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NL-14-043

March 31, 2014

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
11545 Rockville Pike, TWFN-2 F1
Rockville, MD 20852-2738

SUBJECT: Entergy Seismic Hazard and Screening Report (CEUS Sites), Response to NRC Request for Information Pursuant to 10 CFR 50.54(f) Regarding Recommendation 2.1 of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident
Indian Point Unit No. 3
Docket No. 50-286
License No. DPR-64

REFERENCES:

1. NRC letter to Entergy, Request for Information Pursuant to Title 10 of the Code of Federal Regulations 50.54(f) Regarding Recommendations 2.1, 2.3, and 9.3 of the Near-Term Task Force Review of Insights from the Fukushima Dai-Ichi Accident, dated March 12, 2012 (ML12053A340).
2. NEI Letter to NRC, Proposed Path Forward for NTTF Recommendation 2.1: Seismic Reevaluations, dated April 9, 2013 (ML13101A345)
3. NRC Letter, Electric Power Research Institute Final Draft Report XXXXXX, "Seismic Evaluation Guidance: Augmented Approach for the Resolution of Fukushima Near-Term Task Force Recommendation 2.1: Seismic," as an Acceptable Alternative to the March 12, 2012, Information Request for Seismic Reevaluations, dated May 7, 2013, (ML13106A331)
4. EPRI Report 1025287, Seismic Evaluation Guidance: Screening, Prioritization and Implementation Details (SPID) for the Resolution of Fukushima Near-Term Task Force Recommendation 2.1: Seismic (ML12333A170)
5. NRC Letter, Endorsement of EPRI Final Draft Report 1025287, "Seismic Evaluation Guidance," dated February 15, 2013 (ML12319A074)

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6. Entergy Letter (NL-13-118), Entergy's Response to NRC Request for Information Pursuant to 10 CFR 50.54(f) Regarding the Seismic Aspects of Recommendation 2.1 of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident - 1.5 Year Response for CEUS Sites, dated September 13, 2013

Dear Sir or Madam:

On March 12, 2012, the Nuclear Regulatory Commission (NRC) issued Reference 1 to all power reactor licensees and holders of construction permits in active or deferred status. Enclosure 1 of Reference 1 requested each addressee located in the Central and Eastern United States (CEUS) to submit a seismic hazard evaluation within 1.5 years from the date of Reference 1.

In Reference 2, the Nuclear Energy Institute (NEI) requested NRC agreement to delay submittal of the final CEUS Seismic Hazard Evaluation and Screening Reports so that an update to the Electric Power Research Institute (EPRI) ground motion attenuation model could be completed and used to develop that information. NEI proposed that descriptions of subsurface materials and properties and base case velocity profiles be submitted to the NRC by September 12, 2013, with the remaining seismic hazard and screening information submitted by March 31, 2014. NRC agreed with that proposed path forward in Reference 3 for EPRI Report 300200704.

Reference 4 contains industry guidance and detailed information to be included in the seismic hazard evaluation submittal. NRC endorsed this industry guidance in Reference 5.

Entergy Nuclear Operations, Inc. submitted the descriptions of subsurface materials and properties and base case velocity profiles for Indian Point in Reference 6.

The attached Seismic Hazard Evaluation and Screening Report for Indian Point Unit No 3 provides the information described in Section 4 of Reference 4, with the exception of the use of a reassessment of the seismic core damage frequency discussed in Section 3.3 of the attached. This was done in accordance with the schedule identified in Reference 2.

This letter contains no new regulatory commitments.

If you have any questions or require additional information, please contact Robert Walpole, Regulatory Assurance, at (914) 254-6710.

I declare under penalty of perjury that the foregoing is true and correct. Executed on March 31, 2014.

Respectfully,

JAV/sp

Attachment: IP3 Seismic Hazard and Screening Report (CEUS Sites)

cc: Mr. Douglas V. Pickett, Senior Project Manager, NRC NRR DORL
Mr. William M. Dean, Regional Administrator, NRC Region 1
NRC Resident Inspectors Office
Mr. Francis J. Murray, Jr., President and CEO, NYSERDA
Ms. Bridget Frymire, New York State Dept. of Public Service

ATTACHMENT TO NL-14-043

IP3 SEISMIC HAZARD AND SCREENING REPORT (CEUS SITES)

ENTERGY NUCLEAR OPERATIONS, INC.
INDIAN POINT NUCLEAR GENERATING UNIT NO. 3
DOCKET NO. 50-286

Seismic Hazard and Screening Report for Indian Point Unit 3

Table of Contents

1.0 Introduction

Following the accident at the Fukushima Daiichi nuclear power plant resulting from the March 11, 2011, Great Tohoku Earthquake and subsequent tsunami, the Nuclear Regulatory Commission (NRC) established a Near-Term Task Force (NTTF) to conduct a systematic review of NRC processes and regulations and to determine if the agency should make additional improvements to its regulatory system. The NTTF developed a set of recommendations intended to clarify and strengthen the regulatory framework for protection against natural phenomena. Subsequently, the NRC issued a 50.54(f) letter (U.S. NRC, 2012a) that requests information to assure that these recommendations are addressed by all U.S. nuclear power plants. The 50.54(f) letter (U.S. NRC, 2012a) requests that licensees and holders of construction permits under 10 CFR Part 50 reevaluate the seismic hazards at their sites against present-day NRC requirements. Depending on the comparison between the reevaluated seismic hazard and the current design basis, the result is either no further risk evaluation or the performance of a seismic risk assessment. Risk assessment approaches acceptable to the staff include a seismic probabilistic risk assessment (SPRA), or a seismic margin assessment (SMA). Based upon the risk assessment results, the NRC staff will determine whether additional regulatory actions are necessary.

This report provides the information requested in items (1) through (7) of the "Requested Information" section and Attachment 1 of the 50.54(f) letter (U.S. NRC, 2012a) pertaining to NTTF Recommendation 2.1 for Indian Point Unit 3, located in upper Westchester County, New York. In providing this information, Entergy followed the guidance provided in the *Seismic Evaluation Guidance: Screening, Prioritization, and Implementation Details (SPID) for the Resolution of Fukushima Near-Term Task Force Recommendation 2.1: Seismic* (EPRI, 2013a). The Augmented Approach, *Seismic Evaluation Guidance: Augmented Approach for the Resolution of Fukushima Near-Term Task Force Recommendation 2.1: Seismic* (EPRI, 2013c), has been developed as the process for evaluating critical plant equipment as an interim action to demonstrate additional plant safety margin prior to performing the complete plant seismic risk evaluations.

The original geologic and seismic siting investigations for Indian Point Unit 3 were performed in accordance with Appendix A to 10 CFR Part 100 as it existed prior to the construction permits in August 1969. To the extent discussed in the Final Safety Analysis Report (FSAR) (Entergy, 2011a), Indian Point Unit 3 meet General Design Criterion 2 in Appendix A to 10 CFR Part 50 which was not part of the original licensing basis. The Safe Shutdown Earthquake (SSE) ground motion was subsequently evaluated against the criteria in Appendix A to 10 CFR Part 100 and was found to be acceptable. This SSE was used for the design of seismic Category I systems, structures and components.

In response to the 50.54(f) letter (U.S. NRC, 2012a) and following the guidance provided in the SPID (EPRI, 2013a), a seismic hazard reevaluation for Indian Point Unit 3 was performed. For screening purposes, a Ground Motion Response Spectrum (GMRS) was developed. Based on the results of the screening evaluation, Indian Point Unit 3 screens-in for a Spent Fuel Pool evaluation and a High Frequency Confirmation. Additionally, based on the results of the screening evaluation, Indian Point Unit 3 screens-out of a risk evaluation.

2.0 Seismic Hazard Reevaluation

Indian Point Energy Center, which includes two adjacent units, namely Indian Point Unit 2 and Indian Point Unit 3, is located approximately 24 miles northeast of the New York City boundary line and approximately two miles southwest of the city of Peekskill, Westchester County, New York, on the east bank of the Hudson River. The rocks in the vicinity of the Indian Point Unit 3 belong to three geologic provinces, the Hudson Highlands, the Manhattan Prong and the Newark Basin. Rocks that outcrop within the provinces range in age from Precambrian through Triassic Geologically, the site consists of a hard limestone in a jointed condition that provides a solid bed for the plant foundation. The bedrock is sufficiently sound to support any loads that could be expected up to 50 tons/ft^2, which is far in excess of any load that may be imposed by the plant. (Entergy, 2010)(Entergy, 2011a)

The site is located in Zone I of the Uniform Building Code with intensities limited to V and VI on the Modified Mercalli Intensity Scale of 1931 and only slight earthquake activity can be expected. However, the Indian Point Energy Center facility was built per requirements of Zone 2 of the Uniform Building Code, i.e., corresponding to an intensity VII of the Modified Mercalli Intensity Scale of 1931. The range of expected horizontal acceleration of ground motion for earthquakes of this intensity is 70-150 cm/sec^2 near the epicenter or about 0.15 g max. At a distance of 100 miles from the epicenter, the acceleration drops to 50%. (Entergy, 2011a)

The nearest event larger than intensity VII on the Modified Mercalli Intensity Scale of 1931 occurred near Cape Ann, Massachusetts, a distance of more than 200 miles from the site, in 1755. This event was classified as intensity VIII on the Modified Mercalli Intensity Scale of 1931. It was believed, therefore, that the plant's structural design, allowing for safe shutdown in the event of an earthquake of intensity VII on the Modified Mercalli Intensity Scale of 1931, was adequate. (Entergy, 2011a)

