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

January 20, 2016

Mr. Jon A. Franke
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NUCSB3
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SUBJECT: SUSQUEHANNA STEAM ELECTRIC STATION, UNITS 1 AND 2 - 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 (CAC NOS. MF3707 AND MF3708)

Dear Mr. Franke:

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.

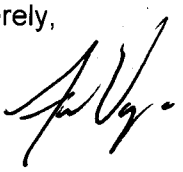
By letter dated March 26, 2014, Susquehanna Nuclear, LLC, previously as PPL, Susquehanna, LLC (the licensee), responded to this request for Susquehanna Steam Electric Station, Units 1 and 2 (SSES).

The NRC staff has reviewed the information provided related to the reevaluated seismic hazard for SSES and, as documented in the enclosed staff assessment, determined that you provided sufficient information in response to Enclosure 1, Items (1) – (3), (5) - (8) and the comparison portion of Item (4) 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".

Contingent upon the NRC staff's review and acceptance of the licensee's high frequency confirmation and spent fuel pool evaluation (i.e., Items (4) and (9)) for SSES, 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 G. Vega, Project Manager
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Docket Nos. 50-387 and 50-388

Enclosure:
Staff Assessment of Seismic
Hazard Evaluation and Screening Report

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STAFF ASSESSMENT BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO SEISMIC HAZARD AND SCREENING REPORT

SUSQUEHANNA STEAM ELECTRIC STATION, UNITS 1 AND 2

DOCKET NOS. 50-387 AND 50-388

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).

(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 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 model 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 12, 2013 (Franke,

2013), Susquehanna Nuclear, LLC, previously as PPL Susquehanna, LLC (Susquehanna, the licensee) submitted at least partial site response information for Susquehanna Steam Electric Station, Units 1 and 2 (SSES). By letter dated March 26, 2014 (Rausch, 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) GMMs. 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 26, 2014 (Rausch, 2014a), the licensee provided its SHSR for the SSES site. The licensee's SHSR indicates that the site GMRS exceeds the site SSE for a portion of the frequency range between 1 to 10 Hertz (Hz). However, the licensee indicated that over the frequency range of 1 to 10 Hz, the GMRS is bounded by either the site SSE or the site Individual Plant Examination of External Events (IPEEE) plant-level high confidence of low probability of failure (HCLPF) spectrum (IHS). Additionally, for a portion above 10 Hz, the GMRS exceeds the IHS and therefore, the licensee indicated that it will perform a HF confirmation. Following the guidance in the SPID, the licensee provided an evaluation of its IPEEE program in order to use the IHS for its screening comparison. As such, the licensee stated that a seismic risk evaluation will not be performed. However, a SFP evaluation will be performed since the IPEEE program did not include the SFP and the GMRS exceeds the SSE in the 1 to 10 Hz range.

On May 9, 2014 (NRC, 2014), the NRC staff issued a letter providing the outcome of its 30-day screening and prioritization evaluation. As indicated in the letter, the NRC staff confirmed the licensee's screening results. The licensee's GMRS, as well as the staff's confirmatory GMRS, exceeds the SSE over a portion of the frequency range of 1 to 10 Hz. However, the NRC staff confirmed that the licensee demonstrated that it met the IPEEE program screening criteria in the SPID. Therefore, because either the SSE or the IHS bounds the GMRS over the 1 to 10 Hz frequency range, SSES screens out of a seismic risk evaluation. In addition, the NRC staff confirmed that because the GMRS exceeds the IHS for a portion above 10 Hz, a HF confirmation is merited for SSES. Finally, a SFP evaluation is also merited for SSES because the IPEEE program did not include the SFP and the GMRS exceeds the SSE from approximately 7 to 100 Hz.

