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10 CFR 50.54(f)

December 21, 2016
Serial: HNP-16-083

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

Shearon Harris Nuclear Power Plant, Unit 1
Docket No. 50-400
Renewed License No. NPF-63

Subject: Mitigating Strategies Assessment Report for Flooding Hazard Information

References:

1. U.S. Nuclear Regulatory Commission (NRC) Letter to All Power Reactor Licensees and Holders of Construction Permits in Active or Deferred Status, Request for Information Pursuant to Title 10 of the Code of Federal Regulations 50.54(f) Regarding Recommendations 2.1, 2.3, and 9.3 of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident, March 12, 2012 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML12053A340)

2. Duke Energy Letter to NRC, Flooding Hazard Reevaluation Report, March 12, 2013 (ADAMS Accession No. ML13079A253)

3. NRC Letter, Shearon Harris Nuclear Power Plant, Unit 1 - Request for Additional Information Regarding Fukushima Lessons Learned - Flooding Hazard Reanalysis Report (TAC NO. MF1103), February 10, 2014 (ADAMS Accession No. ML14030A419)

4. Duke Energy Letter to NRC, Response to Request for Additional Information Regarding Fukushima Lessons Learned - Flooding Hazard Reanalysis Report, March 24, 2014 (ADAMS Accession No. ML14087A165)

5. Duke Energy Letter to NRC, Flood Hazard Reevaluation Report, Revision 1, April 1, 2015 (ADAMS Accession No. ML 15091A590)

6. NRC Staff Requirements Memorandum to COMSECY-14-0037, Integration of Mitigating Strategies for Beyond-Design-Basis External Events and the Reevaluation of Flooding Hazards, March 30, 2015 (ADAMS Accession No. ML15089A236)

7. Nuclear Energy Institute (NEI), Report NEI 12-06, Revision 2, Diverse and Flexible Coping Strategies (FLEX) Implementation Guide, December 2015 (ADAMS Accession No. ML16005A625)

8. NRC, JLD-ISG-2012-01, Revision 1, Interim Staff Guidance regarding Compliance with Order EA-12-049, Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events, January 22, 2016 (ADAMS Accession No. ML15357A163)

9. NRC Letter, Shearon Harris Nuclear Power Plant, Unit 1 – Staff Assessment of Response to 10 CFR 50.54(f) Information Request Flood Causing Mechanism Reevaluation (TAC NO. MF1103), April 29, 2015 (ADAMS Accession No, ML15104A370)

10. NRC Letter, Shearon Harris Nuclear Power Plant, Unit 1 - Supplement to Staff Assessment of Response to 10 CFR 50.54(f) Information Request – Flood-Causing Mechanism Reevaluation (TAC NO. MF1103), November 2, 2015 (ADAMS Accession No, ML15301A557)

11. NRC Letter, Supplemental Information Related to Request for Information Pursuant to Title 10 of the Code of Federal Regulations 50.54(f) Regarding Flooding Hazard Reevaluations for Recommendation 2.1 of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident, March 1, 2013 (ADAMS Accession No. ML13044A561)

Ladies and Gentlemen:

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). For Shearon Harris Nuclear Power Plant, Unit 1 (HNP), the FHRR was submitted on March 12, 2013 (Reference 2), and a revision to the FHRR was provided April 1, 2015 (Reference 5). In response to a Request for Additional information from the NRC (Reference 3), Duke Energy provided a response (Reference 4). Per Reference 11, the NRC considers the reevaluated flood hazard to be “beyond the current design/licensing basis of operating plants.”

The NRC staff reviewed the information provided and determined that sufficient information in response to the Reference 1 letter had been provided (Reference 9). A supplement to this staff assessment was provided by Reference 10. The supplement updated the original staff assessment to address changes in the NRC's approach to the steps following the review of the flood hazard reevaluations as directed by the Commission (Reference 6). The letter also addressed the next steps associated with the mitigation strategies assessment with respect to the reevaluated flood hazards. As documented in Reference 10, the staff concluded that HNP reevaluated flood hazard information is suitable for the assessment of mitigation strategies developed in response to Order EA-12-049 for HNP. Further, the HNP reevaluated flood hazard information is suitable for other assessments associated with NTTF Recommendation 2.1 for Flooding.

Concurrently with the flood hazard reevaluation, HNP 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." At HNP, the FLEX design basis (FLEX DB) flood was based on the plant’s current design basis (CDB) flood.

