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

April 27, 2015

Mr. C. R. Pierce
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SUBJECT: EDWIN I. HATCH 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 RELATING TO RECOMMENDATION 2.1 OF THE NEAR-TERM TASK FORCE REVIEW OF INSIGHTS FROM THE FUKUSHIMA DAI-ICHI ACCIDENT (TAC NOS. MF3772 AND MF3773)

Dear Mr. Pierce:

By letter dated March 12, 2012, the U.S. Nuclear Regulatory Commission (NRC) issued a request for information pursuant to Title 10 of the *Code of Federal Regulations*, Part 50, Section 50.54(f) (hereafter referred to as the 50.54(f) letter). The purpose of that request was to gather information concerning, in part, seismic hazards at each operating reactor site and to enable the NRC staff, using present-day NRC requirements and guidance, to determine whether licenses should be modified, suspended, or revoked.

By letter dated March 31, 2014, Southern Nuclear Operating Company, Inc. (SNC) responded to this request for Edwin I. Hatch Nuclear Plant, Units 1 and 2 (Hatch).

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

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

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

Sincerely,

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

Docket Nos. 50-321 and 50-366

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

EDWIN I. HATCH NUCLEAR STATION, UNIT S. 1 AND 2

DOCKET NOS. 50-321 AND 50-366

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 requested 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 licensees to submit Requested Information Items (1) through (7) within 1.5 years of the date of the 50.54(f) letter for sites within the Central and Eastern United States (CEUS). Specifically, the NRC requested that each addressee provide the following information:

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,

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

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

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

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

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

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

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

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

By letter dated November 27, 2012 (Keithline, 2012), the Nuclear Energy Institute (NEI) submitted Electric Power Research Institute (EPRI) report "Seismic Evaluation Guidance: Screening, Prioritization, and Implementation Details (SPID) for the Resolution of Fukushima Near-Term Task Force Recommendation 2.1 Seismic" (EPRI, 2012), hereafter referred to as 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 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 (Pierce, 2013), Southern Nuclear Operating Company, Inc. (the licensee, SNC), submitted partial site response information for Edwin I Hatch Nuclear Station, Units 1 and 2 (Hatch). By letter dated March 31, 2014 (Pierce, 2014), the licensee submitted its SHSR.

2.0 REGULATORY EVALUATION

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

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 requests that licensees conduct an evaluation of the local site response in order to develop site-specific hazard curves and GMRS for comparison with the plant SSE.

2.1 Screening Evaluation Results

By letter dated March 31, 2014 (Pierce, 2014), SNC provided the SHSR for Hatch, Units 1 and 2. The licensee's SHSR indicates that the site GMRS exceeds the SSE for Hatch, Units 1 and 2 over the frequency range of 1 to 10 Hertz (Hz). Therefore, the licensee indicated that it will perform a seismic risk evaluation and a SFP evaluation for Hatch, Units 1 and 2. Further, the licensee indicated that since the SSE also exceeds the GMRS above 10 Hz, that a high frequency confirmation will be performed for Hatch, Units 1 and 2.

On May 9, 2014 (NRC, 2014), the staff issued a letter providing the outcome of its 30-day screening and prioritization evaluation. As indicated in the letter, the staff confirmed the licensee's screening results. The response spectrum for Hatch, Units 1 and 2 over the frequency range of between 1 to 10 Hz and above 10 Hz. As such, a seismic risk evaluation, high-frequency confirmation and SFP evaluation are merited for Hatch, Units 1 and 2.

On January 20, 2015 (Pierce, 2015), the licensee provided additional information it developed for use in the Hatch, Units 1 and 2 seismic probabilistic risk assessment (SPRA).

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 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 bases for Hatch, Units 1 and 2. The licensee stated that the SSE for Hatch, Units 1 and 2 is based on a postulated earthquake producing a Modified Mercalli intensity of VII. Based on this earthquake, the Hatch, Units 1 and 2 SSE are defined in terms of a PGA of 0.15 g (15 percent of the acceleration due to earth's gravity). For Hatch Unit 1, the SSE is a Housner spectral shape while the Hatch, Unit 2 SSE is a Modified Newmark spectral shape.

The licensee specified that the SSE control point for Unit 1 and 2 is located at an elevation of 129 ft (39.3 m), which is general plant grade. The licensee noted that there are safety-related structures founded at the plant grade. The licensee also noted that there is a free field acceleration sensor that is surface mounted which further supports the location of the control point for the SSE and GMRS at plant grade.

