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

December 8, 2016

Mr. Bryan C. Hanson
Senior Vice President
Exelon Generation Company, LLC
President and Chief Nuclear Officer
Exelon Nuclear
4300 Winfield Road
Warrenville, IL 60555

SUBJECT: DRESDEN NUCLEAR POWER STATION, UNITS 2 AND 3 – FLOOD HAZARD MITIGATION STRATEGIES ASSESSMENT (CAC NOS. MF7921 AND MF7922)

Dear Mr. Hanson:

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*, 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 report (ADAMS Accession No. ML111861807).

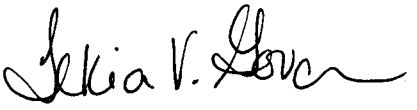
Enclosure 2 to the 50.54(f) letter requested that licensees reevaluate flood hazards for their sites using present-day methods and regulatory guidance used by the NRC staff when reviewing applications for early site permits and combined licenses. Concurrent with the reevaluation of flood hazards, licensees were required to develop and implement mitigating strategies in accordance with NRC Order EA-12-049, "Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events" (ADAMS Accession No. ML12054A735). In order to proceed with implementation of Order EA-12-049, licensees used the current licensing basis flood hazard or the most recent flood hazard information, which may not be based on present-day methodologies and guidance, in the development of their mitigating strategies.

By letter dated June 30, 2016 (ADAMS Accession No. ML16182A388), the Exelon Generation Company, LLC (the licensee) submitted the flooding mitigation strategies assessment (MSA) for Dresden Nuclear Power Station, Units 2 and 3 (Dresden). 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. The purpose of this letter is to provide the NRC's assessment of the Dresden MSA.

The NRC staff has concluded that the Dresden MSA was performed consistent with the guidance described in Appendix G of NEI 12-06, Revision 2, as endorsed by Japan Lessons-Learned Division (JLD) Interim Staff Guidance (ISG) JLD-ISG-2012-01, Revision 1, and that the licensee has demonstrated that the mitigation strategies are reasonably protected from reevaluated flood hazard conditions. This closes out the NRC's efforts associated with CAC Nos. MF7921 and MF7922.

If you have any questions, please contact me at 301-415-6197 or at Tekia.Govan@nrc.gov.

Sincerely,



Tekia Govan, Project Manager
Hazards Management Branch
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Office of Nuclear Reactor Regulation

Enclosure:
Staff Assessment Related to the
Mitigating Strategies for Dresden

Docket Nos. 50-237 and 50-249

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STAFF ASSESSMENT BY THE OFFICE OF NUCLEAR REACTOR REGULATION RELATED TO MITIGATION STRATEGIES FOR DRESDEN NUCLEAR POWER STATION, UNITS 2 AND 3, AS A RESULT OF THE REEVALUATED FLOODING HAZARD NEAR-TERM TASK FORCE RECOMMENDATION 2.1 – FLOODING (CAC NOS. MF7921 AND MF7922)

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), "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 respective sites using present-day methods and regulatory guidance used by the NRC staff when reviewing applications for early site permits and combined licenses. Concurrent with the reevaluation of flood hazards, licensees were required to develop and implement mitigating strategies in accordance with NRC Order EA-12-049, "Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events" (ADAMS Accession No. ML12054A735). That order requires holders of operating reactor licenses and construction permits issued under 10 CFR Part 50 to modify the plants to provide additional capabilities and defense-in-depth for responding to beyond-design-basis external events, and to submit to the NRC for review a final integrated plan that describes how compliance with the requirements of Attachment 2 of the order was achieved. In order to proceed with implementation of Order EA-12-049, licensees used the current licensing basis flood hazard or the most recent flood hazard information, which may not be based on present-day methodologies and guidance, in the development of their mitigating strategies.

The NRC staff and industry recognized the difficulty in developing and implementing mitigating strategies before completing the reevaluation of flood hazards. The NRC staff described this issue and provided recommendations to the Commission on integrating these related activities in COMSECY-14-0037, "Integration of Mitigating Strategies for Beyond-Design-Basis External Events and the Reevaluation of Flood Hazards," dated November 21, 2014 (ADAMS Accession No. ML14309A256). The Commission issued a staff requirements memorandum on March 30, 2015 (ADAMS Accession No. ML15089A236), affirming that the Commission expects licensees for operating nuclear power plants to address the reevaluated flood hazards, which are considered beyond-design-basis external events, within their mitigating strategies.

