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

June 11, 2015

Mr. Joseph E. Pacher
Vice President
R.E. Ginna Nuclear Power Plant
R.E. Ginna Nuclear Power Plant, LLC
1503 Lake Road
Ontario, NY 14519

SUBJECT: R.E. GINNA NUCLEAR POWER PLANT - 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. MF3972)

Dear Mr. Pacher:

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, Constellation Energy Nuclear Group, LLC, acting for R.E. Ginna Nuclear Power Plant, LLC (the licensee), responded to this request for R.E. Ginna Nuclear Power Plant (Ginna).

The NRC staff has reviewed the information provided related to the reevaluated seismic hazard for Ginna and, as documented in the enclosed staff assessment, determined that you provided sufficient information in response to Enclosure 1, Items (1) – (3), (5), (7) and the screening review portion of Item (4) of the 50.54(f) letter. The information for Enclosure 1 of the 50.54(f) letter Items (6), (8) and (9) are not required since the reevaluated seismic hazard level is bounded by the plant design-basis for frequencies between 1 and 10 Hertz, in accordance with the Screening, Prioritization and Implementation Details criteria. Further, the 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 staff's review and acceptance of the licensee's high frequency confirmation (i.e., Item (4)) for Ginna, the Seismic Hazard Evaluation identified in Enclosure 1 of the 50.54(f) letter will be completed.

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

Sincerely,

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

Docket No. 50-244

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

R.E. GINNA NUCLEAR POWER PLANT

DOCKET NO. 50-244

1.0 INTRODUCTION

By letter dated March 12, 2012 (NRC, 2012a), the U.S. Nuclear Regulatory Commission (NRC or the 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 for screening purposes. High-frequency evaluation, if necessary,

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

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

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

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

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

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

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

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

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

By letter dated April 9, 2013 (Pietrangelo, 2013), industry committed to follow the SPID to develop the SHSR for existing nuclear power plants. By letter dated September 12, 2013 (Spina, 2013), Exelon Generation Company, LLC (Exelon, the licensee), previously as Constellation Energy Nuclear Group, LLC, submitted partial site response information for R.E. Ginna Nuclear Power Plant (Ginna). By letter dated March 31, 2014 (Korsnick, 2014), Exelon submitted its SHSR for Ginna.

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." 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) 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 (Korsnick, 2014), Exelon provided the SHSR for Ginna. The licensee's SHSR indicated that the site GMRS is bounded by the SSE over the frequency range of 1 to 10 Hertz (Hz). Neither a seismic risk evaluation nor a SFP evaluation will be performed. However, due to exceedances above 10 Hz, the licensee indicated that a high-frequency confirmation would be performed for Ginna.

On May 9, 2014 (NRC, 2014), the staff issued a letter providing the outcome of its 30-day screening and prioritization evaluation applying the SPID screening criteria. 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, only slightly exceeded the SSE for Ginna over the frequency range of 9 to 10 Hz, which constitutes a narrow band exceedance, as defined by guidance in the SPID. Therefore, a seismic risk evaluation and SFP evaluation are not merited for Ginna based on the SPID criteria. The staff also confirmed the licensee's conclusion that a high-frequency confirmation for Ginna should be performed because the GMRS exceeds the SSE at frequencies above 10 Hz.

3.0 TECHNICAL EVALUATION

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

3.1 Plant Seismic Design-Basis

Enclosure 1 of the 50.54(f) letter requests the licensee provide the SSE ground motion values, as well as the specification of the control point elevation(s) for comparison to the GMRS. For operating reactors licensed before 1997, the SSE is the plant licensing basis 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 its seismic design-basis for Ginna. The licensee stated that the original SSE for Ginna is based on a Housner spectrum anchored at 0.2g (20 percent of the acceleration due to earth's gravity). The PGA of 0.2g is based on consideration of two earthquakes with the first earthquake having a magnitude 6.0 located 60 miles [97 km] from the site and the second having a magnitude 7 located 90 miles [145 km] from the site. The licensee stated that they used a higher design spectra than its SSE during the NRC's Systematic Evaluation Program (SEP) for plant design evaluations. The SEP spectrum, a Regulatory Guide

1.60 spectral shape anchored at 0.2 g, exceeds the SSE for Ginna out to 30 Hz and is an additional engineering consideration the licensee used for seismic screening for Ginna.

