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

December 15, 2015

Mr. Thomas A. Vehec
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SUBJECT: DUANE ARNOLD ENERGY CENTER - STAFF ASSESSMENT OF INFORMATION PROVIDED PURSUANT TO TITLE 10 OF THE *CODE OF FEDERAL REGULATIONS* PART 50, SECTION 50.54(f), SEISMIC HAZARD REEVALUATIONS FOR RECOMMENDATION 2.1 OF THE NEAR-TERM TASK FORCE REVIEW OF INSIGHTS FROM THE FUKUSHIMA DAI-ICHI ACCIDENT (TAC NO. MF3783)

Dear Mr.Vehec:

On March 12, 2012, the U.S. Nuclear Regulatory Commission (NRC) issued a request for information pursuant to Title 10 of the *Code of Federal Regulations*, Part 50, Section 50.54(f) (hereafter referred to as the 50.54(f) letter). The purpose of that request was to gather information concerning, in part, seismic hazards at each operating reactor site and to enable the NRC staff, using present-day NRC requirements and guidance, to determine whether licenses should be modified, suspended, or revoked.

By letter dated March 28, 2014, NextEra Energy Duane Arnold, LLC (NextEra, the licensee), responded to this request for Duane Arnold Energy Center (Duane Arnold).

The NRC staff has reviewed the information provided related to the reevaluated seismic hazard for Duane Arnold and, as documented in the enclosed staff assessment, determined that you provided sufficient information in response to Requested Information Items (1) – (3), (5) - (9) and the comparison portion to Item (4), identified in Enclosure 1 of the 50.54(f) letter. Further, the NRC staff concludes that the licensee's reevaluated seismic hazard is suitable for other actions associated with Near-Term Task Force Recommendation 2.1, "Seismic".

Contigent upon the NRC's review and acceptance of NextEra's high frequency confirmation (Item 4) for Duane Arnold, the Seismic Hazard Evaluation identified in Enclosure 1 of the 50.54(f) letter will be completed.

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

Sincerely,

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

Docket No. 50-331

Enclosure:
Staff Assessment of Seismic
Hazard Evaluation and Screening Report

cc w/encl: Distribution via Listserv

STAFF ASSESSMENT BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO SEISMIC HAZARD AND SCREENING REPORT

DUANE ARNOLD ENERGY CENTER

DOCKET NO. 50-331

1.0 INTRODUCTION

By letter dated March 12, 2012 (NRC, 2012a), the U.S. Nuclear Regulatory Commission (NRC or Commission) 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 license" (hereafter referred to as the "50.54(f) letter"). The request and other regulatory actions were issued in connection with implementing lessons-learned from the 2011 accident at the Fukushima Dai-ichi nuclear power plant, as documented in the "Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident" (NRC, 2011b).[1] In particular, the NRC Near-Term Task Force (NTTF) Recommendation 2.1, and subsequent Staff Requirements Memoranda (SRM) associated with Commission Papers SECY-11-0124 (NRC, 2011c) and SECY-11-0137 (NRC, 2011d), instructed the NRC staff to issue requests for information to licensees pursuant to 10 CFR 50.54(f).

Enclosure 1 to the 50.54(f) letter requests that addressees perform a reevaluation of the seismic hazards at their sites using present-day NRC requirements and guidance to develop a ground motion response spectrum (GMRS).

The required response section of Enclosure 1 requests that each addressee provide the following information:

(1) Site-specific hazard curves (common fractiles and mean) over a range of spectral frequencies and annual exceedance frequencies,

(2) Site-specific, performance-based GMRS developed from the new site-specific seismic hazard curves at the control point elevation,

(3) Safe Shutdown Earthquake (SSE) ground motion values including specification of the control point elevation,

(4) Comparison of the GMRS and SSE. A high-frequency (HF) evaluation (if necessary),

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[1] Issued as an enclosure to Commission Paper SECY-11-0093 (NRC, 2011a).

(5) Additional information such as insights from NTTF Recommendation 2.3 walkdown and estimates of plant seismic capacity developed from previous risk assessments to inform NRC screening and prioritization,

(6) Interim evaluation and actions taken or planned to address the higher seismic hazard relative to the design basis, as appropriate, prior to completion of the risk evaluation (if necessary),

(7) Statement if a seismic risk evaluation is necessary,

(8) Seismic risk evaluation (if necessary), and

(9) Spent fuel pool (SFP) evaluation (if necessary).

Present-day NRC requirements and guidance with respect to characterizing seismic hazards use a probabilistic approach in order to develop a risk-informed performance-based GMRS for the site. Regulatory Guide (RG) 1.208, A Performance-based Approach to Define the Site- Specific Earthquake Ground Motion (NRC, 2007), describes this approach. As described in the 50.54(f) letter, if the reevaluated seismic hazard, as characterized by the GMRS, is not bounded by the current plant design-basis SSE, further seismic risk evaluation of the plant is merited.

By letter dated November 27, 2012 (Keithline, 2012), the Nuclear Energy Institute (NEI) submitted Electric Power Research Institute (EPRI) report "Seismic Evaluation Guidance: Screening, Prioritization, and Implementation Details (SPID) for the Resolution of Fukushima Near-Term Task Force Recommendation 2.1 Seismic" (EPRI, 2012), hereafter called the SPID. The SPID supplements the 50.54(f) letter with guidance necessary to perform seismic reevaluations and report the results to NRC in a manner that will address the Requested Information Items in Enclosure 1 of the 50.54(f) letter. By letter dated February 15, 2013 (NRC, 2013b), the staff endorsed the SPID.

