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

October 16, 2015

Mr. C. R. Pierce
Regulatory Affairs Director
Southern Nuclear Operating Co., Inc.
P.O. Box 1295, Bin 038
Birmingham, AL 35201-1295

SUBJECT: JOSEPH M. FARLEY NUCLEAR PLANT, UNITS 1 AND 2 - STAFF ASSESSMENT OF INFORMATION PROVIDED PURSUANT TO TITLE 10 OF THE *CODE OF FEDERAL REGULATIONS* PART 50, SECTION 50.54(f), SEISMIC HAZARD REEVALUATIONS FOR RECOMMENDATION 2.1 OF THE NEAR-TERM TASK FORCE REVIEW OF INSIGHTS FROM THE FUKUSHIMA DAI-ICHI ACCIDENT (TAC NOS. MF3832 AND MF3833)

Dear Mr. Pierce:

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.

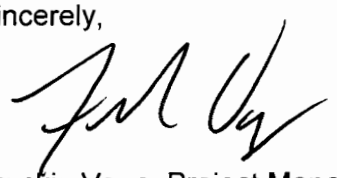
By letter dated March 31, 2014, Southern Nuclear Operating Company, Inc. (the licensee), responded to this request for Joseph M. Farley Nuclear Plant, Units 1 and 2 (Farley).

The NRC staff has reviewed the information provided related to the reevaluated seismic hazard for Farley and, as documented in the enclosed staff assessment, determined that you provided sufficient information in response to Requested Information Items (1) – (3), (5) - (9) and the comparison portion to Item (4), identified in Enclosure 1 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 the licensee's low-frequency evaluation and high frequency confirmation (Item 4) for Farley, 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 Vega, Project Manager
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Office of Nuclear Reactor Regulation

Docket Nos. 50-348 and 50-364

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

JOSEPH M. FARLEY NUCLEAR PLANT, UNITS 1 AND 2

DOCKET NOS. 50-348 AND 364

1.0 INTRODUCTION

By letter dated March 12, 2012 (NRC, 2012a), the U.S. Nuclear Regulatory Commission (NRC or Commission) issued a request for information to all power reactor licensees and holders of construction permits in active or deferred status, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR), Section 50.54(f) "Conditions of license" (hereafter referred to as the "50.54(f) letter"). The request and other regulatory actions were issued in connection with implementing lessons-learned from the 2011 accident at the Fukushima Dai-ichi nuclear power plant, as documented in the "Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident" (NRC, 2011b).[1] In particular, the NRC Near-Term Task Force (NTTF) Recommendation 2.1, and subsequent Staff Requirements Memoranda (SRM) associated with Commission Papers SECY-11-0124 (NRC, 2011c) and SECY-11-0137 (NRC, 2011d), instructed the NRC staff to issue requests for information to licensees pursuant to 10 CFR 50.54(f).

Enclosure 1 to the 50.54(f) letter requests that addressees perform a reevaluation of the seismic hazards at their sites using present-day NRC requirements and guidance to develop a ground motion response spectrum (GMRS).

The required response section of Enclosure 1 requests that each addressee provide the following information:

(1) Site-specific hazard curves (common fractiles and mean) over a range of spectral frequencies and annual exceedance frequencies,

(2) Site-specific, performance-based GMRS developed from the new site-specific seismic hazard curves at the control point elevation,

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

(4) Comparison of the GMRS and SSE. A high-frequency (HF) and low frequency evaluation (LF), (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 (NRC, 2007), describes this approach. As described in the 50.54(f) letter, if the reevaluated seismic hazard, as characterized by the GMRS, is not bounded by the current plant design-basis SSE, further seismic risk evaluation of the plant is merited.

