



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

June 16, 2014

Mr. Eric A. Larson, Site Vice President  
FirstEnergy Nuclear Operating Company  
Beaver Valley Power Station  
Mail Stop A-BV-SEB1  
P.O. Box 4, Route 168  
Shippingport, PA 15077

**SUBJECT: BEAVER VALLEY POWER STATION UNITS 1 AND 2 – STAFF ASSESSMENT OF THE FLOODING WALKDOWN REPORT SUPPORTING IMPLEMENTATION OF NEAR-TERM TASK FORCE RECOMMENDATION 2.3 RELATED TO THE FUKUSHIMA DAI-ICHI NUCLEAR POWER PLANT ACCIDENT (TAC NOS. MF0196 AND MF0197)**

Dear Mr. Larson:

On March 12, 2012, the U.S. Nuclear Regulatory Commission (NRC) issued a request for information letter per Title 10 of the *Code of Federal Regulations*, Section 50.54(f) (50.54(f) letter). The 50.54(f) letter was issued to power reactor licensees and holders of construction permits requesting addressees to provide further information to support the NRC staff's evaluation of regulatory actions that may be taken in response to lessons learned from Japan's March 11, 2011, Great Tōhoku Earthquake, resultant tsunami, and subsequent accident at the Fukushima Dai-ichi nuclear power plant. The request addressed the methods and procedures for nuclear power plant licensees to conduct seismic and flooding hazard walkdowns to identify and address degraded, nonconforming, or unanalyzed conditions through the corrective action program, and to verify the adequacy of the monitoring and maintenance procedures.

By letter dated November 27, 2012, as supplemented by letter February 25, 2014, FirstEnergy Nuclear Operating Company (FENOC) submitted a Flooding Walkdown Report as requested in Enclosure 4 of the 50.54(f) letter for Beaver Valley Power Station, Units 1 and 2. By letter dated January 30, 2014, FENOC provided a response to the NRC request for additional information dated December 23, 2013, for the staff to complete its assessments.

The NRC staff reviewed the information provided and, as documented in the enclosed staff assessment, determined sufficient information was provided to be responsive to Enclosure 4 of the 50.54(f) letter. This concludes the NRC staff's efforts associated with TAC Nos. MF0196 and MF0197.

E. Larson

- 2 -

If you have any questions, please contact me at (301) 415-4090 or by e-mail at [Jeffrey.White@nrc.gov](mailto:Jeffrey.White@nrc.gov).

Sincerely,

A handwritten signature in black ink, appearing to read "Jeffrey A. Whited". The signature is fluid and cursive, with a small circular mark at the end.

Jeffrey A. Whited, Project Manager  
Plant Licensing Branch I-2  
Division of Operating Reactor Licensing  
Office of Nuclear Reactor Regulation

Docket Nos. 50-334 and 50-412

Enclosure:  
Staff Assessment of Flooding Walkdown  
Report

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STAFF ASSESSMENT OF FLOODING WALKDOWN REPORT  
NEAR-TERM TASK FORCE RECOMMENDATION 2.3 RELATED TO  
THE FUKUSHIMA DAI-ICHI NUCLEAR POWER PLANT ACCIDENT  
FIRSTENERGY NUCLEAR OPERATING COMPANY  
BEAVER VALLEY POWER STATION, UNITS 1 AND 2  
DOCKET NOS. 50-334 AND 50-412

1.0 INTRODUCTION

On March 12, 2012,<sup>1</sup> the U.S. Nuclear Regulatory Commission (NRC) issued a request for information per Title 10 of the *Code of Federal Regulations*, Section 50.54(f) (50.54(f) letter) to all power reactor licensees and holders of construction permits in active or deferred status. The request was part of the implementation of lessons learned from the accident at the Fukushima Dai-ichi nuclear power plant. Enclosure 4, "Recommendation 2.3: Flooding,"<sup>2</sup> to the 50.54(f) letter requested licensees to conduct flooding walkdowns to identify and address degraded, nonconforming, or unanalyzed conditions using the corrective action program (CAP), verify the adequacy of monitoring and maintenance procedures, and report the results to the NRC.

