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

June 18, 2018

Mr. Ed Burchfield, Jr.
Site Vice President
Oconee Nuclear Station
Duke Energy Carolinas, LLC
7800 Rochester Highway
Seneca, SC 29672-0752

SUBJECT: OCONEE NUCLEAR STATION, UNITS 1, 2, AND 3 – STAFF ASSESSMENT OF FLOODING FOCUSED EVALUATION (CAC NOS. MG0265, MG0266, MG0267, AND EPID L-2017-JLD-0029)

Dear Mr. Burchfield:

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*, 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 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. By letter dated March 12, 2013 (ADAMS Accession No. ML13079A227), Duke Energy Carolinas, LLC (Duke, the licensee) submitted its flood hazard reevaluation report (FHRR) for Oconee Nuclear Station, Units 1, 2 and 3 (Oconee). Duke also provided supplemental information, as documented in the audit summary report issued January 12, 2016 (ADAMS Accession No. ML15355A164). The supplemental information included the licensee's revised FHRR for Oconee that was submitted on March 6, 2015 (ADAMS Accession No. ML15072A106).

After its review of the licensee's FHRR, the NRC issued an interim staff response (ISR) letter for Oconee dated September 24, 2015 (ADAMS Accession No. ML15239B261). The ISR letter provided the reevaluated flood hazard mechanisms that exceeded the current design basis (CDB) for Oconee and parameters that are a suitable input for the mitigating strategies assessment (MSA). As stated in the letter, because the local intense precipitation (LIP); streams and rivers; and dam failure flood-causing mechanisms at Oconee are not bounded by the plant's CDB, additional assessments of these flood hazard mechanisms are necessary.

Enclosure 1 transmitted herewith contains Security-Related Information and Critical Electric Infrastructure Information (CEII). When separated from Enclosure 1, this document is decontrolled.

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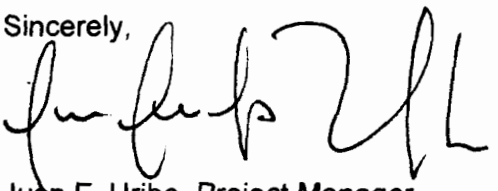
By letter dated July 31, 2017 (ADAMS Accession No. ML17222A068), the licensee submitted a focused evaluation (FE) for Oconee. The FE is intended to confirm that the licensee has adequately demonstrated, for the unbounded flooding mechanisms identified in the ISR letter, that: 1) a flood mechanism is bounded based on further reevaluation of flood mechanism parameters; 2) effective flood protection is provided for each unbounded mechanism; or 3) a feasible 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 FE for Oconee.

As set forth in the attached staff assessment, the NRC staff has concluded that the Oconee FE was performed consistent with the guidance described in the Nuclear Energy Institute's (NEI's) guidance document NEI 16-05, Revision 1, "External Flooding Assessment Guidelines" (ADAMS Accession No. ML16165A176). Guidance document NEI 16-05, Revision 1, has been endorsed by the NRC staff in Japan Lessons-Learned Division (JLD) interim staff guidance (ISG) JLD-ISG-2016-01, "Guidance for Activities Related to Near-Term Task Force Recommendation 2.1, Flooding Hazard Reevaluation" (ADAMS Accession No. ML16162A301). The NRC staff has further concluded that the licensee has demonstrated that effective flood protection, if appropriately implemented, exists for the LIP, streams and rivers, and dam breach flood mechanisms during a beyond-design-basis external flooding event. No further information is needed from the licensee related to the reevaluated flooding hazard portion of the 50.54(f) letter and this letter closes out the NRC staff's efforts associated with CAC Nos. MG0265, MG0266, MG0267, and EPID L-2017-JLD-0029.

If you have any questions, please contact me at 301-415-3809 or by e-mail at Juan.Uribe@nrc.gov.

Sincerely,



Juan F. Uribe, Project Manager
Beyond-Design-Basis Management Branch
Division of Licensing Projects
Office of Nuclear Reactor Regulation

Docket Nos. 50-269, 50-270 and 50-287

Enclosures:
1. Staff Assessment Related to the
   Focused Evaluation for Oconee (Non-Public)
2. Staff Assessment Related to the
   Focused Evaluation for Oconee (Public)

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STAFF ASSESSMENT BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO THE FOCUSED EVALUATION FOR

OCONEE NUCLEAR STATION, UNITS 1, 2, AND 3

AS A RESULT OF THE REEVALUATED FLOODING HAZARD

NEAR-TERM TASK FORCE RECOMMENDATION 2.1 – FLOODING

(CAC NOS. MG0265, MG0266, MG0267, AND EPID L-2017-JLD-0029)

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*, 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 report (ADAMS Accession No. ML111861807).