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

The required response section of Enclosure 1 to the 50.54(f) letter specifies that Central and Eastern United States (CEUS) licensees provide their Seismic Hazard and Screening Report (SHSR) by 1.5 years after issuance of the 50.54(f) letter. However, in order to complete its update of the EPRI seismic ground motion models (GMM) for the CEUS (EPRI, 2013), industry proposed a six-month extension to March 31, 2014, for submitting the SHSR. Industry also proposed that licensees perform an expedited assessment, referred to as the Augmented Approach, for addressing the requested interim evaluation (Item 6 above), which would use a simplified assessment to demonstrate that certain key pieces of plant equipment for core cooling and containment functions, given a loss of all alternating current power, would be able to withstand a seismic hazard up to two times the design basis. Attachment 2 to the April 9, 2013, letter (Pietrangelo, 2013) provides a revised schedule for plants needing to perform (1) the Augmented Approach by implementing the Expedited Seismic Evaluation Process (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 agreed to follow the SPID to develop the SHSR for existing nuclear power plants. By letter dated September 12, 2013 (Pierce, 2013), Southern Nuclear Operating Company, Inc. (SNC, the licensee) submitted at least partial site response information for Joseph M. Farley Nuclear Plant, Units 1 and 2 (Farley). By letter dated March 31, 2014 (Pierce, 2014), the licensee submitted its Seismic Hazard and Screening Report (SHSR).

2.0 REGULATORY BACKGROUND

The structures, systems, and components (SSCs) important to safety in operating nuclear power plants are designed either in accordance with, or meet the intent of Appendix A to 10 CFR Part 50, General Design Criteria (GDC) 2: "Design Bases for Protection Against Natural Phenomena;" and Appendix A to 10 CFR Part 100, "Reactor Site Criteria." The GDC 2 states that SSCs important to safety at nuclear power plants shall be designed to withstand the effects of natural phenomena such as earthquakes, tornadoes, hurricanes, floods, tsunami, and seiches without loss of capability to perform their safety functions.

For initial licensing, each licensee was required to develop and maintain design bases that, as defined by 10 CFR 50.2, identify the specific functions that an SSC of a facility must perform, and the specific values or ranges of values chosen for controlling parameters as reference bounds for the design. The design bases for the SSCs reflect appropriate consideration of the most severe natural phenomena that had been historically reported for the site and surrounding area. The design bases also considered limited accuracy, quantity, and period of time in which the historical data have been accumulated.

The seismic design bases for currently operating nuclear power plants were either developed in accordance with, or meet the intent of GDC 2 and 10 CFR Part 100, Appendix A. Although the regulatory requirements in Appendix A to 10 CFR Part 100 are fundamentally deterministic, the NRC process for determining the seismic design-basis ground motions for new reactor applications after January 10, 1997, as described in 10 CFR 100.23, requires that uncertainties be addressed through an appropriate analysis such as a probabilistic seismic hazard analysis (PSHA).

Section 50.54(f) of 10 CFR states that a licensee shall at any time before expiration of its license, upon request of the Commission, submit written statements, signed under oath or affirmation, to enable the Commission to determine whether or not the license should be modified, suspended, or revoked. On March 12, 2012, the NRC staff issued requests for licensees to reevaluate the seismic hazards at their sites using present-day NRC requirements and guidance, and identify actions planned to address plant-specific vulnerabilities associated with the updated seismic hazards.

Attachment 1 to Enclosure 1 of the 50.54(f) letter described an acceptable approach for performing the seismic hazard reevaluation for plants located in the CEUS. Licensees are expected to use the CEUS Seismic Source Characterization (CEUS-SSC) model in NUREG- 2115 (NRC, 2012b) along with the appropriate EPRI (2004, 2006) ground motion models. The SPID provided further guidance regarding the appropriate use of GMMs for the CEUS. Specifically, Section 2.3 of the SPID recommended the use of the updated GMM (EPRI,

2013) and, as such, licensees used the NRC-endorsed updated EPRI GMM instead of the older EPRI (2004, 2006) GMM to develop PSHA base rock hazard curves. Finally, Attachment 1 requested that licensees conduct an evaluation of the local site response in order to develop site-specific hazard curves and GMRS for comparison with the plant SSE.