The staff reviewed the licensee's description of its SSE for Hatch, Units 1 and 2 in the SHSR. To further confirm the SSE, the staff also reviewed the Hatch updated final safety analysis report (UFSAR), Revision 32 (SNC, 2014) and verified that it is consistent with the licensee's description in the SHSR. Finally based on review of the SHSR and the UFSAR, the staff confirmed that the licensee's control point elevation for both the Hatch, Units 1 and 2 SSEs is consistent with the guidance provided in the SPID.

3.2 Probabilistic Seismic Hazard Analysis

In Section 2.2 of the SHSR, the licensee stated that, in accordance with the 50.54(f) letter and the SPID, it performed a PSHA using the CEUS-SSC model and the updated EPRI GMM for the CEUS (EPRI, 2013). For its PSHA, the licensee used a minimum moment magnitude (**M**) 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 mi (640 km) and included the Charleston, Commerce, Eastern Rift Margin Fault northern segment, Eastern Rift Margin Fault southern segment, Marianna, New Madrid Fault System, and the Wabash Valley repeated large magnitude earthquake (RLME) sources, which lie within 620 mi (1,000 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. The licensee provided base rock seismic hazard curves in SHSR Section 2.2.2.

As part of its confirmatory analysis of the licensee's GMRS, the staff performed PSHA calculations for base rock site conditions at the Hatch 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 400 mi (640 km) radius of the Hatch site. In addition, the staff included all of the RLME sources falling within a 620 mi (1,000 km) radius of the site. For each of the CEUS-SSC sources used in the PSHA, the staff used the mid-continent version of the updated EPRI GMM (EPRI, 2013). The staff used the resulting base rock seismic hazard curves together with a confirmatory site response analysis, described in the next section, to develop control point seismic hazard curves and a GMRS for comparison with the licensee's results.

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

3.3 Site Response Evaluation

After completing PSHA calculations for reference rock site conditions, Attachment 1 to Enclosure 1 of the 50.54(f) letter requests that 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 the licensee perform a site response analysis.

Detailed site response analyses were not typically performed for many of older the 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 Hatch UFSAR (SNC, 2014). The licensee stated that the site is underlain by approximately 4,100 ft (1,250 m) of compacted and K-krete backfill and alternating layers of sand, limestones, marl, and clays overlying bedrock.

Geophysical investigations for the Hatch site consisted of independent spent fuel storage installation (ISFSI) pad investigations and nearby oil wells with gamma ray and sonic log data. The licensee provided a brief description of the subsurface materials in terms of geologic units and thicknesses in its SHSR. The licensee provided best-estimate velocities for the compacted backfill, K-krete, and in-situ materials in SHSR Tables 2.3.2-2 and 2.3.2-3 and SHSR Figures 2.3.2-1 and 2.3.2-2, respectively.

To characterize the subsurface geology, the licensee developed three site base case profiles. The middle, or best estimate, base case profile was developed using measured shear wave velocities from the ISFSI pad investigations for depths to 229 ft (70 m), linear interpolation was used for depths from 229 ft (70 m) to 509 ft (155 m), and nearby well data was used for portions of the profile deeper than 509 ft (155 m). To obtain the licensee's base case profile for depths greater than 509 ft (155 m), the licensee converted the well data from compressional wave velocities to shear wave velocities using a Poisson's ratio of 0.25. To account for uncertainty in

the profile, the licensee used a logarithmic standard deviation of 0.35 to develop the upper and lower base case profiles. Figure 3.3-1 of this assessment shows the licensee's three shear-wave velocity base case profiles.
In Section 2.3.2.1 of its SHSR, the licensee stated that no site-specific dynamic material properties were determined in the initial siting of Hatch, Units 1 and 2. Therefore, the licensee used the EPRI soil shear modulus reduction and hysteretic damping curves to a depth of 279 ft (85 m), Idriss and Boulanger (2010) curves for weathered rock for material between depths of 279 ft (85 m) to 509 ft (155 m), and assume linear behavior with no damping for material at depths greater than 509 ft (155 m).

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 Hatch site, the licensee determined that the deep soil kappa value of 0.04s dominates the profile and used a natural log standard deviation of 0.4 to estimate the upper and lower range values of kappa. Total profile kappa values for the best estimate, upper, and lower base case velocity profiles are 0.054, 0.060, and 0.052 sec, respectively.

To account for randomness in material properties across the plant site, the licensee randomized its base case shear-wave velocity profiles using a natural log standard deviation of 0.25 over the upper 90 ft (27.4 m) and a natural log standard deviation of 0.15 below that depth. Additionally, the licensee stated in Section 2.3.3 of its SHSR that it randomized its base case shear-wave velocity profiles using the guidance in the SPID.

