



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

June 17, 2014

Mr. Michael J. Pacilio  
President and Chief Nuclear Office  
Exelon Nuclear  
4300 Winfield Road  
Warrenville, IL 60555

**SUBJECT: LIMERICK GENERATING 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. MF0242 AND MF0243)**

Dear Mr. Pacilio:

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 19, 2012, Exelon Generation Company, LLC (Exelon) submitted a Flooding Walkdown Report as requested in Enclosure 4 of the 50.54(f) letter for Limerick Generating Station, Units 1 and 2. Exelon provided supplemental information in letters dated July 31, 2013, January 31, 2014, and May 7, 2014.

The NRC staff has reviewed the information provided and, as documented in the enclosed staff assessment, determined that sufficient information has been provided to be responsive to Enclosure 4 of the 50.54(f) letter. This closes out the NRC's efforts associated with TAC Nos. MF0242 and MF0243.

M. Pacilio

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If you have any questions, please contact me at 301-415-1420 or by e-mail at Rick.Ennis@nrc.gov.

Sincerely,

A handwritten signature in black ink, appearing to read "R B Ennis". The signature is fluid and cursive, with the first letters of the first and last names being capitalized and prominent.

Richard B. Ennis, Senior Project Manager  
Plant Licensing Branch I-2  
Division of Operating Reactor Licensing  
Office of Nuclear Reactor Regulation

Docket Nos. 50-352 and 50-353

Enclosure:  
Staff Assessment of Flooding Walkdown  
Report

cc w/encl: Distribution via Listserv

STAFF ASSESSMENT OF FLOODING WALKDOWN REPORT  
NEAR-TERM TASK FORCE RECOMMENDATION 2.3 RELATED TO  
THE FUKUSHIMA DAI-ICHI NUCLEAR POWER PLANT ACCIDENT  
EXELON GENERATION COMPANY, LLC  
LIMERICK GENERATING STATION, UNITS 1 AND 2  
DOCKET NOS. 050-352 AND 50-353

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

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

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

- 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 19, 2012,<sup>5</sup> Exelon Generation Company, LLC (the licensee), provided a response to Enclosure 4 of the 50.54(f) letter, Required Response Item 2, for Limerick Generating Station, Units 1 and 2 (LGS). The licensee submitted supplements dated July 31, 2013,<sup>6</sup> and May 7, 2014,<sup>7</sup> in addition to the letter dated November 19, 2012. The NRC staff issued a request for additional information (RAI) to the licensee regarding the available physical margin (APM) dated December 23, 2013.<sup>8</sup> The licensee responded by letter dated January 31, 2014.<sup>9</sup>

The NRC staff evaluated the licensee's submittals to determine if the information provided in the walkdown report 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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<sup>3</sup> ADAMS Package Accession No. ML121440522.

<sup>4</sup> ADAMS Accession No. ML12144A142.

<sup>5</sup> ADAMS Accession No. ML12331A204.

<sup>6</sup> ADAMS Accession No. ML13212A247.

<sup>7</sup> ADAMS Accession No. ML14127A324.

<sup>8</sup> ADAMS Accession No. ML13325A891.

<sup>9</sup> ADAMS Accession No. ML14031A443.

## 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 to 10 CFR Part 100, "Seismic and Geological Siting Criteria for Nuclear Plants." 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, tsunami, 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 LGS

The licensee stated that the design basis flood hazard for the site is a Local Intense Precipitation (LIP) event with a maximum flood elevation of 218.6 feet (ft) mean sea level (MSL), which is higher than the power block elevation of 217 ft MSL. The licensee stated that the peak flood level occurs 3 hours into the event, and overall flood duration is approximately 6 hours.

The licensee added that other flooding events were reviewed as part of the LGS CLB such as: river water rising due to dam failure; tank failures; and cooling tower basin failure. For the latter event, the licensee stated that a cooling tower basin failure could produce a peak flood level of 218.8 ft MSL. The licensee stated that although the peak flood level is higher, it only lasts for a brief period of time and for an overall flood duration of only 35 minutes. The licensee concludes though the LIP flooding event is slightly smaller spatially than the cooling tower basin failure event, its duration is significantly larger to warrant it as the bounding scenario.