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 from 20 to 30 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 SSES. The licensee stated that the design basis of SSES was developed as specified in 10 CFR Part 100, Appendix A, based on the maximum earthquake potential in the site region. The licensee identified a maximum earthquake of intensity VI. The response spectrum for SSES, except for the Emergency Diesel Generator (EDG), is anchored at 0.1 g (10 percent the acceleration of earth's gravity) with a Newmark spectral shape. The response spectrum for SSES EDG is also anchored at 0.1 g (10 percent the acceleration of earth's gravity) with a Regulatory Guide (RG) 1.60 spectral shape. The licensee specified that the control point for the SSE is located at the top of bedrock at elevation 640 ft. (195 m).

The NRC staff reviewed the licensee's description of the SSE in the SHSR. Based on its review of the SHSR and SSES's Updated Final Safety Analysis Report (UFSAR) (PPL, 2011), the NRC staff confirmed that the licensee's SSE, except for the EDG, is a Newmark spectral shape anchored at 0.1 g. In addition, based on its review of the SHSR and SSES's UFSAR, the NRC staff confirmed that the licensee's EDG SSE is based on a Regulatory Guide (RG) 1.60 spectral shape and is anchored at 0.1 g. Lastly, based on the review of the licensee's SHSR and the UFSAR, the NRC staff confirms that the licensee's SSE control point elevation determination is consistent with information provided in the SSES UFSAR as well as 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 Charleston, Charlevoix and Wabash Valley Repeated Large Magnitude Earthquake (RLME) sources, which lie within 620 mi (1,000 km) of SSES. 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 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 SSES 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 SSES site. In addition, the NRC staff included the Charleston, Charlevoix and Wabash Valley RLME sources, which lie within 620 mi (1,000 km) of the SSES 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.

Based on its review of the SHSR, the NRC staff concludes that the licensee 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 is 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 SSES. According to the licensee, the current site grade is underlain by approximately 15 ft. (4.6 m) of glacial sand and gravel atop 15 ft. (4.6 m) of weathered rock before encountering the top of Paleozoic sedimentary rocks and the SSE control point at elevation 640 ft. (195 m). Precambrian basement rock occurs at a depth of about 33,000 ft. (10,000 m). The Mahantango Formation, consisting of weathered and sound shale, is encountered through the deepest boring at a depth of about 420 ft. (128 m).

The licensee provided site profile descriptions in Sections 2.3.1 and 2.3.2 of its SHSR based on information in the SSES's UFSAR (UFSAR, PPL, 2011), as well as more recent investigations for the nearby Bell Bend Nuclear Power Plant (BBNPP) site (UniStar, 2013). The licensee noted that the BBNPP data extends deeper than the SSES data and noted that the measured shear-wave velocities were consistent between the two sites. Using the results of the down-hole and cross-hole investigations for BBNPP, the licensee developed the base case profile for the SSES site. The licensee developed upper and lower base case profiles using a scale factor of 1.25. Table 2.3.2-1 and Figure 2.3.2-1 of the SHSR provide the licensee's shear-wave

velocity profile for each of the three base cases. Figure 3.3-1 of this assessment shows the licensee's three shear-wave velocity base case profiles.

In Section 2.3.2.1 of its SHSR, the licensee stated that no site-specific nonlinear dynamic material properties were available for the SSES firm rocks. Therefore, the licensee followed the SPID guidance and assumed the rock material could be modeled as either linear or non-linear. In one characterization, the licensee used the EPRI rock curves to represent the upper range nonlinearity. The licensee assumed the linear analyses were an equally plausible alternative rock response across the loading level using low strain damping from the EPRI rock curves as the constant damping value in the upper 500 ft. (152 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. The licensee stated that for a firm rock over hard reference rock site, like SSES, a median kappa of 0.006 sec is combined with low strain damping resulting in a value of 0.009 sec. The licensee estimated kappa values of 0.012 sec and 0.006 sec for the lower and upper profiles respectively. The licensee weighted each base case profile, as shown in Table 2.3.2-2 of the SHSR.