Nuclear Energy Institute (NEI) 12-06, Revision 2, "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide" (ADAMS Accession No. ML16005A625), has been endorsed by

the NRC as an appropriate methodology for licensees to perform assessments of the mitigating strategies against the reevaluated flood hazards developed in response to the March 12, 2012, 50.54(f) letter. The guidance in NEI 12-06, Revision 2, and Appendix G in particular, supports the proposed Mitigation of Beyond-Design-Basis Events rulemaking. The NRC's endorsement of NEI 12-06, including exceptions, clarifications, and additions, is described in Japan Lessons-Learned Division (JLD) Interim Staff Guidance (ISG) 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). As discussed in JLD-ISG-2012-01, Appendix G of NEI 12-06, Revision 2, describes acceptable methods for demonstrating that the reevaluated flooding hazard is addressed within the Dresden Nuclear Power Station, Units 2 and 3 (Dresden), mitigating strategies for beyond-design-basis external events.

2.0 BACKGROUND

By letter dated November 4, 2015 (ADAMS Accession No. ML15307A056), the NRC issued an interim staff response (ISR) letter for Dresden. The ISR letter provided the reevaluated flood hazard mechanisms that exceeded the current design basis (CDB) for Dresden, which are to be used in conducting the mitigating strategies assessment (MSA), as described in NEI 12-06. For Dresden, the mechanisms listed as not bounded by the CDB in the ISR letter are local intense precipitation (LIP) and upstream dam failure. By letter dated June 30, 2016 (ADAMS Accession No. ML16182A388), Exelon Generation Company, LLC (the licensee) submitted the Dresden MSA for review by the NRC staff.

3.0 TECHNICAL EVALUATION

3.1 Dresden's Current FLEX Strategies

The licensee stated in the MSA that Dresden's FLEX strategy is based upon the probable maximum flood (PMF) event from the Des Moines and Kankakee Rivers, combined with upstream dam failure and wave runup. The river PMF event, along with upstream dam failure and wave runup, has a current design basis (CDB) flood level of 528 ft mean sea level (MSL). The licensee's FLEX strategy did not consider a LIP event because the CDB flooding level for LIP of 517.45 ft MSL is below the site grade level of 517.5 ft MSL. Both of these flooding mechanisms were evaluated in the Dresden Flood Hazard Reevaluation Report (FHRR) (ADAMS Accession No. ML15072A007).

The following FLEX support guides (FSGs) are used in conjunction with other site emergency procedures for the combined river PMF flood event: FSG-01, "Station Blackout;" FSG-80, "FLEX Flood Pump Deployment/Operation;" FSG-61, "FLEX Fire System Isolation;" and FSG-62, "FLEX Generator Deployment During a Flood." The use of these FSGs, along with the Dresden flood procedure, provide instructions for FLEX equipment deployment and staging for the combined effects PMF flood event.

A brief summary of the licensee's FLEX strategies is as follows:

- Deployment of barge-mounted FLEX flood pumps in the Dresden Unit 3 turbine building trackway and filling all the diesel fuel barrels on the barge. The Dresden Units 2 and 3 emergency diesel generator (EDG) fuel oil tank vent line extension pipe(s) are installed.

The B.5.b pump used for FLEX, dam failure submersible pumps/power racks, portable isolation condenser diesel-driven make-up pump, and hoses are relocated to an offsite location above elevation 529 ft MSL so they are available during the period when flood waters recede to the plant grade level. The FLEX diesel generator and associated power distribution unit are staged on top of the Dresden Unit 2 turbine building trackway interlock. A boat with necessary supplies and fuel is also staged near the barge.

- Installation of plate-type flood barriers to cover all reactor building openings and EDG rooms.

- Shut down of both Dresden Units 2 and 3 after receiving weather notification of rainfall that will lead to the prediction of flood waters exceeding 509 ft MSL on site, with a given warning time of at least 23 hrs.

- Filling Dresden Units 2 and 3 reactor vessels to aid in cool down if time is available before service water systems are secured at flood elevation 513 ft MSL.