2.1 Screening Evaluation Results

By letter dated March 31, 2014 (Pierce, 2014), the licensee provided its SHSR for the Farley site. The licensee's SHSR indicates that the plant GMRS exceeds the SSE between 1 and 10 Hertz (Hz); however, since the peak value of the GMRS is below 0.4g and the exceedance is below 2.5 Hz, Farley screens out of performing seismic risk and SFP evaluations and instead merits a Low Frequency evaluation. Additionally, because the GMRS exceeds the SSE at frequencies above 10 Hz, the licensee indicated that a HF confirmation will be performed.

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, falls below the 0.4g Low Hazard Threshold and exceeds the SSE for Farley only below 2.5 Hz. In addition, the licensee's GMRS and the NRC staff's confirmatory GMRS exceeds the SSE above 10 Hz. Therefore, a Low Frequency Evaluation and HF confirmation are merited for Farley.

3.0 TECHNICAL EVALUATION

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

3.1 Plant Seismic Design-Basis

Enclosure 1 of the 50.54(f) letter requests the licensee provide the SSE ground motion values, as well as the specification of the control point elevation(s) for comparison to the GMRS. For operating reactors licensed before 1997, the SSE is the plant licensing basis ground motion and is characterized by 1) a peak ground acceleration (PGA) value which anchors the response spectra at high frequencies (typically 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 its SHSR, the licensee described its seismic design basis for Farley. The licensee stated that the design-basis of Farley was developed as specified in 10 CFR Part 100, Appendix A, based on the maximum earthquake potential in the site region. The licensee identified a maximum earthquake of intensity V from which it established a PGA anchor point of 0.1 g for the plant SSE. The licensee used a Newmark spectral shape for the SSE and specified that the control point is located at the plant grade at Elevation 155 ft. (47 m).

The NRC staff reviewed the licensee's description of the SSE for Farley and confirms that the SSE, as described in the SHSR, is consistent with information provided in the Updated Final

Safety Analysis Report (UFSAR). Additionally, the NRC staff confirms that the licensee's SSE control point elevation determination is consistent with information provided in the Farley UFSAR, as well as guidance in the SPID.

3.2 Probabilistic Seismic Hazard Analysis

In Section 2.2 of its SHSR, the licensee stated that, in accordance with the 50.54(f) letter and the SPID, it performed a PSHA using the CEUS-SSC model and the updated EPRI GMM for the CEUS (EPRI, 2013). The licensee used a minimum magnitude cutoff of **M**5.0, as specified in the 50.54(f) letter. The licensee further stated that it included the CEUS-SSC background sources out to a distance of 400 mi (640 km) around the site and included the Charleston, Commerce, Eastern Rift Margin-North, Eastern Rift Margin-South, Marianna, New Madrid Fault System, and Wabash Valley Repeated Large Magnitude Earthquake (RLME) sources, which lie within 620 mi (1,000 km) of Farley. 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. For most of the CEUS- SSC sources, the licensee used the Gulf version of the updated EPRI GMM for each of the CEUS-SSC sources. However, for the Charleston source, the licensee used a combination of the Gulf (36 percent) and mid-continent (64 percent) versions of the updated EPRI GMM. 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 staff assessment.

As part of its confirmatory analysis of the licensee's GMRS, the NRC staff performed PSHA calculations for base rock site conditions at the Farley 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 Farley site. In addition, the NRC staff included the Charleston, Commerce, Eastern Rift Margin-North, Eastern Rift Margin-South, Marianna, New Madrid Fault System, and Wabash Valley RLME sources, which lie within 620 km (1,000 mi) of the Farley site. The Farley site lies near the boundary between the Midcontinent and Gulf regions, as identified in the updated EPRI GMM (EPRI, 2013). Consistent with guidance provided in the SPID, the NRC staff used the Midcontinent version of the GMM for CEUS-SSC sources that lie within the Midcontinent region and the Gulf version for CEUS-SSC sources that lie within the Gulf region. For all RLME sources, the NRC staff used the Midcontinent version of the EPRI GMM because the majority of the source-to-site path lies within the Midcontinent region of the model.