Enclosure 4 of the 50.54(f) letter requested licensees to respond with the following information:

- a. Describe the design basis flood hazard level(s) for all flood-causing mechanisms, including groundwater ingress.
- b. Describe protection and migration features that are considered in the licensing basis evaluation to protect against external ingress of water into SSCs [systems, structures, and components] important to safety.
- c. Describe any warning systems to detect the presence of water in rooms important to safety.
- d. Discuss the effectiveness of flood protection systems and exterior, incorporated, and temporary flood barriers. Discuss how these systems and barriers were evaluated using the acceptance criteria developed as part of Requested Information item 1.h.
- e. Present information related to the implementation of the walkdown process (e.g., details of selection of the walkdown team and procedures) using the

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<sup>1</sup> Agencywide Documents Access and Management System (ADAMS) Accession No. ML12053A340.

<sup>2</sup> ADAMS Accession No. ML12056A050.

documentation template discussed in Requested Information item 1.j, including actions taken in response to the peer review.

- f. Results of the walkdown including key findings and identified degraded, nonconforming, or unanalyzed conditions. Include a detailed description of the actions taken or planned to address these conditions using guidance in Regulatory Issues Summary 2005-20, Revision 1, Revision to the NRC Inspection Manual Part 9900 Technical Guidance, "Operability Conditions Adverse to Quality or Safety," including entering the condition in the corrective action program.
- g. Document any cliff-edge effects identified and the associated basis. Indicate those that were entered into the corrective action program. Also include a detailed description of the actions taken or planned to address these effects.
- h. Describe any other planned or newly installed flood protection systems or flood mitigation measures including flood barriers that further enhance the flood protection. Identify results and any subsequent actions taken in response to the peer review.

In accordance with the 50.54(f) letter, Enclosure 4, Required Response Item 2, licensees were required to submit a response within 180 days of the NRC's endorsement of the flooding walkdown guidance. By letter dated May 21, 2012,<sup>3</sup> the Nuclear Energy Institute (NEI) staff submitted NEI 12-07, Revision 0, "Guidelines for Performing Verification Walkdowns of Plant Flood Protection Features," to the NRC staff to consider for endorsement. NEI 12-07 describes a methodology for performing walkdowns in a manner that will address requested information items 1.a through 1.j of Enclosure 4 to the 50.54(f) letter. By letter dated May 31, 2012,<sup>4</sup> the NRC staff endorsed the walkdown guidance.

By letter dated November 27, 2012,<sup>5</sup> as supplemented by letter dated February 25, 2014,<sup>6</sup> FirstEnergy Nuclear Operating Company (FENOC, the licensee), provided a response to Enclosure 4 of the 50.54(f) letter Required Response Item 2, for Beaver Valley Power Station (BVPS). The NRC staff issued a request for additional information (RAI) to the licensee regarding the available physical margin (APM) dated December 23, 2013.<sup>7</sup> The licensee responded by letter dated January 30, 2014.<sup>8</sup>

The NRC staff evaluated the licensee's submittals to determine if the information provided in the walkdown report, as supplemented, met the intent of the walkdown guidance and if the licensee responded appropriately to Enclosure 4 of the 50.54(f) letter.

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3 ADAMS Package Accession No. ML121440522.

