Entergy Operations, Inc.
17265 River Road
Killona, LA 70057-3093
Tel 504-739-6660
Fax 504-739-6678
mchisum@entergy.com

Michael R. Chisum
Vice President - Operations
Waterford 3

W3F1-2016-0064

November 14, 2016

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
11555 Rockville Pike
Rockville, MD 20852

Subject: Mitigating Strategies Assessment (MSA) Report for Flooding Hazard
Waterford Steam Electric Station, Unit 3 (Waterford 3)
Docket No. 50-382
License No. NPF-38

References:

1. NRC letter to Entergy, 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
(ADAMS Accession Number ML12053A340)
2. Entergy letter to NRC, Flood Hazard Reevaluation Report, W3F1-2015-0042, dated July 21, 2015
(ADAMS Accession Number ML15204A321)
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 (ADAMS Accession Number ML 15089A236)
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 Number ML15174A257)
5. Nuclear Energy Institute (NEI), Report NEI 12-06, Revision 2, Diverse and Flexible Coping Strategies (FLEX) Implementation Guide, dated December 2015
(ADAMS Accession Number ML15348A015)
6. U.S. Nuclear Regulatory Commission, JLD-ISG-2012-01, Revision 1, Compliance with Order EA-12-049, Order Modifying Licenses with Regard to Requirements for Mitigating Strategies for Beyond-Design-Basis External Events, dated January 22, 2016
(ADAMS Accession Number ML1537A163)

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 Number 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). The Waterford 3 FHRR was submitted on July 21, 2015 (Reference 2).

Concurrent with the flood hazard reevaluation, Waterford 3 developed and implemented mitigating strategies in accordance with NRC Order EA-12-049, "Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond Design-Basis External Events". In Reference 3, the NRC affirmed that licensees need to address the reevaluated flooding hazards within their mitigating strategies for beyond-design basis (BDB) external events, including the reevaluated flood hazards. This requirement was confirmed by the NRC in Reference 4. Guidance for performing MSA for Flooding is contained in Appendix G of Reference 5, endorsed by the NRC in Reference 6. For the purpose of the MSA for Flooding and in Reference 4, the NRC termed the reevaluated flood hazard, summarized in Reference 7, as the "Mitigating Strategies Flood Hazard Information" (MSFHI). Reference 5, Appendix G, describes the MSA for Flooding.

In Reference 7, the NRC concluded that the "reevaluated flood hazards information, as summarized in the Enclosure, is suitable for the assessment of mitigating strategies developed in response to Order EA-12-049 for Waterford, Unit 3."

The enclosure to this letter provides the Mitigating Strategies Assessment for Flooding Report for Waterford 3. The assessment concluded that the existing FLEX strategy can be successfully implemented and deployed as designed for all applicable flood-causing mechanisms.

This letter contains no new regulatory commitments.

Should you have any questions regarding this submittal, please contact John Jarrell, Regulatory Assurance Manager, at (504) 739-6685.

I declare under penalty of perjury that the foregoing is true and correct. Executed on November 14, 2016.

Sincerely,

MRC/AJH

Enclosure: Mitigating Strategies Assessment for Flooding Report

cc: Mr. Kriss Kennedy, Regional Administrator
U. S. NRC, Region IV
RidsRgn4MailCenter@nrc.gov

NRC Project Manager for Waterford 3
April.Pulvirenti@nrc.gov

NRC Senior Resident Inspector for Waterford 3
Frances.Ramirez@nrc.gov
Chris.Speer@nrc.gov

U. S. Nuclear Regulatory Commission
Robert Bernardo
Hazards Management Branch
Japan Lessons-Learned Division
MS O-13F15M
One White Flint North
11555 Rockville Pike
Rockville, MD 20852

Enclosure to

W3F1-2016-0064

Mitigating Strategies Assessment for Flooding Report

Entergy

ENTERGY NUCLEAR
Engineering Report Cover Sheet

Engineering Report Title:

2016 MITIGATING STRATEGIES ASSESSMENT FOR FLOODING DOCUMENTATION REQUIREMENTS 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. 65468

Report Origin: ☐ Entergy ☒ Vendor
Vendor Document No.: ENTCORP038-REPT-003.

Quality-Related: ☐ Yes ☒ No

Prepared by: Enercon / See attached sheets — Date: 9/7/16
Responsible Engineer (Print Name/Sign)

Design Verified: N/A — Date: _____
Design Verifier (if required) (Print Name/Sign)

Reviewed by: Stephen Picard / Stephen Picard — Date: 9/8/16
Reviewer (Print Name/Sign)

Approved by: Nicholas Petit / — Date: 9-12-16
Supervisor / Manager (Print Name/Sign)

ENERCON Excellence—Every project. Every day.	PROJECT REPORT COVER SHEET	PAGE 2 OF 20

Title:	2016 MITIGATING STRATEGIES ASSESSMENT FOR FLOODING DOCUMENTATION REQUIREMENTS AT WATERFORD STEAM ELECTRIC STATION-3	REPORT NO.: ENTCORP038-REPT-003
		REVISION: 0
		Client: Entergy
		Project Identifier: ENTCORP038

