



UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
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December 15, 2017

Ms. Tanya M. Hamilton  
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Shearon Harris Nuclear Plant  
5413 Shearon Harris Road  
M/C HNP01  
New Hill, NC 27562-0165

SUBJECT: SHEARON HARRIS NUCLEAR POWER PLANT, UNIT 1 – STAFF  
ASSESSMENT OF FLOODING FOCUSED EVALUATION (CAC NO. MG0279;  
EPID L-2017-JLD-0033)

Dear Ms. Hamilton:

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, pursuant to 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 March 12, 2013 (ADAMS Accession No. ML13079A253), Duke Energy Progress, LLC (the licensee) responded to this request for Shearon Harris Nuclear Power Plant, Unit 1 (HNP).

After its review of the licensee's response, by letter dated April 29, 2015 (ADAMS Accession No. ML15104A370), supplemented by letter dated November 2, 2015 (ADAMS Accession No. ML15301A557), the NRC issued a staff assessment of the flooding reevaluation report for HNP. The staff assessment provided the reevaluated flood hazard mechanisms that exceeded the current design basis (CDB) for HNP and parameters that are suitable for other assessments associated with Near-Term Task Force Recommendation 2.1 "Flooding." As stated in the staff assessment, because the local intense precipitation (LIP), floods from streams and rivers, and storm surge flooding mechanisms are not fully bounded by the plant's CDB, additional assessments of these flood hazard mechanisms are necessary.

By letter dated September 13, 2017 (ADAMS Accession No. ML17257A043), the licensee submitted the focused evaluation (FE) for HNP. The FEs are intended to confirm that licensees have adequately demonstrated, for the unbounded mechanism identified in the staff assessment for the reevaluated flood hazard, that: 1) a flood mechanism is bounded based on further 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. The purpose of this letter is to provide the NRC's assessment of the HNP FE.

As set forth in the attached staff assessment, the NRC staff has concluded that the HNP FE was performed consistent with the guidance described in Nuclear Energy Institute (NEI) 16-05, Revision 1, "External Flooding Assessment Guidelines" (ADAMS Accession No. ML16165A178). Guidance document NEI 16-05, Revision 1, has been endorsed by 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, Flood 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 unbounded flooding mechanisms during a beyond-design-basis external flooding event at HNP. This closes out the licensee's response for HNP for the reevaluated flooding hazard portion of the 50.54(f) letter and the NRC's efforts associated with CAC No. MG0279.

If you have any questions, please contact me at 301-415-2864 or at Milton.Valentin@nrc.gov.

Sincerely,



Milton O. Valentin, Project Manager  
Beyond-Design-Basis Management Branch  
Division of Licensing Projects  
Office of Nuclear Reactor Regulation

Enclosure:  
Staff Assessment Related to the  
Flooding Focused Evaluation for HNP

Docket No: 50-400

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STAFF ASSESSMENT BY THE OFFICE OF NUCLEAR REACTOR REGULATION  
RELATED TO THE FOCUSED EVALUATION FOR  
SHEARON HARRIS NUCLEAR POWER PLANT, UNIT 1  
AS A RESULT OF THE REEVALUATED FLOODING HAZARD NEAR-TERM TASK FORCE  
RECOMMENDATION 2.1 - FLOODING

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, pursuant to 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 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 Division (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 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 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, describes acceptable methods for demonstrating that Duke

Energy Progress, LLC (Duke, the licensee) has effective flood protection for the Shearon Harris Nuclear Power Plant, Unit 1 (HNP).

## 2.0 BACKGROUND

This background section describes the reevaluated flood information provided by the licensee and the associated assessments performed by the NRC staff. The reevaluated flood information includes the flood hazard reevaluation report (FHRR), the mitigation strategies assessment (MSA), and the FE.

### Flood Hazard Reevaluation Report

By letter dated March 12, 2013 (ADAMS Accession No. ML13079A253), the licensee submitted the FHRR for HNP. After its review of the licensee's response, by letter dated April 29, 2015 (ADAMS Accession No. ML15104A370), supplemented by letter dated November 2, 2015 (ADAMS Accession No. ML15301A557), the NRC issued a staff assessment of the flooding reevaluation report for HNP. The staff assessment provided the reevaluated flood hazard mechanisms that exceeded the CDB for HNP and parameters that are suitable for other assessments associated with Near-Term Task Force Recommendation 2.1 "Flooding." As stated in the staff assessment, because the local intense precipitation (LIP), floods from streams and rivers, and storm surge flooding mechanisms are not fully bounded by the plant's CDB, additional assessments of these flood hazard mechanisms are necessary.