3.3.2 Site Response Method and Results

In Section 2.3.4 of its SHSR, the licensee described the process used to develop input ground motions for the site response analysis. 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 seven 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, and the amplification functions and their associated uncertainties, determined from the site response analysis.

3.3.3 Staff Confirmatory Analysis

To confirm the licensee's site response analysis, the staff performed site response calculations for the Hatch site. The staff reviewed the licensee's site response analysis and performed confirmatory calculations to independently test the licensee's results following the guidance in Appendix B of the SPID.

To characterize the subsurface geology, the staff developed three site base case profiles. The middle, or best estimate, profile was developed using measured shear wave velocities from the ISFSI pad investigations for depths to 229 ft (70 m), the SPID template velocity profile for the layers between 229 ft (70 m) to 509 ft (155 m), and nearby well data for portions of the profile deeper than 509 ft (155 m). To obtain the its base case profile for depths great than 509 ft (155 m), the staff converted the well data from compressional wave velocities to shear wave velocities using relationships developed by Castagna (1985) and Brocher (2005). To account for uncertainty in the profile, the staff used a logarithmic standard deviation of 0.15 to develop the upper and lower base case profiles. Figure 3.3-1 of this assessment illustrates the velocity profiles the staff used in its confirmatory analysis.

In the absence of any site-specific dynamic material property measurements, the staff followed the SPID guidance for soil sites and selected two alternative characterizations of dynamic material behavior. In one characterization, the staff used the EPRI soil shear modulus reduction and hysteretic damping curves over the upper 276 ft (84 m), EPRI rock shear modulus reduction and hysteretic damping curves between depths of 276 ft (84 m) and 500 ft (152 m), and linear behavior with no damping below 500 ft (152 m). In the second characterization, the staff used the Peninsular Range shear modulus reduction and hysteretic damping curves over the upper 276 ft (84 m), linear behavior with 1 percent damping between depths of 276 ft (84 m) and 500 ft (152 m), and linear with no damping below 500 ft (152 m). The staff assigned equal weights to the two characterizations.

To determine kappa for its final case profiles, the staff calculated kappa for each shear wave profile using the seismic quality factor values from Campbell (2009), along with the shear wave velocities, and layer thicknesses for each layer to arrive at kappa values for the best estimate, upper, and lower base case velocity profiles of 0.044, 0.062, and 0.033 sec, respectively. The staff used a natural log standard deviation of 0.15 to estimate the upper and lower range values of kappa.

To account for randomness in material properties across the plant site, the staff 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 a natural log standard deviation of 0.15 below that depth. Additionally, the staff randomized its base case shear wave velocity profiles using the guidance in the SPID.

Figure 3.3-2 of this assessment shows a comparison of the staff's and licensee's median site amplification factors and uncertainties (±1 standard deviation) for two of the eleven input loading levels. The staff's median site amplification factors are similar to the licensee's, except where the staff's amplification factors are larger than the licensee's values, at frequencies of approximately 0.2 Hz and between 0.5 to 2.5 Hz.

Overall, the licensee's approach to modeling the subsurface rock properties and their uncertainties results in site amplification factors that are similar in shape but somewhat lower than the staff's site amplification factors. This result is due to the wide range between the licensee's three base case velocity profiles, which extend from velocities around 2,500 ft/sec (762 m/sec) for the lower base case profile to over 10,000 ft/sec (3049 m/sec) for the upper base case profile. These shear wave velocity values are consistent with material in between soil and rock (lower base case) to a very stiff hard rock (upper base case). In contrast, the staff characterized the site subsurface as a weaker rock site with interbedded layers of soil. As such, the staff used a standard deviation of 0.15 to develop the upper and lower base case profiles. In contrast, the licensee used a standard deviation of 0.35, which is recommended by the SPID for sites with little or no subsurface data.

However, as shown in Figure 3.3-3 of this assessment, the differences between the licensee's and staff's site response analyses do not have a significant impact on the control point seismic hazard curves over the important annual frequency of exceedance range of 10^{-4} to 10^{-6}. Appendix B of the SPID provides guidance for performing site response analyses, including capturing the uncertainty for sites with less subsurface data; however, the guidance is neither entirely prescriptive nor comprehensive.

In summary, the staff concludes that the licensee's site response was conducted using present-day guidance and methodology, including the NRC-indorsed SPID. The staff performed independent calculations to 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 Hatch site.