Based on the NRC staff's review, the licensee appears to have sufficiently described the design basis flood hazard level(s) as 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 stated that the current flood boundary features for LGS are composed of both incorporated passive and active features. The licensee noted that the LGS CLB makes no distinction regarding the operating mode of the plant. As stated previously, the licensee considered a LIP duration of 6 hours and a peak water level 3 hours into the event. The LIP event results in an elevation of 218.6 ft MSL and the plant grade is at an elevation of at least 217 ft MSL. Drainage facilities were assumed blocked and non-functional, except for open-channel portions. Storm drain pipes and culverts were assumed plugged and all flow is assumed to be surface flow, overland, or over roadway.

#### 3.2.2 Incorporated and Exterior Barriers

The licensee stated that the LGS site has incorporated and/or exterior barriers that are permanently in-place, requiring no operator manual actions and incorporated features that require manual actions. Incorporated passive features include: site drainage, concrete barriers, roads, walls, and dikes. Incorporated active features are mainly composed of doors. The licensee noted that doors, that are intended to prevent water entry, are kept closed under all modes of plant operations. The licensee also notes that conduit penetrations into areas housing SSCs are sealed at wall penetrations.

#### 3.2.3 Temporary Barriers and Other Manual Actions

The licensee stated that LGS does not rely upon temporary features for protection. The licensee notes sandbags would be installed to prevent water damage, if time permits. However, sandbag installation is not required to maintain the plant in a safe condition.

#### 3.2.4 Reasonable Simulation and Results

The licensee discussed a procedure required to address pump house flooding and determined that the actions involved are not necessary to maintain the plant in safe shutdown; therefore, a simulation was not necessary.

The same procedure discusses actions regarding the external flooding of the power block. The licensee stated that the plant staff needs to ensure that all exterior power block doors identified in the procedure are closed and, if time permits, install sand bags to protect assets unrelated to maintaining the plant in a safe condition. After discussing with site staff and reviewing the procedure, the licensee stated that the closure of doors is considered a routine activity and that the installation of sand bags is not required; therefore, simulations of these activities were not necessary. The licensee stated that all exterior power block doors involved in the procedure were included in the walkdown list.

### 3.2.5 Conclusion

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 consistent with the walkdown guidance.

### 3.3 Warning Systems

The licensee stated that there are no warning systems related to external flood events at LGS.

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 developed its own guidance as a supplement to the approved NEI guidance to judge the acceptance criteria of all features. The licensee stated the supplemental guidance was designed to provide more specific criteria for judging acceptance of flood protection features. The licensee stated that observations that were not immediately judged to be acceptable during the walkdowns were entered into the plant's CAP for further evaluation.

In general, the licensee assessed, by way of visual inspection, that barriers, dikes, berms, topography, and flood doors were generally in acceptable condition and able to perform their intended functions. The licensee stated several Incident Reports (IRs) were issued for damaged seals in doors credited for protecting SSCs from external flooding. However, their current condition does not represent a significant degradation to the barrier system.

The licensee designated manholes to be inaccessible due to significant electrical hazard. In order to ascertain their acceptability, the licensee verified that the conduits between the manholes and the power block area were properly capped, sealed, had no water leakage, or terminated at elevations higher than the flood elevation. The following observations were made:

- Conduits were determined to be oriented, elevated, or capped sufficiently to prevent water entry;
- Visual inspections did not identify any leakage in areas around obstructed conduits; and,
- Video inspection through manholes of conduits leading to the power block indicated that they were not without seals.

The licensee concluded there was reasonable assurance conduits would not become a pathway for floodwaters to enter the plant.

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 consistent with the walkdown guidance.

### 3.5 Walkdown Methodology

By letter dated June 11, 2012,<sup>10</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>11</sup>

The licensee's walkdown submittal dated November 19, 2012, indicated that the licensee implemented the walkdowns consistent with the intent of the guidance provided in NEI 12-07. The licensee did not identify any exceptions from NEI 12-07.

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 consistent with the walkdown guidance.