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:
Initial Issue

Revision Impact on Results:
N/A

	Safety-Related ☐	**Non-Safety-Related** ☒	
Originator:	**Dora Garcia**	Dora G Garcia	9/7/2016
Reviewer:	**Michael Cymbor**		9/7/16
Approver:	**Jared Monroe**		**Date:** 9/7/2016

ENERCON Excellence—Every project. Every day.	REVISION STATUS SHEET	PAGE 3 OF 20

2016 MITIGATING STRATEGIES ASSESSMENT FOR FLOODING DOCUMENTATION REQUIREMENTS AT WATERFORD STEAM ELECTRIC STATION-3	REPORT NO.: ENTCORP038-REPT-003
	REVISION: 0

PROJECT REPORT REVISION STATUS

REVISION	DATE	DESCRIPTION
0	9/7/2016	Initial Issue

ATTACHMENT REVISION STATUS

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

2016 Mitigating Strategies Assessment
Flooding Documentation Requirements
Waterford Steam Electric Station Unit 3

Acronyms:

- BDBEE – Beyond-Design-Basis External Event
- DB – Design Basis
- DCT – Dry Cooling Tower
- ELAP – Extended Loss of AC Power
- FHRR – Flood Hazard Reevaluation Report
- FLEX DB – FLEX Design Basis (flood hazard)
- ISFSI – Independent Spent Fuel Storage Installation
- ISR – Interim Staff Response
- LIP – Local Intense Precipitation
- MSFHI – Mitigating Strategies Flood Hazard Information (from the FHRR and MSFHI letter)
- MSIV – Main Steam Isolation Valve
- MSL – Mean Sea Level
- NPIS – Nuclear Plant Island Structure
- PMF – Probable Maximum Flood
- PMP – Probable Maximum Precipitation
- SSE – Safe Shutdown Earthquake
- UHS – Ultimate Heat Sink
- WSES – Waterford Steam Electrical Station Unit 3

Definitions:

FLEX Design Basis: The flood hazard for which FLEX was designed.

FLEX Design Basis Flood Hazard: the controlling flood parameters used to develop the FLEX flood strategies.

1. Summary

The WSES FLEX design basis flood is not affected by the results of the MSFHI. Specifically, the flood mechanisms listed below do not impact the site FLEX strategies.

- LIP event,
- PMF on the Mississippi River,
- PMF combined with an hypothetical dam break within the Mississippi River and Levee Failure at WSES and
- Combined Event H.3 (Alternative 3): 25-Year flood in the Mississippi River, probable maximum surge including antecedent water level, levee failure, and coincident wind-generated waves.

Details of the FLEX strategies along with bounding flood will be discussed later in this document. Therefore, the current FLEX strategies can be fully deployed with no additional operator actions.

2. Documentation

2.1. NEI 12-06, Rev. 2, Section G.2 – Characterization of the MSFHI.

Characterization of the MSFHI is summarized in Table 1 and Table 2 of the NRC's Interim Staff Response (ISR) (Ref. 2) to the flood hazard reevaluation submittal (Ref.1). A more detailed description of the flood mechanisms identified in the MSFHI, along with the basis for inputs, assumptions, methodologies, and models, is provided in the following references:

- LIP: Reference 1, Attachment 2, Section 3.1.
- Flooding in Streams and Rivers: Reference 1, Attachment 2, Section 3.2.
- Dam Breaches and Failures: Reference 1, Attachment 2, Section 3.3.
- Storm Surge: Reference 1, Attachment 2, Section 3.4.
- Seiche: Reference 1, Attachment 2, Section 3.5.
- Tsunami: Reference 1, Attachment 2, Section 3.6.
- Ice-Induced Flooding: Reference 1, Attachment 2, Section 3.7.
- Channel Migration or Diversion: Reference 1, Attachment 2, Section 3.8.
- Combined Effects (including wind-waves and run-up effects): Reference 1, Attachment 2, Section 3.9.

Based on the results of the flood hazard reevaluation, the ISR issued by the NRC (Ref. 2) identified that the flood mechanisms described below are not bounded by the WSES design basis flood level. Therefore, these mechanisms are evaluated as part of this mitigating strategies assessment developed in response to Order EA-12-049. All other mechanisms evaluated in the MSFHI (i.e., tsunami, seiche, ice-induced flooding, etc.) are bounded by design basis flood level and have no impact on the site.

Local Intense Precipitation (outside the NPIS)

The LIP (outside the NPIS) maximum flow depths determined by the MSFHI (Ref. 1, Attachment 2, Section 3.1.1) range from 0.5 ft. at the southeast side of the NPIS to 1.1 ft. at the southeast side of the ISFSI pad. This flood mechanism can cause certain areas along the deployment path from the "N+1" storage building (located south of the ISFSI) to become inundated. The equipment stored in the "N+1" storage building is not the primary equipment for any WSES BDBEE and only serves as a backup capability should the "N" equipment unexpectedly become unavailable. The primary storage location for a full "N" set of FLEX equipment is inside and on top of the NPIS, and all equipment stored there is protected from external flooding up to +30 ft. MSL. Because the "N" set of FLEX equipment is completely protected from external flooding, the FLEX strategies are not affected by the LIP event (outside the NPIS) and can be implemented successfully.