3.4 Ground Motion Response Spectra

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

The staff independently 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. For Unit 1, Figure 3.4-1 of this assessment shows a comparison of the GMRS determined by the licensee (SHSR GMRS), the GMRS determined by the staff (NRC GMRS), and the Hatch, Unit 1 SSE. For Unit 2, Figure 3.4-2 of this assessment shows a comparison of the GMRS determined by the licensee (SHSR GMRS), the GMRS determined by the staff (NRC GMRS), and the Hatch, Unit 2 SSE.

As shown in Figures 3.4-1 of this assessment, the licensee's GMRS shape differs somewhat from that calculated by the staff, although both exceed the SSE for Hatch, Unit 1 at all frequencies. In addition, as shown in Figure 3.4-2 of this assessment, the licensee's and staff's confirmatory GMRS both exceed the SSE for Hatch, Unit 2 at most frequencies. The NRC staff's confirmatory GMRS is slightly higher than the licensee's at frequencies between approximately 1.5 to 3 Hz and above 10 Hz for both Hatch, Units 1 and 2. Also shown in Figures 3.4-1 and 3.4-2 of this assessment is the Hatch SPRA GMRS described in Pierce (2015). As described in Pierce (2015), the licensee will use the Hatch SPRA GMRS and associated hazard curves for its SPRA analysis, rather than the GMRS described in the SHSR. Because the Hatch SPRA GMRS is higher than both the licensee's SHSR GRMS and staff's confirmatory GMRS, the staff concludes that the Hatch SPRA GMRS and its accompanying hazard curves are acceptable for use in response to the 50.54(f) letter.

The staff confirms that the licensee used the present-day guidance and methodology outlined in RG 1.208 and the SPID to calculate the horizontal GMRS, as requested in the 50.54(f) letter. As such, the staff concludes that both the SHSR and SPRA GMRS determined by the licensee adequately characterize the reevaluated hazard for the Hatch site. In addition, since the licensee's SPRA GMRS envelopes both the licensee's SHSR GMRS and the staff's confirmatory GMRS, it is suitable for use in subsequent evaluations and confirmations, as needed, for the response to the 50.54(f) letter, dated March 12, 2012. The 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 Hatch site. Based on its review, the staff concludes that the licensee conducted the hazard reevaluation using present-day methodologies and guidance, it appropriately characterized the site given the information available, and met the intent of the guidance for determining the reevaluated seismic hazard. Based upon the preceding analysis, the NRC staff concludes that the licensee provided an acceptable response to Requested Information Items (1) – (3), (5), (7), and a partial response to Item (4), identified in Enclosure 1 of the 50.54(f) letter. Further, the licensee's reevaluated seismic hazard is acceptable to address other actions associated with NTTF Recommendation 2.1, "Seismic."

In reaching this determination, the staff confirmed the licensee's conclusion that the licensee's GMRS for the Hatch site exceeds the SSE for Hatch Units 1 and 2 over the frequency range of 1 to 10 Hz, and also above the 10 Hz range. As such, the licensee will perform a seismic risk evaluation, which will include a high-frequency confirmation, and a SFP evaluation. NRC review and acceptance of SNC's seismic risk evaluation which includes the high frequency confirmation, an ESEP interim evaluation and a SFP evaluation (i.e., Items (4), (6), (8), and (9)) for Hatch, Units 1 and 2 will complete the Seismic Hazard Evaluation identified in Enclosure 1 of the 50.54(f) letter.

REFERENCES

Note: ADAMS Accession Nos. refers to documents available through NRC's Agencywide 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), 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.

