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W3F1-2017-0042

May 17, 2017

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
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SUBJECT: Focused Evaluation of External Flooding for Waterford Steam Electric Station, Unit 3 (Waterford 3)
Docket No. 50-382
License No. NPF-38

REFERENCES:

1. NRC letter to Entergy, "RFI Pursuant to Title 10 of the Code of Federal Regulations 50.54(f) Regarding Recommendations 2.1, 2.3, and 9.3 of the NTTF Review of Insights from the Fukushima Dai-ichi Accident", dated March 12, 2012 (ADAMS Accession No. ML12053A340)

2. Entergy letter to NRC, "Flood Hazard Reevaluation Report", W3F1-2015-0042, dated July 21, 2015 (ADAMS Accession No. ML15204A321)

3. NRC Staff Requirements Memoranda to COMSECY-15-0019, "Closure Plan for the Reevaluation of Flooding Hazards for Operating Nuclear Power Plants", dated July 28, 2015 (ADAMS Accession No. ML15209A682).

4. NRC Letter, "Coordination of Requests for Information Regarding Flooding Hazard Reevaluations and Mitigating Strategies for Beyond-Design-Basis External Events", dated September 1, 2015 (ADAMS Accession No. ML15174A257)

5. Nuclear Energy Institute (NEI), Report NEI 16-05 [Rev 1], "External Flooding Assessment Guidelines", dated June 2016 (ADAMS Accession No. ML16165A178)

6. U.S. Nuclear Regulatory Commission, JLD-ISG-2016-01, Revision 0, "Guidance for Activities Related to Near-Term Task Force Recommendation 2.1, Flooding Hazard Reevaluation; Focused Evaluation and Integrated Assessment", dated June 11, 2016 (ADAMS Accession No. ML16162A301)

7. NRC letter to Entergy, "Interim Staff Response to Reevaluated Flood Hazards submitted in Response to 10 CFR 50.54(f) Information Request—Flood-Causing Mechanism Reevaluation", dated April 12, 2016 (ADAMS Accession No. ML16090A327)

Dear Sir or Madam:

On March 12, 2012, the NRC issued Reference 1 to request information associated with Near Term Task Force (NTTF) Recommendation 2.1 for Flooding. One of the Required Responses in Reference 1 directed licensees to submit a Flood Hazard Reevaluation Report (FHRR). Waterford 3 submitted the FHRR on July 21, 2015 (Reference 2).

A second Required Response of Reference 1 directed licensees to submit an Integrated Assessment Report for any flood causing mechanism not bounded by the current design basis. In Reference 3, the NRC affirmed that licensees need to address the reevaluated flooding hazards not bounded by the current design basis by a revised integrated assessment process that applies a graded approach. This requirement was confirmed by the NRC in more detail in Reference 4. Guidance for performing the revised process is included in Reference 5, which was endorsed by the NRC in Reference 6. The revised process applicable to Waterford 3 is the Focused Evaluation (FE).

In Reference 7, the NRC concluded that the reevaluated flood hazards information, as summarized in the Enclosure, is suitable input for the FE.

The enclosure to this letter provides the FE for External Flooding for Waterford 3. Path 2 was applied to flood mechanisms Local Intense Precipitation, Streams and Rivers, Failure of Dams and Onsite Water Control/Storage Structures, and Storm Surge. All four mechanisms are addressed by available physical margin, reliability of passive and active flood protection features, and site response demonstrated acceptable results.

This submittal of the FE completes the actions related to External Flooding required by the March 12, 2012, 10 CFR 50.54(f) letter (Reference 1).

Should you have any questions concerning the content of this letter, please contact the Regulatory Assurance Manager, John Jarrell at (504) 739-6685.

I declare under penalty of perjury that the foregoing is true and correct. Executed on May 17, 2017.

Sincerely,

MRC/AJH

Enclosure: 2017 Focused Evaluation for External Flooding at Waterford 3

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Enclosure to

W3F1-2017-0042

2017 Focused Evaluation for External Flooding at Waterford 3

(24 pages)

ENTERGY NUCLEAR
Engineering Report Cover Sheet

Engineering Report Title:

2017 FOCUSED EVALUATION FOR EXTERNAL FLOODING AT WATERFORD STEAM ELECTRIC STATION-3

Engineering Report Type:

New ☐ Revision ☒ Cancelled ☐ Superseded ☐
Superseded by: ____________

Applicable Site(s)

IP1	☐	IP2	☐	IP3	☐	JAF	☐	PNPS	☐	VY	☐	WPO	☐
ANO1	☐	ANO2	☐	ECH	☐	GGNS	☐	RBS	☐	WF3	☒	PLP	☐

EC No. 71793

Report Origin: ☐ Entergy ☒ Vendor
Vendor Document No.: ENTCORP043-REPT-002

Quality-Related: ☐ Yes ☒ No

Prepared by:	ENERCON / See attached sheets Responsible Engineer (Print Name/Sign)	Date:
Design Verified:	N/A Design Verifier (if required) (Print Name/Sign)	Date:
Reviewed by:	Stephen Picard / See associated EC Reviewer (Print Name/Sign)	Date:
Approved by:	Nicholas Petit / See associated EC Supervisor / Manager (Print Name/Sign)	Date:

Title:	2017 FOCUSED EVALUATION FOR EXTERNAL FLOODING AT WATERFORD STEAM ELECTRIC STATION-3	REPORT NO.: ENTCORP043-REPT-002
		REVISION: 1
		Client: Entergy
		Project Identifier: ENTCORP043

Item	Cover Sheet Items	Yes	No
1	Does this Project Report contain any open assumptions, including preliminary information that require confirmation? (If **YES**, identify the assumptions.)	☐	☒
2	Does this Project Report supersede an existing Project Report? (If **YES**, identify the superseded Project Report.) **Superseded Project Report No.** ______________	☐	☒

Scope of Revision:

Editorial changes were made to remove the word "portable" when referring to the diesel powered DCT sump pumps, as they are permanently pre-staged and "portable" implies the pumps are moved. Section 6.1.3.6 was also revised to remove discussion of the diesel powered DCT sump pumps being sheltered. This section now points to an NRC Inspection Report that affirms the components involved with the manual actions for flooding are accessible during the postulated adverse conditions.