To account for aleatory variability 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. For the base case profile, the licensee extended hard reference rock to a depth of 391 ft. (119 m) randomized +/- 117 ft. (36 m). For the lower range profile with reference rock at a depth of 5,000 ft. (1,524 m), the licensee stated that it also randomized the depth to reference rock ±1,500 ft. (460 m). 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 associate uncertainties for the eleven input loading levels for each base case profile.

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 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 bedrock hazard curves, determined from the initial PSHA (Section 3.2 of this assessment), and their associated uncertainties, and the site-specific estimates of soil or soft- rock response 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 SSES site. The NRC staff independently developed a shear-wave velocity profile, damping values, and modeled the potential non-linear behavior of the site using measurements and geologic information provided in the SSES UFSAR (PPL, 2011), as well as more recent investigations for the nearby BBNPP site (UniStar, 2013). For its site response calculations, the NRC staff employed the RVT approach and developed input ground motions in accordance with Appendix B of the SPID.

Because of the high quality of the data and the geologic consistency between the SSES and BBNPP sites, the staff's base case shear-wave velocity is based on measured shear-wave velocity data reported in the SSES UFSAR (PPL, 2011) and the BBNPP FSAR (Unistar, 2013). In addition, due to the consistencies between the SSES and BBNPP sites, the NRC staff used a single base case velocity profile rather than the three profiles developed by the licensee. Figure 3.3-1 of this assessment shows the NRC staff velocity profile compared to the base case profiles developed by the licensee.

Because no site-specific nonlinear dynamic material properties were available for the SSES firm rocks, the NRC staff followed the SPID guidance and assumed the rock material could be modeled as either linear or non-linear. In one characterization, the NRC staff used the EPRI rock curves to represent the upper range of nonlinearity. The NRC staff assumed that a linear analyses was an equally plausible alternative rock response across the loading levels using the low strain damping values from the EPRI rock curves as the constant damping value for the profile. To determine kappa for its base case profile, the NRC staff used the low strain damping values, shear wave velocities, and layer thicknesses for each layer to arrive at kappa values for the base case velocity profile of 0.007.

Figure 3.3-2 of this assessment shows a comparison of the staff's and licensee's median site amplification factors and uncertainties (±1 standard deviation) for 2 of the 11 input loading levels. The staff's median site amplification factors are larger than the licensee's. Differences in site amplification curves developed by the NRC staff and the licensee are due to differences in site base case profiles and kappa values. However, these differences in the site amplification curves do not result in large difference in the control point hazard curves, or the GMRS, as described below.

Figure 3.3-3 of this assessment shows a comparison of the licensee's and staff's control point hazard curves. The staff's median site amplification factors are similar to the licensee's and Figure 3.3-3 of this assessment figure shows that the differences in site amplification curves had only a minor impact on the control point seismic hazard curves. 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 the 50.54(f) response.
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 independent calculations which confirmed 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 SSES 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 then computed the GMRS using the criteria in RG 1.208.

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 NRC 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 generally similar to that calculated by the NRC staff. The minor differences in the licensee's and staff's GMRS result from the differences in the site response analyses, 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 SSES 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 SSES 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 upon the preceding analysis, the NRC staff concludes that the licensee provided an acceptable response to Requested Information Items (1) – (3), (5) - (7), and the comparison portion to 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 its IPEEE program met the SPID criteria for screening purposes and that the GMRS for the SSES site is bounded by either the IHS or SSE over the 1 to 10 Hz frequency range. As such, a seismic risk evaluation (Item 8) is not merited. However, a SFP evaluation (Item 9) and HF confirmation (Item 4) are merited. The NRC review and acceptance of the Susquehanna's SFP evaluation and HF confirmation for SSES will complete Seismic Hazard Evaluation 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.

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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.

NRC (U.S. Nuclear Regulatory Commission), 2011b, "Recommendations for Enhancing Reactor Safety in the 21st Century: The Near-Term Task Force Review of Insights from the Fukushima Dai-Ichi Accident," Enclosure to SECY-11-0093, July 12, 2011, ADAMS Accession No. ML11186A950.