The required response section of Enclosure 1 to the 50.54(f) letter specifies that Central and Eastern United States (CEUS) licensees provide their Seismic Hazard and Screening Report (SHSR) by 1.5 years after issuance of the 50.54(f) letter. However, in order to complete its update of the EPRI seismic ground motion models (GMM) for the CEUS (EPRI, 2013), industry proposed a six-month extension to March 31, 2014, for submitting the SHSR. Industry also proposed that licensees perform an expedited assessment, referred to as the Augmented Approach, for addressing the requested interim evaluation (Item 6 above), which would use a simplified assessment to demonstrate that certain key pieces of plant equipment for core cooling and containment functions, given a loss of all alternating current power, would be able to withstand a seismic hazard up to two times the design-basis. Attachment 2 to the April 9, 2013, letter (Pietrangelo, 2013) provides a revised schedule for plants needing to perform (1) the Augmented Approach by implementing the Expedited Seismic Evaluation Process (ESEP) and (2) a seismic risk evaluation. By letter dated May 7, 2013 (NRC, 2013a), the NRC determined that the modified schedule was acceptable and by letter dated August 28, 2013 (NRC, 2013c), the NRC determined that the updated GMM (EPRI, 2013) is an acceptable GMM for use by CEUS plants in developing a plant-specific GMRS.

By letter dated April 9, 2013 (Pietrangelo, 2013), industry agreed to follow the SPID to develop the SHSR for existing nuclear power plants. By letter dated September 11, 2013 (Anderson, 2013), NextEra Energy Duance Arnold, LLC (NextEra, the licensee) submitted at least partial site response information for Duane Arnold Energy Center (DAEC). By letter dated March 28, 2014 (Anderson, 2014), the licensee submitted its SHSR.

2.0 REGULATORY BACKGROUND

The structures, systems, and components (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 (GDC) 2: "Design Bases for Protection Against Natural Phenomena;" and Appendix A to 10 CFR Part 100, "Reactor Site Criteria." The GDC 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 that an SSC of a facility must perform, 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 had been historically reported for the site and surrounding area. The design bases also considered limited accuracy, quantity, and period of time in which the historical data have been accumulated.

The seismic design bases for currently operating nuclear power plants were either developed in accordance with, or meet the intent of GDC 2 and 10 CFR Part 100, Appendix A. Although the regulatory requirements in Appendix A to 10 CFR Part 100 are fundamentally deterministic, the NRC process for determining the seismic design-basis ground motions for new reactor applications after January 10, 1997, as described in 10 CFR 100.23, requires that uncertainties be addressed through an appropriate analysis such as a probabilistic seismic hazard analysis (PSHA).

Section 50.54(f) of 10 CFR states that a licensee shall at any time before expiration of its license, upon request of the Commission, submit written statements, signed under oath or affirmation, to enable the Commission to determine whether or not the license should be modified, suspended, or revoked. On March 12, 2012, the NRC staff issued requests for licensees to reevaluate the seismic hazards at their sites using present-day NRC requirements and guidance, and identify actions planned to address plant-specific vulnerabilities associated with the updated seismic hazards.

Attachment 1 to Enclosure 1 of the 50.54(f) letter described an acceptable approach for performing the seismic hazard reevaluation for plants located in the CEUS. Licensees are expected to use the CEUS Seismic Source Characterization (CEUS-SSC) model in NUREG- 2115 (NRC, 2012b) along with the appropriate EPRI (2004, 2006) ground motion models. The SPID provided further guidance regarding the appropriate use of GMMs for the CEUS. Specifically, Section 2.3 of the SPID recommended the use of the updated GMM (EPRI,

2013) and, as such, licensees used the NRC-endorsed updated EPRI GMM instead of the older EPRI (2004, 2006) GMM to develop PSHA base rock hazard curves. Finally, Attachment 1 requested that licensees conduct an evaluation of the local site response in order to develop site-specific hazard curves and GMRS for comparison with the plant SSE.

2.1 Screening Evaluation Results

By letter dated March 28, 2014 (Anderson, 2014), the licensee provided the SHSR for the DAEC site. The licensee's SHSR indicates that the site SSE bounds the GMRS for DAEC in the frequency range of 1 to 10 Hertz (Hz). As such, a seismic risk evaluation and SFP evaluation will not be performed. The GMRS exceeds the SSE at frequencies above 10 Hz. Therefore, the licensee indicated that it will perform a HF confirmation.

On May 9, 2014 (NRC, 2014a), the NRC staff issued a letter providing the outcome of its 30-day, preliminary, screening and prioritization evaluation. In the letter, the staff characterized the DAEC site as conditionally screened-in to perform a seismic risk evaluation and SFP evaluation in addition to the HF confirmation, because additional information was needed to support a screening decision. On August 21, 2014 (NRC, 2014b), the staff issued a letter providing the outcome of its final seismic screening and prioritization results. The licensee's GMRS, as well as the NRC staff's confirmatory GMRS, are bounded by the SSE for DAEC over the frequency range of 1 to 10 Hz. Therefore, a seismic risk evaluation and SFP evaluation are not merited. Additionally, due to exceedences of the GMRS above the SSE for frequencies above 10 Hz, a HF confirmation is merited for DAEC.

