PMLevyCOLPEm Resource

From: Habib, Donald
Sent: Wednesday, June 20, 2012 8:52 AM
To: john.mcconaghy@duke-energy.com
Subject: FW: Draft LNP RAI response - Seismic Evaluation
Attachments: RAI L-0998 Response Outline 06-18-12.pdf

Mr. McConaghy -

Attached is the handout for the public meeting. It is in ADAMS, but I don't think it is publicly available yet.

Thank you
Don Habib

Hearing Identifier: Levy_County_COL_Public
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NRC RAI

Evaluate the seismic hazard at your site against current NRC requirements and guidance and, if necessary, update the design basis and structures systems and components important to safety to protect against updated hazards (seismic portion only – of detailed Recommendation 2.1 – Enclosure 7 of SECY-12-0025).

Response L-0998 Outline:

Sensitivity evaluations were performed to develop LNP site hard rock seismic hazard, finished grade 10^{-5} Uniform Hazard Response Spectra (UHRS), Ground Motion Response Spectra (GMRS), finished grade Performance Based Surface Response Spectra (PBSRS), and Foundation Interface Response Spectra (FIRS) (EL +11 ft.) using the Central and Eastern United States Seismic Source Characterization (CEUS SSC) (NUREG 2115) methodology and the modified cumulative absolute velocity (CAV) filter (NRC SECY-2012-0025 Enclosure 7 – Attachment 1 to Enclosure 1). The LNP site hard rock seismic hazard, finished grade 10^{-5} UHRS, GMRS, finished grade PBSRS, and FIRS (EL +11 ft.) using the CEUS SSC model were compared to the corresponding hazard and response spectra using the Electric Power Research Institute Seismic Owners Group (EPRI SOG) methodology. It was concluded that the site specific designs (liquefaction evaluations, Soil Structure Interaction (SSI) analysis, and the evaluations for seismic interaction between the Annex Building (AB), Turbine Building (TB), and Radwaste Building (RB) with the nuclear island) for the CEUS SSC methodology ground motions are bounded by that for the EPRI SOG methodology currently presented in the FSAR. Similarly, the Seismic Margin Assessments for the standard plant components, site liquefaction potential, adjacent buildings' seismic interaction with the nuclear island, and the RCC bridging mat capacity for the CEUS SSC methodology ground motions are bounded by that for the EPRI SOG methodology currently presented in the FSAR.

<u>CEUS SSC Evaluations</u>

The CEUS SSC methodology, verification of the CEUS SSC methodology implementation, the LNP site hard rock seismic hazard, finished grade 10^{-5} UHRS, GMRS, finished grade PBSRS, FIRS (EL +11 ft.), and their comparison to the corresponding LNP site seismic hazards and amplified ground motions (to meet 10 CFR Part 50 Appendix S requirements) using the EPRI SOG model currently presented in the FSAR can be summarized as follows:

- Methodology for CEUS SSC Evaluations
    - Methodology
    - Design Inputs
- Verification of Implementation of CEUS SSC Model
    - Overview of CEUS SSC Model
    - Hazard Inputs
    - Summary Hazard Results at Demonstration sites
- Seismic Hazard at LNP Site using the CEUS SSC Model
    - Hard Rock Hazard Results
    - Comparison of hard rock UHRS from FSAR Subsection 2.5.2.4.4 and CEUS SSC (Figure RAI L-0998-1)
    - Rock Hazard Deaggregation (text and figures)
    - Comparison of finished grade CEUS 10^{-5} UHRS with EPRI SOG finished

    grade 10^{-5} UHRS (Figure RAI L-0998-4)

- Ground Motion Response Spectra
    - Horizontal GMRS with modified CAV filter
    - Comparison of CEUS Modified CAV filter GMRS with CSDRS and EPRI SOG GMRS (Figure RAI L-0998-2)
    - Comparison of 1.67*GMRS developed using the CEUS SSC methodology and modified CAV filter with the EPRI SOG 10^{-5} UHRS (Figure RAI L-0998-6)
- PBSRS and FIRS for CEUS SSC with Modified CAV filter
    - CEUS SSC PBSRS
    - Comparison of CEUS SSC PBSRS with scaled EPRI SOG PBSRS and CSDRS (Figure RAI L-0998-3)
    - Comparison of 1.67* PBSRS, developed using the CEUS SSC methodology and modified CAV filter, with the EPRI SOG 10^{-5} UHRS (Figure RAI L-0998-7)
    - Horizontal CEUS SSC FIRS (EL+11 ft.)
    - Comparison of CEUS SSC FIRS with scaled EPRI SOG FIRS (Figure RAI L-0998-5)
    - Vertical CEUS SSC FIRS (EL +11 ft.) - The vertical will scale directly with the horizontal FIRS as the V/H ratios are unaffected.

<u>Site Liquefaction Evaluations</u>

The soils under the nuclear island (NI) will be excavated and backfilled with Roller Compacted Concrete (RCC). Thus, no liquefaction potential exists under the NI foundation. To evaluate the liquefaction potential of soils under the adjacent AB, TB, and RB, earthquake induced cyclic stresses in the soil column were based on ground motions consistent with the finished grade scaled PBSRS. As shown in Figure RAI L-0998-3, the CEUS SSC PBSRS is enveloped by the EPRI SOG scaled PBSRS. Thus, the liquefaction evaluations based on the EPRI SOG LNP ground motions bound those from the CEUS SSC ground motions.

<u>Soil Structure Interaction Analysis</u>

The scaled EPRI SOG scaled FIRS (EL +11 ft.) was the input ground motion for the LNP site specific SSI analysis. As shown in Figure RAI L-0998-5, the CEUS SSC FIRS (EL +11 ft.) is enveloped by the EPRI SOG scaled FIRS (EL +11 ft.). Thus, the conclusions of the LNP site specific SSI analysis that the LNP floor response spectra (FRS) at the six key locations are bounded by the CSDRS FRS and the maximum bearing pressure is less than the 24 ksf design value are also valid for the for the LNP site ground motions based on the CEUS SSC model.

<u>Seismic Interaction between the Adjacent Buildings with the Nuclear Island</u>

The EPRI SOG scaled finished grade PBSRS was used to show that there is no interaction between the adjacent AB, TB, and RB with the NI. As shown in Figure RAI L-0998-3, the CEUS SSC finished grade PBSRS is enveloped by the EPRI SOG scaled finished grade PBSRS. Thus, the conclusions that there is no interaction between the adjacent AB, TB, and RB with the NI is valid for the LNP site ground motions based on the CEUS SSC model.

Seismic margin Analysis

As shown in Figures RAI L-0998-2 and RAI L-0998-3, both the CEUS SSC GMRS and the PBSRS are enveloped by the AP1000 CSDRS. As discussed above, the CEUS SSC LNP site specific floor response spectra (FRS) at the six key locations are bounded by the CSDRS FRS and the maximum bearing pressure is less than the 24 ksf design value. Thus, LNP site unique foundation conditions and CEUS SSC ground motions do not lower the High Confidence Low Probability of Failure (HCLPF) values calculated for the certified design.

To evaluate the HCLPF liquefaction potential of soils under the adjacent AB, TB, and RB, earthquake induced cyclic stresses in the soil column based on ground motions consistent with the EPRI SOG finished grade 10^{-5} UHRS were used. As shown in Figures RAI L-0998-6 and RAI L-0998-7, 1.67*GMRS and 1.67*PBSRS developed using the CEUS SSC methodology and modified CAV filter are enveloped by the EPRI SOG finished grade 10^{-5} UHRS. Thus, HCLPF capacity for no liquefaction potential of soil under the AB, TB, and RB exceeds the 1.67*GMRS goal for the plant level HCLPF for the CEUS SSC ground motions.

To calculate the HCLPF capacity for seismic interaction between the AB, TB, and RB and the NI, the AB, TB, and RB displacements relative to the NI were calculated using the EPRI SOG finished grade 10^{-5} UHRS. As shown in Figures RAI L-0998-6 and RAI L-0998-7, 1.67*GMRS and 1.67*PBSRS developed using the CEUS SSC methodology and modified CAV filter are enveloped by the EPRI SOG finished grade 10^{-5} UHRS. Thus, HCLPF capacity for no seismic interaction between the AB, TB, and RB and the NI exceeds the 1.67*GMRS goal for the plant level HCLPF for the CEUS SSC ground motions.

The HCLPF capacity of the RCC mat was calculated as 0.30g using the conservative deterministic failure margin (CDFM) methodology of FSAR Reference 19.55.7-201. The peak ground acceleration for the CEUS SSC GMRS is 0.0731. Thus, the 0.30g HCLPF capacity of the RCC bridging mat exceeds the overall plant HCLPF acceptance criteria of 1.67*GMRS using the CEUS SSC methodology and modified CAV filter.

FSAR Revisions

FSAR revision are shown in the attached markup for Subsections 2.5.0, 2.5.2, 3.7, and 19.55

Figures

New Figures RAI L-0998-1 through RAI L-0998-7 are attached

Rock UHRS

Figure RAI L-0998-1 compares the hard rock UHRS based on the EPRI-SOG/UCSS source model used in the FSAR to the hard rock UHRS based on the CEUS SSC source model. The rock UHRS based on the CEUS SSC model are somewhat lower at spectral frequencies above 2.5 Hz and are similar to the Calculation LNP-0000-X7C-031 results for lower spectral frequencies. The only place where the CEUS SSC model produces higher motions is for the 10^{-3} UHRS at low frequencies. This higher hazard is likely due to the larger maximum magnitudes for the distributed seismicity sources in the CEUS SSC model.

