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

February 26, 2018

Site Vice President
Entergy Operations, Inc.
Waterford Steam Electric Station
Unit 3
17265 River Road
Killona, LA 70057-3093

SUBJECT: WATERFORD STEAM ELECTRIC STATION, UNIT 3 – FLOOD FOCUSED EVALUATION ASSESSMENT (CAC NO. MF9710; EPID L-2017-JLD-0009)

Dear Sir or Madam:

By letter dated March 12, 2012 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML12053A340), the U.S. Nuclear Regulatory Commission (NRC) issued a request for information to all power reactor licensees and holders of construction permits in active or deferred status, under Title 10 of the *Code of Federal Regulations* (10 CFR), Section 50.54(f), "Conditions of Licenses" (hereafter referred to as the "50.54(f) letter"). The request was issued in connection with implementing lessons learned from the 2011 accident at the Fukushima Dai-ichi nuclear power plant, as documented in the NRC's Near-Term Task Force (NTTF) report (ADAMS Accession No. ML111861807). Enclosure 2 to the 50.54(f) letter requested that licensees reevaluate flood hazards for their sites using present-day methods and regulatory guidance used by the NRC staff when reviewing applications for early site permits and combined licenses (ADAMS Accession No. ML12056A046). By letter dated July 21, 2015 (ADAMS Accession No. ML15204A321), Entergy Operations, Inc. (the licensee) responded to this request for Waterford Steam Electric Station, Unit 3 (Waterford).

After its review of the licensee's response, the NRC staff sent the licensee an interim staff response (ISR) letter on April 12, 2016 (ADAMS Accession No. ML16090A313), which provided a summary of the Waterford reevaluated flood-causing mechanisms. As stated in the letter, because the local intense precipitation; streams and rivers; failure of dams and onsite water storage structures; and storm surge flood-causing mechanisms at Waterford are not bounded by the plant's current design basis, additional assessments of the flood hazard mechanisms are necessary.

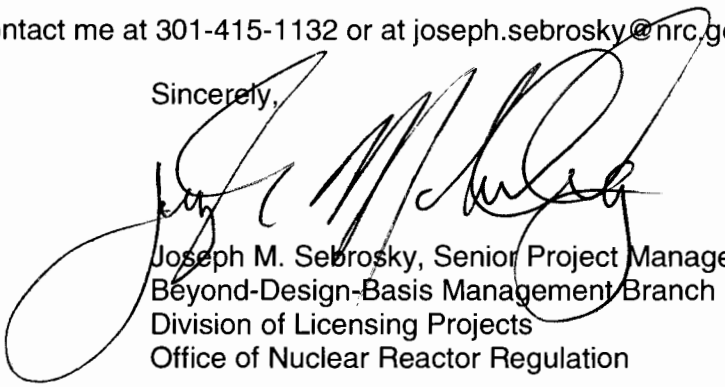
By letter dated May 17, 2017 (ADAMS Accession No. ML17137A355), the licensee submitted the focused evaluation (FE) for Waterford. The FEs are intended to confirm that licensees have adequately demonstrated, for unbounded mechanisms identified in the ISR letter, that: 1) a flood mechanism is bounded based on a reevaluation of flood mechanism parameters, 2) effective flood protection is provided for the unbounded mechanism, or 3) a feasible flood response is provided if the unbounded mechanism is local intense precipitation. The purpose of this letter is to provide the NRC's assessment of the Waterford FE.

The NRC staff concludes that the Waterford FE was performed consistent with the guidance described in Nuclear Energy Institute 16-05, Revision 1, as endorsed by Japan Lessons-Learned Division (JLD) interim staff guidance (ISG) JLD-ISG-2016-01, and that the licensee has

demonstrated that they have effective flood protection during beyond-design-basis external flooding events. This closes out the NRC's efforts associated with CAC No. MF9710.

If you have any questions, please contact me at 301-415-1132 or at joseph.sebrosky@nrc.gov.

Sincerely,



Joseph M. Sebrosky, Senior Project Manager
Beyond-Design-Basis Management Branch
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Office of Nuclear Reactor Regulation

Enclosure:
Staff Assessment Related to the
Focused Evaluation for Waterford

Docket No. 50-382

cc w/encl: Distribution via Listserv

STAFF ASSESSMENT BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO THE FOCUSED EVALUATION FOR

WATERFORD STEAM ELECTRIC STATION, UNIT 3

AS A RESULT OF THE REEVALUATED FLOODING HAZARD NEAR-TERM TASK FORCE

RECOMMENDATION 2.1- FLOODING

CAC NO. MF9710

1.0 INTRODUCTION

By letter dated March 12, 2012 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML12053A340), the U.S. Nuclear Regulatory Commission (NRC) issued a request for information to all power reactor licensees and holders of construction permits in active or deferred status, under Title 10 of the *Code of Federal Regulations* (10 CFR), Section 50.54(f)(hereafter referred to as the "50.54(f) letter"). The request was issued in connection with implementing lessons learned from the 2011 accident at the Fukushima Dai-ichi nuclear power plant, as documented in the NRC's Near-Term Task Force (NTTF) report (ADAMS Accession No. ML111861807).

Enclosure 2 of the 50.54(f) letter requested that licensees reevaluate flood hazards for their respective sites using present-day methods and regulatory guidance used by the NRC staff when reviewing applications for early site permits and combined licenses (ADAMS Accession No. ML12056A046). If the reevaluated hazard for any flood-causing mechanism is not bounded by the plant's current design basis (CDB) flood hazard, an additional assessment of plant response would be necessary. Specifically, the 50.54(f) letter states that an integrated assessment should be submitted, and described the information that the integrated assessment should contain. By letter dated November 30, 2012 (ADAMS Accession No. ML12311A214), the NRC staff issued Japan Lessons-Learned Project Directorate (JLD) interim staff guidance (ISG) JLD-ISG-2012-05, "Guidance for Performing the Integrated Assessment for External Flooding."