Revision Impact on Results:

N/A

Safety-Related [1] ☐	**Non-Safety-Related** ☒
Originator: Brian Froese	
Design Verifier [1] (Reviewer for Non-Safety-Related): Dora Garcia	
Approver: Jared Monroe	**Date: 5/9/2017**

Note 1: Design Verification is required for all safety-related Project Reports. A review is adequate for non-safety-related Project Reports.

PROJECT REPORT REVISION STATUS

REVISION	DATE	DESCRIPTION
0	4/17/2017	Initial Issue
1	5/9/2017	Editorial changes made throughout the document to clarify the associated actions and protection of the diesel powered DCT sump pumps during a flooding event.

ATTACHMENT REVISION STATUS

APPENDIX NO.	NO. OF PAGES	REVISION	ATTACHMENT NO.	NO. OF PAGES	REVISION
N/A					

TABLE OF CONTENTS

1 EXECUTIVE SUMMARY 5
2 BACKGROUND 6
3 TERMS AND DEFINITIONS 7
4 FLOOD HAZARD PARAMETERS FOR UNBOUNDED MECHANISMS 8
5 OVERALL SITE FLOODING RESPONSE 10
5.1 DESCRIPTION OF OVERALL SITE FLOODING RESPONSE 10
5.2 SUMMARY OF PLANT MODIFICATIONS AND CHANGES 12
6 FLOOD IMPACT ASSESSMENT 13
6.1 LOCAL INTENSE PRECIPITATION – PATH 2 13
6.1.1 Description of Flood Impact 13
6.1.2 Adequate APM Justification and Reliability of Flood Protection 13
6.1.3 Adequate Overall Site Response 14
6.2 STREAMS AND RIVERS – PATH 2 17
6.2.1 Description of Flood Impact 17
6.2.2 Adequate APM Justification and Reliability of Flood Protection 17
6.2.3 Adequate Overall Site Response 18
6.3 FAILURE OF DAMS AND ONSITE WATER CONTROL/STORAGE STRUCTURES – PATH 2 18
6.3.1 Description of Flood Impact 18
6.3.2 Adequate APM Justification and Reliability of Flood Protection 18
6.3.3 Adequate Overall Site Response 19
6.4 PROBABLE MAXIMUM STORM SURGE – PATH 2 19
6.4.1 Description of Flood Impact 19
6.4.2 Adequate APM Justification and Reliability of Flood Protection 20
6.4.3 Adequate Overall Site Response 21
7 CONCLUSION 22
8 REFERENCES 23

WATERFORD STEAM ELECTRIC STATION-3 FLOODING FOCUSED EVALUATION SUMMARY

1 EXECUTIVE SUMMARY

The Waterford Steam Electric Station-3 (WSES) site has reevaluated its flooding hazard in accordance with the NRC's March 12, 2012, 10 CFR 50.54(f) request for information (RFI) (Reference 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 report. This information was submitted to the NRC in a flood hazard reevaluation report (FHRR) on July 21, 2015 (Reference 2) and is provided in the Mitigating Strategies Flood Hazard Information (MSFHI) documented in the NRC's "Interim Staff Response to Reevaluated Flood Hazards" letter dated April 12, 2016 (Reference 8). No changes to the flooding analysis have been performed since the issuance of the MSFHI letter and this flooding analysis will serve as input to this Focused Evaluation (FE). There are four (4) mechanisms that were found to exceed the Current Design Basis (CDB) flood level at WSES. These mechanisms are listed below and included in this FE:

1. Local Intense Precipitation
2. Streams and Rivers
3. Failure of Dams and Onsite Water Control/Storage Structures
4. Storm Surge

Associated effects (AE) and flood event duration (FED) parameters were assessed and submitted as a part of the Mitigating Strategies Assessment (MSA). This FE concludes that the strategy for maintaining key safety functions (KSFs) during all four (4) mechanisms has effective flood protection through the demonstration of adequate Available Physical Margin (APM) and reliable flood protection features, and that the overall site response is adequate. This FE followed Path 2 of NEI 16-05, Rev. 1 and utilized Appendices B and 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) letter.

2 BACKGROUND

On March 12, 2012, the NRC issued Reference 1 to request information associated with Near-Term Task Force (NTTF) Recommendation 2.1 for flooding. The RFI (Reference 1) directed licensees, in part, to submit a FHRR to reevaluate the flood hazards for their sites using present-day methods and guidance used for early site permits and combined operating licenses. For Waterford Steam Electric Station-3, the FHRR was submitted on July 21, 2015 (Reference 2).

Following the Commission's directive to NRC Staff in Reference 3, the NRC issued a letter to industry (Reference 6) indicating that new guidance is being prepared to replace instructions in Reference 3 and provide 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 4), which was endorsed by the NRC in Reference 5. NEI 16-05 indicates that each flood-causing mechanism not bounded by the design basis flood (using only stillwater and/or wind-wave run-up level) should follow one of the following five assessment paths:

- Path 1: Demonstrate Flood Mechanism is Bounded Through Improved Realism
- 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 would only require an FE to complete the actions related to external flooding required by the March 12, 2012 10 CFR 50.54(f) letter. Mechanisms in Paths 4 or 5 require an Integrated Assessment.

