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

April 20, 2015

Mr. C. R. Pierce
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SUBJECT: VOGTLE ELECTRIC GENERATING PLANT, 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 RELATING TO RECOMMENDATION 2.1 OF THE NEAR-TERM TASK FORCE REVIEW OF INSIGHTS FROM THE FUKUSHIMA DAI-ICHI ACCIDENT (TAC NOS. MF3770 AND MF3771)

Dear Mr. Pierce:

By letter dated 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 31, 2014, Southern Nuclear Operating Company, Inc. (SNC) responded to this request for Vogtle Electric Generating Plant, Units 1 and 2 (Vogtle).

The NRC staff has reviewed the information provided related to the reevaluated seismic hazards for Vogtle and, as documented in the enclosed staff assessment, determined that you provided sufficient information in response to Requested Information Items (1) – (3), (5), (7), and a partial response to Item (4), identified in Enclosure 1 of the 50.54(f) letter. Further, the staff concludes that SNC's reevaluated seismic hazard for Vogtle is suitable for other activities associated with the NRC Near-Term Task Force Recommendation 2.1, "Seismic."

Contingent upon the NRC's review and acceptance of SNC's expedited seismic evaluation process, and seismic risk evaluation including the high frequency and spent fuel pool evaluations (i.e., Items (4), (6), (8), and (9)) for Vogtle, the seismic hazard evaluation identified in Enclosure 1 of the 50.54(f) letter will be complete.

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

Sincerely,

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

Docket Nos. 50-424 and 50-425

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

VOGTLE ELECTRIC GENERATING PLANT, UNIT NOS. 1 AND 2

DOCKET NOS. 50-424 AND 50-425

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 (SRMs) 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,

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

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

(4) Comparison of the GMRS and SSE (If the GMRS is completely bounded by the SSE, an interim action plan or risk evaluation is not necessary. However if the GMRS exceeds the SSE only at higher frequencies, information related to the functionality of high-frequency sensitive SSCs is requested),

(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," 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 ground motion 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 (Pierce, 2013), Southern Nuclear Operating Company (SNC, the licensee) submitted partial site response information for Vogtle Electric Generating Plant Units 1 and 2 (Vogtle). By letter dated March 31, 2014 (Pierce, 2014), SNC submitted its SHSR.

2.0 REGULATORY EVALUATION

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." 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 31, 2014 (Pierce, 2014), SNC provided the SHSR for Vogtle, Units 1 and 2. The licensee's SHSR indicated that the GMRS exceeds the SSE for Vogtle over the frequency range of 1 to 10 Hz. As such, Vogtle screens in for a plant seismic risk evaluation. A SFP evaluation will also be performed. The GMRS also exceeded the SSE at frequencies above 10 Hz. The licensee indicated that the seismic risk evaluation would address the high frequency exceedance.

On May 9, 2014 (NRC, 2014), the staff issued a letter providing the outcome of its 30-day screening and prioritization evaluation. As indicated in the letter, the staff confirmed the licensee's screening results. The licensee's GMRS, as well as the confirmatory GMRS developed by the staff, exceed the SSE for Vogtle over the frequency range of 1 to 10 Hz. Therefore, a plant seismic risk evaluation, SFP evaluation, and a high-frequency confirmation are merited for Vogtle.

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 requested that licensee's 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 earthquake 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 NPPs; (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 the SHSR, the licensee described its seismic design bases for Vogtle. The licensee stated that the SSE for Vogtle is based on a Modified Mercalli Intensity VII – VIII event in the Charleston-Summerville, South Carolina area. Based on this earthquake, the response spectral shape is anchored to a PGA of 0.2 g (20-percent of the acceleration due to earth's gravity) with a spectrum based on Regulatory Guide 1.60, "Design Response Spectra for Seismic Design of Nuclear Power Plants."

The licensee specified that the SSE control point is located at plant grade at a mean sea level (MSL) elevation of 220 ft. The licensee specified the control point location based on the Vogtle Units 1 and 2 UFSAR (SNC, 2014) specification of the location of input motion at plant grade for seismic analysis of structures.