The licensee specified that the SSE control point is located at the top of rock at a mean sea level (MSL) elevation of 231.75 feet (ft) (71 m). In the absence of a control point definition in the updated final analysis report (UFSAR), the licensee relied on other UFSAR information, which states that the reactor foundation is located on firm rock, along with guidance provided in Section 2.4.2 of the SPID to define the control point.

The staff reviewed the licensee's description of its SSE, as well as the SEP spectrum for Ginna in the SHSR. To confirm the licensee's SSE and SEP spectrum, the staff also reviewed the Ginna UFSAR, Revision 21 (Constellation, 2008). The staff confirmed that the SEP design spectrum has been incorporated in the UFSAR. However, because not all structures, systems, and components were within the scope of the SEP, the staff used the SSE for its screening evaluation. Finally, based on a review of the SHSR and the UFSAR, the staff confirmed that the licensee's control point elevation for the Ginna 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). 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 Charlevoix and Wabash Valley Repeated Large Magnitude Earthquake (RLME) sources, which lie within 620 miles (1000 km) of the site. The RLME sources are those source areas or faults for which more than one large magnitude (**M** ≥ 6.5) earthquake has occurred in the historical or paleo-earthquake (geologic evidence for prehistoric seismicity) record. The licensee used the mid-continent version of the updated EPRI GMM (EPRI, 2013) for each of the CEUS-SSC sources. Consistent with the SPID, the licensee did not provide its base rock seismic hazard curves because it performed a site response analysis to determine the control point seismic hazard curves. The licensee provided its control point seismic hazard curves in Section 2.3.7 of its SHSR. The NRC staff's review of the licensee's control point seismic hazard curves is provided in Section 3.3 of this assessment.

As part of its confirmatory analysis of the licensee's GMRS, the NRC staff performed PSHA calculations for base rock site conditions at the Ginna site. As input, the 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 staff included all CEUS-SSC background seismic sources within a 310 mi (500 km) radius of the Ginna site. In addition, the staff included all of the RLME sources falling within a 620 mi (1,000 km) radius of the site, which includes the Charlevoix and Wabash Valley 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 its review of the SHSR, the staff concludes that the licensee followed the guidance provided in the SPID for selecting the PSHA input models and parameters for the site. This includes the licensee's use and implementation of the CEUS-SSC model and the updated EPRI GMM.

3.3 Site Response Evaluation

After completing PSHA calculations for reference rock 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 base 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 Ginna UFSAR (Constellation, 2008). The licensee stated that the site is underlain by approximately 40 ft (12 m) of soil and glacial till overlying approximately 2,700 ft (823 m) of firm Ordovician age (490 – 445 Ma) sedimentary rocks consisting of sandstones, shales, and limestones.

The licensee stated that little detailed geophysical data was collected at the site during initial construction. As a result, the licensee based its shear wave velocity estimates on compressional wave measurements, of which only the Queenston Formation, which directly underlies the glacial till layer, was measured directly at the site.

To characterize the subsurface geology, the licensee developed three site base case profiles. The middle, or best estimate, profile was developed using measured and assumed compressional wave velocities and assumed Poisson's ratios (a ratio of the compressional wave to shear wave velocity). The licensee developed upper and lower base case profiles using a natural log standard deviation of 0.2 and limited the upper base case velocity to 9,285 ft/s (2,800 m/s), the velocity of hard rock. Figure 3.3-1 of this assessment shows the licensee's three shear-wave velocity base case profiles.