3 TERMS AND DEFINITIONS

- AE – Associated Effects
- AIMs – Assumptions, Inputs, and Methods
- APM – Available Physical Margin
- CCEF – Controlling Combined Effect Flood
- CDB – Current Design Basis
- CFS – Cubic Feet per Second
- DCT – Dry Cooling Tower
- FED – Flood Event Duration
- FIAP – Flooding Impact Assessment Process
- FHRR – Flood Hazard Reevaluation Report
- FLEX – Diverse and Flexible Coping Strategies covered by NRC order EA-12-049
- HHA – Hierarchal Hazard Assessment
- Key SSC – A System Structure or Component relied upon to fulfill a Key Safety Function
- KSF – Key Safety Function, i.e. core cooling, spent fuel pool cooling, or containment function.
- LIP – Local Intense Precipitation
- LOOP – Loss of Offsite Power
- MCC – Motor Control Center
- MSA – Mitigating Strategies Assessment as described in NEI 12-06 Rev 2, App G
- MSFHI – Mitigating Strategies Flood Hazard Information
- NAVD88 – North American Vertical Datum of 1988
- NPIS – Nuclear Plant Island Structure
- NTTF – Near Term Task Force commissioned by the NRC to recommend actions following the Fukushima Dai-ichi accidents
- NWS – National Weather Service
- PMF – Probable Maximum Flood
- PMSS – Probable Maximum Storm Surge
- RFI – Request for Information
- TCA – Time Critical Action
- TSA – Time Sensitive Action
- RFI – Request for Information
- UHS – Ultimate Heat Sink

4 FLOOD HAZARD PARAMETERS FOR UNBOUNDED MECHANISMS

The NRC has completed the "Interim Staff Response to Reevaluated Flood Hazards" (Reference 8) which contains the MSFHI related to WSES's FHRR (Reference 2). In Reference 8, the NRC states that the "staff has concluded that the licensee's reevaluated flood hazards information, as summarized in the Enclosure, 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' [Reference 7]) for Waterford, Unit 3. Further, the NRC staff has concluded that the licensee's reevaluated flood hazard information is a suitable input for other assessments associated with Near-Term Task Force Recommendation 2.1 'Flooding.'" The enclosure to Reference 8 includes a summary of the CDB and reevaluated flood hazard parameters. In Table 1 of the enclosure to Reference 8, the NRC lists the following flood-causing mechanisms for the Current 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; and
- Channel Migrations/Diversions.

In Table 2 of the enclosure to Reference 8, the NRC lists flood hazard information (specifically stillwater elevation and wind-wave run-up elevation) for the following flood-causing mechanisms that are not bounded by the CDB hazard flood level at WSES:

- Local Intense Precipitation
- Streams and Rivers
- Failure of Dams and Onsite Water Control/Storage Structures
- Storm Surge

It should be noted that the "storm surge" flood-causing mechanism for WSES also includes the NUREG/CR-7046 (Reference 9), Section H.3.2, Combined-Effects Flood (Floods along Shores of Open and Semi-Enclosed Bodies of Water (Streamside Location)). These are the reevaluated flood-causing mechanisms that should be addressed in the external flooding assessment. The four non-bounding flood mechanisms for WSES are described in detail in Reference 2, the FHRR submittal. The following summarizes how these unbounded mechanisms were addressed in this external flooding assessment:

	Flood Mechanism	Summary of Assessment
1	Local Intense Precipitation	Path 2 was determined to be pursued for all four (4) mechanisms at WSES since all flooding vulnerabilities are addressed by flood protection features (see FIAP Path Determination Table, Section 6.3.3 of NEI 16-05). Adequate APM, reliability of passive and active flood protection features, and adequate site response are all demonstrated.
2	Streams and Rivers	
3	Failure of Dams and Onsite Water Control/Storage Structures	
4	Storm Surge	

5 OVERALL SITE FLOODING RESPONSE

5.1 DESCRIPTION OF OVERALL SITE FLOODING RESPONSE

The site response for LIP is as follows:

The WSES plant requires the use of two sump pumps in each DCT sump to maintain KSFs and Key SSCs during a LIP event. Without these, floodwaters may reach the permanently installed sump pump motors (thereby disabling them) resulting in floodwaters reaching MCCs for the UHS located inside the DCTs. Typically, only one sump pump (primary) is used. In the event of a Level Hi Annunciator, the second (alternate) pump starts per Procedure OP-500-002, Control Room Cabinet B (Reference 11). This procedure drives an action to place a diesel powered DCT sump pump into service within 30 minutes if one of the two permanently installed motor driven sump pumps is inoperable and the alarm has not cleared. These diesel powered DCT sump pumps (one for each of the A & B sumps) are permanently pre-staged and effectively serve as a backup to the permanently installed motor driven sump pumps.

Procedure OP-901-521, Severe Weather and Flooding (Reference 10), echoes this action to place a diesel powered DCT sump pump into service for a Severe Thunderstorm Watch/Warning and a Hurricane or Tropical Storm Watch/Warning if the Level Hi alarm does not clear within 30 minutes and one of the permanently installed motor driven pumps is inoperable. This satisfies the recommended action from the FHRR (Reference 2) that two DCT sump pumps are required to be in operation within 30 minutes to ensure flood levels remain below the height of the permanently installed sump pump motors and the MCCs inside the DCTs.

Procedure OP-901-521 also utilizes severe weather triggers and weather monitoring to station qualified personnel at the permanently installed motor driven or diesel powered DCT sump pumps (if a permanently installed motor driven pump is non-functional) once the forecasted precipitation trigger defined in OP-901-521 is reached. There are additional sump pumps identified in this procedure that also have personnel stationed at them once the precipitation trigger is reached; however, these other sump pumps are not credited in the FHRR (Reference 2).