### Mitigation Strategies Assessment

By letter dated December 21, 2016 (ADAMS Accession No. ML16356A665), Duke submitted the HNP MSA for NRC review. 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 May 9, 2017 (ADAMS Accession No. ML17100A780), the NRC staff issued its assessment of the HNP MSA. The NRC staff concluded that the HNP 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). 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 hazards conditions for beyond-design-basis external events.

### Focused Evaluation

By letter dated September 13, 2017 (ADAMS Accession No. ML17257A043), the licensee submitted the FE for HNP. The FEs are intended to confirm that licensees have adequately demonstrated, for unbounded mechanisms identified in the staff assessment for the reevaluated flood hazard, that: 1) a flood mechanism is bounded based on further 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, or 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 HNP FE.

### 3.0 TECHNICAL EVALUATION

As described in the FHRR staff assessment, the LIP, streams and rivers, and storm surge were found to exceed the plant's CDB. The licensee stated that the FE for HNP followed Path 2 of NEI 16-05, Revision 1 and followed guidance in Appendix B to evaluate the site's strategy. This technical evaluation characterizes flood parameters and evaluates the following flood impact assessment topics for each unbounded flood-causing mechanisms: description of impact of unbounded hazard; evaluation of available physical margin and reliability of flood protection features; and overall site response.

#### 3.1 Characterization of Flood Parameters

The FE states that the flood-causing mechanisms that are not bounded by design are the LIP, streams and rivers, and storm surge. Tables 7.1, 7.2, and 7.3 in the FE provide elevation comparisons between the reevaluated unbounded flood-causing mechanism, protected elevations, and CDB flood values at locations of interest. The licensee also stated that the elevation data is based on the National Geodetic Vertical Datum of 1929 (NGVD29). All elevations in this assessment are also based on the NGVD29.

For consistency, the NRC staff compared the flood hazard information provided in FE Tables 7.1, 7.2, and 7.3 against the information in the FHRR. The FHRR information was previously found acceptable for use in NRC letter dated April 29, 2015 (ADAMS Accession No. ML15104A370), supplemented by letter dated November 2, 2015 (ADAMS Accession No. ML15301A557). Based on this comparison, the staff concluded that the licensee's characterization of the unbounded flood-causing mechanisms in the FE is appropriate.

The licensee concluded in its FE, that key safety functions (KSFs) are protected from the non-bounded reevaluated flood-causing mechanisms by protective measures and permanent/passive features with adequate margin. The licensee also stated that human actions are not required to protect structures, systems, and components (SSCs) needed to maintain the KSFs; therefore, an evaluation of the overall site response was not necessary.

#### 3.2 Evaluation of Flood Impact Assessment for LIP

##### 3.2.1 Description of Impact of Unbounded Hazard

The licensee stated in its FE, that the LIP flood elevation at some locations is above the floor level and that it has the potential to cause internal flooding to plant buildings. Table 7.1 of the licensee's FE provides a summary of the LIP flood impact at HNP. The same table shows the waste processing building (WPB) as the only safety-related building at HNP without adequate physical margin to prevent water intrusion from the reevaluated LIP event. For that reason, Duke assessed water pressure on exterior walls and doors, identified potential water pathways into the WPB, and estimated the volume of water that could potentially enter the WPB.

Table 7.1 of the licensee's FE shows that water accumulation around the WPB could reach 0.3 feet (3.6 inches) above floor elevation 261 feet. This water accumulation could generate hydrostatic pressure over walls and exterior doors. The licensee identified two exterior doors (1FP-D0833 and 1FP-D0838) that are not equipped with water proofing materials and may

(1FP-D0833 and 1FP-D0838) that are not equipped with water proofing materials and may serve as pathways for water to enter the WPB. The licensee estimated the potential water ingress at the WPB to be around 2,576 cubic feet. The water ingress could transfer from the WPB to the Fuel Handling Building (FHB) at elevation 261 feet. From the FHB, Duke stated that water could propagate to the Reactor Auxiliary Building (RAB). Once the water reaches the lowest floor level inside the RAB (elevation 190 feet), it could pond up to 4.21 inches.

The licensee's LIP event calculation provided in response to the March 12, 2012, 50.54(f) letter was evaluated by the staff as documented in the staff's assessment of the FHRR dated April 29, 2015 (ADAMS Accession No. ML15104A370), supplemented by letter dated November 2, 2015 (ADAMS Accession No. ML15301A557). The NRC staff confirmed that the information provided in the FHRR is consistent with the information used for the FE to assess the effects of this unbounded flood-mechanism at HNP.

### 3.2.2 Evaluation of Available Physical Margin and Reliability of Flood Protection Features

The licensee stated in its FE that potential water intrusion into the WPB from the LIP event should drain into the lowest levels of the RAB. The license also stated that the lowest elevation of the RAB can accommodate the estimated water intrusion without compromising KSF equipment.

