



UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
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September 11, 2017

Mr. James J. Hutto  
Regulatory Affairs Director  
Southern Nuclear Operating Co., Inc.  
P.O. Box 1295, Bin 038  
Birmingham, AL 35201-1295

SUBJECT: VOGTLE ELECTRIC GENERATING PLANT, UNITS 1 AND 2 - STAFF  
ASSESSMENT OF FLOODING FOCUSED EVALUATION (CAC NOS. MF9891  
AND MF9892)

Dear Mr. Hutto:

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. ML12056A048). By letter dated March 5, 2013 (ADAMS Accession No. ML13067A283, non-public), Southern Nuclear Operating Company, Inc. (the licensee) responded to this request for Vogtle Electric Generating Plant, Units 1 and 2 (VEGP).

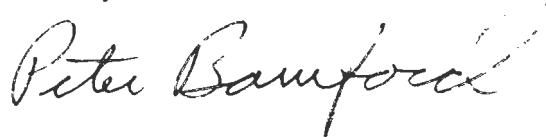
After its review of the licensee's response, by letter dated November 6, 2014 (ADAMS Accession No. ML14279A352), supplemented by letter dated November 3, 2015 (ADAMS Accession No. ML15300A140), the NRC issued a staff assessment of the flooding hazard reevaluation report for VEGP. The supplement dated November 3, 2015, provided the reevaluated flood hazard mechanisms that exceeded the current design basis (CDB) for VEGP and parameters that are a suitable input for the mitigating strategies assessment (MSA). As stated in this letter, because the local intense precipitation (LIP) and failure of upstream dams flood-causing mechanisms at VEGP were not bounded by the plant's CDB, additional assessments of those flood hazard mechanisms are expected to be performed by the licensee.

By letter dated June 30, 2017 (ADAMS Accession No. ML17181A428), the licensee submitted a focused evaluation (FE) for VEGP. The FEs are intended to confirm that, for unbounded mechanisms, licensees have adequately demonstrated that: 1) a flood mechanism is bounded based on a reevaluation of flood mechanism parameters; 2) effective flood protection is provided for the unbounded mechanism; or 3) a feasible response is provided if the unbounded mechanism is local intense precipitation. The purpose of this letter is to provide the NRC's assessment of the VEGP FE.

As set forth in the attached staff assessment, the NRC staff has concluded that the VEGP 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. ML16090A140). The NRC staff has further concluded that the licensee has demonstrated that effective flood protection exists for the LIP and dam breaches and failures flood mechanisms during a beyond-design-basis external flooding event at VEGP, assuming appropriate implementation of the regulatory commitments identified in the licensee's FE. This closes out the licensee's response for VEGP for the reevaluated flooding hazard portion of the 50.54(f) letter and the NRC's efforts associated with CAC Nos. MF9891 and MF9892.

If you have any questions, please contact me at 301-415-2833 or at [Peter.Bamford@nrc.gov](mailto:Peter.Bamford@nrc.gov).

Sincerely,

A handwritten signature in black ink that reads "Peter Bamford". The signature is written in a cursive style with a large, looped initial "P".

Peter J. Bamford, Senior Project Manager  
Orders Management Branch  
Japan Lessons-Learned Division  
Office of Nuclear Reactor Regulation

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

Docket Nos: 50-424 and 50-425

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STAFF ASSESSMENT BY THE OFFICE OF NUCLEAR REACTOR REGULATION  
RELATED TO THE FOCUSED EVALUATION FOR  
VOGTLE ELECTRIC GENERATING PLANT, UNIT NOS. 1 AND 2  
AS A RESULT OF THE REEVALUATED FLOODING HAZARD NEAR-TERM TASK FORCE  
RECOMMENDATION 2.1 - FLOODING  
CAC NOS. MF9891 AND MF9892

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. ML12056A048). 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. On 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 focused evaluation in response to the 50.54(f) letter. The NRC's endorsement of NEI 16-05, including exceptions, clarifications, and additions, is described in JLD-ISG-2016-01, "Guidance for Activities Related to Near-Term Task Force

Recommendation 2.1, Flood Hazard Reevaluation” (ADAMS Accession No. ML16090A140). Therefore, NEI 16-05, Revision 1, as endorsed, describes acceptable methods for demonstrating that Vogtle Electric Generating Plant, Units 1 and 2 (VEGP, Vogtle) has effective flood protection.

