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

August 3, 2015

Mr. Ernest J. Harkness
Site Vice President
FirstEnergy Nuclear Operating Company
PO Box 97, A290
Perry, OH 44081

SUBJECT: PERRY NUCLEAR POWER PLANT, UNIT 1 - STAFF ASSESSMENT OF INFORMATION PROVIDED PURSUANT TO TITLE 10 OF THE *CODE OF FEDERAL REGULATIONS* PART 50, SECTION 50.54(f), SEISMIC HAZARD REEVALUATIONS FOR RECOMMENDATION 2.1 OF THE NEAR-TERM TASK FORCE REVIEW OF INSIGHTS FROM THE FUKUSHIMA DAI-ICHI ACCIDENT (TAC NO. MF3729)

Dear Mr. Harkness:

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 31, 2014, FirstEnergy Nuclear Operting Company (FENOC, the licensee) responded to this request for Perry Nuclear Power Plant, Unit 1 (Perry).

The NRC staff has reviewed the information provided related to the reevaluated seismic hazard for Perry and, as documented in the enclosed staff assessment, determined that the licensee provided sufficient information in response to Enclosure 1, Items (1) through (3), (5), (7) and 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".

Contigent upon the NRC's review and acceptance of FENOC'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 Perry, 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) 415-6197 or at Tekia.Govan@nrc.gov.

Sincerely,

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

Docket No. 50-440

Enclosure:
Staff Assessment of Seismic
Hazard Evaluation and Screening Report

cc w/encl: Distribution via Listserv

STAFF ASSESSMENT BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO SEISMIC HAZARD AND SCREENING REPORT

PERRY NUCLEAR POWER PLANT, UNIT 1

DOCKET NO. 50-440

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. High-frequency evaluation, if necessary.

---

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

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

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

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

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

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

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

By letter dated November 27, 2012 (Keithline, 2012), the Nuclear Energy Institute (NEI) submitted Electric Power Research Institute (EPRI) report “Seismic Evaluation Guidance: Screening, Prioritization, and Implementation Details (SPID) for the Resolution of Fukushima Near-Term Task Force Recommendation 2.1 Seismic" (EPRI, 2012), hereafter called the SPID. The SPID supplements the 50.54(f) letter with guidance necessary to perform seismic reevaluations and report the results to NRC in a manner that will address the Requested Information Items in Enclosure 1 of the 50.54(f) letter. By letter dated February 15, 2013 (NRC, 2013b), the NRC 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 (Pietrangelo, 2013), letter provides a revised schedule for plants needing to perform (1) the Augmented Approach by implementing the Expedited Seismic Evaluation Process (ESEP) and (2) a seismic risk evaluation. By letter dated May 7, 2013 (NRC, 2013a), the NRC determined that the modified schedule was acceptable and by letter dated August 28, 2013 (NRC, 2013c), the NRC determined that the updated GMM (EPRI, 2013) is an acceptable GMM for use by CEUS plants in developing a plant-specific GMRS.

By letter dated April 9, 2013 (Pietrangelo, 2013), industry committed to follow the SPID to develop the SHSR for existing nuclear power plants. By letter dated September 11, 2013 (Belcher, 2013), FirstEnergy Nuclear Operating Company (FENOC, the licensee) submitted at least partial site response information for the Perry Nuclear Power Plant, Unit 1 (Perry, PNPP). By letter dated March 31, 2014 (Sena, 2014), FENOC submitted its SHSR for Perry.

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 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) ground motion models. 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 (Dent, 2014), FENOC provided its SHSR for Perry, Unit 1. The licensee's SHSR indicates that the site GMRS exceeds the SSE for PNPP over the frequency range of 1 to 10 Hertz (Hz). As such, PNPP screens-in to perform a seismic risk evaluation. The GMRS also exceeds the SSE at frequencies above 10 Hz and thus warrants a high-frequency evaluation. The licensee indicated that its plant risk evaluation would address the high frequency exceedance.

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 confirmatory GMRS, developed by the NRC staff, exceed the SSE for PNPP over the frequency range of approximately 7 to 100 Hz. Therefore, a seismic risk evaluation, SFP evaluation, and a high-frequency evaluation are merited for PNPP, Unit 1.