Enclosure 2 of 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. 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 stated 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 may 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) guidance document 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 FE in response to the 50.54(f) letter. The NRC's endorsement of NEI 16-05, including exceptions, clarifications, and additions, is described in interim staff guidance 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 Oconee Nuclear Station, Units 1, 2 and 3 (Oconee) has effective flood protection.

2.0 BACKGROUND

This assessment provides the final NRC staff assessment associated with the information that the licensee provided in response to the reevaluated flooding hazard portion of the 50.54(f) letter. This background section includes a summary description of the reevaluated flood information provided by the licensee and the associated assessments performed by the NRC staff. The reevaluated flood information includes: 1) the flood hazard reevaluation report (FHRR); 2) the mitigation strategies assessment (MSA); and 3) the focused evaluation (FE). The term "FLEX equipment" refers to equipment such as diesel-powered pumps and generators that the licensee acquired in response to the Mitigation Strategies Order EA 12-049 issued by the NRC on March 12, 2012 (ADAMS Accession No. ML12054A735).

Flood Hazard Reevaluation Report

By letter dated March 12, 2013 (ADAMS Accession No. ML13079A227), Duke Energy Carolinas, LLC (Duke, the licensee) submitted its FHRR for Oconee, as required by the 50.54(f) letter. Duke later provided supplemental information resulting from NRC staff reviews and audits, as documented in the audit summary report issued January 12, 2016 (ADAMS Accession No. ML15355A164). The supplemental information included the licensee's revised FHRR for Oconee that was submitted on March 6, 2015 (ADAMS Accession No. ML15072A106). After its review of the licensee's FHRR, the NRC staff issued an interim staff response (ISR) letter for Oconee on September 24, 2015 (ADAMS Accession No. ML15239B261). The ISR letter provided the reevaluated flood hazard mechanisms that exceeded the CDB for Oconee and parameters that are a suitable input for the MSA. As stated in the letter, because the local intense precipitation (LIP); streams and rivers; and dam failure flood-causing mechanisms at Oconee are not bounded by the plant's CDB, additional assessments of these flood hazard mechanisms are necessary. The NRC staff issued a final staff assessment of the FHRR in a letter dated April 14, 2016 (ADAMS Accession No. ML15352A207). The NRC staff's conclusions regarding LIP, streams and rivers, and dam failure exceeding the Oconee CDB remained unchanged from the information provided in the ISR letter.

Mitigation Strategies Assessment

By letter dated January 31, 2017 (ADAMS Accession No. ML17222A068), Duke submitted the MSA for Oconee for review by the NRC staff. The MSAs are intended to confirm that licensees have adequately addressed the reevaluated flooding hazards within their mitigation strategies for beyond-design-basis external events. By letter dated July 11, 2017 (ADAMS Accession No. ML17166A260), the NRC staff issued its assessment of the Oconee MSA. The NRC staff concluded that the Oconee MSA was performed consistent with the guidance described in Appendix G of guidance document NEI 12-06, Revision 2, "Diverse and Flexible Coping

Strategies (FLEX) Implementation Guide" (ADAMS Accession No. ML16005A625). 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 has demonstrated that the mitigation strategies, if appropriately implemented, are reasonably protected from reevaluated flood hazard conditions for beyond-design-basis external flooding events.

Focused Evaluation

By letter dated July 31, 2017 (ADAMS Accession No. ML17222A068), the licensee submitted its FE for Oconee. The FE is intended to confirm that the licensee has adequately demonstrated, for the unbounded flooding mechanisms identified in the ISR letter, that: 1) a flood mechanism is bounded based on further reevaluation of flood mechanism parameters; 2) effective flood protection is provided for each unbounded mechanism; or 3) a feasible response is provided if the unbounded mechanism is local intense precipitation. These 3 options associated with performing a FE are referred to as Path 1, 2, or 3, as described in NEI 16-05, Revision 1. The purpose of this assessment is to provide the results of the NRC staff's evaluation of the Oconee FE.