## 2.0 BACKGROUND

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

### Flood Hazard Reevaluation Report

By letter dated March 5, 2013 (ADAMS Accession No. ML13067A283, non-public), Southern Nuclear Operating Company (SNC, the licensee), responded to the 50.54(f) letter for VEGP and submitted the FHRR. After reviewing the licensee’s response, by letter dated November 6, 2014 (ADAMS Accession No. ML14279A352), supplemented by letter dated November 3, 2015 (ADAMS Accession No. ML15300A140), the NRC issued a staff assessment of the FHRR for VEGP. The NRC’s letter dated November 3, 2015, provided the reevaluated flood hazard mechanisms that exceeded the CDB for VEGP, specifically local intense precipitation (LIP) and dam failure flooding. The supplement concluded that the licensee’s reevaluated flood-causing mechanism information was appropriate input to the additional assessments as described in the 50.54(f) letter and COMSECY-15-0019. However, the staff also noted that the licensee had not incorporated the variability of the land surface elevations in the powerblock area into the LIP evaluation and this omission could result in flood levels higher than the 219.3 feet mean sea level (MSL) elevation calculated in the licensee’s FHRR. As stated in the letter dated November 3, 2015, because the LIP and failure of upstream dams flood-causing mechanisms at VEGP were not bounded by the plant’s CDB, additional assessments of these flood hazard mechanisms would be expected to be performed by the licensee.

### Mitigation Strategies Assessment

By letter dated December 21, 2016 (ADAMS Accession No. ML16356A455), SNC submitted the MSA for VEGP. The MSA included a revised LIP model that was performed to address the NRC’s comments that were provided to the licensee in the staff assessment supplement dated November 3, 2015. The MSAs are intended to confirm that licensees have adequately addressed the reevaluated flooding hazards within their mitigating strategies for beyond-design-basis external events. By letter dated August 10, 2017 (ADAMS Accession No. ML17198A190), the NRC issued its assessment of the VEGP MSA. The NRC staff concluded that the VEGP MSA was performed consistent with the guidance described in Appendix G of 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 also concluded that the licensee has demonstrated that the mitigation strategies, if appropriately implemented as described, are reasonably protected from reevaluated flood hazards conditions for beyond-

design-basis external events. Finally the NRC staff concluded that the reevaluated hazards reported in the MSA letter (elevations, duration, and any associated effects), including the revised LIP model, were adequate for use in the MSA.

### Focused Evaluation

By letter dated June 30, 2017 (ADAMS Accession No. ML17181A428), the licensee submitted the FE for VEGP. The FEs are intended to confirm that, for unbounded mechanisms, licensees have adequately demonstrated that: 1) a flood mechanism is bounded based on a reevaluation of flood mechanism parameters; 2) effective flood protection is provided for the unbounded mechanism; or 3) a feasible response is provided if the unbounded mechanism is LIP. These 3 options associated with performing an FE are referred to as Path 1, 2, or 3, respectively, 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 VEGP FE.

## 3.0 TECHNICAL EVALUATION

The licensee stated that its FE followed Path 2 of NEI 16-05, Revision 1, and utilized Appendices B and C for guidance on evaluating the site strategy. The LIP and upstream dam failure flooding mechanisms were found to exceed the CDB flood at VEGP, and were addressed by SNC in the VEGP FE. This technical evaluation will address the following topics: characterization of flood parameters; evaluation of flood impact assessments; evaluation of available physical margin (APM); reliability of flood protection features; and overall site response.

### 3.1 Characterization of Flood Parameters

According to the licensee, the LIP elevations that are used as inputs to the FE are the same as those that were used for the MSA. In the powerblock area, these elevations vary from 219.15 feet MSL to 220.51 feet MSL. In addition, the licensee's FE states that the site will have 72 hours of warning time for the LIP event, with up to 8.5 hours of inundation and 11 hours of recession. Regarding the dam failure flooding mechanism, the NRC's staff assessment supplement letter specified a reevaluated flood hazard level of 178.1 feet MSL, and this elevation was used in the FE.

The FE generally credits passive protection features to demonstrate that key structures, systems, and components (SSCs) are protected from the LIP flooding mechanism, with two areas being identified for the application of temporary protection features (sandbags) during the LIP event warning time. For the dam failure mechanism, the reevaluated flood hazard level of 178.1 feet MSL is approximately 40 feet below the site grade elevation and results in no impact to the key SSCs based on the passive protection of the site topography and grading.

The NRC staff reviewed the LIP parameters listed in the licensee's FE and confirmed that they were consistent with the parameters that were presented in the MSA for the LIP event. Based on the review that was previously performed for the MSA, the staff concludes that the licensee's characterization of the LIP event in the FE is appropriate. The staff also concludes that the dam failure mechanism was characterized consistent with the supplemental staff assessment of the FHRR, and is therefore appropriate for the FE.