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 earthquake and is characterized by 1) a peak ground acceleration (PGA) value which anchors the response spectra at high frequencies (typically between 20 to 30 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 its SHSR, the licensee described its seismic design bases for PNPP. The licensee stated that the SSE for PNPP was developed in accordance with 10 CFR Part 100, Appendix A. Based on the historic seismicity of the region, the maximum postulated earthquake was determined to have an intensity of VII on the Modified Mercalli Intensity (MMI) Scale and a corresponding PGA in the range of 0.07 to 0.13 g. Therefore the licensee selected a PGA anchor value of 0.15g and assumed a RG 1.60 spectral shape for the PNPP SSE.

The licensee specified that the SSE control point is located at the base of the Reactor Building foundation at an elevation of 561 ft. [171 m] based on the information provided in the Updated

Final Safety Analysis Report (UFSAR). This selection of the SSE control point elevation is consistent with the guidance provided in Section 2.4.2 of 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). For its PSHA, the licensee used a minimum moment magnitude (M_w) of 5.0 as specified in the 50.54(f) letter. The licensee further stated that it included CEUS-SSC background sources out to a distance of 400 miles [640 km] and included the Charlevoix, Charleston, New Madrid Fault System, Commerce Fault and Wabash Valley repeated large magnitude earthquake (RLME) sources which lie within 620 miles [1,000 km] of the site. The RLME sources are those source areas or faults for which more than one large magnitude ($M_w \geq$ 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 provided base rock seismic hazard curves in SHSR Section 2.2.2. The NRC staff's review of the licensee's control point seismic hazard curves is provided in Section 3.3 of this staff assessment.

As part of its confirmatory analysis of the licensee's GMRS, the NRC staff performed PSHA calculations for base rock conditions at the PNPP 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 PNPP site. In addition, the NRC staff included all of the RLME sources falling within a 620 mi [1000 km] radius of the site, which includes the Charlevoix, Charleston, New Madrid Fault System, Commerce Fault and Wabash Valley RLME sources. For each of the CEUS-SSC sources used in the PSHA, the NRC staff used the mid-continent version of the updated EPRI GMM (EPRI, 2013). The NRC staff used the resulting base rock seismic hazard curves together with a confirmatory site response analysis, described in the next section, to develop control point seismic hazard curves and a GMRS for comparison with the licensee's results.

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

3.3 Site Response Evaluation

After completing PSHA calculations for reference rock site conditions, Attachment 1 to Enclosure 1 of the 50.54(f) letter requests that the licensee provide a GMRS developed from the site-specific seismic hazard curves at the control point elevation. In addition, the 50.54(f) letter specifies that the subsurface site response model, for both soil and rock sites, should extend to sufficient depth to reach the generic or reference rock conditions as defined in the GMMs used in the PSHA. To develop site-specific hazard curves at the control point elevation, Attachment 1 requests that 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 PNPP UFSAR (, FENOC, 2011) from geotechnical investigations at the site. The licensee stated that the Perry site is underlain by approximately 60 ft [18 m] of lacustrine deposits and glacial till underlain by about 1,035 ft. [315 m] of shale atop 2,250 ft [686 m] of sedimentary rocks overlying the Precambrian granite basement rock at approximate El. 5,300 ft [1,615 m].

Geophysical investigations for PNPP consisted of refraction surveys, cross-hole shear wave velocity measurements and down-hole measurements. These measurements, as well as nearby well log data, were the basis for shear wave velocities used by the licensee for its site response analyses. The licensee provided a brief description of the subsurface materials in terms of geologic units and thickness in its SHSR. Seismic velocities associated with subsurface materials by the licensee are 827 to 1,785 ft/s [252 to 544 m/s] for the lacustrine deposits and glacial till, 4,772- 6,187 ft/s [1,455-1,886 m/s] for the shale, and 6,187-10,540 ft/s [1,886 to 3,213 m/s] for the sedimentary rocks.

To characterize the subsurface geology, the licensee developed three site base case profiles (P1, P2, P3). The middle, or best estimate, profile was developed using measured shear-wave velocity from the site refraction surveys and cross-hole geophysical investigations. Upper and lower base case profiles were developed using a scale factor of 1.15. Consistent with the SPID, the licensee constrained the upper range base-case profile to not exceed a shear wave velocity of 9,200 ft/s [2,804 m/s]. Figure 3.3-1 of this assessment shows the licensee’s three shear-wave velocity base case profiles.