3.0 TECHNICAL EVALUATION

Duke stated that its FE for Oconee followed Path 2 of NEI 16-05, Revision 1, and utilized Appendices B and C for guidance on evaluating the site strategy. The Oconee FE addresses the LIP, streams and rivers, and dam failure flooding mechanisms, which were found to exceed the plant's CDB as described in the licensee's FHRR and the NRC's ISR letter. Path 2 is designed to evaluate if there is effective flood protection for these events and assesses the ability of permanent plant equipment (equipment other than the FLEX equipment) to maintain the key safety functions (KSFs) of core cooling, spent fuel pool cooling, and the containment function during flooding events. This technical evaluation will address the following topics: characterization of flood parameters; evaluation of flood impact assessments; evaluation of available physical margin; reliability of flood protection features; and overall site response. The elevations used in this assessment are relative to the mean sea level (MSL) vertical datum, unless otherwise stated.

Oconee was initially designed and licensed as a dry site, as the Atomic Energy Commission decided that a failure of the upstream Jocassee dam was unlikely due to its robust construction, and no flood elevation was determined for a LIP event. Oconee is located on Lake Keowee, next to the Keowee dam. The upstream dam is the Jocassee dam. [[~~(CEII)~~ [redacted]]] After initial operation of the units, safety improvements led Duke to construct the Standby Shutdown Facility (SSF) at the site, and later adding a flood wall around it which protects it to 803.5 feet (ft.). Grade level at the SSF is 796 ft. The SSF is designed to provide safe shutdown to all three reactors at the site. The SSF has a diesel generator (DG) which can power equipment in the SSF and also power some external equipment. One important component in the SSF is the auxiliary service water (ASW) pump, which is capable of pumping water to all six steam generators (SGs) (two per unit), with suction taken from an underground condenser circulating water pipe for Unit 2. Steam release to the atmosphere through the SG safety valves or the manual atmospheric

dump valves (ADVs) provides core cooling. The SSF DG also powers reactor coolant makeup (RCMU) pumps (one per unit, located in each containment structure, called reactor buildings), which inject borated water from the spent fuel pools (SFPs) into the shaft seals of the reactor coolant pumps (RCPs) to protect the RCP seals from overheating and thereby preventing excessive leakage. This also provides some makeup water to the reactor coolant system (RCS). The SSF is able to operate until flood waters recede from the site, and to continue in operation with replenishment of items such as diesel fuel and water.

The licensee stated in its FE that during the LIP event and dam failure event, flood waters are expected to inundate lower elevations of many buildings onsite including the auxiliary building and the turbine building. The licensee made the assumption that the inundation of these buildings will have the effect of disabling the SG feedwater systems and the high pressure injection systems, and will cause a loss of electrical power. The licensee will then use the SSF to maintain the KSFs for safe shutdown. In the NRC's safety evaluation for Mitigating Strategies (Order EA-12-049), dated August 30, 2017 (ADAMS Accession No. ML17202U791), the NRC staff evaluated the use of the SSF and the portable mitigating strategies (FLEX) equipment during an extended loss of alternating current power (ELAP), without considering flooding events, and found it acceptable. In the NRC staff's assessment of the licensee's MSA submittal, described in Section 2.0 above, the NRC staff evaluated the use of the SSF and the FLEX equipment during flooding events and found it acceptable. Following the guidance criteria described in Path 2 of NEI 16-05, Revision 1, this staff assessment will evaluate the use of the SSF and other permanent plant equipment without crediting the use of the FLEX equipment at the site.

A brief summary of Oconee's initial flood strategies are listed below:

- The reactors will be shut down when procedural conditions are met. Flow in the RCS transitions to natural circulation. Operators will take prompt actions to minimize RCS inventory losses by isolating potential RCS letdown paths. Decay heat is removed by steaming to the atmosphere from the SGs through the ADVs or SG safety valves.

- Plant operators will go to the SSF and start the SSF DG. Operators will then start the SSF ASW pump, which is capable of pumping water to all six SGs (two per unit).

- At the SSF, operators will also start the RCMU pumps (one per unit), which inject borated water from the SFPs into the shaft seals of the RCPs to protect the RCP seals from overheating, which may result in excessive leakage. The pumps also provide makeup water to the RCS.