The staff reviewed the licensee's description of its SSE in the SHSR. To confirm the SSE, the staff reviewed the Vogtle UFSAR (SNC, 2014). Based on its review, the staff confirmed both the SSE spectrum and control point are consistent with guidance provided in the SPID.

3.2 Probabilistic Seismic Hazard Analysis

In Section 2.2 of the 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). For its PSHA, the licensee used a minimum moment magnitude (**M**) of 5.0, as specified in the 50.54(f) letter. The licensee stated that it included CEUS-SSC background sources out to a distance of 400 miles [640 km]. In addition, the licensee included the Charleston, New Madrid Fault System, Commerce, Eastern Rift Margin Fault northern segment, Eastern Rift Margin Fault southern segment, Marianna, and Wabash Valley repeated large magnitude earthquake (RLME) sources, which lie within 620 miles [1,000 km] of the site. 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 paleoearthquake (geologic evidence for prehistoric seismicity) record. The licensee used the 9 general, non-rift ground motion models from the updated EPRI GMM (EPRI, 2013) for the background sources, and the 12 non-general, rift ground motion models from the updated EPRI GMM (EPRI, 2013) for each of the RLME sources. The licensee's resulting base rock seismic hazard curves are provided in Figure 2.2.2-1 and Tables 2.2.2-2a-g of its SHSR.

As part of its confirmatory analysis of the licensee's GMRS, the staff performed PSHA calculations for base rock at the Vogtle site. As input, the staff used the CEUS-SSC model, as documented in NUREG-2115 (NRC, 2012b) along with the updated EPRI GMM model (EPRI, 2013). Consistent with the guidance provided in the SPID, and the licensee's approach, the staff included all of the CEUS-SSC background seismic sources within a 310 mi [500 km] radius of the Vogtle site. In addition, the staff included all of the RLME sources falling within a 620 mi [1,000 km] radius of the site. For each of the CEUS-SSC sources used in the PSHA, the staff used the mid-continent version of the updated EPRI GMM (EPRI, 2013), except for the Extended Continental Crust-Gulf Coast background seismic source, which used the gulf coast version of the updated EPRI GMM (EPRI, 2013). The 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 review of the SHSR, the 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 site conditions, Attachment 1 to Enclosure 1 of the 50.54(f) letter requests that licensees 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 rock or base conditions as defined in the ground motion models used in the PSHA. To develop site-specific hazard curves at the control point elevation, Attachment 1 requests that licensees 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 will 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 the layers, and the degree to which the shear modulus and damping change with increasing input bedrock amplitude.

3.3.1 Site Base Case Profiles

The licensee provided detailed site profile descriptions in Sections 2.3.1 and 2.3.2 of its SHSR, based on information provided in the Vogtle, Units 1 and 2 UFSAR (SNC, 2014), the Vogtle, Units 3 and 4 (under contruction) FSAR (SNC, 2013), and the investigation carried out for the Independent Spent Fuel Storage Installation (ISFSI) (Bechtel, 2011). The licensee stated that the site is underlain by: 1) approximately 90 ft [27 m] of sands, silty sands, and clayey sands with occasional clay seams; 2) approximately 5 ft [1.5 m] of Utley Limestone; 3) 60 to 100 ft of [18 to 30 m] of Blue Bluff Marl; 4) approximately 900 ft [274 m] of dense, coarse to fine sand with interbedded silty clay and clayey silt; and 5) Triassic-Jurassic sedimentary rock of the Dunbarton Basin (Triassic basin). Underlying this sedimentary section is Paleozoic crystalline rock. The licensee stated that the upper sand stratum and the Utley Limestone were removed and replaced with 88 ft [27 m] of compacted backfill within the powerblock areas.

