandbagged in anticipation of a major hurricane.

Note 1: The East MS&FW Pipe Chase (Door EM408) and SW Cooling Tower (Doors CT102 & CT103) are also affected by PMSS flooding when on-site generated waves are considered.

Note 2: Floor/Threshold elevations are taken from the FHRR or plant drawings if not directly available in the FHRR. Data is for limiting case.

Note 3: The FSB has two doors into the truck bay (POI 19 & 20), a large rollup door (F204) and a personnel door (F203). The truck bay floor elevation is 19.73 ft.-NAVD88 (20.5 ft.-Plant Datum). The personnel door will see a LIP WSEL of 20.78 ft. and at the rollup door it will be 20.19 ft. Since the rollup door has much more gap area around it, the level in the FSB truck bay will be less than the average of the two depths and thus below the critical 20.73 ft. elevation.

Note 4: The calculated PMSS depths are 0 at these points. There will likely be some water present at these locations when on-site generated wave action is considered. However it will not exceed the 20.73 ft.-NAVD88 elevation where flooding would impact plant equipment.

Note 5: There are several flow paths for flood waters to enter the RHR Vault. One flow path through the vault's exterior door (P900, POI 30) will result in minimal water in the vault and have no impact. The other flow paths enter the vault from the Admin Building (POIs 37, 38, 43-46) and RCA Alt. Checkpoint (POI 60, 61) through the RCA Tunnel at PAB El. +5 ft. (Plant Datum).

Note 6: LIP WSEL value is extrapolated from the increase in WSEL from POI 32 to 31.

Note 7: Points of Interest (POI) are shown on the following pages.

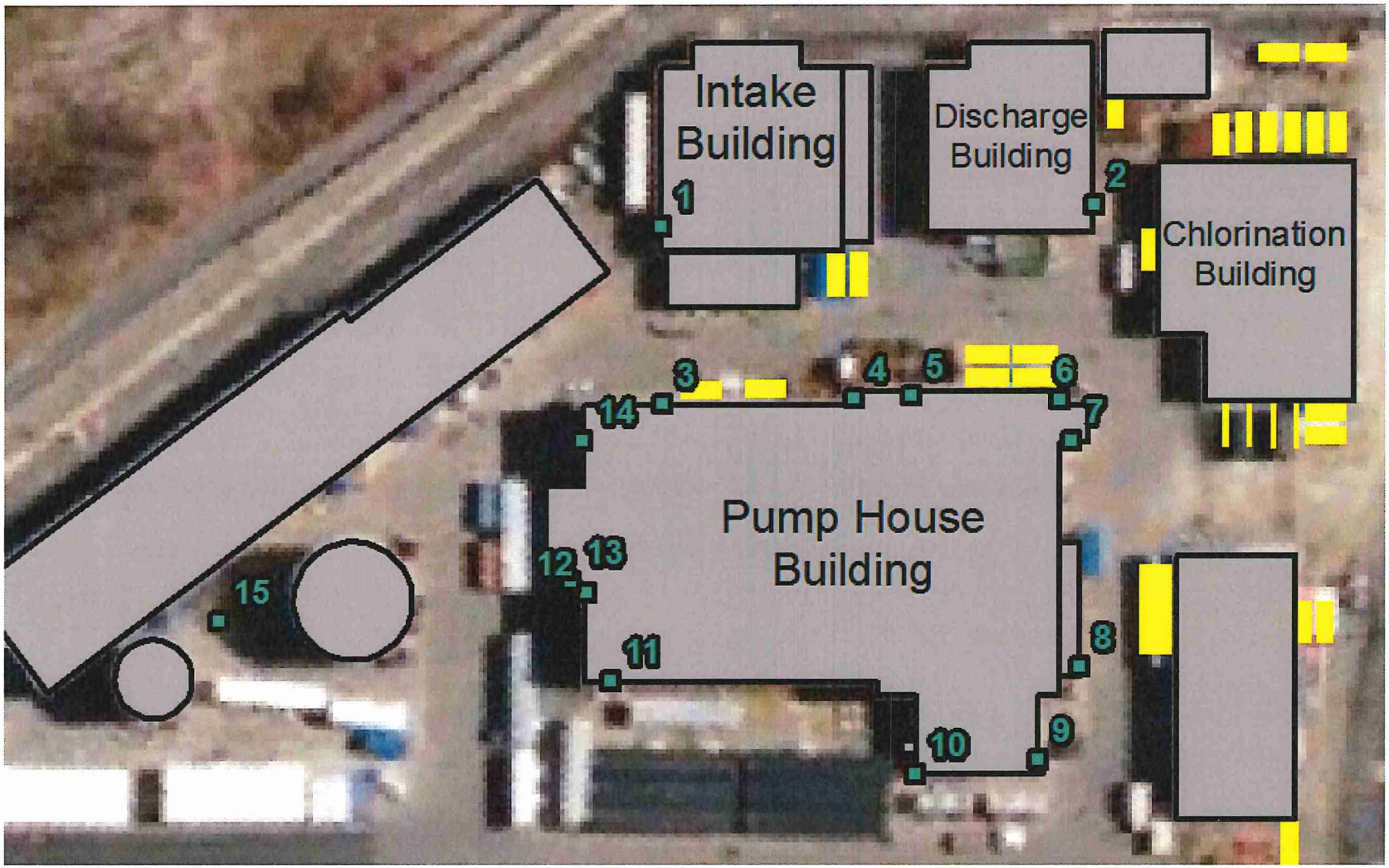
SEABROOK STATION FLOODING FOCUSED EVALUATION SUMMARY

