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

April 20, 2015

Mr. Bryan C. Hanson
President and Chief Nuclear Officer
Exelon Nuclear
4300 Winfield Road
Warrenville, IL 60555

SUBJECT: PEACH BOTTOM ATOMIC POWER STATION, UNITS 2 AND 3 - 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. MF3866 AND MF3867)

Dear Mr. Hanson:

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, Exelon Generation Company, LLC (Exelon) responded to this request for Peach Bottom Atomic Power Station, Units 2 and 3 (PBAPS).

The NRC staff has reviewed the information provided related to the reevaluated seismic hazards for PBAPS 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 the licensee's reevaluated seismic hazard for PBAPS is suitable for other activities associated with NRC Near-Term Task Force Recommendation 2.1, "Seismic."

Contingent upon the NRC's review and acceptance of Exelon'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 PBAPS, the seismic hazard evaluation identified in Enclosure 1 of the 50.54(f) letter will be complete.

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

Sincerely,

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

Docket Nos. 50-277 and 50-278

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

PEACH BOTTOM ATOMIC POWER STATION, UNITS 2 AND 3

DOCKET NOS. 50-277 AND 50-278

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,

(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

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

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 (Kaegi, 2013), Exelon Generation Company, LLC (Exelon, the licensee) submitted partial site response information for Peach Bottom Atomic Power Station, Units 2 and 3 (Peach Bottom, Units 2 and 3). By letter dated March 31, 2014 (Barstow, 2014), the licensee 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. Peach Bottom, Units 2 and 3 were licensed using the Principal Design Criteria to evaluate the design bases. The Principal Design Criteria is consistent with 10 CFR Part 100 and meets the intent of GDC 2.

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 describes 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 provides further guidance regarding the appropriate use of GMMs for the CEUS. Specifically, Section 2.3 of the SPID recommends 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 (Barstow, 2014), Exelon provided the SHSR for Peach Bottom, Units 2 and 3. The licensee's SHSR indicated that the site GMRS exceeds the SSE for both Peach Bottom, Units 2 and 3 over the frequency range of 1 to 10 (Hertz) Hz. As such, the licensee concluded that both a seismic risk and a SFP evaluation are merited. In addition, due to the GMRS exceeding the SSE for frequencies above 10 Hz, the licensee indicated that it will perform a high-frequency confirmation. The licensee stated that the high frequency confirmation will be addressed as part of the seismic risk evaluation.

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 the Peach Bottom site over the frequency range of 1 to 10 Hz. Therefore, Peach Bottom Units 2 and 3 screens in for conducting a seismic risk evaluation. A SFP evaluation is also merited. The staff also confirmed the licensee's conclusion that a high frequency confirmation for Peach Bottom, Units 2 and 3 is merited because the GMRS exceeds the SSE for frequencies above 10 Hz.

3.0 TECHNICAL EVALUATION

The NRC staff evaluated the licensee's submittals 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 licensees provide the SSE ground motion values, as well as the specification for 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 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 the SHSR, the licensee described the seismic design basis for Peach Bottom, Units 2 and 3. The licensee stated that the SSE for Peach Bottom, Units 2 and 3 is based on the magnitude 5 to 5.5, 1871 Wilmington, Delaware earthquake. Based on this earthquake, the SSE is anchored at 0.12g (12 percent of gravity) with a Housner-type response spectral shape. The same SSE is defined for both Units 2 and 3 at the Peach Bottom site.

The Peach Bottom updated final safety analysis report (UFSAR) does not specify a control point elevation. Most major safety-related structures, including the reactor buildings, are founded on "competent rock". The licensee specified that the control point is located at the top of relatively un-weathered rock at elevation 136 ft (41.5 m).