In the event of a LOOP, which is assumed to occur during a LIP per Section 3.1.2.3.3 of the FHRR, procedures OP-902-003 (Reference 21) and OP-902-009 (Reference 22) drive an action to energize the permanently installed motor driven DCT sump pumps from Emergency Power. This was already included as part of the design basis and is not a result of the reevaluated flood levels.

Recirculation Barriers on the DCTs are planned to be installed per EC 52043 (Reference 12), which will consist of flat roof and rain gutter systems that direct a large portion of the rainfall out of the DCT area. These enhancements are not credited in the

FHRR, but will provide additional margin. Also not credited in this evaluation, additional defense-in-depth is provided by FLEX (as confirmed in the MSA, Reference 17).

For precipitation external to the NPIS, all Key SSCs are located within the NPIS, which is a "reinforced concrete box structure with solid exterior walls" and protected from external flooding to elevation 29.18 ft MSL (Reference 2, Section 3.1.1.2). Exterior doors that lead to areas containing safety-related equipment within the NPIS located below the flood-protected elevation are watertight and verified closed via actions in procedure OP-901-521 (Reference 10). Plant personnel are also required to inspect all exterior penetrations by the same procedure. The LIP maximum water surface elevations outside the NPIS range from 16.4 ft MSL to 20.5 ft MSL per Section 3.1.1.2.4 of the FHRR. This is significantly below the NPIS protected elevation of 29.18 ft MSL.

With the change to place a diesel powered DCT sump pump into service in 30 minutes now incorporated into plant procedures, instead of the original 3 hours as discussed in Section 5.1.1 of the FHRR (Reference 2), all KSFs and Key SSCs will remain available during the LIP event.

The site response for Streams and Rivers is as follows:

Per Section 3.2.3 of the FHRR (Reference 2), the peak PMF water surface elevation in the Mississippi River at WSES is 29.9 ft MSL. This peak elevation is slightly below the top elevation of the levee that is at 30.0 ft MSL. Therefore, there is no impact to Key SSCs from this flooding event, as it does not reach the NPIS.

The site response for Failure of Dams and Onsite Water Control/Storage Structures is as follows:

Per Section 3.3.2 of the FHRR (Reference 2), the maximum peak combined dam failure and PMF flood height was calculated to be 29.9 ft MSL (28.5 ft NAVD88), which is the same as the peak Mississippi River PMF water surface elevation. The levee protection height of 30.0 ft MSL bounds this flood mechanism and therefore there is no impact to Key SSCs. There were four (4) additional dam break scenarios also included in Table 2 of the ISR (Reference 8), however these are all significantly lower in elevation than the bounding scenario discussed and therefore also do not impact Key SCCs.

The site response for a Storm Surge (Controlling Combined Effect Flood) is as follows:

This FE demonstrates that no flooding propagation pathways that contain Key SSCs are challenged by the flood waters during the CCEF event. The calculated stillwater and significant wave crest elevations are below the CDB stillwater level and thus the hydrodynamic loading is considered bounded. The low flow velocity of the CCEF event would also limit the potential for significant debris load impact force on the NPIS and this is bounded by the missile load requirements of the NPIS exterior wall. Wave overtopping of the NPIS into the DCTs is minimal and does not impact the permanently installed sump pump motors or MCCs. This overtopping is also bounded by the LIP and does not credit protection from the planned roof and rain gutter systems. An additional penetration into the heat and ventilation (H&V) fan room was also evaluated and determined not to be impacted since the maximum wave crest does not reach the bottom of the air intake to this room.

Therefore, no Key SSCs are impacted by this event. This CCEF also bounds the PMSS from the Gulf of Mexico identified in the ISR (Reference 8), which is below the CDB stillwater elevation of 27.6 ft MSL and does not impact any Key SSCs.

5.2 Summary of Plant Modifications and Changes

There are no additional open items or planned changes other than the Recirculation Barrier enhancements being added to the DCTs per EC 52043 (Reference 12), which are not credited in this FE other than as defense in depth.

6 FLOOD IMPACT ASSESSMENT

6.1 LOCAL INTENSE PRECIPITATION – PATH 2

6.1.1 DESCRIPTION OF FLOOD IMPACT

The DCTs are located within the NPIS wall. Conservatively neglecting the planned roof and rain gutter systems as discussed in Section 5.1, these DCTs are assumed to be open vertically to the atmosphere. As a result, there is potential for precipitation to infiltrate directly into the DCT areas. Inside DCT A and DCT B, there are two permanently installed motor driven sump pumps and MCCs for the UHS that are potentially vulnerable to flooding. Crediting two DCT sump pumps activating within 30 minutes, either two permanent motor driven pumps or one diesel powered pump and one permanent motor driven pump, the APM is calculated based on the critical heights (above building slab) of the permanently installed sump pump motors in Table 1. These heights are taken from the FHRR (Reference 2).

Table 1 – LIP APM

Areas with SSCs Potentially Impacted due to Flooding	Maximum Flood Height with 2 Pumps Starting After 30 Minutes	Sump Pump Motor Height (Above Building Slab)	MCCs for the UHS Height (Above Building Slab)	APM
DCT Basin A	1.40 ft	1.417 ft	1.66 ft	0.017 ft
DCT Basin B	1.50 ft	1.513 ft	1.65 ft	0.013 ft

6.1.2 ADEQUATE APM JUSTIFICATION AND RELIABILITY OF FLOOD PROTECTION

As indicated in Table 1, the minimum APM between the DCT Basin flood height and the permanently installed sump pump motors is 0.013 ft. While this is relatively small, 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 the LIP analysis are conservative and the Recirculation Barrier enhancements planned for the DCTs from EC 52043 (Reference 12) were conservatively not included, this APM is adequate. The following are examples of conservatisms used in the NPIS LIP analysis (Reference 23):

1. A loss of offsite power (LOOP) was conservatively assumed to simultaneously occur during the LIP.

2. Each DCT sump pump is rated for 350 gpm. The pump flow was conservatively reduced to 300 gpm while aligned with an inoperable circulating water system which was assumed to occur during a LOOP. This assumption also applies to the diesel powered DCT sump pumps.