FSAR – EPRI-SOG/UCSS (Updated Charleston Seismic Source)

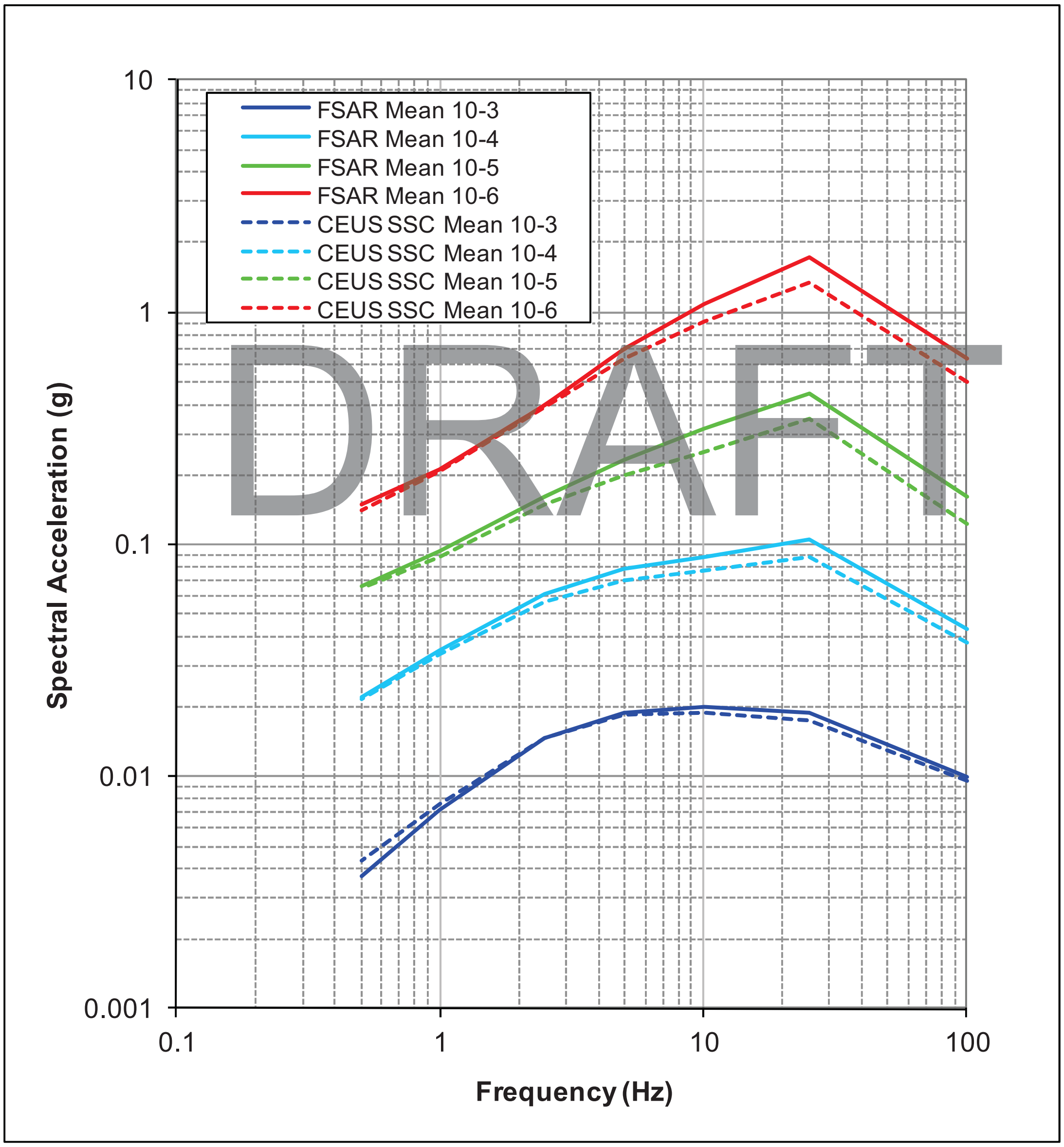

Figure RAI L-0998-1: Comparison of hard rock UHRS based on the EPRI-SOG/UCSS model from FSAR with hard rock UHRS using CEUS SSC model.

GMRS

Figure RAI L-0998-2 compare the scaled GMRS based on the EPRI-SOG/UCSS model with full CAV with the GMRS based on the CEUS SSC model with modified CAV. The scaled GMRS based on the CEUS SSC is lower than the GMRS based on the EPRI-SOG/UCSS model with full CAV except for frequencies between 0.2 and 2 Hz where the maximum increase is approximately 4 percent at 1 Hz.

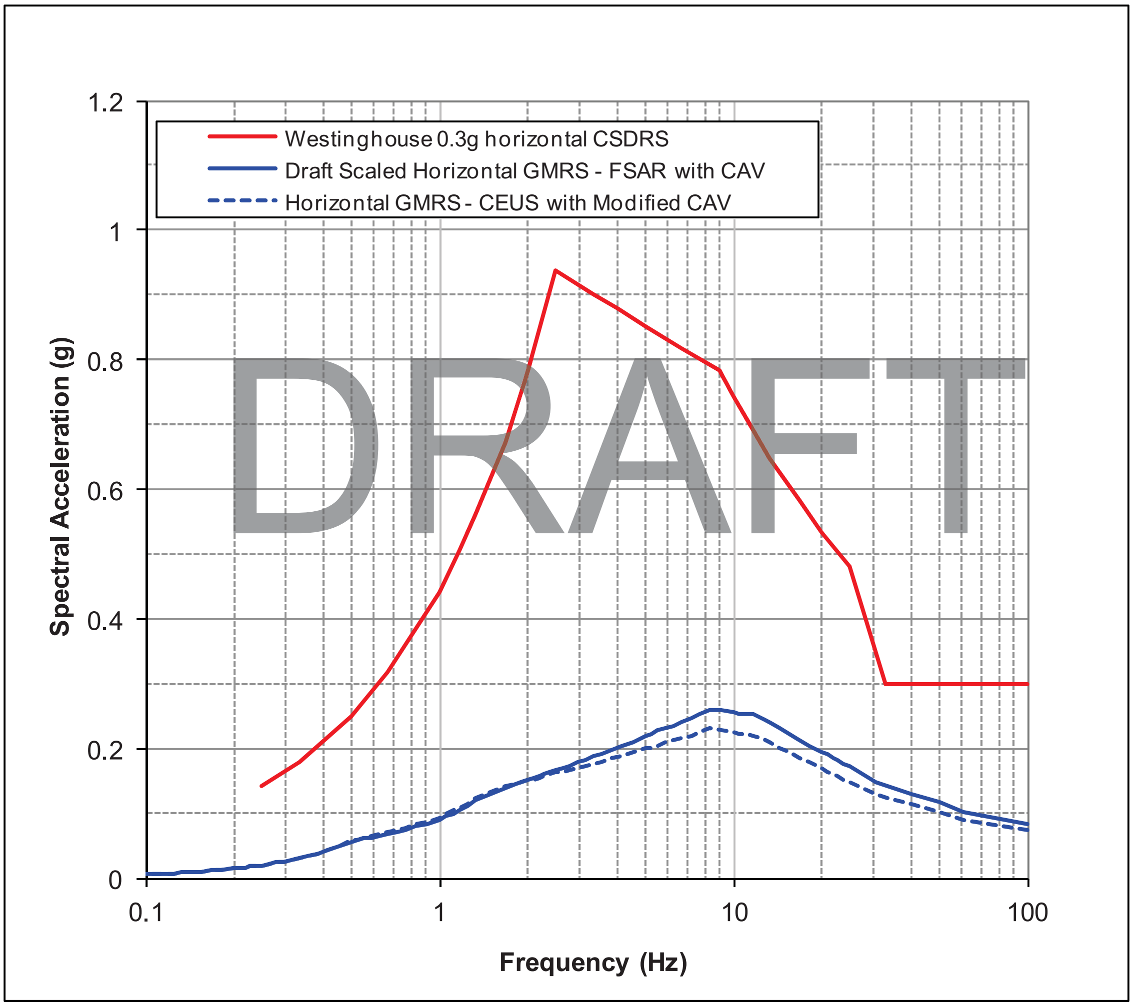

Figure RAI L-0998-2: Comparison of scaled GMRS based on EPRI-SOG/UCSS model with full CAV with the GMRS based on the CEUS SSC model with modified CAV

Figure RAI L-0998-3 compares the scaled PBSRS based on the EPRI-SOG/UCSS model with full CAV with the PBSRS based on the CEUS SSC model with modified CAV. The PBSRS based on the CEUS SSC model is enveloped by the scaled PBSRS based on the EPRI-SOG/UCSS model at all frequencies,