In Tables 2.3.1-1, 2.3.2-1, and 2.3.2-2 of the SHSR, the licensee provided a list of the subsurface materials in terms of the geologic units and layer thicknesses. Tables 2.3.1-1 and 2.3.2-2 also provide the shear-wave velocities developed using reported data for Vogtle, Units 1 and 2, the reported data for Vogtle, Units 3 and 4 during the licensing phase, data collected as part of the

recent ISFSI investigation, and recent data collected during the construction phase at Units 3 and 4. The licensee also relied on shear-wave velocity data from the nearby Savannah River Site for the shear-wave velocity profile through the Triassic Basin to the crystalline bedrock.

The licensee stated that it adopted a single base case profile for shear-wave velocity because the site is well-characterized. SHSR Table 2.3.1-1 shows the base case profile from the top of the profile to the base of the lower sand unit. Shear wave velocities in the soil layers range from 458 feet per second (fps) [140 meters per second] to 2,710 fps [826 meters per second]. The base case profile from the top of the Triassic Basin to the crystalline bedrock, where reference rock conditions are encountered, is calculated using the average of six alternative profiles developed from deep borehole shear-wave velocity measurements at the nearby Savannah River Site and is provided in SHSR Table 2.3.2-2.

The licensee stated that site-specific dynamic material properties were determined for the backfill, the Blue Bluff Marl, and the lower sand stratum during the investigations for Vogtle, Units 3 and 4. The licensee used two sets of alternative relationships for the Blue Bluff Marl to account for the presence of low and high plasticity soils. The licensee gave these alternatives equal weight in the site response analysis. For the underlying Triassic Basin and crystalline bedrock to a depth of 2,275 ft [693 m], the licensee used a strain-independent damping ratio of one percent.

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 Vogtle, a site with 1,059 ft [323 m] of soil and approximately 1,216 ft [371 m] of rock over base-rock material, the licensee used the low strain damping values for the site specific damping curves over the soil profile and assumed a damping value of one-percent for the rock layers in order to calculate kappa for the base case profile. The licensee added an additional 0.006 sec to account for the damping in the underlying base rock material. The total kappa value for the base case profile is 0.016 sec.

To account for randomness in material properties across the plant site, the licensee stated that, consistent with Appendix B of the SPID, that it randomized the base case profiles. In addition, the licensee randomized the depth to bedrock by ±375 ft [±114 m], which corresponds to 20-percent of the total profile thickness.

3.3.2 Site Response Method and Results

In Section 2.3.4 of its SHSR, the licensee stated that it developed site response input response spectra for a suite of high- and low-frequency cases corresponding to mean annual exceedance frequency levels ranging from 10^{-3} to 10^{-8}, using the methodology presented in Regulatory Guide 1.208 (NRC, 2007) and NUREG/CR-6728 (NRC, 2001). 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 twelve input hard rock motions and two alternative sets of shear modulus and damping curves for the Blue Bluff Marl.

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 Section 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 bedrock hazard curves, determined from the initial PSHA (Section 3.2), and the amplification functions 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 staff performed site response calculations for the Vogtle site. The staff independently developed a shear-wave velocity profile, damping values, and modeled the potential nonlinear behavior of the rock using measurements and geologic information provided in the Vogtle, Units 1 and 2 UFSAR (SNC, 2014) and the Vogtle, Units 3 and 4 Site Safety Analysis Report (SSAR) (SNC, 2008). Because the site is very well characterized and the velocities reported at the Vogtle, Units 1 and 2 and the Vogtle, Units 3 and 4 sites are similar, the staff used the base case profiles from the Vogtle, Units 3 and 4 SSAR (SNC, 2008). The staff based its profile on the single base case profile for the soils above the Triassic basin and the weighted mean of the six alternative base case profiles for the sedimentary rocks of the Triassic basin. To capture uncertainty in the depth to hard rock, the staff randomized the best estimate depth to base rock of 2,209 ft [673 m] by ±20 percent. Figure 3.3-1 shows the staff base case shear-wave velocity profiles compared to the base case profiles developed by the licensee. The licensee's and staff's base case shear-wave velocity profiles in the upper 1,058 ft are very similar. The observed differences in the approximate depth range of 100 to 153 ft, which corresponds to the Blue Bluff Marl, are because the licensee considered shear-wave velocity data from the ISFSI, Units 1 and 2, and Units 3 and 4 areas, while the staff used the shear-wave velocity profiles presented in the Vogtle, Units 3 and 4 SSAR. Differences in the depth to hard rock are due to different averaging methods used to calculate thicknesses and velocities of the rocks in the Triassic basin.