3. It was conservatively assumed that rainfall on the wet cooling towers would contribute to DCT Basin ponding.

These DCT sump pumps (both motor driven and diesel powered) are already credited as part of the CDB flood protection and therefore are Type 1 features. Per NEI 16-05 Appendix B Section B.2, a reliability analysis to reconstitute all aspects of the original barrier design is not required. These pumps, defined as Active Features in NEI 16-05 Appendix B Section B.2.2.1, do not face any increased impacts from the FHRR since the credited pumping capacity remains the same. The only change is a diesel powered DCT sump pump is now placed into service within 30 minutes instead of within 3 hours, in the event one of the permanently installed motor driven pumps is inoperable.

6.1.3 ADEQUATE OVERALL SITE RESPONSE

This evaluation, performed in accordance with NEI 16-05 Appendix C, has demonstrated the overall site flooding response to a LIP event is adequate. Through updates to the strategy following the completion of the FHRR (interim actions identified in Reference 2), flooding of the DCT basins is prevented via the use of sump pumps. Placement of a diesel powered DCT sump pump into service in the event one of the permanently installed motor driven pumps is inoperable is the only manual action required as part of the site flooding response and has already been integrated into procedures OP-901-521 (Reference 10) and OP-500-002 (Reference 11). This action is defined and tracked as a Time Critical Action (TCA-16) under WSES procedure UNT-007-067 (Reference 14).

In the event of a LOOP, which can occur during a LIP, the permanently installed motor driven DCT sump pumps are energized from Emergency Power per procedures OP-902-003 (Reference 21) and OP-902-009 (Reference 22). This action is tracked as TCA-15 under WSES procedure UNT-007-067 (Reference 14) to ensure completion within 30 minutes. Response to a LOOP is considered different from the external flood response strategies based on the content of Appendix C in NEI 16-05 (Reference 4). Therefore, an Appendix C evaluation of the site response to a LOOP is not required or included in this FE.

There are no Time Sensitive Actions (TSAs) required as part of the site flooding response. The following sections outline the results of evaluating the criteria in NEI 16-05 Appendix C.

6.1.3.1 DEFINING CRITICAL PATH AND IDENTIFYING TIME CRITICAL ACTIONS

The overall strategy for protecting the WSES Plant from a LIP event contains relatively simple and straightforward actions as identified in OP-901-521 (Reference 10), Severe Weather and Flooding. Operators are staged at sump pumps once defined precipitation triggers are reached. The only TCA identified in this procedure is:

1. Place diesel powered DCT sump pump into service within 30 minutes if the Level Hi Annunciator is illuminated and one of the associated motor driven pumps is inoperable.

6.1.3.2 Demonstration that all Time Critical Actions are Feasible

Time Critical Operator Actions are identified, controlled, validated, and documented as Time Critical Action (TCA) tasks in procedure UNT-007-067 (Reference 14). Baseline validation for a TCA requires at least three (3) different performers in order to provide reasonable assurance that the TCA can be completed within the required time and an average completion time of less than or equal to 80% of the required time is desired.

For TCA-16, placing a diesel powered DCT sump pump into service, the Time Critical Action Program Bases Document (Reference 20) states that walkthroughs performed both prior to and during the NRC inspection for this flood event have shown that a diesel powered DCT sump pump can be placed in service within 5 minutes from the time the order is received. Since validation is covered under the TCA program, validation under NEI 12-06 Appendix E for TSAs has been satisfied by TCA-16.

6.1.3.3 Establishing Unambiguous Procedural Triggers

The site will receive a Severe Thunderstorm Watch/Warning, Hurricane Watch/Warning, or Tropical Storm Watch/Warning from the NWS. This will be the trigger for initiating OP-901-521 (Reference 10). This procedure directs the monitoring of the 24-Hour Forecast 95th percentile value of Precipitation Amount for the next three days. If this three-day forecast anticipates a rainfall amount of ≥10 inches over any 24-hour period, then qualified personnel are stationed at the associated sump pumps listed in Attachment 1 of this procedure, which includes the DCT sump pumps. Once the DCT Level Hi alarm annunciates, this triggers the TCA to place the diesel powered DCT sump pump into service within 30 minutes if one of the permanent motor driven pumps is inoperable.

The trigger value of ≥10 inches over 24-hours three days out was reviewed against the guidance provided in NEI 15-05 (Reference 18). Per the NOAA Precipitation Frequency Estimates at the nearest location to WSES (Reference 19, Reserve Station), this is comparable to a 25-year storm and has an associated 1-hr rainfall amount of approximately 4.0 inches. By comparison, the 1-hr LIP rainfall is 15.8 inches and the 1-hr CDB rainfall is 11.67 inches. Conservatively (with respect to frequency) taking the 1-hr CDB rainfall as the consequential flood, one half of this value (as defined by the trigger in NEI 15-05) is equal to 5.8 inches and is roughly equivalent to a 200-year storm by the same NOAA Precipitation Frequency Estimates. Therefore, this forecasted precipitation trigger of ≥10 inches over 24-hours three days out is conservatively low as the Severe Weather and Flooding procedure OP-901-521 (Reference 10) will be initiated more frequently than is recommended by the NEI 15-05 guidance.

6.1.3.4 Proceduralized and Clear Organizational Response to a Flood

OP-901-521 (Reference 10) provides clear guidance in Section E of the procedure on actions that are required to be taken once the NWS notification is received. The first action to occur at the site is make the applicable plant page announcement and advise the Shift Manager to take specific actions. As there is only one TCA in this procedure for personnel qualified to operate the diesel powered DCT sump pump, additional actions taking place simultaneously do not detract or otherwise undermine the success of this TCA.