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 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 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 would occur as a result of bedrock ground motions propagating upwards through the soil/rock column to the surface. The critical parameters that determine what frequencies of ground motion are affected by the upward propagation of bedrock motions are the layering of soil and/or soft rock, the thicknesses of these layers, the shear-wave velocities and low-strain damping of these layers, and the degree to which the shear modulus and damping change with increasing input bedrock amplitude. To develop site-specific hazard curves at the control point, the licensee performed a site response analysis.

3.3.1 Site Base Case Profiles

According to the licensee, the Farley site is underlain by approximately 7,000 ft. (2,130 m) of unconsolidated Mesozoic and Cenozoic sedimentary deposits, including sandstone, claystone and limestone. The uppermost materials at the site are about 90 ft. (27 m) of fill and residuum beneath which is 255 ft. (78 m) of the Claiborne Group sedimentary rocks. Additional sedimentary rock deposits of increasing age occur to a depth of about 7,300 ft. (2,230 m) at which point Paleozoic sedimentary rock is encountered.

The licensee provided site profile descriptions in Sections 2.3.1 and 2.3.2 of its SHSR based on information in the Farley UFSAR (SNC, 2014) and more recent investigations for the independent spent fuel storage installation (ISFSI) (SNC, 2001). The licensee used the shear wave velocity (Vs) measurements from the UFSAR and ISFSI with additional deeper shear wave velocity information from a nearby petroleum well. Using the available data, the licensee developed the best estimate base case shear wave velocity profile to a depth of about 200 ft. (61 m) for the Farley site. Below that depth, the licensee used historic sonic data to develop the deeper profile assuming that the reference rock Vs value of 9,200 fps (2,800 m/s) is encountered at a depth of about 7,850 ft. (2,390 m). Except for the Lisbon formation, found at depths between 90 to 210 ft. (27 to 64 m), the licensee used a natural log standard deviation of 0.35 to calculate upper and lower profiles base case velocity profiles. For the Lisbon formation, the licensee used a natural log standard deviation of 0.5, to reflect a larger amount of uncertainty in the Vs value.

To model the potential dynamic material properties of the subsurface, the licensee used shear modulus reduction and damping curves that are based on the results of its recent subsurface investigations. Due to the consistency between its site specific analyses and readily-available published shear modulus degradation and damping curves, the licensee opted to use the

published information. The licensee used the EPRI (1993) soil curves for the fill and overburden layers and selected the curves associated with the depth ranges of 50-120 ft. (15-37 m) and 120-250 ft. (37-76 m) as equally plausible alternatives. For the Lisbon to Ripley Formations between the depths of 90 to 2,540 ft. (27 to 774 m), the licensee used the shear modulus degradation and damping relationship developed by Idriss and Boulanger (2010). Below the depth of 2,540 ft. (774 m), the licensee treated the material as linear with a constant damping value.

The licensee also considered the impact of kappa, or small strain damping, on site response. Kappa is measured in units of seconds (sec), and is the damping contributed by both intrinsic hysteretic damping, as well as scattering due to wave propagation in heterogeneous material. The licensee stated that for a deep soil site, like Farley, a median kappa of 0.04 sec is considered suitable for the best estimate base case profile. The licensee used a natural log standard deviation of 0.4 to estimate the upper and lower range kappa values resulting in kappa values that range from 0.024 to 0.067 sec. To confirm that the kappa values used in the site response analysis were appropriate, the licensee also used the empirical relationship of Campbell (2009) and determined a total site kappa of 0.151 sec, which is significantly higher than the values used in the licensee's site response analysis.

To account for aleatory variability in material properties across the plant site in its site response calculations, the licensee stated that it randomized its base case profiles in accordance with Appendix B of the SPID. The licensee also applied a 10 percent variation in layer thickness and generated sixty simulated Vs profiles for each base case profile.

3.3.2 Site Response Method and Results

In Section 2.3.4 of its SHSR, the licensee stated that developed input base rock acceleration response spectra for a suite of high and low frequency cases. 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 seven spectral frequencies of interest.

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 (Section 3.2 of this assessment), and their associated uncertainties, and the site-specific estimates of soil or soft-rock response determined from the site response analysis.