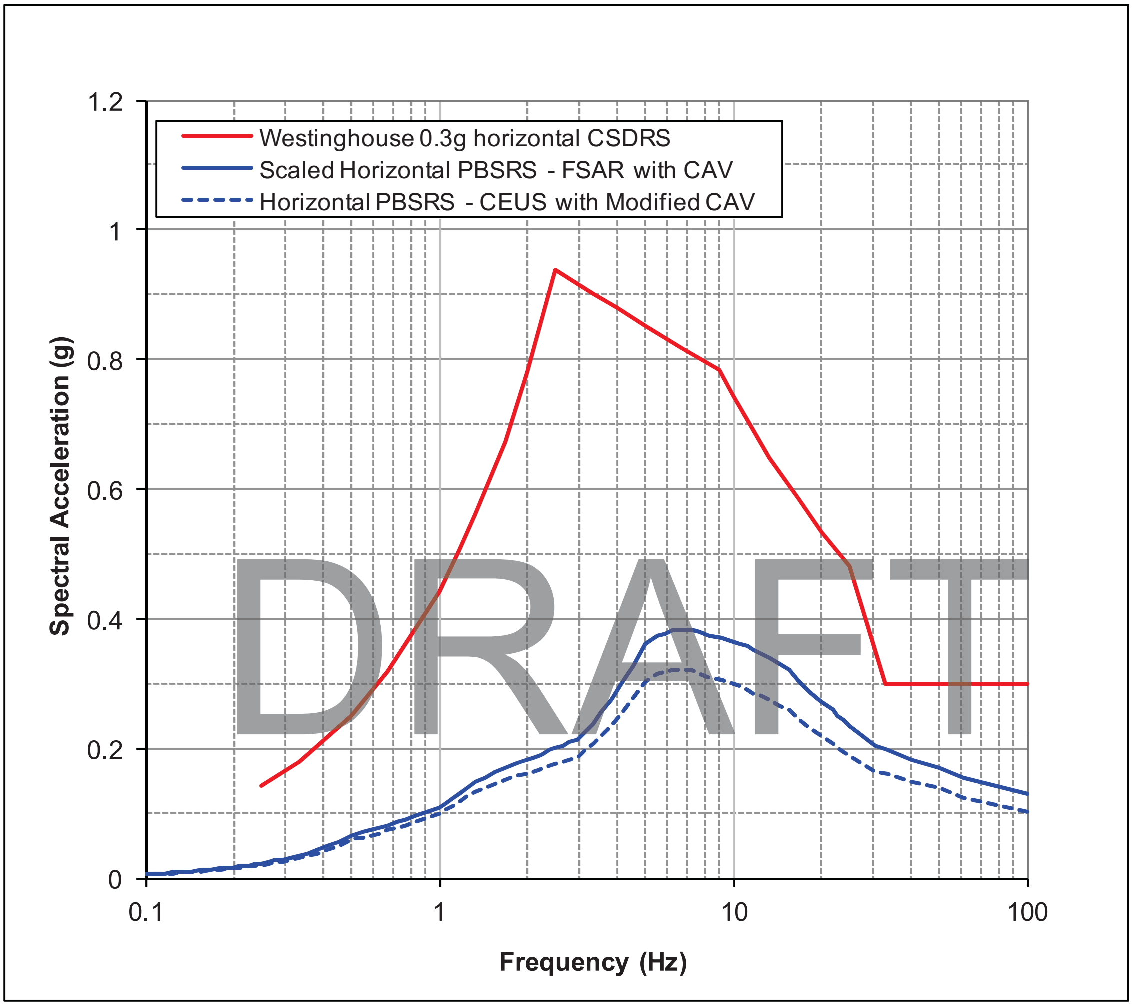

Figure RAI L-0998-3: Comparison of PBSRS based on EPRI-SOG/UCSS model with full CAV with the PBSRS based on the CEUS SSC model with modified CAV

Figure RAI L-0998-4 compares the 10^{-5} UHRS based on the EPRI-SOG/UCSS model with full CAV with the 10^{-5} UHRS based on the CEUS SSC model with modified CAV. The 10^{-5} UHRS based on the CEUS SSC model is enveloped by the scaled 10^{-5} UHRS based on the EPRI-SOG/UCSS model at all frequencies except in the frequency range of 0.5 to 1.7 Hz where the 10^{-5} UHRS based on the CEUS SSC model is up to 1.7 percent higher.

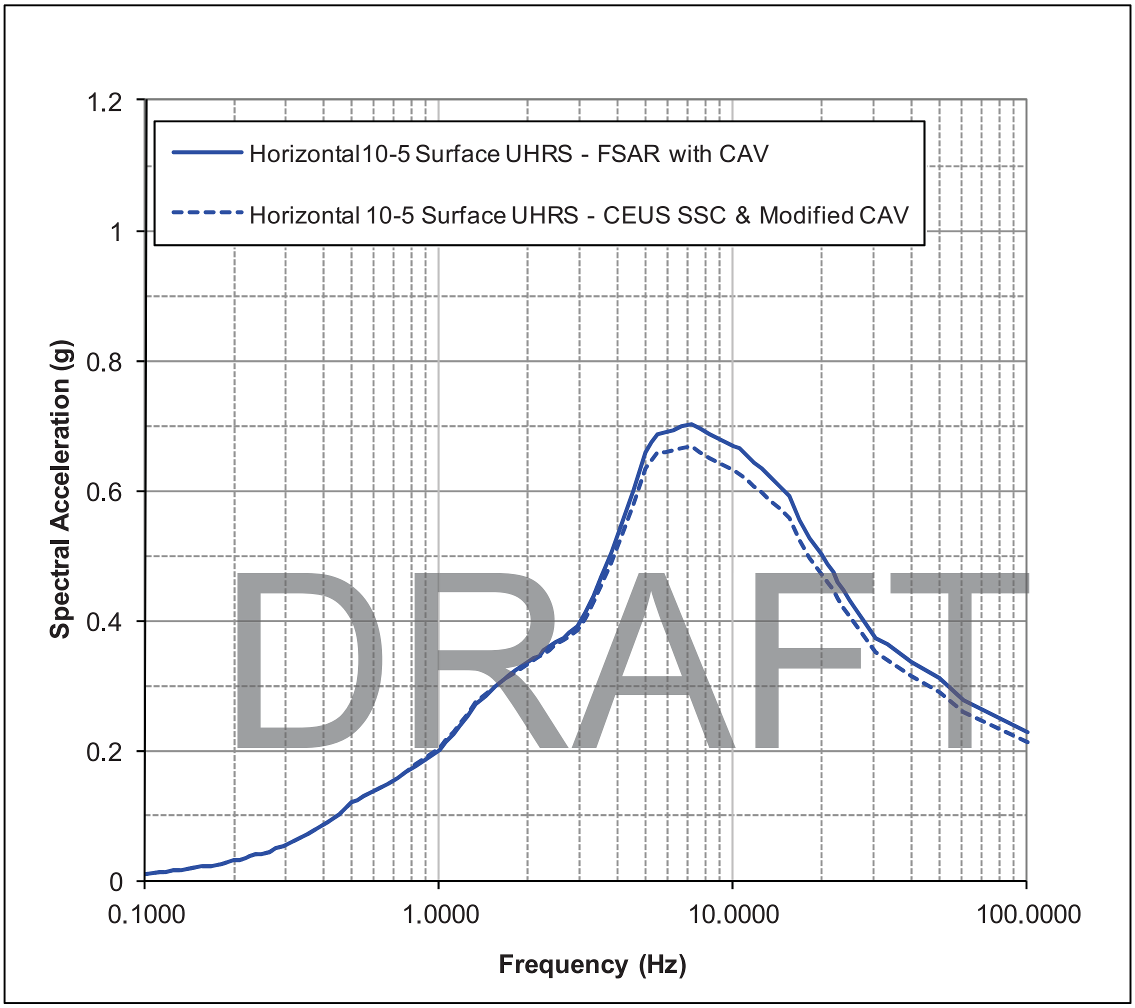

Figure RAI L-0998-4: Comparison of 10^{-5} surface UHRS based on EPRI-SOG/UCSS model with full CAV with the 10^{-5} surface UHRS based on the CEUS SSC model with modified CAV.

Figure RAI L-0998-5 compares the scaled Reactor Building FIRS based on the EPRI-SOG/UCSS model with full CAV with the Reactor Building FIRS based on the CEUS SSC model with modified CAV. The Reactor Building FIRS based on the CEUS SSC model is enveloped by the scaled Reactor Building FIRS based on the EPRI-SOG/UCSS model at all frequencies.

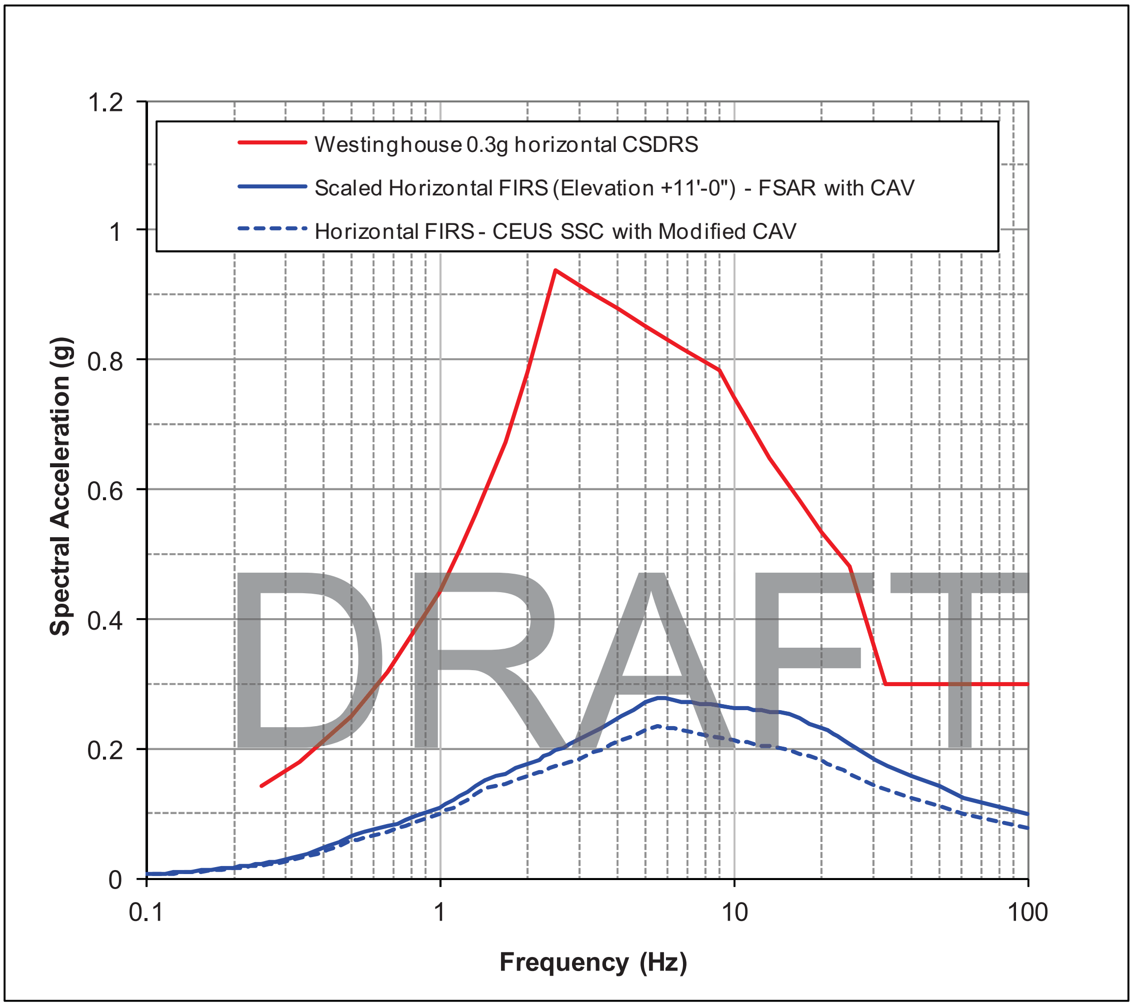

Figure RAI L-0998-5: Comparison of RB FIRS (+11 ft) based on EPRI-SOG/UCSS model with full CAV with the RB FIRS based on the CEUS SSC model with modified CAV

Figures RAI L-0998-6 and -7 compare the 10^{-5} horizontal surface UHRS based on the EPRI-SOG/UCSS model with full CAV to 1.67 x the GMRS and PBSRS, respectively, based on the CEUS SSC model with modified CAV. The 1.67 x the GMRS and PBSRS based on the CEUS SSC model with modified CAV are enveloped by the 10^{-5} horizontal surface UHRS based on the EPRI-SOG/UCSS model with full CAV.