Local Intense Precipitation (inside the NPIS)

The LIP (inside the NPIS) maximum flow depths determined by the MSFHI around the DCT Basin A is 1.53 ft. and 1.63 ft. in DCT Basin B (Ref. 1, Attachment 2, Section 3.1.3) depending on the pumping capacity and starting time of pumps used to remove water from

the basins. The DB flow depth around these areas is 1.6 ft. (Ref.1) The maximum flow depths within the DCT basins were based on the assumption that one sump pump started 30 minutes after the initiation of the LIP event. This event also determined the ponding within the MSIV east and west areas. The resultant maximum flood depths were 0.69 ft. (east area) and 0.62 ft. (west area).

Inside DCT A and DCT B, there are sump pump motors and motor control centers (MCCs) for the ultimate heat sink (UHS) that are potentially vulnerable to flooding. Flooding can exceed the height of the sump pump motors without directly impacting plant safety, but exceeding the height of the UHS MCCs would result in loss of the UHS. Therefore, procedures (Ref. 6) have been revised to activate two sump pumps within 30 minutes after the onset of the LIP event to maintain the ponding levels below the height of the MCCs. Each DCT basin is connected via four, 4-inch-diameter pipes (each with a flapper) to the Fuel Handling Building (FHB) sub-basement (Ref. 1). This area of the FHB (-35 ft. MSL) is considered as rain water storage capability for the DCT areas.

The FLEX strategies do not credit the DCT basins nor equipment located in the FHB sub-basement. Therefore, even when the area around the DCT basins becomes inundated during an LIP event, the FLEX strategies can be implemented successfully. The “N” set of FLEX equipment is stored in indoor areas inside the NPIS. There is no FLEX equipment at the DCT basins, which are exposed to the elements. The emergency feedwater (EFW) control and isolation valves are located in the MSIV area, but the level of ponding in this area will not challenge the manual operation of these valves during an ELAP event. The travel path to get to these valves is within the Reactor Auxiliary Building (RAB) structure, which is protected from flooding; therefore, the valves are accessible. Thus, the FLEX strategies are not affected by the LIP event (inside the NPIS) and can be implemented successfully.

Probable Maximum Flood on Mississippi River

The peak water surface elevation on the Mississippi River channel resulting from the reevaluated PMF is slightly below the top of the levee of about +29.9 ft. MSL. This reevaluated level is 2.9 ft. higher than the DB flood height of +27.0 ft. MSL (Ref. 1, Attachment 2, Section 3.2.3). As mentioned above, the primary storage location for a full “N” set of FLEX equipment is inside and on top of the NPIS, and all equipment stored there is protected from external flooding up to +30 ft. MSL. In addition, if the Mississippi River level fronting the site rises to +25 ft. MSL, procedures have been revised and steps have been integrated into the severe weather strategies for relocating specific “N+1” FLEX equipment to the NPIS (Ref. 6). It has been determined that it could take 26 hours for the Mississippi River level to increase from +25 ft. MSL to +27 ft. MSL (Ref. 4); therefore, there is sufficient time to re-locate the “N+1”equipment from the “N+1” storage building to the NPIS, if required. Therefore, this event does not challenge the FLEX strategies and they can be implemented successfully.

Failure of Dams and Onsite Water Control/Storage Structures

The different scenarios for failure of dams, documented in the NRC Interim Staff Response Letter (Ref. 2, Table 2), that exceed the DB are listed below:

- PMF combined with a hypothetical dam break within the Mississippi River
- PMF combined with a hypothetical dam break at WSES site
- PMF combined with a hypothetical dam break within the Mississippi River and levee failure (East of NPIS)

- PMF combined with a SSE seismic dam failure, levee failure and induced wind waves (Northwest of NPIS)

- PMF combined with a SSE seismic dam failure, levee failure and induced wind waves (East of NPIS)

From all these scenarios, the highest reevaluated elevation is represented by the PMF combined with a hypothetical dam break within the Mississippi River with a level of +29.9 ft. MSL (Ref. 1, Attachment 2, Section 3.3.2). This value represents the elevation value at the Mississippi River with a corresponding reevaluated elevation value at the site of +20.6 ft. MSL. The bounding reevaluated elevation at the site is the PMF combined with a hypothetical dam break within the Mississippi River and levee failure (East of NPIS). For this scenario, the reevaluated hazard elevation is +27.7 ft. MSL (+22.8 ft. MSL stillwater elevation + 4.9 ft. of wave/run-up). The rest of the scenarios evaluated in the MSFHI for dam failures result in lower elevation levels at the WSES site (Ref. 1, Attachment 2, Sections 3.3.2 and 3.9.3.2), even in those cases where applicable waves run-up were taken in consideration.

The primary storage location for a full “N” set of FLEX equipment is inside and on top of the NPIS, and all equipment stored there is protected from external flooding up to +30 ft. MSL. Because the “N” set of FLEX equipment is completely protected from external flooding, the FLEX strategies are not affected by the different scenarios presented above. Therefore, the FLEX strategies can be implemented successfully. In addition, as stated above, if the Mississippi River level fronting the site rises to +25 ft. MSL, mechanisms are in place for relocating specific “N+1” FLEX equipment to the NPIS (Ref. 6), where it will be protected from external flooding.