In Reference 10, the NRC concluded that the reevaluated flood hazards results for local intense precipitation, streams, rivers, and storm surge were not bounded by the current design-basis flood hazard (Table 4.0-2, Reevaluated Flood-Causing Mechanisms and Associated Effects for

Flooding-Causing Mechanisms Not Bounded by CDB Hazard). The reevaluated flood-causing mechanism information is appropriate input for additional assessments of mitigating strategies developed in response to Order EA-12-049 for HNP.

Guidance for performing mitigating strategies assessments (MSAs) is contained in Appendix G of Reference 7, which has been endorsed by the NRC in Reference 8. The enclosure to this letter provides the Mitigating Strategies Assessment Report for HNP Flooding Hazard Information. For the purpose of the MSAs, the NRC has termed the reevaluated flood hazard, summarized in Reference 10, as the "Mitigating Strategies Flood Hazard Information" (MSFHI). Reference 7, Appendix G, describes the MSA for flooding as containing the following elements:

- Section G.2 – Characterization of the MSFHI
- Section G.3 – Comparison of the MSFHI and FLEX DB Flood
- Section G.4.1 – Assessment of Current FLEX Strategies (if necessary)
- Section G.4.2 – Assessment for Modifying FLEX Strategies (if necessary)
- Section G.4.3 – Assessment of Alternative Mitigating Strategies (if necessary)
- Section G.4.4 – Assessment of Targeted Hazard Mitigating Strategies (if necessary)

The enclosure to this letter concludes that the current FLEX implementation is successful with the mitigating strategies flood hazard information. The overall FLEX planned response to an extended loss of alternating current power (ELAP) and a loss of normal access to the ultimate heat sink (LUHS) will be initiated through normal plant command and control procedures and practices. Site emergency operating procedures (EOPs) or abnormal operating procedures (AOPs) govern the operational response. The FLEX strategies will be deployed in support of the AOPs/EOPs using the FLEX Support Guidelines (FSGs), which will provide direction for using FLEX equipment in maintaining or restoring key safety functions. Therefore, the current FLEX strategies can be successfully deployed as designed for all applicable flood-causing mechanisms and no further actions, including modifications to FLEX, are required.

This letter contains no new regulatory commitments and no change to existing regulatory commitments.

Should you have any questions regarding this submittal, please contact Jeff Robertson, Regulatory Affairs Manager, at 919-362-3137.

I declare under penalty of perjury that the foregoing is true and correct. Executed on December 21, 2016.

Sincerely,

Tanya M. Hamilton

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Enclosure: Mitigating Strategies Assessment Report for Flooding Hazard Information

cc: Mr. C. Jones, NRC Resident Inspector, HNP
Ms. M. Barillas, NRC Project Manager, HNP
Mr. S. R. Monarque, NRC Japan Lessons-Learned Project Manager, HNP
NRC Regional Administrator, Region II

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SERIAL HNP-16-083

ENCLOSURE

MITIGATING STRATEGIES ASSESSMENT REPORT FOR FLOODING HAZARD INFORMATION

SHEARON HARRIS NUCLEAR POWER PLANT, UNIT 1

DOCKET NO. 50-400

RENEWED LICENSE NUMBER NPF-63

Table of Contents

1 Executive Summary

The Flood Hazard Revaluation Report (FHRR, Reference 4) summarizes the results of the evaluation performed at Shearon Harris Nuclear Power Plant, Unit No. 1 (HNP) in response to the March 12, 2012, NRC 50.54(f) Request for Information, Item 2.1. The FHRR was completed using current regulatory guidance and methodologies used for early site permits and combined license applications for the Main Dam, Auxiliary Dam, and Unit 1 Plant Island. For each flood hazard, the reevaluated flood elevations were compared to the design basis flood hazard level to determine whether it was bounded.

There were several instances of more significant impact in the reevaluated flood hazards versus the Current Design Basis (CDB). The Local Intense Precipitation (LIP) event resulted in higher flood levels. In addition, the Probable Maximum Flood (PMF), Probable Maximum Storm Surge (PMSS), and combined effects flooding events also affected the entire watershed, including dams, reservoirs, and the plant site.

Other mechanisms such as dam failure, seiche, tsunami, ice-induced flooding, and channel migration diversions have no impact on the site and will not be considered in the Mitigating Strategies Assessments (MSA). The overall strategy for the storage and deployment of FLEX equipment is unaffected by the results of the FHRR. The current FLEX strategies can be deployed fully with no additional operator actions or pre-staging of additional equipment.