Because the seismic velocities of the site are different from that of hard rock conditions used in the PSHA analysis, a site specific model of shear modulus and damping is required. In Section 2.3.2.1 of its SHSR, the licensee assumed that the rock material over the upper 500 ft (152 m) could be modeled as either linear or non-linear. To model the potential non-linear behavior of the rock, the licensee used the generic EPRI shear modulus reduction and hysteretic damping curves over the upper 500 ft (152 m). To model the linear behavior of the rock over the upper 500 ft (152 m), the licensee used the low strain damping values (approximately 3 percent) from the EPRI rock curves for each of the rock layers. The licensee weighted these alternative material behaviors equally, assigning 50 percent to each case.

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 and scattering due to wave propagation in heterogeneous material. For Ginna, a site with approximately 2,700 ft (823 m) of firm rock over the assumed hard rock material, the licensee used the low strain damping values from the EPRI rock curves (approximately 3 percent) over the upper 500 ft (152 m) and assumed a damping value of 1.25 percent for the rock layers below 500 ft (152 m) in order to calculate a kappa value for each of the three base case profiles. The licensee also added an additional kappa of 0.006 sec to account for the damping in the underlying hard rock material. The total profile kappa values for the best estimate, upper, and lower base case velocity profiles are 0.012, 0.019, and 0.006 sec, respectively.

To account for randomness in material properties across the plant site, the licensee stated that it randomized its base case shear-wave velocity profiles in accordance with the SPID. In addition, the licensee randomized the depth to hard rock by ±802 ft (±245 m), which corresponds to 30 percent of the total profile thickness. The licensee stated that this randomization did not represent the actual uncertainty in the depth to hard rock, but was used to broaden the spectral peaks. As discussed in Section 3.3.3 of this assessment, the staff's review found that this approach did not significantly impact the seismic hazard curves through a sensitivity analysis.

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 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, 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 hard rock hazard curves, determined from the initial PSHA (Section 3.2), and the amplification functions and their associated uncertainties, determined form 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 Ginna site. The staff independently developed a shear-wave velocity profile, damping values, and modeled the potential nonlinear behavior of rock using measurements and geologic information provided in the Ginna UFSAR (Constellation, 2008), the Nine Mile Point Nuclear Station (Nine Mile Point), Unit 3 Safety Analysis Report (SAR) (UniStar, 2009), geologic unit thickness measurements available at a deep well located approximately 15 mi (24.1 km) from the Ginna site (Kreidler et al., 1972), and Appendix B of the SPID.

Because many of the same geologic units underlie both the Ginna and the Nine Mile Point sites, the staff used geophysical measurements from the Nine Mile Point, Unit 3 SAR for these common geologic units. The staff used these velocity data along with information about the thickness of geologic units from deep well data to develop the middle, or best estimate, base case velocity profile. Geologic evidence at the nearby borehole indicated approximately 2950 ft of sedimentary rock overlying the Precambrian basement (Kreidler et al., 1973). Because the site lacks specific data about layer thicknesses and seismic velocities, the staff used Appendix B of the SPID to generate upper and lower base case profiles using a natural log standard deviation of 0.2. To capture the uncertainty in the depth to base rock, the staff used a value of ±150 ft (±46 m), which is consistent with the more recent investigations for Nine Mile Point and considerably less than the ±802 ft (±245 m) depth used by the licensee. Figure 3.3-1 of this assessment shows the velocity profiles developed by the staff compared with those developed by the licensee. Estimates of shear-wave velocity and profile thickness determined by the staff differ somewhat from those developed by the licensee. However, as described below, these differences do not significantly impact the final hazard results.

Similar to the approach used by the licensee, the staff assumed both linear and non-linear behavior for the rock beneath Ginna in response to the range of input loading motions. Like the licensee, the NRC staff applied the EPRI rock shear modulus and damping curves over the upper 500 ft (152 m) of the profile, consistent with guidance in the SPID, to model the non-linear site response. However, to model the linear response, the staff selected a damping value of 1 percent, which is less than the 3 percent value used by the licensee and is more consistent with the recent information provided in the Nine Mile Point, Unit 3 SAR (UniStar, 2009). The staff applied this damping value over the upper 500 ft (152 m). Below a depth of 500 ft (152 m), the staff assumed linear behavior for the rock with a damping value of 1.25 percent, following guidance in the SPID.