4 ADAMS Accession No. ML12144A142.

5 ADAMS Accession No. ML12335A341.

6 ADAMS Accession No. ML14057A548.

7 ADAMS Accession No. ML13325A891.

8 ADAMS Accession No. ML14030A559.

## 2.0 REGULATORY EVALUATION

The SSCs important to safety in operating nuclear power plants are designed either in accordance with, or meet the intent of Appendix A to 10 CFR Part 50, "General Design Criteria for Nuclear Power Plants," Criterion 2: "Design Bases for Protection Against Natural Phenomena;" and Appendix A "Seismic and Geological Criteria for Nuclear Power Plants," to 10 CFR Part 100. Criterion 2 states that SSCs important to safety at nuclear power plants shall be designed to withstand the effects of natural phenomena such as earthquakes, tornadoes, hurricanes, floods, tsunamis, and seiches without loss of capability to perform their safety functions.

For initial licensing, each licensee was required to develop and maintain design bases that, as defined by 10 CFR 50.2, identify the specific functions to be performed by an SSC, and the specific values or ranges of values chosen for controlling parameters as reference bounds for the design.

The design bases for the SSCs reflect appropriate consideration of the most severe natural phenomena that have been historically reported for the site and surrounding area. The design bases also reflect sufficient margin to account for the limited accuracy, quantity, and period of time in which the historical data have been accumulated.

The current licensing basis (CLB), as defined in 10 CFR 54.3(a), is the set of NRC requirements applicable to a specific plant, and a licensee's written commitments for ensuring compliance with, and operation within, applicable NRC requirements and the plant-specific design basis that are in effect.

## 3.0 TECHNICAL EVALUATION

### 3.1 Design Basis Flooding Hazard for Beaver Valley Power Station

The licensee reported that the design basis flood (DBF) hazard at the BVPS is a probable maximum flood (PMF) on the Ohio River resulting in an elevation of 730.0 feet mean sea level (MSL) at the power block. Coincident wind and wave runup was calculated as 6.7 ft above the PMF. The Intake Structure is also affected by wave runup, which results in an overall surface water level of 736.7 ft MSL. The local probable maximum precipitation (PMP) event produces a local site flooding level elevation of over 728.0 ft MSL for approximately 18 hours. The licensee evaluated the effect of postulated dam failures on the river levels at the BVPS site with the failure of the most critically located dam, (Conemaugh Dam), resulting in a maximum level of 725 ft at the site. Flooding due to ice jams was deemed improbable and not evaluated. Groundwater ingress was considered negligible due to the low permeability of the bedrock and drainage of shallow surface sediments.

Based on the NRC staff's review, the licensee appears to have described the design basis flood hazard level(s) requested in the 50.54(f) letter and consistent with the walkdown guidance.

### 3.2 Flood Protection and Mitigation

#### 3.2.1 Flood Protection and Mitigation Description

The licensee reported that the CLB flood protection level and mitigation is 730 ft MSL. When the Ohio River rises to 670 ft MSL, the site enters an Abnormal Operating Procedure (AOP). The AOP includes a plant shutdown when river surface water level elevations are expected to exceed 700 ft MSL. As a primary means of flood protection, all of BVPS, Unit 1 (BVPS-1) and the majority of Unit 2 (BVPS-2) safety-related structures are above the PMF level. Although the BVPS-1 base mat elevation is below 705 ft MSL, BVPS-1 SSCs are designed to be water tight and withstand the buoyancy and pressures of the PMF. BVPS-1 charging pumps are located in the lowest level of the Primary Auxiliary Building at 722 ft MSL. These pumps are required for safe shutdown and individually protected against the PMF. BVPS-2 has several safety-related systems and components that are located below 730 ft MSL, although these features are within buildings and housed within an enclosed structure that has no penetrations below elevation 730 ft MSL. The Intake Structure contains both BVPS-1 and BVPS-2 components and is located at elevation 705 ft MSL; however, all equipment required for a safe shutdown is located in watertight concrete cubicles with penetrations sealed with the exception of flood door openings. The associated flood doors are installed in the openings when surface water levels reach an elevation of 695 ft MSL.

The credited flood protection features below the PMF level associated with buildings and structures are penetration seals, sump pumps, and curbing for flood prone features. The licensee stated that the walkdown and the results found that the flood protection features at BVPS conform to the CLB.