2.1 Regional and Local Geology

The general landscape of the region consists of bedrock-supported ridges following generally northeasterly structural trends and rather steep and broad swampy valleys. The highest elevation in the region is 1,000 ft, and elevations range from 50 to 300 ft above mean sea level in low-lying areas. At the plant site the ground is level, about 15 ft above sea level and is covered with fill. The surface is artificially leveled and bedrock lies very close to the surface. (Entergy, 2011a)

The eastern part of the United States has gone through tectonism since the Precambrian age and is known as the Appalachian Orogen. Indian Point Energy Center is situated within the Manhattan Prong of the Appalachian Mountains. It is estimated that the earliest tectonic activity in the Appalachian Orogen was in Precambrian age and was a result of continental rifting and associated intrusive activity. A striking characteristic of the region is the high degree of metamorphism exhibited by the rocks. This has resulted from their long and complex history (Precambrian through the mid-Ordovician time) which included extensive thrust faulting, folding, instrusion, etc. The Taconic Orogeny was intense in the Manhattan Prong region and produced most of the structures evident in the map today. Essentially, the rocks in the plant site area belong to three tectonic provinces, e.g., the Hudson Highlands, the Manhattan Prong and the Newark Basin. (Entergy, 2011a)

The Hudson Highlands are a part of the much larger Blue Ridge – New Jersey Highlands Province. Here the northeast trending ridges are underlain by complexly folded granitoid gneisses and schists. These also involve granodioritic intrusives. Prevailing dips in the entire region are steep towards the southeast. The bulk of the Highland rocks represent a sequence of Precambrian aged miogeosynclinal and engeosynclinal deposits, however those in the areas of concern are in faulted and in-folded strata of Cambro - Ordovician age. It was recognized that a mappable sequence of five rock units exists in the Lake Carmel, New York, area of the Highlands. These rocks were metamorphosed to granulite facies, and were multiply deformed in the Greenville Orogeny. There was recrystallization to amphibolite facies accompanied by folding during the Taconic Orogeny (mid-Ordovician). The Ramapo Fault Zone separates the Highlands from the Manhattan Prong and the Newark Basin. (Entergy, 2011a)

The Manhattan Prong is bounded on the east by Cameron's line, on the west by the Newark Basin border fault and the Hudson River. It covers the geographic areas of New York City (Manhattan), Westchester County, New York and parts of Fairfield County, Connecticut. The uppermost formation of sedimentary origin is called a Phyllite or Schist known as the Manhattan Schist. This is the most recent geologic formation. In order of increasing age and depth are the Inwood Marble, the Lowerre Quartzite, the Yonkers-Pound Ridge Granite and the Fordham Gneiss. Due to the extremely complicated nature of the region's geology this stratigraphy varies with location. (Entergy, 2011a)

The Manhattan Formation was deposited in a miogeosyncline. It was metamorphosed, deformed and intruded during the Taconic and the Acadian episodes. The Inwood Marble, consisting of dolomite and calcite marbles with interlayed calc – silicate schists, were deposited during the Cambrian – Ordovician period. It is widespread in the Appalachian Orogen.

The Lowerre Quartzite underlies the Inwood Marble. It is a relatively thin, discontinuous unit representing an arkosic sandstone. The Lowerre consists mainly of quartz with potassium feldspar and biotite. It is always found underlying the Cambro-Ordovician aged rocks. (Entergy, 2011a)

The Yonkers and Fordham formations are Precambrian in age and are separated from the Lowerre. Inwood and Manhattan formations are joined by an angular unconformity. The Fordham formation was deformed and metamorphosed to granulite facies during the Greenville Orogeny. The Yonkers – Pound Ridge Granite, emplaced during the opening of the Proto-Atlantic in late Precambrian age, is mostly a metamorphosed rhyolite. (Entergy, 2011a)

The Newark Basin formation, west of the Hudson River, extends from York County, Pennsylvania to Rockland County, New York. The northern tip of this basin very closely approaches the Indian Point Energy Center Site on the opposite side of the Hudson River near Stony Point. This is an assemblage of conglomerates, sandstones and shales with their intercalated beds of basaltic lava and the well-known intrusive sill of the "Palisades". Deposition was continuous from the late Triassic through the upper Jurassic ages. The boundary fault between this basin and older crystalline rocks is the well-known Ramapo Fault. (Entergy, 2011a)

2.2 Probabilistic Seismic Hazard Analysis

2.2.1 Probabilistic Seismic Hazard Analysis Results

In accordance with the 50.54(f) letter (U.S. NRC, 2012a) and following the guidance in the SPID (EPRI, 2013a), a probabilistic seismic hazard analysis (PSHA) was completed using the recently developed Central and Eastern United States Seismic Source Characterization (CEUS-SSC) for Nuclear Facilities (CEUS-SSC, 2012) together with the updated Electric Power Research Institute (EPRI) Ground-Motion Model (GMM) for the Central and Eastern United States (CEUS) (EPRI, 2013b). For the PSHA, a lower-bound moment magnitude of 5.0 was used, as specified in the 50.54(f) letter (U.S. NRC, 2012a). (EPRI, 2013d)

For the PSHA, the CEUS-SSC background seismic source zones out to a distance of 400 miles (640 km) around the site were included. This distance exceeds the 200 mile (320 km) recommendation contained in Reg. Guide 1.208 (U.S. NRC, 2007) and was chosen for completeness. Background sources included in this site analysis are the following (EPRI, 2013d):

1. Atlantic Highly Extended Crust (AHEX)
2. Extended Continental Crust—Atlantic Margin (ECC_AM)
3. Great Meteor Hotspot (GMH)
4. Mesozoic and younger extended prior – narrow (MESE-N)
5. Mesozoic and younger extended prior – wide (MESE-W)
6. Midcontinent-Craton alternative A (MIDC_A)
7. Midcontinent-Craton alternative B (MIDC_B)
8. Midcontinent-Craton alternative C (MIDC_C)
9. Midcontinent-Craton alternative D (MIDC_D)
10. Northern Appalachians (NAP)
11. Non-Mesozoic and younger extended prior – narrow (NMESE-N)
12. Non-Mesozoic and younger extended prior – wide (NMESE-W)
13. Paleozoic Extended Crust narrow (PEZ_N)
14. Paleozoic Extended Crust wide (PEZ_W)
15. St. Lawrence Rift, including the Ottawa and Saguenay grabens (SLR)
16. Study region (STUDY_R)

For sources of large magnitude earthquakes (designated Repeated Large Magnitude Earthquake (RLME) sources), in NUREG-2115 (CEUS-SSC, 2012) modeled for the CEUS-SSC, the following sources lie within 1,000 km of the site and were included in the analysis (EPRI, 2013d):

- Charleston
- Charlevoix

For each of the above background and RLME sources, the mid-continent version of the updated CEUS EPRI GMM was used. (EPRI, 2013d)

2.2.2 Base Rock Seismic Hazard Curves

Indian Point Unit 3 is a hard-rock site. To be consistent with the SPID (EPRI, 2013a), hard-rock seismic hazard curves are shown below in Section 2.3.7 at the SSE control point elevation. (EPRI, 2013d)

2.3 Site Response Evaluation

Based on information describing the Indian Point Unit 3 site presented in Section 2.3.1, the geologic layers underlying the foundation of the plant consist of hard rock (Vs $\geq$ 9280 fps). Therefore no site-specific evaluation of site amplification was performed for the Indian Point Unit 3 site. (EPRI, 2013d)

2.3.1 Description of Subsurface Material

The rocks in the vicinity of the Indian Point Unit 3 belong to three geologic provinces, the Hudson Highlands, the Manhattan Prong and the Newark Basin. Rocks that outcrop within the provinces range in age from Precambrian through Triassic (possibly Jurassic). (EPRI, 2013d)

The landscape consists of northeast trending ridges and rather broad swampy valleys. Ridges are supported by bedrock and tend to follow prominent generally northeast, structural trends. Valley walls tend to be steep, the result of modification by Pleistocene glaciation. Elevations in the area reach a maximum of 1,000 ft, and range from 50 to 300 ft above sea level in low lying areas. (EPRI, 2013d)

The Hudson Highlands outcrop in a northeast (040°) trending belt, approximately 10- miles wide, north, northwest and west of the Indian Point Unit 3 site. Four major rock types are present in the vicinity of Dunderburg Mountain, across the Hudson River from Indian Point Unit 3. They are quartzo-feldspathic ± calc-silicate hornblende gneiss; migmatitic quartzo-feldspathic biotite ± gamet gneiss; calc-silicate bearing quartzite; and gneissic hornblende granite. Granite probably intruded the gneisses during Precambrian time. (EPRI, 2013d)

The Manhattan Prong is a sequence of highly deformed metamorphic rocks, trending north-northeast, from New York City through Westchester County and western Fairfield County, Connecticut. The prong is bounded on the east by Cameron's Line, a complicated structure possibly representing a suture between two crustal blocks. On the west, the prong is bounded by the Newark Basin border fault and the Hudson River. (EPRI, 2013d)

The third geologic province in the area is the Newark-Gettysburg Basin. The basin extends 140-miles from York County, Pennsylvania, to Rockland County, New York. The basin, a down dropped crustal block, formed during Mesozoic time. Deposition was continuous from the late Triassic through the upper Jurassic (Dames & Moore, 1977). Intrusion of the Palisades sill apparently occurred during deposition of sediments in latest Triassic-earliest Jurassic. The extrusion of the Watchung basalt flows followed later in the Jurassic. Rocks of the Newark series are in contact with the crystalline rocks of both the Manhattan and Reading Prongs, but the nature of the contact varies. At the northeastern edge of the basin, Triassic sediments unconformably lie over the Highland rocks, while the northeastern edge of the basin is in contact with the rocks of the Highlands. (EPRI, 2013d)

Interpretations documented in site-specific information from the FSAR indicate that rock supporting reactor structures have shear-wave velocities exceeding 9,200 fps. Therefore the Indian Point Unit 3 site is treated as a hard-rock site. (Entergy, 2011a)

2.3.2 Development of Base Case Profiles and Nonlinear Material Properties

This section is not needed because this site is a hard rock site.