On June 30, 2015, the NRC staff issued COMSECY-15-0019, describing the closure plan for the reevaluation of flooding hazards for operating nuclear power plants (ADAMS Accession No. ML15153A104). The Commission approved the closure plan on July 28, 2015 (ADAMS Accession No. ML15209A682). COMSECY-15-0019 outlines a revised process for addressing cases in which the reevaluated flood hazard is not bounded by the plant's CDB. The revised process describes a graded approach in which licensees with hazards exceeding their CDB flood will not be required to complete an integrated assessment, but instead will perform a focused evaluation (FE). As part of the FE, licensees will assess the impact of the hazard(s) on their site and then evaluate and implement any necessary programmatic, procedural, or plant modifications to address the hazard exceedance.

Nuclear Energy Institute (NEI) 16-05, Revision 1, "External Flooding Assessment Guidelines" (ADAMS Accession No. ML16165A178), has been endorsed by the NRC as an appropriate methodology for licensees to perform the focused evaluation in response to the 50.54(f) letter. The NRC's endorsement of NEI 16-05, including exceptions, clarifications, and additions, is described in NRC JLD-ISG-2016-01, "Guidance for Activities Related to Near-Term Task Force Recommendation 2.1, Flood Hazard Reevaluation" (ADAMS Accession No. ML16162A301). Therefore, NEI 16-05, Revision 1, as endorsed, describes acceptable methods for

demonstrating that Waterford Steam Electric Station, Unit 3 (Waterford) has effective flood protection.

2.0 BACKGROUND

This NRC staff assessment is the last staff assessment associated with the information that the licensee provided in response to the reevaluated flooding hazard portion of the 50.54(f) letter. Therefore, the background section includes a discussion of the reevaluated flood information provided by the licensee and the associated staff assessments. The reevaluated flood information includes: 1) the flood hazard reevaluation report (FHRR); 2) the mitigation strategies assessment (MSA); and 3) the focused evaluation.

Flood Hazard Reevaluation Report

By letter dated July 21, 2015 (ADAMS Accession No. ML15204A321), Entergy Operations, Inc. (Entergy, the licensee) responded to the 50.54(f) request for Waterford and submitted the flood hazard reevaluation report (FHRR). After the review of the licensee's response, by letter dated April 12, 2016 (ADAMS Accession No. ML16090A313), the NRC issued an interim staff response (ISR) letter for Waterford. The ISR letter provided the reevaluated flood hazard mechanisms that exceeded the CDB for Waterford and parameters that are a suitable input for the MSA. As stated in the letter, because the local intense precipitation, streams and rivers, failure of dams and onsite water storage structures, and storm surge flood-causing mechanisms at Waterford are not bounded by the plant's current design basis, additional assessments of the flood hazard mechanisms are necessary. The staff issued a final staff assessment of the FHRR by letter dated November 30, 2017 (ADAMS Accession No. ML17311B351). The flood hazard mechanism values presented in the November 30, 2017, FHRR staff assessment match and are identical to the values in the April 12, 2016 ISR letter without change or alteration.

Mitigation Strategies Assessment

By letter dated November 14, 2016 (ADAMS Accession No. ML16319A089), Entergy submitted its MSA for Waterford for review by the NRC staff. The MSAs are intended to confirm that licensees have adequately addressed the reevaluated flooding hazards within their mitigating strategies for beyond-design-basis external events. By letter dated February 27, 2017 (ADAMS Accession No. ML17023A282), the NRC issued its assessment of the Waterford MSA. The NRC staff concluded that the Waterford MSA was performed consistent with the guidance described in Appendix G of Nuclear Energy Institute 12-06, Revision 2, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide" (ADAMS Accession No. ML16005A625), as endorsed by the NRC. The NRC's endorsement of NEI 12-06, Revision 2, is described in JLD-ISG-2012-01, Revision 1, "Compliance with Order EA-12-049, Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events" (ADAMS Accession No. ML15357A163). The NRC staff further concluded that the licensee had demonstrated that the mitigation strategies, if appropriately implemented, are reasonably protected from reevaluated flood hazards conditions for beyond-design-basis external events.

Focused Evaluation

By letter dated May 17, 2017 (ADAMS Accession No. ML17137A355), the licensee submitted the FE for Waterford. The FEs are intended to confirm that licensees have adequately demonstrated, for unbounded mechanisms identified in the ISR letter, that: 1) a flood mechanism is bounded based on a reevaluation of flood mechanism parameters; 2) effective flood protection is provided for the unbounded mechanism; or 3) a feasible response is provided if the unbounded mechanism is LIP. These 3 options associated with performing an FE are

referred to as Path 1, 2, and 3, as described in NEI 16-05, Revision 1. The purpose of this staff assessment is to provide the results of the NRC's evaluation of the Waterford FE.

3.0 TECHNICAL EVALUATION

As stated above, the four mechanisms that were found to exceed the current design basis flood level at Waterford were: local intense precipitation, streams and rivers, failure of dams and onsite water storage structures, and storm surge. The licensee's FE follows Path 2 (i.e., demonstration of effective flood protection) of NEI 16-05, Revision 1. The licensee's FE concluded that the strategy for maintaining key safety functions for all four mechanism includes effective flood protection through the demonstration of adequate available physical margin (APM) and reliable flood protection features, and that the overall response is adequate.

Per Waterford's CDB, the structures, systems and components (SSCs) important to safety are flood protected because they are enclosed in a rectangular box-like reinforced concrete structure 380 feet (ft.) long, 267 ft. wide, and extending 64.5 ft. below grade known as the nuclear plant island structure (NPIS). The NPIS is the common structure of the reactor containment building (RCB), reactor auxiliary building (RAB) and the Fuel Handling Building (FHB). All seismic Category I structures, safety-related systems and components are housed in the NPIS. All exterior doors and penetrations which lead to areas containing safety-related equipment are watertight up to 29.18 ft. mean sea level (MSL). Figure 3.0-1 of this document provides a general overview of the site including an outline of the NPIS.

The component cooling water system (CCWS) is the ultimate heat sink (UHS) for the plant. It is designed to remove heat from the reactor coolant and the auxiliary systems during normal operation, shutdown, or emergency shutdown following a loss of coolant accident. The CCWS is a closed-loop cooling water system that uses two component cooling water heat exchangers, three 100-percent capacity pumps, two dry cooling towers (DCTs), one surge tank, and one chemical addition tank. The cooling water is pumped by the component cooling water pumps, through the DCTs and the tube side of the component cooling water heat exchangers, through the components being cooled and back to the pumps.

