



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

September 21, 2017

ANO Site Vice President  
Arkansas Nuclear One  
Entergy Operations, Inc.  
1448 S.R. 333  
Russellville, AR 72802

SUBJECT: ARKANSAS NUCLEAR ONE, 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. MF7798 AND MF7799)

Dear Sir or Madam:

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 30, 2016, letter (Agencywide Documents Access and Management System (ADAMS) Accession No. ML16365A084), submitted by Entergy Operations, Inc. (the licensee), for Arkansas Nuclear One, Units 1 and 2 (ANO). 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 28, 2014 (ADAMS Accession No. ML14092A021), the licensee provided its reevaluated seismic hazard for ANO 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 ANO 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 ANO as a site that is eligible to perform an MSA based on the IHS capacity of the facility.

#### MITIGATION STRATEGIES ASSESSMENT

By letter dated December 15, 2015 (ADAMS Accession No. ML15344A109), 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 ANO 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 characterized the reevaluated seismic hazard for the ANO.

The licensee's IPEEE for ANO, Unit 1 was performed as a modified full scope Seismic Margin Assessment (SMA) and the IPEEE for ANO, Unit 2 was performed as a modified focused scope SMA both 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 SMAs demonstrated seismic capacity of structures, systems, and components (SSCs) in the two IPEEE safe shutdown paths and concluded that ANO, 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 (HF) evaluation. As documented below, this information was provided by the licensee by letter dated December 30, 2016 (ADAMS Accession No. ML16365A084).

### 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 fuel oil inventories, were evaluated based on limited onsite supply. The licensee identified several alternative water and diesel fuel oil supplies that would 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 modified full-scope IPEEE for Unit 1 and the focused-scope IPEEE for Unit 2 were upgraded to full-scope IPEEEs. 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. ML15344A109), the NRC staff reviewed this information and concluded that ANO 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 (including the SFP level instrumentation components and the SFP makeup riser) and portable FLEX equipment availability (including its storage and deployment pathways) relied on for the implementation of the SFP cooling FLEX strategy, have been evaluated considering the GMRS-consistent loading conditions in NEI 12-06, Appendix H, Section 5, and /or Seismic Qualification Utility Group (SQUG) experienced walkdowns. The licensee concludes that the SFP cooling related SSC are 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 ANO, 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. Specifically the staff asked the licensee to provide Reference 12 of the MSA submittal "CALC-13-E-0005-57, "HCLPF Evaluation of FLEX SFP Cooling and Instrumentation, Revision 000". As requested, the licensee provided CALC-13-E-0005-57. This calculation package included the specific SSCs needed to support SFP cooling that were evaluated to the MSSHI. CALC-13-E-0005-57 described that SSCs were either evaluated by calculations or by Seismic Qualification Utility Group (SQUG) walkdowns to meet the guidelines outlined in Appendix H of NEI 12-06. Specifically, as referenced in Appendix H of NEI 12-06, the licensee used the highest ratio of the GMRS to the safe shutdown earthquake (SSE) from 1 to 10 Hz and multiplied this ratio to the actual SSE peak acceleration values to evaluate the seismic adequacy of SSCs. The SQUG walkdowns were used to further support qualification of equipment and operator access paths to support the MSA for ANO.

The staff reviewed the information provided by the licensee and concludes that such equipment has been appropriately evaluated to the reevaluated seismic hazard consistent with Revision 2 of NEI 12-06, Appendix H, Section H.4.3.

#### High Frequency Evaluation

Licensees with HF exceedances (GMRS>IHS above 10 Hz) were requested to perform a HF evaluation of potentially sensitive devices in the IPEEE scope. As stated in the seismic hazard staff assessment, the GMRS exceeds the IHS for ANO above 10 Hz. By letters dated December 30, 2016, and August 31, 2017 (ADAMS Accession Nos. ML17003A327 and ML17249A081, respectively), the licensee provided its HF evaluation report following NRC endorsed guidance: Electric Power Research Institute Report 3002004396, "High-Frequency Program: Application Guidance for Functional Confirmation and Fragility Evaluation" (ADAMS Accession No. ML15223A100). As documented in NRC letter dated September 14, 2017 (ADAMS Accession No. ML17257A042), the NRC staff reviewed the HF evaluation report and concludes that the licensee appropriately implemented the HF confirmation guidance and identified and evaluated the HF seismic capacity of certain key installed plant equipment, including those credited in the IPEEE, to ensure critical functions will be maintained following a seismic event up to the GMRS. Therefore, the staff concludes that HF 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.

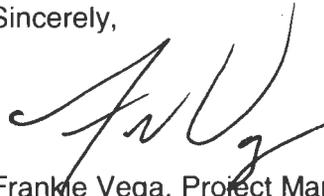
CONCLUSION

The NRC staff has reviewed the seismic hazard MSA for ANO. 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, 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,

A handwritten signature in black ink, appearing to read 'Frankie Vega', written in a cursive style.

Frankie Vega, Project Manager  
Hazards Management Branch  
Japan Lessons-Learned Division  
Office of Nuclear Reactor Regulation

Docket Nos. 50-313 and 50-368

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SUBJECT: ARKANSAS NUCLEAR ONE, 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 DATED SEPTEMBER 21, 2017

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**ADAMS Accession No. ML17261B103**

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