2 List of Acronyms

- MSFHI – Mitigating Strategies Flood Hazard Information
- FHRR – Flood Hazard Reevaluation Report
- HNP - Shearon Harris Nuclear Power Plant, Unit No. 1
- BDB - Beyond Design Basis
- CDB – Current Design Basis
- DB – Design Basis
- AMS – Alternate Mitigating Strategies
- THMS – Targeted Hazard Mitigating Strategies
- FLEX DB – FLEX Design Basis (flood hazard)
- FLEX – Diverse and Flexible Coping Strategies
- FSAR - Final Safety Analysis Report
- HHA - Hierarchical Hazard Assessment
- HMR – US Weather Bureau Hydro-meteorological Report
- NEI – Nuclear Energy Institute
- NGVD29 – National Geodetic Vertical Datum of 1929
- MSL – Mean Sea Level
- MSA - Mitigating Strategies Assessments
- NTTF - Near-Term Task Force
- PMF – Probable Maximum Flood
- PMP – Probable Maximum Precipitation
- PMSS – Probable Maximum Storm Surge
- LIP – Local Intense Precipitation
- ELAP – Extended Loss of AC Power
- LUHS – Loss of Ultimate Heat Sink
- SSC – Structures, Systems, or Components

3 Background

3.1 Purpose

On March 12, 2012, the NRC issued a request for information associated with NTTF Recommendation 2.1 for flooding (Reference 1). One of the required responses in this request for information directed licensees to submit a FHRR. For HNP, the FHRR was submitted on March 12, 2013 (Reference 2), and a revision to the FHRR was provided on April 15, 2015 (Reference 4). The NRC considers the reevaluated flood hazard to be "beyond the current design/licensing basis of operating plants."

Concurrently with the flood hazard reevaluation, HNP 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." The Commission affirmed that licensees need to address the reevaluated flooding hazards within their mitigating strategies for BDB external events, including the reevaluated flood hazards. Guidance for performing mitigating strategies flood hazard assessments (MSFHAs) is contained in Appendix G of NEI 12-06, Revision 2 (Reference 6). For the purpose of the MSFHAs, the NRC termed the reevaluated flood hazard, as the "Mitigating Strategies Flood Hazard Information." NEI 12-06, Revision 2, Appendix G, describes the MSFHA as containing the following elements:

- Section G.2 – Characterization of the MSFHI
- Section G.3 – Basis for Mitigating Strategies Assessment (MSFHI-FLEX DB Comparison)
- Section G.4.1 – Assessment of Current FLEX Strategies (if necessary)
- Section G.4.2 – Assessment for Modifying FLEX Strategies (if necessary)
- Section G.4.3 – Assessment of Alternative Mitigating Strategies (if necessary)
- Section G.4.4 – Assessment of Targeted Hazard Mitigating Strategies (if necessary)

3.2 Site Description

HNP lies within the floodplain of Buckhorn Creek in Wake and Chatham Counties in central North Carolina. The site grade at the power block is elevation 260 foot (ft) or 79.2 meters (m) NGVD29 (Duke, 2014b). Associated and nearby water storage impoundments include the Main Reservoir and the Auxiliary Reservoir. These two reservoirs are collectively referred to as Harris Lake. The Auxiliary Reservoir is formed by the Auxiliary Dam which impounds the Tom Jack Branch, a tributary of Buckhorn Creek. The Auxiliary Dam has a crest elevation of 260.0 ft (79.25 m).

The Main Dam and Reservoir impound Buckhorn Creek. The Main Dam, constructed on Buckhorn Creek approximately 2.5 miles north of its confluence with the Cape Fear River, created the 4,000 acre Main Reservoir and is located approximately 4.5 miles (7.2 km) south of HNP. An arm of the Main Reservoir, the Thomas Branch, is adjacent to and east of HNP. The Main Dam has a crest elevation of 260.0 ft (79.25 m). The Main Reservoir provides water to the plant through the Cooling Tower Makeup Water Intake Structure that adjoins the plant and is the secondary source of Emergency Service Water (ESW). The Auxiliary Dam created the smaller 317-acre Auxiliary Reservoir. Each dam is equipped with an uncontrolled spillway. The plant island is bounded by the Main Reservoir on the east, south, and southwest sides and by the Auxiliary Reservoir on the west and northwest sides. The Auxiliary Reservoir is the preferred source of ESW.

3.3 Overview of FLEX Strategy

The objective of the FLEX Strategies is to establish indefinite coping capability in order to:

- Prevent damage to the fuel in the reactors
- Maintain the containment function
- Maintain cooling and prevent damage to fuel in the Spent Fuel Pool (SFP)

This indefinite coping capability will address an ELAP – extended loss of off-site power, emergency diesel generators (EDGs) and any other alternating current (AC) source, but not the loss of AC power to buses fed by station batteries through inverters – with a simultaneous LUHS.