In Section 2.3.2.2 of its SHSR, the licensee followed the SPID guidance for firm rock sites and selected two alternative characterizations of dynamic material behavior with equal weights. For the first characterization, the licensee assumed a non-linear response over the upper 500 ft. [152 m] of the profile and used the EPRI rock shear modulus and damping curves. For the second alternative, the license assumed a linear response over the upper 500 ft. [152 m] with a low-strain EPRI rock damping of about 3 percent. From 500 ft. [152 m] to the reference rock the licensee assumed linear behavior and used a damping value of 1.25 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 the PNPP site, the licensee used the guidance in the SPID for a firm rock site with less than 3,000 ft [1,000 m] of firm rock in thickness to estimate kappa values of 0.016, 0.021, and 0.015 sec for the best case, lower, and upper profiles, respectively. Because the kappa values for the lower and upper profiles are similar to the best case estimate, the licensee increased the kappa value for the lower profile by 50 percent and decreased the kappa value for the upper profile by 50 percent. As such, the kappa values for the lower profile are 0.021 sec and 0.031 sec with weights of 0.6 and 0.4. Similarly, the kappa values for the upper profiles are 0.015 sec and 0.010 sec with weights of 0.6 and 0.4.

Finally, to account for randomness in material properties across the plant site, the licensee stated that it randomized its base case shear-wave velocity profiles using a natural log standard deviation of 0.25 over the upper 50 ft. [15 m] and 0.15 below a depth of 50 ft. [15 m].

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 two of the many cases analyzed. Amplification functions are shown for multiple input loading levels for the base case profile with EPRI rock curves as well as the base case profile assuming a linear response.

In order to develop probabilistic site-specific control point hazard curves, as requested in Requested Information Item 1 of the 50.54(f) letter, the licensee used Method 3, described in Appendix B-6.0 of the SPID. The licensee’s use of Method 3 involved computing the site-specific control point elevation hazard curves for a broad range of spectral accelerations by combining the site-specific bedrock hazard curves, determined from the initial PSHA 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 NRC staff performed site response calculations for the PNPP site. The NRC staff independently developed shear-wave velocity profiles, damping values, and modeled the potential nonlinear behavior of the rock using the measurements and geologic information provided mainly by the deep well log data in the vicinity of the PNPP site, and the guidance in Appendix B of the SPID. 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.

The NRC staff developed three velocity profiles based primarily on comparison of the on-site data with the data from a well about 3.6 mi [5.7km] from the PNPP site (Ohio Department of Natural Resources, Division of Oil and Gas). The measured shear-wave velocity of well logs indicated a range of 5,733 ft/s [1,747 m/s] to 9481 ft/s [2,890 m/s] to a depth of 6,060 ft. [1,847 m] below the control point. The NRC staff developed the lower and upper base-case velocity profiles using the estimated natural-log standard deviations of 0.175 to a depth of 1864 ft. [568 m], 0.21 between 1,864 to 3,078 ft [568-938 m], and 0.09 between 3,078 and 6,060 ft. [938-1847 m]. Figure 3.3-1 of this assessment shows a comparison between the NRC staff and the licensee base-case profiles. Although at first glance there seem to be significant differences between the licensee and NRC staff velocity profiles, on average they are similar. The licensee's velocities are generally lower than those of the NRC in the top 1,200 ft. [366 m], but higher at lower depths. The crystalline basement is placed at 6,060 ft. [1,847 m/s] below the control point.

Similar to the approach used by the licensee, the NRC staff used the SPID guidance to characterize the dynamic material behavior of the site response profile. In the upper 500 ft. [152 m], the NRC staff used two alternative characterizations of nonlinear dynamic material behavior, EPRI rock curves and linear behavior for the Dedham granodiorite. The damping for the linear behavior was set equal to the small strain damping value of about 3 percent. Below 500 ft. [152 m], staff assumed a linear response with a damping value of 1.25 percent.

To determine kappa, the NRC staff used guidance provided in the SPID for sites with at least 3,000 ft. [1,000 m] of firm sedimentary rock to estimate kappa. The NRC total kappa values for the best estimate, lower, and upper base case velocity profiles are 0.013, 0.017, and 0.010 sec, respectively. Similar to the licensee's approach the NRC staff added additional uncertainty to the lower and upper kappa estimates (0.022 and 0.008 sec, respectively).

To account for aleatory variability in material properties across the plant site in site response calculations, the NRC staff randomized its base case shear-wave velocity profiles following the SPID guidance provided in Appendix B of the SPID. Similar to the licensee, the NRC staff did not randomize the depth to bedrock.