As part of the audit process, the NRC staff reviewed the evaluation of LIP flooding effects on building internals (Duke Engineering Change 409305, "Beyond Design Basis Flooding Impact Evaluation," Revision 0). One of the elements covered by Duke's evaluation addressed hydrostatic pressure loads generated by flood water over WPB external walls and doors. The licensee explained that exterior walls are made of reinforced concrete and have sufficient capacity to withstand the hydrostatic pressure from the 0.3 feet of water accumulation outside the WPB. The 0.3 feet of water could generate hydrostatic pressures up to 0.13 pounds per square inch (psi). The NRC staff agrees with Duke regarding the structural capacity of the walls to withstand the expected hydrostatic pressure. The licensee's evaluation also stated that exterior doors are capable to withstand a hydrostatic pressure of 1.5 psi. Specifically, doors 1FP-D0833 and 1FP-D0838 were described to be standard metal double doors and to open outward. After evaluating the information provided by Duke, the NRC staff concluded that the WPB doors 1FP-D0833 and 1FP-D0838 should be able to withstand the hydrostatic pressure during the LIP event.

The licensee further described that water could enter the WPB through doors 1FP-D0833 and 1FP-D0838 because these doors do not have water proofing protection. Water intrusion could potentially result in water accumulation of 4.21 inches at the lowest floor level of the RAB. Duke further stated that the safety-related equipment located in the lowest RAB floor (elevation 190 feet) is 14 inches above the floor surface. Based on the information provided by the licensee, the NRC staff concludes that the elevation difference (9.79 inches) between the projected water level (4.21 inches over the lowest floor elevation of 190 feet) and the safety-related equipment (mounted 14 inches over the lowest floor elevation of 190 feet) provides adequate physical margin to protect the KSFs in the RAB.

In addition, the NRC staff used the HNP Updated Final Safety Analysis Report (UFSAR) to confirm the information in the FE and supporting evaluations. The NRC staff found that the configuration of SSCs in the FE and in Duke Engineering Change 409305 was consistent with the HNP UFSAR. The NRC staff also noticed, in HNP UFSAR Section 3.4.1.1, that the lowest portion of the RAB has a sump cavity. This sump has pumps in place to discharge water to the

heating, ventilation, and air conditioning condensate drainage system. If available, these features will provide additional margin of protection against internal flooding at the RAB.

Regarding other WPB external doors (with flood protection) that could be subject to LIP flooding, the licensee explained that the protection penetration seals were evaluated as part of the walkdowns completed to address NTTF Recommendation 2.3, Flooding. In its letter dated June 27, 2014 (ADAMS Accession No. ML14169A520), the NRC staff concluded that HNP verified the adequacy of monitoring and maintenance programs for protective features. As part of the audit process, the NRC staff confirmed that inspection of penetration seals is controlled by Duke's Engineering Periodic Test (EPT) Procedure 040, "Flood Barrier Penetration Seal Visual Inspection," Revision 0. If inspected and adequately maintained, the penetration seals should protect the KSFs in the WPB from water intrusion.

For these reasons, the NRC staff concluded that the licensee's evaluation followed the guidance in NEI 16-05 for evaluating and describing flood impacts. In addition, the NRC staff concludes that existing margins provide adequate protection to maintain KSFs as defined in Appendix B of NEI 16-05, Revision 1.

### 3.2.3 Overall Site Response

The licensee does not rely on any personnel actions or new modifications to the plant in order to respond to the LIP event. As described above, the licensee's evaluation relied on passive existing flood protection features to demonstrate adequate flood protection; therefore, there is no need to review overall site response.

## 3.3 Evaluation of Flood Impact Assessment for Streams and Rivers

### 3.3.1 Description of Impact of Unbounded Hazard

The reevaluated streams and rivers flood elevations for HNP are provided in FE Table 7.2. The NRC staff noticed that the FHRR flood elevation values in Table 7.2 represent the stillwater elevation and do not consider the associated effects of wind setup and wave runup. A complete description of the reevaluated flood levels from streams and rivers is available in Table 4.0-2 of the NRC staff letter dated November 2, 2015 (ADAMS accession No. ML15301A557). Reevaluated flood elevations with associated effects were estimated for three locations: Plant Island (257.64 feet), Main Dam (249.80 feet), and Auxiliary Dam (259.34 feet). The licensee reported in its FE that the plant grade elevation and the crest elevation of both Main Dam and Auxiliary Dam are all at elevation 260 feet. Because the reevaluated flood values for streams and rivers do not exceed elevation 260 feet, the HNP site should not be impacted by the reevaluated streams and rivers hazard.