The plant indefinite coping capability is attained through the implementation of pre-determined strategies that are focused on maintaining or restoring key plant safety functions. The FLEX strategies are not tied to any specific damage state or mechanistic assessment of external events. Rather, the strategies are developed to maintain the key plant safety functions based on the evaluation of plant response to the coincident ELAP/LUHS event. A safety function-based approach provides consistency with, and allows coordination with, existing plant emergency operating procedures (EOPs). FLEX strategies are implemented in support of EOPs using FLEX Support Guidelines (FSGs).

The strategies for coping with the plant conditions that result from an ELAP/LUHS event involve a three-phase approach:

- Phase 1 – Initially cope by relying on installed plant equipment and on-site resources.
- Phase 2 – Transition from installed plant equipment to on-site FLEX equipment.
- Phase 3 – Obtain additional capability and redundancy from off-site equipment and resources until power, water, and coolant injection systems are restored.

The strategies described below are capable of mitigating an ELAP/LUHS resulting from a beyond design basis external event (BDBEE) by providing adequate capability to maintain or restore core cooling, containment, and SFP cooling capabilities at HNP. Though specific strategies have been developed, due to the inability to anticipate all possible scenarios, the strategies are also diverse and flexible to encompass a wide range of possible conditions.

<u>Phase 1</u>

Upon loss of AC power due to a BDBEE, operators verify reactor and turbine trip and isolate the Reactor Coolant System (RCS). HNP will use the steam generators (SGs) as the heat sink for core cooling. The SGs will be fed by the Turbine-Driven Auxiliary Feedwater (TDAFW) pump. To assure power to essential instrumentation and controls, including the TDAFW pump, a load shed strategy will be completed. The Condensate Storage Tank (CST) is the water source to the TDAFW pump. Implementation of the core cooling strategy requires depressurization of the SGs, which will be performed using the SG Power Operated Relief Valves (PORVs). During an ELAP event, all SG PORV main control room controllers are powered by using the safety-related batteries.

No actions are anticipated during Phase 1 for SFP makeup. HNP will monitor SFP water level using SFP level instrumentation. HNP has determined that no actions were required as part of Phase 1, aside from monitoring containment pressure.

<u>Phase 2</u>

The Phase 2 core cooling strategy continues to use the SGs as the heat sink. In Phase 2, HNP will transition to an electric motor-driven FLEX Auxiliary Feedwater (AFW) Pump, which can deliver water to the SG injection point at 325 gallons per minute (gpm) and 363 pounds per square inch gauge (psig). Use of existing AFW system flow control valves (FCVs) allows flow to each SG to be controlled from the main control board. To provide a means of RCS makeup as well as maintaining subcriticality via RCS boration, an electric-powered FLEX RCS Pump will be mobilized at the Charging/Safety Injection Pump (CSIP) rooms. HNP will restore power to select plant equipment and provide power to FLEX equipment using a permanently pre-staged FLEX Diesel Generator (DG) rated at 480 volts that is located in the EDG Building Bay 2B. A second permanently pre-staged DG provides backup capability.

The strategy to provide SFP makeup water consists of using a FLEX ESW Pump to pressurize an ESW header, which can supply make-up water through the Safe Shutdown Earthquake Fire Protection header. HNP also has several SFP makeup strategies which do not require personnel access to the Fuel Handling Building (FHB) operating deck. Clean water is preferred for SFP makeup; however, any water source can be used. If condensate-grade water supply is limited, preference for this water is given to feeding SGs.

HNP has determined that no actions were required as part of Phase 2 to maintain the containment function except monitoring containment pressure. However, when the ESW header is pressurized using a FLEX ESW Pump, a containment air cooler can be placed into service if desired. From the time the fan cooler is started, the fan cooler immediately begins removing more heat than is being added.

Phase 3

The Phase 3 core cooling strategy continues to use the SGs as the heat sink. The FLEX RCS, AFW, and ESW pumps can be replaced, if necessary, by pumps from the National SAFER Response Center (NSRC). HNP will receive water treatment equipment from the NSRC to ensure a long-term source of clean water for core cooling.

HNP will receive water treatment equipment from the NSRC to ensure a long-term source of clean water for SFP cooling. If necessary, the FLEX ESW pump can be replaced by a pump from the NSRC.

In summary, the overall FLEX planned response to an ELAP and LUHS will be initiated through normal plant command and control procedures and practices. Site EOPs or abnormal operating procedures (AOPs) govern the operational response. The FLEX strategies will be deployed in support of the AOPs/EOPs using the FSGs, which will provide direction for using FLEX equipment in maintaining or restoring key safety functions.