The staff reviewed the licensee's description of its SSE in the SHSR. To further confirm the updated SSE, the staff also reviewed the Peach Bottom UFSAR (Exelon, n.d.). Based on its review, the staff confirms that the licensee's SSE for both Units 2 and 3 is a Housner-type spectrum anchored at a PGA of 0.12 g. In addition, based on review of the SHSR and the UFSAR, the staff confirms that the licensee's control point elevation for the Peach Bottom SSE is consistent with the 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 magnitude 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 miles (640 km) around the site and included the Charleston, Charlevoix, 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 paleo-earthquake (geologic evidence for prehistoric seismicity) record. The licensee used the mid-continent version of the updated EPRI GMM (EPRI, 2013) for each of the CEUS-SSC sources. The licensee did not provide its base rock seismic hazard curves since a site response analysis was 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 3.3.2 of this staff assessment.

As part of its confirmatory analysis of the licensee's GMRS, the staff performed PSHA calculations for base rock site conditions at the Peach Bottom 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 CEUS-SSC background seismic sources within a 310 mile (500 km) radius of the Peach Bottom site. In addition, the staff included all of the RLME sources that are within a 620 mi (1,000 km) radius of site, which includes the Wabash Valley, Charlevoix, and Charleston RLME sources. 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). 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 model.

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 or base rock 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

As described in the licensee's SHSR, the Peach Bottom site consists of a veneer of residual soils overlying partially weathered rock grading into hard un-weathered metamorphic rocks. The basement rock is the Peters Creek schist, which is of late-Paleozoic or early Pre-Cambrian age. The licensee concluded that there is approximately 20 ft (6.1 m) of overburden before reaching base rock (assumed to have a shear-wave velocity of 9285 ft/sec (2830 m/sec)). In Table 2.3.1-1 of the SHSR, the licensee provided a brief description of the subsurface materials in terms of the geologic units and layer thicknesses.

No in-situ seismic wave velocities were obtained by the licensee in the Peters Creek schist at the Peach Bottom site. However, during the original siting investigation the licensee performed laboratory measurements to obtain compressional-wave velocities and unit weights from core samples from several boreholes at selected depths (documented in UFSAR Table 2.5.2). In Table 2.3.2-2 of the SHSR, the licensee provided shear-wave velocity estimates determined from the compressional-wave velocities listed in SHSR Table 2.3.1-1 and assumed Poisson's ratios.

To capture the uncertainty in the shear wave velocities at the Peach Bottom site for the approximately 20 ft (6.1 m) of weathered rock, the licensee developed three base case profiles. For the best estimate or base case shear-wave velocity profile, the licensee used a shear-wave velocity of 3,742 ft/s (1,141 m/s). To develop the upper and lower base case profiles, the licensee used a standard deviation of 0.35 (corresponding to a scale factor of 1.57 for the 10^{th} and 90^{th} percentile values) to estimate the lower and upper base case shear-wave velocity profiles. These estimated velocities ranged from 2,383 to 5,874 ft/sec (728 to 1,790 m/s) in the upper 20 ft (6.1 m). Figure 3.3-1 in this assessment shows the licensee's shear-wave velocity profile for each of the three base cases.

The licensee stated that no site-specific dynamic material properties were determined in the initial siting of Peach Bottom, Units 2 and 3. Therefore, the licensee stated that it followed the SPID guidance for firm rock sites and selected two alternative characterizations to represent the range in dynamic material behavior in the upper 20 ft (6.1m). The first model (M1) uses the modulus degradation and damping characteristics of the EPRI rock curves. The second model (M2) represents modulus behavior as strain-independent or linear and uses the low strain damping values of the EPRI rock curve.

The licensee also considered the impact of kappa, or small strain damping, on the 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 Peach Bottom site, the thickness of the profiles considered by the licensee are only about 20 ft (6.1 m) and the material is very stiff hard rock. As such, the kappa contribution of 0.006 sec from the base or reference rock dominates the profile low-strain damping. The upper 20 ft (6.1 m) of firm rock contributes only an additional 0.0003 sec.

To account for randomness in material properties across the plant site in its site response calculations, the licensee stated that it randomized each of the three base case shear-wave velocity profiles. The licensee described the development of its random velocity profiles in Section 2.3.3 of its SHSR and stated that its approach is consistent with Appendix B of the SPID.