Flooding Point of Interest (POI) Locations

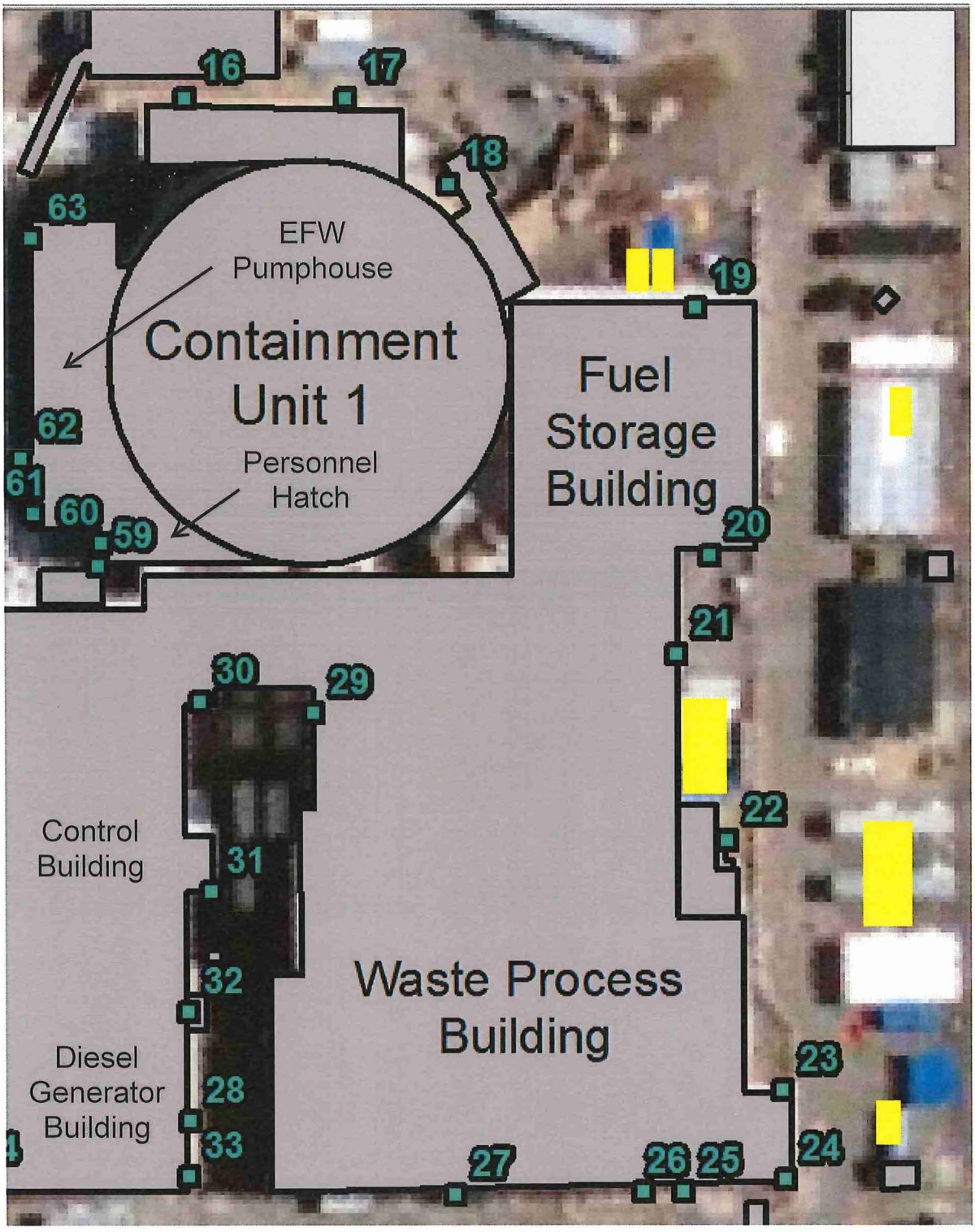
POI	Description
1	Intake Structure
2	Discharge Structure
3	CWPH
4	CWPH
5	SWPH
6	SWPH Missile Barrier
7	SWPH
8	SWPH Roof Stair
9	SWPH-Elec.
10	SWPH-Elec.
11	CWPH
12	CWPH
13	CWPH
14	CWPH
15	East CR HVAC Intake
16	East Pipe Chase
17	East Pipe Chase
18	Equip. Hatch Entry
19	FSB - Personnel Door
20	FSB - Overhead Door
21	PAB
22	RCA Tunnel
23	Asphalt Building
24	Asphalt Building
25	WPB

POI	Description
26	WPB
27	WPB
28	B DG Bldg Vents
29	PAB
30	RHR Vault
31	B ESS SWGR
32	DG Bldg
33	DG Bldg
34	DG Bldg
35	A DG Bldg Vents
36	Non-Ess SWGR
37	Admin Bldg
38	Storage
39	Storage
40	Storage
41	Storage
42	Storage
43	Admin Bldg
44	Admin Bldg
45	Admin Bldg
46	Admin Bldg
47	Admin Bldg
48	Admin Bldg
49	Admin Bldg
50	Admin Bldg