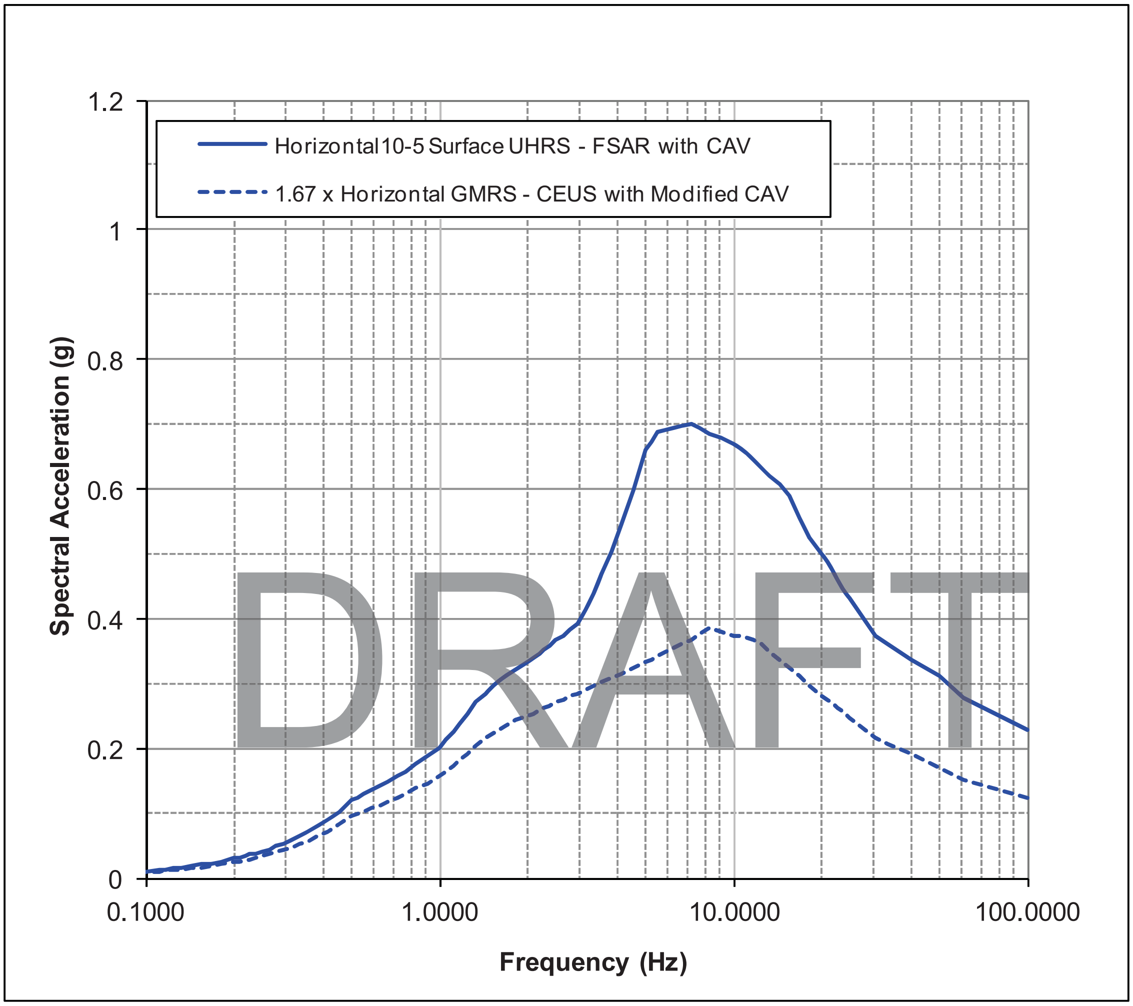

Figure RAI L-0998-6: Comparison of the horizontal 10^{-5} UHRS at finished grade developed using the EPRI-SOG/UCSS source model presented in the FSAR with 1.67 x the GMRS developed using the CEUS SSC model with modified CAV.

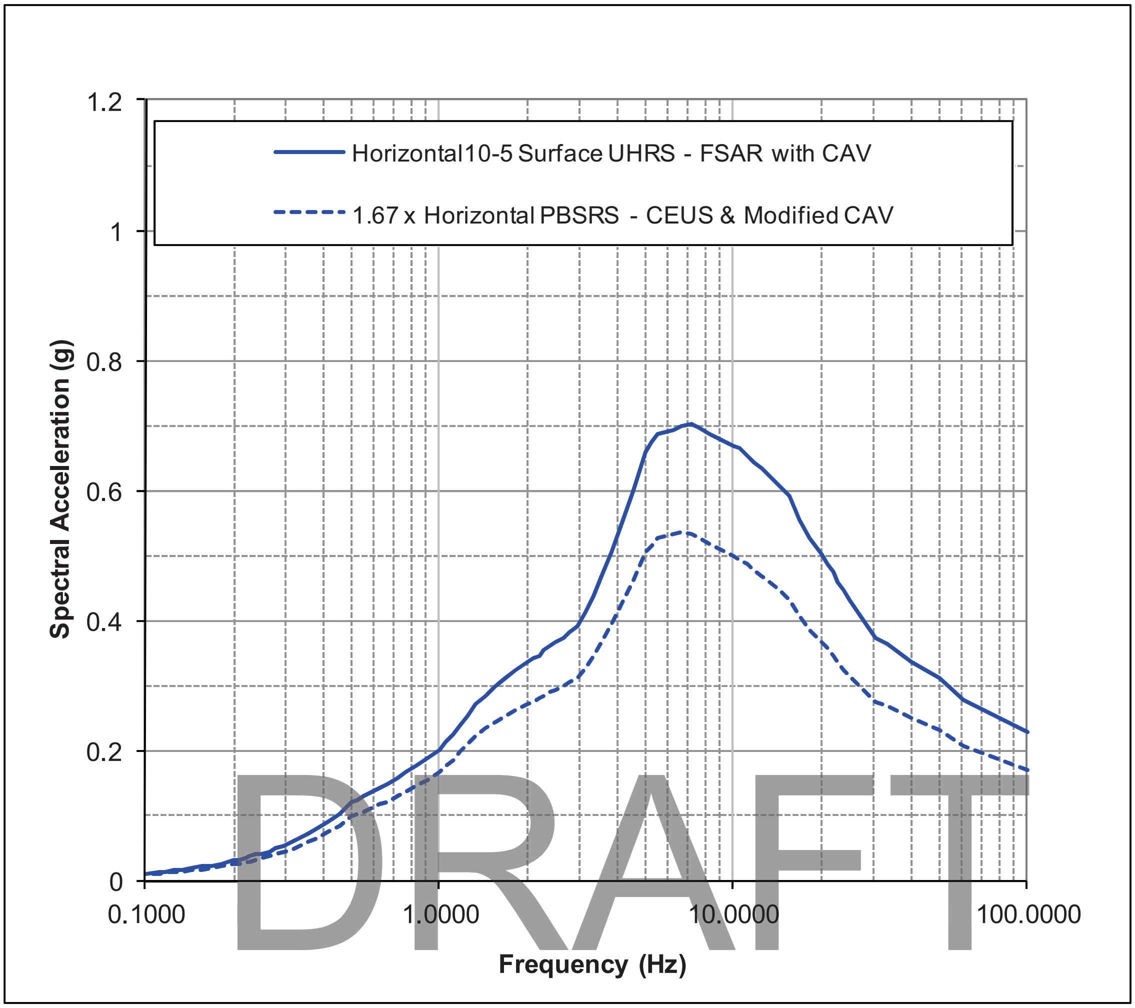

Figure RAI L-0998-7: Comparison of the horizontal 10^{-5} UHRS at finished grade developed using the EPRI-SOG/UCSS source model presented in the FSAR with 1.67 x the PBSRS developed using the CEUS SSC model with modified CAV.

PGA Values

Table 1 compares the PGA values based on the CEUS SSC model with those based on the EPRI-SOG/UCSS model. The PGA values based the CEUS model are lower than those based on the EPRI-SOG/UCSS model.