- Installation of the flood barriers or construction of a flood protection berm to protect the isolation condenser make-up pump building to a flood elevation of 519.6 ft MSL.

- Filling of all water storage tanks.

- Alignment and initiation of one barge-mounted FLEX flood pump when the flood level reaches elevation 518 ft MSL. The FLEX flood pump takes flood water suction from the test boiler pit and delivers it to the fire header at elevation 538 ft MSL. The flood pump provides make-up water to the isolation condensers, spent fuel pools (SFPs) and the reactor vessel until flood waters recede and recovery and cleanup activities start. The barge-mounted flood pump will be started at a flood level elevation of 518 ft MSL.

- Operation of the service water system when the flood level recedes to below elevation 509 ft MSL.

3.2. Evaluation of Associated Effects

Flood-related associated effects for Dresden were assessed during the NRC staff's review of the Dresden FHRR (ADAMS Accession No. ML15072A007).

3.3 Evaluation of Flood Event Duration

Flood event duration parameters (including warning time and period of inundation) were assessed during the NRC staff's review of the Dresden FHRR (ADAMS Accession No. ML15072A007).

3.4 Evaluation of Flood Protection Features – Local Intense Precipitation and Upstream Dam Failure

Section 4 in the Dresden MSA describes the CDB LIP flood as having a maximum flood elevation of 517.45 ft MSL, whereas the plant floor level is elevation 517.5 ft MSL. Therefore, during the CDB LIP, water does not enter any structures at the CDB 517.5 ft MSL elevation.

The licensee stated in the Dresden FHRR that the maximum reevaluated LIP flood elevation is 518.1 ft MSL and the maximum flood inundation time above elevation 517.5 ft MSL is 1.75 hrs. The licensee identified the largest leak path for water intrusion into the Dresden Unit 2 reactor building is through the turbine building trackway interlock, where the maximum flood height is 518.04 ft MSL for 1.35 hrs. The licensee indicated in the Dresden MSA that the reevaluated LIP flood will accumulate in Dresden Unit 2 reactor building torus basement through large pipe annular openings at elevation 517.5 ft MSL near the south wall. For each unit, the licensee has placed one FLEX pump on a 12-in high pedestal in the torus basement. The 12-inch pedestal is a flood protection measure based upon the licensee's determination that the reevaluated LIP flood water can cause 9.78 in of flooding in the torus basement. Therefore, the FLEX pumps, in both Dresden Units 2 and 3, would not be affected by the reevaluated LIP flood event.

Dresden MSA, Section 6.1, describes how FLEX equipment survives the reevaluated LIP flood event. Most time-critical equipment is staged in a robust FLEX Building A, which is located about 50 ft from the southwest corner of the reactor building and is not subject to the reevaluated LIP flood. The FLEX equipment in FLEX Building B is either trailer mounted or elevated so that it is not impacted by the reevaluated LIP flood. The FLEX Building C is a commercial building with a floor level at elevation 517.83 ft MSL. The FLEX Building C is outside the protected area in a parking lot on the southeast side of the reactor building. The licensee also described that the connection points for electrical cables are at least 3.5 ft above the plant grade and are not impacted by the reevaluated LIP flood.

The NRC staff reviewed the licensee's assessment of the reevaluated LIP flood level in the Dresden FHRR and MSA. Due to the use of the 12-inch pedestal and the height of the LIP water intrusion of 9.78 in into the torus basements, the NRC staff agrees that the FLEX pumps in those locations would not be impacted by the reevaluated LIP flood event. The NRC staff performed the mitigation strategies audit of the Dresden site in August 2015. As a result of the site audit walkdown, the NRC staff agrees that the FLEX storage locations will provide adequate flood protection for the reevaluated LIP hazard. This is based on the location of the FLEX Building A being above 518.5 ft MSL, the FLEX equipment being mounted on trailers and elevated well above the reevaluated LIP flood level of 518.1 ft MSL, and the fact that FLEX Building C not having any vital FLEX equipment needed for the reevaluated LIP flood event. The NRC staff further agrees that the deployment and configuration of the FLEX waterproof cable connections 3.5 ft above the plant grade elevation of 517.5 ft MSL would be protected from the reevaluated LIP event.