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 base case profile and EPRI rock shear modulus and damping curves.

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, as 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 Peach Bottom site. Consistent with the implied assumption of the licensee, the NRC staff assumed a single control point elevation (elev. 136ft MSL) was appropriate for both Units 2 and 3 at the Peach Bottom site. The staff independently developed a shear-wave velocity profile, damping values, and modeled the potential nonlinear behavior of the weathered and un-weathered rock using geologic information provided in the Peach Bottom UFSAR (Exelon, 2011), the General Atomic Company Site Parameter Study (Leeds, 1974), EPRI Updated GMM (EPRI, 2013), Appendix B of the SPID and other references. For its site response calculations, the staff employed the RVT approach and developed input ground motions in accordance with Appendix B of the SPID.

As discussed above, no in-situ seismic wave velocities are available in the Peters Creek schist at the Peach Bottom site. Laboratory measurements of compressional-wave velocities and unit weights were obtained from core samples (using shock-scope tests) from several boreholes at selected depths (documented in UFSAR Table 2.5.2). The staff independently developed shear-wave velocity profiles based on an analysis of the available data and augmented by additional reference material. The staff concluded that the average of the measured near-surface compressional-wave velocities in the moderately weathered schist is approximately 7000 ft/sec (2134 m/s). Based on Poisson's ratio values appropriate for schist at near-surface conditions (Bourbie, et al. (1987), Sheriff and Geldart (1995)), the staff concluded a shear-wave velocity of 3620 ft/sec is appropriate for the base case profile at the control point elevation. This value is similar to that cited in the General Atomics study and the value used by the licensee of 3742 ft/s (1141 m/s). To develop upper and lower base case profiles, the staff used the observed range of compressional wave velocities and an appropriate range of Poisson's ratio for these materials (0.28 to 0.34). The lower and upper profiles used in the NRC staff assessment have shear wave velocities of 2901 ft/sec (lower base case) and 8185 ft/sec (upper base case), respectively. Rather than using a single shear wave velocity value and a thickness of 20 ft (6.1 m) for the depth to reference or base rock, the staff's base case profiles used the velocity templates described in Appendix B of the SPID to more realistically model the subsurface of the Peach Bottom site. Figure 3.3-1, in this assessment, compares the staff's base case profiles to those developed by the licensee.

Similar to the approach used by the licensee, the staff assumed the variability in shear modulus degradation with strain could be modeled by applying both the EPRI rock curves and linear dynamic properties to the 20 ft (6.1 m) of weathered rock. However, rather than using the licensee's damping value of about 3 percent for its linear model, the staff used a constant damping value of 1-percent.

Figure 3.3-2 compares the staff's and licensee's median site amplification functions and uncertainties for two of the eleven input loading levels. The results are very similar with a modest site amplification of about 1.2 to 1.4 at about 30 Hz. As shown in Figure 3.3-4, the minor differences in the site response analyses between the licensee and staff have a minimal impact on the resulting 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, 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 Peach Bottom 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 RG 1.208.

The staff independently obtained the 10^{-4} and 10^{-5} UHRS using the results of its confirmatory PSHA and site response calculations described in Sections 3.2 and 3.3 of this staff assessment, respectively. As shown in Figure 3.4-1 of this assessment, the licensee's GMRS shape is very similar to that calculated by the staff. As described above in Section 3.3, the staff concludes that these minor differences over the higher frequency range are primarily due to the differences in assumptions made in the site response analyses performed by the licensee and staff. The staff concludes that these differences are acceptable because the licensee followed the guidance provided in the SPID with respect to both the PSHA and site response analysis for the Peach Bottom site.

The staff confirms that the licensee used present-day guidance and methodology, as 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 Peach Bottom site. Therefore, the control point hazard curves (and GMRS) are 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 Peach Bottom 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 licensee's reevaluated seismic hazard is acceptable to address other actions associated with NTTF Recommendation 2.1, "Seismic."