### 3.6 Walkdown Results

#### 3.6.1 Walkdown Scope

The licensee documented the results of walkdown activities by letter dated November 19, 2012, and by supplemental letters dated July 31, 2013, and May 7, 2014. The licensee stated that the walkdown list consisted of 109 flood protection features including barriers, dikes, berms, topography, doors, and conduit banks.

The licensee developed 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. As discussed previously, the flood protection features at LGS are incorporated passive and incorporated active. The licensee noted the majority of features inspected were determined to be acceptable.

The licensee stated that 109 features were included in the walkdown list. The licensee indicated the majority of the features were judged to be acceptable during the walkdown activities. Nine features were determined to be in restricted areas or inaccessible. The licensee's letters dated July 31, 2013, and May 7, 2014, indicated that restricted access features were inspected and determined to be acceptable. Reasonable assurance was provided that inaccessible features would perform their intended function.

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 any deficiencies during the course of the flood walkdowns.

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<sup>10</sup> ADAMS Accession No. ML12164A569.

<sup>11</sup> ADAMS Accession No. ML12173A215.



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. The licensee stated a number of door seals were degraded and IRs were initiated to repair them. However, the license stated the doors would perform their intended flood protection.

### 3.6.3 Flood Protection and Mitigation Enhancements

The licensee stated that there are no flood protection and mitigation enhancements identified by the walkdown effort.

### 3.6.4 Planned or Newly Installed Features

The licensee stated that there are no planned or newly installed features identified by the walkdown effort.

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

The licensee stated that no deficiencies were identified by the walkdown effort.

### 3.6.6 NRC Staff Analysis of Walkdowns

The NRC staff reviewed the licensee walkdown report dated November 19, 2012, and supplemental letters dated July 31, 2013, and May 7, 2014. The staff noted that the licensee followed the intent of the recommended walkdown guidance. The licensee provided reasonable explanations for not performing simulations.

The NRC staff noted that a small number of doors were judged by the licensee to be immediately acceptable even with the fact that the seals attached to them were in a degraded state. The staff noted that the licensee promptly issued IRs for these degraded seals in order to repair and track them.

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>12</sup> The licensee responded with a letter dated January 31, 2014.<sup>13</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.

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<sup>12</sup> ADAMS Accession No. ML13325A891.

<sup>13</sup> ADAMS Accession No. ML14031A443.

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." 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 dated February 5, 2013<sup>14</sup>, documents the results of this inspection. No findings of significance were identified.

### 3.8 Walkdowns Not Performed for Flood Protection Features

#### 3.8.1 Restricted Access

In the November 19, 2012, letter, the licensee identified three features in restricted access areas. The licensee provided justification for the delay in walkdowns of restricted access features. The walkdowns for one of these features could only be performed during a refueling outage. The remaining two features are inspected every 2 years, therefore there was no need to inspect them during the flooding walkdowns.

The licensee performed walkdowns of all restricted access features and provided supplemental responses documenting the results by letters dated, July 31, 2013, and May 7, 2014. There are no remaining features in restricted access areas.

#### 3.8.2 Inaccessible Features

The licensee stated that six areas were inaccessible to the walkdown teams. All features were related to conduit banks in manholes. The licensee stated that manholes were designated as inaccessible due to significant electrical hazard. The licensee performed a number of investigations to ascertain their functionality, including: visual inspection of conduits within the power block area by verifying proper capping, orientation or elevation relative to flood height; visual inspection of lack of water leakage in adjacent areas; and video inspections of some manholes to verify the status of seals. The licensee stated that the combination of these investigations provides a basis for reasonable assurance that inaccessible access features are available and will perform credited functions.

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<sup>14</sup> ADAMS Accession No. ML13036A364.

#### 4.0 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 licensee's walkdown results, which were verified by the staff's inspection, identified no immediate safety concerns. 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.

M. Pacilio

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If you have any questions, please contact me at 301-415-1420 or by e-mail at Rick.Ennis@nrc.gov.

Sincerely,

*/RA/*

Richard B. Ennis, Senior Project Manager  
Plant Licensing Branch I-2  
Division of Operating Reactor Licensing  
Office of Nuclear Reactor Regulation

Docket Nos. 50-352 and 50-353

Enclosure:  
Staff Assessment of Flooding Walkdown  
Report

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