#### 3.2.2 Incorporated and Exterior Barriers

The licensee reported that the site has incorporated exterior barriers including curbs, penetrations seals, and automatic sump pumps that are permanently in place requiring no operator manual actions. The Intake Structure has a water tight door system that can seal each pump cubicle individually and allow the BVPS-1 and BVPS-2 pumps to continue to perform as required during PMF conditions.

The licensee stated that the primary barrier for flood protection at BVPS is geography, where most components required for the safe shutdown of the plant are above PMF levels. The licensee did not discuss local intense precipitation as a relevant flooding event.

#### 3.2.3 Temporary Barriers and Other Manual Actions

The licensee reported that the site identified manual actions that require operator action. The licensee stated that the closure of the flood doors of the Intake Structure is the only operator action that is performed for the protection of safety-related equipment required for safe shutdown.

### 3.2.4 Reasonable Simulation and Results

The licensee discussed reasonable simulations. A plant procedure (Procedure 1/20M-53C.4A.75.2) is in place for flooding when water levels reach or exceed the PMF or the Plant Shift Manager is notified that a flood alert has been issued.

### 3.2.5 Conclusions

Based on the NRC staff's review, the licensee appears to have described protection and mitigation features as requested in the 50.54(f) letter and is consistent with the walkdown guidance.

### 3.3 Warning Systems

The licensee stated that there are leak sensors to identify leakage through the water tight membranes for the BVPS-1 and BVPS-2 containment structures. Additionally, there are sensors in the sump area of the Intake Structure to detect water accumulation.

Based on the NRC staff's review, the licensee appears to have provided information to describe any warning systems as requested in the 50.54(f) letter and consistent with the walkdown guidance.

### 3.4 Effectiveness of Flood Protection Features

The licensee reported that, with the exception of flood doors for pump cubicles in the Air Intake Structure, flood protection features are passive or active mechanical systems that do not require operator action. The flood doors require a closure and sealing action in the event of a flood level exceeding 705 ft MSL. The site AOP, "Acts of Nature – Flood" is entered when river water levels rise to 670 ft MSL or the Plant Manager is notified that flood alert has been issued. At water levels of 690 ft MSL, the Intake Structure is inspected to confirm that no openings for flood water entry are available. Intake structure cubicles are sealed closed when flood levels reach 695 ft MSL. The licensee has an AOP, "Acts of Nature – Dam Failure;" however, this procedure refers the operator back to "Acts of Nature – Flood."

The licensee used acceptance criteria consistent with the walkdown guidance. Based on the NRC staff's review, the licensee appears to have discussed the effectiveness of flood protection features as requested in the 50.54(f) letter and is consistent with the walkdown guidance.

### 3.5 Walkdown Methodology

By letter dated June 11, 2012,<sup>9</sup> the licensee responded to the 50.54(f) letter indicating that it intended to utilize the NRC-endorsed walkdown guidance contained in NEI 12-07, Rev. 0-A, "Guidelines for Performing Verification Walkdowns of Plant Flood Protection Features."<sup>10</sup>

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<sup>9</sup> ADAMS Accession No. ML12163A318.

<sup>10</sup> ADAMS Accession No. ML12173A215.

Based on the NRC staff's review, the licensee appears to have presented information related to the implementation of the walkdown process as requested in the 50.54(f) letter, and is consistent with the walkdown guidance.

### 3.6 Walkdown Results

#### 3.6.1 Walkdown Scope

The licensee performed walkdowns of relevant flood-protection features at the Standby Auxiliary Feedwater Building, Auxiliary Building, Turbine Building, Diesel Generator Building, and Control Building. The licensee cited the BVPS-AOP for Intake Structure cubicles requiring that operators "Perform Attachment 2, 'Flood Door Installation and Removal Procedure' within 8 hours of exceeding 695 feet." This Attachment describes the process to correctly seal all intake structure flood doors before flood level reaches the cubicle door elevation. The licensee concluded that the implementation procedures can be implemented as written and within the allowed time considering the warning time available for the applicable flood hazard.