3.1 Characterization of Flood Parameters

Flood event duration (FED) and associated effects (AE) parameters were assessed by Duke and have already been reviewed by the NRC, as documented in the staff's MSA assessment dated July 11, 2017 (ADAMS Accession No. ML17166A260). The FED and AE parameters are summarized in Table 3.1.1 and Table 3.1.2 below, respectively. Duke used the FED and AE parameters as input into the Oconee FE and concluded that the site's flood strategy is effective in protecting structures, systems, and components (SSCs) that support KSFs. Duke supported its conclusion of adequate flood protection by demonstrating adequate available physical margin

(APM) and reliable flood protection features for the LIP, streams and rivers, and dam failure flood-causing mechanisms. In its FE for Oconee, Duke stated that the site does not require additional manual actions by plant personnel to protect key SSCs; therefore, an evaluation of the overall site response was not necessary.

The NRC staff notes that although plant personnel are not required to install flood protection to address a flooding response, they are required to activate the SSF. However, the activation of the SSF is not a result of the FE analysis or new to the site, and instead is directed by well established procedures that operators have trained on for many years.

3.2 Evaluation of Flood Impact Assessment for Streams and Rivers

The streams and rivers flood hazard mechanism results in a large flow of water into Lake Keowee as a result of heavy precipitation in the upstream watershed. The typical water level in Lake Keowee is about 800 ft. In the NRC's ISR letter, the staff stated that the licensee's analysis shows the water level in Lake Keowee for the streams and rivers reevaluated hazard flood mechanism reaches 808.9 ft. for stillwater and 812.2 ft. with waves and runup, and is suitable input for use in further assessments of plant response. [[T
(~~OEII~~) [redacted] .]] This will prevent any further increase in the water level in Lake Keowee. The licensee also stated that there will not be a significant increase in the water level in the Keowee River, downstream of the Keowee dam. The normal river level downstream of the dam is about 686 ft., well below the grade level of the powerblock, which is about 796 ft. The NRC staff reviewed and accepted this analysis in the staff's assessment of the FHRR.

3.2.1 Conclusion for Streams and Rivers Mechanism

The NRC staff concludes that the flood mechanism for streams and rivers does not need analysis for protection of plant SSCs, as this flooding mechanism does not impact the Oconee
(~~OEII~~) site, and there still is approximately [[.]] of margin in the water-retaining structures for Lake Keowee, even after accounting for waves and runup.

3.3 Evaluation of Flood Impact Assessment for Local Intense Precipitation

In the NRC's ISR letter, the staff summarized the licensee's analysis which shows that the water level in the powerblock reaches 800.4 ft. during the LIP event, with only a minimal effect from waves and runup. The NRC staff found that analysis suitable for use in further assessments of plant response. The LIP event does not result in any dam failures, as the spillways on the Jocassee dam and the Keowee dam can pass the analyzed flow. As described in Table 3.1.1, the analysis shows that no warning time is credited, and estimates that water inundates the site with a maximum of 4.4 ft. of water for 5 hours, and recedes from the site over the next 4 hours.

Although no warning time is credited, the licensee stated that there are procedures in place to help mitigate a high rainfall storm approaching the site. Initially the operators would use procedure RP/0/A/1000/035, "Severe Weather Preparations." This procedure provides instructions for site preparation for severe weather prior to the rainfall event, and therefore provides defense-in-depth for the response to the rainfall hazard. One entry condition is a rainfall forecast in excess of 4 inches of rain in any 6 hour period. When this rainfall prediction

is made, RP/0/A/1000/035 directs the operator to enter procedure AP/0/A/1700/006, "Natural Disaster." In the natural disaster procedure, enclosures exist for both a severe weather event and a probable maximum precipitation event. In both of these enclosures there are monitoring activities that allow for the staffing of the SSF prior to the rainfall event.

The licensee stated in its FE that during the LIP event, flood waters are expected to inundate lower elevations of many buildings onsite including the auxiliary building and the turbine building. The licensee made the assumption that the inundation of these buildings will have the effect of disabling the SG feedwater systems and the high pressure injection systems, and will cause a loss of electrical power. The licensee will then use the SSF, with steam release from the SGs to atmosphere, to maintain the KSFs for safe shutdown. The licensee stated that the SSF was designed and constructed to be a watertight structure, and it is flood protected to an elevation of 803.5 ft. The NRC staff notes that the licensee installed a roof structure over the SSF courtyard, as discussed in its FE submittal, to divert rain from the courtyard area in order to prevent excessive water from entering the SSF through the access door.