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.

NRC (U.S. Nuclear Regulatory Commission), 2011d, "Prioritization of Recommended Actions to be Taken in Response to Fukushima Lessons Learned," Commission Paper SECY-11-0137, October 3, 2011, ADAMS Accession No. ML11272A111.

NRC (U.S. Nuclear Regulatory Commission), 2012a, letter from Eric J. Leeds, Director, Office of Nuclear Reactor Regulation and Michael R. Johnson, Director, Office of New Reactors, to All Power Reactor Licensees and Holders of Construction Permits in Active or Deferred Status, March 12, 2012, ADAMS Accession No. ML12053A340.

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Figure 3.3-1 Plot of Staff's and Licensee's Base Case Shear-Wave Velocity Profiles for the SSES Site

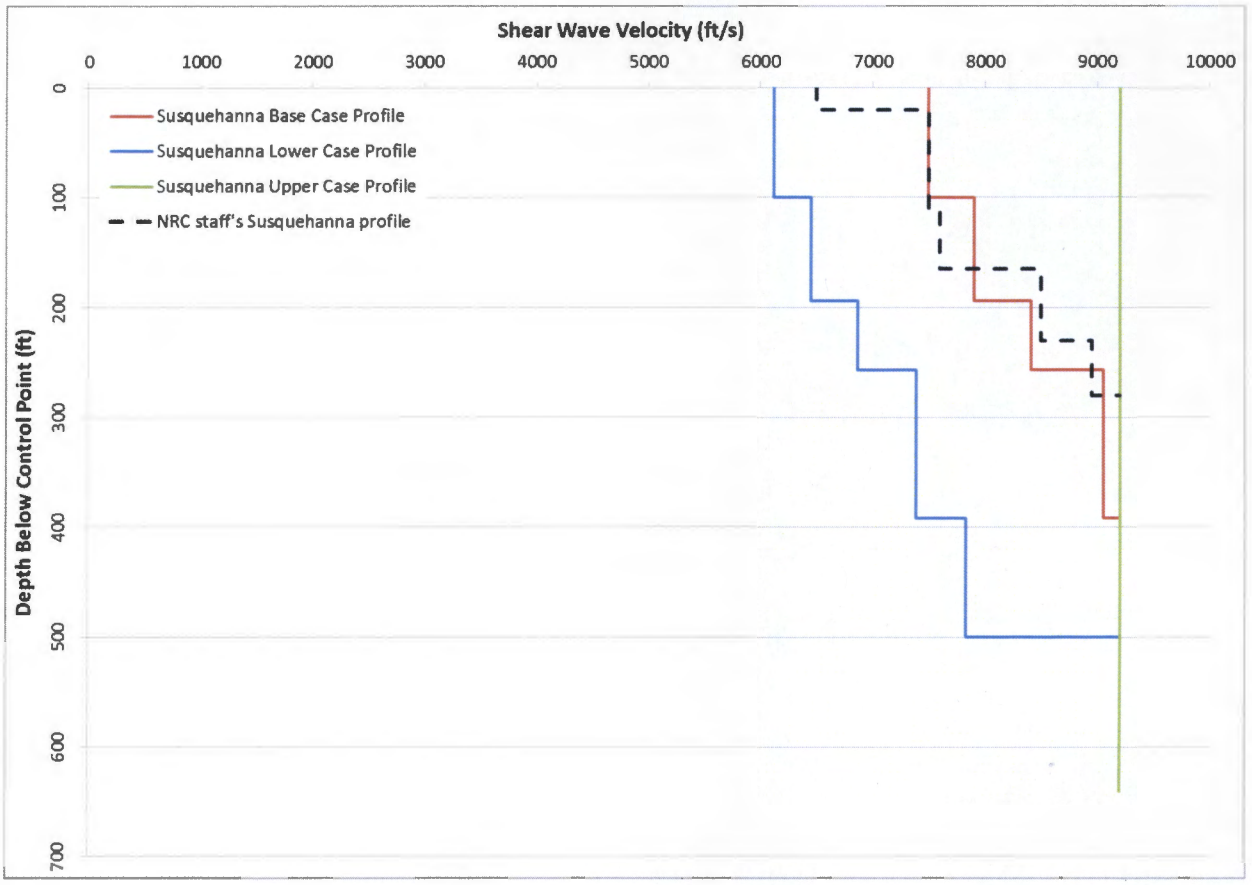


Figure 3.3- 2 Plot Comparing the Staff's and the Licensee's Median Amplification Functions and Uncertainties for the SSES site.