In reaching this determination, the staff confirmed the licensee's conclusion that the licensee's GMRS for the Peach Bottom site exceeds the SSE above approximately 4 Hz to the 100 Hz range. As such, Peach Bottom, Units 2 and 3 screens in for a seismic risk evaluation, SFP evaluation, and high frequency confirmation, which the licensee indicated would be performed as part of its seismic risk evaluation. NRC review and acceptance of Exelon's ESEP interim evaluation and seismic risk evaluation with the high frequency and SFP evaluation (i.e., Items (4), (6), (8), and (9)) for Peach Bottom, Units 2 and 3 will complete the items requested 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

NRC (U.S. Nuclear Regulatory Commission), 2007, "A Performance-Based Approach to Define the Site-Specific Earthquake Ground Motion." 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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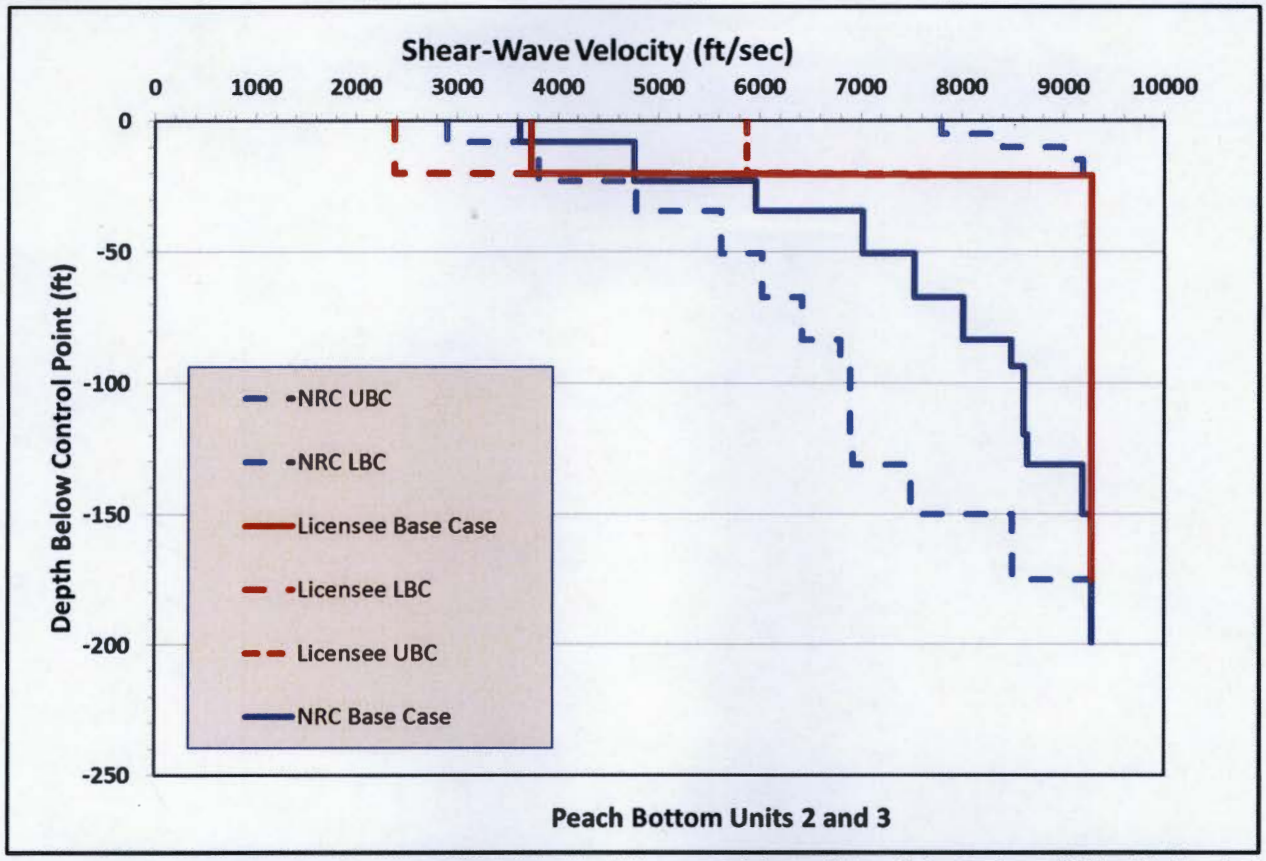

