



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

June 16, 2014

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

SUBJECT: OYSTER CREEK NUCLEAR GENERATING STATION – STAFF ASSESSMENT OF FLOODING WALKDOWN REPORT SUPPORTING IMPLEMENTATION OF NEAR-TERM TASK FORCE RECOMMENDATION 2.3 RELATED TO THE FUKUSHIMA DAI-ICHI NUCLEAR POWER PLANT ACCIDENT (TAC NO. MF0256)

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 Co., LLC (licensee) submitted a Flooding Walkdown Report as requested in Enclosure 4 of the 50.54(f) letter for Oyster Creek Nuclear Generating Station. The licensee supplemented the initial response by letter dated March 19, 2013.

The NRC staff has 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 closes the NRC's efforts associated with TAC No. MF0256.

M. Pacilio

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If you have any questions, please contact me at (301) 415-3100 or via e-mail at John.Lamb@nrc.gov.

Sincerely,

A handwritten signature in black ink, appearing to read "John G. Lamb". The signature is fluid and cursive, with the first name "John" being the most prominent.

John Lamb, Senior Project Manager
Plant Licensing Branch I-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-219

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 NUCLEAR
OYSTER CREEK NUCLEAR GENERATING STATION
DOCKET NO. 50-219

1.0 INTRODUCTION

On March 12, 2012,¹ 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,"² 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.

¹ Agencywide Documents Access and Management System (ADAMS) Accession No. ML12053A340.

² 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, 2012,³ 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, 2012,⁴ the NRC staff endorsed the walkdown guidance.

By letter dated November 19, 2012,⁵ as supplemented by letter dated March 19, 2013,⁶ Exelon Generation Co., LLC (Exelon), provided for a response for the Oyster Creek Nuclear Generating Station (OCNGS).

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.

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, tsunamis, and seiches without loss of capability to perform their safety functions.

3 ADAMS Package Accession No. ML121440522.

4 ADAMS Accession No. ML12144A142.

5 ADAMS Accession No. ML12331A203.

6 ADAMS Accession No. ML13078A330.

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 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 Oyster Creek Nuclear Generating Station

The licensee reported that the design basis flood hazards for OCNGS are the local intense probable maximum precipitation (PMP) and the probable maximum hurricane (PMH). The licensee stated that the PMP local intense precipitation water-surface elevation was 23.5 feet (ft.) mean sea level (MSL)⁷ over the site, except adjacent to the Reactor Building where the water-surface elevation was calculated to be 23.6 ft. MSL. The licensee reported the probable maximum storm surge (PMSS) is 22.0 ft. MSL; with wave action adding 1.0 ft. Therefore, the CLB is 23.0 ft. (PMSS with concurrent wave action). The PMH stillwater-surface elevation is shown as a function of time in Exelon and exceeds 21.0 ft. MSL for about 70 minutes.

The PMP water-surface elevation adjacent to the Reactor Building is 0.1 ft. higher than at the Reactor Building entrances.

Based on the NRC staff's review, the licensee appears to have sufficiently 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 stated that the CLB flood protection is to an elevation of 23.5 ft. MSL. The flood protection and mitigation features were designed using the following assumptions and inputs:

The licensee stated that the plant undergoes a phased shutdown and scram procedure when water-surface elevations exceed 4.5 and 6.0 ft. MSL, respectively. The licensee does not state

⁷ The licensee expressed elevations in terms of MSL and did not provide the site differential between MSL and a common reference datum such as NAVD88 or NGVD29.

the time required for the procedures to be executed, except that the time required to execute the scram procedure is insignificant. The licensee did not state the expected elapsed time between the 4.5 and 6.0 ft. MSL triggering water-surface elevations and when the PMSS would be expected to occur.

The licensee assumed that the PMP event would occur without warning and thus assumed normal plant operations. The longest PMP flood duration analyzed was 24 hours. The licensee assumed a loss of offsite power for the purposes of the walkdown.

3.2.2 Incorporated and Exterior Barriers

The licensee reported that the site has incorporated and/or exterior barriers that are permanently in place, requiring no operator manual actions. These barriers (i.e., the external walls and floors below flood level of the Turbine Building, Reactor Building, and Emergency Diesel Generator Building) are designated as flood-protection features.

3.2.3 Temporary Barriers and Other Manual Actions [if applicable]

The licensee indicated that the site has no temporary barriers or manual actions that require operator action that are credited for flood protection and committed to in the CLB.

3.2.4 Reasonable Simulation and Results

The licensee stated that no reasonable simulations were conducted as part of the walkdown. The credited flood-protection system does not depend on manual actions and therefore reasonable simulations were not required.

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 is consistent with the walkdown guidance.