To determine the value of kappa, the staff used the low strain damping values, shear wave velocities, and layer thicknesses for each layer to arrive at values of 0.016, 0.018, and 0.009 sec for the best-estimate, lower, and upper velocity profiles, respectively. These three kappa values include the 0.006 sec contribution from the hard rock. To further model the uncertainty in the kappa value, the staff used a natural log standard deviation of 0.35 to calculate lower and upper values of kappa for each profile. This approach resulted in nine kappa values, which range from 0.006 to 0.029 sec. The staff applied this approach to account for the large uncertainties associated with estimating kappa for the Ginna site, for which limited subsurface data were collected. The staff gave the best-estimate kappa values for each profile a weight of 40 percent and the upper and lower kappa values a weight of 30 percent each in the site response analysis. Figure 3.3-2 of this assessment shows a comparison of the staff's and the licensee's median site amplification functions and uncertainties (±1 standard deviation) for two of the eleven input loading levels. The NRC staff's and licensee's amplification functions are generally similar in shape and amplitude. Amplification functions determined by the staff are slightly higher than those developed by the licensee for frequencies between 0.2 and 5 Hz. However, as shown in Figure 3.3-3 of this assessment, these differences in 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 prescriptive nor comprehensive. As such, various approaches in performing site response analyses, including the modeling of uncertainty, are acceptable for this application.

In summary, the staff concludes that the licensee's site response analysis was conducted using present-day guidance and methodology, including the NRC-endorsed SPID. The NRC staff performed independent calculations which confirm 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 Ginna site.

3.4 Ground Motion Response Spectra

In Section 2.4 of its SHSR, the licensee stated that it used the control point hazard curves described in SHSR Section 2.3.7 to develop the 10^{-4} and 10^{-5} (mean annual frequency of exceedance) uniform hazard response spectra (UHRS) and then computed the GMRS using the criteria in RG 1.208.

The NRC staff independently calculated 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. Figure 3.4-1 of this assessment shows a comparison of the GMRS determined by the licensee to that determined by the staff.

As shown in Figures 3.4-1 of this assessment, the NRC staff's GMRS is very similar to the licensee's in both amplitude and shape. 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. As such, the NRC staff concludes that the GMRS determined by the licensee adequately characterizes the reevaluated hazard for the Ginna site. Therefore, this GMRS is suitable for use in subsequent evaluations and conformations, as needed, for the response to 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.

4.0 CONCLUSION

The NRC staff reviewed the information provided by the licensee for the reevaluated seismic hazard for the Ginna 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), and (7), and screening review portion of Item (4), identified in Enclosure 1 of the 50.54(f) letter. The information for Enclosure 1 of the 50.54(f) letter Items (6), (8) and (9), are not required since, in accordance with the SPID criteria, the reevaluated seismic hazard level is bounded by the plant design-basis for frequencies between 1 and 10 Hz. 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 confirmed the licensee's conclusion that the licensee's GMRS for the Ginna site is bounded by the SSE for Ginna in the 1 to 10 Hz range, except for a narrow band exceedance between 9 and 10 Hz. The staff also confirmed the licensee's conclusion that the GMRS exceeds the SSE for Ginna above 10 Hz. As such, a seismic risk evaluation and SFP evaluation are not merited and a high-frequency confirmation is merited in accordance with the SPID criteria. The NRC review and acceptance of Exelon's high-frequency confirmation (i.e., Item (4)) will complete the Seismic Hazard Evaluation identified in Enclosure 1 of the 50.54(f) letter, for Ginna.

REFERENCES

Note: ADAMS Accession Nos. refer 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.

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.