## 3.2 Evaluation of Flood Impact Assessment for LIP

### 3.2.1 Description of Impact of Unbounded Hazard

The VEGP FE references the LIP flood evaluation levels that range from 219.15 to 220.51 feet MSL at representative locations around the main powerblock structures. The licensee's FE also states that the elevations calculated for the reevaluated hazard LIP analysis exceed the CDB elevation of 219.1 feet MSL. Further, the FE states that the surveyed plant grade was determined to be 219.6 feet MSL. A more detailed ground elevation listing is also presented in the FE, representing various points on the site with elevations ranging from 217.31 to 220.03 feet MSL. Since analysis for the reevaluated LIP flooding mechanism shows water levels above building entry points at various locations, the licensee evaluated the possible volume of water that could enter during the LIP event at those locations and any resulting impact to key SSCs. The licensee determined that two locations housing key SSCs required temporary barriers (sandbags) to prevent any water ingress. The locations for the temporary barriers are the north Control Building doors and the Unit 2 Diesel Fuel Oil Storage (DFOS) Building.

### 3.2.2 Evaluation of Available Physical Margin

For the areas where building in-leakage was possible, and where temporary measures are not credited in the FE, the licensee determined that the Unit 2 Turbine-Driven Auxiliary Feedwater (TDAFW) pump would have the least amount of APM. The licensee determined that the APM would be 2.44 inches and the licensee concluded that this was sufficient due to the conservative assumptions used to calculate the water ingress.

Based on the LIP analysis, the licensee determined the north Control Building doors and DFOS should have a barrier installed temporarily when a large scale rain event is forecast. This barrier will prevent water intrusion that could impact the station batteries and the Unit 2 Emergency Diesel Generator fuel oil supply, respectively. According to the licensee, the installation of the temporary barriers will be procedurally controlled, with a specified trigger point to ensure the barrier is installed prior to water reaching a critical level. The procedural controls will also specify the amount of material to use such that the barrier is approximately twice as high as the predicted ponding depth in order to establish adequate APM. The licensee states that by having the barrier at this height it will exceed the APM for the Unit 2 TDAFW pump and the conservative nature of the analysis would therefore justify the APM, similar to the TDAFW pump.

Since the TDAFW pump is also integral to the licensee's FLEX strategy, the NRC staff previously reviewed the LIP event parameters for the Unit 2 TDAFW pump and found it to be acceptable, as documented in the MSA staff assessment. Specifically, the staff concluded that the licensee's LIP simulation used realistic or conservative assumptions, and the staff also performed a confirmatory model run to determine adequacy.

Based on the review performed for the licensee's MSA, the staff concludes that the licensee has demonstrated the use of conservative assumptions, inputs, and methods, and therefore the APM is acceptable. Regarding the temporary barriers, the staff also concludes that the factor of two margin in the height of the sandbag barriers provides adequate APM since the projected water height has been determined conservatively.

### 3.2.3 Reliability of Flood Protection Features

Site topography and building external flood boundaries up the CDB LIP flooding level are passive features. Since these features are already credited as part of the VEGP design-basis flood protection, the NRC staff concludes that a reliability analysis of these features is not necessary in accordance with the guidance found in NEI 16-05, Revision 1.

The licensee's FE did not specifically address reliability for the beyond-design-basis LIP flooding mechanism. For the temporary features that are included in the licensee's FE, the staff notes that NEI 16-05, Section B.2.3 addresses reliability. It suggests that standards, codes, guidance documents, and operating experience should be used in the configuration of the temporary feature. In the case of a sandbag wall, NEI 16-05 suggests the use of a U.S. Army Corps of Engineers (USACE) sandbag construction guideline, available online at the USACE website. Since the licensee's procedure for the sandbag operation is not yet fully developed, use of the USACE guideline was not able to be confirmed. Thus, the staff concludes that an acceptable reliability determination is contingent upon completion of the licensee's first regulatory commitment listed in the FE. Specifically, this commitment for procedure development must address the use of standards, codes, guidance documents, and operating experience in the final configuration of the temporary feature instructions, consistent with the provisions of NEI 16-05, Appendix B.

The licensee also identified that since the reevaluated LIP elevations exceed the CDB, there may be penetrations not covered by the walkdowns conducted for Enclosure 4 to the 50.54(f) letter (Fukushima NTT Item 2.3, Flooding Walkdowns). These penetrations could provide a potential pathway for water at the reevaluated LIP elevation to possibly impact key SSCs. An activity to identify and, if necessary, correct such penetrations has not yet been performed and thus the licensee's FE has identified a second regulatory commitment to evaluate such penetrations. The staff views this commitment as a key activity that needs to be performed properly to support a reliability conclusion for the potentially affected key SSCs.