OP-901-521 has been determined to have very clear guidelines for severe weather preparations and organizational response. Checklists are included as attachments to the procedure and identity all operating sump pumps, all NPIS penetrations below El. 30 ft MSL, and all NPIS exterior watertight doors below El. 30 ft MSL to ensure that all responsible organizations understand the actions they need to perform and the appropriate priority is given to each action.

6.1.3.5 Detailed Flood Response Timeline

As discussed in previous sections, the only TCA as part of the external flooding response occurs when one of the permanently installed sump pumps is inoperable. Completion of this action is validated via Time Critical Action Program Procedure UNT-007-067 (Reference 14). Additional actions such as stationing personnel at sump pumps, verifying exterior doors are closed, and verifying the integrity of exterior penetrations as defined in OP-901-521 have ample time to be completed. For a precipitation event, once a Severe Thunderstorm Watch/Warning, Hurricane Watch/Warning, or Tropical Storm Watch/Warning is issued by the NWS, the 24-Hour Forecast 95th percentile value of Precipitation Amount is monitored for the proceeding three days.

6.1.3.6 Accounting for the Expected Environmental Conditions

Given the short amount of time expected to complete the action, it is highly unlikely that conditions will deteriorate enough to impede placement of the diesel powered DCT sump pump into service if required. These pumps are placed in close proximity to the permanently installed motor driven pumps and operators are already staged in the cooling tower area per procedure when a rainfall event of this magnitude is predicted. Per Section 6.1.3.2, the validated time of <5 minutes is significantly less than the required time of 30 minutes, which provides substantial margin to account for the environmental conditions. Also, per NRC Inspection Report 05000382/2016001 (Reference 25, Section 4OA5), inspectors walked down the manual actions associated with flooding to verify the procedures and involved components are accessible during postulated adverse conditions.

6.1.3.7 Demonstration of Adequate Site Response

The site response to a LIP has been demonstrated as adequate by meeting the guidelines in NEI 16-05 Appendix C. There is only one TCA as part of the external flooding response in the event one of the permanently installed motor driven DCT sump pumps becomes unavailable, which has been validated per Program Procedure UNT-007-067 (Reference 14).

6.2 Streams and Rivers – Path 2

6.2.1 Description of Flood Impact

The PMF on the Mississippi River will not impact any structures that contain Key SSCs. As discussed in Section 5.1, the peak PMF water surface elevation in the Mississippi River at WSES is 29.9 ft MSL, which is slightly below the top elevation of the levee, which is at 30.0 ft MSL. This results in an APM of 0.1 ft as shown in Table 2. Therefore, protection of all Key SSCs is provided by the levee. APM justification is provided below in Section 6.2.2 and no further evaluation is required.

Table 2 – Streams and Rivers APM

Mississippi River PMF Stillwater Elevation	Levee Elevation	APM
29.9 ft MSL	30.0 ft MSL	0.1 ft

6.2.2 Adequate APM Justification and Reliability of Flood Protection

Protection of all Key SSCs is provided by the levee, which is inherently permanently installed and passive. Per NEI 16-05 Appendix B Section B.1, the APM of 0.1 ft is adequate since the AIMs used in the PMF analysis were conservative. The levee is considered reliable per Appendix B Section B.2.1.1 since the maximum water surface elevation is within the freeboard and there is no wave run-up or overtopping. The following are examples of conservatisms used in the PMF analysis (Reference 15):

1. The Project Design Flood was conservatively assumed to be 40 percent of the PMF, which is more conservative than the UFSAR, where the Project Design Flood was assumed to be 60 percent of the CDB flood.

$$PMF\ Peak\ Flow = PDF \times \left(\frac{1}{0.4}\right) = PDF \times 2.5$$

2. The PMF was conservatively modeled as steady state.

3. The Bonnet Carre Spillway and Floodway, located downstream of WSES, was conservatively not modeled.

6.2.3 Adequate Overall Site Response

There are no required manual actions for this response to be successful and, therefore, an evaluation of the overall site response is not necessary.

6.3 Failure of Dams and Onsite Water Control/Storage Structures – Path 2

6.3.1 Description of Flood Impact

The combined dam failure and PMF flood height will not impact any structures that contain Key SSCs. As discussed in Section 5.1, the peak water surface elevation was calculated to be 29.9 ft MSL, which is the same as the peak Mississippi River PMF and slightly below the top elevation of the levee, which is at 30.0 ft MSL. This results in an APM of 0.1 ft as shown in Table 3. Therefore, protection of all Key SSCs is provided by the levee. APM justification is provided below in Section 6.3.2 and no further evaluation is required.

Table 3 – Dam Failure APM

Dam Failure Stillwater Elevation	Levee Elevation	APM
29.9 ft MSL	30.0 ft MSL	0.1 ft

6.3.2 Adequate APM Justification and Reliability of Flood Protection

Protection of all Key SSCs is provided by the levee, which is inherently permanently-installed and passive. Per NEI 16-05 Appendix B Section B.1, the APM of 0.1 ft is adequate since the AIMs used in the Dam Failure analysis were conservative. The levee is considered reliable per Appendix B Section B.2.1.1 since the maximum water surface elevation is within the freeboard and there is no wave run-up or overtopping. The following are examples of conservatisms used in the analysis (Reference 16):

1. Dams for each watershed were combined and treated as one hypothetical dam / reservoir with hypothetical dam geometry and parameters calculated based on the information provided in the National Atlas database. The combined dam for each watershed was placed at the location of the most downstream dam within the watershed.