Table 1: Peak Ground Accelerations Computed from nonCAV Hazard

Elevation	Parameter	Value Computed from EPRI-SOG/UCSS Source Model	Value Computed from CEUS SSC Source Model
GMRS (+32 ft)	10^{-4} PGA	0.060	0.050
	10^{-5} PGA	0.193	0.144
	ASCE/SEI PGA	0.092	0.070
PBSRS (+51 ft)	10^{-4} PGA	0.081	0.069
	10^{-5} PGA	0.246	0.186
	ASCE/SEI PGA	0.118	0.091
Base of Excavation (-24 ft)	10^{-4} PGA	0.047	0.040
	10^{-5} PGA	0.148	0.111
	ASCE/SEI PGA	0.071	0.054

LNP SUP 2.0-1

Table 2.0-201 (Sheet 2 of 9)
Comparison of AP1000 DCD Site Parameters and LNP Site Characteristics

	AP 1000 DCD Site Parameters	LNP Site Characteristics	LNP Site Characteristic Reference	Bounding Yes/No
Seismic				
CSDRS	CSDRS free field peak ground acceleration of 0.30 g with modified Regulatory Guide 1.60 response spectra (see Figures 5.0-1 and 5.0-2.). The SSE is now referred to as CSDRS. Seismic input is defined at finished grade except for sites where the nuclear island is founded on hard rock. If the site-specific spectra exceed the response spectra in Figures 5.0-1 and 5.0-2 at any frequency, or if soil conditions are outside the range evaluated for AP1000 design certification, a site-specific evaluation can be performed. This evaluation will consist of a site-specific dynamic analysis and generation of in-structure response spectra at key locations to be compared with the floor response spectra of the certified design at 5 percent damping. The site is acceptable if the floor response spectra from the site-specific evaluation do not exceed the AP1000 spectra for each of the locations or the exceedances are justified. The HRHF envelope response spectra are shown in Figure 5.0-3 and Figure 5.0-4 defined at the foundation level for 5 percent damping. The HRHF envelope response spectra provide an alternative set of spectra for evaluation of site-specific GMRS. A site is acceptable if its site-specific GMRS falls within the AP1000 HRHF envelope response spectra. Evaluation of a site for application of the HRHF envelope response spectra includes consideration of the limitation on shear wave velocity identified for use of the HRHF envelope response spectra. This limitation is defined by a shear wave velocity at the bottom of the basemat equal to or higher than 7,500 ft/sec, while maintaining a shear wave velocity equal to or above 8,000 ft/sec at the lower depths. [d]	For EPRI SOG SSC peak ground acceleration: 0.069 g horizontal 0.051 g vertical For CEUS SSC peak ground acceleration: 0.0731 g horizontal GMRS peak ground acceleration defined at 100 Hz. Ground Response Spectra: At LNP 1 and LNP 2: The horizontal and vertical EPRI SOG GMRS are bounded by the CSDRS (Figure 2.5.2-296). The CEUS SSC horizontal GMRS is also bounded by the CSDRS (Subsection 2.5.2.7).	FSAR Subsections 2.5.2.6 and 3.7	Yes

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separating the Upper Floridan aquifer within the Avon Park Formation from the Lower Floridan aquifer within the Oldsmar Limestone.

The LNP site stratigraphy and surface morphology are consistent with expected characteristics of a developed, older (paleo) karst landscape mantled by several meters of sand (i.e., a mantled epikarst subsurface). Although there are no recognized sinkholes in the State of Florida sinkhole database or the SDII Global Corporation's much larger, private database (Reference 2.5.1-328) within 2 km (1.28 mi.) of the LNP site and no sinkholes at the land surface were observed during site investigations and reconnaissance within the LNP site, the presence of a few voids at depths identified in some borings suggests that paleo sinks such as those developed on the barren mature epikarst surface are locally present at the site.

Based on the review and updating of the geological, seismological, geophysical, and geotechnical data for the LNP site, nothing was identified that would preclude the safe operation of the facilities. The only geologic hazard identified in the LNP site area is potential surface deformation related to carbonate dissolution and slow cover subsidence related to the occurrence of karst. Karst features encountered below the nuclear islands at the LNP site are determined to be associated with near-vertical to vertical fractures and subhorizontal bedding planes, and vary in size from a few centimeters to approximately 1.5 m (5 ft.). Karst-related solution zones and/or infilled zones that exist in the subsurface beneath the LNP foundation will be addressed through appropriate design considerations in the LNP foundation conceptual design, as described in FSAR Subsection 2.5.4.

2.5.0.2 Vibratory Ground Motion

The selected starting point for developing the site-specific ground motion assessments for the LNP site was the Probabilistic Seismic Hazard Analysis (PSHA) conducted by the EPRI-SOG in the 1980s. Following guidance in the U.S. Nuclear Regulatory Commission (NRC) Regulatory Guide 1.208, the adequacy of the EPRI-SOG hazard results was evaluated in light of new data and interpretations and evolving knowledge pertaining to seismic hazard evaluation in the central and eastern United States (CEUS). PSHA sensitivity analyses were conducted to test the effect of the new information on the seismic hazard. Using these results, an updated PSHA analysis was performed; the results of that analysis have been used to develop uniform hazard response spectra (UHRS) and the identification of the controlling earthquakes.

Sensitivity evaluations were performed for the CEUS SSC (NUREG 2115) and the modified CAV filter (SECY-2012-0025 Enclosure 7 – Attachment 1 to Enclosure 1) to show that the site specific ground response spectra obtained using the CEUS SSC are bounded by those using the EPRI SOG methodology scaled to meet 10 CFR Part 50 Appendix S requirements. The CEUS SSC sensitivity evaluations are described in Subsection 2.5.2.7.

2.5.2 VIBRATORY GROUND MOTION

LNP COL 2.5-2

This subsection provides a detailed description of vibratory ground motion assessments that were carried out for LNP 1 and LNP 2. The subsection begins with a review of the approaches outlined in NRC Regulatory Guide 1.208 for conducting the vibratory ground motion studies. Following this review of the regulatory framework used for the project, results of the seismic hazard evaluation are documented and the site-specific GMRS for horizontal and vertical motions are developed. In addition, sensitivity evaluations were performed for the CEUS SSC (NUREG 2115) and the modified CAV filter (SECY-2012-0025 Enclosure 7 – Attachment 1 to Enclosure 1) to show that the site specific groung response spectra (PBSRS and FIRS) obtained using the CEUS SSC are bounded by those using the EPRI SOG methodology scaled to meet 10 CFR Part 50 Appendix S requirements. The CEUS SSC sensitivity evaluations are described in Subsection 2.5.2.7.

The NRC Regulatory Guide 1.208 provides guidance on methods acceptable to the NRC to satisfy the requirements of the seismic and geologic regulation, 10 Code of Federal Regulations (CFR) 100.23, for assessing the appropriate safe shutdown earthquake (SSE) ground motion levels for new nuclear power plants. Regulatory Guide 1.208 states that the PSHA conducted by the EPRI-SOG in the 1980s (References 2.5.2-201 and 2.5.2-202) has been used for studies in the past. The EPRI-SOG study involved a comprehensive compilation of geological, geophysical, and seismological data; evaluations of the scientific knowledge concerning earthquake sources, maximum earthquakes, and earthquake rates in the CEUS by six multidisciplinary teams of experts in geology, seismology, and geophysics; and separately, development of state-of-knowledge earthquake ground motion modeling, including epistemic and aleatory uncertainties.[c] The uncertainty in characterizing the frequency and maximum magnitude of potential future earthquakes associated with these sources and the ground motion that may be produced was assessed and explicitly incorporated in the seismic hazard model.

Regulatory Guide 1.208 further specifies that the adequacy of the EPRI-SOG hazard results must be evaluated in light of new data and interpretations and evolving knowledge pertaining to seismic hazard evaluation in the CEUS. The

c. Epistemic uncertainty is uncertainty attributable to incomplete knowledge about a phenomenon that affects the ability to model it. Epistemic uncertainty is reflected in a range of viable models, model parameters, multiple expert interpretations, and statistical confidence. In principle, epistemic uncertainty can be reduced by the accumulation of additional information. Aleatory uncertainty (often called aleatory variability or randomness) is uncertainty inherent in a nondeterministic (stochastic, random) phenomenon. Aleatory uncertainty is accounted for by modeling the phenomenon in terms of a probability model. In principle, aleatory uncertainty cannot be reduced by the accumulation of more data or additional information.

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following steps describe a procedure acceptable to the NRC staff for performing a PSHA.

1. Perform regional and site geological, seismological, and geophysical investigation in accordance with Regulatory Position 1 and Appendix C to RG 1.208.

2. Perform an evaluation of seismic sources, in accordance with Appendix C to RG 1.208, to determine whether they are consistent with the site-specific data gathered in Regulatory Positon 3.1 or if they require updating. If potentially significant differences are identified, perform sensitivity analyses to assess whether those differences have a significant effect on site hazard.

3. If Step 2 indicates that there are significant differences in site hazard, then the PSHA for the site is revised by either updating the previous calculations or, if necessary, performing a new PSHA. If not, the previous EPRI-SOG results may be used to assess the appropriate SSE ground motions.

Regulatory Guide 1.208 provides guidance on performance goal-based methods acceptable to the NRC to satisfy the requirements of the seismic and geologic regulation, 10 CFR 100.23, for assessing the appropriate site-specific performance goal-based ground motions for new nuclear power plants. Specifically, the performance-based approach described in American Society of Civil Engineers/Structural Engineering Institute (ASCE/SEI) Standard 43-05, "Seismic Design Criteria for Structures, Systems, and Components in Nuclear Facilities" may be used to define site-specific performance goal-based GMRS at the ground surface based on mean hazard results (Reference 2.5.2-203). The development of mean seismic hazard results is to be based on a site-specific PSHA combined with site-specific site amplification analyses. The procedures to be used to perform the PSHA and site amplification studies are in Regulatory Guide 1.208. Regulatory Guide 1.208 also provides guidance on an alternative approach for addressing the lower-bound magnitude used in the PSHA based on the likelihood that earthquakes of various sizes can produce potentially damaging ground motions. The ground motion measure used to correlate with the threshold of potential damage is cumulative absolute velocity (CAV). The alternative approach using the CAV filter is used to develop the final GMRS for LNP 1 and 2.