2.3.3 Randomization of Base Case Profiles

This section is not needed because this site is a hard rock site.

2.3.4 Input Spectra

This section is not needed because this site is a hard rock site.

2.3.5 Methodology

This section is not needed because this site is a hard rock site.

2.3.6 Amplification Functions

This section is not needed because this site is a hard rock site.

2.3.7 Control Point Seismic Hazard Curves

The procedure to develop probabilistic seismic hazard curves for hard rock follows standard techniques documented in the technical literature (e.g., McGuire, 2004). Separate seismic hazard calculations are conducted for the 7 spectral frequencies for which ground motion equations are available (100 Hz=peak ground acceleration or PGA, 25 Hz, 10 Hz, 5.0 Hz, 2.5 Hz, 1.0 Hz, and 0.5 Hz). As discussed in Section 2.2.1, ground motion equations from the updated EPRI GMM for the CEUS (EPRI, 2013b) were used for the calculation of rock hazard. All spectra accelerations presented herein correspond to 5% of critical damping. Figure 2.3.7-1 shows the mean hard-rock seismic hazard curves for the 7 spectral frequencies. The digital values for the mean and fractile hazard curves are provided in Appendix A. (EPRI, 2013d)

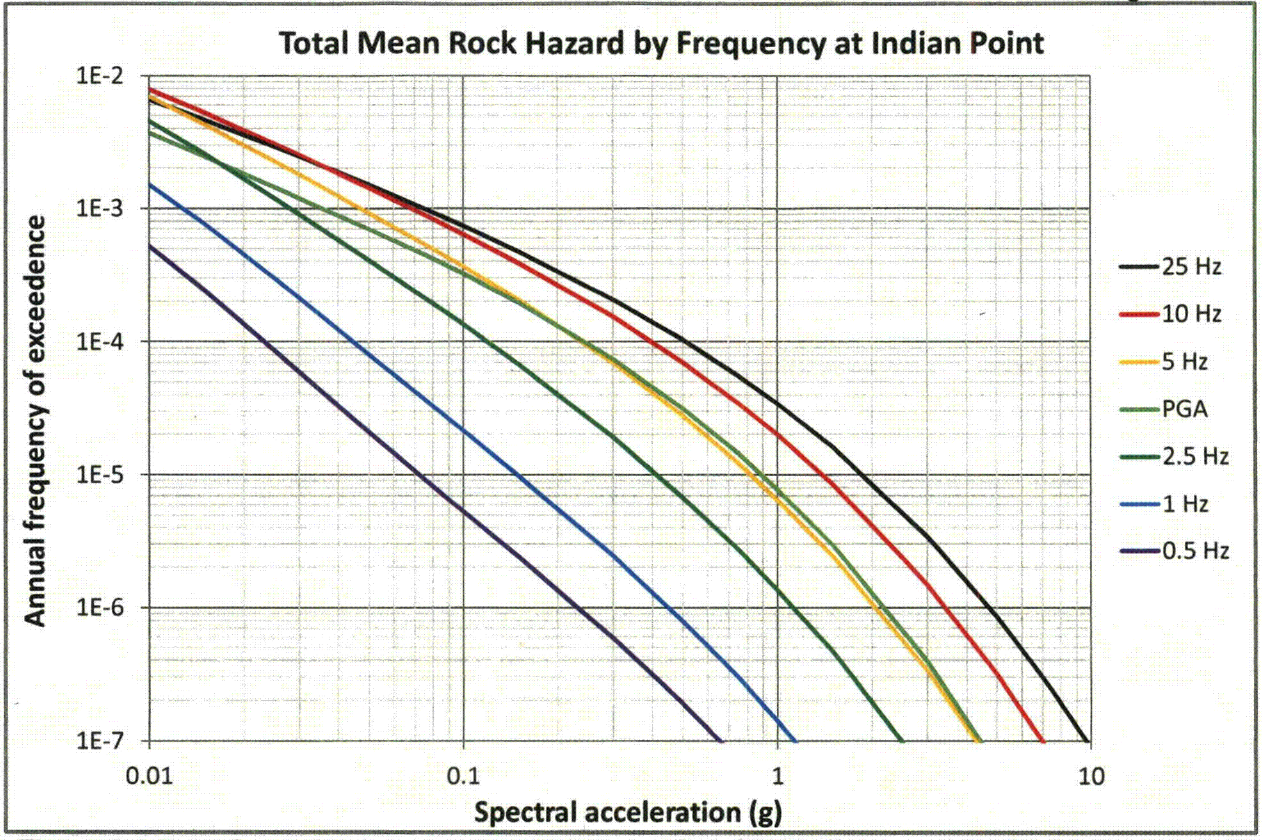

Figure 2.3.7-1. Control point mean hazard curves for spectral frequencies of 0.5, 1.0, 2.5, 5.0, 10, 25 and PGA (100 Hz) at Indian Point Unit 3. (EPRI, 2013d)

2.4 Control Point Response Spectrum

The hard-rock hazard curves described in Section 2.3.7 were used to develop uniform hazard response spectra (UHRS) and the GMRS. The UHRS were calculated through log-log interpolation of mean seismic hazard curves for a range of spectral frequencies, for annual frequencies of exceedance of 10^{-4} and 10^{-5}. Table 2.4-1 shows the UHRS and GMRS for a range of spectral frequencies. (EPRI, 2013d)

Table 2.4-1. UHRS and GMRS for Indian Point Unit 3. (EPRI, 2013d)

Freq. (Hz)	10^{-4} UHRS (g)	10^{-5} UHRS (g)	GMRS
100	2.43E-01	8.91E-01	4.12E-01
90	2.63E-01	9.62E-01	4.46E-01
80	2.98E-01	1.09E+00	5.04E-01
70	3.51E-01	1.28E+00	5.94E-01
60	4.17E-01	1.52E+00	7.04E-01
50	4.78E-01	1.74E+00	8.06E-01
45	5.00E-01	1.82E+00	8.42E-01
40	5.14E-01	1.87E+00	8.66E-01
35	5.21E-01	1.89E+00	8.77E-01
30	5.20E-01	1.89E+00	8.75E-01
25	5.11E-01	1.85E+00	8.58E-01
20	4.97E-01	1.78E+00	8.28E-01
15	4.64E-01	1.65E+00	7.67E-01
12.5	4.36E-01	1.54E+00	7.17E-01
10	3.97E-01	1.39E+00	6.48E-01
9	3.70E-01	1.29E+00	6.04E-01
8	3.41E-01	1.19E+00	5.55E-01
7	3.09E-01	1.07E+00	5.02E-01
6	2.75E-01	9.52E-01	4.46E-01
5	2.38E-01	8.21E-01	3.85E-01
4	1.94E-01	6.69E-01	3.14E-01
3	1.46E-01	5.04E-01	2.36E-01
2.5	1.20E-01	4.13E-01	1.94E-01
2	9.90E-02	3.39E-01	1.59E-01
1.5	7.38E-02	2.49E-01	1.17E-01
1.25	5.96E-02	2.00E-01	9.42E-02
1	4.49E-02	1.49E-01	7.04E-02
0.9	4.12E-02	1.35E-01	6.40E-02
0.8	3.71E-02	1.20E-01	5.71E-02
0.7	3.28E-02	1.05E-01	4.99E-02
0.6	2.82E-02	8.91E-02	4.25E-02
0.5	2.33E-02	7.27E-02	3.48E-02
0.4	1.87E-02	5.82E-02	2.78E-02
0.3	1.40E-02	4.36E-02	2.09E-02
0.2	9.33E-03	2.91E-02	1.39E-02
0.167	7.79E-03	2.43E-02	1.16E-02
0.125	5.83E-03	1.82E-02	8.69E-03
0.1	4.67E-03	1.45E-02	6.95E-03

The 10^{-4} and 10^{-5} UHRS and GMRS are plotted in Figure 2.4-1. (EPRI, 2013d)