3.3.3 Staff Confirmatory Analysis

To confirm the licensee's site response analysis, the NRC staff performed site response calculations for the Farley site. The NRC staff independently developed a shear-wave velocity profile, damping values, and modeled the potential nonlinear behavior of the subsurface using measurements and geologic information provided in the Farley UFSAR (SNC, 2014), the Farley ISFSI (ISFSI, SNC, 2001), and Appendix B of the SPID.

Based on the amount and quality of information provided in the Farley UFSAR, the NRC staff adopted the base case site profile used by the licensee. Given the availability of data at the site, the NRC staff used a natural log standard deviation of 0.3 to calculate upper and lower base case velocity profile. This standard deviation is slightly lower than that used by the licensee (0.35) and is based on the staff's interpretation of the uncertainty in the properties of the subsurface soil and rock layers. Figure 3.3-1 of this assessment shows a comparison of base case profiles developed by the licensee with those developed by the NRC staff. To capture the uncertainty in the depth to base rock beneath the site, the NRC staff randomized the depth to base rock by ±10 percent, approximately 785 ft. (239 m). In addition, the NRC staff adopted the shear modulus degradation and damping curves used by the licensee because these curves are based on direct measurement of at site materials.

Similar to the licensee, the NRC staff considered the impact of kappa on site response. To determine the value of kappa for each profile, the NRC staff used the equation provided in the SPID for sites with more than 3,000 ft. (914 m) of soft rock overlying base rock combined with the kappa contribution from the surface soils to arrive at values of 0.038, 0.025, and 0.04 for the best-estimate, upper, and lower profiles respectively. To further model the uncertainty in the kappa value, the NRC 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 0.016 to 0.063 sec.

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 staff's and licensee's amplification functions are generally similar in shape to the licensee's but are systematically higher due to differences in developing site profiles, as discussed above. As shown in Figure 3.3-3 of this assessment, these differences in site response analysis have a moderate impact on the control point seismic hazard curves, and 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 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 Farley 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) an then computed the GMRS using the criteria in RG 1.208.

The NRC staff independently calculated the 10^{-4} and 10^{-5} UHRS using the results of its confirmatory PSHA and site response analysis, as described in Sections 3.2 and 3.3 of this 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 below, the staff's confirmatory GMRS is similar in shape to that calculated by the licensee but slightly higher in amplitude. These minor differences in GMRS are the result of differences in the site response analyses performed by the licensee and the NRC staff as discussed in Section 3.3 above.

The NRC staff confirms that the licensee used the present-day guidance and methodology outlined in RG 1.208 and the SPID to calculate the horizontal GMRS, as requested in the 50.54(f) letter. The NRC staff performed both a PSHA and site response confirmatory analysis and achieved results consistent with the licensee's horizontal GMRS. As such, the NRC staff concludes that the GMRS determined by the licensee adequately characterizes the reevaluated hazard for the Farley site. Therefore, this GMRS is suitable for use in subsequent evaluations and confirmations, as needed, for the licensee's response to the 50.54(f) letter.

4.0 CONCLUSION

The NRC staff reviewed the information provided by the licensee for the reevaluated seismic hazard for the Farley site. Based on its review, the NRC staff concludes that the licensee conducted the seismic hazard reevaluation using present-day methodologies and regulatory guidance, appropriately characterized the site given the information available, and met the intent of the guidance for determining the reevaluated seismic hazard. Based on the preceding analysis, the NRC staff concludes that the licensee provided an acceptable response to Requested Information Items (1) – (3), (5) - (9) and the comparison portion to Item (4), identified in Enclosure 1 of the 50.54(f) letter. Further, the staff concludes that the licensee's reevaluated seismic hazard is suitable for 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 exceeds the SSE below 2.5 Hz for the Farley site and therefore, a LF evaluation is merited. In addition, due to the GMRS exceeding the SSE above 10 Hz, a HF confirmation is merited. The NRC review and acceptance of SNC's low-frequency evaluation and HF confirmation (Item 4) for Farley will complete Seismic Hazard Evaluation identified in Enclosure 1 of the 50.54(f) letter.