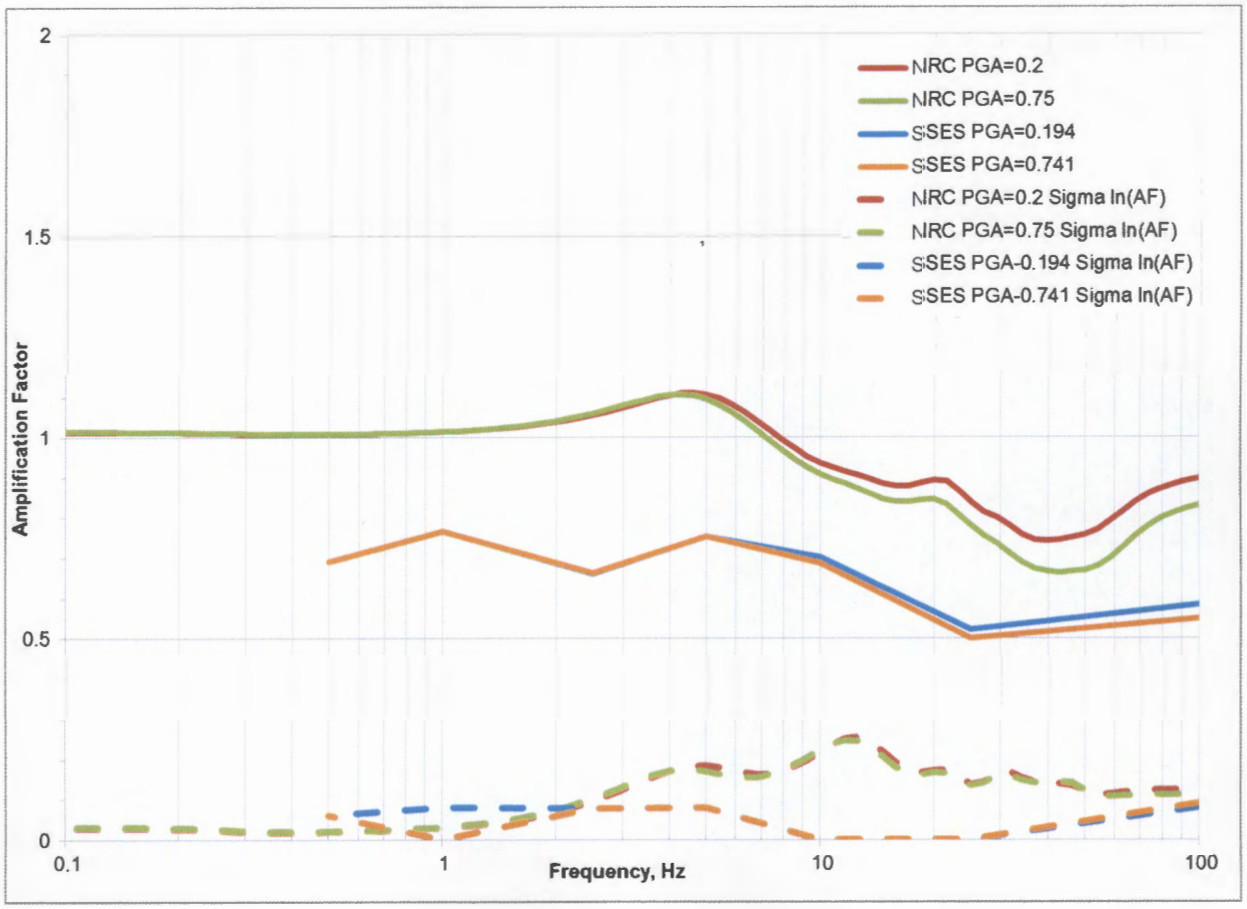


Figure 3.3-3 Plot Comparing the Staff's and the Licensee's Mean Control Point Hazard Curves at a Variety of Frequencies for the SSES site