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

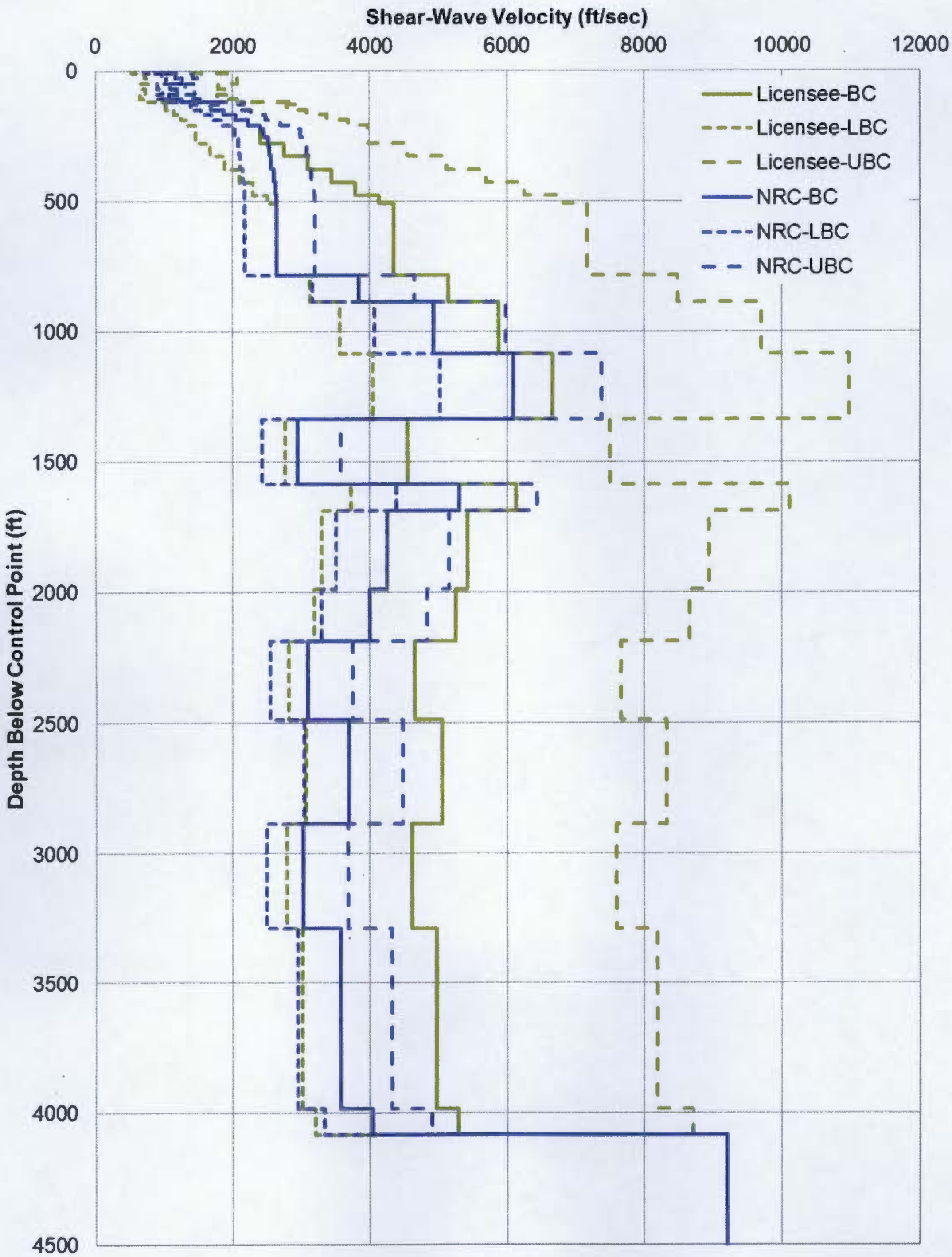


Figure 3.3-2 Plot Comparing the Staff's and the License's Median Amplification Functions and Uncertainties for two input loading levels for the Hatch site