Figure 3.3-2 of this assessment shows a comparison of the NRC staff and the licensee median site amplification functions and uncertainties for 2 of the 11 input loading levels. As shown in this figure, the licensee's amplification functions are very similar to those of the NRC between 2 to 100 Hz, but slightly higher between 0.5 to 2 Hz. Overall, the licensee's approach to modeling the subsurface rock properties and the associated uncertainties result in similar site amplification factors with slight differences. Figure 3.3-3 of this assessment shows a comparison of the licensee and NRC control point hazard curves, which are also very similar.

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 PNPP site.

3.4 Ground Motion Response Spectra

In Section 2.5 of its SHSR, the licensee stated that it used the control point hazard curves, described in SHSR Section 2.4, 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 analyses, as described in Sections 3.2 and 3.3 of this staff assessment, respectively. Figure 3.4-1 of this assessment shows a comparison of the GMRS determined by the licensee to that determined by the NRC staff. As shown in Figure 3.4-1, the licensee's and NRC staff's GMRS shapes are generally similar. The licensee's GMRS is somewhat lower than the NRC staff's confirmatory analysis at frequencies between 20 and 100 Hz. As described above, in Section 3.3, the NRC staff concludes that these differences over this frequency range are primarily due to the differences in the site response analyses performed by the licensee and staff. The NRC staff concludes that these differences are acceptable for this application because the licensee followed the guidance provided in the SPID with respect to both the PSHA and site response analysis for the PNPP site.

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 PNPP 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 Perry site. Based on its review, the NRC 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) through (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 the licensee's GMRS for the PNPP site exceeds the SSE in the 1 to 10 Hz range, and also above 10 Hz range. As such, a seismic risk evaluation, SFP evaluation, and high frequency confirmation are merited. The licensee indicated that it would perform the high frequency confirmation as part of its seismic risk evaluation. The NRC review and acceptance of the FENOC's seismic risk evaluation with the high frequency confirmation, and also an interim ESEP evaluation and SFP evaluation (i.e., Items (4), (6), (8), and (9)) for PNPP 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.

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.

NRC (U.S. Nuclear Regulatory Commission), 2012b, "Central and Eastern United States Seismic Source Characterization for Nuclear Facilities", NUREG-2115, ADAMS stores the NUREG as multiple ADAMS documents, which are accessed through the web page http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr2115/.

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.

NRC (U.S. Nuclear Regulatory Commission), 2013b, letter from David L. Skeen, Director, Japan Lessons-Learned Directorate, to Joseph E. Pollock, Executive Director, Nuclear Energy Institute, Endorsement of Electric Power Research Institute Draft Report 1025287, "Seismic Evaluation Guidance," February 15, 2013, ADAMS Accession No. ML12319A074.

NRC (U.S. Nuclear Regulatory Commission) 2013c. Letter from D. L. Skeen (NRC) to K. A. Keithline (NEI), Approval of Electric Power Research Institute Ground Motion Model Review Project Final Report for Use by Central and Eastern United States Nuclear Power Plants, August 28, 2013 ADAMS Accession No. ML13233A102.

NRC (U.S. Nuclear Regulatory Commission) 2014. Letter from Eric J. Leeds, Director, Office of Nuclear Reactor Regulation to All Power Reactor Licensees and holders of Construction Permits in Active or Deferred Status, Seismic Screening and Prioritization Results Regarding Information Pursuant to Title 10 of the Code of Federal Regulations 50.54(f) Regarding Seismic Hazard Reevaluations for Recommendations 2.1 of the Near-Term Task Force Review of Insights, May 9, 2014, ADAMS Accession No. ML14111A147.

Other References

Belcher, S., 2013, Letter from S. Belcher (FENOC) to NRC, Response to NRC Request for Information Pursuant to 10 CFR 50.54(f) Regarding the Seismic Aspects of Recommendation 2.1 of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident – 1.5 Year Response for CEUS Sites, September 11, 2013, ADAMS Accession No. ML13254A312.

Electric Power Research Institute (EPRI), 2004. EPRI Report 1009684, "CEUS Ground Motion Project Final Report." Palo Alto, CA, 2004.

Electric Power Research Institute (EPRI), 2006. EPRI Report 1014381, "Truncation of the Lognormal Distribution and Value of the Standard Deviation for Ground Motion Models in the Central and Eastern United States." Palo Alto, CA, 2006.