4 Characterization of MSFHI (NEI 12-06, Revision 2, Section G.2)

NRC completed its review of the HNP Flood Hazard Reevaluation Report. The NRC staff concluded that the HNP reevaluated flood hazards information is suitable for the assessment of mitigation strategies developed in response to Order EA-12-049 (i.e., defines the mitigating strategies flood hazard information described in NEI 12-06, Appendix G, Revision 2). In Reference 10, the NRC lists the following flood-causing mechanisms for the current design basis flood at HNP:

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

- Ice Induced Flooding; and
- Channel Migrations/Diversions.

There were several instances of more significant impact in the reevaluated flood hazards than the CDB. The flood hazard reevaluation evaluated nine flooding hazards and identified four flood-causing mechanisms that are not bounded by the current design basis:

1. LIP
2. PMF in Streams and Rivers
3. PMSS
4. Combined Effects Flooding (PMF with wind wave effects)

The LIP event has no impact on the storage, deployment and implementation of FLEX strategies. Due to a minor change in flood level at the Waste Processing Building (WPB), the LIP is considered in the MSA. The current FLEX strategies can be successfully deployed and implemented as designed and no further actions, including modifications to FLEX, are required.

The PMF, PMSS, and combined effects flooding affect the entire watershed, including dams, reservoirs, and the plant site. However, the protected elevation of the dams (260 ft MSL) is greater than the reevaluated flood hazards, and the plant site is bounded for these events by the CDB. Therefore, these events have no impact on the storage, deployment, and implementation of FLEX strategies.

Other mechanisms such as dam failure, seiche, tsunami, ice-induced flooding, and channel migration diversions have no impact on the site and will not be considered in the MSA.

LIP

The effects of local intense precipitation were evaluated. For the assessment of flood hazards at safety-related SSCs, the HHA process, as described in NUREG/CR-7046, Design-Basis Flood Estimation for Site Characterization at Nuclear Power Plants in the United States of America, was followed. It is conservatively assumed there are no precipitation losses during the entire PMP event and runoff process, and all underground storm drains, driveway pipes, and culverts are clogged and not functioning during the local PMP storm event. The HNP site is drained by overland flow on open roads and ground surface away from the safety-related structures and directly to the Main Reservoir and the Auxiliary Reservoir.

Flood Height:

The reevaluated LIP analysis documented in the FHRR results in a peak water level of 261.36 ft NGVD29 at the WPB, which is 1.36 ft above site grade. This flood level is slightly higher than the DB flood elevation at the WPB of 261.27 ft NGVD29. Two doors in the WPB do not have flood protection for flood levels higher than 261.06 ft NGVD29 as stated in the HNP FSAR (Reference 4, Section 3.1.3). These two entrances to the WPB provide access to areas which house locker room, shower stalls and do not house any safety-related equipment. An evaluation of water entry into the WPB is summarized in Reference 4, Section 5.1. For the other safety-related SSCs, flood levels are lower than the DB flood level or the protected elevation. The original DB flood is 261.27 ft NGVD29 for local PMP as reported in Section 3.4.1.1 of the HNP FSAR. However, all SSCs are protected from flooding up to elevation 262 ft NGVD29 at the Turbine Building (TB), EDG Building, and Diesel Fuel Oil Storage Tank Building (DFOSTB) by curbing or raised entrances (Reference 4, Section 3.1.3).

Flood Event Duration:

Reference 4, Section 3.1.3, states that “the total duration of the PMP event is one hour. Peak flows are expected to occur at timing associated to the time of concentration on the order of seven to 52 minutes. Total duration of peak flood elevation is not expected to exceed 30 minutes based on the one-hour rainfall distribution for the local PMP."

Table 1: Probable Maximum Precipitation Depths for HNP Using HMR 51 and 52

	1-mile^2 Point Rainfall			
	5-min	15-min	30-min	1-hr
PMP (inches)	6.18	9.7	13.9	18.9

Phase 1 FLEX response can continue well beyond the LIP flood duration; deployment of personnel or FLEX equipment is not required before floodwaters recede. There is no FLEX equipment stored or deployed in the WPB. FLEX storage and deployment are not affected by the LIP event.

Relevant Associated Effects:

<u>Hydrodynamic Effects</u>

The potential of erosion due to high velocity flow is low at the site. According to the results presented in Reference 4, Table 3, the maximum velocity at safety-related SSCs is 1.27 feet per second (fps). For flow velocity less than 3 fps, the earth bed will not be eroded.