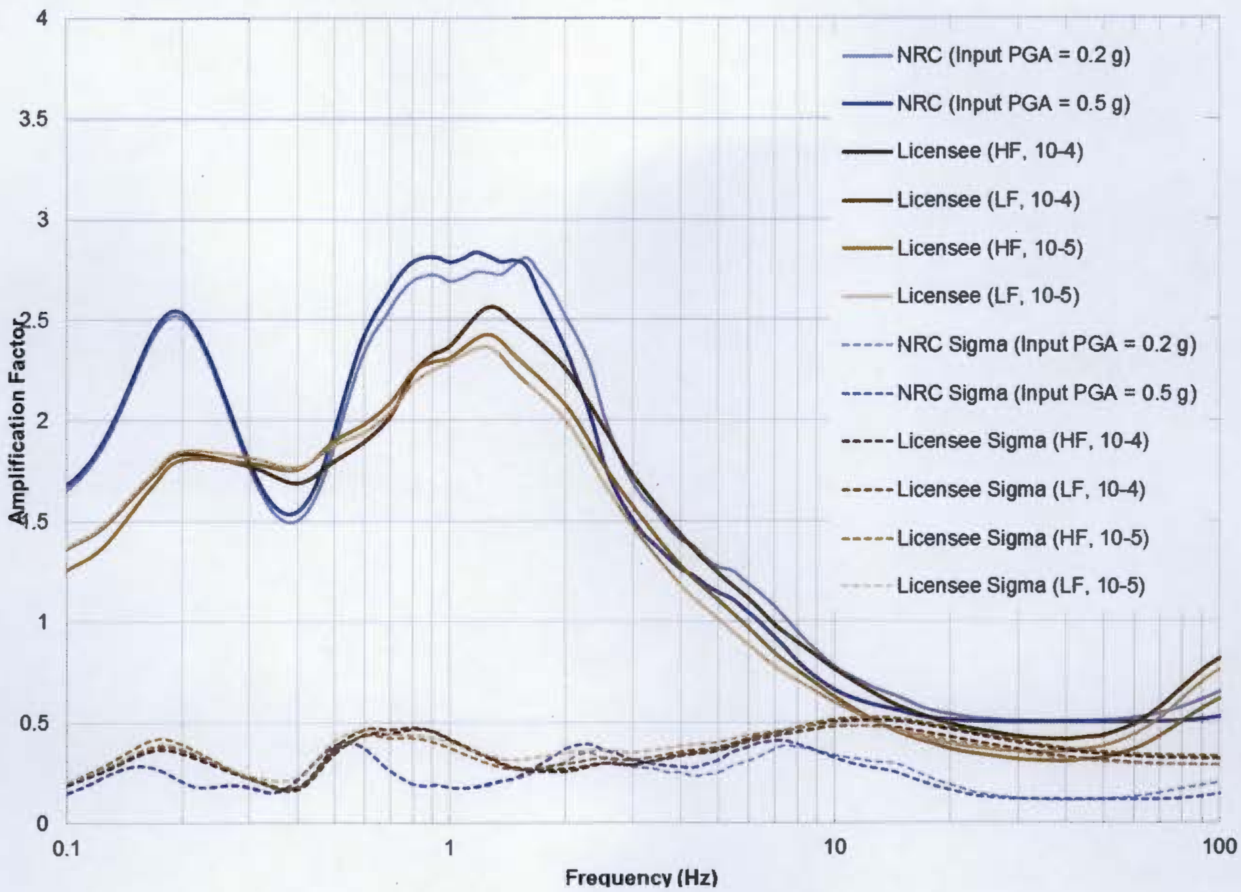


Figure 3.3-3 Plot Comparing the Staff's and the Licensee's Mean Control Point Hazard Curves at a Variety of Frequencies for the Hatch site