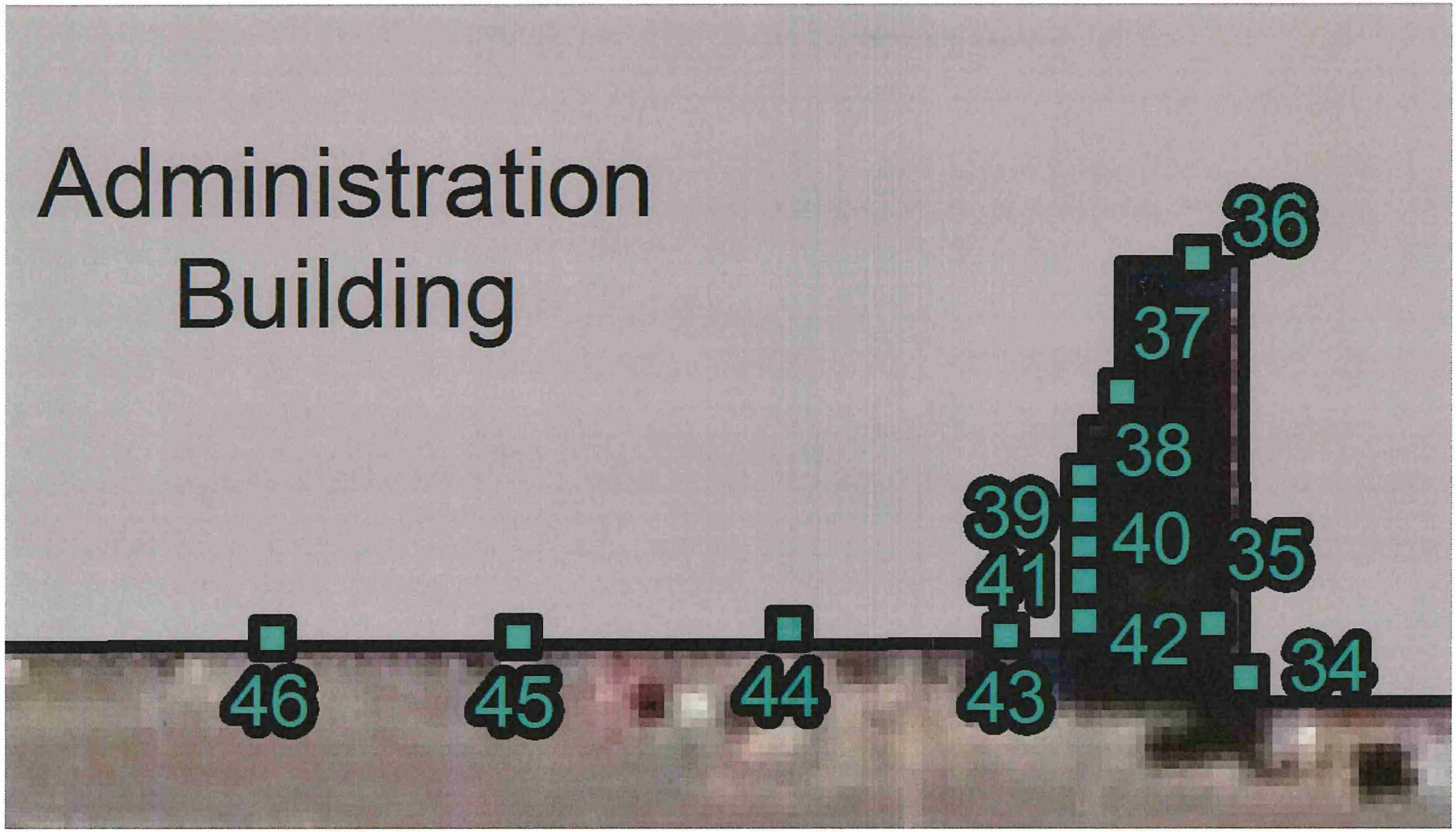
POI	Description
51	Admin Bldg
52	Turbine Building
53	Turbine Building
54	Turbine Building
55	Turbine Building
56	Turbine Building
57	Turbine Building
58	Turbine Building
59	Storage
60	RCA Ckpt / Cont. Hatch
61	RCA Checkpoint
62	EFW Pump Room
63	FP Room
64	Cooling Tower
65	West CR HVAC Intake
66	Cooling Tower
67	SEPS - Elec
68	SEPS - Elec
69	SEPS - Elec
70	SEPS - Elec
71	SEPS - SWGR
72	SEPS - SWGR
73	SEPS - SWGR
74	SEPS – DG 2A
75	SEPS – DG 2B