<u>Debris Effects</u>

The areas within the protected area that could potentially provide a source for debris are either paved or covered with gravel or paved surfaces with little vegetation or loose materials available. The protected area is also surrounded by a vehicle barrier system and security fences which would significantly decrease the potential for any debris to impact safety-related structures. In addition, relatively low velocities would limit the movement of debris throughout the power block. Therefore, debris effects at HNP were considered negligible.

<u>Effects Caused by Sediment Deposition and Erosion</u>

As described previously, the maximum velocity throughout the site is 1.27 ft/sec. Since most areas within the power block are paved, no erosion is expected because maximum values of flow velocity that can be sustained without significant erosion are higher than the average maximum velocity. The LIP event is a localized flooding event, which is not expected to carry significant amount of sediment typical for riverine flooding. Therefore, sediment deposition at HNP was considered negligible.

<u>Concurrent Site Conditions</u>

The meteorological events that could potentially result in significant rainfall approaching the LIP magnitude are mesoscale convective systems, synoptic systems with embedded thunderstorms, and tropical cyclones. These meteorological events can also be accompanied by hail, strong winds, and possibly even tornadoes.

<u>Groundwater Ingress</u>

Groundwater levels on-site will not increase due to LIP where floodwaters will be above site grade for approximately 1 hour. The plant design basis groundwater level is 251 ft. HNP is protected against groundwater ingress to 259 ft NGVD29.

Flood Duration

The applicable flood duration parameters include the warning time the site will have to prepare for the event, the period of time the site is inundated, and the period of time necessary for water to recede from the site. For the LIP flood event - The warning time for an inundation of the site as a consequence of a LIP event is zero, since it may occur without warning from localized storms. The site is assumed to be inundated for a period of one hour. The water level is then expected to recede below site grade within one hour, resulting in a flood duration of approximately 2 hours.

Warning Time

Warning time is not required to enable FLEX to be executed as designed for an ELAP. The site's ultimate heat sink is the Auxiliary Reservoir with the Main Reservoir as a backup; neither is challenged by the LIP event. The water sources credited for the FLEX response strategy remain available as described in the FLEX response strategy. The Phase 1 coping time for FLEX exceeds the duration of a LIP event so that FLEX deployment can be performed after flood waters have receded.

5 Basis for Mitigating Strategy Assessment (NEI 12-06, Rev 2, Section G.3)

The Current Licensing Basis for HNP states that the site is considered a "Dry Site." Table 2 reflects data from the FHRR and HNP Supplement to Staff Assessment (SA) per Reference 10 for the LIP event that is bounded or comparable to the site's DB/FLEX flood.

Table 2: Flood Causing Mechanism or Bounding Set of Parameters for LIP

Flood Scenario Parameter		Plant DB Flood (PDB)	FLEX Design Basis Flood Hazard	FHRR/SA	FHRR/SA Bounded (B) or Not Bounded (NB) by FLEX DB
Flood Level and Associated Effects	1. Maximum Stillwater Elevation (ft NGVD29)	261.27	261.27	261.36	NB Note 1
	2. Maximum Wave Run-up Elevation (ft NGVD29)	N/I	N/A	N/A	N/A
	3. Maximum Hydrodynamic/Debris Loading	N/I	N/I	Minimal Note 2	B
	4. Effects of Sediment Deposition/Erosion	N/I	N/I	N/I Note 2	B
	5. Other associated effects (identify each effect)	N/I	N/A	N/A	N/A
	6. Concurrent Site Conditions	N/I	N/A	N/I Note 3	N/A
	7. Effects on Groundwater (ft MSL)	251	Same As PDB	None	Note 4
Flood Event Duration	8. Warning Time (hours)	N/I	N/I	0 hours	Note 5
	9. Period of Site Preparation (hours)	N/I	N/I	0 hours	Note 5
	10. Period of Inundation (hours)	N/I	N/I	1 hour	Note 5
	11. Period of Recession (hours)	N/I	N/I	1 hour	Note 5 Note 6
Other	12. Plant Mode of Operations	N/I	N/I	All	Note 7
	13. Other Factors	N/I	None	None	N/A

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

Table 2 Notes listed on next page.