Figure 3.3-1 Plot of Staff's and Licensee's Base Case Shear-Wave Velocity Profiles

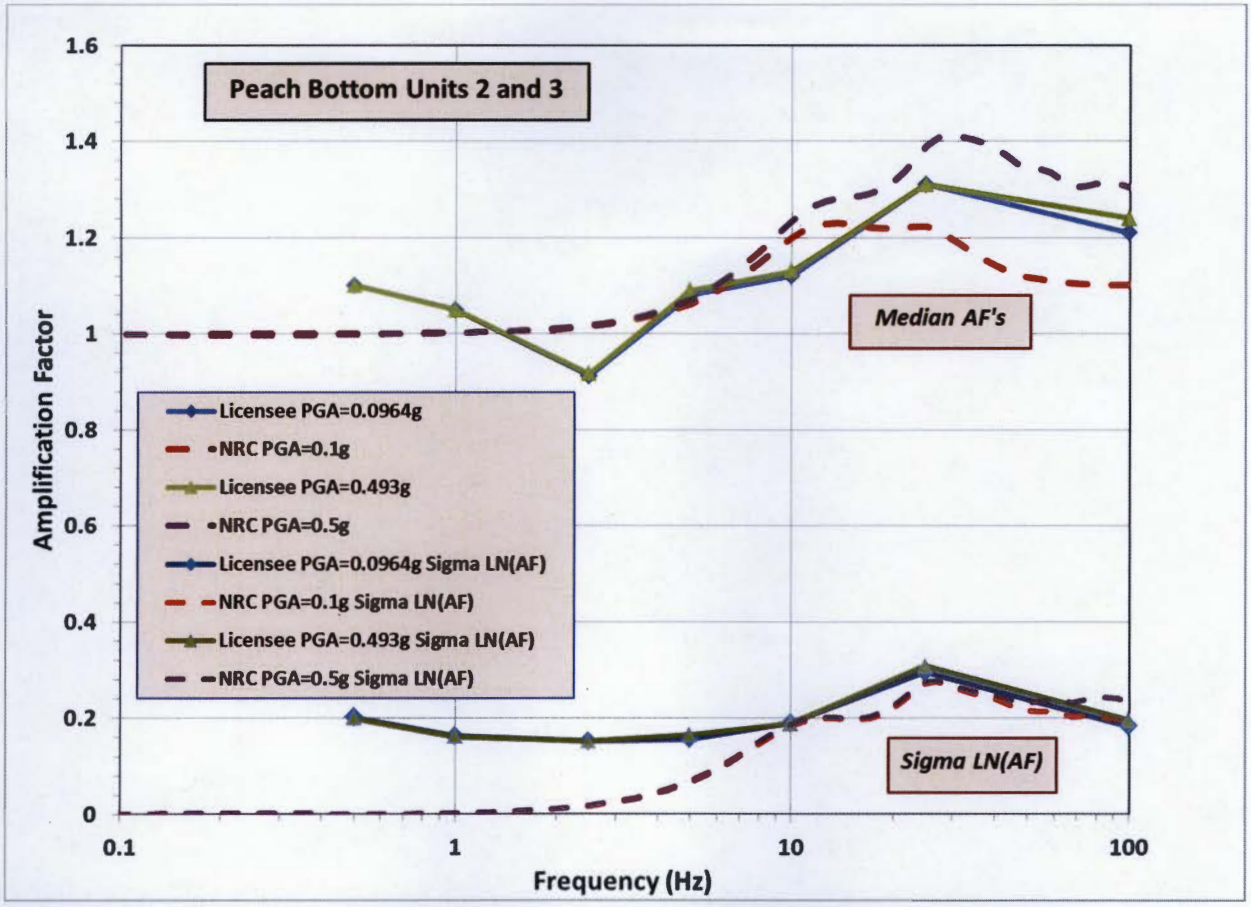

Figure 3.3-2 Comparison of the Licensee's and NRC Staff's Median Amplification Functions and Uncertainties (Sigma Ln(AF)).