Electric Power Research Institute (EPRI), 2012. EPRI Report 1025287 "Seismic Evaluation Guidance, Screening, Prioritization and Implementation Details [SPID] for the Resolution of Fukushima Near-Term Task Force Recommendation 2.1: Seismic" November 27, 2012, ADAMS Accession No. ML12333A170.

Electric Power Research Institute (EPRI), 2013. EPRI Ground Motion Model Review Final Report, June 3, 2013, ADAMS Accession No. ML13155A553.

FENOC, 2011, "Updated Final Safety Analysis Report (UFSAR)," Revision 17, FirstEnergy Nuclear Operating Company.

Keithline, 2012, Letter from Kimberly Keithline, Senior Project Manager, NEI, to David L. Skeen, Director, Japan Lessons Learned Project Directorate, NRC, Final Draft of Industry Seismic Evaluation Guidance (EPRI 1025287), November 27, 2012, ADAMS Accession No. ML12333A168.

Ohio Department of Natural Resources, Division of Oil and Gas website: https://gis.ohiodnr.gov/Website/DOG/WellSummaryCard.asp?api=34085201420000

Pietrangelo, 2013. Letter from A. R. Pietrangelo (NEI) to D. L. Skeen (NRC), Proposed Path Forward for NTTF Recommendation 2.1: Seismic Reevaluations, April 9, 2013, ADAMS Accession No. ML13101A379.

Sena, P., 2014, Letter from Peter Sena (FirstEnergy Nuclear Operating Company) to NRC, Seismic Hazard and Screening Report (CEUS Sites), Response to NRC Request for Information Pursuant to 10 CFR 50.54(f) Regarding Recommendation 2.1 of the Near-Term Task Force (NTTF) Review of Insights from the Fukushima Dai-ichi Accident, March 31, 2014, ADAMS Package Accession No. ML14090A143.

Figure 3.3-1: Plot of Staff's and Licensee's Base Case Shear-Wave Velocity Profiles for the Perry site