Probable Maximum Storm Surge

The two scenarios for the PMSS, documented in the Interim Staff Response Letter (Ref. 2, Table 2), that are not bounded by the DB are:

- PMSS from Gulf of Mexico at WSES

- Combined Event H.3 (Alternative 3): 25-Year Flood in the Mississippi River, PMSS Including Antecedent Water Level, Levee Failure, and Coincident Wind-Generated Waves at Site.

From these scenarios, the bounding reevaluated elevation of +31.8 ft. MSL is represented by the Combined Event H.3 (Alternative 3). This flood scenario results in a stillwater level at the NPIS of +26 ft. MSL, a significant wave crest elevation of +26.9 ft. MSL, and a maximum wave crest elevation of +31.8 ft. MSL. This maximum wave crest elevation results in an overtopping rate of 0.0087 cubic feet per second (cfs) (Ref. 9), which is conservatively rounded up to 0.1 cfs (Ref. 1). Note this overtopping is only applicable to the eastern side of the NPIS, specifically along the DCT B outer wall. The duration of maximum wave overtopping is about 5.3 hours (Ref. 1, Attachment 2, Section 3.9.4). For this PMSS bounding event, an evaluation of the significance of the peak overtopping rate of 0.1 cfs combined with rainfall was performed using the results of the inside NPIS LIP calculation (Ref. 5) for the DCT Basin B area. The peak inflow to DCT Basin B due to the LIP is 15.9 cfs during the first 5-minute burst of rainfall. The inflow rate during hours 2 through 6 of the LIP (after the front-loaded, 1-hr LIP) is a steady 0.59 cfs. The peak wave overtopping rate of 0.1 cfs along the DCT B outer wall due to the combined event H.3 is therefore relatively low compared to the peak LIP inflow rate (Ref. 1, Attachment 2, Section 3.9.3.3). The threshold ponding depth in the DCT basin B area is 1.65 ft. The time required to reach this threshold ponding depth within DCT basin B, the area of the NPIS subject to overtopping due to wave action, was calculated to be 28.9 hours. During the LIP-inside the

NPIS, the maximum depth is attained after 1 hour (Ref. 5). Therefore, the wave overtopping rate is insignificant relative to the LIP-inside the NPIS, and it is considered bounded. Additionally, it is noted that the duration of wave overtopping of the NPIS was calculated to be approximately 5.3 hours and, therefore, the NPIS threshold depth is not attained through wave overtopping alone (Ref. 1, Attachment 2, Section 3.9.3.3).

The stillwater elevation for the combined event H.3 (+26 ft. MSL) is bounded by the stillwater elevation of the DB controlling combined effect flood scenario (+27.6 ft. MSL) and by the FLEX DB flood elevation of +30 ft. MSL. The significant wave crest of +26.9 ft. MSL is also below the bounding DB stillwater level and by the FLEX DB flood elevation. The maximum wave crest elevation is +31.8 ft. MSL, and results in overtopping of the eastern side of the NPIS at a rate of 0.1 cfs. This overtopping rate and resulting ponding in the DCT Basin B area is bounded by the LIP-inside NPIS event. As discussed above, the DCT basins are not credited as part of the FLEX strategies. Furthermore, the level of ponding at the DCT Basin B area is bounded by the level of ponding resulting from the LIP-inside NPIS event.

An additional area that is subject to the effects of the combined event H.3 on the eastern side of the NPIS 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 and is covered by a missile protection grating. This air intake is 9 ft. wide. The elevation of this air intake is calculated taking into account the settlement of the NPIS (31.98 ft. MSL (Ref. 10) – (30-29.18) ft. MSL).

The FLEX Diesel Generator Connection Panel (FLEXEPNL0001) is located within the H&V fan room, on the wall opposite to the air intake, at approximately 2 ft. above the floor.

Since the maximum wave crest elevation exceeds the bottom of the H&V air intake, an evaluation of the impact to the FLEX strategy/equipment is provided below:

The combined event H.3 results in a maximum stillwater level at the NPIS of 26.0 ft. MSL, with a maximum significant wave crest elevation of 26.9 ft. MSL, and a maximum reflected wave crest elevation of 31.8 ft. MSL with a duration of approximately 3 hours of wave overtopping (above elevation 31 ft. MSL). Since the bottom of the H&V fan room air intake (31.16 ft. MSL) is located above the stillwater level elevation and the significant wave crest elevation, only the maximum reflected wave crest elevation needs to be evaluated.

The maximum reflected wave crest elevation represents the elevation of a wave that strikes a vertical wall and reflects/splashes upwards to a maximum level of 31.8 ft. MSL. This is a function of the stillwater level and the angle of incidence against the wall, amongst other factors. The maximum value of 31.8 ft. MSL reported in the FHRR corresponds to the east side of the NPIS, where the maximum stillwater elevation is 25.4 ft. MSL. The H&V fan room air intake is 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 stillwater elevation is 24.6 ft. MSL. Therefore, since the maximum reflected wave is a function of the stillwater height, this section of the NPIS will be approximately 0.8 ft. (conservative) below the reported maximum wave reflection height of 31.8 ft. MSL, which equates to an elevation of 31 ft. MSL. This elevation provides a margin of approximately 2 inches from the bottom of the air intake to the H&V fan room, located at 31.16 ft. MSL. In addition, the H&V fan room air intake is protected by a missile grating structure. This grating juts out from the wall, such that the bottom bar will obstruct any unexpected wave splashing. Furthermore, if splashing were to get inside the room, it will not land on top of the FLEX panel due to the distance of this equipment from the H&V fan room opening.