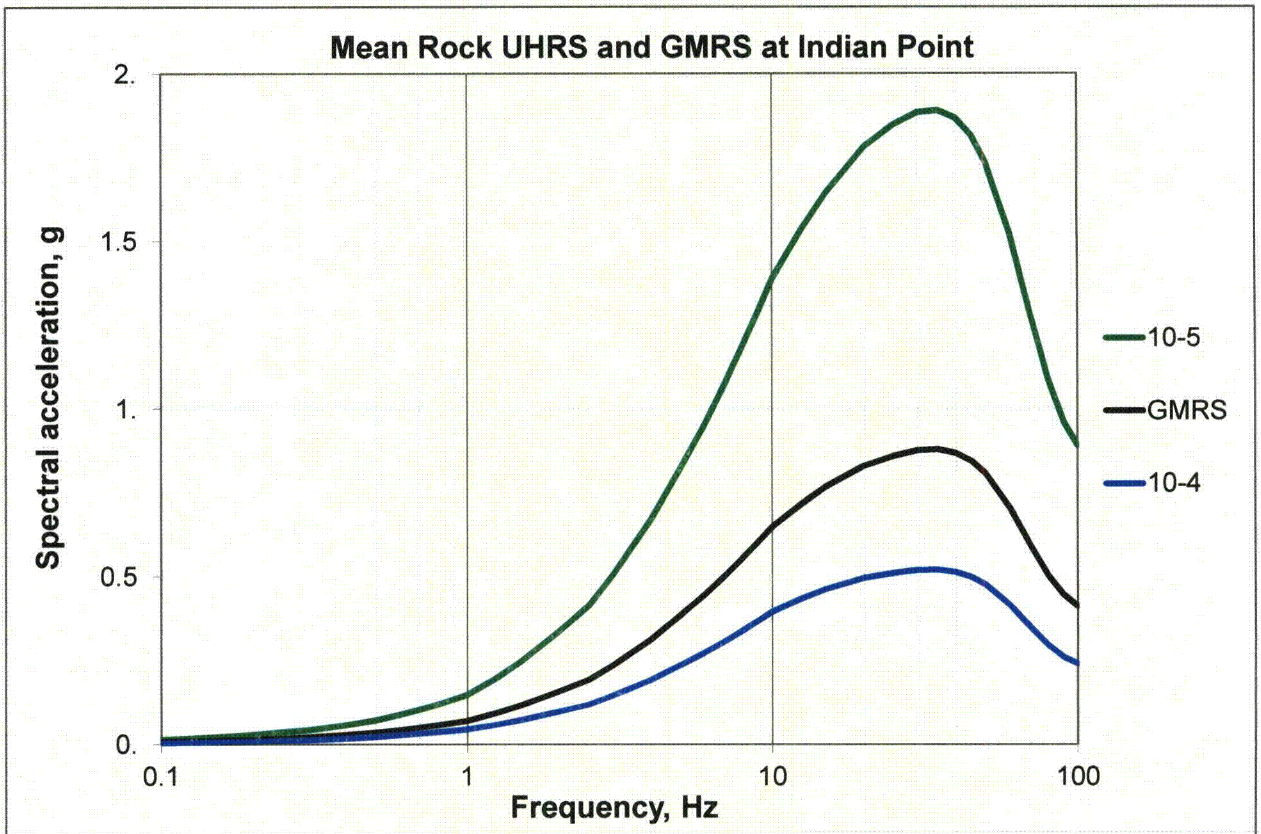

Figure 2.4-1. UHRS for 10^{-4} and 10^{-5} and GMRS at control point for Indian Point Unit 3 site (5% - damped response spectra). (EPRI, 2013d)

3.0 Plant Design Basis and Beyond Design Basis Evaluation Ground Motion

The design basis for Indian Point Unit 3 is identified in the Updated Final Safety Analysis Report (Entergy, 2011a), and other pertinent documents. For Indian Point Unit 3, an evaluation for beyond design basis (BDB) ground motions was performed in the Individual Plant Examination of External Events (IPEEE). The IPEEE plant level high confidence of low probability of failure (HCLPF) response spectrum, adjusted to more realistically reflect the Indian Point Unit 3 seismic robustness, is included below for screening purposes.

3.1 Safe Shutdown Earthquake Description of Spectral Shape

The SSE was developed in accordance with 10 CFR Part 100, Appendix A that existed at the time of the construction permit through an evaluation of the maximum earthquake potential for the region surrounding the site. Subsequently, the Atomic Safety Licensing Board (ASLB), considering the historic seismicity of the site region, ruled "in accordance with Appendix A to 10 CFR 100, neither the Cape Ann earthquake nor any historic event required the assumption of a safe shutdown earthquake for the Indian Point site of greater than a Modified Mercalli intensity VII" (ASLB, 1977) It was believed, therefore, that the plant's structural design, allowing for safe shutdown in the event of an earthquake of intensity VII on the Modified Mercalli Intensity Scale of 1931, was adequate. (Entergy, 2011a)

The SSE is defined in terms of a peak ground acceleration (PGA) and a design response spectrum. Table 3.1-1 shows the spectral acceleration (SA) values as a function of frequency for the 5% damped horizontal SSE. (Entergy, 2011a)

Table 3.1-1. SSE for Indian Point Unit 3. (Entergy, 2011a)

Frequency (Hz)	100	25	10	5	2.5	1	0.5
SA (g)	0.15	0.15	0.168	0.228	0.234	0.127	0.075

3.2 Control Point Elevation

In accordance with the guidance provided in the SPID (EPRI, 2013a) Section 2.4.2 for rock sites, the SSE control point elevation is defined at the top of hard-rock and is applicable at grade in the free field as well as the various foundations elevations. (EPRI, 2013a)

3.3 IPEEE Description and Capacity Response Spectrum

The Individual Plant Examination of External Events (IPEEE) was performed as a full-scope SPRA using the guidance in NUREG/CR-2300 (U.S. NRC, 2012b) and NUREG-1407 (U.S. NRC, 1991). Using the Indian Point Unit 3 Individual Plant Examination (IPE) (Entergy, 1994) (internal events Probabilistic Risk Assessment (PRA)) and the guidance in the NUREG documents, the SPRA was developed and structures, systems and components were screened using a 0.38g HCLPF, which exceeds the seismic review level earthquake (RLE) of 0.3g PGA. Components and structures that were determined to have sufficient capacity to survive the screening capacity without loss of function were screened out. Items that did not screen were subjected to a more detailed evaluation, including calculation of a HCLPF PGA for that item..

The IPEEE report was submitted to the NRC (Entergy, 1997). Results of the NRC review are documented in the NRC Staff Evaluation Report (SER) (U.S. NRC, 2001). The Structures, Systems, and Components (SSCs) fragilities in the Indian Point Unit 3 IPEEE were developed based on the Lawrence Livermore National Laboratory (LLNL) 10,000 Year Uniform Hazard Spectrum (UHS) shown in Table 3.3-1. The seismic IPEEE was recognized to be very conservative and the results did not adequately reflect the seismic robustness of the plant. A reassessment of the seismic core damage frequency was performed in 2011 (Entergy, 2011b) and the updated risk assessment was provided to the NRC (Entergy, 2013). As part of this reassessment, more realistic fragilities for the SSCs were established and new plant level HCLPF Spectra (IHS) were developed. The Series 4 plant level HCLPF spectrum developed as part of the reassessment is used for screening purposes. The IHS spectral accelerations are provided in Table 3.3-2.

The SSC fragilities in the Indian Point No. 3 IPEEE were developed based on Lawrence Livermore National Laboratory (LLNL) 10,000 Year Uniform Hazard Spectrum (UHS) shown in Table 3.3-1

Table 3.3-1. LLNL 10,000 Year UHS Ground Response. (Entergy, 1997)

Frequency (Hz)	Acceleration (g)
1.0	0.037
2.5	0.133
5.0	0.236
10	0.343
25	0.368
50	0.230
PGA	0.230

The 5% damped horizontal IHS spectral accelerations are shown in Table 3.3-2.

Table 3.3-2. IHS Spectrum. (Entergy, 2011b)

Frequency (Hz)	IHS Acceleration (g)
1.0	0.078
2.5	0.281
5.0	0.498
10	0.724
25	0.776
50	0.490
PGA	0.490

The SSE and IHS spectra are shown in Figure 3.3-1

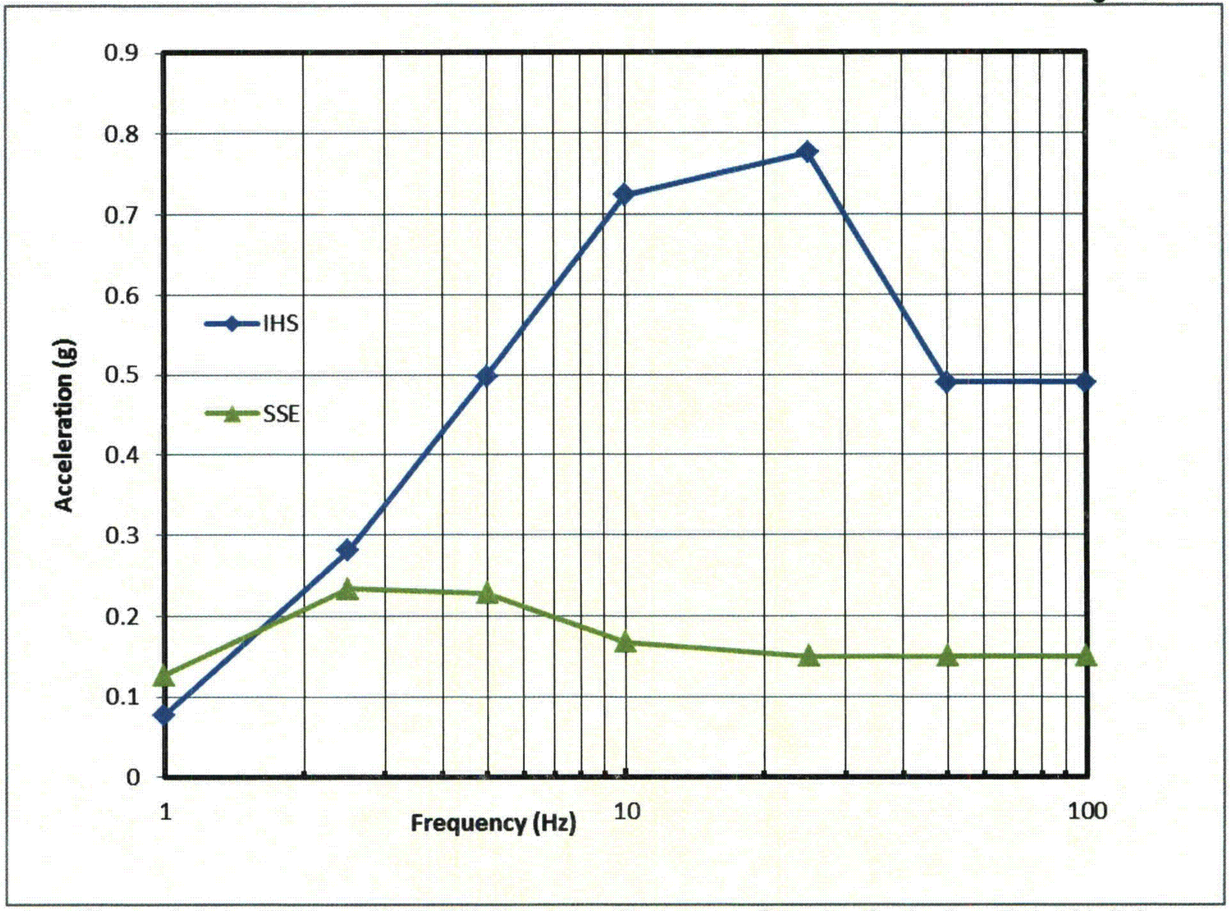

Figure 3.3-1. SSE and IHS 5% Damping Response Spectra for Indian Point Unit 3.