3.0 TECHNICAL EVALUATION

The NRC staff evaluated the licensee's submittal to determine if the provided information responded appropriately to Enclosure 1 of the 50.54(f) letter with respect to characterizing the reevaluated seismic hazard.

3.1 Plant Seismic Design-Basis

Enclosure 1 of the 50.54(f) letter requests the licensee provide the SSE ground motion values, as well as the specification of the control point elevation(s) for comparison to the GMRS. For operating reactors licensed before 1997, the SSE is the plant licensing basis ground motion and is characterized by (1) a peak ground acceleration (PGA) value which anchors the response spectra at high frequencies (typically at 33 Hz for the existing fleet of nuclear power plants); (2) a response spectrum shape which depicts the amplified response at all frequencies below the PGA; and (3) a control point where the SSE is defined.

In Section 3.1 of its SHSR, the licensee described its seismic design-basis for DAEC. The licensee stated that design bases earthquakes (DBE) were developed for structures founded on rock, as well as for structures founded on soil. As described in the Updated Final Safety Analysis Report (UFSAR) (DAEC, 2015) Section 2.5.2.6, the shape of the response spectra for the bedrock design-basis earthquake is a Housner spectrum, which is anchored at a PGA of 0.12 g. While the shape of the response spectrum for the soil design-basis earthquake is a smoothed spectrum from the 1952 Taft, California earthquake. This spectrum is also anchored at a PGA of 0.12 g. The licensee stated that it used the modified El Centro time history for comparison with the GMRS rather than either of the two DBE spectra because it represents the input motion used to analyze all buildings and generate the in- structure response spectra for systems and equipment at DAEC. In addition, the licensee specified that the SSE control point is defined at the top of bedrock for the Reactor Building at an elevation of 707 ft. (215 m), about 50 ft. (15 m) below site grade.

The NRC staff reviewed the licensee's description of its DBE or SSE in the SHSR for the DAEC site. Based on its review of the SHSR and the UFSAR (DAEC, 2015), the staff used the rock DBE response spectrum for comparison with the GMRS rather than the El Centro time history spectrum. Use of the rock DBE as the SSE for screening is consistent with the SPID guidance and is also consistent with the licensee's decision to establish the SSE control point at the top of bedrock for the Reactor Building. Finally, based on its review of the SHSR and the UFSAR, the NRC staff confirmed that the licensee's control point elevation for the DAEC site is defined at an elevation of 707 ft. (215 m) at the top of bedrock, consistent with guidance in the SPID.

3.2 Probabilistic Seismic Hazard Analysis

In Section 2.2 of its SHSR, the licensee stated that, in accordance with the 50.54(f) letter and the SPID, it performed a PSHA using the CEUS-SSC model and the updated EPRI GMM for the CEUS (EPRI, 2013). The licensee used a minimum magnitude cutoff of **M**5.0, as specified in the 50.54(f) letter. The licensee further stated that it included the CEUS-SSC background sources out to a distance of 400 mi (640 km) around the site and included the Commerce, Eastern Rift Margin Fault – North, Eastern Rift Margin Fault – South, Marianna, Meers, New Madrid Fault System, and Wabash Valley Repeated Large Magnitude Earthquake (RLME) sources, which lie within 620 mi (1,000 km) of DAEC. The RLME sources are those source areas or faults for which more than one large magnitude (**M** ≥ 6.5) earthquake has occurred in the historical or paleo-earthquake (geologic evidence for prehistoric seismicity) record. The licensee used the mid-continent version of the updated EPRI GMM for each of the CEUS-SSC sources. Consistent with the SPID, the licensee did not provide its base rock seismic hazard curves since a site response analysis is necessary to determine the control point seismic hazard curves. The licensee provided its control point seismic hazard curves in Section 2.3.7 of its SHSR. The NRC staff's review of the licensee's control point seismic hazard curves is provided in Section 3.3 of this staff assessment.

As part of its confirmatory analysis of the licensee's GMRS, the NRC staff performed PSHA calculations for base rock site conditions at the DAEC site. As input, the NRC staff used the CEUS-SSC model, as documented in NUREG-2115 (NRC, 2012b) along with the updated EPRI GMM (EPRI, 2013). Consistent with the guidance provided in the SPID, the NRC staff included all CEUS-SSC background seismic sources within a 310 mi (500 km) radius of the DAEC site. In addition, the NRC staff included the Commerce, Eastern Rift Margin Fault – North, Eastern Rift Margin Fault – South, Marianna, Meers, New Madrid Fault System, and Wabash Valley RLME sources, which lie within 620 km (1,000 mi) of the DAEC site. For each of the CEUS- SSC sources used in the PSHA, the NRC staff used the mid-continent version of the updated EPRI GMM (EPRI, 2013). The NRC staff used the resulting base rock seismic hazard curves together with a confirmatory site response analysis, described in the next section, to develop control point seismic hazard curves and a GMRS for comparison with the licensee's results.

Based on its review of the SHSR, the NRC staff concludes that the licensee appropriately followed the guidance provided in the SPID for selecting the PSHA input models and parameters for the site. This includes the licensee's use and implementation of the CEUS-SSC model and the updated EPRI GMM.