This subsection discusses the following aspects of vibratory ground motion:

- Seismicity (FSAR Subsection 2.5.2.1)
- Geologic and Tectonic Characteristics of the Site and Region (FSAR Subsection 2.5.2.2)
- Correlation of Earthquake Activity with Seismic Sources (FSAR Subsection 2.5.2.3)

- Probabilistic Seismic Hazard Analysis and Controlling Earthquake (FSAR Subsection 2.5.2.4)
- Seismic Wave Transmission Characteristics of the Site (FSAR Subsection 2.5.2.5)
- Ground Motion Response Spectra (FSAR Subsection 2.5.2.6)
- Sensitivity Evaluations for CEUS SSC (FSAR Subsection 2.5.2.7)

2.5.2.1 Seismicity

An important component in developing a seismic hazard model for the LNP site is the seismic history of the region. The selected starting point for developing the site-specific PSHA for the LNP site is the EPRI-SOG (Reference 2.5.2-201) seismic hazard model for the CEUS. The data used to assess earthquake occurrence rates for the seismic sources in the EPRI-SOG model were those in the earthquake catalog.

The first step in the three-step process for evaluating the adequacy of this model for the assessment of seismic hazards at the LNP site involved an assessment of the effect of recent information on the characterization of the seismicity of the southeastern United States. The development of an updated earthquake catalog for the project region is described in FSAR Subsection 2.5.2.1.1. Information on significant earthquakes is provided in FSAR Subsection 2.5.2.1.2. In addition to the discussion of significant earthquakes within the site region, this subsection also discusses recent earthquakes in Gulf of Mexico that postdate the EPRI-SOG catalog. Although these events fall outside the 320-km (200-mi.) radius site region, they occurred within some of the EPRI-SOG background seismic source zones that include the LNP site and thus have implications for assessment of maximum magnitudes in these source zones as discussed in FSAR Subsection 2.5.2.4.1.2. In addition, further assessment of catalog completeness and earthquake recurrence parameters for the offshore region were required as discussed in FSAR Subsections 2.5.2.4.1.3 and 2.5.2.4.1.4.

2.5.2.1.1 Earthquake Catalog

Earthquake occurrence rates for the seismic sources developed in the EPRI-SOG study were based on the EPRI-SOG CEUS earthquake catalog that was developed for the time period of 1627 through February 1985. The EPRI-SOG catalog has gone through two significant revisions. Seeber and Armbruster (Reference 2.5.2-204) conducted a thorough review of the catalog, revising the magnitude estimates and locations of many events, removing some events as non-earthquakes and adding others. The revised earthquake catalog is denoted as the National Center for Earthquake Engineering Research (NCEER)-91 catalog (Reference 2.5.2-205). Subsequently, Mueller et al. reviewed the NCEER-91 catalog along with additional information and developed

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was set equal to values interpolated between the median iterated soil properties for the 10^{-4} and 10^{-5} ground motion level input cases using the ratio of the GMRS peak ground acceleration to the peak acceleration for the 10^{-4} and 10^{-5} UHRS. The resulting site profile is listed in Table 2.5.2-228. The lower bound profile was set equal to the 16th percentile of the distribution of randomized soil properties for the 500 ft/sec engineered fill velocity case, and the upper bound profile was set equal to the 84th percentile of the distribution of randomized soil properties for the 1000 ft/sec engineered fill case. The range in the upper bound and lower bound shear wave velocities was increased where necessary to maintain the minimum coefficient of variation in shear modulus of 1.5. Tables 2.5.2-229 and 2.5.2-230 list the lower bound and upper bound profile properties, respectively. Figure 2.5.2-298 shows the top 500 feet of the three V_s profiles. The corresponding damping ratios were obtained from the statistics of the iterated profiles assuming negative correlation between V_s and damping: that is the 16th percentile damping was used for the upper bound profile and the 84th percentile damping was used for the lower bound profile. The compression wave velocities were based on the measured values for the in-situ materials and the recommend Poisson's ratio of 0.3 for the engineered fill (Table 2.5.4.5-201). The compression wave velocity of water, set to a nominal value of 5000 ft/sec, was used as a minimum value for the compression wave velocities of materials below the water table.

LNP COL 2.5-3
LNP SUP 3.7-3

A fourth profile called the Lower Lower Bound (LLB) was developed as described in FSAR Subsection 3.7.1.1.1. LLB soil profile is used to account for the degradation of soil shear modulus due foundation installation activities for use in the SSI analysis. The LLB soil profile and properties are shown in Table 2.5.2-231. The degradation of soil shear modulus for the LLB soil profile only applies to in-situ soil layers (layers 7 to 19 in Table 2.5.2-231 which corresponds to depths of 15 ft. to 75 ft.). The material properties for the engineered fill (depths 0 to 15 ft.) and rock (depths greater than 75 ft.) are the same as in the LB soil profile. The low strain shear modulus of the in-situ soil is reduced by 10 percent and the new reduced shear wave velocity was calculated from the shear modulus. The compression wave velocity (V_P) for the in-situ soil was calculated as follows: For in-situ soil below the water table, if the V_P is less than that of water (i.e., 5000 ft/sec), the V_P of the soil is set to 5000 ft/sec (layers 5 to 14 in Table 2.5.2-231). If the V_P is greater than 5000 ft/sec (layer 15 to 19 in Table 2.5.2-231), the V_P is then reduced in the same ratio that the shear wave velocity is being reduced (approximately 5 percent).

2.5.2.7 Sensitivity Evaluations for CEUS SSC

This subsection describes the sensitivity evaluations performed using the CEUS SSC (NUREG 2115) and the modified CAV filter (SECY-2012-0025 Enclosure 7 – Attachment 1 to Enclosure 1) and present the comparison of the CEUS hard rock seismic hazards, 10^{-5} finished grade UHRS, GMRS, PBSRS, and FIRS using the CEUS SSC methodology and those using the EPRI SOG methodology scaled to meet 10 CFR Part 50 Appendix S requirements.

2.5.2.7.1 Methodology for CEUS SSC Evaluations

- Methodology
- Design Inputs

2.5.2.7.2 Verification of Implementation of CEUS SSC Model

- Overview of CEUS SSC Model
- Hazard Inputs
- Summary Hazard Results at Demonstration sites

2.5.2.7.3 Seismic Hazard at LNP Site using the CEUS SSC Model

- Hard Rock Hazard Results
- Comparison of hard rock UHRS from FSAR Subsection 2.5.2.4.4 and CEUS SSC (Figure RAI L-0998-1)
- Rock Hazard Deaggregation (text and figures)
- Comparison of finished grade CEUS 10^{-5} UHRS with EPRI SOG 10^{-5} UHRS (Figure RAI L-0998-4)

2.5.2.7.4 Ground Motion Response Spectra

- GMRS with modified CAV filter
- Comparison of CEUS Modified CAV filter GMRS with CSDRS and EPRI SOG GMRS (Figure RAI L-0998-2)
- Comparison of 1.67*GMRS developed using the CEUS SSC methodology and modified CAV filter with the EPRI SOG 10^{-5} UHRS (Figure RAI L-0998-6).

2.5.2.7.5 PBSRS and FIRS for CEUS SSC with Modified CAV filter

- CEUS SSC PBSRS
- Comparison of CEUS SSC PBSRS with scaled EPRI SOG PBSRS and CSDRS (Figure RAI L-0998-3)
- Comparison of 1.67* PBSRS, developed using the CEUS SSC methodology and modified CAV filter, with the EPRI SOG 10^{-5} UHRS (Figure RAI L-0998-7).
- CEUS SSC FIRS (EL+11 ft.)
- Comparison of CEUS SSC FIRS (EL +11 ft.) with scaled EPRI SOG FIRS (Figure RAI L-0998-5)
- Vertical CEUS SSC FIRS (EL +11 ft.) - The vertical will scale directly with the horizontal FIRS as the V/H ratios are unaffected.

For the area under the Annex, Turbine, and Radwaste building footprint, in-situ soil will be replaced or improved to a depth of approximately 2.1 m (7 ft.) below existing grade (elevation 12.8 m [42 ft.] NAVD88). The plant design grade will be established at elevation 15.5 m (51 ft.) NAVD88 by placing engineered fill above the improved / replaced in-situ material. In addition, the earthwork design incorporates vertical and horizontal drains to prevent buildup of excess pore pressures that cause liquefaction as shown in Figures 2.5.4.8-205 and 2.5.4.8-206 for LNP 1 and 2 respectively.

2.5.4.8.6 Median Centered Liquefaction Evaluations for 10^{-5} UHRS

As a sensitivity analysis, the median centered liquefaction potential (factor of safety <1.0) for 10^{-5} UHRS was evaluated. The methodology and design parameters used for 10^{-5} UHRS liquefaction analysis were the same as that used for design basis liquefaction analysis described in FSAR Subsection 2.5.4.8 except liquefaction was postulated when the computed factor of safety was <1.0 and the soil cyclic shear stress were computed for the 10^{-5} UHRS ground motions and the median shear wave velocity soil profile derived from the randomized soil profiles used to compute the 10^{-5} UHRS. In addition, the equivalent number of stress cycles was computed for the weighted average moment magnitude of 5.74 for the site. Tables 2.5.4.8-203A and 2.5.4.8-203B present liquefaction analysis results for 10^{-5} UHRS for LNP 1 and 2 respectively. The results include the computed factors of safety against liquefaction and the depth below the Annex, Radwaste, or Turbine Building foundation mat where liquefaction is postulated. Figures 2.5.4.8-207 and 2.5.4.8-208 show, in plan and elevation respectively, the location of the liquefaction zones identified in Table 2.5.4.8-203A for LNP 1. Figure 2.5.4.8-209 and Figure 2.5.4.8-210 show, in plan and elevation view respectively, the liquefaction zones identified in Table 2.5.4.8-203B for LNP 2. In these figures, the liquefaction zones with a factor of safety of less than or equal to 1.0 are shown by circles with yellow infill. For Unit 1, liquefiable zones were postulated in boreholes O-2, A-15, A-18/O-4, A-13, and B-28. Boreholes O-2, A-15 and A-18/O-4 are in the nuclear island excavation zone. Borehole A-13 (factor of safety = 1.0) is under the Radwaste Building, and B-28 is under the Annex Building. For Unit 2, liquefiable zones were postulated for boreholes B-01, B-07, B-07A, B-31, and B-33. Borehole B-01 is well away from the AP1000 footprint. Boreholes B-07, B-07A, B-31, and B-33 are under the Turbine Building. Based on these figures, it can be concluded that liquefiable zones under the LNP 1 and 2 footprints are confined to the northwest corner of the LNP 2 Turbine Building and in isolated random pockets under the remaining LNP 1 and 2 footprints. These conclusions for median centered liquefaction potential for 10^{-5} UHRS are the same as the conclusions for the design basis liquefaction analysis described in FSAR Subsection 2.5.4.8.

