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

April 13, 2017

Mr. Brad Berryman
Site Vice President
Susquehanna Nuclear, LLC
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NUCSB3
Berwick, PA 18603-0467

SUBJECT: SUSQUEHANNA STEAM ELECTRIC STATION, UNITS 1 AND 2 – STAFF REVIEW OF MITIGATION STRATEGIES ASSESSMENT REPORT OF THE IMPACT OF THE REEVALUATED SEISMIC HAZARD DEVELOPED IN RESPONSE TO THE MARCH 12, 2012, 50.54(f) LETTER (CAC NOS.MF7883 AND MF7884)

Dear Mr. Berryman:

The purpose of this letter is to provide the U.S. Nuclear Regulatory Commission's (NRC) assessment of the seismic hazard mitigation strategies assessment (MSA), as described in the December 19, 2016, letter (Agencywide Documents Access and Management System (ADAMS) Accession No. ML16355A338), submitted by Susquehanna Nuclear, LLC, (the licensee), for Susquehanna Steam Electric Station, Units 1 and 2 (Susquehanna). The licensee demonstrated that an Alternate Mitigating Strategy (AMS) based on the Individual Plant Examination of External Events (IPEEE) can be implemented to address the impacts of the reevaluated seismic hazard.

BACKGROUND

By letter dated March 12, 2012 (ADAMS Accession No. ML12053A340), the NRC issued a request for information pursuant to Title 10 of the *Code of Federal Regulations (10 CFR)*, Section 50.54(f) (hereafter referred to as the 50.54(f) letter). The 50.54(f) letter was issued as part of implementing lessons-learned from the accident at the Fukushima Dai-ichi nuclear power plant. Enclosure 1 to the 50.54(f) letter requested licensees reevaluate the seismic hazard using present-day methodologies and guidance. Concurrent with the reevaluation of seismic hazards, the NRC issued Order EA-12-049, "Order Modifying Licenses with Regard to Requirements for Mitigation Strategies for Beyond-Design-Basis External Events" (ADAMS Accession No. ML12054A736). The order requires holders of operating power reactor licenses and construction permits issued under 10 CFR Part 50 to develop, implement, and maintain guidance and strategies to maintain or restore core cooling, containment and spent fuel pool (SFP) cooling capabilities following a beyond-design-basis external event.

By letter dated March 26, 2014 (ADAMS Accession No. ML14086A163), the licensee provided its reevaluated seismic hazard for Susquehanna in response to the 50.54(f) letter. In addition, the licensee provided an IPEEE adequacy review, included in the reevaluated seismic hazard report, to demonstrate plant seismic capacity at IPEEE high confidence of low probability of failure (HCLPF) spectrum (IHS) acceleration levels. The IHS acceleration levels are higher than

the reevaluated seismic hazard acceleration levels, and thus, with the completion of the adequacy review, the IPEEE results were appropriate for screening Susquehanna out of performing a complete seismic risk evaluation.

On December 10, 2015 (ADAMS Accession No. ML16005A621), the Nuclear Energy Institute (NEI) submitted Revision 2 to NEI 12-06 "Diverse and Flexible Coping Strategies (FLEX) Implementation Guide" including guidance for mitigating strategies assessments regarding reevaluated hazard information. The NRC subsequently endorsed NEI 12-06, Revision 2, with exceptions, clarifications, and additions 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). Section 6.1.2 of JLD-ISG-2012-01, Revision 1, lists Susquehanna as a site that is eligible to perform an MSA based on the IHS capacity of the facility.

MITIGATION STRATEGIES ASSESSMENT

By letter dated January 20, 2016 (ADAMS Accession No. ML15356A247), the NRC staff documented its review of the licensee's reevaluated seismic hazard, also referred to as the mitigating strategies seismic hazard information (MSSHI). The NRC staff confirmed the licensee's conclusion that its Ground Motion Response Spectrum (GMRS) for Susquehanna is bounded by the plant-level IHS over the frequency range of 1 to 10 Hertz (Hz). For a portion of the range above 10 Hz, the GMRS exceeds the IHS. The NRC staff also confirmed that the licensee met the IPEEE adequacy criteria in accordance with the Screening, Prioritization, and Implementation Details (SPID) (ADAMS Accession No. ML12333A170). In addition, the staff concluded that the GMRS determined by the licensee adequately characterizes the reevaluated seismic hazard for the Susquehanna.