3.3 Site Response Evaluation

After completing PSHA calculations for reference rock conditions, Attachment 1 to Enclosure 1 of the 50.54(f) letter requests that the licensee provide a GMRS developed from the site-specific seismic hazard curves at the control point elevation. In addition, the 50.54(f) letter specifies that the subsurface site response model, for both soil and rock sites, should extend to sufficient depth to reach the generic or reference rock conditions as defined in the GMMs used in the PSHA. To develop site-specific hazard curves at the control point elevation, Attachment 1 requests that the licensee perform a site response analysis. Detailed site response analyses were not typically performed for many of the older operating plants; therefore, Appendix B of the SPID provides detailed guidance on the development of site- specific amplification factors (including the treatment of uncertainty) for sites that do not have detailed, measured soil and rock parameters to extensive depths.

The purpose of the site response analysis is to determine the site amplification that would occur as a result of bedrock ground motions propagating upwards through the soil/rock column to the surface. The critical parameters that determine what frequencies of ground motion are affected by the upward propagation of bedrock motions are the layering of soil and/or soft rock, the thicknesses of these layers, the shear-wave velocities and low-strain damping of these layers, and the degree to which the shear modulus and damping change with increasing input bedrock amplitude. To develop site-specific hazard curves at the control point, the licensee performed a site response analysis.

3.3.1 Site Base Case Profiles

In its SHSR, the licensee indicated that it performed a site response analysis for DAEC. According to the licensee, the site is founded on firm limestone and dolomite about 380 ft. (116 m) thick. The licensee noted that there are about 2,100 ft. (640 m) of Devonian and Cambrian sedimentary rocks overlying Precambrian Basement at the site.

The licensee provided site profile descriptions in Sections 2.3.1 and 2.3.2 of its SHSR based on information in the DAEC UFSAR (DAEC, 2015). The plant surface is underlain by clay till with some sand and gravel of varying thickness between 12 and 80 ft. (3.7 and 24 m) in the site area but averaging about 20 ft. (6.1 m) in the plant area. The SSE control point is located in a 380 ft. (116 m) thick unit of firm limestone and dolomite rock. An additional 2,100 ft. (640 m) of Devonian and Cambrian sedimentary rocks overlay Precambrian basement. The licensee noted that shear wave velocity measurements were calculated from the P-wave velocity and an assumed Poisson ratio.

The licensee assumed the depth from the SSE to reference rock is either 380 ft. (116 m) at the top of the Ordovician, or 2,500 ft. (762 m). To capture the uncertainty in the shear wave velocity beneath the site, the licensee developed three base-case profiles using a scale factor of 1.57. The licensee used this scale factor and the estimated shear wave velocities to develop the base-case profiles for the DAEC site. For the best estimate base-case profile, the licensee assumed that reference rock conditions occur at a depth of 380 ft. (116 m) below the SSE, at the bottom of the upper limestone unit. For the lower range profile, the licensee assumed that reference rock conditions occur at a depth of 2,500 ft. (762 m), at the base of the sedimentary section. For the upper base-case, the licensee assumed that reference rock conditions occur at the depth of the SSE control point. Figure 3.3-1 of this assessment shows the licensee's three shear-wave velocity base case profiles.

The licensee stated that no site-specific dynamic material properties were determined during the initial investigations of the DAEC site. Therefore, the licensee assumed that the rock material in the upper 500 ft. (150 m) could be modeled as either linear or non-linear using two sets of shear modulus reduction and hysteretic damping curves. Consistent with the SPID, the licensee used the EPRI rock curves (model M1) to represent the more nonlinear response and for the linear analyses (model M2), the licensee used a constant low strain damping value of about three percent in the upper 500 ft. (150 m).

The licensee also considered the impact of kappa, or small strain damping, on site response. Kappa is measured in units of seconds (sec), and is the damping contributed by both intrinsic hysteretic damping as well as scattering due to wave propagation in heterogeneous material. For the DAEC site, with firm rock thicknesses of 380 ft. (116 m), 2,500 ft. (762 m) and 0 ft. (0 m) for the best, lower and upper profiles, respectively, the licensee determined kappa values of 0.008 sec, 0.020 sec, and 0.006 sec, respectively.

To account for aleatory randomness in material properties across the plant site in its site response calculations, the licensee stated that it randomized its base case profiles in accordance with Appendix B of the SPID. The licensee stated that it also randomized the depth of the best-estimate and lower-range profiles +/- 750 ft. (229 m) reflecting 30 percent of the depth. The licensee stated that this randomization did not represent actual uncertainty in the depth to reference rock, but was used to broaden the spectral peak.

3.3.2 Site Response Method and Results

In Section 2.3.4 of its SHSR, the licensee stated that it followed the guidance in Appendix B of the SPID to develop input ground motions for the site response analysis, and in Section 2.3.5, the licensee described its implementation of the random vibration theory (RVT) approach to perform its site response calculations. Finally, Section 2.3.6 of the SHSR shows the resulting amplification functions and associated uncertainties for the eleven input loading levels for the each base case profile. Consistent with the SPID, the licensee used a minimum median amplification value of 0.5 in the analysis.

In order to develop probabilistic site-specific control point hazard curves, as requested in Requested Information Item (1) of the 50.54(f) letter, the licensee used Method 3, described in Appendix B-6.0 of the SPID. The licensee's use of Method 3 involved computing the site- specific control point elevation hazard curves for a broad range of spectral accelerations by combining the site-specific reference rock hazard curves, determined from the initial PSHA (Section 3.2 of this assessment), and the amplification function and their associated uncertainties, determined from the site response analysis.