The auxiliary component cooling water system (ACCWS) removes heat, if required, from the CCWS via the component cooling water heat exchangers and dissipates it to the atmosphere. The ACCWS consists of two independent loops which include two CCWS heat exchangers (shell side); two full-capacity pumps; two wet type, mechanical draft cooling towers; and two cooling tower basins, each of which stores sufficient water to complete a safe shutdown based upon a loss of coolant accident and minimum safeguards operation. Figure 3.0-2 of this document provides an overview of the location of the "B" wet and dry cooling towers, which are both located within the NPIS.

The description of the overall site flooding response for the flood mechanisms exceeding the current design basis is provided below.

Local Intense Precipitation

Waterford's strategy requires the use of sump pumps in each of the DCT sumps in order to maintain key safety function and key SCCs during a LIP event. Without these sump pumps, flood waters may reach the permanently installed sump pump motors thereby disabling them and potentially resulting in flood waters reaching the motor control centers for the UHS located inside the DCTs. There are two permanently-installed motor-driven sump pumps in each DCT basin and a permanently-installed diesel-powered DCT sump pump in each DCT basin. Typically only one sump pump is used. The licensee has procedures in place to start the second motor-driven sump pump in the event of a high sump level annunciator. In addition, the

licensee has procedures in place to start the diesel-powered DCT sump pump if one of the two motor-driven sump pumps is inoperable and the high level sump alarm has not cleared. This satisfies the recommended state in the flood hazard reevaluation report (FHRR) that two DCT sump pumps are in operation if the high level alarm does not clear within 30 minutes in order to ensure that flood levels remain below the height of the permanently installed sump pump motors and the motor control centers inside the DCTs.

For precipitation events external to the NPIS, all key SSCs are located within the NPIS, which is protected from external flooding to an elevation of 29.18 ft. MSL. The LIP maximum water surface elevations outside the NPIS range from 16.4 ft. MSL to 20.5 ft. MSL which is below the NPIS protected elevation of 29.18 ft.

The licensee plans to install recirculation barriers that are not credited in its FHRR. The recirculation barriers consist of flat roofs and rain gutter systems that direct a large portion of the rainfall out of the DCT area.

Streams and Rivers

The peak probable maximum flood (PMF) water surface elevation for the streams and rivers reevaluated hazard is slightly below the top elevation of the levee that protects the site. Therefore, the licensee contends there is no impact to key SSCs from this flooding event because the flood does not reach the NPIS. In the FHRR the licensee does model a levee breach under these conditions as one of the scenarios evaluated under the failure of dams and onsite water storage structure analysis.

Failure of Dams and Onsite Water Storage Structures

The bounding scenario for the failure of dams and onsite water storage structures is below the levee protection height. Therefore, the licensee contends there is no impact to key SSCs from this flooding event because the flood does not reach the NPIS. The licensee also evaluated a levee failure in one of the scenarios in this section. The resulting flood is below the NPIS design basis of 29.18 ft.

Storm Surge

The calculated storm surge stillwater elevation is below the CDB stillwater elevation. The licensee contends that wave overtopping of the NPIS into the DCTs is minimal and does not impact the permanently-installed sump pump motors or motor control centers.

3.1 Evaluation of Flood Impact Assessment for Local Intense Precipitation

3.1.1 Description of Impact for Unbounded Hazard

The licensee's FE includes the following table that provides the flood levels for a LIP event in the DCT basins. The table is based on the presumption that the LIP event precipitation falls into the DCT areas. The values in the table are consistent with the values provided in the July 21, 2015, FHRR Table 3-14 and with the description of the DCT sump elevations found in FHRR Section 2.2.1.

Table 3.1-1

Areas with SSCs Potentially Impacted due to Flooding	Maximum Flood Height with 2 Pumps Starting After 30 minutes (Above Building Slab)	Sump Pump Motor Height (Above Building Slab)	MCCs for the UHS Height (Above Building Slab)	Available Physical Margin
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.

The APM is based on keeping the base of the DCT sump pump motors from being flooded.

3.1.2 Evaluation of Available Physical Margin

The APM provided in Table 3.1-1 is small. In NEI 16-05, Rev 1 Appendix B provides guidance that negligible or zero APM can be justified if the use of conservative inputs, assumptions and/or methods in the flood hazard reevaluation can be established. While small, the staff concludes that Waterford's APM for the DCT sump areas is acceptable for the following reasons: :

1) No credit is given in the calculation for the water that will be diverted from the LIP event outside of the DCT sump areas by the roof and gutter system modification that the licensee plans to implement.

2) While three DCT sump pumps would typically be expected to be available in a LIP event, the licensee assumes only two pumps are operating. The licensee discusses the procedures and warning time associated with the LIP event and the steps taken to ensure that operators are stationed to ensure that the DCT diesel sump pump and the motor-driven DCT sump pumps can be quickly placed into service as needed.

3) The licensee's evaluation does not credit additional portable sump pumps that would be expected to be deployed in the event of a LIP. As discussed above, the licensee's evaluation is based on a Path 2 response in accordance with NEI 16-05, Revision 1. Such a response does not credit the use of portable equipment. In accordance with Commission approved direction, for a LIP event, the licensee can also choose a Path 3 response as discussed in NEI 16-05, Revision 1. For a Path 3 response the licensee can credit the use of portable equipment such as sump pumps as an aid to keeping the DCT sump levels within tolerable limits. In addition, as documented in the licensee's MSA FLEX strategies, which provide an alternate means of maintaining core cooling, containment function, and spent fuel pool cooling, the licensee does not credit equipment in the DCT basins as part of their FLEX strategies in response to a LIP event. Therefore, the staff considers the licensee's evaluation to be conservative in this area, because the licensee's evaluation does not credit portable sump pumps, for which procedures have been developed to deploy in the event of a LIP that could inundate the DCTs, nor does the licensee credit equipment in the DCTs as part of the FLEX strategies in the event of a LIP.

3.1.3 Evaluation of Reliability of Protection Features

The licensee's evaluation notes that the DCT pumps are active features, but do not face any increased impacts from the LIP event since the credited pumping capacity remains the same. The licensee does note that it changed the assumption regarding the availability of the permanently-installed diesel-powered DCT sump pump. Namely, the licensee assumes this

pump is placed into service within 30 minutes instead of within 3 hours, in the event one of the permanently-installed motor-driven pumps is inoperable.