Because increased focus has been placed on flood protection since the accident at Fukushima, licensees and NRC inspectors have identified deficiencies with equipment, procedures, and analyses relied on to either prevent or mitigate the effects of external flooding at a number of licensed facilities. Recent examples include those found in Information Notice 2015-01, "Degraded Ability to Mitigate Flooding Events" (ADAMS Accession No. ML14279A268). In addition, the NRC is cooperatively performing research with the Electric Power Research Institute to develop flood protection systems guidance that focuses on flood protection feature descriptions, design criteria, inspections, and available testing methods in accordance with a memorandum of understanding dated September 28, 2016 (ADAMS Accession No. ML16223A495). The NRC staff expects that licensees will continue to maintain flood protection features in accordance with their current licensing basis. The staff also expects that licensee's will use the site corrective action program to disposition flood-related maintenance, operations, and design issues, consistent with the provisions of NEI 16-05 and NEI 12-07, "Guidelines for Performing Verification Walkdowns of Plant Flood Protection Features," as endorsed by the NRC, where appropriate. Continued research involving flood protection systems will be performed and shared by the NRC staff with licensees in accordance with the guidance provided in Management Directive 8.7 "Reactor Operating Experience Program" (ADAMS Accession No. ML122750292), as appropriate.

The NRC staff concludes that, assuming successful completion of the licensee's regulatory commitments identified in the FE, the VEGP flood protection features described above are reliable to maintain key safety functions, as described in Appendix B of NEI 16-05, Revision 1.

### 3.2.4 Overall Site Response

The licensee relies on personnel actions to erect temporary flood protection features in order to respond to the beyond-design-basis LIP event. The sandbagging evolution is a task not normally performed by site operators. The licensee has indicated that the instructions for the sandbag placement will be contained in site procedures and validated. This is a future activity. In the MSA review, the staff evaluated the licensee's procedural controls for the LIP event triggering criteria and found them to be acceptable. Thus, subject to completion of the procedure(s) developed in accordance with the licensee first regulatory commitment identified in its FE, as well as confirmation by the validation, the staff concludes that the licensee should be able to place the temporary features into place consistent with the FE description.

## 3.3 Evaluation of Flood Impact Assessment for Upstream Dam Failure

### 3.3.1 Description of Impact of Unbounded Hazard

The reevaluated analysis regarding failure of upstream dams is 178.1 feet MSL, which exceeds the CDB elevation of 168 feet MSL. Thus, the reevaluated dam failure event is addressed in the FE. Even though the reevaluated hazard is higher, it is still significantly below the site grade and existing flooding protection level for the plant.

The staff confirmed that the licensee's parameters used as input to the FE are consistent with the parameters specified in the NRC's staff assessment supplement letter dated November 3, 2015, which specified the parameters appropriate for further evaluation for this flood-causing mechanism.

### 3.3.2 Evaluation of Available Physical Margin

The APM for the dam failure scenario is greater than 41 feet in relation to the plant grade of 219.6 feet MSL. The staff concludes that this APM is acceptable because it exceeds the guidance found in NEI 16-05, Revision 1, Section B.1, which refers to Federal Emergency Management Agency flood insurance studies to define "adequate APM" for a river flood as 2.5 feet.

### 3.3.3 Reliability of Flood Protection Features

The staff further concludes that the reliability of the site provisions for the dam failure flood are acceptable because the 178.1 feet MSL is below the 219.1 feet MSL design-basis flood height for the plant. Any necessary design-basis flood protection measures were verified in accordance with the NTF Recommendation 2.3 flooding walkdowns that were performed at Vogtle. The staff concludes that the site topography and grading ensure sufficient reliability of flood protection.

### 3.3.4 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 dam failure event. As described above, the licensee's



evaluation relied on passive existing features to demonstrate adequate flood protection. Therefore, there is no need to review overall site response.

#### 4.0 AUDIT REPORT

The generic audit plan dated July 18, 2017, 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 VEGP audit included a review of the licensee's submittals 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 NRC staff's letter dated July 18, 2017.

#### 5.0 CONCLUSION

The NRC staff has concluded that SNC performed the VEGP 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, assuming appropriate implementation of the licensee's regulatory commitments, from the reevaluated flood hazards. Furthermore, the NRC staff concludes that VEGP 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.

SUBJECT: VOGTLE ELECTRIC GENERATING PLANT, UNITS 1 AND 2 - STAFF  
 ASSESSMENT OF FLOODING FOCUSED EVALUATION  
 DATED SEPTEMBER 11, 2017

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