### 3.3.2 Evaluation of Available Physical Margin and Reliability of Flood Protection Features

The FE states that the site relies on permanent passive features (Main Dam, Auxiliary Dam, and the plant grade elevation) for protection against streams and rivers floods. The reevaluated flood elevations do not exceed the elevation of these permanent passive features. The NRC staff confirmed that the information provided in the FE about the dams and plant grade is consistent with the description provided in the HNP UFSAR. Design-basis flood protection measures were verified in accordance with the NTTF Recommendation 2.3 flooding walkdowns performed at HNP, as documented in the staff's walkdown report dated June 27, 2014 (ADAMS Accession No. ML14169A520). During the flooding walkdown, the Main and Auxiliary Dams were subject of



inspections to ensure that its integrity and configuration is still reliable as described in the UFSAR. The NRC staff's walkdown report concluded that the licensee verified the plant configuration with the licensing basis; addressed degraded, nonconforming, or unanalyzed flooding conditions; and verified the adequacy of monitoring and maintenance programs for protective features. For these reasons, the NRC staff concludes that the plant grade elevation, the Main Dam, and the Auxiliary Dam should provide adequate protection from streams and rivers flooding.

### 3.3.3 Overall Site Response

The licensee does not rely on any personnel actions or new modifications to the plant in order to respond to the beyond-design-basis flood event. As described above, the licensee's evaluation relied on passive existing features to demonstrate adequate flood protection against flooding from streams and rivers. Therefore, there is no need to review overall site response for this hazard.

## 3.4 Evaluation of Flood Impact Assessment for Storm Surge

### 3.4.1 Description of Impact of Unbounded Hazard

The reevaluated flood elevations from storm surge are provided in FE Table 7.3. The NRC staff confirmed that these values are the same as those used in the FHRR, and that these considered associated effects. The reevaluated storm surge flooding values were also tabulated for three locations: Plant Island (254.47 feet), Main Dam (233.43 feet), and Auxiliary Dam (257.85 feet). As explained before, the plant grade elevation and the crest elevation of both Main Dam and Auxiliary Dam are all at elevation 260 feet. Because the reevaluated flood values for storm surge do not exceed elevation 260 feet, the HNP site should not be impacted by the reevaluated storm surge hazard.

### 3.4.2 Evaluation of Available Physical Margin and Reliability of Flood Protection Features

The FE states that the site relies on permanent passive features (Main Dam, Auxiliary Dam, and the plant grade elevation) for protection against storm surge floods. The reevaluated flood elevations do not exceed the elevation of the permanent passive features. The NRC staff confirmed that the information provide in the FE about the dams and plant grade is consistent with the description provided in the HNP UFSAR. Design-basis flood protection measures were verified in accordance with the NTTF Recommendation 2.3 flooding walkdowns performed at HNP, as documented in the staff's walkdown report dated June 27, 2014 (ADAMS Accession No. ML14169A520). During the flooding walkdown, the Main and Auxiliary Dams were subject of inspections to ensure that its integrity and configuration is still reliable as described in the UFSAR. The NRC staff's walkdown report concluded that the licensee verified the plant configuration with the licensing basis; addressed degraded, nonconforming, or unanalyzed flooding conditions; and verified the adequacy of monitoring and maintenance programs for protective features. For these reasons, the NRC staff concludes that the plant grade elevation, the Main Dam, and the Auxiliary Dam should provide adequate protection from storm surge flooding.

### 3.4.3 Overall Site Response

The licensee does not rely on any personnel actions or new modifications to the plant in order to respond to the beyond-design-basis flood event. As described above, the licensee's evaluation



relied on passive existing features to demonstrate adequate flood protection against flooding from storm surge. Therefore, there is no need to review overall site response for this hazard.

#### 4.0 AUDIT REPORT

The July 18, 2017, generic audit plan describes the NRC staff's intention to issue an audit report that summarizes and documents the NRC's regulatory audit of the licensee's FE. The NRC staff's HNP audit was limited to the review of the calculations and procedures described above. Because this staff assessment appropriately summarizes the results of the audit, the NRC staff concludes a separate audit report is not necessary, and that this document serves as the audit report described in the staff's July 18, 2017, letter.

#### 5.0 CONCLUSION

The NRC staff concludes that Duke performed the HNP 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 against the reevaluated flood hazards. Furthermore, the NRC staff concludes that HNP 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, beyond those associated with mitigation strategies assessment, are not warranted. The licensee has satisfactorily completed providing responses to the 50.54(f) activities associated with the reevaluated flood hazards.

SHEARON HARRIS NUCLEAR POWER PLANT, UNIT 1 – STAFF ASSESSMENT OF FLOODING FOCUSED EVALUATION DATED December 15, 2017

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**\*via email**

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