To characterize the dynamic material behavior of the profile above the Triassic Basin, the staff used the shear modulus reduction and damping curves for the compacted backfill, Blue Bluff Marl, and lower sands presented in the Vogtle Units 3 and 4 SSAR, which are the same curves used by the licensee and presented in Table 2.3.2-3 of the SHSR. Below a depth of 1,059 ft [323 m], the staff assumed linear behavior for the rock with a damping value of 1.25-percent.

To determine kappa for its single profile, the staff used the low strain damping values, shear wave velocities, and layer thicknesses for each layer to arrive at a value of 0.017 sec, which includes the 0.006 sec contribution from the base rock. To model uncertainty in the kappa value, the staff used a natural log standard deviation value of 0.2 to calculate lower and upper values for kappa of 0.015 and 0.02 sec, respectively.

Figure 3.3-2 shows a comparison of the staff's and licensee's median site amplification functions and uncertainties (±1 standard deviation) for two of the input loading levels. The licensee's approach to modeling the subsurface rock properties and their uncertainty results in amplification factors similar to those developed by the staff. As shown in Figure 3.3-3, these small differences in the site response analysis do not have a large impact on the control point seismic hazard

curves or the resulting GMRS, as discussed below. 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, alternative approaches in performing site response analyses, including the modeling of uncertainty, are acceptable for this application.

In summary, the staff concludes that the licensee's site response was conducted using present-day guidance and methodology, including the NRC-endorsed SPID. The 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 Vogtle site.

3.4 Ground Motion Response Spectra

In Section 2.4 of the 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 Regulatory Guide (RG) 1.208, A Performance-Based Approach to Define the Site-Specific Earthquake Ground Motion.

The staff independently calculated the 10^{-4} and 10^{-5} UHRS using the results of its confirmatory PSHA and site response analyses, as described in Sections 3.2 and 3.3 of this staff assessment, respectively. As shown in Figure 3.4-1 below, the licensee's GMRS shape is generally similar to that calculated by the staff.

The 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 staff performed both a PSHA and site response confirmatory analysis and achieved results consistent with the licensee's horizontal GMRS. As such, the staff concludes that the GMRS determined by the licensee adequately characterizes the reevaluated hazard for the Vogtle site. Therefore, this GMRS is suitable for use in subsequent evaluations and confirmations, as needed, for the 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 Vogtle site. Based on its review, the staff concludes that the licensee conducted the hazard reevaluation using present-day methodologies and regulatory guidance, it 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 a partial response to Item (4), identified in Enclosure 1 of the 50.54(f) letter. Further, the staff concludes that the site's reevaluated seismic hazard for Vogtle, Units 1 and 2 is suitable for other activities associated with the NTTF Recommendation 2.1, "Seismic."

In reaching this determination, staff confirmed the licensee's conclusion that the licensee's GMRS for the Vogtle exceeds the SSE in the 1 to 10 Hz range. As such, a plant seismic risk evaluation, a SFP evaluation and a high-frequency confirmation are merited. The licensee indicated that the high-frequency confirmation would be performed as part of its plant seismic risk evaluation. NRC review and acceptance of the Southern Nuclear Operating Company's plant ESEP interim evaluation, and seismic risk evaluation including the high frequency confirmation and SPF evaluation (i.e., Items (4), (6), (8), and (9)) for Vogtle will complete the 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 Document 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

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Figure 3.3-1 Plot of Staff's and Licensee's Base Case Shear-Wave Velocity Profiles for Vogtle Units 1 and 2