Thus, given the short duration of the maximum reflected wave overtopping, the obstruction provided by missile grating on the opening, and the location of the FLEX panel, it can be

concluded that the FLEX equipment located in the H&V fan room is not impacted by this combined effect.

Therefore, even when the maximum reevaluated level for this event is +31.8 ft. MSL, the FLEX strategies are not affected and can be implemented successfully.

2.2. NEI 12-06, Rev. 2, Section G.3 – Comparison of the MSFHI and FLEX DB Flood

A complete comparison of the DB, the FLEX DB and reevaluated flood hazards is provided in the tables listed below:

- Table 1 reflects data from the MSFHI for the LIP (inside the NPIS).
- Table 2 reflects data from the MSFHI for the PMF on the Mississippi River.
- Table 3 reflects data from the MSFHI for the PMF combined with a hypothetical dam break within the Mississippi River and Levee Failure (bounding case for dam failure scenarios at the site).
- Table 4 reflects data from the MSFHI for the Combined Effect H.3 (25-Year Flood in the Mississippi River, PMSS Including Antecedent Water Level, Levee Failure, and Coincident Wind-Generated Waves at Site).

Table 1: Flood Causing Mechanism (LIP) (Inside of NPIS) or Bounding Set of Parameters

Flood Scenario Parameter		Plant Current Design Basis Flood Hazard	FLEX Design Basis Flood Hazard	MSFHI LIP	Bounded (B) or Not Bounded (NB) by FLEX DB
Flood Level and Associated Effects	1. Max Stillwater Elevation (Ponding)	Less than 1.6 ft. DCT ponding	See Note 1	1.63 ft. (DCT Basin B)	B See Note 1
	2. Max Wave Run-up Elevation (ft. MSL)	Minimal	N/A	See Note 2	B
	3. Max Hydrodynamic/Debris Loading (psf)	N/I	N/A	See Note 3	B
	4. Effects of Sediment Deposition / Erosion	N/I	See Note 4	See Note 4	B
	5. LIP associated effects	N/I	N/A	N/A	B
	6. Concurrent Site Conditions	N/I	N/A	N/A	B
	7. Effects on Groundwater	N/I	N/A	N/A	B
Flood Event Duration	8. Warning Time (hours)	N/I	See Note 5	See Note 6	B
	9. Period of Site Preparation (hours)	See Note 7	See Note 8	See Note 6	B
	10. Period of Inundation (hours)	N/I	See Note 9	N/I	B
	11. Period of Recession (hours)	N/I	See Note 10	N/I	B
Other	12. Plant Mode of Operations	N/I	All Modes	Normal Operations	B
	13. Other Factors	N/A	N/A	N/A	N/A

Flood Scenario Parameter	Plant Current Design Basis Flood Hazard	FLEX Design Basis Flood Hazard	MSFHI LIP	Bounded (B) or Not Bounded (NB) by FLEX DB

N/A = Not Applicable N/I = Not Included

Additional notes, 'N/A' justifications (why a particular parameter is judged not to affect the site), and explanations regarding the bounded/non-bounded determination.

1. The DCT basins are not credited as part of the FLEX strategies. Therefore, the FLEX strategies are not affected by this parameter and can be successfully implemented.
2. Consideration of wind-wave action for the LIP event is not explicitly required by NUREG/CR-7046 and is judged to be negligible because of flow depths.
3. The MSFHI did not evaluate hydrodynamic loading. Debris loading was not considered a credible hazard due to the relatively low flow velocities and limited debris sources within the NPIS. Essential Task PMRQ8620-07 was created to inspect and clean roof drains on the reactor containment building (RCB) on an annual basis to ensure they remain free of debris.
4. The NPIS is a rectangular box-like reinforced concrete structure; therefore, sediment deposition and/or erosion is considered minimal and/or non-existent.
5. The "N" set of FLEX equipment is protected and stored away from the flooding areas identified in the LIP; therefore, warning time is not applicable.
6. Operations Off-Normal Procedure for Severe Weather and Flooding, OP-901-521, includes interim actions to ensure two sump pumps are activated within 30 minutes after the onset of a LIP event.
7. During the DB probable maximum precipitation (PMP) event, it is assumed that one motor driven sump pump is engaged within 30 minutes of the onset of the event, and the diesel powered sump pump is engaged within 3 hours of the onset of the event.
8. The "N" set of FLEX equipment is protected and stored away from the flooding areas identified in the LIP; therefore, period of site preparation is not applicable
9. The "N" set of FLEX equipment is protected and stored away from the flooding areas identified in the LIP; therefore, period of inundation is not applicable
10. The "N" set of FLEX equipment is protected and stored away from the flooding areas identified in the LIP; therefore, period of recession is not applicable.