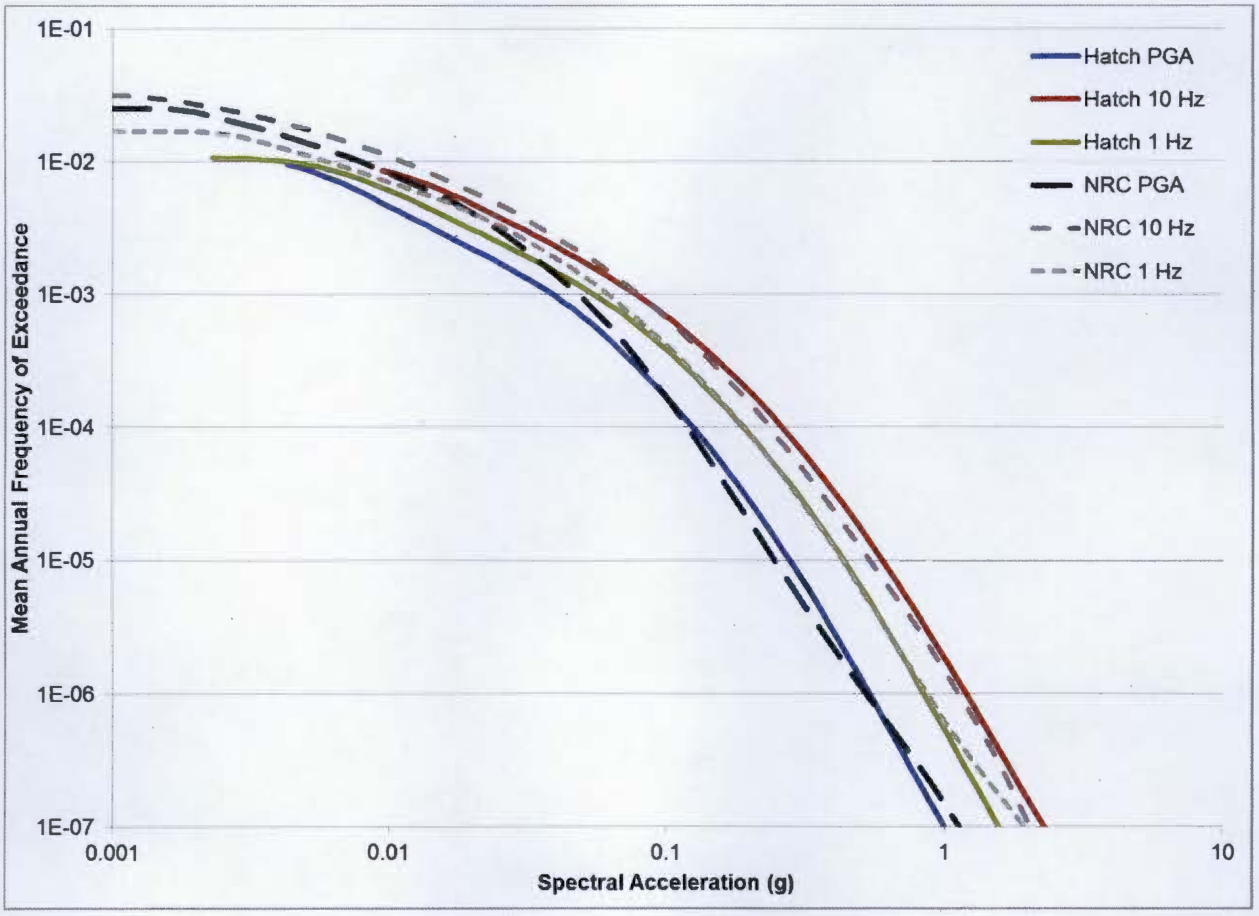


Figure 3.4-1 Comparison of the Staff's GMRS with Licensee's GMRS and the SSE for Hatch Unit 1