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

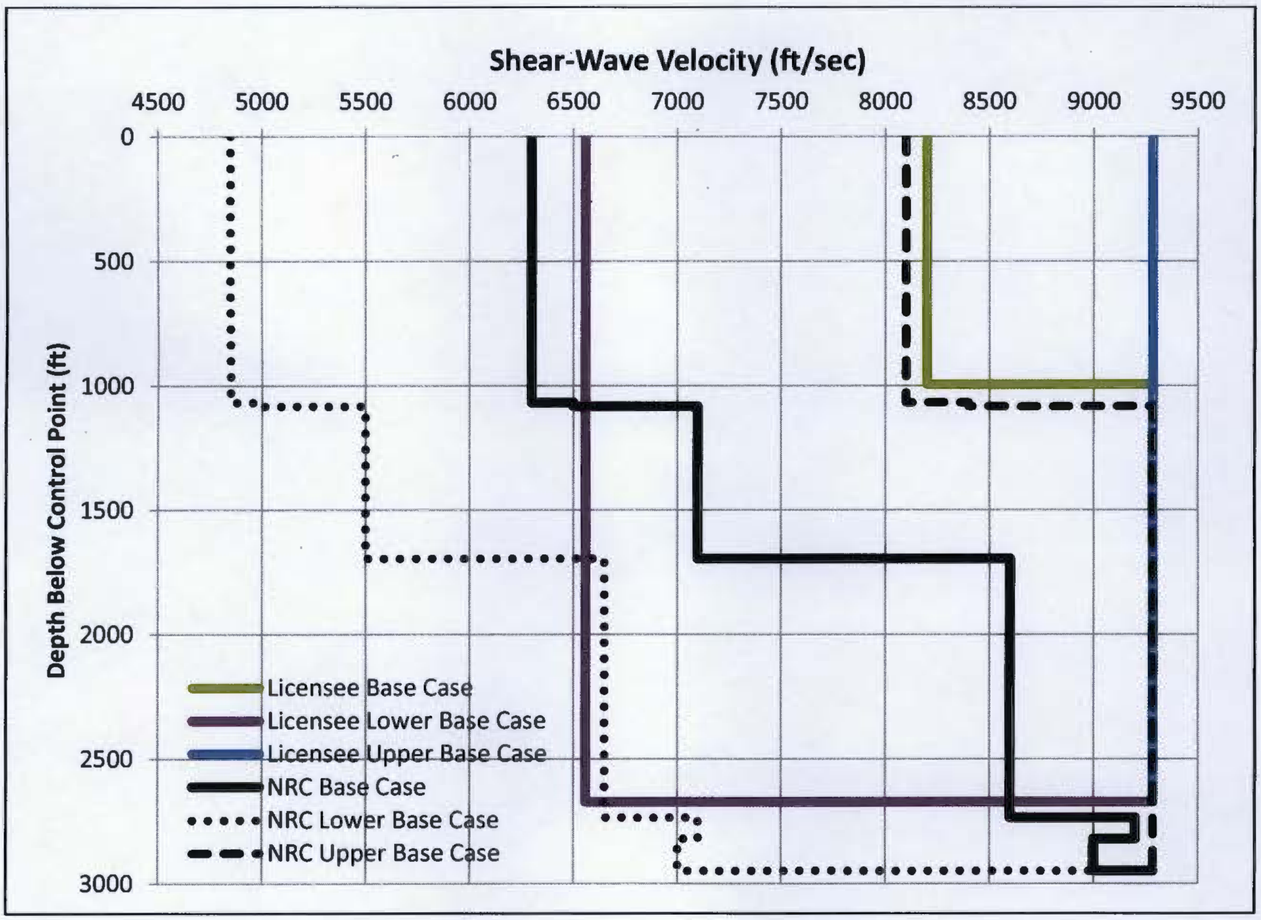


Figure 3.3-2 Plot Comparing the Staff's and the License's Median Amplification Functions and Uncertainties for the Ginna site