The licensee's IPEEE was performed as a focused scope Seismic Margin Assessment (SMA) using NUREG -1407 "Procedural and Submittal Guidance for the Individual Plant Examination of External Events (IPEEE) for Severe Accident Vulnerabilities (ADAMS Accession No. ML063550238). As documented in the IPEEE adequacy review, the licensee upgraded its IPEEE to a full-scope assessment. The IPEEE SMA demonstrated seismic capacity of structures, systems, and components (SSCs) in the two IPEEE safe shutdown paths and concluded that Susquehanna, Units 1 and 2, can maintain or restore core cooling and containment capabilities for a beyond-design-basis seismic event up to the level of the IHS and maintain that condition for 72 hours. The licensee relied on these results to develop an AMS and demonstrate robustness of the SSCs to the MSSHI following the guidance in Revision 2 of NEI 12-06, Appendix H, Section H.4.3.

According to NEI 12-06 Section H.4.3, in order to provide a complete AMS, licensees should provide the following: information regarding the IPEEE upgrade to full scope: (1) an assessment of limitations that are based on the 72-hour coping duration; (2) a spent fuel pool cooling evaluation; and (3) a high frequency evaluation. As documented below, this information was provided by the licensee by letter dated December 19, 2016 (ADAMS Accession No. ML16355A338).

Indefinite Coping

Licensees that relied on an SMA-based IPEEE were requested to evaluate their IPEEE results for limitations that are based on 72-hour coping duration. Specifically, licensees were requested to verify that SSCs that limit the SMA-based IPEEE coping duration to 72 hours are available for an indefinite period following a seismic event to support a safe shutdown condition.

The licensee stated that, as part of their IPEEE, a plant-specific review was performed to identify consumables and/or SSCs in either safe shutdown path that would limit the SMA-based IPEEE coping duration to 72 hours. Based on this review, no consumables or SSCs were identified. However, the licensee stated that several consumable items, such as water and diesel fuel oil inventories, were evaluated based on limited onsite supply. The licensee identified several alternative water and diesel fuel oil supplies that may be available to support extended coping. Additionally, consistent with Sections 3.3 and 12 of NEI 12-06, the licensee stated that additional supplies can be delivered to the site to support extended coping and continued maintenance of the safe shutdown condition.

IPEEE Upgrade

In order to use the IPEEE results to perform the AMS, licensees were required to perform a full-scope IPEEE. Licensees that had performed focused-scope IPEEEs were allowed to upgrade their IPEEEs to be consistent with a full-scope IPEEE by performing a series of enhancements detailed in the SPID. Specifically, the SPID requested licensees to perform a full-scope, detailed review of relay chatter and a full evaluation of potential soil failures such as liquefaction, slope stability, and settlement.

The licensee stated that the focused-scope IPEEE for Susquehanna was upgraded to a full-scope IPEEE. Details regarding this upgrade were provided by the licensee as part of their reevaluated seismic hazard and a brief summary was provided as part of the MSA submittal. As stated in the seismic hazard staff assessment (ADAMS Accession No. ML15356A247), the NRC staff reviewed this information and concluded that Susquehanna met the IPEEE program adequacy criteria in the SPID.

Spent Fuel Pool Cooling Evaluation

Licensees were requested to ensure that the credited SFP cooling capability is maintained by demonstrating robustness to the MSSHI of the SFP makeup capability equipment.

The licensee summarized its FLEX strategy as it relates to SFP level monitoring and make-up capability. The licensee stated that the permanently installed equipment relied on for the implementation of the SFP cooling FLEX strategy has been designed and evaluated to the Safe Shutdown Earthquake (SSE) loading conditions. Additionally, the licensee stated that the storage and deployment pathways for portable FLEX equipment, as well permanently installed equipment relied on for SFP cooling, have been subsequently reviewed considering GMRS loading conditions. The licensee concludes that the SFP cooling strategy is seismically adequate in accordance with NEI 12-06, Appendix H.

By letter dated December 5, 2016 (ADAMS Accession No. ML16259A189), the NRC staff issued a generic audit plan to perform regulatory audits of licensees' MSAs on an as-needed basis, in order to support the NRC staff's review of the MSAs and issuance of the associated NRC staff assessments. As a result, this was the mechanism used to exchange information

with the licensee for Susquehanna, consistent with NRC Office of Nuclear Reactor Regulation (NRR) Office Instruction LIC-111 "Regulatory Audits" (ADAMS Accession No. ML082900195).

The NRC staff asked the licensee for additional information to demonstrate that the SFP equipment relied on for cooling has been appropriately evaluated to the reevaluated seismic hazard. In its response, the licensee clarified that it did not perform any new evaluations, but instead relied on previously existing information to determine that the portable and permanently installed SFP cooling equipment will likely be functional following a GMRS-type seismic event. Specifically, the licensee stated that the portable FLEX equipment is stored in Susquehanna's FLEX building, which is seismically designed to two times the SSE. The licensee stated that the two times the SSE spectrum bounds the GMRS at all frequencies below 20 Hz. The licensee also stated that the deployment pathways defined to comply with NRC Order EA-12-049 were evaluated against soil liquefaction potential. The licensee referenced the soil liquefaction evaluation provided as part of the IPEEE adequacy review (ADAMS Accession No. ML14086A163), which concluded that liquefaction is not a concern for the site.