3.3.3 Staff Confirmatory Analysis

To confirm the licensee's site response analysis, the NRC staff performed site response calculations for the DAEC site. Based on the limited subsurface data at the site and because the licensee followed the guidance in the SPID for sites with limited data, the NRC staff used the licensee's three base case shear wave velocity profiles for its confirmatory analysis. Figure 3.3- 1 of this assessment shows the licensee's and staff's three shear-wave velocity base case profiles.

In the absence of any site-specific dynamic material property measurements, the NRC staff followed the SPID guidance and selected two alternative characterizations of dynamic material behavior. In one characterization, the NRC staff assumed linear behavior with 1 percent damping in the upper 500 ft. (150 m), which is somewhat lower than the low strain damping value of about 3 percent used by the licensee. For the second characterization, the NRC staff used the EPRI rock shear modulus reduction and hysteretic damping curves over the upper 500 ft. (150 m). The NRC staff assigned equal weights to the two characterizations.

To determine kappa for its final case profiles, the NRC staff calculated base-case kappa estimates using Appendix B-5.1.3.1 of the SPID. The resulting kappa values for the best, lower and upper profiles are 0.008 sec, 0.020 sec, and 0.006 sec, respectively, which are equal to the licensee's kappa values.

Figure 3.3-2 of this assessment shows a comparison of theNRC staff's and licensee's median site amplification factors and uncertainties (±1 standard deviation) for two of the eleven input loading levels. As expected, due to similar site response analyses, the staff's median site amplification factors are very close to the licensee's. Based on the staff's confirmatory calculations of amplification factors, the NRC staff concludes that the licensee's evaluation for the DAEC site adequately captures the site amplification occurring as a result of bedrock ground motions travelling upward through the soil/rock column to the control point elevation.

Figure 3.3-3 of this assessment shows that the licensee's and NRC staff's control point hazard curves are also very similar. Minor differences are due primarily to the licensee's use of higher low strain damping (three percent) than the damping value (one percent) used by the NRC staff for the rock. Appendix B of the SPID provides guidance for performing site response analyses, including capturing the uncertainty for sites with less subsurface data; however, the guidance is neither entirely prescriptive nor comprehensive. As such, various approaches in performing site response analyses, including the modeling of uncertainty, are acceptable for this application.

In summary, the NRC staff concludes that the licensee's site response was conducted using present-day guidance and methodology, including the NRC-endorsed SPID. The NRC staff performed confirmatory calculations to verify that the licensee's amplification factors and control point hazard curves adequately characterize the site response, including the uncertainty associated with the subsurface material properties, for the DAEC site.

3.4 Ground Motion Response Spectra

In Section 2.4 of its SHSR, the licensee stated that it used the control point hazard curves, described in SHSR Section 2.3.7, to develop the 10^{-4} and 10^{-5} (mean annual frequency of exceedance) uniform hazard response spectra (UHRS) and the GMRS.

The NRC staff independently calculated the 10^{-4} and 10^{-5} UHRS using the results of its confirmatory PSHA and site response analysis, as described in Sections 3.2 and 3.3 of this staff assessment, respectively. Figure 3.4-1 of this assessment shows a comparison of the GMRS determined by the licensee to that determined by the NRC staff.

As shown in Figure 3.4-1, the licensee's GMRS shape is very similar to that calculated by the NRC staff. At higher frequencies, the staff's confirmatory GMRS is slightly higher than the licensee's. These differences in GMRS are the result of differences in the site response analyses performed by the licensee and NRC staff as discussed in Section 3.3 above.

The NRC staff confirms that the licensee used the present-day guidance and methodology outlined in RG 1.208 and the SPID to calculate the horizontal GMRS, as requested in the 50.54(f) letter. The NRC staff performed both a PSHA and site response confirmatory analysis and achieved results consistent with the licensee's horizontal GMRS. As such, the NRC staff concludes that the GMRS determined by the licensee adequately characterizes the reevaluated hazard for the DAEC site. Therefore, this GMRS is suitable for use in subsequent evaluations and confirmations, as needed, for the licensee's response to the 50.54(f) letter.

4.0 CONCLUSION

The NRC staff reviewed the information provided by the licensee for the reevaluated seismic hazard for the DAEC site. Based on its review, the NRC staff concludes that the licensee conducted the seismic hazard reevaluation using present-day methodologies and regulatory guidance, appropriately characterized the site given the information available, and met the intent of the guidance for determining the reevaluated seismic hazard. Based on the preceding analysis, the NRC staff concludes that the licensee provided an acceptable response to Requested Information Items (1) – (3) and (5) – (7), and the comparison portion for Item (4), identified in Enclosure 1 of the 50.54(f) letter. Further, the licensee's reevaluated seismic hazard is acceptable to address other actions associated with NTTF Recommendation 2.1: seismic.

In reaching this determination, the NRC staff confirms the licensee's conclusion that the licensee's GMRS for the DAEC site is bounded by the SSE, except for frequencies above 10 Hz. As such, a seismic risk evaluation and SFP evaluation (i.e., Requested Information Items (8) and (9)) are not merited, but a HF confirmation (Item 4) is merited. The NRC review and acceptance of NextEra's HF confirmation will complete the Seismic Hazard Evaluation for DAEC identified in Enclosure 1 of the 50.54(f) letter.

REFERENCES

Note: ADAMS Accession Nos. refers to documents available through NRC's Agencywide Documents Access and Management System (ADAMS). Publicly-available ADAMS documents may be accessed through http://www.nrc.gov/reading-rm/adams.html.