Notes for Table 2:

1. The WPB is affected by the FHRR/SA LIP; all other plant site structures are protected to 262 ft and are not affected by the FHRR/SA LIP. The WPB FHRR/SA change in flood level is 0.09 ft above DB, or approximately 1 inch. The WPB contains no FLEX equipment and is accessed by self-closing doors. The storage and deployment of FLEX equipment is not affected by this event.
2. The simulated peak velocities vary from 0.06 to 1.27 fps, which will not produce any erosion hazards at the plant (Reference 4, Section 3.1.3). The debris loading is determined to not be an applicable hazard because there are no credible sources of debris as the site is higher in elevation relative to the surrounding areas. All the site surface cover is pavement, concrete or gravel. Additionally, because the water velocities and depths are very low during the LIP flood event, only smaller loose items at the site will float during the LIP flood. These smaller items will not generate a significant impact on the safety-related concrete structures.
3. The meteorological events that could potentially result in significant rainfall approaching the LIP magnitude are mesoscale convective systems, synoptic systems with embedded thunderstorms, and tropical cyclones. These meteorological events can also be accompanied by hail, strong winds, and possibly even tornadoes.
4. Exterior walls of the buildings which are exposed to groundwater have been provided with impervious bithuthene waterproofing membrane up to elevation 259 ft MSL. Any in-leakage through the waterproofing membrane, construction joints or cracks in the reinforced concrete walls or base mats will be handled by floor drains routed to associated sumps and pumps (Reference 4, Section 2.2). FLEX strategies are not affected because flooding of SSCs due to groundwater will not occur.
5. Reference HNP Supplement to SA, Table 4.0-1 (Reference 10)
6. Reference HNP Supplement SA, Table 4.0-2 (Reference 10)
7. Safety-related equipment will not be jeopardized as a result of the maximum still water level due to the PMF or wave run-up associated with the PMH or storm water accumulated at the HNP site due to a PMP event; therefore, it will not be necessary to bring the reactor to cold shutdown for flood conditions. The flood protection and mitigation features are not associated with a unique mode of operation of the plant.

6 Assessment of Current Flex Strategy (NEI 12-06, Rev 2, Section G.4.1)

The LIP event is not bounded by the FLEX DB, and thus this flooding event is evaluated below as part of the MSA for HNP. In addition, the PMF, PMSS, and combined effects flooding events are not bounded by the FLEX DB; However, the protected elevation of the dams (260 ft MSL) is greater than the reevaluated flood hazards, and the plant site is protected for these events. Therefore, these events have no impact on the storage, deployment, and implementation of FLEX strategies and will not be considered in the MSA. Other mechanisms such as dam failure, seiche, tsunami, ice-induced flooding, and channel migration diversions have no impact on the site and will not be considered in the MSA.

6.1 Assessment Methodology and Process

FLEX mitigating strategies as described in the HNP Final Implementation Plan (Reference 11, Attachment 6) remain viable without modification for all FHRR/SA flooding scenarios. Modified FLEX, AMS or THMS will not be required to address the associated hazard.

The reevaluated flood hazard does not cause the ELAP/LUHS. The reevaluated flood hazard period of concentration is on the order of seven to 52 minutes. The total duration of peak flood elevation is not expected to exceed 30 minutes based on the one-hour rainfall distribution for the local PMP. Phase 1 FLEX response can continue well beyond the LIP flood duration; deployment of personnel or FLEX equipment is not required before floodwaters recede. The flood hazard does not impact the FLEX storage and deployment strategies. The time when the ELAP/LUHS occurs has no consequence on FLEX strategies.

The FHRR/SA flood level is only slightly higher than the DB flood elevation at the WPB, which contains no safety-related SSCs or FLEX deployment functions. For the safety-related SSCs, FHRR/SA flood levels are lower than the DB flood level or the protected elevation; all SSCs are protected from flooding up to elevation 262 ft NGVD29 at the TB, EDG Building, and DFOSTB by curbing or raised entrances. Only two doors of the WPB do not have flood protection for flood levels higher than 261.06 ft NGVD29 as stated in the HNP FSAR. Protection, deployment and implementation of FLEX strategies are not affected by the FHRR/SA flooding levels.

FLEX equipment is stored in the structures identified below (Reference 11, Section 2.7):.

- EDG Building – Bays 2A and 2B: The building is a Seismic Category I structure that meets the HNP design basis requirements for seismic, flood, and wind protection. The EDG Building is protected from flooding up to elevation 262 ft NGVD29; the FHRR/SA LIP level is 261.12 ft NGVD29.
- Reactor Auxiliary Building (RAB) and Tank Building: The RAB and Tank Building are Seismic Category I structures that meet the HNP design basis requirements for seismic, flood, and wind protection. The RAB is protected from flooding up to elevation 262 ft NGVD29; the FHRR/SA LIP level is 261.36 ft NGVD29.
- DFOSTB: The DFOSTB is a buried Seismic Category I structure that meets the HNP design basis requirements for seismic, flood, and wind protection. The DFOSTB is protected from flooding up to elevation 262 ft NGVD29; the FHRR/SA LIP level is 261.41 ft NGVD29.
- FLEX (N+1) Storage Building (FSB): The FSB is a commercial structure that is not protected from the external event hazards. If flooding renders FLEX equipment unavailable, HNP will track the unavailability using existing tracking procedures.