The staff notes that the motor-driven sump pumps are capable of being powered from the emergency diesel generators and that the FHRR, as well as the licensee's FE describes the procedures for powering these pumps from emergency power as part of the licensee's current licensing basis. There are also procedures in place to have operators present at the diesel powered sump pump when a rainfall event of the magnitude of a LIP event is predicted. In such cases, the licensee noted that the DCT sump pump can be placed in service within 5 minutes from the time the control room operators request the pump be placed in service.

Section 5.1.2 of the licensee's FHRR described interim actions taken due to the LIP flooding in the DCT basin and states that based on the results of the LIP evaluation, two sump pumps are activated within 30 minutes after the onset of a LIP event. These interim actions were inspected by the NRC and documented in an inspection report dated April 25, 2016 (ADAMS Accession No. ML16116A210). The inspection report documents that NRC inspectors, through a tabletop simulation with the licensee, reviewed the sequence of licensee activities from the initial triggers through full implementation of those actions. The report also documents the visual examination and walk down of associated manual actions that were performed by the inspectors, which led to the conclusion that the licensee's proposed interim actions (which are consistent with the actions identified in the licensee's FE) would perform their intended function.

In addition, the staff documented in an internal evaluation dated July 6, 2016 (ADAMS Accession No. ML16174A386 (non-public)) that the licensee has procedures in place to ensure that at least two of the three DCT sump pumps are available at all times. In conditions where offsite power remains available, the two motor-driven DCT sump pumps automatically start. If offsite power is unavailable the licensee has the ability to manually start the diesel-driven DCT sump pump and a motor-driven DCT sump pump once it is aligned to emergency power. Both of these activities can be done within 30 minutes of the onset of a LIP event.

Based on each DCT having two motor-driven sump pumps, a diesel-driven sump pump and based on inspections of the procedures to place these sump pumps in service to ensure the DCT sump pumps are not flooded in the event of a LIP, the staff concludes that the pumps (which are active features) meet the guidance in NEI 16-05, Revision 1 for functional characteristics, operational characteristics, and unavailability characteristics.

3.1.4 Overall Site Response

The staff reviewed the licensee's manual actions described above in accordance with the guidance found in Appendix C of NEI 16-05, Revision 1, as endorsed by the NRC. The manual actions described by the licensee include ensuring that two of the three sump pumps in each DCT are removing water from the sumps within 30 minutes of the onset of a LIP at the site. Based on its review the staff concludes that the manual actions required to implement the flood response strategy for a LIP event at Waterford are feasible and the overall implementation of the strategy is adequate for the following reasons:

- Based on the NRC's inspection of the FHRR interim actions, which are consistent with the actions described in the licensee's FE, the licensee's actions provide a reasonable means to address a LIP event at Waterford.

- The timeline for placing two sump pumps in each DCT within 30 minutes of the onset of a LIP was inspected by the NRC and found to be reasonable.

- The NRC inspectors concluded that the licensee's interim actions, which are consistent with those assumed by the licensee in the FE, will perform their intended function.

3.1.5 Conclusion

Based on the evaluation above, the NRC staff concludes that the Waterford LIP FE was performed consistent with the guidance described in NEI 16-05, Revision 1, as endorsed by JLD-ISG-2016-01. The staff further concludes that, if properly implemented, the licensee has demonstrated that there is effective flood protection available at Waterford for a beyond-design-basis LIP external event.

3.2 Evaluation of Flood Impact Assessment for Streams and Rivers

3.2.1 Description of Impact for Unbounded Hazard

The peak PMF water surface elevation for the beyond-design-basis stream and rivers event is 29.9 ft. MSL. This is below the top elevation of the levee that protects the Waterford site, which is 30.0 ft. This results in an APM of 0.1 ft. for this beyond-design-basis event.

3.2.2 Evaluation of Available Physical Margin

The staff notes that Appendix B of NEI 16-05, Revision 1 states that negligible or zero APM can be justified as acceptable if the use of conservative inputs, assumptions, and/or methods in the flood hazard evaluation can be established. While small, the staff concludes that Waterford's APM for this mechanism is acceptable because of the following conservative assumptions:

- The licensee used a conservative assumption to develop the PMF flow rate. As noted in Section 3.2.2.1 of the FHRR, the U.S. Army Corps of Engineers project design flood (PDF) was judged to be a reasonable basis for estimating the PMF for the Mississippi River Basin. The PDF is approximately equivalent to the standard design flood, which is generally 40 to 60 percent of the PMF (i.e., PDF is equal to 0.4 or 0.6 times the PMF). Solving for PMF, the PMF peak flow is therefore equal to the PDF times 2.5 or 1.67. The licensee's PMF analysis is based on a PMF peak flow that is 2.5 times the PDF, which the staff agrees is conservative.

- As described in Section 3.2.2 of its FHRR, the licensee's evaluation did not credit the Bonnett Carre Spillway and Floodway that could be used to divert flow from the Mississippi River to Lake Pontchartrain) was not modeled. Figure 3.2-1 shows the location of this spillway in relation to Waterford. Allowing water to be diverted via this spillway to Lake Pontchartrain would lower the PMF water surface elevation at Waterford. The staff agrees with the licensee's assertion that it is a conservative assumption to not model this spillway.

- The licensee evaluated a levee failure at a Mississippi River elevation of 29.9 ft. MSL, thus not relying on the levee remaining intact under this scenario. The staff's assessment of this scenario is found in Section 3.3 of this document.

3.2.3 Evaluation of Reliability of Protection Features

The staff evaluated the reliability of the levee protecting Waterford in accordance with NEI 16-05, Revision 1, Section B.2.1.1, "Earthen Embankments (Earth Dams, Levees and Dikes)." The staff's evaluation also considered guidance found in JLD-ISG-2013-01, "Guidance for Assessment of Flooding Hazards due to Dam Failure" (ADAMS Accession No. ML13151A153). The staff position found in JLD-ISG-2013-01 states that levees should be assumed to fail when

overtopped, which does not occur in this scenario for Waterford. Assuming the levees in the vicinity of Waterford provide protection for this height, the site conditions remain within the CDB.