U.S. Nuclear Regulatory Commission Documents and Publications

NRC (U.S. Nuclear Regulatory Commission), 2007, A Performance-based Approach to Define the Site-Specific Earthquake Ground Motion, Regulatory Guide (RG) 1.208, March 2007.

NRC (U.S. Nuclear Regulatory Commission), 2011a, "Near-Term Report and Recommendations for Agency Actions Following the Events in Japan," Commission Paper SECY-11-0093, July 12, 2011, ADAMS Accession No. ML11186A950.

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NRC (U.S. Nuclear Regulatory Commission), 2011c, "Recommended Actions to be Taken Without Delay from the Near-Term Task Force Report," Commission Paper SECY-11-0124, September 9, 2011, ADAMS Accession No. ML11245A158.

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NRC (U.S. Nuclear Regulatory Commission), 2013a. Letter From Eric J. Leeds, to Joseph Pollock, Executive Director NEI, Acceptance Letter for NEI Submittal of Augmented Approach, Ground Motion Model Update Project, and 10 CFR 50.54(f) Schedule Modifications Related to the NTTF Recommendation 2.1, Seismic Reevaluations, May 7, 2013, ADAMS Accession No. ML13106A331.

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the DAEC Site

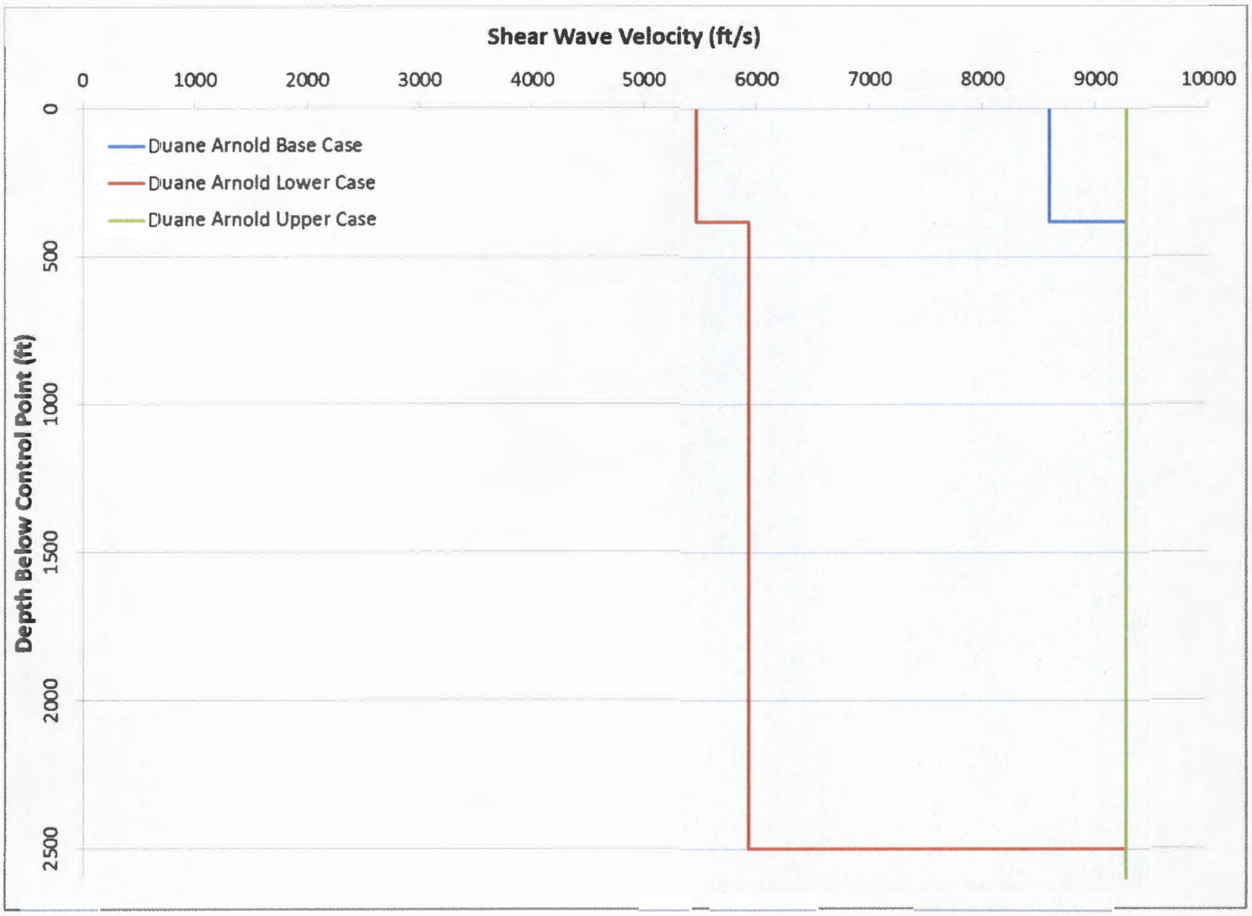


Figure 3.3- 1 Plot Comparing the Staff's and the Licensee's Median Amplification Functions and Uncertainties for the DAEC site.