The IPEEE and its reassessment were reviewed for adequacy utilizing the guidance provided in Section 3.3 of the SPID (EPRI, 2013a). A detailed description of the results of the IPEEE adequacy review is included in Appendix B.

The results of these reviews have shown, in accordance with the criteria established in SPID (EPRI, 2013a) Section 3.3, that the IPEEE and reassessment of the IHS are adequate to support screening of the updated seismic hazard for Indian Point Unit 3. The review also concluded that the risk insights obtained from the IPEEE are still valid under the current plant configuration.

A full-scope detailed review of relay chatter as required in SPID (EPRI, 2013a) Section 3.3.1 was completed as part of the IPEEE (Entergy, 1997).

4.0 Screening Evaluation

In accordance with SPID (EPRI, 2013a) Section 3, a screening evaluation was performed as described below.

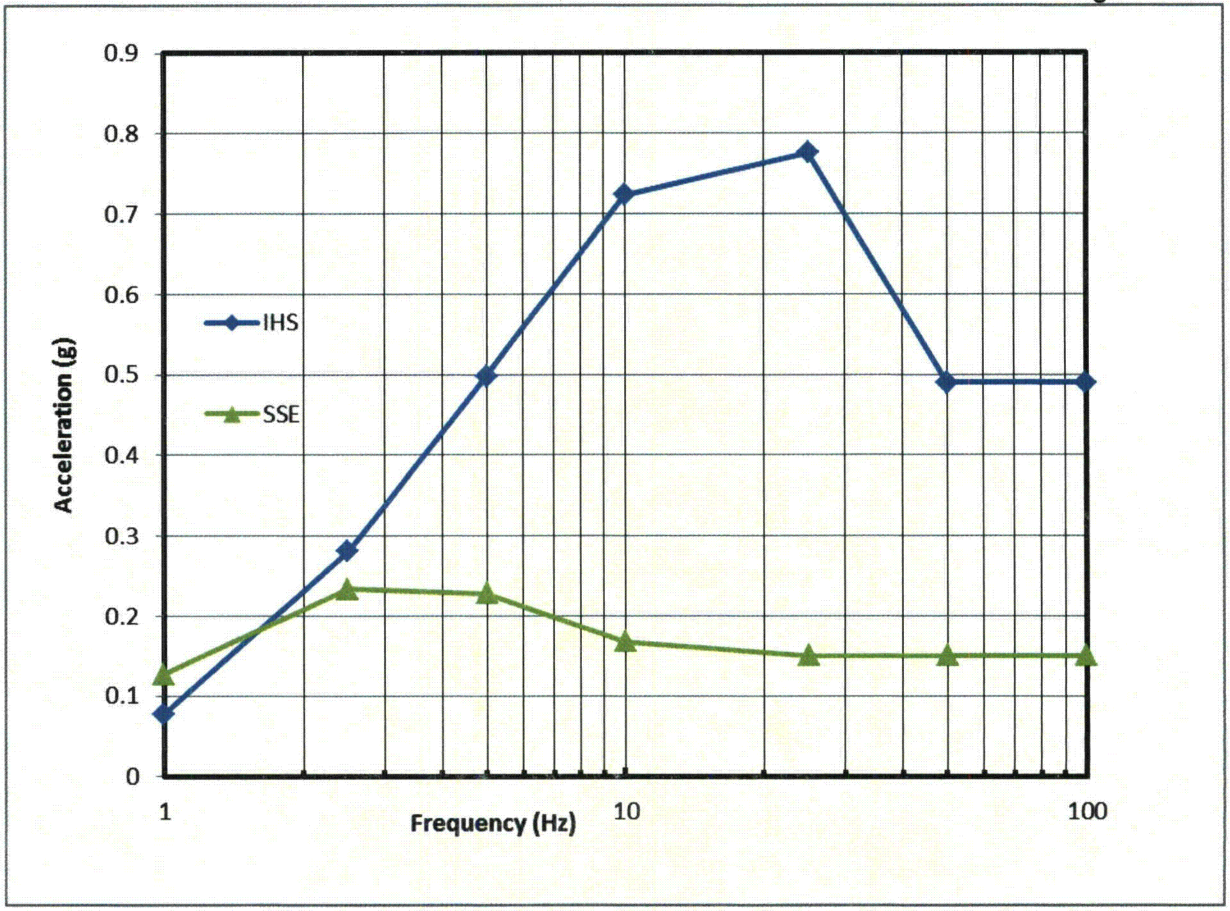

Figure 3.3-1. SSE and IHS 5% Damping Response Spectra for Indian Point Unit 3.

The IPEEE and its reassessment were reviewed for adequacy utilizing the guidance provided in Section 3.3 of the SPID (EPRI, 2013a). A detailed description of the results of the IPEEE adequacy review is included in Appendix B.

The results of these reviews have shown, in accordance with the criteria established in SPID (EPRI, 2013a) Section 3.3, that the IPEEE and reassessment of the IHS are adequate to support screening of the updated seismic hazard for Indian Point Unit 3. The review also concluded that the risk insights obtained from the IPEEE are still valid under the current plant configuration.

A full-scope detailed review of relay chatter as required in SPID (EPRI, 2013a) Section 3.3.1 was completed as part of the IPEEE (Entergy, 1997).

4.0 Screening Evaluation

In accordance with SPID (EPRI, 2013a) Section 3, a screening evaluation was performed as described below.

4.1 Risk Evaluation Screening (1 to 10 Hz)

In the 1 to 10 Hz part of the response spectrum, the updated IHS [Entergy (2011b)] exceeds the GMRS. Based on this comparison, a risk evaluation would not be required to be performed, however, since NRC has not formally reviewed the updated IHS, Indian Point Unit 3 currently "screens in" for a risk evaluation. We believe that, once it has been reviewed by NRC, a comparison to the updated IHS will be more appropriate than a comparison to the original IPEEE analysis for the final screening.

4.2 High Frequency Screening (> 10 Hz)

Above 10 Hz, the GMRS exceeds the SSE. Therefore, Indian Point Unit 3 screens in for a High Frequency Confirmation.

4.3 Spent Fuel Pool Evaluation Screening (1 to 10 Hz)

In the 1 to 10 Hz part of the response spectrum, the GMRS exceeds the SSE. Therefore, Indian Point Unit 3 screens in for a Spent Fuel Pool evaluation.

5.0 Interim Actions

Based on the screening evaluation, the expedited seismic evaluation described in EPRI 3002000704 (EPRI, 2013c) will be performed as proposed in a letter to the NRC (ML13101A379) dated April 9, 2013 (NEI, 2013) and agreed to by the NRC (ML13106A331) in a letter dated May 7, 2013 (U.S. NRC, 2013).

Consistent with NRC letter (ML14030A046) dated February 20, 2014 (U.S. NRC, 2014), the seismic hazard reevaluations presented herein are distinct from the current design and licensing bases of Indian Point Unit 3. Therefore, the results do not call into question the operability or functionality of SSCs and are not reportable pursuant to 10 CFR 50.72, "Immediate notification requirements for operating nuclear power reactors," and 10 CFR 50.73, "Licensee event report system".

The NRC letter also requests that licensees provide an interim evaluation or actions to demonstrate that the plant can cope with the reevaluated hazard while the expedited approach and risk evaluations are conducted. In response to that request, NEI letter dated March 12, 2014 (NEI, 2014), provides seismic core damage risk estimates using the updated seismic hazards for the operating nuclear plants in the Central and Eastern United States. These risk estimates continue to support the following conclusions of the NRC GI-199 Safety/Risk Assessment (U.S. NRC, 2010):

> Overall seismic core damage risk estimates are consistent with the Commission's Safety Goal Policy Statement because they are within the subsidiary objective of 10^{-4}/year for core damage frequency. The GI-199 Safety/Risk Assessment, based in part on information from the U.S. Nuclear Regulatory Commission's (NRC's) Individual Plant Examination of External Events (IPEEE) program, indicates that no concern exists regarding adequate protection and that the current seismic design of operating reactors provides a safety margin to withstand potential earthquakes exceeding the original design basis.

Indian Point Unit 3 is included in the March 12, 2014 risk estimates (NEI, 2014). Using the methodology described in the NEI letter, all plants were shown to be below 10^{-4}/year; thus, the above conclusions apply.

In accordance with the Near-Term Task Force Recommendation 2.3, Indian Point Unit 3 performed seismic walkdowns using the guidance in EPRI Report 1025286 (EPRI, 2012). The seismic walkdowns were completed and captured in Fukushima Seismic Walkdown Report IP-RPT-12-00039 (Entergy, 2012). The goal of the walkdowns was to verify current plant configuration with the existing licensing basis, to verify the current maintenance plans, and to identify any vulnerabilities. The walkdown also verified that any vulnerabilities identified in the IPEEE (Entergy, 1997) are adequately addressed. The results of the walkdown, including any identified corrective actions, confirm that Indian Point Unit 3 can adequately respond to a seismic event.