The JLD-ISG-2013-01 guidance also states that levees are generally not designed to withstand high water levels for long periods. The staff notes that FHRR Section 3.9.3.1 and the April 12, 2016, ISR provide a scenario that assumes that because the Mississippi River levee PDF is 25.1 ft. MSL at Waterford, the levee is assumed to fail. This scenario is evaluated in Section 3.3 of this assessment.

3.2.4 Overall Site Response

Based on the protection provided by the levee elevation of 30.0 ft. MSL near the Waterford site staying intact in this scenario, the impact to the site is within the design basis of the plant. Therefore, there are no adverse impacts expected at the site as a result of this beyond-design-basis event.

3.2.5 Conclusion

Based on the evaluation found above for the streams and rivers PMF in which the levees around Waterford remain intact, the NRC staff concludes that the Waterford PMF FE was performed consistent with the guidance described in NEI 16-05, Revision 1, as endorsed by JLD-ISG-2016-01. The staff further concludes, for this scenario in which the levees remain intact that the licensee has demonstrated that, if properly implemented, there is effective flood protection for Waterford for a beyond-design-basis streams and rivers PMF external event. The evaluation of levees failing under the conditions assumed for the streams and rivers PMF is found in Section 3.3 of this document.

3.3 Evaluation of Flood Impact Assessment for Failure of Dams and Onsite Water Storage Structures

3.3.1 Description of Impact for Unbounded Hazard

The NRC's April 12, 2016, ISR provides several scenarios and resulting water surface elevations for failure of dams and onsite water control/storage structures. The licensee's FE considered a dam failure still water elevation that leads to a 29.9 ft. MSL water surface elevation. This is below the top elevation of the levee that protects the Waterford site, which is 30.0 ft. This results in an APM of 0.1 ft. for this beyond-design-basis event.

In FHRR Sections 3.9.3.1 and 3.9.3.2, the licensee evaluates combined effect floods at Waterford. Section 3.9.3.1 evaluates a PMF plus a hypothetical dam break within the Mississippi River that leads to a levee failure near Waterford. The hypothetical dam break evaluation found in Section 3.9.3.1 assumed the following as initial conditions:

- A PMF plus dam failures in the Mississippi River and the Atchafalaya River.
- The assumption leads to an initial condition of a Mississippi River water surface elevation of 29.9 ft. MSL at Waterford.
- The Atchafalaya River dam failure leads to onsite flooding at Waterford because this mechanism bypasses the Mississippi River levee system around Waterford. As a result

the calculated flooding at Waterford due to the Atchafalaya dam failure mechanism is 20.6 ft. MSL.

As stated in Section 3.2 of this evaluation, the PDF for Mississippi River near Waterford is 25.1 ft. MSL. The licensee's evaluation in FHRR Section 3.9.3.1 assumes a levee failure based on the initial conditions of 29.9 ft. MSL in the Mississippi River and 20.6 ft at the site. The evaluation concluded that the maximum water surface elevation at Waterford is 27.7 ft. including wind wave runup. The water surface elevation based on this scenario is below the minimum protection height of the NPIS of 29.18 ft. MSL. The APM for this scenario is therefore approximately 1.5 ft.

In the FHRR, Section 3.9.3.2 assumes a PMF level of 29.9 ft. and a subsequent seismic failure of the levee near Waterford. The initial assumption is that the site is dry. This scenario leads to a maximum surface water elevation near the site of 20.8 ft., which is below the 27.7 ft. calculated for the scenario described in FHRR Section 3.9.3.1. Because the staff considers that the dam failure scenario found in FHRR Section 3.9.3.1 bounds the Section 3.9.3.2 scenario, the Section 3.9.3.2 scenario is not evaluated further by the staff.

3.3.2 Evaluation of Available Physical Margin

The licensee's FE evaluated the APM of 0.1 ft. for the dam breach analysis, which assumes that the levee near Waterford does not fail in this condition. The staff concludes that the APM for this scenario is acceptable because of the following conservatisms in the calculation:

- Dams for each watershed (i.e, the Mississippi River and the Atchafalaya River) were combined and treated as one hypothetical dam with dam geometry and parameters based on the information in the National Atlas database. The combined dam for each watershed was placed at the location of the most downstream dam within the watershed.

- The estimate of the storage volume for the hypothetical dams was based on conservatively assuming reservoir levels for each individual dam within the respective watersheds are at maximum storage volumes.

The APM for the scenario described in FHRR Section 3.9.3.1, which assumes the levee near Waterford fails, is approximately 1.5 ft. The staff finds this APM acceptable for the following reason:

- As documented above, the calculated dam breach result of 29.9 ft. MSL water surface elevation in the Mississippi River near the site and 20.6 ft MSL water surface elevation at the site includes conservative assumptions related to the dam characteristics for the Mississippi River watershed and the Atchafalaya River watershed.

- The levee break analysis includes a wind wave runup of 4.9 ft. The maximum stillwater elevation is 22.8 ft. MSL. The stillwater elevation is below the NPIS design basis of 29.18 ft. by approximately 6.4 ft.

- The APM for the NPIS is approximately 1.5 ft. for the levee failure scenario which includes the conservative assumptions for the dam break analysis and includes the wind wave runup of 4.9 ft.

3.3.3 Evaluation of Reliability of Protection Features

The NPIS is considered a "Type 1" feature as defined in NEI 16-05, Rev 1 Appendix B. A "Type 1" feature is considered and engineered in the design basis or licensing basis as having a

flood protection function. The NPIS flood protection features were verified as part of the licensee's response to the 50.54(f) letter which addressed the methods and procedures for licensees to conduct flooding hazard walkdowns to identify and address degraded, nonconforming, or unanalyzed conditions through the corrective action program, and to verify the adequacy of the monitoring and maintenance procedures. Entergy provided its response to this portion of the 50.54(f) letter by letter dated November 27, 2012 (ADAMS Accession No. ML12333A147), as supplemented by letter dated November 11, 2013 (ADAMS Accession No. ML13317A076). The staff's assessment of the licensee's walkdown report can be found in a letter dated June 23, 2014 (ADAMS Accession No. ML14135A349).