The SSF is described in the Oconee Updated Final Safety Analysis Report (UFSAR) Section 9.6. The UFSAR states that the SSF ASW pump is sized to provide enough flow to all three Oconee units in order to adequately remove decay heat from the RCS. The UFSAR also states that the SSF is designed to achieve and maintain Mode 3 (reactor is subcritical) with an average RCS temperature ≥ 525 °F for all three of the Oconee units for a 72 hour coping duration. The SSF is required to be operable per unit Technical Specification (TS) 3.10.1 with at least 25,000 gallons of diesel fuel in the underground fuel oil storage tank when any of the three units are in Modes 1, 2, or 3. The NRC staff notes that the SSF and the components needed to meet the TSs are included in the site's Maintenance Rule per 10 CFR Section 50.65.

Per TS surveillance requirement 3.10.1.9, the SSF DG is periodically tested with a load of at least 3280 kilowatts (kW). Per UFSAR Section 9.6.3.4.2, it is rated for continuous operation at 3500 kW, and the SSF design load does not exceed the continuous rating of the DG. Per UFSAR Section 9.6.3.5, the SSF powers selected plant instrumentation. This allows the operator at the SSF control panel inside the SSF to monitor the relevant parameters on all 3 Units.

The NRC staff reviewed the information provided by the licensee in order to ensure that adequate flood parameters were used. The NRC staff verified that the assumed flood heights and the assumed duration of flooding above threshold elevation was consistent with previous information reviewed by the NRC staff for the Oconee FHRR and MSA.

3.3.1 Evaluation of APM and Reliability of Flood Protection Features for the LIP Event

The licensee relies on passive features to justify that there is APM. The licensee evaluated the key SSC elevations to determine if the SSCs were affected, and evaluated the corresponding hydrostatic loads.

The licensee stated in its FE that the SSF can be accessed throughout the event via a covered and elevated security walkway from the auxiliary building and a short transit through flood waters in order to reach the steps that go over the SSF floodwall. In the NRC staff's assessment of the MSA, the staff concluded that although the water level could be as high as 4.4 ft., this access was acceptable. This was based on the high likelihood that the SSF would

be manned prior to flood waters reaching their peak, on the low flow velocities of the water in this area, and on the short distance to the SSF (about 15 ft.).

The SSF flood protection provides 3.1 ft. of physical margin above the calculated LIP flood level of 800.4 ft., therefore the equipment installed in the SSF should be available.

With regards to other access points located in the SSF, the licensee stated that the passive protection features relied upon for flooding control, such as access plates, have been added to the Passive Design Feature Program at the site. In addition, an Oconee site directive is also relied upon to ensure that adequate controls are in place to avoid bypassing SSCs designated as passive design features. Further, the licensee stated that a Selected Licensing Commitment was created in order to ensure that the SSF external flood protection integrity is maintained and monitors that any Maintenance Rule functions determined to be "High Safety Significant" are being met. Finally, the licensee stated that periodic inspections of the SSF are performed on a 5-year recurrence interval using site procedure AD-EG-ONS-1214.

The SSF ASW pump and the SSF DG cooling water pump take a suction from the underground circulating water pipe, which should remain full of water during the LIP event. Steam release to the atmosphere for core decay heat removal would be accomplished by the SG safety valves, or by locally opening the SG ADVs, which are accessed on elevation 822 ft. in the turbine building. This elevation is well above the reevaluated LIP flood level.

The RCMU pumps (one per unit) are located in each reactor building. Per the UFSAR, the reactor buildings (one per unit) are designed to remain relatively leak-free at an internal pressure of 59 pounds per square inch gauge (psig) (resulting from a design-basis accident). The licensee stated in its FE that each reactor building has an external pressure rating of 3 psig (applied over the entire building simultaneously) and that the external water level of 4.4 ft. would apply a maximum pressure of about 1.9 psig. The NRC staff concludes that based on the approximately 4.4 ft. of water adjacent to the reactor buildings from the LIP event, the impact of the external pressure is not expected to result in any significant leakage into the reactor buildings because of the available margin and therefore, the LIP event is not expected to adversely affect the equipment inside the reactor building.