Table 2: Flood Causing Mechanism (PMF on the Mississippi River) or Bounding Set of Parameters

Flood Scenario Parameter		Plant Current Design Basis Flood Hazard	FLEX Design Basis Flood Hazard	MSFHI PMF on the Mississippi River	Bounded (B) or Not Bounded (NB) by FLEX DB
Flood Level and Associated Effects	1. Max Stillwater Elevation (ft. MSL)	27.0	30.0	29.9	B See Note 1
	2. Max Wave Run-up Elevation (ft. MSL)	N/A	N/A	N/A	B
	3. Max Hydrodynamic / Debris Loading (psf)	N/I	N/A	N/A	B
	4. Effects of Sediment Deposition/Erosion	N/I	N/A	N/I	B
	5. Associated effects (not including LIP)	N/I	N/A	N/A	B
	6. Concurrent Site Conditions	N/I	N/A	N/A	B
	7. Effects on Groundwater	N/I	N/A	N/A	B
Flood Event Duration	8. Warning Time (hours)	See Note 2	See Notes 1 and 2	N/I	B
	9. Period of Site Preparation (hours)	N/I	N/A	N/I	B
	10. Period of Inundation (hours)	N/I	See Note 3	N/I	B
	11. Period of Recession (hours)	N/I	See Note 4	N/I	B
Other	12. Plant Mode of Operations	N/I	All Modes	All Modes	B
	13. Other Factors	N/A	N/A	N/A	N/A

Flood Scenario Parameter	Plant Current Design Basis Flood Hazard	FLEX Design Basis Flood Hazard	MSFHI PMF on the Mississippi River	Bounded (B) or Not Bounded (NB) by FLEX DB
N/A = Not Applicable N/I = Not Included Additional notes, 'N/A' justifications (why a particular parameter is judged not to affect the site), and explanations regarding the bounded/non-bounded determination. 1. The primary storage location for a full "N" set of FLEX equipment is inside and on top of the NPIS, and all equipment stored there is protected from external flooding up to +30 ft. MSL. Because the "N" set of FLEX equipment is completely protected from external flooding, the FLEX strategies are not affected by this event and can be implemented successfully. 2. Operations Off-Normal Procedure for Severe Weather and Flooding, OP-901-521, Section E3 Step 7, requires that if Mississippi River level at the levee fronting the site is projected to rise to 27 feet MSL within the next 12 hours, all NPIS external flood doors and penetration below the +30.0 ft. elevation should be locked shut. 3. The "N" set of FLEX equipment is protected and stored inside the NPIS. In addition, mechanisms are in place for relocating specific "N+1" FLEX equipment from the "N+1" storage building to the NPIS. Therefore, period of inundation is not applicable for this event. 4. The "N" set of FLEX equipment is protected and stored inside the NPIS. In addition, mechanisms are in place for relocating specific "N+1" FLEX equipment from the "N+1" storage building to the NPIS. Therefore, period of recession is not applicable for this event.				

Table 3: Flood Causing Mechanism (PMF + Hypothetical Dam Break within Mississippi River and Levee Failure – Scenario H.1 at East of NPIS)

Flood Scenario Parameter		Plant Current Design Basis Flood Hazard	FLEX Design Basis Flood Hazard	MSFHI PMF + Hypothetical Dam Break within Mississippi River and Levee Failure – Scenario 1	Bounded (B) or Not Bounded (NB) by FLEX DB
Flood Level and Associated Effects	1. Max Stillwater Elevation (ft. MSL)	No Hazard	30.0	22.8	B See Note 1
	2. Max Wave Run-up Elevation (ft. MSL)	N/I	30.0	27.7	B See Note 2
	3. Max Hydrodynamic / Debris Loading (psf)	N/I	See Note 3	70 / 4,900	B
	4. Effects of Sediment Deposition/Erosion	N/I	N/A	N/A	B
	5. Associated effects (not including LIP)	N/I	N/A	N/A	B
	6. Concurrent Site Conditions	N/I	N/A	N/A	B
	7. Effects on Groundwater	N/I	N/A	N/A	B
Flood Event Duration	8. Warning Time (hours)	N/I	See Notes 1 and 4	N/I	B
	9. Period of Site Preparation (hours)	N/I	N/A	N/I	B
	10. Period of Inundation (hours)	N/I	See Note 5	N/I	B
	11. Period of Recession (hours)	N/I	See Note 6	N/I	B
Other	12. Plant Mode of Operations	N/I	All Modes	All Modes	B
	13. Other Factors	N/A	N/A	N/A	N/A

Flood Scenario Parameter	Plant Current Design Basis Flood Hazard	FLEX Design Basis Flood Hazard	MSFHI PMF + Hypothetical Dam Break within Mississippi River and Levee Failure – Scenario 1	Bounded (B) or Not Bounded (NB) by FLEX DB
N/A = Not Applicable N/I = Not Included Additional notes, 'N/A' justifications (why a particular parameter is judged not to affect the site), and explanations regarding the bounded/non-bounded determination. 1. The primary storage location for a full "N" set of FLEX equipment is inside and on top of the NPIS, and all equipment stored there is protected from external flooding up to +30 ft. MSL. Because the "N" set of FLEX equipment is completely protected from external flooding, the FLEX strategies are not affected by this event and can be implemented successfully. 2. The maximum wave crest elevation is less than the top elevation of the east side of the NPIS. 3. The potential hydrodynamic loading and debris loading resulting from this flood event are bounded by the missile load requirements of the NPIS exterior wall (Ref. 8). The flow velocity of flood waters at the NPIS wall are relatively low and as a result, the hydrodynamic loads and debris impact loads are also relatively low. 4. Operations Off-Normal Procedure for Severe Weather and Flooding OP-901-521 Section E3 Step 7, requires that if Mississippi River level at the levee fronting the site is projected to rise to +27 feet MSL within the next 12 hours, all NPIS external flood doors and penetration below the +30.0 ft. MSL elevation should be locked shut. 5. The "N" set of FLEX equipment is protected and stored inside the NPIS. In addition, mechanisms are in place for relocating specific "N+1" FLEX equipment from the "N+1" storage building to the NPIS. Therefore, period of inundation is not applicable for this event. 6. The "N" set of FLEX equipment is protected and stored inside the NPIS. In addition, mechanisms are in place for relocating specific "N+1" FLEX equipment from the "N+1" storage building to the NPIS. Therefore, period of recession is not applicable for this event.				