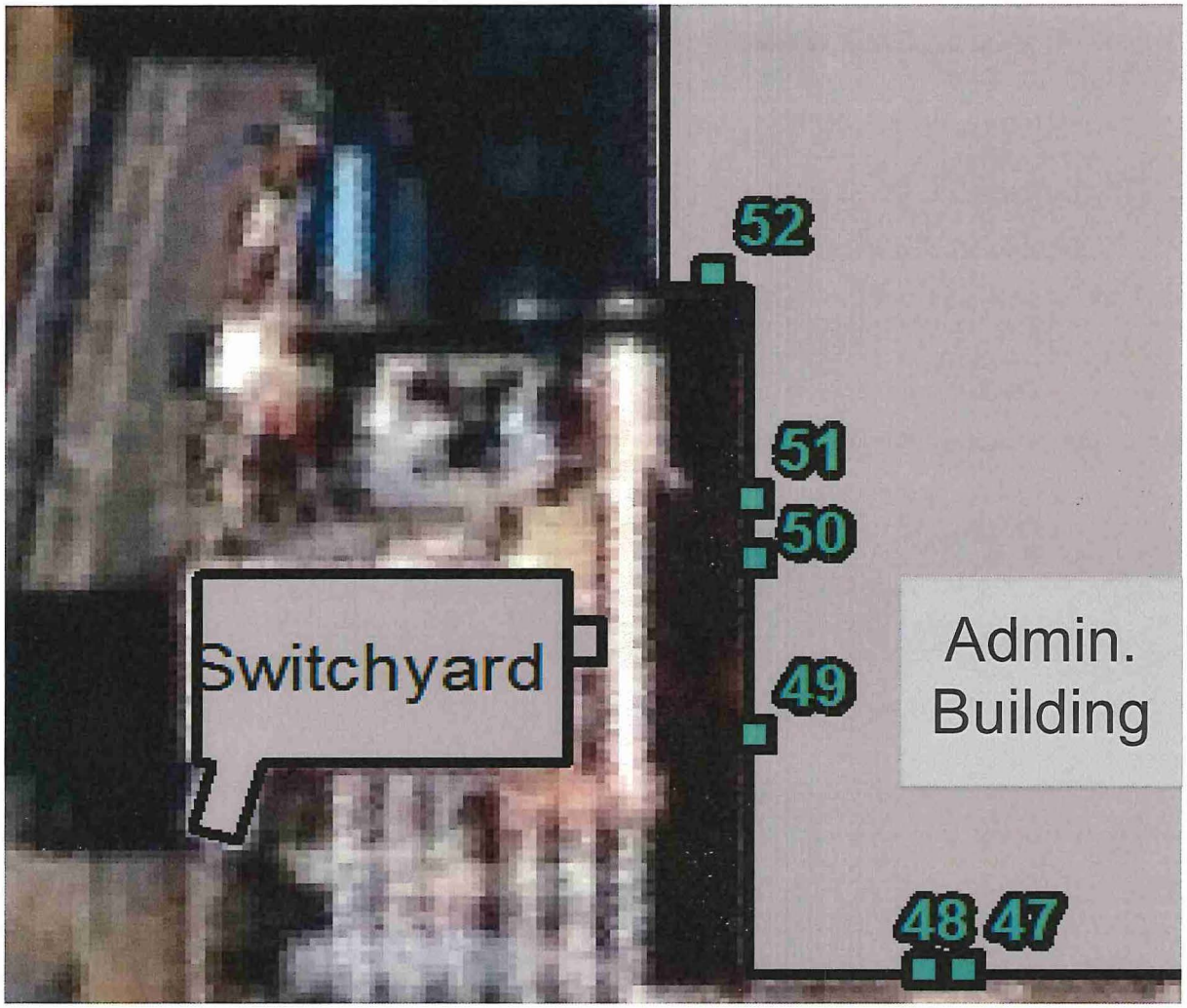
Points of Interest 1-15



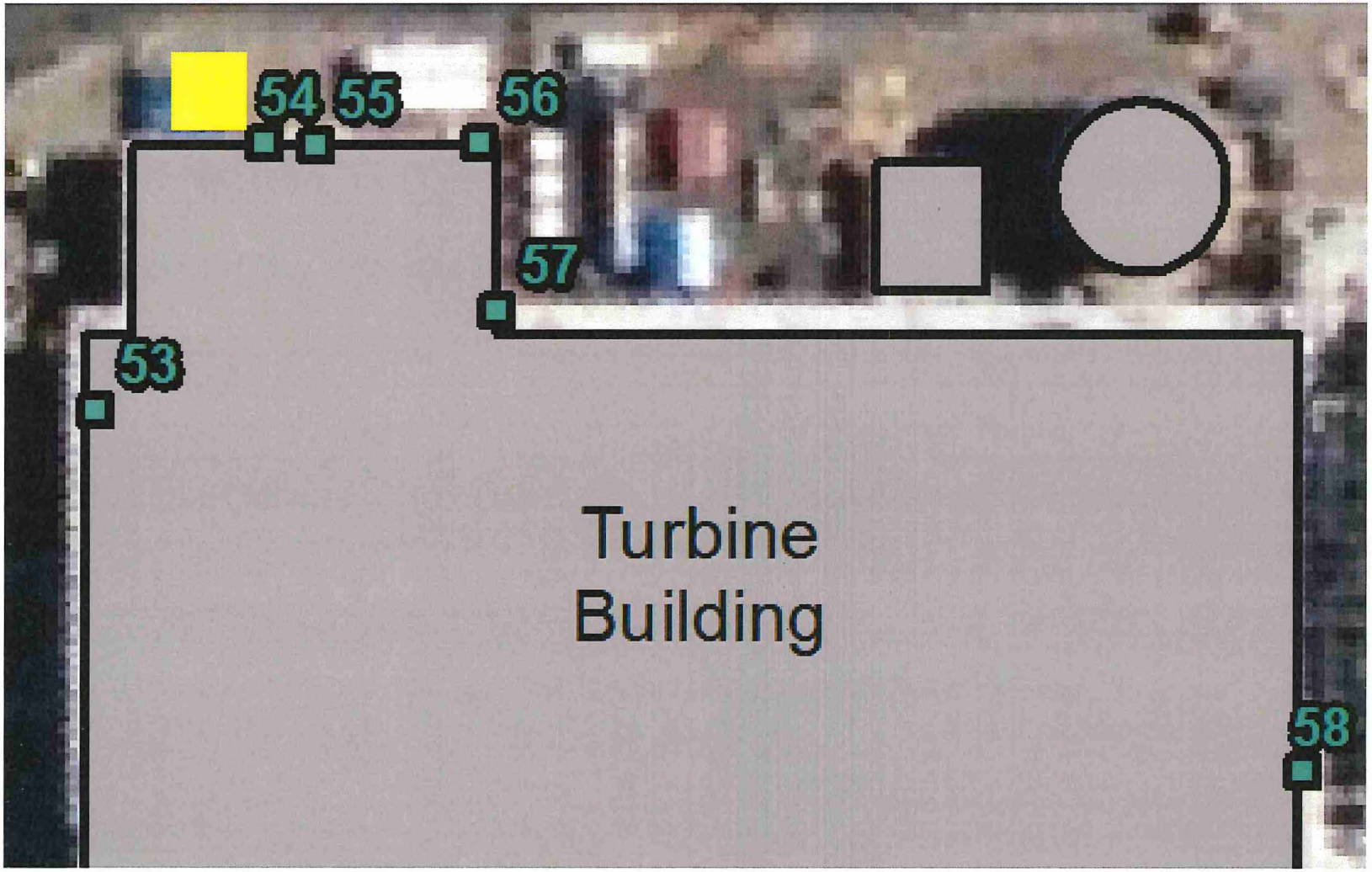