3.3 Warning Systems

The licensee stated that no OCNCS room water-surface elevation warning systems are CLB-credited for external flood protection.

3.4 Effectiveness of Flood-Protection Features

The licensee indicated that the concrete floors and walls were found to be undergraded with the exception of the Turbine Building base slab. Aside from that exception, the floors and walls were found to be effective flood-protection features. The Reactor Building airlock doors were found to be in good condition and thus effective flood-protection features.

The licensee reported that the majority of penetrations and associated seals were found to have no material degradation. Some penetrations showed evidence of past or active water intrusions; these penetrations were entered into the Corrective Action Program (CAP).

The licensee stated that the majority of roof drains and scuppers were found to be in place and without blockage. Three drains associated with the Turbine Building, found to be partially blocked, were entered into CAP.

The licensee stated that the credited non-water-tight doors were observed to meet the acceptance criteria and thus found to be effective flood-protection features.

The licensee stated that the Reactor Building entrances are at an elevation of 23.5 ft. MSL and that the PMP water-surface elevation is 0.1 ft. higher than this entrance elevation. The licensee stated that due to door closure the ingress of external water would be minimized and would not contribute to a severe accident at OCNCS.

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, 2012,⁸ the licensee responded to the 50.54(f) letter that they intended to utilize the NRC-endorsed walkdown guidelines contained in NEI 12-07. The licensee's walkdown submittal dated November 19, 2012, as supplemented by letter dated March 19, 2013, 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.

The NRC staff was not presented with any deviations that needed to be evaluated in the submittal.

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 421 flood-protection features including passive features (e.g., walls, doors, and penetration seals; an external flood barrier for the Reactor Building, Turbine Building, and Emergency Diesel Generator Building; roof drains; and scuppers). The licensee did not perform reasonable simulations of manual actions because the credited flood-protection system does not depend on manual actions and therefore reasonable simulations were not required. The licensee did not identify any actions performed using physical simulations, tabletop exercises, or a combination thereof.

The OCNCS CLB does not refer to specific plant configurations during a flooding event. The NRC staff understood this to mean that the CLB is not dependent on plant modes of operation.

⁸ ADAMS Accession No. ML12164A569.

The licensee did use acceptance criteria in accordance with NEI 12-07. The licensee developed supplemental walkdown inspection guidance based on Appendix A of NEI 12-07. The licensee did not use its supplemental walkdown inspection guidance to supersede NEI 12-07, nor did it specifically detail the supplemental walkdown inspection guidance that was developed.

3.6.2 Licensee Evaluation of Flood-Protection Effectiveness, Key Findings, and Identified Efficiencies

The licensee performed an evaluation of the overall effectiveness of the plant's flood-protection features. The licensee stated that with the exception of the Turbine Building base slab, the external flood barriers were not degraded. The only observed water intrusion was directly attributable to penetrations. The licensee stated that the expansion joints between the Reactor and Turbine Buildings were found to have no material degradation and that no evidence was found of past water intrusion into the airlocks between the Reactor Building and Turbine Building.

The licensee did not identify any credited procedures requiring reasonable simulations; thus no feasibility assessments of operator actions were necessary.

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 identified 36 features that were not immediately judged as acceptable:

- 5 deficiencies to be resolved by November 27, 2012
- 17 deficient conduit penetrations
- 13 pipe and conduit penetration seals with signs of wear or corrosion
- 1 general observation that the OCNCS site topography has changed since the last PMP calculation was made

The licensee-identified deficiencies included: two partially obstructed roof drains, one partially obstructed scupper, and two cut and uncapped conduits. These were entered into the CAP. The licensee stated these deficiencies were to be resolved by November 27, 2012.

The licensee-identified 17 deficient conduit penetrations related to the emergency diesel generator cables where water leakage was evident. These were entered into the CAP. The licensee determined that these were deficient by CLB standards; however, because water ingress was negligible and sealing the conduits would expose cables within the conduits to longer exposure to water, the condition of the conduits was deemed acceptable and, therefore, the conduit penetrations were not included as CLB deficiencies.

The licensee identified 13 penetration pipe and conduit penetration seals with signs of wear that will be addressed by painting the area under the penetration at an unspecified date. These signs of wear were not included as CLB deficiencies.

NEI 12-07 requires licensees to identify observations in the CAP that were not yet dispositioned at the time the walkdown report was submitted. Exelon did not identify observations awaiting disposition.

Further, the licensee stated that no observations are awaiting final disposition in CAP.

3.6.3 Flood-Protection and Mitigation Enhancements

The licensee stated that there are no newly-installed or planned flood protection features at the OCNCS.