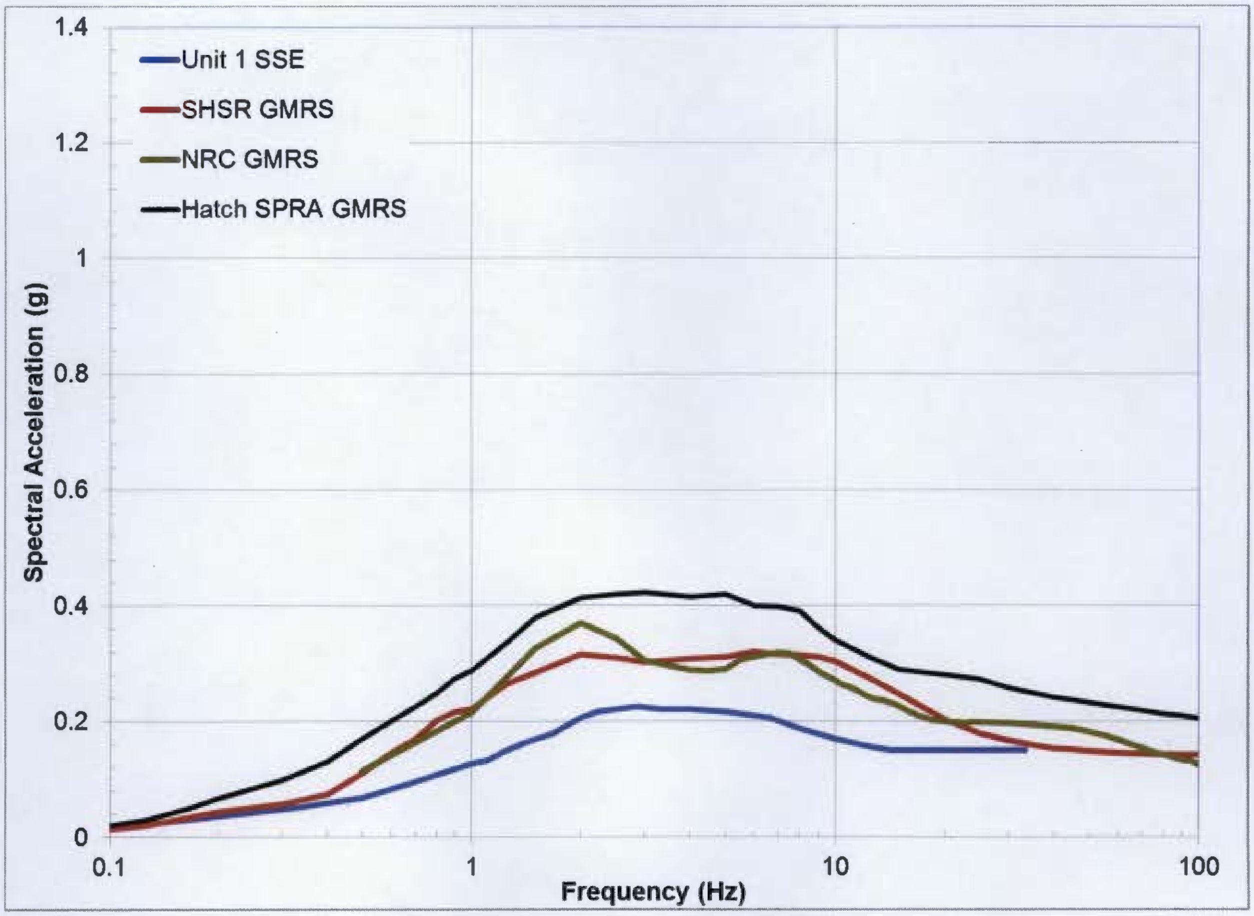
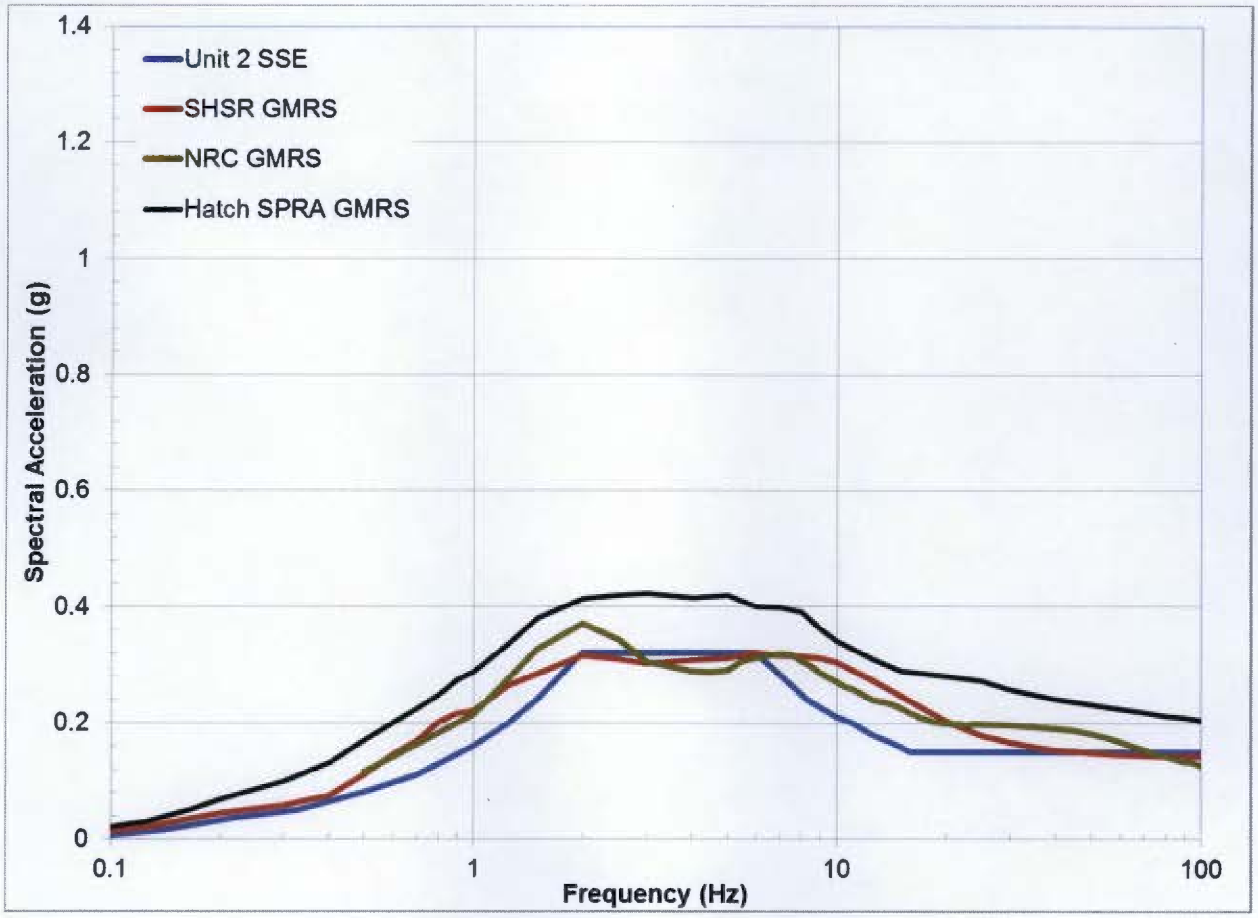


Figure 3.4-2 Comparison of the Staff's GMRS with Licensee's GMRS and the SSE for Hatch Unit 2



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

Sincerely,

/RA/

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

Docket Nos. 50-321 and 50-366

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