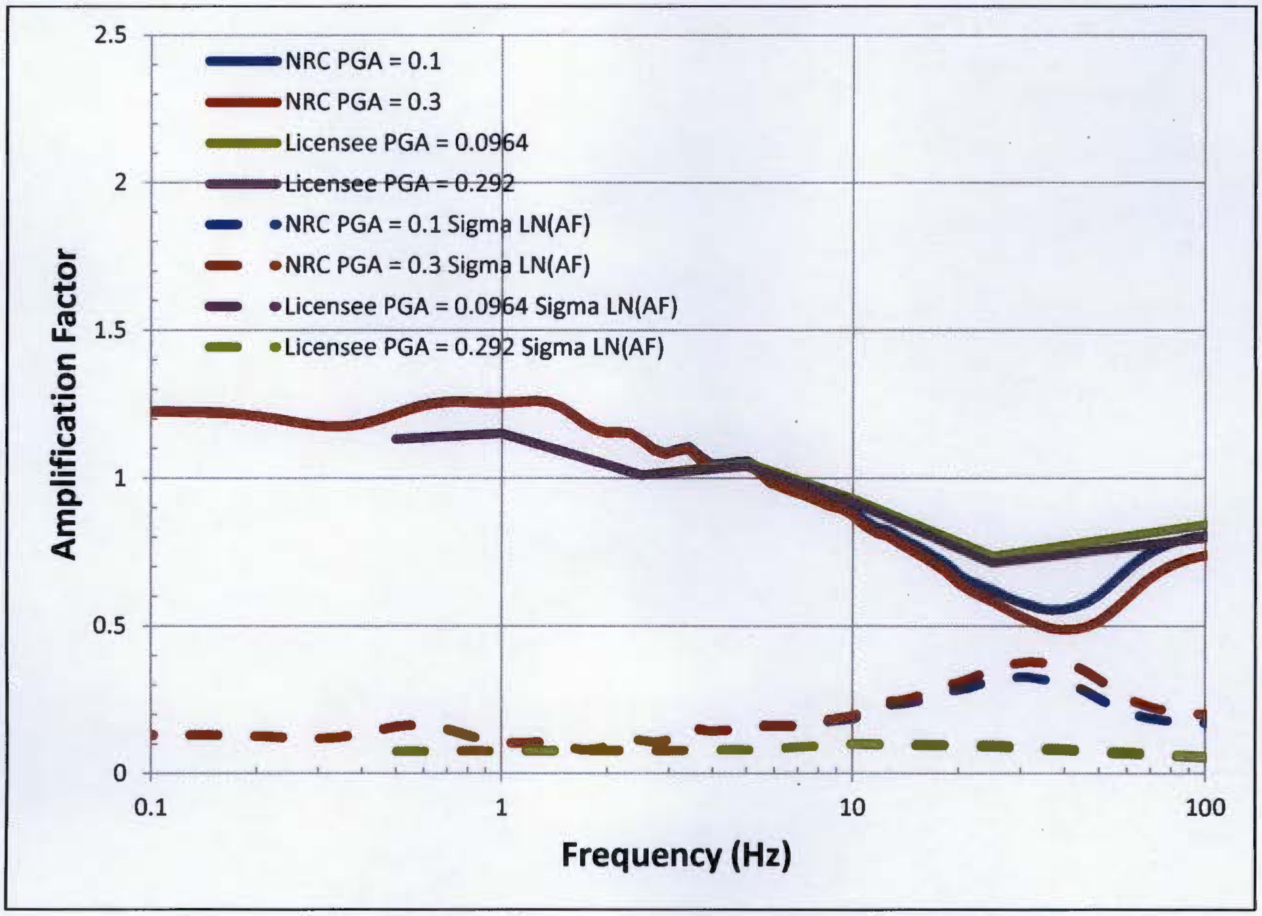


Figure 3.3-3 Plot Comparing the Staff's and the Licensee's Mean Control Point Hazard Curves at a Variety of Frequencies for the Ginna site