FLEX equipment storage is not compromised by the FHRR/SA flood levels. The following passive flood protection features meet the criteria of Section G.5:

- Retaining Wall Cavity Areas

- Curbs, Raised Entrances
- The boundary conditions and assumptions of the initial FLEX design are maintained.
- The sequence of events for the FLEX strategies remains valid with the evaluation of the impacts of the FHRR/SA (including impacts due to the environmental conditions created by the FHRR/SA) in such a way that the FLEX strategies may be implemented as currently developed.
- The validation performed for the deployment of the FLEX strategies is not affected by the impacts of the FHRR/SA.

6.2 Results

LIP is a short duration, low impact event at HNP and does not adversely impact the FLEX strategies. The MSFHI for LIP does not cause the ELAP/LUHS. Assuming the ELAP/LUHS occurs at the peak of the LIP, the LIP flood would completely drain from the site prior to significant FLEX deployment activities. The storage and deployment of FLEX equipment is not adversely impacted by the results of LIP. No procedural changes or additional actions are required due to LIP.

The overall FLEX planned response to an ELAP and LUHS will be initiated through normal plant command and control procedures and practices. Site EOPs or AOPs govern the operational response. The FLEX strategies will be deployed in support of the AOPs/EOPs using the FSGs, which will provide direction for using FLEX equipment in maintaining or restoring key safety functions.

6.3 Conclusions

The assessment concluded that the existing FLEX strategy can be successfully implemented and deployed as designed for all applicable flood-causing mechanisms. For the LIP event, the assessment showed that storage, deployment and implementation of FLEX equipment is not adversely impacted and no additional actions or procedural changes were required.

7 References

1. U.S. Nuclear Regulatory Commission (NRC) Letter to All Power Reactor Licensees and Holders of Construction Permits in Active or Deferred Status, Request for Information Pursuant to Title 10 of the Code of Federal Regulations 50.54(f) Regarding Recommendations 2.1, 2.3, and 9.3 of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident, March 12, 2012 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML12053A340)

2. Duke Energy Letter to NRC, Flooding Hazard Reevaluation Report, March 12, 2013 (ADAMS Accession No. ML13079A253)

3. NRC Letter, Shearon Harris Nuclear Power Plant, Unit 1 - Request for Additional Information Regarding Fukushima Lessons Learned - Flooding Hazard Reanalysis Report (TAC NO. MF1103), February 10, 2014 (ADAMS Accession No. ML14030A419)

4. Duke Energy Letter to NRC, Flood Hazard Reevaluation Report, Revision 1, April 1, 2015 (ADAMS Accession No. ML 15091A590)

5. NRC Staff Requirements Memoranda to COMSECY-14-0037, Integration of Mitigating Strategies for Beyond-Design-Basis External Events and the Reevaluation of Flooding Hazards, March 30, 2015 (ADAMS Accession No. ML15089A236)

6. NEI, Report NEI 12-06, Revision 2, Diverse and Flexible Coping Strategies (FLEX) Implementation Guide, December 2015 (ADAMS Accession No. ML16005A625)

7. NRC, 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, January 22, 2016 (ADAMS Accession No. ML15357A163)

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

9. NRC Letter, Shearon Harris Nuclear Power Plant, Unit 1 – Staff Assessment of Response to 10 CFR 50.54(f) Information Request Flood-Causing Mechanism Reevaluation (TAC NO. MF1103), April 29, 2015 (ADAMS Accession No. ML15104A370)

10. NRC Letter, Shearon Harris Nuclear Power Plant, Unit 1 - Supplement to Staff Assessment of Response to 10 CFR 50.54(f) Information Request – Flood-Causing Mechanism Reevaluation (TAC NO. MF1103), November 2, 2015 (ADAMS Accession No. ML15301A557)

11. Duke Energy Letter, Notification of Full Compliance with Order EA-12-049, “Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events” and with Order EA-12-051, “Order Modifying Licenses With Regard To Reliable Spent Fuel Pool Instrumentation” - Shearon Harris Nuclear Power Plant, Unit 1, July 10, 2015 (ADAMS Accession No. ML15192A006)

12. NRC Letter, Supplemental Information Related to Request for Information Pursuant to Title 10 of the Code of Federal Regulations 50.54(f) Regarding Flooding Hazard Reevaluations for Recommendation 2.1 of the Near Term Task Force Review of Insights from the Fukushima Dai-ichi Accident, March 1, 2013 (ADAMS Accession No. ML13044A561)