REFERENCES

Note: ADAMS Accession Nos. refers to documents available through NRC's Agencywide Documents Access and Management System (ADAMS). Publicly-available ADAMS documents may be accessed through http://www.nrc.gov/reading-rm/adams.html.

U.S. Nuclear Regulatory Commission Documents and Publications

NRC (U.S. Nuclear Regulatory Commission), 2007, A Performance-based Approach to Define the Site-Specific Earthquake Ground Motion, Regulatory Guide (RG) 1.208, March 2007.

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NRC (U.S. Nuclear Regulatory Commission), 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, Director, Office of Nuclear Reactor Regulation, 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 for the Farley Site

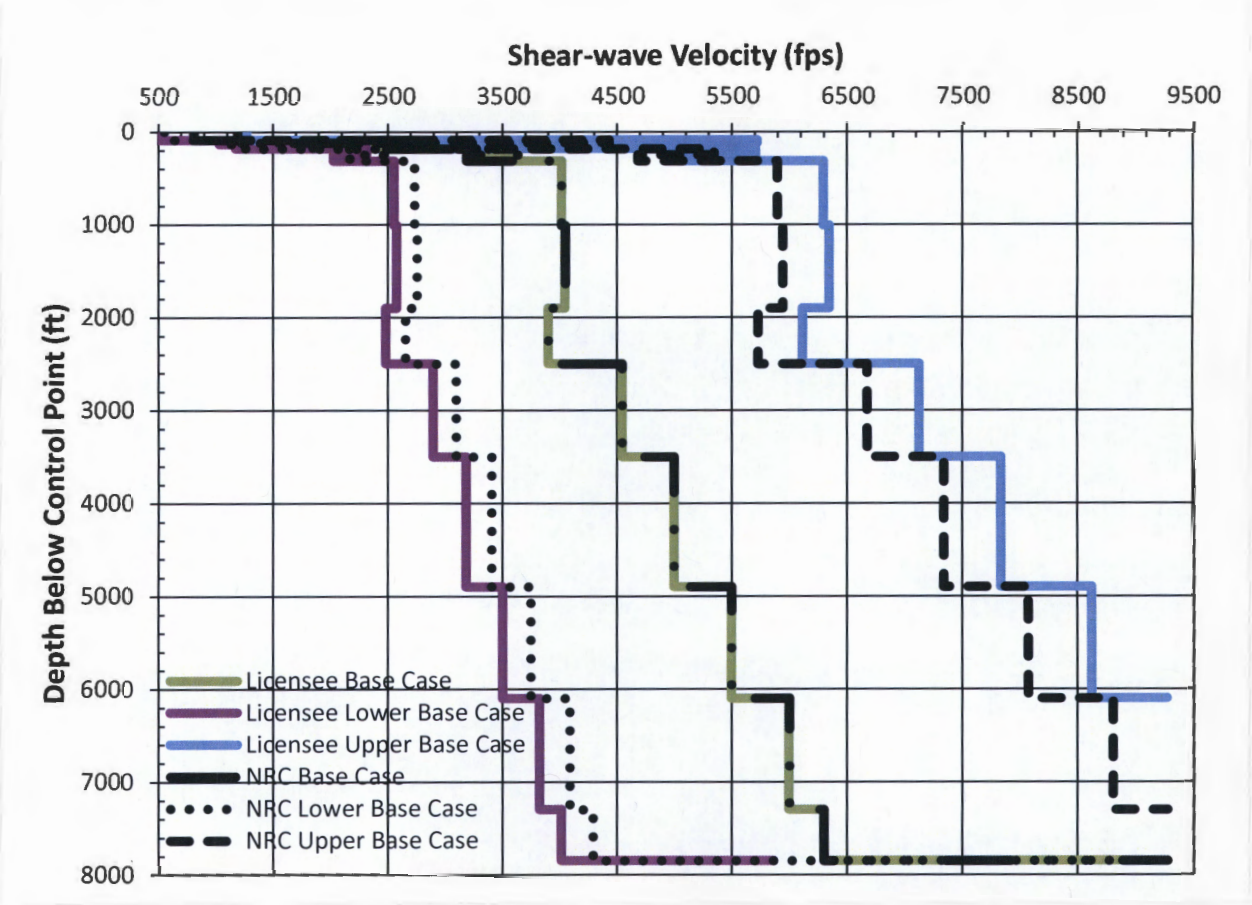

Figure 3.3- 1 Plot Comparing the Staff's and the Licensee's Median Amplification Functions and Uncertainties for the Farley Site.