The RCMU pumps take a suction from the spent fuel pools. The spent fuel pools are robust Seismic Class 1 structures, located inside the Seismic Class 1 auxiliary building, and will not be adversely affected by the LIP event, except for the loss of cooling to the SFPs. The NRC staff concludes that the water supply to the RCMU pumps will be available.

3.3.2 Conclusion for LIP Mechanism

Based on the information provided by the licensee, the NRC staff concludes that adequate passive features exist to provide flood protection of key SSCs, and that adequate physical margin exists for the passive features used during the LIP event. The NRC staff also concludes that the flood protection features described above meet the definition of being reliable as discussed in Appendix B of NEI 16-05, Revision 1, due to appropriate inspection and maintenance programs, including the Technical Specification surveillance requirements for the SSF equipment. The NRC staff notes that for this analysis the licensee followed the guidance of NEI 16-05, Section 7.2. The NRC staff also notes that per NEI 16-05, Section 7.3, the licensee could have chosen to demonstrate a feasible response to the LIP event. This would

have allowed the licensee to also analyze the use of its FLEX equipment, similar to its MSA assessment discussed in Section 2.0 above. In an actual event, the staff expects that the licensee will select the best mitigation strategy available.

3.4 Evaluation of Flood Impact Assessment for Dam Failure

For the dam failure hazard, the licensee assumed a random ("sunny day") failure of the Jocassee dam. This scenario was accepted by the NRC staff in the staff's assessment of the licensee's FHRR. [

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.]] Upon receipt of this notification, operators at Oconee will enter the plant procedure for flood mitigation, begin a shutdown of all three units, and make preparations to place the SSF in service. They will borate each reactor to cold shutdown conditions using normal plant equipment during the warning period.

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The NRC staff reviewed the information provided by the licensee in order to ensure that adequate flood parameters were used. The NRC staff verified that the assumed flood heights and the assumed duration of flooding above threshold elevations was consistent with previous

information reviewed by the staff for the Oconee FHRR and MSA. The NRC staff noted in its staff assessment of the FHRR that when more conservative assumptions were made in a prior flood hazard analysis for Oconee, the flood levels were higher. However, the NRC staff concluded that the FHRR analysis reflects a reasonable analysis that removed some of the conservatism from the previous analysis. The licensee has provided instructions to the operators in plant procedure AP/0/A/1700/047, "External Flood Mitigation," to deploy a backup method of core cooling independent of the SSF, using portable equipment, in case the SSF is unable to cope with the dam failure flood event.

3.4.1 Evaluation of Available Physical Margin and Reliability of Flood Protection Features for the Dam Failure Event

The licensee will rely on passive features to justify that there is available physical margin (APM). The licensee evaluated the key SSC elevations to determine if the SSCs were affected, and evaluated hydrostatic loads.

The licensee stated in its FE that the SSF can be accessed throughout the event via a covered and elevated security walkway from the auxiliary building and a short transit through flood waters to reach the steps that go over the SSF floodwall. [

~~(CEII)~~ [redacted]).]]

~~(CEII)~~ [redacted] .]] The SSF ASW pump and the SSF DG cooling water pump take a suction from the underground circulating water pipe, which should remain full of water during the dam failure event. Steam release to atmosphere for core decay heat removal would be accomplished by the SG safety valves, or by locally opening the SG ADVs, which are accessed on elevation 822 ft. in the turbine building. This is well above the calculated flood level.

~~(CEII)~~ [redacted] .]]
The NRC staff also concludes that based on their robust construction, the SFPs will remain available as a water supply to the RCMU pumps.

Based on the information provided by the licensee, the NRC staff concludes that adequate passive features exist to provide flood protection of key SSCs and that adequate physical margin exists for the passive features. The NRC staff also concludes that the flood protection features and the key SSCs described above meet the definition of being reliable as discussed in Appendix B of NEI 16-05, Revision 1, due to appropriate inspection and maintenance programs, including the TS surveillance requirements. The NRC staff notes that for this analysis the licensee followed the guidance of NEI 16-05, Section 7.2, and demonstrated effective flood protection for the permanent plant equipment used to mitigate the dam failure event.