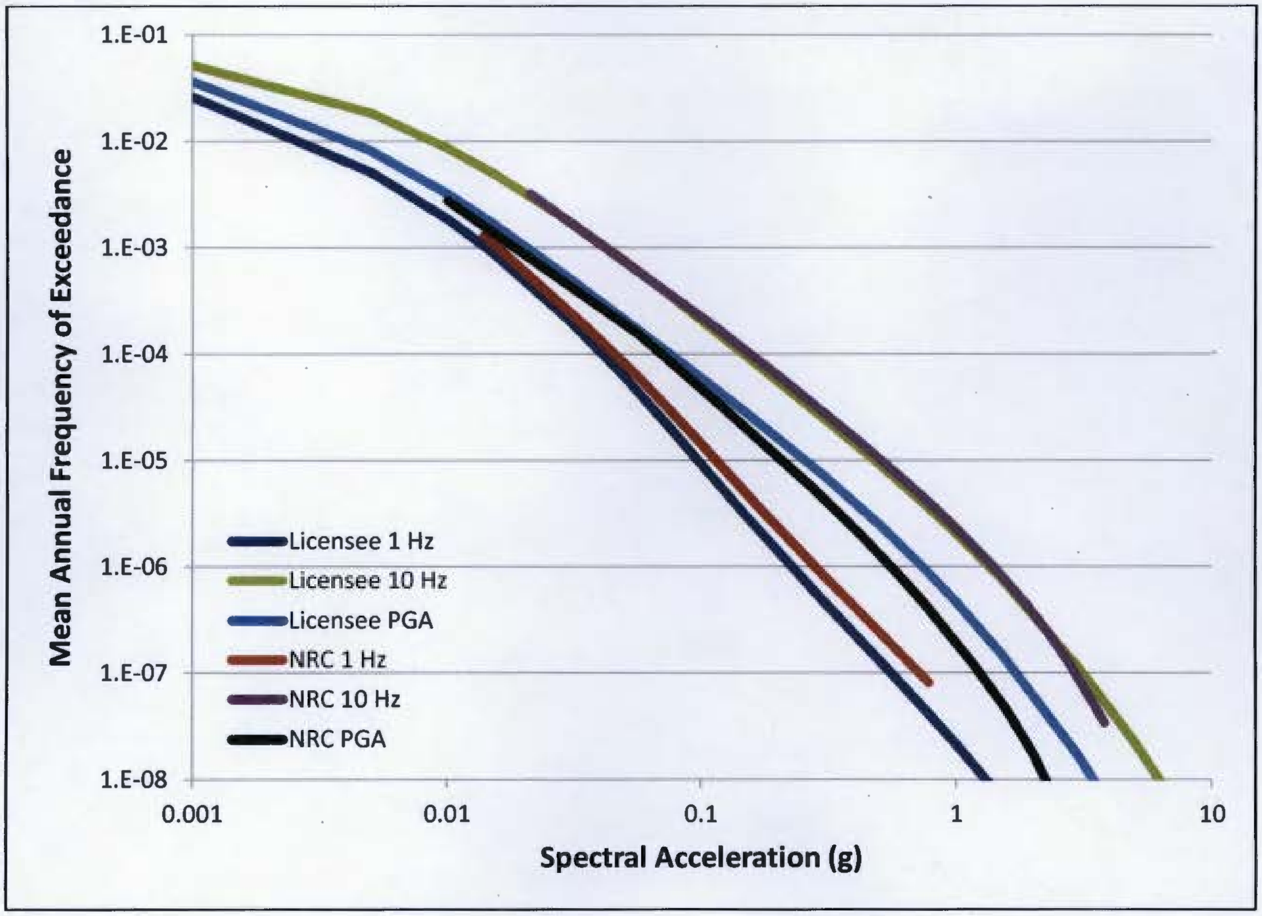
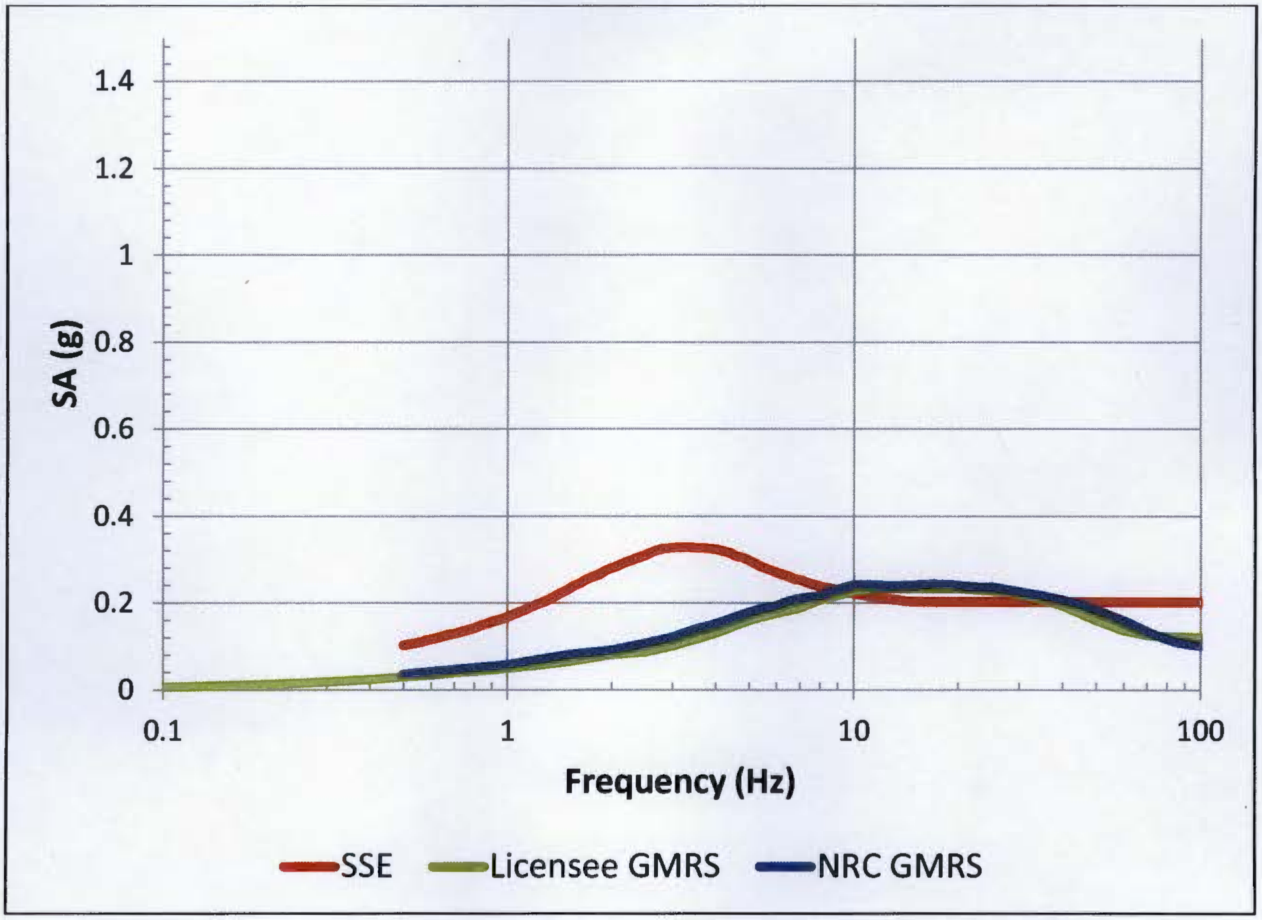


Figure 3.4-1 Comparison of the Staff's GMRS with Licensee's GMRS and the Ginna SSE



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

Sincerely,

/RA/

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

Docket No. 50-244

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