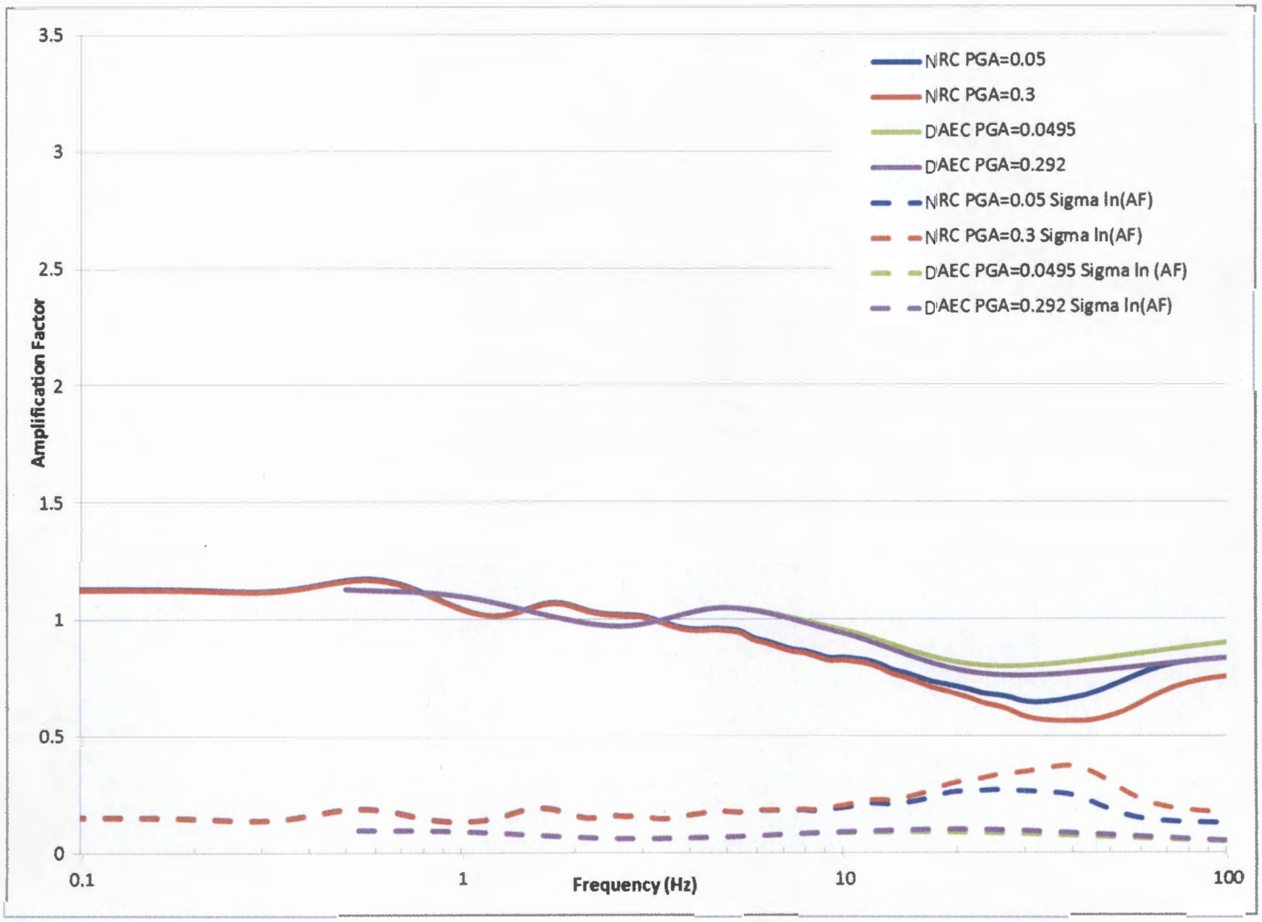


Figure 3.3-2 Plot Comparing the Staff's and the Licensee's Mean Control Point Hazard Curves at a Variety of Frequencies for the DAEC site