Table 4: Combined Event H.3 (Alternative 3): 25-Year Flood in the Mississippi River, PMSS Including Antecedent Water Level, Levee Failure, and Coincident Wind-Generated Waves at Site

Flood Scenario Parameter		Plant Current Design Basis Flood Hazard	FLEX Design Basis Flood Hazard	MSFHI Combined Event H.3 (Alternative 3)	Bounded (B) or Not Bounded (NB) by FLEX DB
Flood Level and Associated Effects	1. Max Stillwater Elevation (ft. MSL)	27.6	30.0	26.0	B See Note 1
	2. Max Wave Run-up Elevation (ft. MSL)	N/I	N/A	31.8	B See Note 2
	3. Max Hydrodynamic / Debris Loading (psf)	N/I	See Note 3	110 / 5,300	B
	4. Effects of Sediment Deposition/Erosion	N/I	N/A	N/A	B
	5. Associated effects (not including LIP)	N/I	N/A	N/A	B
	6. Concurrent Site Conditions	N/I	N/A	N/A	B
	7. Effects on Groundwater	N/I	N/A	N/A	B
Flood Event Duration	8. Warning Time (hours)	N/I	See Note 4	N/I	B
	9. Period of Site Preparation (hours)	N/I	See Note 4	N/I	B
	10. Period of Inundation (hours)	N/I	See Note 5	N/I	B
	11. Period of Recession (hours)	N/I	See Note 6	N/I	B
Other	12. Plant Mode of Operations	N/I	All Modes	All Modes	B
	13. Other Factors	N/A	N/A	N/A	N/A

Flood Scenario Parameter	Plant Current Design Basis Flood Hazard	FLEX Design Basis Flood Hazard	MSFHI Combined Event H.3 (Alternative 3)	Bounded (B) or Not Bounded (NB) by FLEX DB

N/A = Not Applicable N/I = Not Included

Additional notes, 'N/A' justifications (why a particular parameter is judged not to affect the site), and explanations regarding the bounded/non-bounded determination.

1. The primary storage location for a full "N" set of FLEX equipment is inside and on top of the NPIS, and all equipment stored there is protected from external flooding up to +30 ft. MSL. Because the "N" set of FLEX equipment is completely protected from external flooding, the FLEX strategies are not affected by this event and can be implemented successfully.
2. Note, this overtopping is only applicable to the eastern wall of the NPIS. The wave-overtopping rate of 0.0087 cfs for this event is bounded by the level of ponding resulting from the LIP event (inside the NPIS) in the DCT Basin B area. In addition, the DCT basins are not credited in the FLEX strategies. As discussed in Section 2.1, the bottom of the air intake in the H&V fan room is located above the maximum wave run-up elevation on the southeast side of the NPIS, hence is not affected by this new reevaluated value. Therefore, even though this parameter was not bounded by the FLEX DB level, it does not affect the implementation of the FLEX strategies and/or the protection of the "N" set of FLEX equipment.
3. The potential hydrodynamic loading and debris loading resulting from the combined effect flood event are bounded by the missile load requirements of the NPIS exterior wall (Ref. 8). The flow velocity of flood waters at the NPIS wall are relatively low due to the configuration of the combined effect flood, and as a result, the hydrodynamic loads and debris impact loads are also relatively low.
4. The primary storage location for a full "N" set of FLEX equipment is inside and on top of the NPIS. In addition, if a greater than or equal to Category 4 hurricane warning is issued for St. Charles Parish, mechanisms are in place to relocate the "N+1" FLEX Core Cooling Pump, "N+1" FLEX Diesel Generator, and "N+1" Diesel Transfer Pump to the RAB.
5. The "N" set of FLEX equipment is protected and stored inside the NPIS. In addition, mechanisms are in place for relocating specific "N+1" FLEX equipment from the "N+1" storage building to the NPIS. Therefore, period of inundation is not applicable for this event.
6. The "N" set of FLEX equipment is protected and stored inside the NPIS. In addition, mechanisms are in place for relocating specific "N+1" FLEX equipment from the "N+1" storage building to the NPIS. Therefore, period of recession is not applicable for this event.

2.3. NEI 12-06, Rev. 2, Section G.4 – Evaluation of Mitigating Strategies for the MSFHI

2.3.1. NEI 12-06, Rev. 2, Section G.4.1 – Assessment of Current FLEX Strategies

At WSES, the minimum equipment required to support the FLEX strategies ("N" set) is stored within the NPIS (Ref. 7). The areas of the NPIS utilized for storing the "N" equipment are in locations protected from external flooding up to +30 ft. MSL. The "N" set of FLEX equipment is stored within the NPIS to ensure it is protected from all extreme external hazards.