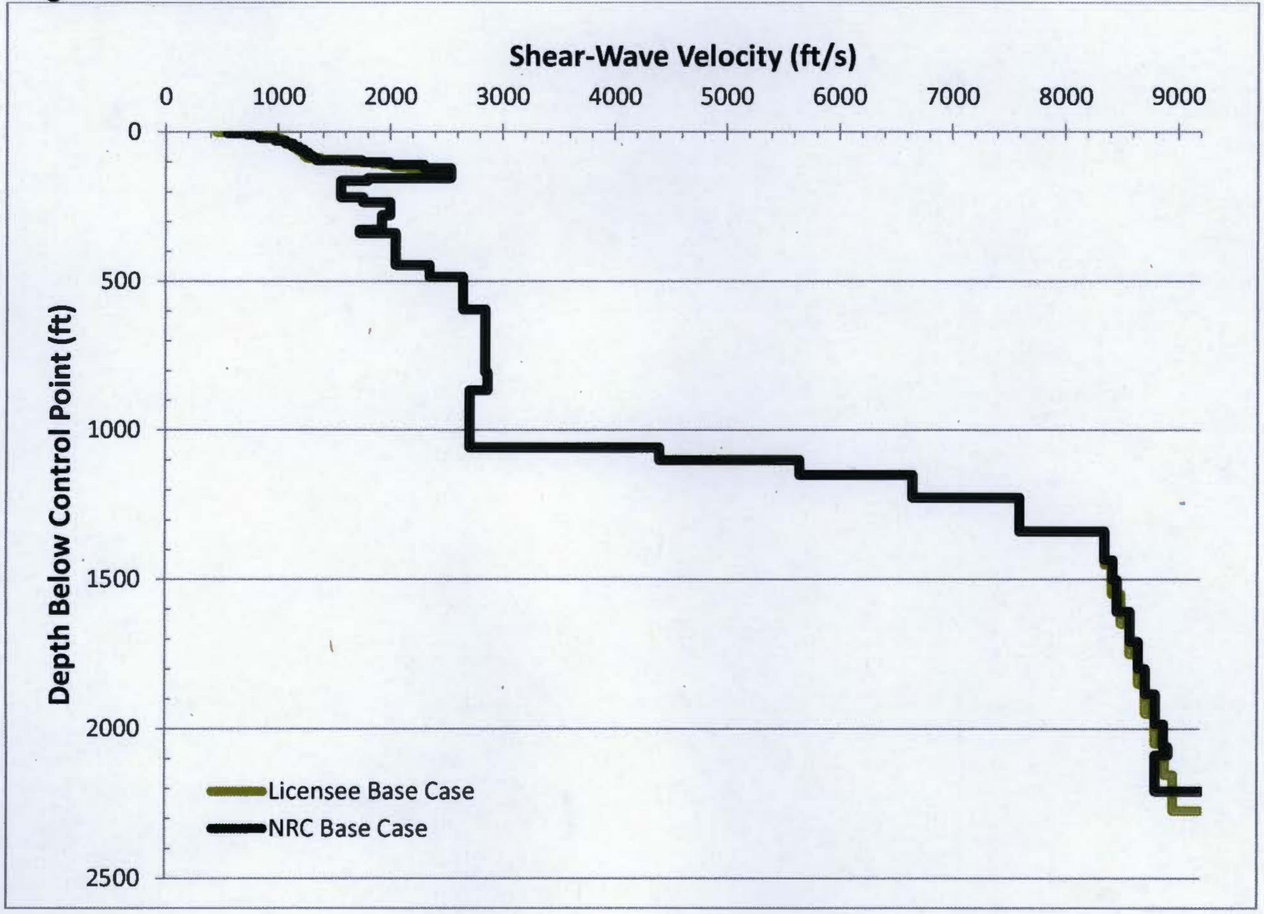


Figure 3.3-1 Plot Comparing the Staff's and the License's Median Amplification Functions and Uncertainties for two input loading levels for Vogtle Units 1 and 2