3.6.4 Planned or Newly Installed Features

The licensee did not determine that changes were necessary by the flooding walkdowns. The licensee stated that there were no newly installed or currently planned flood-protection features at OCNCS.

3.6.5 Deficiencies Noted and Actions Taken or Planned to Address

The licensee noted deficiencies and actions taken or planned to address the deficiencies.

The licensee identified five CLB deficiencies.

The licensee identified two cut and uncapped conduit pipes in the southwest corner of the Turbine Building. This deficiency was resolved by November 27, 2012.

The licensee found two drains and one scupper partially blocked by debris. This deficiency was resolved by November 27, 2012.

The licensee noted active water intrusion via eight penetrations in the southwest corner of the Turbine Building. This condition was entered into the CAP. No action was stated to resolve this deficiency. The licensee determined that the impact of the leakage would be minimal and therefore acceptable though deficient by CLB standards.

The licensee stated that there are no observations awaiting final disposition in the CAP.

3.6.6 Walkdowns Not Performed for Flood-Protection Features

3.6.6.1 Restricted Access

The licensee identified 120 features as having restricted access in Table 5 of its flooding walkdown report.

3.6.6.2 Inaccessible Features

The licensee identified 47 inaccessible flood-protection features. The licensee stated that 26 underground internal conduit seals were determined to be inaccessible flood-protection features

and the 25 of these had a reasonable assurance of being functional. The remaining seal was dispositioned in the CAP and determined to be functional.

The license identified 15 of the 47 inaccessible flood-protection features as conduit penetrations that were covered with material making inspection impossible or unsafe. A total of nine of these were determined to be functional with reasonable assurance. The remaining six conduit penetrations were dispositioned in the CAP.

The licensee identified two inaccessible floor drains in the Emergency Diesel Generator Building. Table 6 of the flooding walkdown report indicates that the functionality of these drains is reasonably assured.

The licensee stated that the 30-inch overboard drain is largely buried and therefore inaccessible. Table 6 of the flooding walkdown report indicates that the functionality of the 30-inch overboard drain is reasonably assured.

Two sumps were inaccessible. Reasonable assurances were made for these related to the unlikelihood of external water ingress into the sumps.

The licensee identified the Turbine Building base slab as an inaccessible flood-protection feature.

The licensee provided a description of all of the inaccessible flood-protection features.

3.6.7 NRC Staff Assessment of Walkdowns

The NRC staff reviewed the licensee walkdown report dated November 19, 2012, as supplemented March 19, 2013.

Based on the above assessment, the NRC staff concludes that the licensee met the intent of the walkdown guidance, NEI-12-07.

Based on the NRC staff's review, 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 submittals, the NRC staff concludes that the licensee's implementation of the walkdown process meets the intent of the walkdown guidance.

3.7 NRC Oversight

3.7.1 Independent Verification

On June 27, 2012, the NRC issued Temporary Instruction (TI) 2515/187, "Inspection of Near-Term Task Force Recommendation 2.3 Flooding Walkdowns."⁹ The TI directed NRC inspectors to independently verify that licensees were implementing the flooding walkdowns in accordance with the NRC endorsed walkdown methodology by accompanying licensee personnel on a

⁹ ADAMS Accession No. ML12129A108.

sample of walkdowns. Additionally, the TI directed the inspectors to independently perform walkdowns of a sample of flood protection features. In Inspection Report 05000219/2012005, dated January 31, 2013 (ADAMS Accession No. ML13031A540), the results of this inspection were documented. No findings of significance were identified.

3.8 NRC Staff Audit

The NRC staff performed an audit of OCNGS during the week of July 25, 2013. During the audit, the NRC staff gained a better understanding of the process used by the licensee to perform the walkdowns. The NRC staff identified and conveyed to the licensee the specific issues to be addressed. The NRC staff also noted that the licensee discussed several self-identified issues in the revised walkdown report. The audit report dated January 9, 2014,¹⁰ provides the results of this audit for OCNGS.

3.9 SSCs to be Walked Down at a Later Date

The licensee identified restricted access features. See Attachment C of the walkdown report for a summary of the restricted areas.

The licensee did not provide justification for the delay in walkdowns of restricted access features. All of the features require plant shutdown and cooldown for access. The licensee entered the restricted access features into the CAP, but did not provide a date by which these features would be walked down.

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 NRC 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 NRC 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.

¹⁰ ADAMS Accession No. ML13277A223.

M. Pacilio

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If you have any questions, please contact me at (301) 415-3100 or via e-mail at John.Lamb@nrc.gov.

Sincerely,

/RA/

John Lamb, Senior Project Manager
Plant Licensing Branch I-2
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-219

Enclosure:
Staff Assessment of Flooding Walkdown
Report

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