6.0 Conclusions

In accordance with the 50.54(f) request for information (U.S. NRC, 2012a), a seismic hazard and screening evaluation was performed for Indian Point Unit 3. A GMRS was developed solely for purpose of screening for additional evaluations in accordance with the SPID (EPRI, 2013a). Based on the results of the screening evaluation, Indian Point Unit 3 screens-in for a High Frequency Confirmation and a Spent Fuel Pool evaluation. Additionally, based on the results of the screening evaluation, Indian Point Unit 3 screens-out of performing a risk evaluation. However, since NRC has not formally reviewed the updated IHS, Indian Point Unit 3 currently "screens in" for a risk evaluation. We believe that, once it has been reviewed by NRC, a comparison to the updated IHS will be more appropriate than a comparison to the original IPEEE analysis for the final screening.

7.0 References

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10 CFR Part 50.72. Title 10, Code of Federal Regulations, Part 50.72, "Immediate Notification Requirements for Operating Nuclear Power Reactors," U.S. Nuclear Regulatory Commission, Washington DC.

10 CFR Part 50.73. Title 10, Code of Federal Regulations, Part 50.73, "Licensee Event Report System," U.S. Nuclear Regulatory Commission, Washington DC.

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Appendix A

Tabulated Data

Table A-1a. Mean and Fractile Seismic Hazard Curves for 100 Hz (PGA) at Indian Point Unit 3. (EPRI, 2013d)

AMPS(g)	MEAN	0.05	0.16	0.50	0.84	0.95
0.0005	4.01E-02	1.79E-02	3.09E-02	4.07E-02	4.98E-02	5.66E-02
0.001	2.81E-02	1.10E-02	2.04E-02	2.76E-02	3.68E-02	4.37E-02
0.005	7.39E-03	3.23E-03	4.56E-03	6.73E-03	9.51E-03	1.57E-02
0.01	3.73E-03	1.53E-03	2.16E-03	3.33E-03	4.70E-03	8.98E-03
0.015	2.47E-03	8.98E-04	1.32E-03	2.13E-03	3.28E-03	6.17E-03
0.03	1.20E-03	3.19E-04	5.35E-04	9.93E-04	1.79E-03	3.09E-03
0.05	7.04E-04	1.34E-04	2.68E-04	5.66E-04	1.10E-03	1.79E-03
0.075	4.52E-04	6.45E-05	1.60E-04	3.57E-04	7.23E-04	1.16E-03
0.1	3.25E-04	3.73E-05	1.11E-04	2.60E-04	5.27E-04	8.35E-04
0.15	1.97E-04	1.72E-05	6.45E-05	1.57E-04	3.23E-04	5.12E-04
0.3	7.45E-05	4.07E-06	2.16E-05	5.83E-05	1.23E-04	1.92E-04
0.5	3.17E-05	1.31E-06	8.23E-06	2.42E-05	5.35E-05	8.60E-05
0.75	1.45E-05	4.43E-07	3.28E-06	1.05E-05	2.46E-05	4.13E-05
1.	7.79E-06	1.98E-07	1.53E-06	5.42E-06	1.32E-05	2.29E-05
1.5	2.93E-06	5.58E-08	4.31E-07	1.84E-06	4.90E-06	9.37E-06
3.	3.94E-07	4.13E-09	2.96E-08	1.98E-07	6.17E-07	1.57E-06
5.	6.52E-08	4.25E-10	2.57E-09	2.42E-08	9.24E-08	3.14E-07
7.5	1.25E-08	1.05E-10	3.19E-10	3.42E-09	1.57E-08	6.73E-08
10.	3.40E-09	6.73E-11	1.11E-10	7.66E-10	4.01E-09	2.01E-08

Table A-1b. Mean and Fractile Seismic Hazard Curves for 25 Hz at Indian Point Unit 3. (EPRI, 2013d)

AMPS(g)	MEAN	0.05	0.16	0.50	0.84	0.95
0.0005	4.56E-02	2.57E-02	3.79E-02	4.56E-02	5.42E-02	6.09E-02
0.001	3.50E-02	1.72E-02	2.76E-02	3.42E-02	4.37E-02	5.05E-02
0.005	1.19E-02	5.42E-03	7.77E-03	1.10E-02	1.51E-02	2.32E-02
0.01	6.62E-03	3.09E-03	4.13E-03	6.00E-03	8.23E-03	1.42E-02
0.015	4.65E-03	2.13E-03	2.84E-03	4.25E-03	5.83E-03	1.02E-02
0.03	2.47E-03	9.79E-04	1.40E-03	2.22E-03	3.28E-03	5.35E-03
0.05	1.50E-03	4.98E-04	7.77E-04	1.34E-03	2.10E-03	3.23E-03
0.075	9.97E-04	2.76E-04	4.70E-04	8.85E-04	1.46E-03	2.16E-03
0.1	7.37E-04	1.77E-04	3.23E-04	6.54E-04	1.11E-03	1.62E-03
0.15	4.73E-04	8.72E-05	1.92E-04	4.13E-04	7.34E-04	1.05E-03
0.3	2.07E-04	2.35E-05	7.89E-05	1.84E-04	3.28E-04	4.63E-04
0.5	1.03E-04	8.47E-06	3.73E-05	9.24E-05	1.67E-04	2.35E-04
0.75	5.55E-05	3.47E-06	1.90E-05	4.90E-05	8.98E-05	1.29E-04
1.	3.42E-05	1.84E-06	1.11E-05	2.96E-05	5.58E-05	8.00E-05
1.5	1.60E-05	6.54E-07	4.77E-06	1.32E-05	2.60E-05	4.07E-05
3.	3.39E-06	8.72E-08	7.55E-07	2.53E-06	5.58E-06	9.93E-06
5.	8.51E-07	1.57E-08	1.32E-07	5.75E-07	1.44E-06	2.88E-06
7.5	2.40E-07	3.37E-09	2.68E-08	1.44E-07	4.07E-07	8.98E-07
10.	8.89E-08	1.05E-09	7.45E-09	4.70E-08	1.49E-07	3.63E-07

Table A-1c. Mean and Fractile Seismic Hazard Curves for 10 Hz at Indian Point Unit 3. (EPRI, 2013d)

AMPS(g)	MEAN	0.05	0.16	0.50	0.84	0.95
0.0005	5.04E-02	3.79E-02	4.31E-02	4.98E-02	5.83E-02	6.45E-02
0.001	4.12E-02	2.64E-02	3.33E-02	4.07E-02	4.98E-02	5.58E-02
0.005	1.48E-02	7.45E-03	1.02E-02	1.40E-02	1.92E-02	2.46E-02
0.01	7.87E-03	3.84E-03	5.12E-03	7.45E-03	1.02E-02	1.40E-02
0.015	5.26E-03	2.53E-03	3.37E-03	4.98E-03	6.83E-03	9.79E-03
0.03	2.54E-03	1.08E-03	1.55E-03	2.35E-03	3.37E-03	4.83E-03
0.05	1.44E-03	5.20E-04	7.89E-04	1.32E-03	2.04E-03	2.80E-03
0.075	9.04E-04	2.72E-04	4.43E-04	8.23E-04	1.32E-03	1.82E-03
0.1	6.43E-04	1.64E-04	2.92E-04	5.83E-04	9.65E-04	1.32E-03
0.15	3.90E-04	7.55E-05	1.62E-04	3.47E-04	6.09E-04	8.35E-04
0.3	1.54E-04	1.74E-05	5.66E-05	1.36E-04	2.46E-04	3.47E-04
0.5	7.02E-05	5.42E-06	2.39E-05	6.09E-05	1.15E-04	1.67E-04
0.75	3.48E-05	2.01E-06	1.08E-05	2.92E-05	5.66E-05	8.72E-05
1.	2.01E-05	9.65E-07	5.91E-06	1.64E-05	3.28E-05	5.20E-05
1.5	8.49E-06	3.14E-07	2.19E-06	6.64E-06	1.40E-05	2.32E-05
3.	1.49E-06	3.42E-08	2.72E-07	1.04E-06	2.53E-06	4.77E-06
5.	3.19E-07	5.27E-09	4.01E-08	1.95E-07	5.50E-07	1.18E-06
7.5	7.91E-08	1.01E-09	6.64E-09	4.13E-08	1.32E-07	3.23E-07
10.	2.66E-08	3.01E-10	1.69E-09	1.16E-08	4.37E-08	1.15E-07

Table A-1d. Mean and Fractile Seismic Hazard Curves for 5.0 Hz at Indian Point Unit 3. (EPRI, 2013d)

AMPS(g)	MEAN	0.05	0.16	0.50	0.84	0.95
0.0005	5.09E-02	3.79E-02	4.31E-02	5.05E-02	5.91E-02	6.54E-02
0.001	4.20E-02	2.60E-02	3.28E-02	4.19E-02	5.12E-02	5.75E-02
0.005	1.43E-02	6.64E-03	9.51E-03	1.38E-02	1.95E-02	2.32E-02
0.01	6.93E-03	3.28E-03	4.43E-03	6.54E-03	9.51E-03	1.16E-02
0.015	4.30E-03	2.04E-03	2.72E-03	4.07E-03	5.83E-03	7.34E-03
0.03	1.81E-03	7.66E-04	1.10E-03	1.74E-03	2.46E-03	3.23E-03
0.05	9.31E-04	3.19E-04	4.98E-04	8.85E-04	1.34E-03	1.77E-03
0.075	5.44E-04	1.51E-04	2.60E-04	5.05E-04	8.23E-04	1.10E-03
0.1	3.67E-04	8.35E-05	1.62E-04	3.37E-04	5.66E-04	7.66E-04
0.15	2.07E-04	3.42E-05	8.35E-05	1.87E-04	3.28E-04	4.50E-04
0.3	6.97E-05	6.54E-06	2.46E-05	6.09E-05	1.13E-04	1.64E-04
0.5	2.78E-05	1.77E-06	8.60E-06	2.35E-05	4.63E-05	6.93E-05
0.75	1.22E-05	6.00E-07	3.33E-06	9.93E-06	2.10E-05	3.19E-05
1.	6.45E-06	2.57E-07	1.57E-06	5.05E-06	1.11E-05	1.77E-05
1.5	2.40E-06	7.13E-08	4.70E-07	1.72E-06	4.19E-06	7.13E-06
3.	3.35E-07	5.83E-09	3.84E-08	1.95E-07	5.83E-07	1.20E-06
5.	6.07E-08	6.54E-10	4.13E-09	2.72E-08	1.02E-07	2.39E-07
7.5	1.31E-08	1.40E-10	5.66E-10	4.43E-09	2.10E-08	5.58E-08
10.	4.01E-09	9.65E-11	1.69E-10	1.11E-09	6.00E-09	1.74E-08