The licensee stated that flood prevention and mitigation measures are designed to function in all modes of operation including full power operations, startup, shutdown, and refueling. For the PMP flooding evaluation, yard drains were assumed to be ineffective due to concurrent high water levels.

Coincident wind and resulting wave activity was considered for the PMF as applied to the Intake Structure only, as this is the only safety-related structure subjected to wave runup. Associated wave runup was calculated as 6.7 ft above the PMF. As a result of this analysis, Intake Structure ventilation air intakes were raised to 737 ft MSL and ventilation exhaust chimneys were attached to exhaust slots for protection.

The licensee used acceptance criteria consistent with the intent of NEI 12-07.

#### 3.6.2 Licensee Evaluation of Flood Protection Effectiveness, Key Findings, and Identified Deficiencies

The licensee performed an evaluation of the overall effectiveness of the plant's flood protection features. The licensee stated that no deficiencies exist that could adversely impact the design basis function(s) of external flood-protection features as credited in the CLB.

NEI 12-07 defines a deficiency as follows: "a deficiency exists when a flood protection feature is unable to perform its intended function when subject to a design basis flooding hazard." The licensee did not identify deficiencies because of the flood walkdowns.

NEI 12-07 specifies that licensees identify observations/potential deficiencies in the CAP that were not yet dispositioned at the time the walkdown report was submitted. FENOC did not identify reported observations awaiting disposition. FENOC entered a number of Condition Reports into the CAP noting observations found during the walkdowns. Condition Reports included observations of open covers, water in sleeves, penetration pathways, storage boxes from anticipated flood areas, cracked concrete, evidence of water seepage, and open flanges.



### 3.6.3 Flood Protection and Mitigation Enhancements

The licensee stated that there are no planned or recommended modifications to flood protection systems or mitigation measures resulting from these walkdowns.

### 3.6.4 Planned or Newly Installed Features

The license created an Engineering Change Package 12-0092 to fabricate covers to be used when pumps in the Intake Structure are removed for extended maintenance. These covers are designed to provide a water tight seal over the opening where the pump is installed. Currently, there is no contingency for PMF conditions when a pump has been removed. Upon removal of a pump, a steel cover plate will be installed and a temporary seal put in place until the pump is ready for reinstallation. The licensee documented this change in a Condition Report . This change was being developed prior to the walkdowns.

### 3.6.5 Deficiencies Noted and Actions Taken or Planned to Address

The licensee stated that the results of the walkdowns per the guidelines of NEI 12-07 affirm that the structures, systems and components will function as described in the CLB. The licensee did not identify any deficiencies where a flood protection feature would not be able to perform the intended function. The licensee documented observations in the CAP for further resolution.

### 3.6.6 Staff Analysis of Walkdowns

The NRC staff reviewed the licensee walkdown report dated November 27, 2012, as supplemented. The licensee provided an evaluation of flood-protection procedures in the walkdown report. The staff found that the BVPS-AOP procedures were adequately described and met the intent of the walkdown guidance. The licensee reviewed the AOP and instituted improvements to the procedures as a result of the review. No reasonable simulations were discussed in the walkdown report as supplemented by the licensee. The licensee found that the flood-protection and mitigation features referred to in the CLB were available, functional, and properly maintained. The licensee identified no deficiencies.

Based on the above assessment, the licensee appears to have provided results of the walkdown and described any other planned or newly installed flood protection systems or flood mitigation measures as requested in the 50.54(f) letter and consistent with the walkdown guidance. Based on the information provided in the licensee's submittal, the NRC staff concludes that the licensee's implementation of the walkdown process meets the intent of the walkdown guidance.