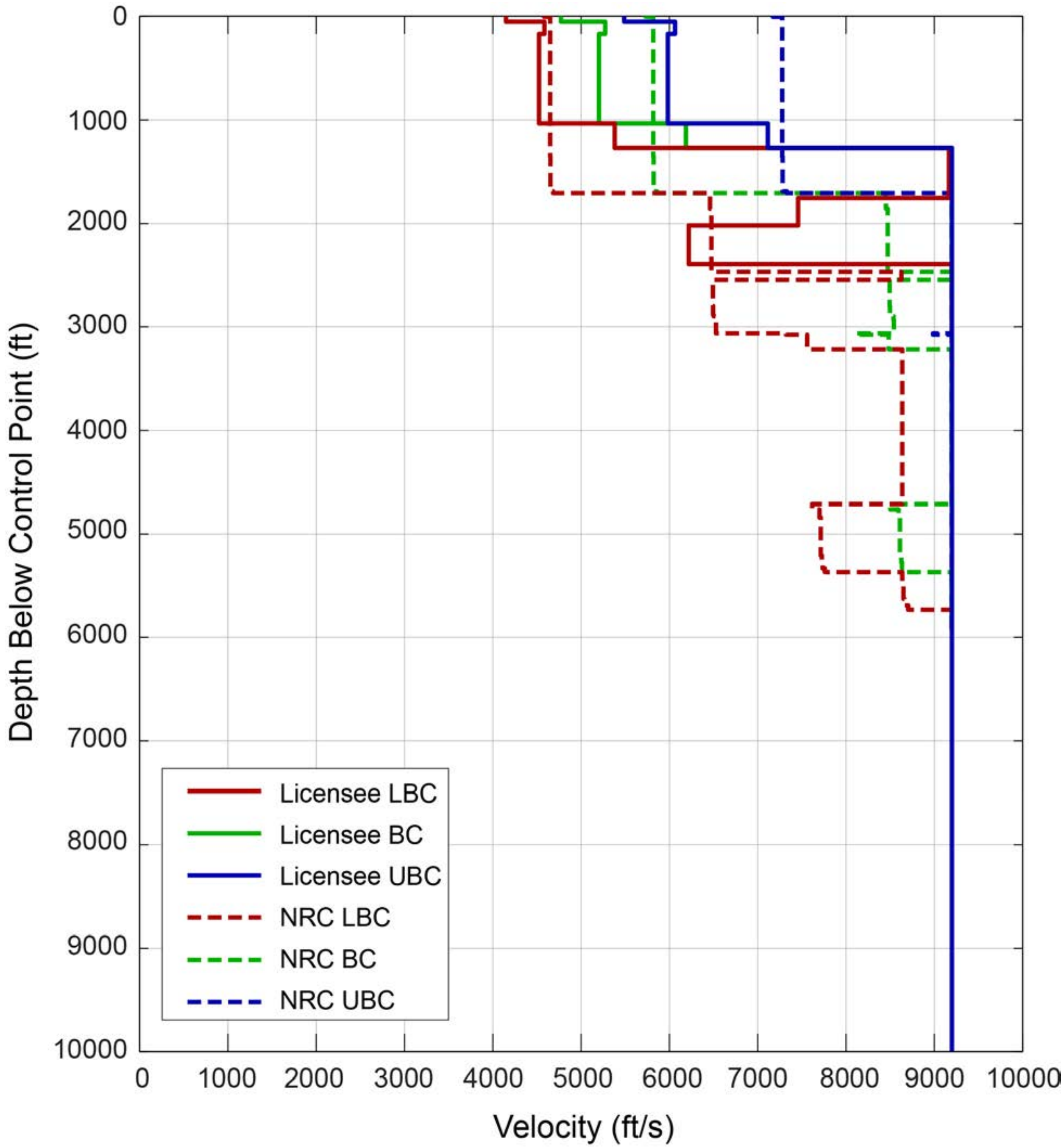


Figure 3.3-2: Plot Comparing the NRC Staff's and the License's Median Amplification Functions and Uncertainties for two input loading levels for the Perry site

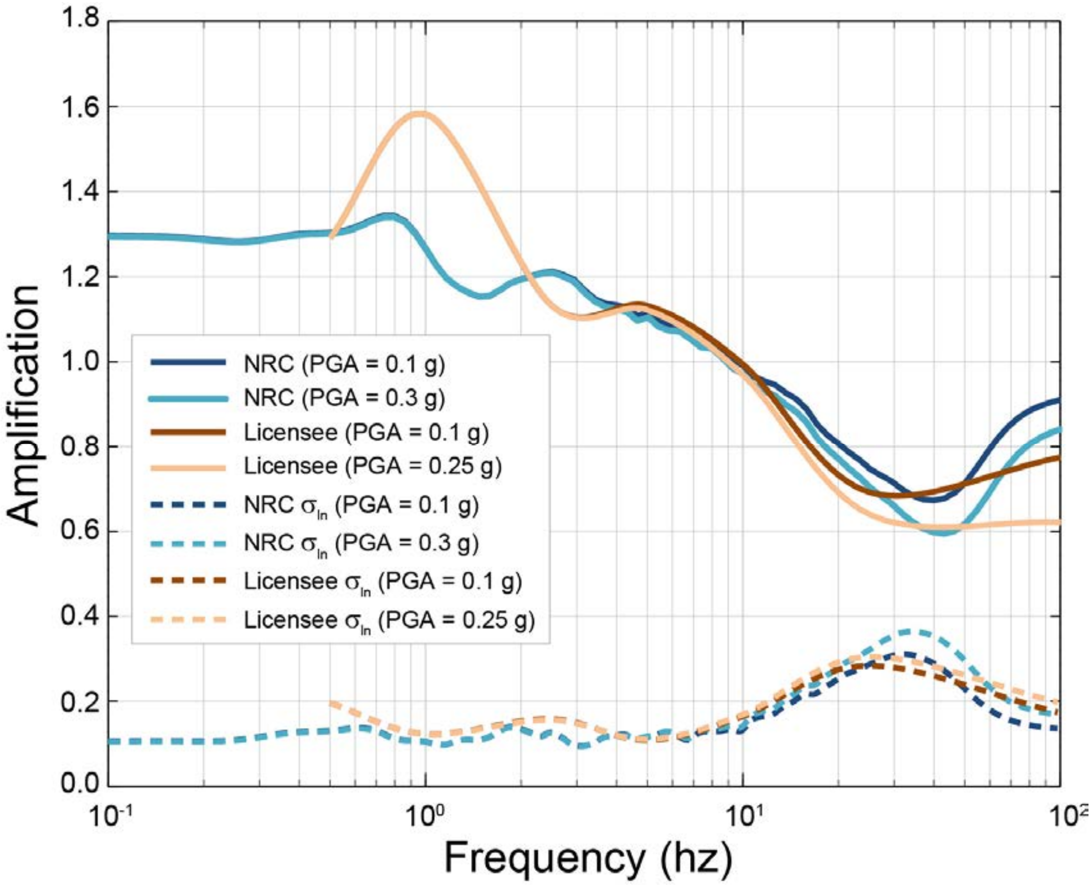


Figure 3.3-2: Plot Comparing the NRC Staff's and the Licensee's Mean Control Point Hazard Curves at a Variety of Frequencies for the Perry site