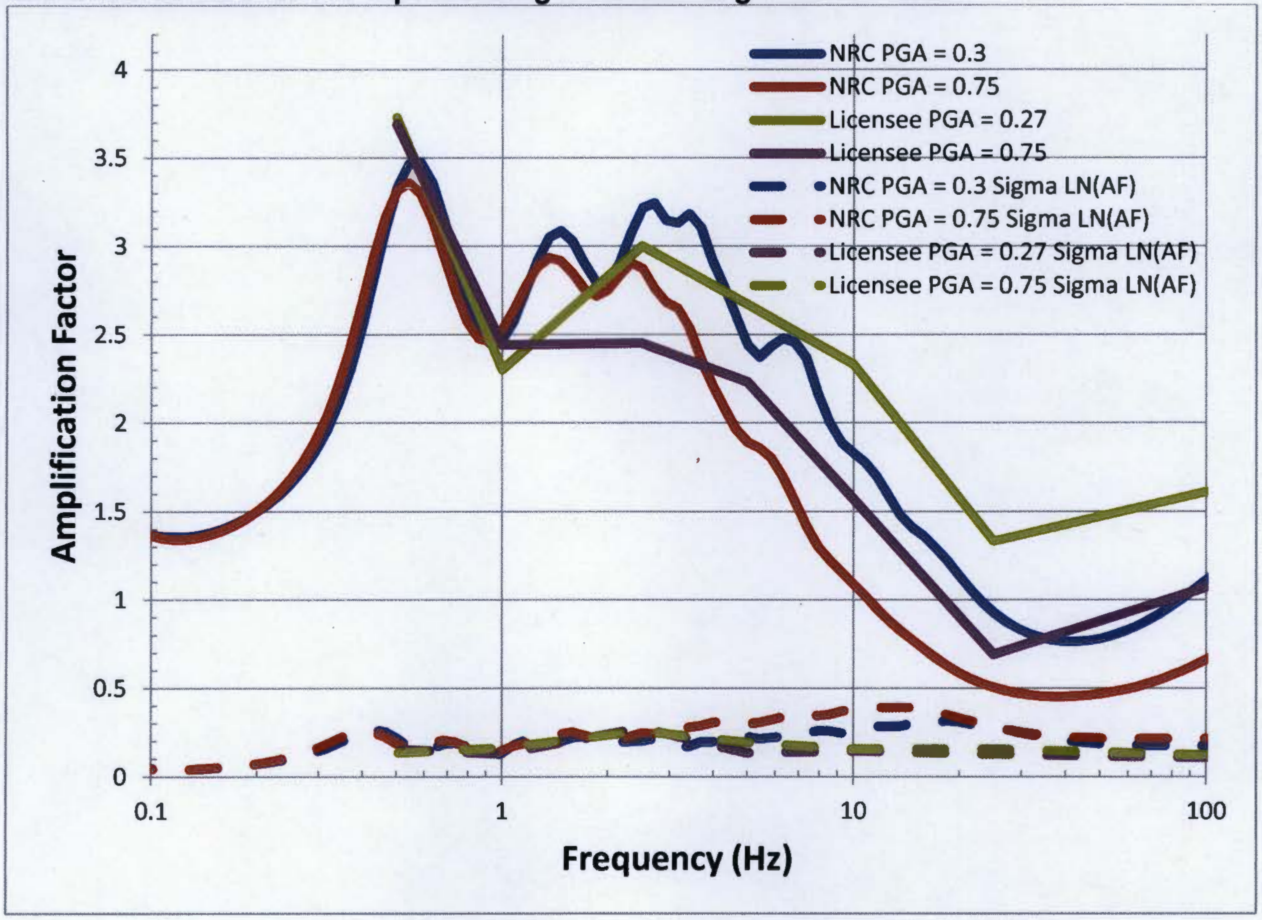


Figure 3.3-2 Plot Comparing the Staff's and the Licensee's Mean Control Point Hazard Curves at a Variety of Frequencies for Vogtle Units 1 and 2