As described in Section 3.2 of this staff assessment, the reevaluated river PMF results from flooding of the Des Moines and Kankakee Rivers. When combined with the upstream dam failure and wave runup, Section 4 of the Dresden MSA describes that the CDB combined effects flood elevation to be 528 ft MSL. The licensee determined in the Dresden FHRR that the maximum reevaluated combined effects flood elevation is 529.0 ft MSL. The licensee stated that the difference is attributed to a higher reevaluated wind-wave runup height of 4 ft, instead of

3 ft in the CDB. The stillwater flood level remains at elevation 525 ft MSL for both the CDB and reevaluated combined effects PMF flood events. The licensee evaluated the combined effects PMF flood event to create the FLEX flooding strategy. As described above, this involves deployment and staging of FLEX equipment on top of a barge and buildings prior to the flood event, installation of flood protection barriers for the reactor buildings, and the execution of the above actions 23 hours prior to the flood event. After conducting the reevaluation of the combined effects flood at the higher elevation of 529 ft MSL, the licensee concluded that the reevaluated combined effects PMF flood remains bounded by the FLEX flooding evaluation. Specifically, the licensee determined that the current FLEX strategies would remain unaffected due to the location and preparation of the FLEX equipment in advance of the flood event.

The NRC staff reviewed the licensee's assessment of the reevaluated combined effects PMF flood event in the Dresden FHRR and MSA to confirm that the licensee's current FLEX strategy will not be impacted by the additional 1 ft of wind-wave runup due to the deployment and placement of the FLEX equipment prior to the flood event. The NRC staff also noted that the use of flood barriers for the combined effects PMF flood event would be dependent on national weather forecasting and deployed ahead of time to protect the reactor buildings.

3.5 Conclusion

The NRC staff has reviewed the information provided in the Dresden MSA related to the original FLEX strategies, as assessed against the reevaluated hazard(s) described in Section 2 of this staff assessment, and found that the licensee has adequately assessed the ISR for the reevaluated LIP flood event and combined effects PMF flood event to determine that the FLEX strategy can be implemented as currently designed. The NRC staff made its determination based upon:

- The use of weather forecast to shut down both Units and pre-deploy and stage equipment to be used for FLEX 23 hours before the PMF flood event;

- The current FLEX flooding strategy bounding the revised combined effects PMF flood event at 529 ft, which would not impact the warning time and deployment of FLEX equipment and flood barge to transport and stage FLEX equipment prior to the combined effects PMF flood event;

- The configuration of pedestals in the Dresden Units 2 and 3 reactor building torus basements to protect the FLEX pumps from the intrusion of LIP flood water;

- The location and flood protection features of the three FLEX storage buildings; and

- The waterproof FLEX cable connections being placed 3.5 ft above the site CDB elevation of 517.5 ft on the reactor buildings.

Therefore, the NRC staff concludes that the licensee has demonstrated the capability to implement the original FLEX strategies, as designed, under the conditions associated with the reevaluated LIP and combined effects PMF floods, including associated effects and flood event duration, as described in NEI 12-06, Revision 2, and JLD-ISG-2012-01, Revision 1.

4.0 CONCLUSION

The NRC staff has reviewed the information presented by the licensee in the MSA for Dresden. The NRC staff confirmed that the licensee's flood hazard MSA for Dresden was performed consistent with the guidance in Appendix G of NEI 12-06, Revision 2, as endorsed by JLD-ISG-2012-01, Revision 1. Based on the licensee's use of the hazard characterized in the NRC staff's ISR, the methodology used in the Dresden MSA evaluation, and the description of its current FLEX strategy in the Dresden MSA, the NRC staff concludes that the licensee has demonstrated that the mitigation strategies are reasonably protected from reevaluated flood hazards conditions.

The NRC staff has concluded that the Dresden MSA was performed consistent with the guidance described in Appendix G of NEI 12-06, Revision 2, as endorsed by Japan Lessons-Learned Division (JLD) Interim Staff Guidance (ISG) JLD-ISG-2012-01, Revision 1, and that the licensee has demonstrated that the mitigation strategies are reasonably protected from reevaluated flood hazard conditions. This closes out the NRC's efforts associated with CAC Nos. MF7921 and MF7922.

If you have any questions, please contact me at 301-415-6197 or at Tekia.Govan@nrc.gov.

Sincerely,

/RA/

Tekia Govan, Project Manager
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