As documented in the staff's assessment the licensee performed visual inspections to evaluate the flood protection features, which included credited flood protection features such as: seals on through-wall penetrations; floor barrier walls; designated flood protection doors; sump pumps; valves; rood drains; and pipe drains. The licensee also visually inspected the majority of the exterior walls of the NPIS and no deficiencies were identified. The licensee reviewed design documents to verify that the inaccessible areas of the NPIS wall were grouted and that other grouted penetrations that were inspected were found to be in good condition.

Because increased focus has been placed on flood protection since the accident at Fukushima, licensees and NRC inspectors have identified deficiencies with equipment, procedures, and analyses relied on to either prevent or mitigate the effects of external flooding at a number of licensed facilities. Recent examples include those found in Information Notice 2015-01, "Degraded Ability to Mitigate Flooding Events" (ADAMS Accession No. ML14279A268). In addition, the NRC is cooperatively performing research with the Electric Power Research Institute to develop flood protection systems guidance that focuses on flood protection feature descriptions, design criteria, inspections, and available testing methods under a memorandum of understanding dated September 28, 2016 (ADAMS Accession No. ML16223A495). The NRC staff expects that licensees will continue to maintain flood protection features under their current licensing basis. The staff also expects that licensees will use the site corrective action program to address flood-related maintenance, operations, and design issues, consistent with the provisions of NEI 16-05 and NEI 12-07, "Guidelines for Performing Verification Walkdowns of Plant Flood Protection Features," as endorsed by the NRC, where appropriate. Continued research involving flood protection systems will be performed and shared by the NRC staff with licensees in accordance with the guidance provided in Management Directive 8.7 "Reactor Operating Experience Program" (ADAMS Accession No. ML18012A156).

The staff concludes that the NPIS flood protection features meet the definition of being reliable to maintain key safety functions found in Appendix B of NEI 16-05, Rev 1.

3.3.4 Overall Site Response

Based on the protection provided by the NPIS, the impact to the site is within the design basis of the plant. Therefore, there are no adverse impacts expected at the site as a result of this beyond-design-basis event.

3.3.5 Conclusion

Based on the evaluation above, the NRC staff concludes that the Waterford FE of the flood impact assessment for failure of dams and onsite water storage structures was performed consistent with the guidance described in NEI 16-05, Revision 1, as endorsed by JLD-ISG-2016-01. The staff further concludes that the licensee has demonstrated that, if

properly implemented, there is effective flood protection for Waterford for a beyond-design-basis failure of dams and onsite water storage structures external event.

3.4 Evaluation of Flood Impact Assessment for Storm Surge

3.4.1 Description of Impact for Unbounded Hazard

The controlling combined effect storm surge is described in FHRR Sections 3.9.3.3, 3.9.4 and FHRR Table 4-1. This combined event consists of a 25-year flood in the Mississippi River, probable maximum storm surge including antecedent water level, levee failure, and coincident wind-generated waves at the site. The scenario results in a maximum stillwater at the NPIS of 26.0 ft. MSL, a significant wave crest elevation of 26.9 ft. MSL, a maximum reflected wave crest of 31.8 ft. MSL, and a resulting overtopping rate at DCT B of 0.1 cubic feet per second (cfs).

The licensee calculated a ponding depth in the DCT based on the duration of the overtopping event, without crediting sump pumps, and concluded that the permanently installed sump pump motors and MCCS for the UHS basins are not impacted by this event. The wave overtopping event includes a flow rate of 0.1 cfs and a short duration of approximately 5.3 hours.

The licensee also evaluated the air intake of the heat and ventilation fan room. This fan room air intake is located at elevation of 31.16 ft. MSL and is covered by missile protection grating. In this location, the maximum reflected wave height was calculated to be 31 ft. MSL which leads to an APM of 0.16 ft.

3.4.2 Evaluation of Available Physical Margin

The staff's evaluation of APM includes two scenario: wave overtopping of the NPIS leading to water inside the DCT, and the maximum reflected wave impacting the heating and ventilation room air intake.

Regarding the DCTs, the staff concludes that the APM is adequate due to the conservative nature of the analysis that included:

- The analysis does not credit the use of sump pumps to dewater the DCTs from the wave overtopping event, and

- The analysis does not credit the installation of the recirculation barriers on the DCTs that are planned to be installed. These barriers would help to reduce the water entering the DCTs from the wave overtopping event.

Regarding the maximum reflected wave impacting the heating and ventilation room air intake, the staff concludes that the APM of 0.16 ft. is adequate due to the conservative nature of the analysis that included:

- The effects of the vehicle barriers, which could serve as wave breaks, were conservatively ignored in the calculation since they are not flood protection structures,

- The levee breach was conservatively assumed to occur at a single location. If multiple breaches were assumed it would reduce the water level in the Mississippi River and thus reduce the available hydraulic head to drive the levee failure, and

- The effect of the missile protection grating protecting the air intake was ignored. The grating protrudes from the side of the structure such that the bottom bar will obstruct any unexpected wave splashing.

3.4.3 Evaluation of Reliability of Protection Features

The flooding protection features relied on to address this flood mechanism are passive in nature and are within the CDB of the plant. The staff's assessment of the reliability of passive flood protection features of the NPIS is found in Section 3.3 of this assessment. Based on this assessment, the staff concludes that these features are reliable to maintain the key safety functions at Waterford.

3.4.4 Overall Site Response

Based on the protection provided by the NPIS, the impact to the site is within the design basis of the plant. Therefore, there are no adverse impacts expected at the site as a result of this beyond-design-basis event.

3.4.5 Conclusion

Based on the evaluation found above the NRC staff concludes that the Waterford FE of combined storm surge event was performed consistent with the guidance described in NEI 16-05, Revision 1, as endorsed by JLD-ISG-2016-01. The staff further concludes that the licensee has demonstrated that, if properly implemented, there is effective flood protection during a beyond-design-basis combined storm surge external event.

4.0 CONCLUSION

The NRC staff concludes that the Waterford FE was performed consistent with the guidance described in NEI 16-05, Revision 1, as endorsed JLD-ISG-2016-01, and that the licensee has demonstrated that they have effective flood protection from the reevaluated flood hazards, if properly implemented. Furthermore, the staff concludes that Waterford screens out for an integrated assessment based on the guidance found in JLD-ISG-2016-01. As such, the staff concludes that in accordance with Phase 2 of the process outlined in the 50.54(f) letter additional regulatory actions associated with the reevaluated flood hazard, beyond those associated with mitigation strategies assessment, are not warranted. The staff further concludes that the licensee has satisfactorily completed providing responses to the 50.54(f) activities associated with the reevaluated flood hazards.