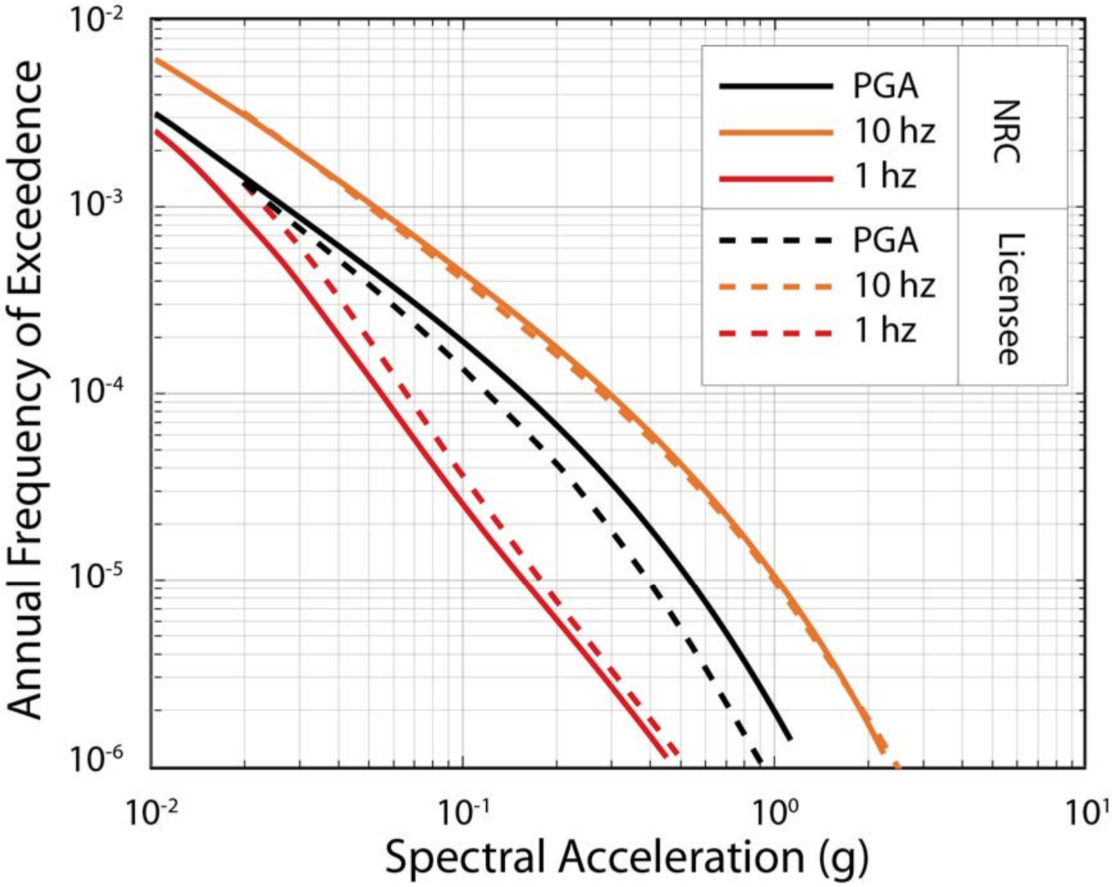
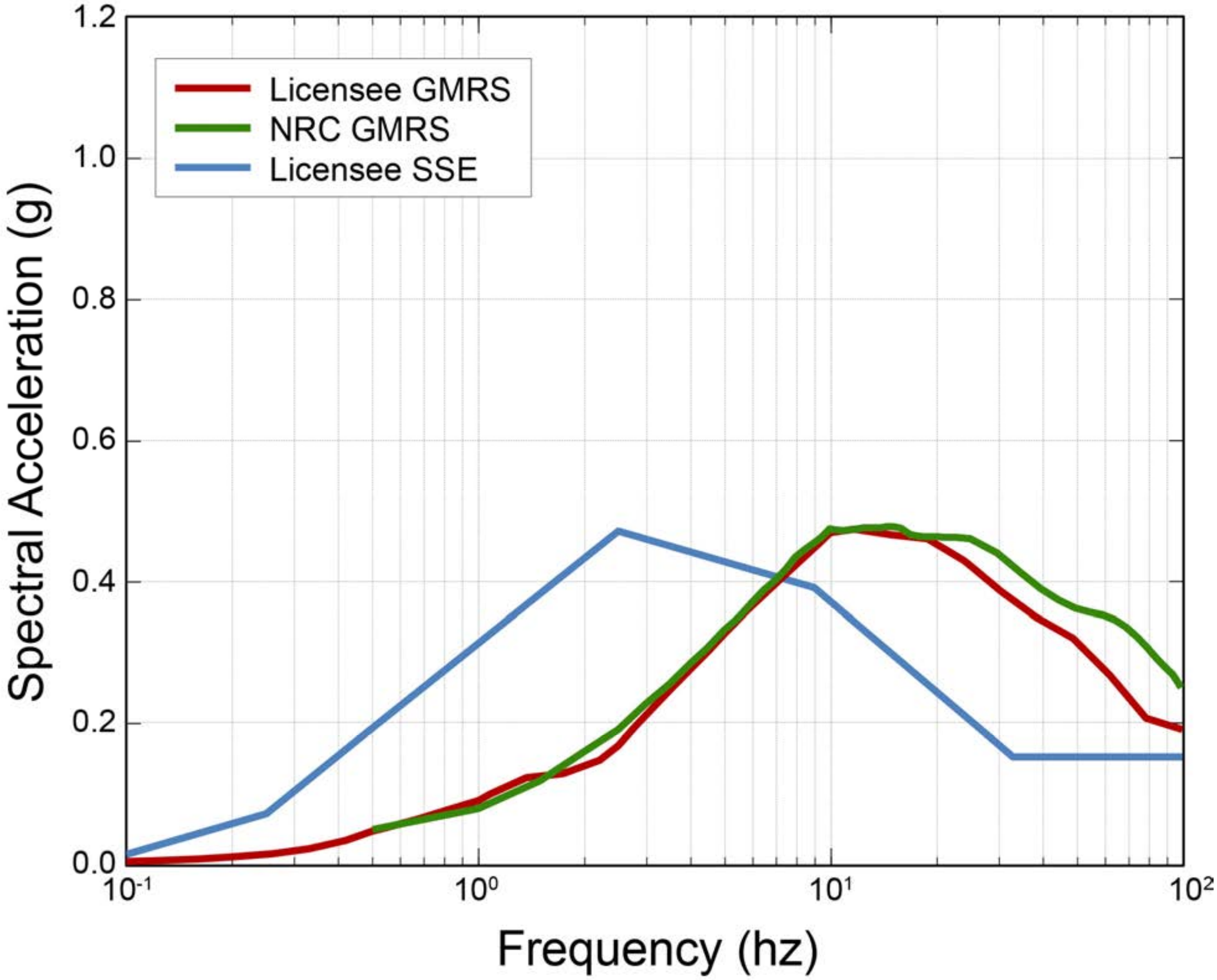


Figure 3.4-1: Comparison of the NRC Staff's GMRS with Licensee's GMRS and the SSE for the Perry site



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

Sincerely,

/RA/

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

Docket No. 50-440

Enclosure:
Staff Assessment of Seismic
Hazard Evaluation and Screening Report

cc w/encl: Distribution via Listserv

DISTRIBUTION:
PUBLIC
JHMB R/F
RidsNrrDorlLpl3-1 Resource
RidsNrrPMPerry Resource
RidsNrrLASLent Resource
RidsAcrsAcnw_MailCTR Resource
TGovan, NRR
NDiFrancesco, NRR
DJackson, NRO
MShams, NRR
KGreen, NRR

ADAMS Accession No.: ML15208A034 ***via email**

OFFICE	NRR/JLD/JHMB/PM	NRR/JLD/LA	NRO/DSEA/RGS1/BC*
NAME	TGovan	SLent	DJackson
DATE	07/27/15	07/27/15	06/19/15
OFFICE	NRR/JLD/JHMB/BC	NRR/JLD/JHMB/PM	
NAME	MShams	TGovan	
DATE	08/02/15	08/03/15	

OFFICIAL RECORD COPY