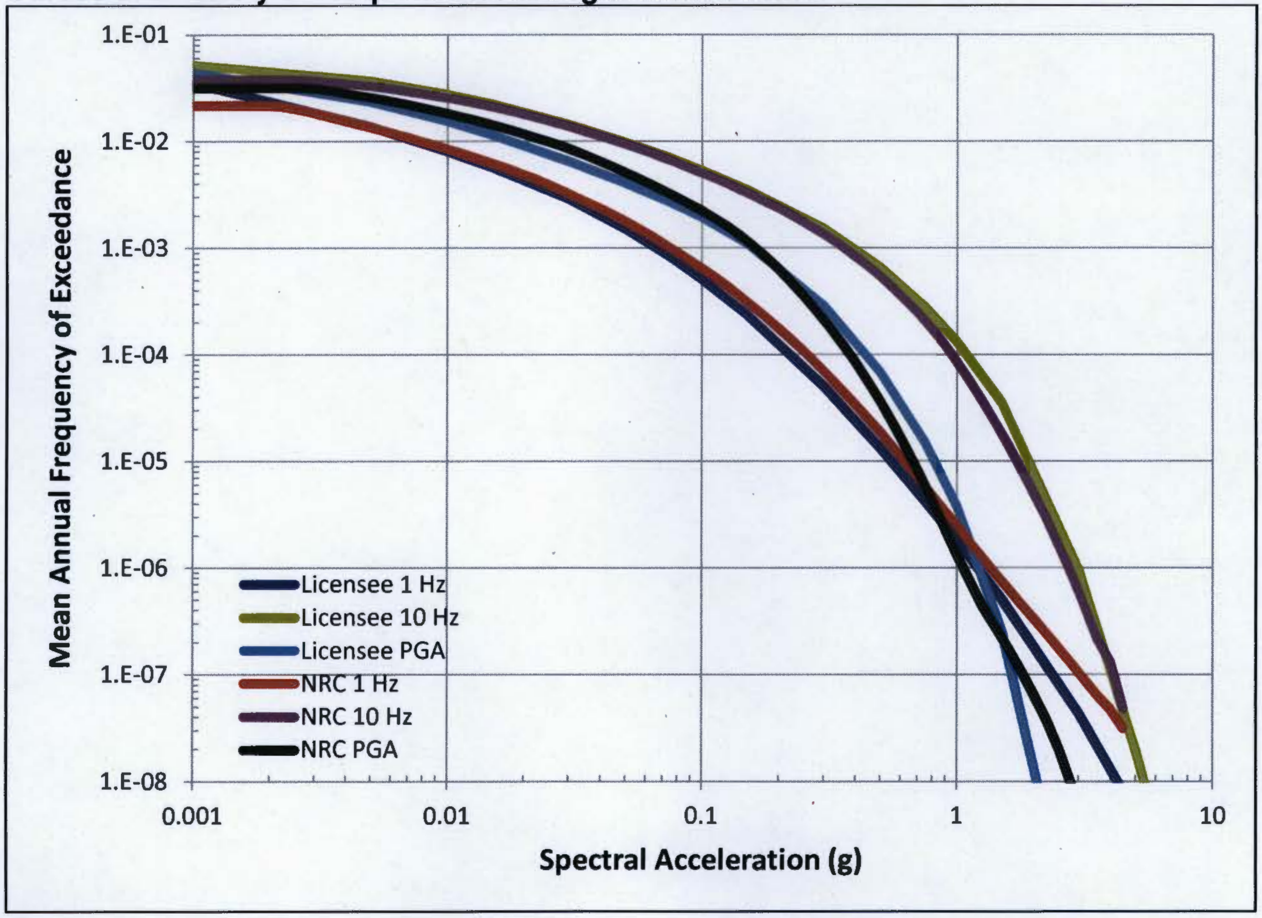
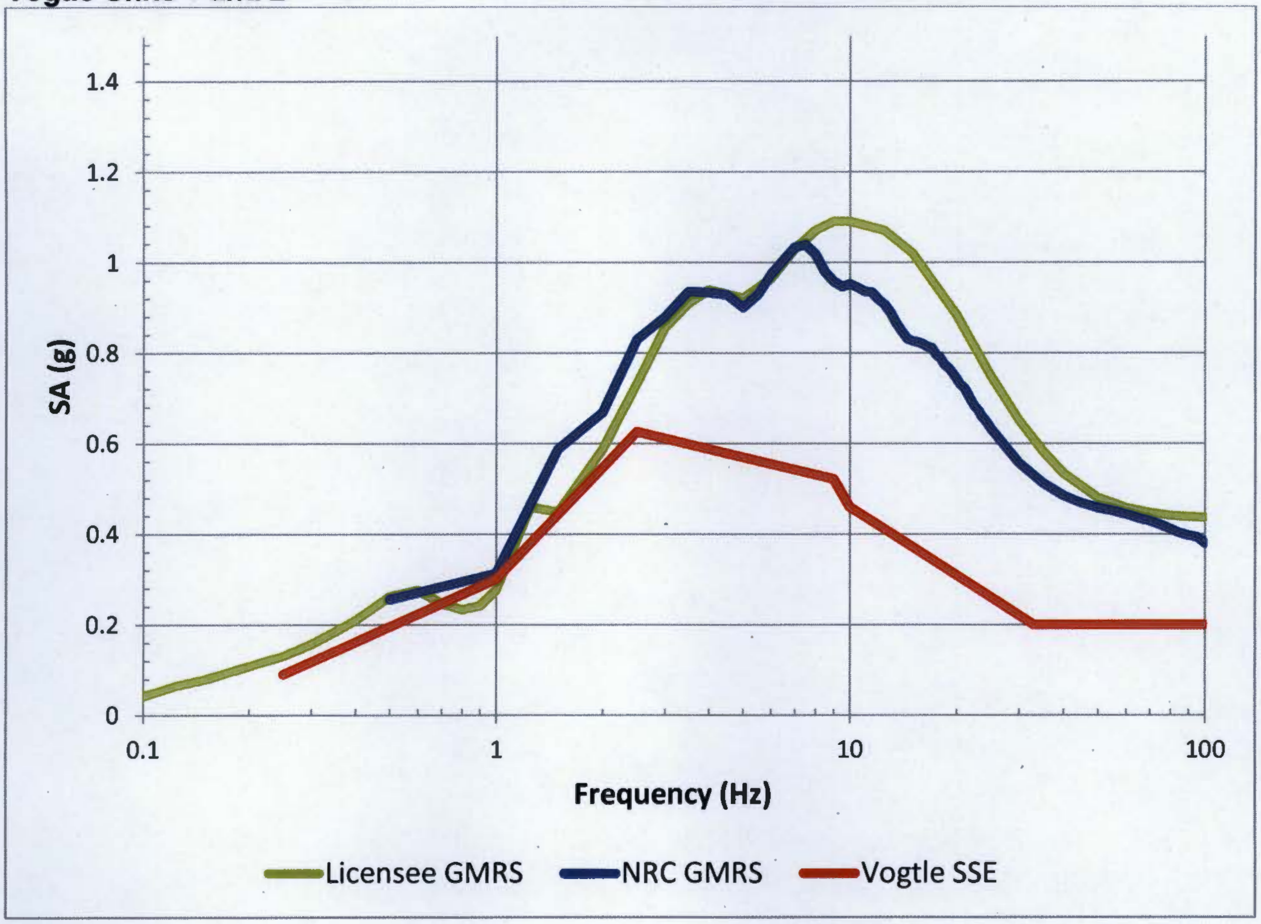


Figure 3.4-1 Comparison of the Staff's GMRS with Licensee's GMRS and the SSE for Vogtle Units 1 and 2



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

Sincerely,

/RA/

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

Docket Nos. 50-424 and 50-425

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