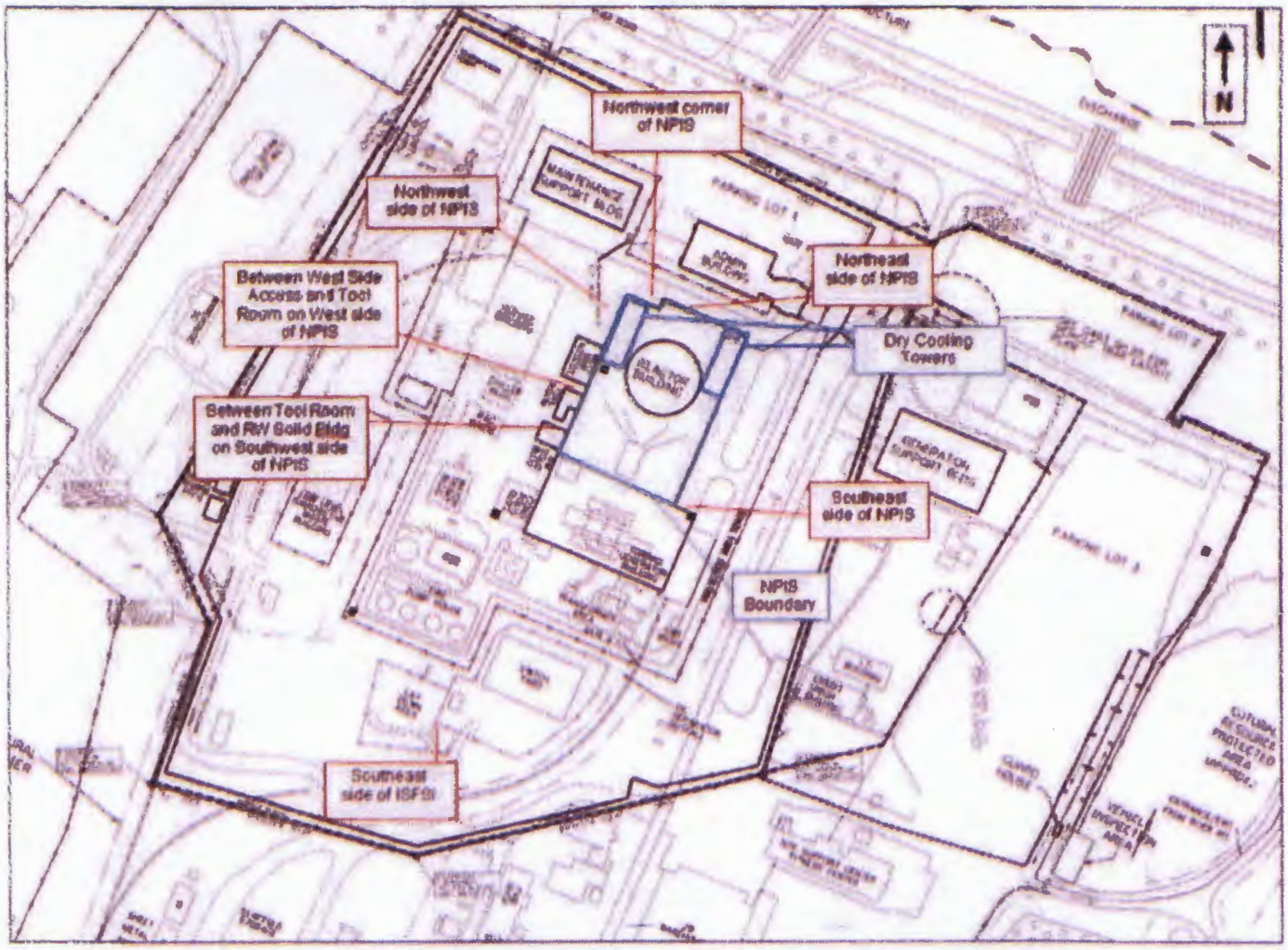

Figure 3.0-1 – General Layout of Waterford Site (adapted from Figure 3-3 of July 21, 2015, FHRR (ADAMS Accession No. ML15204A321))