2.5.4.8.7 Liquefaction Potential Evaluations for CEUS SSC

The soils under the nuclear island (NI) will be excavated and backfilled with Roller Compacted Concrete (RCC). Thus, no liquefaction potential exists under the NI foundation. To evaluate the liquefaction potential of soils under the

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adjacent AB, TB, and RB, earthquake induced cyclic stresses in the soil column were based on ground motions consistent with the finished grade scaled PBSRS. As shown in Figure RAI L-0998-3, the CEUS SSC PBSRS is enveloped by the EPRI SOG scaled PBSRS. Thus, the liquefaction evaluations based on the EPRI SOG LNP ground motions bound those from the CEUS SSC ground motions.

To evaluate the HCLPF liquefaction potential of soils under the adjacent AB, TB, and RB, earthquake induced cyclic stresses in the soil column based on ground motions consistent with the EPRI SOG finished grade 10^{-5} UHRS were used. As shown in Figures RAI L-0998-6 and RAI L-0998-7, 1.67*GMRS and 1.67*PBSRS developed using the CEUS SSC methodology and modified CAV filter are enveloped by the EPRI SOG finished grade 10^{-5} UHRS. Thus, HCLPF capacity for no liquefaction potential of soil under the AB, TB, and RB exceeds the 1.67*GMRS goal for the plant level HCLPF for the CEUS SSC ground motions.

Add Subsection 3.7.1.1.2 as follows:

3.7.1.1.2 Foundation Input Response Spectra

The nuclear island is supported on 10.7 meters (35 feet) of roller compacted concrete over rock formations at the site as described in Subsection 2.5.4.5. As described in Subsection 2.5.2.6.6, foundation input response spectra (FIRS) were developed at elevation -7.3 m (-24 ft.) NAVD88, the base of planned excavation beneath the nuclear island. This FIRS was scaled to ensure that the computed soil column outcropping response (SCOR) at the AP1000 foundation elevation 3.4 m (11 ft.) NAVD88 meets the 0.1g minimum ZPA requirement of 10 CFR 50 Appendix S. The scaled SCOR FIRS at elevation -7 m (-24 ft.) NAVD88 and at elevation 3.4 m (11 ft.) NAVD88 are shown on Figures 3.7-201 and 3.7-205 respectively.

As shown in Figure RAI L-0998-5, the CEUS SSC FIRS is enveloped by the EPRI SOG scaled FIRS used for site specific soil structure interaction analysis described in Subsection 3.7.2.4.1. Because the CEUS SSC vertical FIRS scales directly with the CEUS SSC horizontal FIRS and the V/H ratios are unaffected, the CEUS SSC FIRS will also be enveloped by the scaled EPRI SOG vertical FIRS. Thus, the conclusions of the soil structure analysis presented in Subsections 3.7.2.4.1.5 and 3.7.2.4.1.6 are valid for the LNP site ground motions based on the CEUS SSC model.

The seismic Category II and non-seismic adjacent structures are supported on drilled shafts. The top of the basemat for the Annex Building, Radwaste Building, and the Turbine Building (except for the condenser pit area) is at design grade elevation 15.5 m (51 ft.) NAVD88. The PBSRS described in Subsection 3.7.1.1.1 (Figure 2.5.2-297 and Table 2.5.2-227) are used to compute the maximum relative displacements of the Annex Building, Turbine Building, and the Radwaste Building drilled shaft foundation with respect to the nuclear island to evaluate site-specific aspect of the seismic interaction of these buildings with the nuclear island.

As shown in Figure RAI L-0998-3, the CEUS SSC PBSRS is enveloped by the EPRI SOG scaled PBSRS used for site specific displacement of the Annex Building, Turbine Building, and the Radwaste Building as described in Subsections 3.7.2.8.1, 3.7.2.8.2, and 3.7.2.8.3. Thus the conclusions in these subsections of no seismic interaction between the Annex Building, Turbine Building, and Radwaste Building and the NI is valid for the LNP site ground motions based on the CEUS SSC model.

Add the following subsections after DCD Subsection 3.7.2.4.

3.7.2.4.1 Site Specific Soil Structure Analysis

LNP SUP 3.7-6

foundation as stated in Subsection 2.5.4.5.4. This interface is designed to avoid hard contact between the NI and the Radwaste Building foundation mat resulting from the relative displacements during the seismic event. Thus, no seismic interaction between the Radwaste Building foundation mat and the NI is expected.

3.7.2.8.3 Turbine Building

Add the following text to the end of DCD Subsection 3.7.2.8.3.

LNP SUP 3.7-5

The computed probable maximum relative displacement between the NI and the Turbine Building foundation mat from a Performance Based Surface Response Spectra (PBSRS) is less than 2.5 cm (1 in.). The probable maximum relative displacement calculation included the drilled shaft supported foundation mat displacements including the drilled shaft to drilled shaft interaction effects, additional displacement due to soil column displacement, and the NI displacement at design grade. The SRSS method was used to compute the probable maximum relative displacement. Figure 3.7-226 shows the conceptual design detail for the interface between the Nuclear Island (NI) and the drilled shaft supported foundation mat of the Turbine Building. This design detail provides the 5.0 cm. (2 in.) gap between the Turbine Building foundation and the NI consistent with DCD Subsection 3.8.5.1. The top of the diaphragm wall and controlled low strength material fill between the diaphragm wall and the NI wall is at least 1.5 m (5 ft.) below the bottom of the Turbine Building foundation mat as stated in Subsection 2.5.4.5.1. Engineered fill is used from the top of the controlled low strength material fill to the bottom of the Turbine Building foundation mat as stated in Subsection 2.5.4.5.4. This interface is designed to avoid hard contact between the NI and the Turbine Building foundation mat resulting from the relative displacements during the seismic event. Thus, no seismic interaction between the Turbine Building foundation mat and the NI is expected.

3.7.2.8.4 Median Centered Adjacent Building Relative Displacements for 10^{-5} UHRS

As a sensitivity analysis, the median centered probable maximum relative displacements between the NI and the adjacent Turbine, Annex, and Radwaste Buildings' foundation mat were calculated for 10^{-5} UHRS. The drilled shaft supported foundation mat lateral displacements were obtained from 21 randomly selected soil profiles from the set of several hundred randomized soil profiles used to develop the 10^{-5} UHRS. The median shear wave velocity profile for the 21 soil profiles closely matches the median shear wave velocity profile for the entire set of randomized soil profiles used to develop the UHRS as shown in Figure 3.7-227. The probable maximum relative displacement between the NI and the TB, AB, and the RB foundation mats was computed by combining the soil column displacements for UHRS, the NI displacement at the design grade, and the Turbine, Annex, and Radwaste Buildings' foundation mat displacements for 10^{-5} UHRS using the square root of the sum of squares (SRSS) method. The computed probable maximum median relative displacements between the NI and the adjacent Turbine, Annex, and Radwaste Buildings' foundation mat for 10^{-5} UHRS are less than 2.5 cm. (1 in.). Figure 3.7-226 shows the conceptual design detail for the interface between the Nuclear Island (NI) and the drilled shaft supported foundation mat of the Turbine Building. This design detail provides the 5.0 cm. (2 in.) gap between the Turbine, Annex, and Radwaste Buildings' foundation mat and the NI consistent with DCD Subsection 3.8.5.1. The top of the diaphragm wall and controlled low strength material fill between the diaphragm wall and the NI wall is at least 1.5 m (5 ft.) below the bottom of the Turbine Building foundation mat as stated in Subsection 2.5.4.5.1. Engineered fill is used from the top of the controlled low strength material fill to the bottom of the Turbine Building foundation as stated in Subsection 2.5.4.5.4. This interface is designed to avoid hard contact between the NI and the Turbine Building foundation resulting from the relative displacements during the seismic event. Thus, no seismic interaction between the Turbine, Annex, and the Radwaste Buildings' foundation mat and the NI is expected for 10^{-5} UHRS.

To evaluate the HCLPF capacity for no seismic interaction between the AB, TB, and RB foundation mats and the NI, the relative displacement between the NI and the AB, TB, and RB foundations was computed based on the EPRI SOG finished grade 10-5 UHRS. As shown in Figures RAI L-0998-6 and RAI L-0998-7, 1.67*GMRS and 1.67*PBSRS developed using the CEUS SSC methodology and modified CAV filter are enveloped by the EPRI SOG finished grade 10-5 UHRS. Thus, HCLPF capacity for no seismic interaction between the AB, TB, and RB foundation mats and the NI exceeds the 1.67*GMRS goal for the plant level HCLPF for the CEUS SSC ground motions.

3.7.2.12 Methods for Seismic Analysis of Dams

Add the following text to the end of DCD Subsection 3.7.2.12.

LNP COL 3.7-1 There are no existing dams that can affect the site interface flood level as specified in DCD Subsection 2.4.1.2 and discussed in FSAR Subsection 2.4.4.

3.7.4.1 Comparison with Regulatory Guide 1.12

Add the following text to the end of DCD Subsection 3.7.4.1.