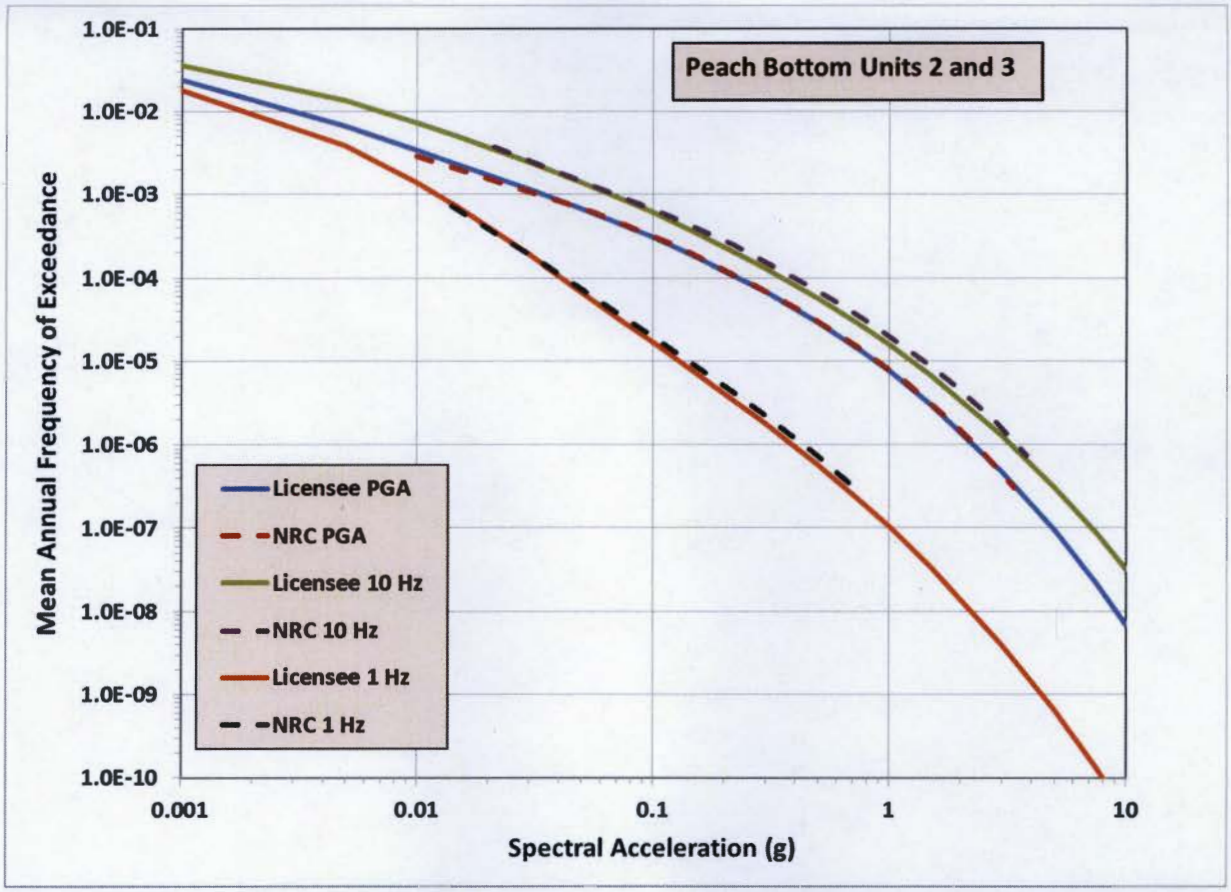

Figure 3.3-3 Comparison of NRC Staff's and the Licensee's Mean Control Point Hazard Curves at a Variety of Frequencies