2. The estimate of storage volume for the hypothetical dam was based on conservatively assuming reservoir levels for each individual dam are at maximum storage volumes (i.e., top of dam).

3. The hypothetical dam height (i.e., maximum water level) was conservatively assumed to be equal to the maximum individual dam height.

6.3.3 Adequate Overall Site Response

There are no required manual actions for this response to be successful and, therefore, an evaluation of the overall site response is not necessary.

6.4 Probable Maximum Storm Surge – Path 2

6.4.1 Description of Flood Impact

The CCEF flood scenario results in a maximum stillwater level at the NPIS of 26.0 ft MSL, a significant wave crest elevation of 26.9 ft MSL, a maximum reflected wave crest elevation of 31.8 ft MSL, and a resulting overtopping rate at DCT B of 0.1 cfs (Reference 2). The maximum stillwater elevation of 26.0 ft MSL is bounded by the CDB stillwater elevation of 27.6 ft MSL. Due to the configuration of the site and the CCEF, wave propagation will only crest against the WSES site on the east side of the NPIS. The significant wave crest is 26.9 ft MSL, which is also below the bounding CDB stillwater level and NPIS minimum protection height of 29.18 ft MSL. Thus, hydrodynamic loading is considered bounded by the CDB flood given it has a higher stillwater level. The low flow velocity of the CCEF event would also limit the potential for significant debris load impact force on the NPIS (Reference 2, Section 5.2.1).

Using the overtopping rate to the DCT B Basin of 0.1 cfs, the time required to reach a threshold ponding depth within DCT Basin B (without crediting sump pumps) was calculated using a mass-balance approach as 28.9 hours (Reference 2, Section 3.9.3.3). The duration of maximum wave overtopping from the CCEF at DCT B is about 5.3 hours (Reference 2, Section 3.9.4) and therefore not long enough to reach this level. Furthermore, this is bounded by the peak inflow to DCT Basin B due to the LIP, which is 15.9 cfs during the first 5-minute burst of rainfall and 0.59 cfs during hours 2 through 6 of the LIP (after the front-loaded, 1-hr LIP) as noted in Section 3.9.3.3 of the FHRR. This also does not credit the Recirculation Barriers on the DCTs that are planned to be installed per EC 52043 (Reference 12). Therefore, the permanently installed sump pump motors and MCCs for the UHS in the DCT basins are not impacted by this event.

An additional area that is subject to the effects of the CCEF that was evaluated in the WSES MSA (Reference 17) is the air intake of the heat and ventilation (H&V) fan room. The H&V fan room air intake is located at an elevation of 31.16 ft MSL (includes settlement) and is covered by missile protection grating. This air intake is 9 ft wide and located in an area designated by the FHRR as the "southeast side" of the NPIS (different from the "east side"). In this location, the maximum reflected wave height was calculated to be 31 ft MSL. This provides a margin of 0.16 ft or approximately 2 inches from the top of the reflected wave to the bottom of the grate. In addition, the H&V fan room air intake is protected by the grating. This grating juts out from the wall, such that the bottom bar will obstruct any unexpected wave splashing.

Given that flooding of the DCTs is not impacted due to the short duration of overtopping and the stillwater/significant wave crest elevations are bounded by the

CDB, the air intake grating to the H&V fan room becomes the basis for calculating the APM, which is shown in Table 4.

Table 4 – CCEF APM

Reflected Wave Height Along the Southeast Side of the NPIS	H&V Fan Room Air Intake	APM
31.0 ft MSL(1)	31.16 ft MSL(2)	0.16 ft

(1)Includes a reduction of 0.8 ft based on a stillwater elevation of 24.56 ft MSL along the southeast side of the plant, compared to 25.4 ft MSL along the east side which produces the maximum height of 31.8 ft MSL per the WSES MSA (Reference 17).
(2)Accounts for settlement of the NPIS per the WSES MSA (Reference 17).

As defense in depth, flooding procedure OP-901-521 (Reference 10) already identifies specific triggers to begin plant preparation in the event of a flood or storm. This includes relocation of the "N+1" FLEX equipment for a river flood ≥25 feet MSL. The "N" set of equipment is already stored within the NPIS.

6.4.2 Adequate APM Justification and Reliability of Flood Protection

Utilizing the Guidance in NEI 16-05 Appendix B, the APM is found to be adequate for the CCEF event. As discussed in Section 6.4.1, wave overtopping into the DCTs does not impact the permanently installed sump pump motors or MCCs for the UHS due to the small volumetric flow rate of 0.1 cfs and short maximum duration of 5.3 hours. This does not credit activation of the sump pumps, which are integrated into procedure OP-901-521 (Reference 10). There are no TCAs identified in this procedure for a flood. While this is not required for the CCEF, if one of the permanently installed motor driven DCT sump pumps is unavailable, OP-901-521 drives an action to place a diesel powered DCT pump into service within 3 hours. This is bounded by the 30-minute TCA for LIP.

As stated in Section 6.4.1, the CCEF stillwater and significant wave crest elevation are below the NPIS and the hydrodynamic loads are bounded. The NPIS is already credited as part of the CDB flood protection and therefore is a Type 1 feature. Per Appendix B of NEI 16-05, a reliability analysis to reconstitute all aspects of the original barrier design is not required.

As indicated in Table 4, there is APM between the CCEF reflected wave height and H&V fan room air intake, but this margin is also very small. Per NEI 16-05 Appendix B Section B.1, this is adequate since the AIMs used in the CCEF analysis were conservative. Several examples of conservatisms include (Reference 13):

1. A conservative methodology based on the American Society of Civil Engineers (ASCE) 7-10 guidance was used to calculate the standing wave crest elevation at the east side of the NPIS, in order to determine if there would be wave overtopping into the NPIS.

2. The effects of the vehicle barriers were conservatively ignored in this calculation since they are not flood protection structures.