Points of Interest 16-33 and 59-63



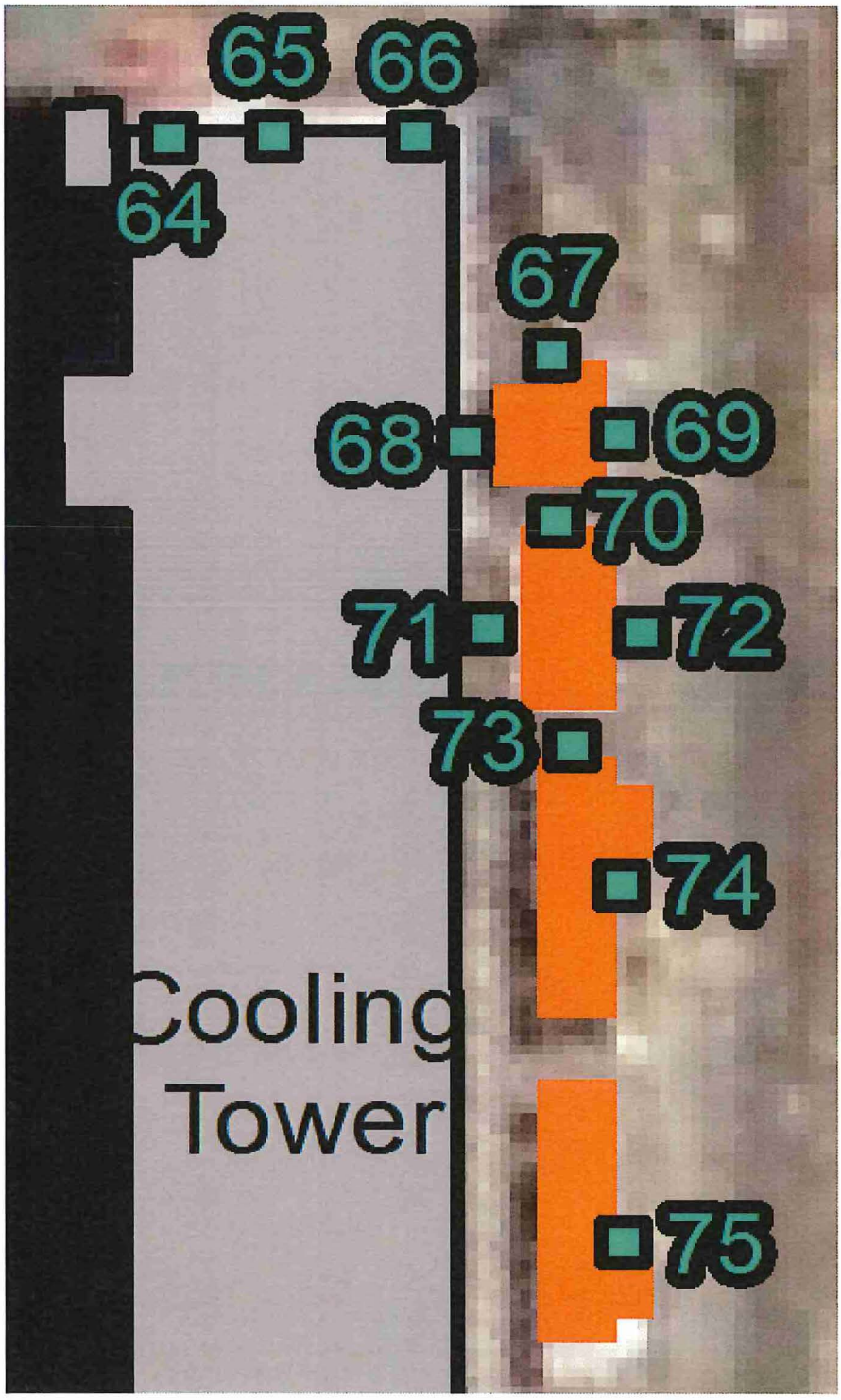
Points of Interest 34-46



Points of Interest 47-52



Points of Interest 53-58



Points of Interest 64-75 (SEPS)