### 3.6.7 Available Physical Margin

The NRC staff issued an RAI to the licensee regarding the available physical margin (APM)

dated December 23, 2013.<sup>11</sup> The licensee responded with a letter dated January 30, 2014.<sup>12</sup>

The licensee has reviewed their APM determination process, and entered any unknown APMs into their CAP. The NRC staff reviewed the response, and concluded that the licensee met the intent of the APM determination per NEI 12-07.

Based on the NRC staff's review, the licensee appears to have documented the information requested for any cliff-edge effects, as requested in the 50.54(f) letter and consistent with the walkdown guidance. Further, the NRC staff reviewed the response, and concluded that the licensee met the intent of the APM determination per NEI 12-07.

### 3.7 NRC Oversight

#### 3.7.1 Independent Verification by Resident Inspectors

On June 27, 2012, the NRC issued Temporary Instruction (TI) 2515/187, "Inspection of Near-Term Task Force Recommendation 2.3 Flooding Walkdowns."<sup>13</sup> In accordance with the TI, NRC inspectors independently verified that the LGS licensee implemented the flooding walkdowns consistent with the intent of the walkdown guidance. Additionally, the inspectors independently performed walkdowns of a sample of flood protection features. The inspection report (05000334/2012005 and 05000412/2012005) dated February 5, 2013,<sup>14</sup> documents the results of this inspection. No identified or licensee-revealed findings were identified.

#### 4.0 Walkdowns Not Performed for Flood Protection Features

NRC staff verified that all restricted flood protection features have been walked down.

#### 4.1 Restricted Access

The licensee identified one restricted access location and generated a work order to complete inspections. The licensee provided justification for the delay in the walkdown of this restricted access feature. The BVPS-1 Containment Building could not be examined given the operating mode of the plant. The licensee performed walkdowns of this restricted access feature during its refueling outage (1R22) and provided a supplemental response on February 25, 2014,<sup>15</sup> documenting the results. The response stated that all restricted flood protection features have been subsequently completed.

#### 4.2 Inaccessible Features

The licensee identified a number of features that could not be completely examined due to their location. The exterior walls of the Containment building and other safety related buildings with

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11 ADAMS Accession No. ML13325A891.

12 ADAMS Accession No. ML14030A559.

13 ADAMS Accession No. ML12129A108.

14 ADAMS Accession No. ML13036A302.

15 ADAMS Accession No. ML14057A548.

underground walls could not be examined from the outside. Interior inspections, drawing reviews, and past excavations help demonstrate the integrity of the walls. The seals for the shake spaces between seismic structures could not be readily examined. The licensee stated that no evidence of water on the metal covers was found and that no evidence of water entry has been found. The licensee provided a basis for reasonable assurance that inaccessible access features are available and will perform credited functions.

## 5.0 CONCLUSION

The NRC staff concludes that the licensee's implementation of the flooding walkdown methodology meets the intent of the walkdown guidance. The staff concludes that the licensee, through the implementation of the walkdown guidance activities and, in accordance with plant processes and procedures, verified the plant configuration with the current flooding licensing basis; addressed degraded, nonconforming, or unanalyzed flooding conditions; and verified the adequacy of monitoring and maintenance programs for protective features. Furthermore, the staff notes that no immediate safety concerns were identified. The NRC staff reviewed the information provided and determined that sufficient information was provided by the licensee to be responsive to Enclosure 4 of the 50.54(f) letter, dated March 12, 2012.

E. Larson

- 2 -

If you have any questions, please contact me at (301) 415-4090 or by e-mail at Jeffrey.White@nrc.gov.

Sincerely,

*/RA/*

Jeffrey A. White, Project Manager  
Plant Licensing Branch I-2  
Division of Operating Reactor Licensing  
Office of Nuclear Reactor Regulation

Docket Nos. 50-334 and 50-412

Enclosure:  
Staff Analysis of Flooding Walkdown  
Report

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ADAMS Accession Number: **ML14156A233**

**\*via e-mail dated**

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