The licensee described the specific permanently installed plant equipment relied upon for SFP cooling. The licensee stated that this equipment includes the NRC Order EA-12-051 Spent Fuel Pool Instrumentation (SFPI), portions of the Residual Heat Removal Service Water (RHRSW) system, and the newly installed SFP standpipe supporting the hose used for the SFP cooling FLEX strategy. The licensee stated that the SFPI was seismically designed to two times the SSE and referenced Susquehanna's letter dated July 2, 2015 (ADAMS Accession No. ML15211A379), documenting compliance with Order EA-12-051. This letter referenced licensee documents "1-0410-9.14 MOHR SFP-1 SSES Seismic Analysis" and "NAI-1791-088 Rev 1, Seismic Induced Hydraulic Response" that describe the seismic analysis performed for the SFPI. Additionally, the licensee stated that the portions of the RHRSW system described were part of the equipment in the two safe shutdown paths evaluated as part of the IPEEE. Finally, the licensee stated that the SFP standpipe was also evaluated to two times the SSE.

The staff reviewed the information provided by the licensee along with other referenced documents that supported the SFPI and FLEX building seismic designs. The licensee clarified that the SFPI and FLEX building were designed to two times the SSE and that the RHRSW equipment and deployment pathways were evaluated to the IHS ground motions. Since both the two times the SSE and the IHS ground motions bound the GMRS at all frequencies up to 20 Hz, the staff concludes that such equipment has been appropriately evaluated to the revaluated seismic hazard consistent with Revision 2 of NEI 12-06, Appendix H, Section H.4.3.

High Frequency Evaluation

Licensees with high frequency exceedances (GMRS>IHS above 10 Hz) were requested to perform a high frequency evaluation of potentially sensitive devices in the IPEEE scope. As stated in the seismic hazard staff assessment, the GMRS exceeds the IHS for Susquehanna by a slight amount above 10 Hz. As documented in the NRC staff letter dated February 18, 2016 (ADAMS Accession No. ML15364A544), the staff reviewed this limited exceedance and concluded that this exceedance falls within the narrow-band-exceedance criteria specified in Section 3.1.2 of the Electric Power Research Institute Report 3002004396, "High-Frequency Program: Application Guidance for Functional Confirmation and Fragility Evaluation" (ADAMS Accession No. ML15223A100). As such, it does not represent a concern and does not warrant additional evaluations to confirm the functionality of control devices in the high frequency range. Therefore, the staff concludes that high frequency evaluation of potentially sensitive devices in

the IPEEE scope was performed consistent with Revision 2 of NEI 12-06, Appendix H, Section H.4.3.

Availability of FLEX Equipment

Appendix H.4.3 of NEI 12-06 states that with the exception of SFP cooling, an IPEEE-based AMS does not rely upon the availability of FLEX equipment.

In order to demonstrate additional mitigating capability, the licensee stated that on-site FLEX equipment may be available for deployment. Additionally, the licensee stated that portable FLEX equipment not being used for the AMS is stored and reasonably protected in accordance with Section 5.3.1 of NEI 12-06. The licensee also emphasized its capability to obtain portable FLEX equipment from off-site sources. The licensee referenced its letter dated August 19, 2016 (ADAMS Accession No. ML16239A011), which describes the use of off-site equipment for Susquehanna.

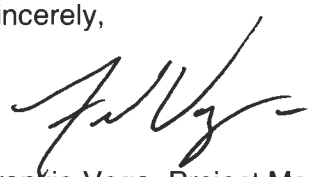
CONCLUSION

The NRC staff has reviewed the seismic hazard MSA for Susquehanna. The NRC staff confirmed that the licensee's seismic hazard MSA is consistent with the guidance in Appendix H.4.3 of NEI 12-06, Revision 2, as endorsed by JLD-ISG-2012-01, Revision 1. Therefore, the methodology used by the licensee was appropriate to perform an assessment of the mitigation strategies that address the reevaluated seismic hazard.

The NRC staff concludes that the IPEEE-based AMS evaluation demonstrates that SSCs relied upon for mitigation strategies have seismic capacity to levels higher than the GMRS, and safe shutdown of the plant can be accomplished and any consequences can be appropriately mitigated.

If you have any questions, please contact me at (301) 415-1617 or via e-mail at Frankie.Vega@nrc.gov.

Sincerely,



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Office of Nuclear Reactor Regulation

Docket Nos. 50-387 and 50-388

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