Table A-1e. Mean and Fractile Seismic Hazard Curves for 2.5 Hz at Indian Point Unit 3. (EPRI, 2013d)

AMPS(g)	MEAN	0.05	0.16	0.50	0.84	0.95
0.0005	4.80E-02	3.42E-02	3.95E-02	4.77E-02	5.66E-02	6.36E-02
0.001	3.75E-02	2.29E-02	2.80E-02	3.73E-02	4.70E-02	5.35E-02
0.005	1.07E-02	4.98E-03	6.93E-03	1.02E-02	1.49E-02	1.82E-02
0.01	4.58E-03	2.10E-03	2.80E-03	4.25E-03	6.36E-03	8.12E-03
0.015	2.59E-03	1.15E-03	1.57E-03	2.42E-03	3.63E-03	4.77E-03
0.03	9.12E-04	3.37E-04	5.05E-04	8.47E-04	1.31E-03	1.74E-03
0.05	4.11E-04	1.20E-04	1.98E-04	3.73E-04	6.17E-04	8.35E-04
0.075	2.16E-04	4.90E-05	9.24E-05	1.90E-04	3.37E-04	4.70E-04
0.1	1.36E-04	2.46E-05	5.27E-05	1.18E-04	2.16E-04	3.09E-04
0.15	6.85E-05	8.72E-06	2.32E-05	5.75E-05	1.13E-04	1.67E-04
0.3	1.93E-05	1.31E-06	5.05E-06	1.44E-05	3.33E-05	5.27E-05
0.5	6.78E-06	2.84E-07	1.36E-06	4.63E-06	1.18E-05	2.01E-05
0.75	2.73E-06	7.77E-08	4.19E-07	1.69E-06	4.83E-06	8.85E-06
1.	1.36E-06	2.88E-08	1.62E-07	7.66E-07	2.42E-06	4.70E-06
1.5	4.66E-07	6.45E-09	3.73E-08	2.22E-07	8.35E-07	1.79E-06
3.	5.64E-08	3.42E-10	2.01E-09	1.72E-08	9.65E-08	2.42E-07
5.	9.07E-09	1.01E-10	2.04E-10	1.77E-09	1.36E-08	4.07E-08
7.5	1.77E-09	5.05E-11	9.93E-11	2.80E-10	2.29E-09	8.12E-09
10.	5.03E-10	4.01E-11	5.66E-11	1.13E-10	6.00E-10	2.29E-09

Table A-1f. Mean and Fractile Seismic Hazard Curves for 1.0 Hz at Indian Point Unit 3. (EPRI, 2013d)

AMPS(g)	MEAN	0.05	0.16	0.50	0.84	0.95
0.0005	3.11E-02	1.53E-02	2.16E-02	3.09E-02	4.07E-02	4.70E-02
0.001	2.00E-02	8.72E-03	1.32E-02	1.98E-02	2.68E-02	3.23E-02
0.005	4.13E-03	1.32E-03	2.22E-03	3.79E-03	6.00E-03	8.35E-03
0.01	1.52E-03	4.31E-04	7.23E-04	1.31E-03	2.32E-03	3.42E-03
0.015	7.72E-04	2.01E-04	3.37E-04	6.36E-04	1.21E-03	1.82E-03
0.03	2.16E-04	4.50E-05	8.00E-05	1.69E-04	3.63E-04	5.27E-04
0.05	8.15E-05	1.31E-05	2.57E-05	6.00E-05	1.38E-04	2.19E-04
0.075	3.76E-05	4.43E-06	9.93E-06	2.64E-05	6.36E-05	1.11E-04
0.1	2.17E-05	1.95E-06	4.98E-06	1.44E-05	3.68E-05	6.83E-05
0.15	9.92E-06	5.83E-07	1.82E-06	6.00E-06	1.69E-05	3.42E-05
0.3	2.45E-06	6.17E-08	2.64E-07	1.18E-06	4.25E-06	9.51E-06
0.5	7.96E-07	9.37E-09	4.98E-08	3.09E-07	1.34E-06	3.33E-06
0.75	3.01E-07	1.87E-09	1.10E-08	8.98E-08	4.83E-07	1.34E-06
1.	1.43E-07	5.58E-10	3.47E-09	3.33E-08	2.16E-07	6.64E-07
1.5	4.58E-08	1.38E-10	6.09E-10	6.93E-09	6.00E-08	2.22E-07
3.	4.99E-09	5.05E-11	1.01E-10	3.63E-10	4.56E-09	2.35E-08
5.	7.59E-10	4.01E-11	5.05E-11	1.01E-10	5.27E-10	3.28E-09
7.5	1.44E-10	4.01E-11	4.19E-11	1.01E-10	1.32E-10	5.91E-10
10.	4.03E-11	4.01E-11	4.01E-11	9.11E-11	1.01E-10	2.01E-10

Table A-1g. Mean and Fractile Seismic Hazard Curves for 0.5 Hz at Indian Point Unit 3. (EPRI, 2013d)

AMPS(g)	MEAN	0.05	0.16	0.50	0.84	0.95
0.0005	1.60E-02	8.00E-03	1.15E-02	1.55E-02	2.07E-02	2.53E-02
0.001	9.40E-03	4.01E-03	6.09E-03	8.98E-03	1.27E-02	1.64E-02
0.005	1.61E-03	3.52E-04	6.64E-04	1.32E-03	2.60E-03	3.90E-03
0.01	5.23E-04	8.72E-05	1.69E-04	3.79E-04	9.11E-04	1.44E-03
0.015	2.45E-04	3.57E-05	6.83E-05	1.64E-04	4.43E-04	7.03E-04
0.03	6.01E-05	6.36E-06	1.32E-05	3.57E-05	1.13E-04	1.87E-04
0.05	2.11E-05	1.55E-06	3.68E-06	1.13E-05	3.79E-05	7.55E-05
0.075	9.41E-06	4.63E-07	1.27E-06	4.56E-06	1.62E-05	3.73E-05
0.1	5.35E-06	1.87E-07	5.83E-07	2.32E-06	8.85E-06	2.29E-05
0.15	2.41E-06	4.63E-08	1.87E-07	8.85E-07	3.84E-06	1.11E-05
0.3	5.88E-07	3.23E-09	1.95E-08	1.38E-07	8.12E-07	3.01E-06
0.5	1.91E-07	4.01E-10	2.84E-09	2.76E-08	2.22E-07	1.02E-06
0.75	7.29E-08	1.18E-10	5.58E-10	6.36E-09	6.93E-08	4.01E-07
1.	3.50E-08	9.93E-11	1.92E-10	2.07E-09	2.72E-08	1.84E-07
1.5	1.15E-08	5.05E-11	1.01E-10	4.13E-10	6.45E-09	5.75E-08
3.	1.32E-09	4.01E-11	5.05E-11	1.01E-10	4.13E-10	5.27E-09
5.	2.11E-10	4.01E-11	4.01E-11	1.01E-10	1.05E-10	7.45E-10
7.5	4.17E-11	4.01E-11	4.01E-11	9.11E-11	1.01E-10	1.79E-10
10.	1.20E-11	4.01E-11	4.01E-11	9.11E-11	1.01E-10	1.01E-10

Appendix B

IPEEE Adequacy Review

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1.0 Background

The Nuclear Regulatory Commission (NRC) staff issued Generic Letter (GL) 88-20, Supplement 4 on June 28, 1991 (Reference 6.27), requesting that each licensee conduct an Individual Plant Examination of External Events (IPEEE) for severe accident vulnerabilities. Concurrently, NUREG-1407, "Procedural and Submittal Guidance for the Individual Plant Examination of External Events (IPEEE) for Severe Accident Vulnerabilities" (Reference 6.5) was issued to provide utilities with detailed guidance for performance of the IPEEE.

A seismic PRA (SPRA) was performed for the seismic portion of the Indian Point Unit 3 IPEEE (Reference 6.1) using the IPE (Reference 6.2), NUREG/CR-2300 (Reference 6.3) guidance, and EPRI NP-6041 (Reference 6.4) with enhancements identified in NUREG-1407 (Reference 6.5). Indian Point Unit 3 performed a 0.3g full scope analysis utilizing a LLNL spectral shape (Reference 6.6). The calculated plant-level high confidence of low probability of failure (HCLPF) for Indian Point Unit 3 resulting from performance of the IPEEE was reported as 0.13g. The results of the Indian Point Unit 3 IPEEE were provided to NRC in a letter dated September 26, 1997. The 0.13g HCLPF reported in the IPEEE was reassessed in 2011 and submitted to NRC in June 2013 (Reference 6.7).

The NRC staff did not submit a request for additional information (RAI) on the seismic portion of the IPEEE.

The NRC issued its Staff Evaluation Report (SER) on February 15, 2001 for the Indian Point Unit 3 IPEEE (Reference 6.8). The SER concluded that the Indian Point Unit 3 IPEEE process was capable of identifying the most likely severe accidents and severe accident vulnerabilities, meeting the intent of Supplement 4 to GL 88-20 (Reference 6.27). The NRC has not formally reviewed the reassessed IPEEE seismic evaluation, but the SER (see Section 3.0) did recognize that the IPEEE SPRA was conservative.