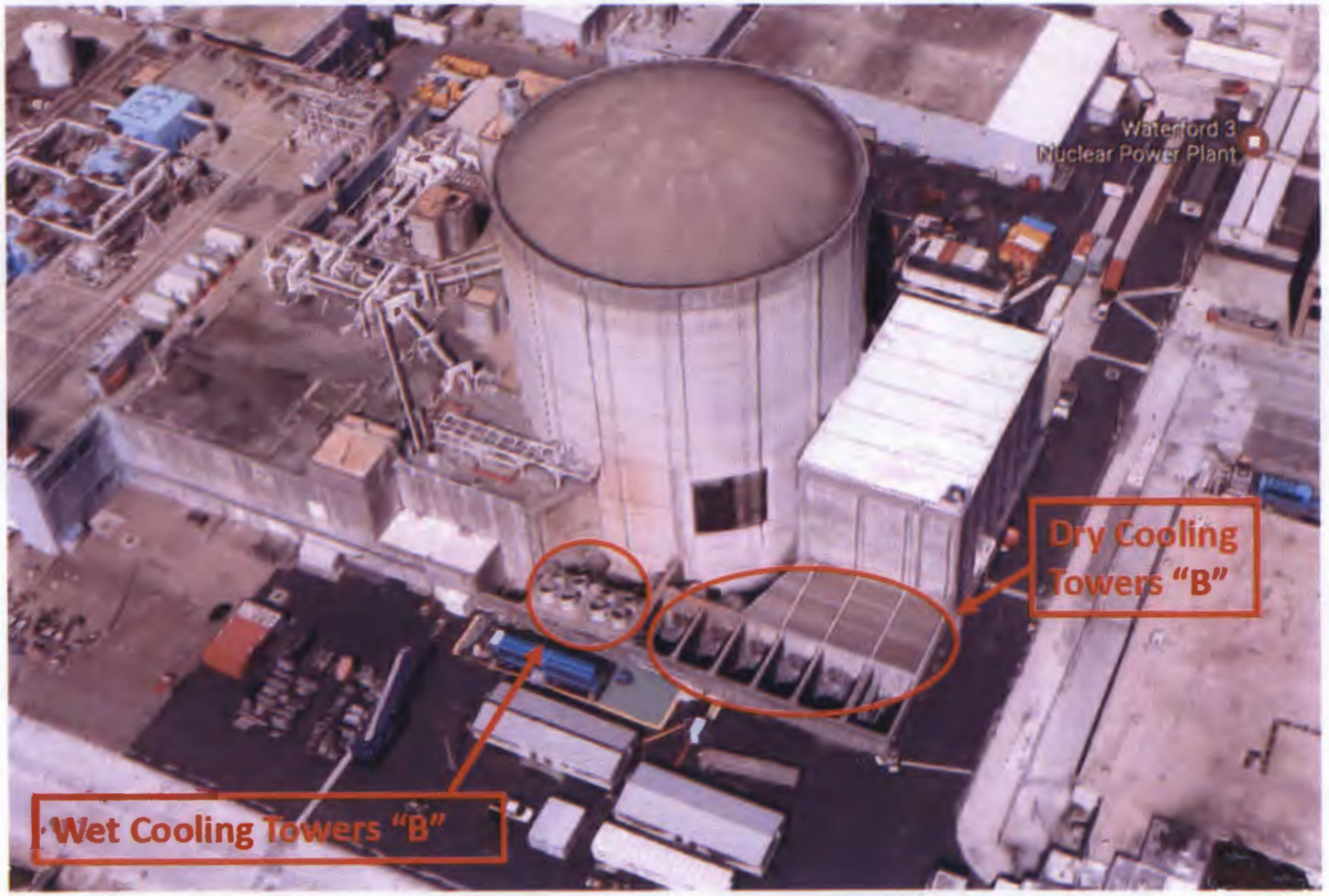

Figure 3.0-2 Overview of the Location of the "B" Wet and Dry Cooling Towers

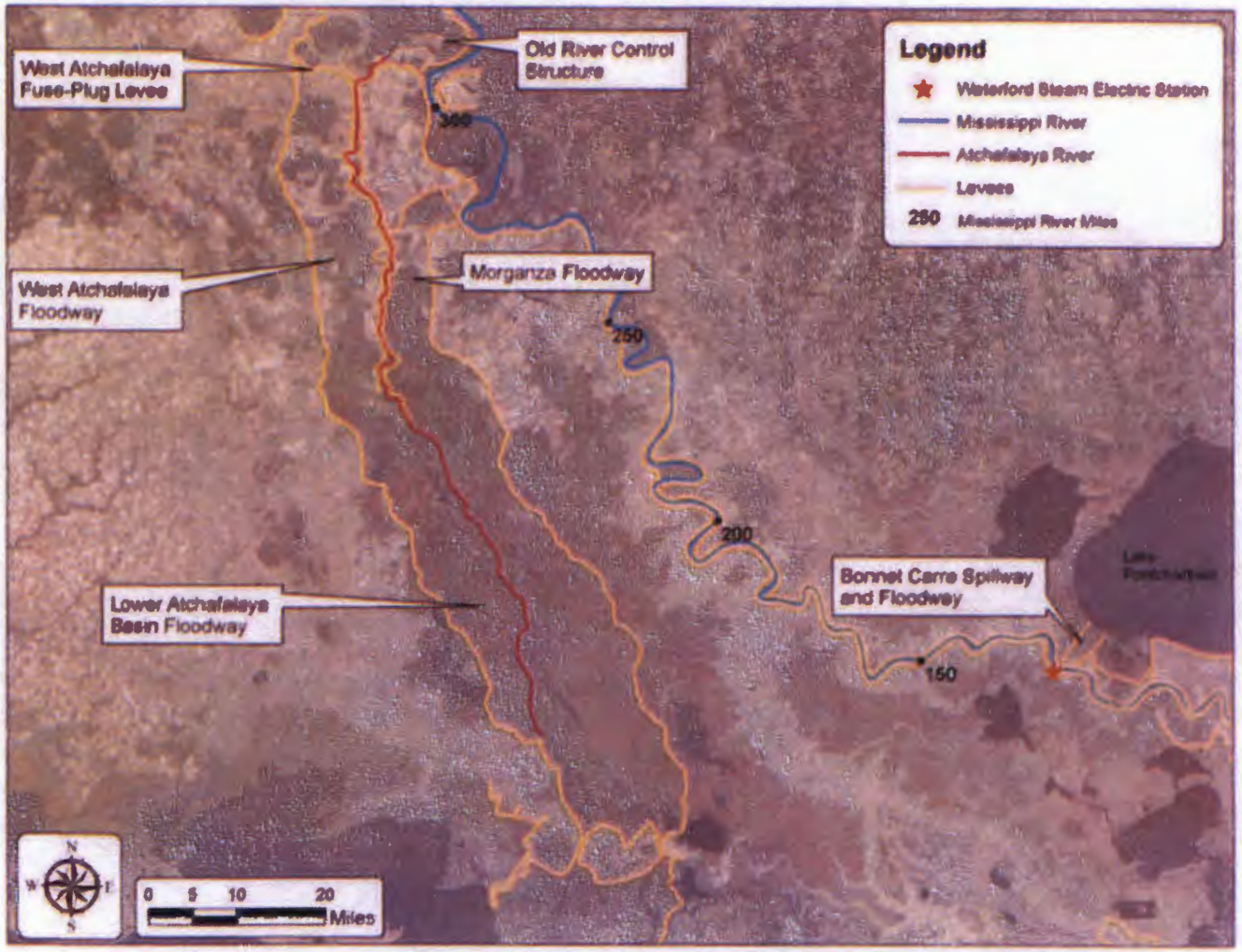

Figure 3.2-1 – Location of the Bonnet Carre Spillway and Floodway in Relation to the Waterford Site (adapted from Figure 3-23 of the July 21, 2015, FHRR (ADAMS Accession No. ML15204A321))

WATERFORD STEAM ELECTRIC STATION, UNIT 3 – FLOOD FOCUSED EVALUATION ASSESSMENT DATED February 26, 2018

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