3.4.2 Evaluation of Site Response for the Dam Failure Event

The licensee stated that it has procedures in place at Oconee to mitigate the consequences of a postulated Jocassee dam failure. [[[redacted]]]

~~(CEII)~~

3.4.3 Conclusion for the Dam Failure Event

Based on the information provided by the licensee, the NRC staff concludes that the licensee has demonstrated to have effective flood protection for the dam failure flood-causing mechanism. This determination is based on the continuous dam monitoring that allows time for advanced site preparations, should a dam failure event occur. In addition, the reliance of passive flood protection features that meet the definition of being reliable, as discussed in Appendix B of NEI 16-05, Revision 1, due to their inclusion in appropriate inspection and maintenance programs. Finally, the licensee has also demonstrated the availability of physical margin above the reevaluated dam failure flood-causing mechanism, which provides additional assurance that the equipment installed in the SSF should be available.

4.0 AUDIT REPORT

The generic audit plan dated July 18, 2017 (ADAMS Accession No. ML17192A452), describes the NRC staff's intention to conduct audits related to focused evaluations and issue an audit report that summarizes and documents the NRC's regulatory audit of the licensee's FE. The NRC staff's activities have been limited to performing the reviews described above. Because this staff assessment appropriately summarizes the results of the audit, the NRC staff concludes that a separate audit report is not necessary, and that this document serves as the audit report described in the staff's letter dated July 18, 2017.

5.0 CONCLUSION

The NRC staff has concluded that the licensee performed the Oconee FE in accordance with the guidance described in NEI 16-05, Revision 1, as endorsed by JLD-ISG-2016-01, and that the licensee has demonstrated that effective flood protection exists from the reevaluated flood hazards. Furthermore, the NRC staff concludes that the licensee screens out of performing an integrated assessment based on the guidance found in JLD-ISG-2016-01. As such, in accordance with Phase 2 of the process outlined in the 50.54(f) letter, additional regulatory actions associated with the reevaluated flood hazard are not warranted. The licensee has satisfactorily completed providing responses to the 50.54(f) activities associated with the reevaluated flood hazards.

Table 3.1.1 Flood Event Durations for Flood-Causing Mechanisms Not Bounded by the CDB

Flood-Causing Mechanism	Time Available for Preparation for Flood Event	Duration of Inundation of Site	Time for Water to Recede from Site
Local Intense Precipitation and Associated Drainage	Not Credited	5 hours	4 hours
Streams and Rivers[1]	Not Applicable	Not Applicable	Not Applicable
~~(CEII)~~ Failure of Dams and Onsite Water Control/Storage Structures	[[redacted]	[redacted]	[redacted]]]

Source: (Oconee FHRR and MSA)
Notes:

(1) The FED parameters for the streams and rivers flood-causing mechanism are not applicable because this mechanism would not inundate the plant site.

Table 3.1.2 Associated Effects Parameters Not Directly Associated With Total Water Height for Flood-Causing Mechanisms Not Bounded by the CDB

Associated Effects Parameter	Local Intense Precipitation and Associated Drainage	Streams and Rivers (3)	Failure of Dams and Onsite Water Control/Storage Structures
Hydrodynamic loading at plant grade	Minimal	Not Applicable	Minimal
Debris loading at plant grade	Minimal	Not Applicable	Minimal(1)
Sediment loading at plant grade	Minimal	Not Applicable	Minimal(2)
Sediment deposition and erosion	Minimal	Not Applicable	Minimal
Concurrent conditions, including adverse weather - Winds	Minimal	Not Applicable	Minimal
Groundwater ingress	Minimal	Not Applicable	Minimal
Other pertinent factors (e.g., waterborne projectiles)	Minimal	Not Applicable	Minimal

Source: (Duke FHRR and MSA)

Notes:

(1) [redacted]

~~(CEII)~~

(2) [redacted]

(3) The AE parameters for the streams and rivers flood-causing mechanism are not applicable because this mechanism would not inundate the plant site.

SUBJECT: OCONEE NUCLEAR STATION, UNITS 1, 2, AND 3 – STAFF ASSESSMENT OF FLOODING FOCUSED EVALUATION DATED June 18, 2018

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ADAMS Accession Nos.: ML18138A229 (Package); ML18137A621 (Non-Public Enclosure); ML18141A755 (Public Cover Letter)

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DATE	4/25/2018	5/22/2018	5 / 27 /2018	6/ 18 /2018

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