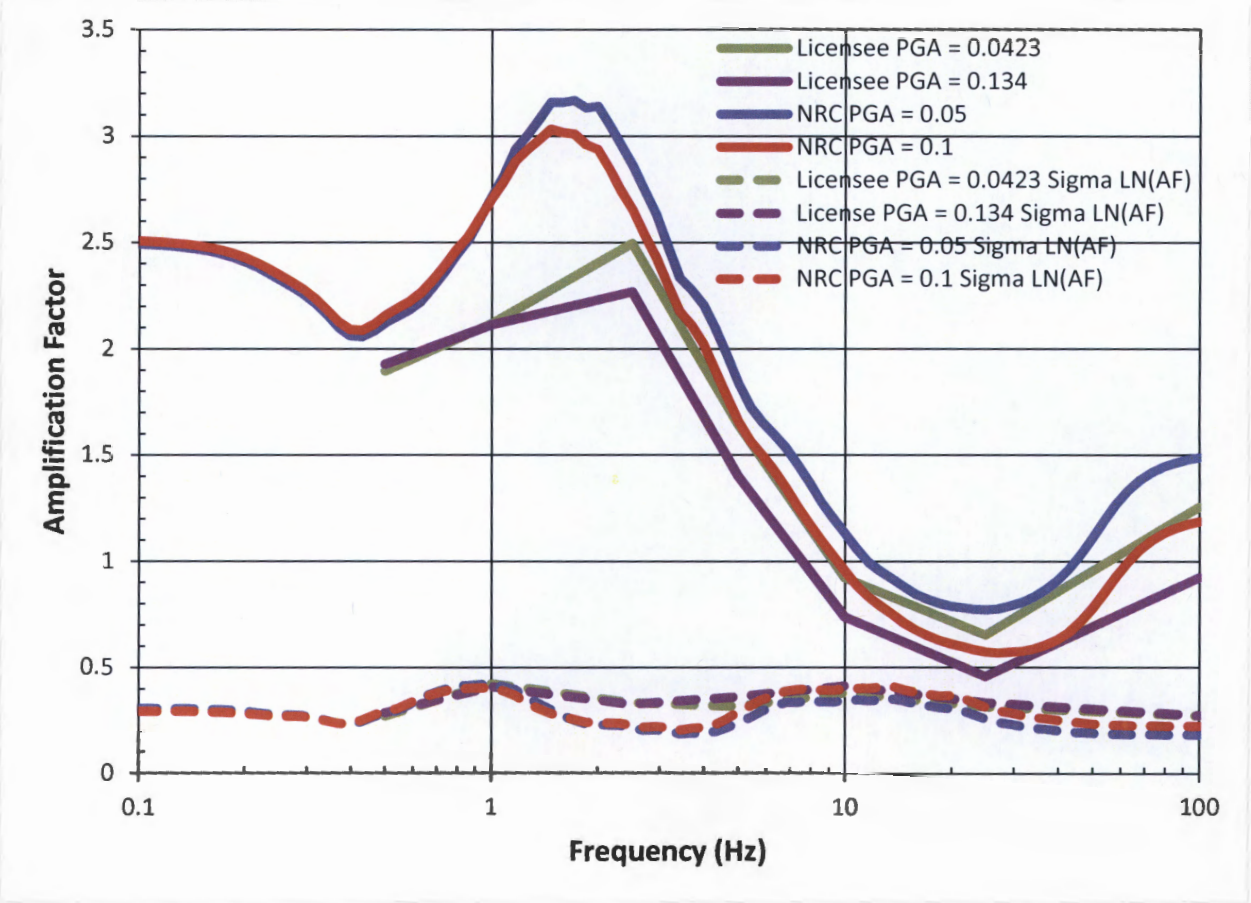

Figure 3.3-2 Plot Comparing the Staff's and the Licensee's Mean Control Point Hazard Curves at a Variety of Frequencies for the Farley Site