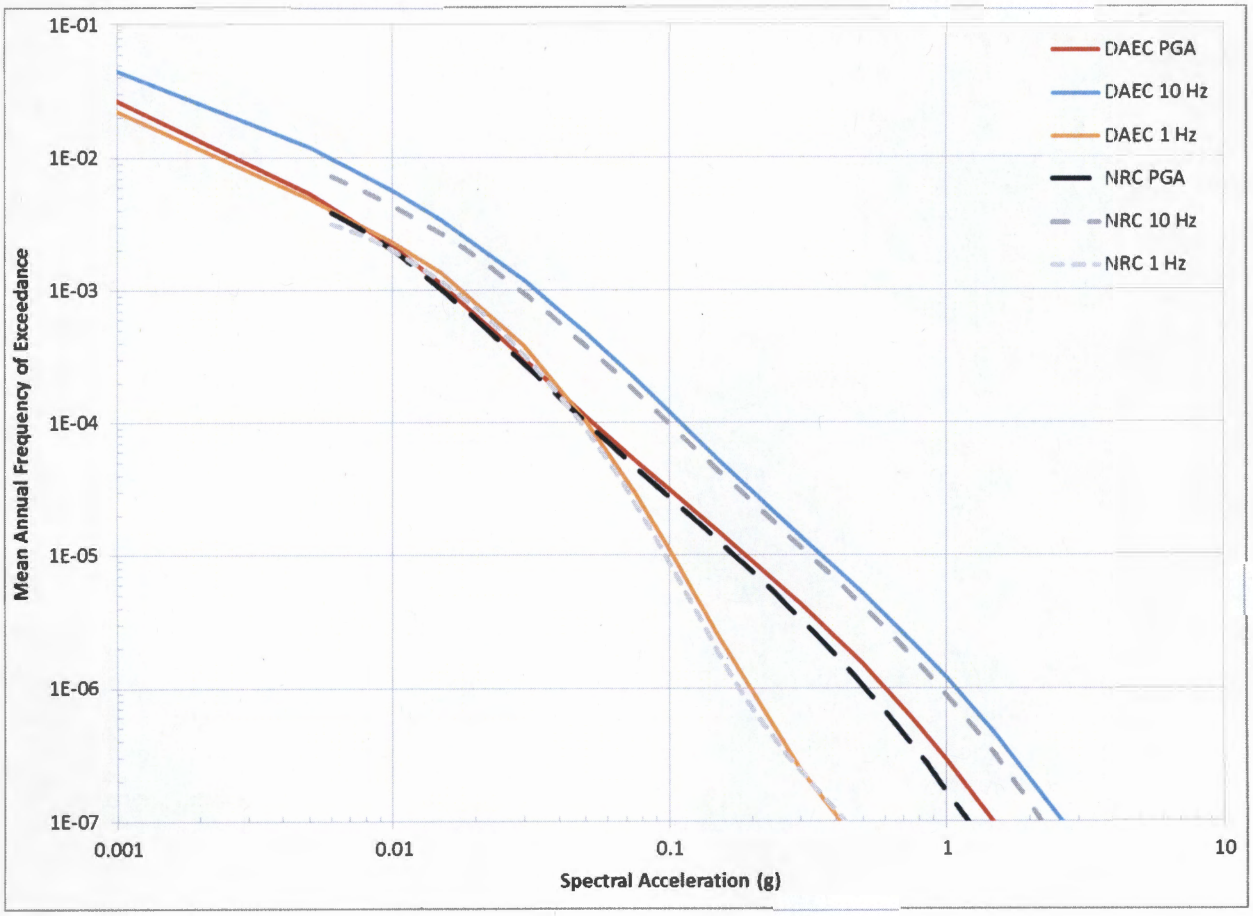
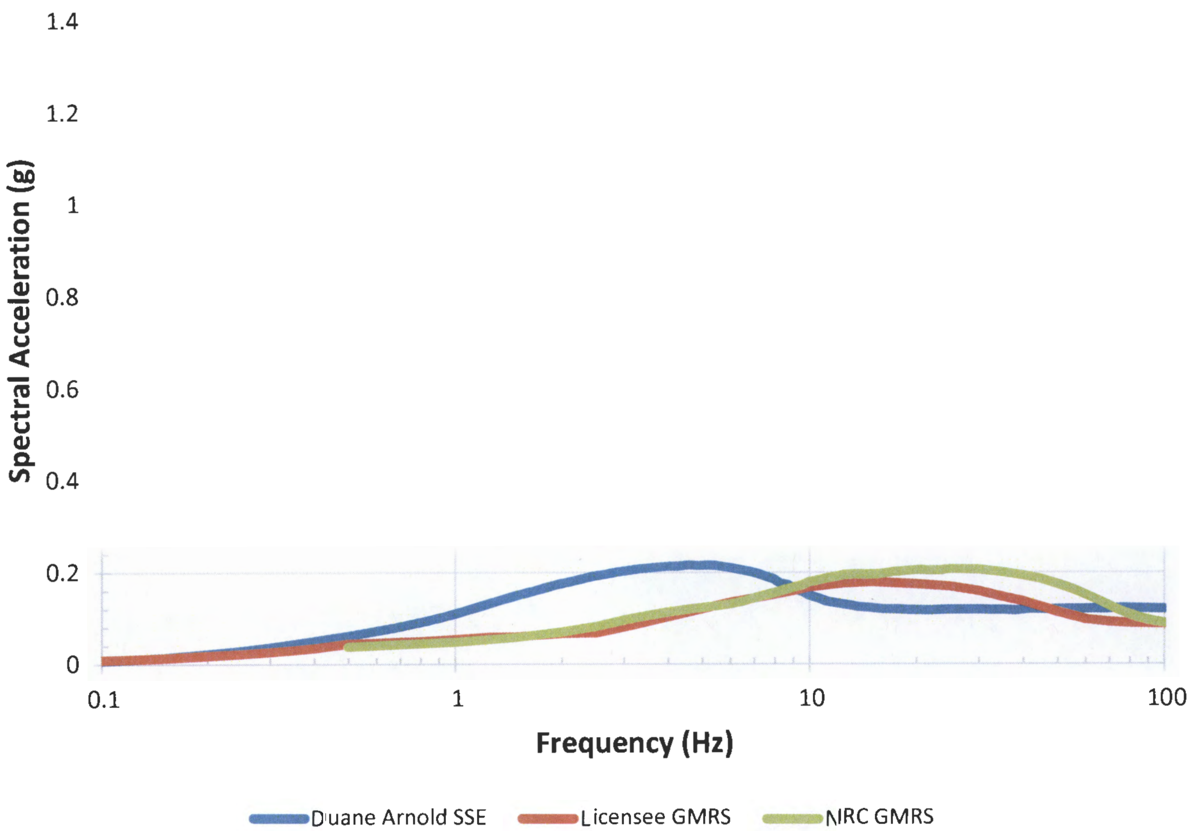


Figure 3.4-1 Comparison of the Staff's GMRS with Licensee's GMRS and the SSE for the DAEC site



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

Sincerely,

/RA/

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

Docket No. 50-331

Enclosure:
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Hazard Evaluation and Screening Report

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