In addition, pre-planned strategies have been developed to provide protection of the "N+1" set for the predictable external events with pre-warning (i.e., floods and hurricanes). The "triggers" for relocation of the "N+1" equipment for predictable external events with pre-warning are as follows:

- If Mississippi River level at the levee fronting the site is ≥ +25 ft. MSL, then the "N+1" FLEX core cooling pump, the "N+1" FLEX diesel generator and·"N+1" FLEX diesel fuel transfer pump should be considered for relocation from the "N+1" storage building to the RAB (Ref. 6).

- If the Mississippi River level at the levee fronting the site is projected to rise to +27 ft. MSL within the next 12 hours, then the "N+1" FLEX core cooling pump transfer pump will be relocated to the RAB EL. -35 ft. (Ref. 6).

- If a greater than or equal to Category 4 hurricane warning is issued for St. Charles Parish, then the "N+1" FLEX core cooling pump, the "N+1" FLEX diesel generator, and the "N+1" diesel transfer pump should be considered for relocation to the RAB. Furthermore, 12 hours prior to the projected hurricane land fall, the "N+1" FLEX core cooling pump will be further relocated to the RAB EL. -35 ft. (Ref. 6).

The reevaluated flood level for the Combined Event H.3 (Alternative 3) is +31.8 ft. MSL. As discussed in Section 2.1, this maximum wave crest and overtopping only pertains to the east side wall of the NPIS. The level of ponding at the DCT B area is bounded by the level of ponding resulting from the LIP event (inside the NPIS). Ponding of rain due to LIP inside the NPIS (DCT basins) does not affect the implementation of the FLEX strategies. Since the DCT basins are not credited in the FLEX strategies, this event does not affect/challenge the deployment of the FLEX equipment and/or the implementation of the FLEX strategies.

The H&V fan room is located on the area designated in the FHRR as the southeast side of the NPIS. The bottom of the air intake for this room is located at +31.16 ft. MSL. A receptacle panel connection for the "N" diesel generator was installed in the opposite wall to the H&V fan room air intake. As discussed in Section 2.1 above, the air intake bottom elevation is located above the maximum wave crest elevation for the southeast area of the NPIS (approximately 31 ft. MSL). Therefore, this Combined Event H.3 does not affect/challenge FLEX equipment and/or the implementation of the FLEX strategies.

Since the "N" set of FLEX equipment is staged/stored inside the NPIS, and it is completely protected from external flooding, the sequence of events for the FLEX strategies and the validation performed for the deployment of the FLEX strategies are not impacted by the flood hazards described in this report.

In persistent flood events, the Phase 3 FLEX strategies contain provisions to address the delivery of the National SAFER Response Center (NSRC) equipment to the site.

Some of these provisions establish that the NSRC equipment can be transported by helicopter from the off-site staging location to the plant site. NSRC equipment will be landed on the RAB +69 ft. roof (Ref. 7). Thus, the Phase 3 FLEX strategies are not impacted by persistent flooding and can be implemented successfully.

2.3.2 Conclusions

A complete comparison of the FLEX DB and reevaluated flood hazards (i.e., MSFHI), provided in this report, shows that the FLEX strategies can be implemented successfully for all applicable flood-causing mechanisms. Therefore, the current FLEX strategies can be deployed as submitted in the Final Integrated Plan (Ref. 3, Attachment 5). Therefore, WSES considers the requirement to address the reevaluated flooding hazards within its beyond-design-basis (BDB) mitigating strategies as being satisfied with no further action required.

2.4. References

1. Letter W3F1-2015-0042, Flood Hazard Reevaluation Report, Waterford Steam Electric Station, Unit 3, dated July 21, 2015
2. Waterford Steam Electric Station – Interim Staff Response to Reevaluated Floor Hazards Submitted in Response to 10 CFR 50.54(f) Information Request – Flood-Causing Mechanism Reevaluation (CAC NO. MF7125), April 12, 2016 (ML16090A327)
3. Letter W3F1-2016-0031, Notification of Full Compliance with EA-12-049, Order Modifying Licenses With Regard To Requirements for Mitigating Strategies for Beyond-Design-Basis External Events
4. EC 39741, Evaluation of Mississippi River Level Rate of Rise Based on Historic High River Levels Obtained from USACE
5. WF3-CS-15-00018, Waterford Steam Electric Station Unit 3 Fukushima Flood Hazard Re-evaluation - NPIS Local Intense Precipitation (AREVA Document No. 32-9231496-000)
6. Procedure OP-901-521, Revision 319, Severe Weather and Flooding
7. WF3-SA-14-00002, Rev. 2, Waterford 3 FLEX Strategies Development
8. Calculation 6W12-RAB-002Q, Rev. 0, Change Number 3, Reactor/Auxiliary Building Exterior Wall Design, 1997
9. WF3-CS-15-00017, Rev. 0, Waterford Steam Electric Station Unit 3 Fukushima Flood Hazard Re-evaluation - Combined Effects
10. G-499 Sheet 4 – Common Foundation Structure Masonry