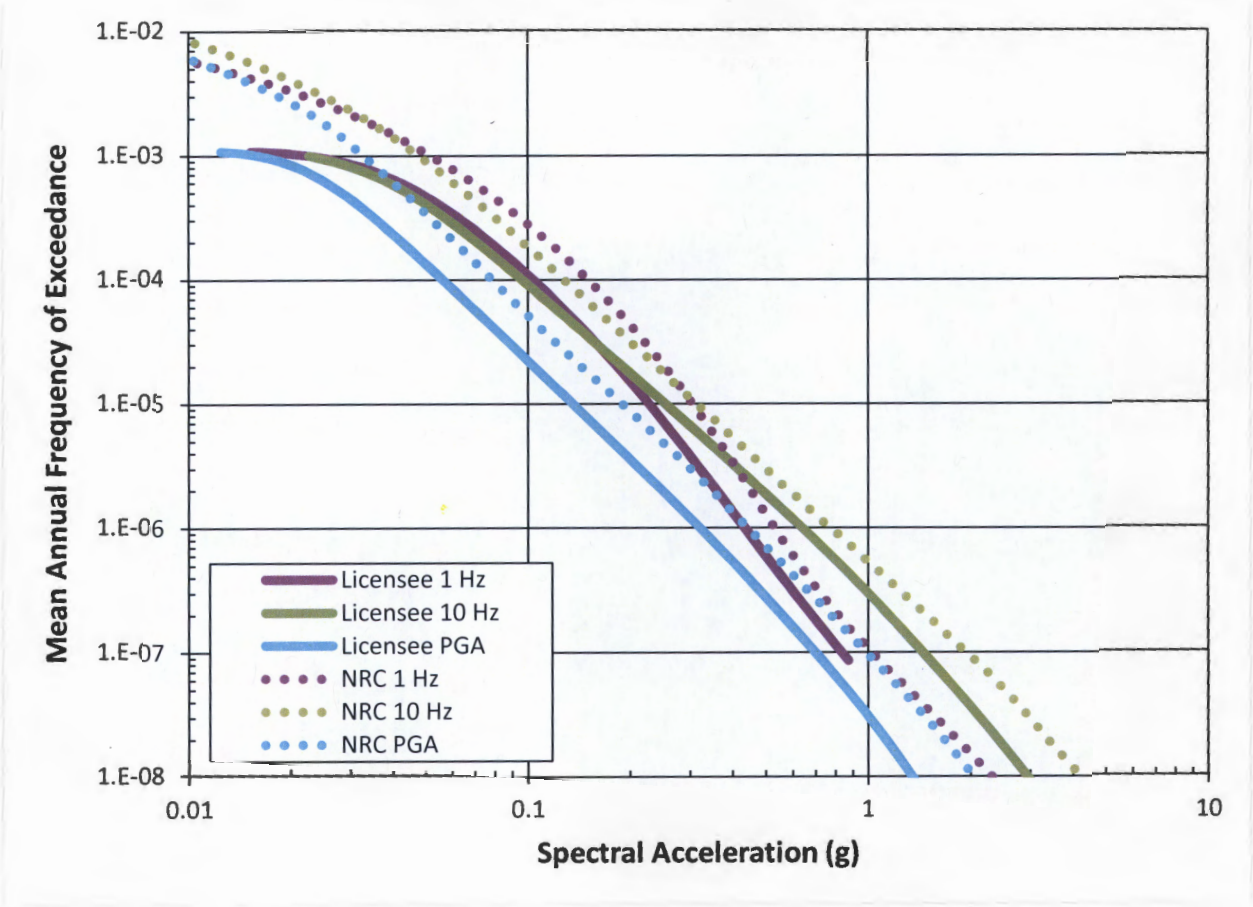

Figure 3.4-1 Comparison of the Staff's GMRS with Licensee's GMRS and the SSE for the Farley Site