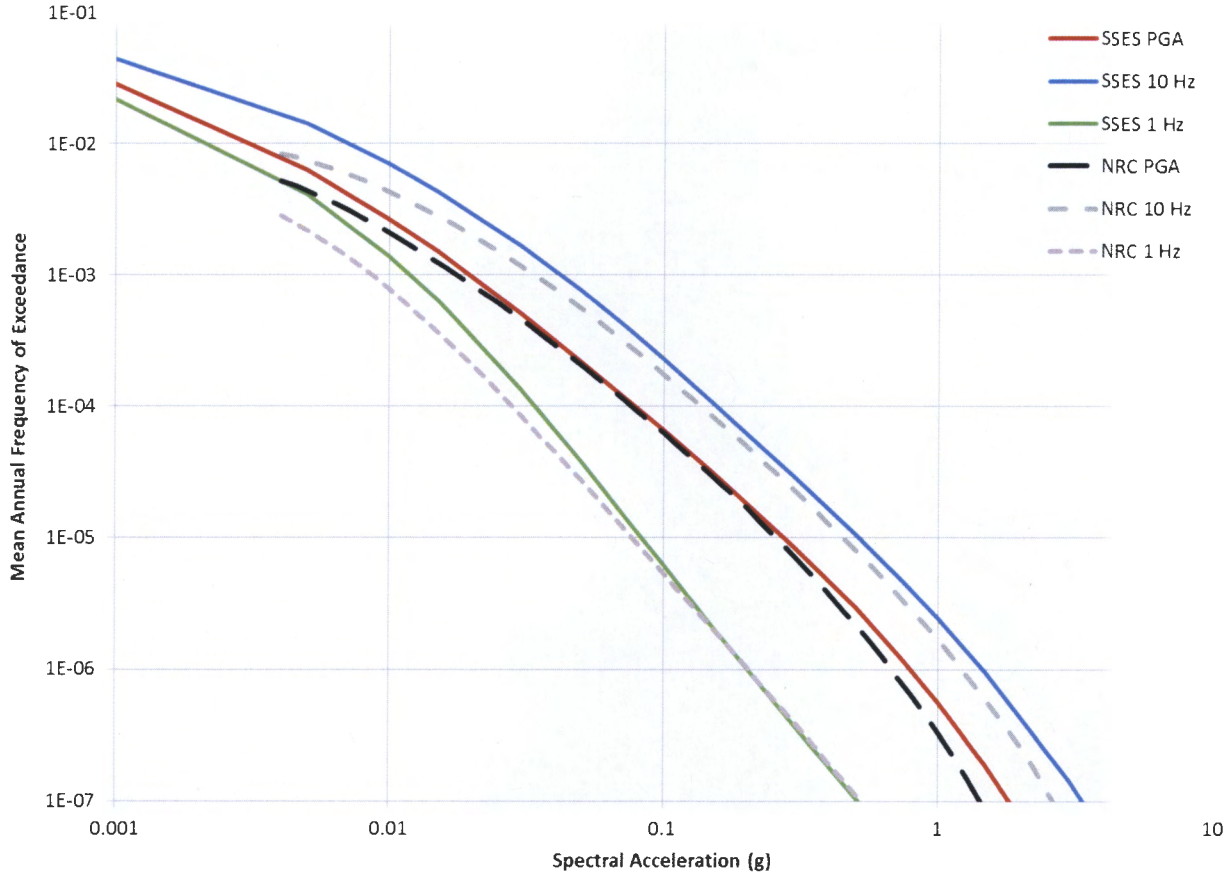
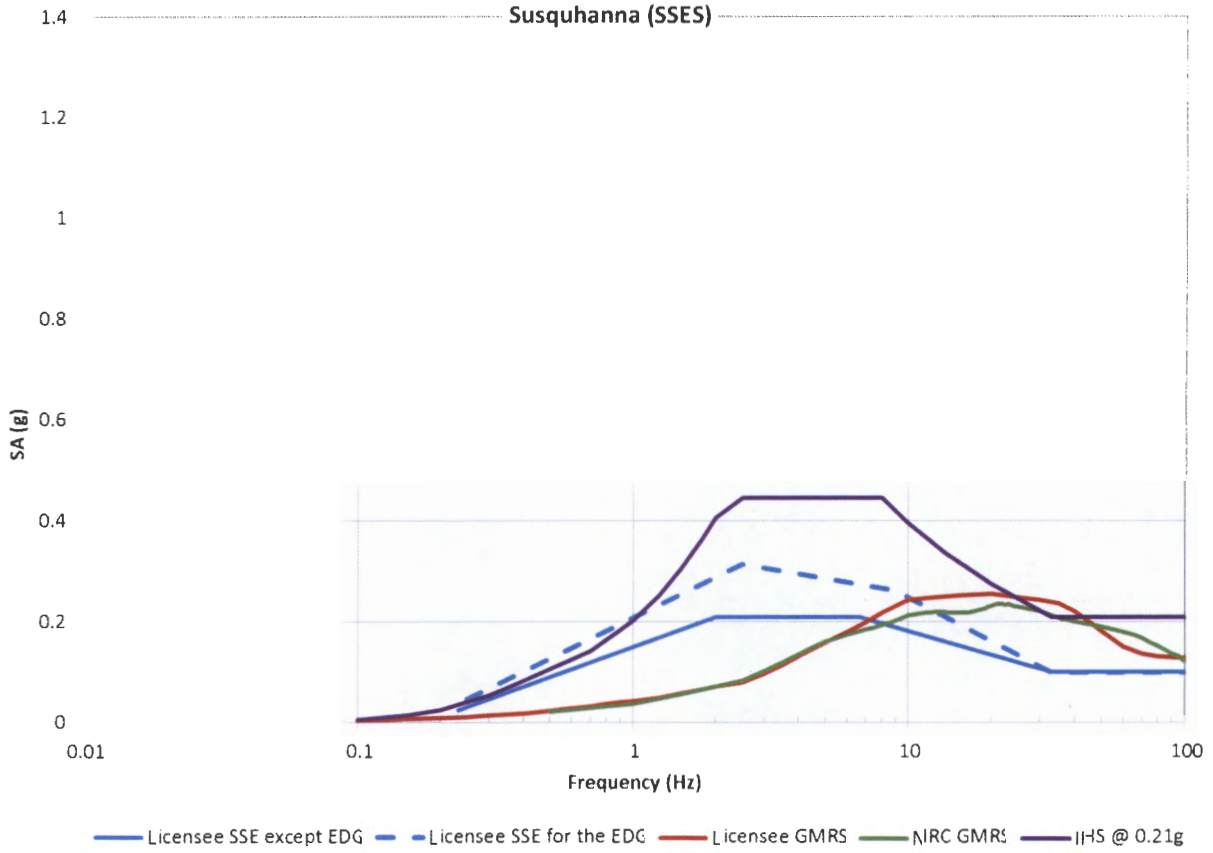


Figure 3.4-1 Comparison of the Staff's GMRS with Licensee's GMRS and the SSE for the SSES site



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

Sincerely,

/RA/

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

Docket Nos. 50-387 & 50-388

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