3. Based on the HHA approach, levee breach was conservatively assumed to occur at a single location (e.g., multiple levee breaches would reduce the water level in the Mississippi River and thus reduce available hydraulic head to drive the levee failure flood).

6.4.3 ADEQUATE OVERALL SITE RESPONSE

Due to the short duration and small flow rate of overtopping into the DCTs, there are no TCAs required for this event. OP-901-521 drives an action to place a diesel powered DCT sump pump into service within 3 hours in the event of a Mississippi River flood, however this not required and is already bounded by the 30-minute requirement for a LIP in Section 6.1. OP-901-521 also verifies all exterior doors are shut and verifies the integrity of exterior penetrations.

7 CONCLUSION

The FHRR showed that four (4) flooding mechanisms were not bounded by the CDB and were required to be evaluated in this FE. The first mechanism, LIP, was calculated to generate a water level that exceeds the permanently installed sump pump motors in the event one of the two pumps in the DCT basins is inoperable. Therefore, WSES has already integrated a TCA that both permanently installed motor driven sump pumps for each DCT sump must be operational or a diesel powered DCT sump pump needs to be placed into service within 30 minutes. There is another TCA in the event of a LOOP to energize the permanently installed motor driven DCT sump pumps with Emergency Power. Both of these have been validated through the site's Time Critical Action Program. This FE demonstrated the site response is adequate.

The second and third mechanisms not bounded by the CDB are the Mississippi River PMF and dam failure events. These flooding heights are below the elevation of the levee and adequate APM was demonstrated. There are no manual actions relied on and no Key SSCs are impacted from these events.

The fourth mechanism that was not bounded by the CDB is the storm surge or CCEF. All buildings that have Key SSCs have been shown to have adequate APM for this mechanism. For the H&V fan room, the reflected wave height is below the bottom of the air intake. For the DCT B Basin, the permanently installed sump pump motors and MCCs for the UHS are also not impacted by flooding due to the small overtopping rate and short duration. The hydrodynamic loads and debris impacts caused by this storm are also bounded by the CDB. Therefore, no water intrusion or accumulation is anticipated in rooms with Key SSCs and the plant will be able to maintain all KSFs throughout the event. There are also no time critical manual actions required for this event, although a diesel powered DCT sump pump will be placed into service in the event one of the permanently installed motor driven sump pumps is inoperable as defense in depth.

Finally, for all four 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 (Reference 17) and the NRC MSA Staff Assessment (Reference 24).

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

8 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; dated March 12, 2012.

2. W3F1-2015-0042, Flood Hazard Reevaluation Report Waterford Steam Electric Station, Unit 3 (Waterford 3) Docket No. 50-382, License No. NPF-38, dated July 21, 2015.

3. 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.

4. Nuclear Energy Institute (NEI), Report NEI 16-05 [Rev 1], External Flooding Assessment Guidelines, dated June 2016.

5. U.S. Nuclear Regulatory Commission, JLD-ISG-2016-01 [Rev 0], Guidance for Activities Related to Near-Term Task Force Recommendation 2.1, Flood Hazard Reevaluation; Focused Evaluation and Integrated Assessment, dated July 11, 2016.

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

7. Nuclear Energy Institute (NEI), Report NEI 12-06 [Rev 2], Diverse and Flexible Coping Strategies (FLEX) Implementation Guide, dated December 2015.

8. Waterford Steam Electric Station, Unit 3 – Interim Staff Response to Reevaluated Flood Hazards Submitted In Response To 10 CFR 50.54(f) Information Request – Flood-Causing Mechanism Reevaluation (CAC No. MF7125), dated April 12, 2016.

9. NUREG-7046, Design-Basis Flood Estimation for Site Characterization at Nuclear Power Plants in the United States of America, November 2011.

10. OP-901-521, Rev. 323, Severe Weather and Flooding.

11. OP-500-002, Rev. 030 (Including Markup from EC53393), Control Room Cabinet B.

12. EC 52043, Rev. 0 (DRAFT), UHS Margin Restoration – Cooling Tower Recirculation Reduction.

13. WF3-CS-15-00017, Rev. 000, Waterford Steam Electric Station Flooding Hazard Re-evaluation – Combined Effects.

14. UNT-007-067, Rev. 000, Time Critical Action Program.

15. WF3-CS-15-00012, Rev. 000, Waterford Steam Electric Station Flooding Hazard Re-evaluation - Probable Maximum Flood.

16. WF3-CS-15-00013, Rev. 000, Waterford Steam Electric Station Flooding Hazard Re-evaluation - Dam Failure.

17. WF3-MS-16-00001, Rev. 000, 2016 Mitigating Strategies Assessment for Flooding Documentation Requirements at Waterford 3.

18. NEI 15-05, Rev. 6, Warning Time for Local Intense Precipitation Events.

19. Hydrometeorological Design Studies Center NOAA, Precipitation Frequency Data Server, NOAA < http://hdsc.nws.noaa.gov/hdsc/pfds/> [Accessed February, 2017].

20. TCAPB, Time Critical Action Program Bases, Rev. 000.

21. OP-902-003, Rev. 010, Loss of Offsite Power/Loss of Forced Circulation Recovery.

22. Op-902-009, Rev. 315, Standard Appendices.

23. WF3-CS-15-00018, Rev. 0, Waterford Steam Electric Station unit 3 Fukushima Flood Hazard Re-evaluation – NPIS Local Intense Precipitation.

24. Waterford Steam Electric Station, Unit 3 – Flood Hazard Mitigation Strategies Assessment (CAC No. MF7989), dated February 27, 2017.

25. NRC Letter, Waterford Steam Electric Station, Unit 3 – NRC Integrated Inspection Report 05000382/2016001, dated April 25, 2016.