STD SUP 3.7-1 Administrative procedures define the maintenance and repair of the seismic instrumentation to keep the maximum number of instruments in-service during plant operation and shutdown in accordance with Regulatory Guide 1.12.

19.55 SEISMIC MARGIN ANALYSIS

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

Add the following Subsection after DCD Subsection 19.55.6.2:

19.55.6.3 Site-Specific Seismic Margin Analysis

LNP COL 19.59.10-6

The LNP GMRS was developed as the Truncated Soil Column Surface Response (TSCSR) on the uppermost in-situ competent material at elevation 11 m (36 ft.) NAVD88 as described in Subsection 2.5.2.6. Since plant design grade will be established at elevation 15.5 m (51 ft.) NAVD88 by engineered fill above in-situ material as noted in Subsection 2.5.4.5, performance based surface horizontal and vertical response spectra (PBSRS) at the design grade were developed as described in Subsection 2.5.2.6. Both the LNP GMRS and the PBSRS are enveloped by the AP1000 Certified Seismic Response Spectra as documented in Subsection 2.5.2.6. In addition, LNP site-specific SSI analysis was performed to evaluate the effect of the LNP unique foundation conditions on seismic demand. It was determined that the LNP site-specific seismic floor response spectra (FRS) at the six key locations are enveloped by the AP1000 CSDRS based FRS at the six key locations. In addition, the LNP maximum bearing pressure is less than the CSDRS based maximum bearing pressure of 24 ksf for soft rock sites. For the 24 ksf bearing pressure, the LNP site specific bearing factor of safety is greater than the acceptable factor of safety for static and dynamic loadings (Subsection 2.5.4.10.1.1). The LNP SSI analysis results are documented in Subsection 3.7.1.1.1. Thus, LNP site unique foundation conditions do not lower the High Confidence Low Probability of Failure (HCLPF) values calculated for the certified design.

As shown in Figures RAI L-0998-2 and RAI L-0998-3, both the CEUS SSC GMRS and the PBSRS are enveloped by the AP1000 CSDRS. As discussed above, the CEUS SSC LNP site specific floor response spectra (FRS) at the six key locations are bounded by the CSDRS FRS and the maximum bearing pressure is less than the 24 ksf design value. Thus, LNP site unique foundation conditions and CEUS SSC ground motions do not lower the High Confidence Low Probability of Failure (HCLPF) values calculated for the certified design.

The soils under the LNP 1 and LNP 2 nuclear islands (NI) foundations will be excavated to rock and backfilled with Roller Compacted Concrete (RCC), as discussed in Subsection 2.5.4.5.3. For the NI, this eliminates any potential site-specific effects such as seismically induced liquefaction settlements, slope stability, foundation failure or relative settlements that would lower the HCLPF values calculated for the certified design. As described in Subsection 2.5.4.8, the LNP site-specific soil conditions also do not affect the nuclear island sliding and overturning stability based on Westinghouse analysis. Thus, LNP site-specific soil conditions do not lower the HCLPF values calculated for the certified design.

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As described in Subsection 2.5.4.8, LNP site-specific liquefaction analysis (for PBSRS) was performed for soil beyond the nuclear island perimeter which will be left in place. Based on the liquefaction analysis, it was concluded that liquefiable zones under the LNP 1 and 2 footprints are confined to the northwest corner of the Unit 2 Turbine Building and in isolated random pockets under the remaining LNP 1 and 2 footprints. The LNP earthwork design will incorporate vertical and horizontal drains that will prevent liquefaction in the northwest corner of the Unit 2 Turbine Building and in isolated random pockets under the remaining LNP 1 and 2 footprints. The extent of these horizontal and vertical drains is shown in Figures 2.5.4.8-205 and 2.5.4.8-206. Liquefaction analysis was also performed for 10^{-5} uniform hazard response spectra (UHRS) for soil beyond the nuclear island perimeter which will be left in place as is described in Subsection 2.5.4.8. Based on this liquefaction analysis, it can be concluded that liquefiable zones under the LNP 1 and 2 footprints for 10^{-5} UHRS are confined soil zones where LNP earthwork design will incorporate vertical and horizontal drains that prevent liquefaction (Figures 2.5.4.8-205 and 2.5.4.8-206). As stated previously, the 10^{-5} UHRS is greater than 1.67 times the LNP GMRS and the PBSRS developed using the EPRI SOG methodology, and the GMRS and the PBSRS developed using the CEUS SSC methodology and modified CAV filter (Subsection 2.5.2.7). Thus, liquefaction potential of soil beyond the nuclear island perimeter which will be left in place has the potential to drive the plant level HCLPF; however the soil liquefaction HCLPF exceeds the 1.67*GMRS goal for the plant level HCLPF.

Seismic Category II structures (Annex Building [AB] and the first bay of the Turbine Building [TB]) and nonsafety-related structures (rest of the TB and Radwaste Building [RB]) adjacent to the NI will be supported on drilled shaft foundations. The Seismic Category II/I interaction issues between the adjacent drilled shaft supported structures and the NI have been addressed in Subsections 3.7.2.8.1, 3.7.2.8.2, and 3.7.2.8.3. The probable maximum relative displacements between the NI and the adjacent Turbine, Annex, and Radwaste Buildings' foundation mat for the PBSRS and the 10^{-5} UHRS are less than the 50 mm (2.0 inch) gap between the NI and the adjacent buildings' foundation mats. The 10^{-5} UHRS is greater than 1.67 times higher than the LNP GMRS and the PBSRS developed using the EPRI SOG methodology (Subsection 2.5.2.6), and the GMRS and the PBSRS developed using the CEUS SSC methodology and modified CAV filter (Subsection 2.5.2.7). Thus, Seismic Category II/I interaction between the NI and the adjacent buildings has the potential to drive the plant level HCLPF; however the HCLPF for Seismic Category II/I interaction between the NI and the adjacent buildings exceeds the 1.67*GMRS goal for the plant level HCLPF.

The LNP RCC bridging mat is designed to span the postulated (conservative) design basis karst void of 10 ft. The failure of the RCC bridging mat can result in displacement of the AP1000 nuclear island foundation in excess of the maximum 6 in. displacements specified in DCD Tier 1 Table 5.0-1. In the AP1000 PRA-based Seismic Margin Assessment, the RCC bridging mat failure is conservatively assumed to fall within the gross structural collapse event modeled in the hierarchical event tree discussed in DCD Section 19.55. As gross structural collapse is assumed to directly lead to core damage, failure of the RCC

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bridging mat has the potential to drive the plant level high confidence low probability of failure (HCLPF) value. The HCLPF capacity of the RCC mat was calculated as 0.30g using the conservative deterministic failure margin (CDFM) methodology of Reference 19.55.7-201. The 0.30g HCLPF capacity of the RCC bridging mat exceeds the overall plant HCLPF acceptance criteria of 1.67*GMRS using the EPRI SOG methodology (Subsection 2.5.2.6) and the 1.67*GMRS developed using the CEUS SSC methodology and modified CAV filter (Subsection 2.5.2.7).

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Table 19.55-201 summarizes the HCLPF capacities of the LNP site-specific design features (e.g., RCC bridging mat, potential against soil liquefaction, and Seismic Category II/I interaction between the nuclear island and the adjacent buildings).

Thus, it can be concluded that the Seismic Margin Assessment analysis documented in Section 19.55 is applicable to the LNP site. Exceeding the HCLPF capacities for soil liquefaction and Seismic Category II/I interaction effects of buildings adjacent to the nuclear island will not affect the plant level HCLPF capacity. The RCC bridging mat HCLPF capacity, while potentially driving the plant-level HCLPF, exceeds the plant level HCLPF goal of 1.67*GMRS using the EPRO SOG methodology (Subsection 2.5.2.6) and the GMRS developed using the CEUS SSC methodology and modified CAV filter (Subsection 2.5.2.7).

19.55.7 REFERENCES

Add the following information at the end of DCD Subsection 19.55.7:

201. EPRI Report No. NP-6041-SL, “A Methodology for Assessment of Nuclear Power Plant Seismic Margin”, Revision 1, August 1991.

Table 19.55-201
HCLPF Capacities for LNP Site Specific Design Features

LNP COL 19.59.10-6

Description	HCLPF Capacity[(a)]	HCLPF/GMRS[(b)]	Basis
Soil Liquefaction Potential under Adjacent Buildings	> 0.12g	> 1.67 GMRS	(c)
Seismic II/I Interaction Potential	> 0.12g	> 1.67 GMRS	(d)
RCC bridging mat	0.30g	>1.67 GMRS	(e)

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Notes:

a) LNP site-specific Ground Motion Response Spectra (GMRS) peak ground acceleration (PGA) is 0.0691g using EPRI SOG methodology (Subsection 2.5.2.6) and 0.0731 using CEUS SSC methodology and modified CAV filter (Subsection 2.5.2.7).

b) HCLPF Capacity as a fraction of LNP site-specific GMRS PGA using CEUS SSC methodology and the modified CAV filter.

c) Liquefaction potential of soils under the adjacent buildings was evaluated for the LNP site-specific 10^{-5} annual exceedance probability Uniform Hazard Response Spectra (10^{-5} UHRS). The LNP 10^{-5} UHRS using EPRI SOG methodology is greater than 1.67*GMRS using the EPRI SOG methodology (Subsection 2.5.2.6) and the CEUS SSC GMRS with the modified CAV filter (Subsection 2.5.2.7).

d) Relative displacement between the NI and adjacent buildings for the LNP site-specific 10^{-5} UHRS is less than the gap provided. The LNP 10^{-5} UHRS is greater than 1.67*GMRS using the EPRI SOG methodology (Subsection 2.5.2.6) and the CEUS SSC GMRS with the modified CAV filter (Subsection 2.5.2.7).

e) HCLPF capacity calculated using conservative deterministic failure margin method of Reference 19.55.7-201.