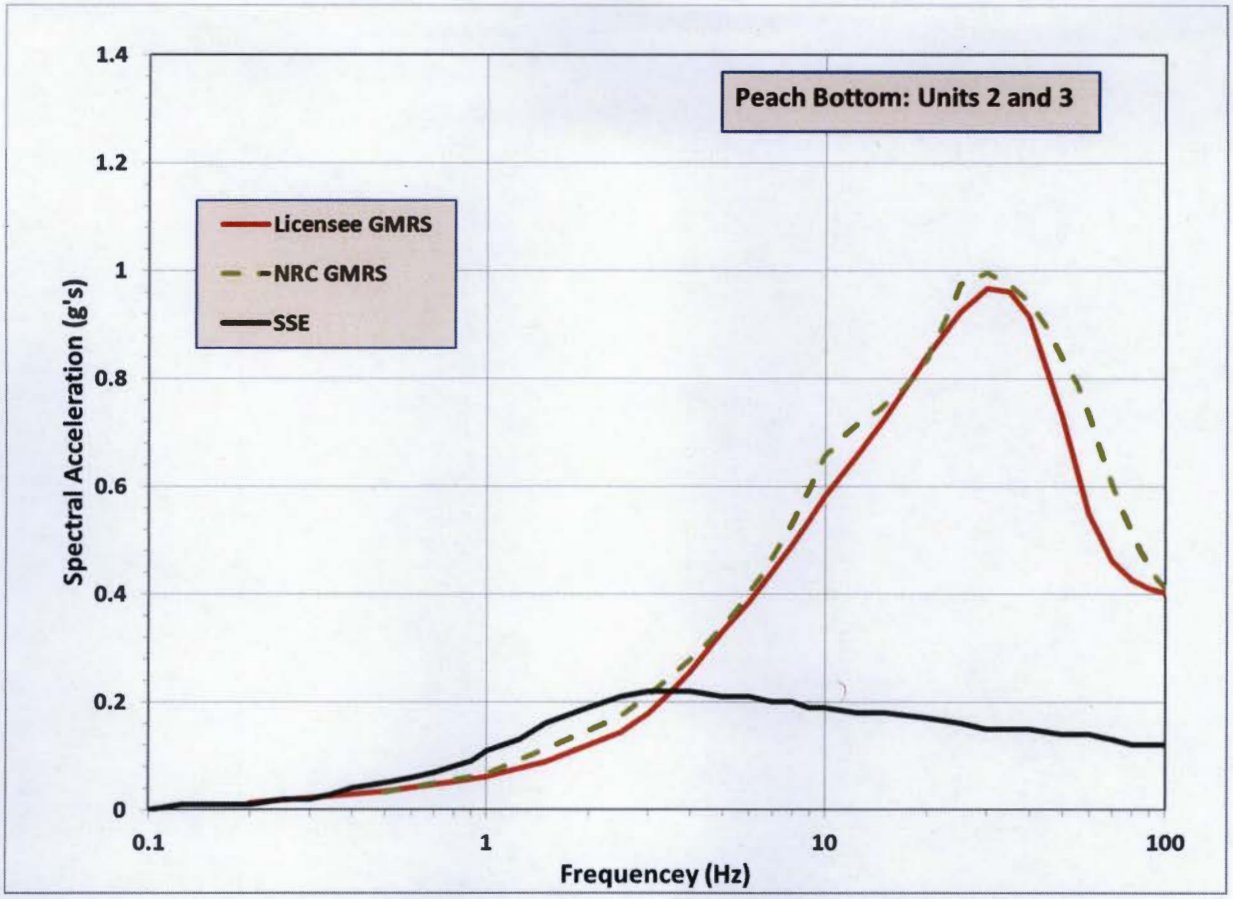

Figure 3.4-1 Comparison of the Staff's GMRS with Licensee's GMRS and the Peach Bottom Units 2 and 3 SSE.

If you have any questions, please contact me at (301) 415-6197 or via e-mail 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. 50-277 and 50-278

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