Indian Point Unit 3 had no commitments in the IPEEE with regard to seismic issues although a modification was completed to resolve spurious CO_2 actuation and ventilation isolation in the Emergency Diesel Generator (EDG) rooms. The NRC SER identified this as closed.

2.0 General Considerations

The plant original licensing seismic design basis earthquake (DBE) is a Housner type spectrum anchored to 0.15g peak ground acceleration (PGA).

The Indian Point Unit 3 IPEEE seismic analysis is a full scope assessment using the SPRA methodology. The IPEEE HCLPF Spectrum (IHS) is developed from LLNL UHS (10,000 Year UHRS at the Indian Point Site). The SPRA was selected as the method for the IPEEE seismic evaluation because it provides more quantitative risk insights. System component capacity evaluations are compatible with the Unresolved Safety Issue (USI) A-46 assessment. The conservative deterministic failure method (CDFM) was used to calculate the HCLPF capacities of components that did not screen out of evaluation.

The original IPEEE was reassessed to develop fragilities and Seismic Core Damage Frequency (SCDF) estimates that more realistically reflect the plant seismic robustness and the results were reported to the NRC via Reference 6.7. The fragilities indicated as Series 4 in the report were used to develop the plant level HCLPF spectrum (IHS) used for the Ground Motion Response Spectra (GMRS) comparisons. As a result of the IPEEE reassessment (Reference 6.7), it was determined that the plant HCLPF was greater than the Review Level Earthquake (RLE) of 0.3g.

There were no IPEEE commitments, but there was a vulnerability identified in the IPEEE associated with spurious CO_2 actuation and ventilation isolation in the EDG rooms. This resulted in a modification. Verification was provided in the Indian Point Unit 3 Response to 10CFR 50.54(f) Request for Information Recommendation 2.3 Seismic (Reference 6.9) and is further discussed below in Section 3.0 Prerequisites. Confirmation that these modifications are still in place is described in the Prerequisites section of this report.

The following sections summarize the results of the IPEEE adequacy evaluation according to the guidance of the SPID (Reference 6.28).

2.1 Relay Chatter

EPRI methods (References 6.12 and 6.13, EPRI-NP-7148 and 7147) were used in the evaluation of relay chatter, along with the Indian Point Unit 3 Individual Plant Examination (IPE). The relay chatter evaluation was based on the recommendations in NUREG-1407 (Reference 6.5). The recommended approach for Indian Point Unit 3, a full scope A-46 plant, requires the evaluation of relays within the scope of A-46 and other relays identified in the IPE but outside the scope of A-46.

A review for bad actor relays was performed as well as a functional relay chatter evaluation to identify those relays to be included in the seismic capability screening and analysis. Table 3A.5 in the IPEEE lists all relays selected for evaluation of seismic capacity and Table 3A.6 lists relays found to have low seismic capacity. These low seismic capacity relays are associated with the three emergency diesels; they were subsequently walked down, evaluated and determined to be seismically qualified.

The potential for interfacing system Loss of Coolant Accidents (ISLOCAs) (i.e., Loss of Coolant Accident (LOCA) outside containment) as a result of relay chatter was evaluated and found to be unlikely regardless of seismic margin results. Containment isolation was also reviewed, and it was again determined that relay chatter was not a concern.

In summary, the relay chatter evaluation determined that relay chatter either had no impact or is recoverable. All relays that were found to be seismically rugged were screened at the screening HCLPF (0.38g).

The NRCs IPEEE SER (Reference 6.8) concluded *"The evaluation procedure for relay chatter appears to meet the guidelines of NUREG-1407."* It also states that "*As the result of the relay screening, a total of 12 relays, all related to the emergency diesel generator system, were identified as bad actor relays. These relays were assumed to chatter regardless of the ground motion acceleration level, and recovery actions were not credited.*" The IPEEE actually did not have to model these relays after the final evaluation noted above.

The evaluation meets the requirements of Section 3.2.4.2 of NUREG 1407 (Reference 6.5) for a full scope relay chatter evaluation.

2.2 Soil Failure Evaluation

The safety-related structures at Indian Point Unit 3 are founded on rock. The shear wave velocity of the foundation material is greater than 9,300 ft/sec. Rock was previously defined as material with a shear-wave velocity greater than 3,500 ft/sec; therefore, soil failure effects (such as liquefaction, slope stability and settlement) are considered negligible (Reference 6.1).

The IPEEE also considered that some of the piping (Section 16.3.4 of the Final Safety Analysis Report (FSAR) specifically discusses two 24-inch service water lines) is buried in trenches which have been backfilled. Seismically induced failure of this soil is not credible because the surrounding bedrock contains the soil. Seismic shaking could induce some compaction, but if the soil was compacted during the backfilling (as normally would be done) the additional compaction should not be significant. Therefore, soil failure is not a credible concern.

The buried EDG Fuel Oil Storage Tanks, the Condensate Storage Tank (CST) and Refueling Water Storage Tank (RWST) evaluations document that for these tanks that the tank bottom rests on rock conditions.

As stated in NUREG-1407, Section 3.2.1 (Reference 6.5), a plant in the full-scope category that is located on a rock site is not required to perform a soil failure evaluation.

3.0 Prerequisites

The following items as outlined in the SPID (Reference 6.28) have been addressed in order to use the IPEEE analysis for screening purposes and to demonstrate that the IPEEE results can be used for comparison with the ground motion response spectra (GMRS):

1) Confirmation that commitments made under the IPEEE have been met.
2) Confirmation that all of the modifications and other changes credited in the IPEEE analysis are in place.
3) Confirmation that any identified deficiencies or weaknesses to NUREG-1407 (Reference 6.5) in the Indian Point Unit 3 IPEEE NRC SER are properly justified to ensure that the IPEEE conclusions remain valid.
4) Confirmation that major plant modifications since the completion of the IPEEE have not degraded/impacted the conclusion reached in the IPEEE.

Response:

The IPEEE commitments and modifications have been completed. Verification of the completion of these commitments and modifications were provided in the Indian Point Unit 3 Response to 10CFR 50.54(f) Request for Information Recommendation 2.3 Seismic (Reference 6.9).

The Indian Point Unit 3 NRC SER (Reference 6.8) on the seismic portion of the IPEEE states that no significant weaknesses in the submittal were found. However, the following observations were noted during review of the SER [the relevance and importance of each observation are addressed in brackets below]:

- Use of the UHS leads to a conservative risk estimate primarily due to the rock site condition at Indian Point Unit 3. [Entergy agrees, note that this and other conservatisms were the reason for updating the IPEEE HCLPF Uniform Hazard Spectrum (UHS) and risk estimates in Reference 6.7]
- Conservative assumptions were made regarding relay chatter. [this will be considered in any further relay evaluations and seismic risk assessments]
- The component screening was performed at a 0.8g peak spectral acceleration level using Tables 2-3 and 2-4 of EPRI NP-6041 (Reference 6.4). According to the submittal, the corresponding HCLPF is estimated to be 0.38g peak ground acceleration (PGA) assuming a β_c value of 0.3. This assumed β_c value is very small compared to values found in other analyses. [Entergy addressed this subject in Reference 6.7]

- The seismic walkdown procedure is not described as a separate subject in the submittal. Particularly, no descriptions are provided regarding the possibility of seismic failures due to spatial interaction. However, the submittal indicates that a series of walkdowns were conducted by the Seismic Review Team (SRT) members on major structures, distribution systems, and equipment not on the A-46 equipment list. All active valves and ductwork were walked down for screening. Additional walkdowns were conducted to address various issues, including containment performance, seismic-induced internal flooding and seismic/fire interaction. The walkdown findings are well documented as part of the various component lists. [this observation is not judged significant given the positive qualifications above given to the subject, additional walkdowns have been conducted per Reference 6.9, and will continue as part of future seismic evaluations]
- Although the failure probabilities of operator actions are clearly defined in the IPEEE (as discussed above), the treatment of some operator actions is not clearly described in the submittal. For example, reactor coolant system (RCS) depressurization, which is required for the successful operation of some systems, is not included in the event tree models. It is not clear from the description provided in the submittal how some of these actions are included in the seismic PRA. (More discussion on this issue is provided in Section 2.12 of this report.) [does not impact component capacities, but human reliability modeling will be considered in any future risk assessments]
- Although storage vessels (in addition to piping) are mentioned in the submittal as potential internal flooding sources, the screened flooding sources discussed in the submittal do not include any storage tanks. [IPEEE appears to adequately address these and state not risk significant; e.g., see Section 1.4.4.1 of IPEEE]
- The examination of seismic/floods and seismic/fire interactions performed in the IPEEE and the discussion provided in the submittal seem adequate. However, no discussion is provided in the submittal on improvements for the identified seismic/fire vulnerabilities. [spurious CO_2 operation was a key seismic interaction identified, which resulted in a modification]
- The submittal does not provide any discussion (e.g., insights that can be obtained from the results) of the risk measure results. [does not impact component capacities, but additional quantification insights are provided in Reference 6.7 and will be considered in any future risk assessments]
- No definition of vulnerability was found in the submittal. In the Section 8.1.1, which deals with general conclusions for seismic events, the submittal states that there are "no unique plant vulnerabilities." However, in Section 8.2.1, the submittal does refer to a "seismic vulnerability," in which a seismic event may induce a spurious operation of the EDG room CO_2 system and subsequent shutdown of the EDG ventilation system. This condition has been addressed with a temporary modification. A permanent modification to install a new actuation control panel is described as being under consideration. This "vulnerability" is not discussed in Section 3.2.2 of the submittal (seismic/fire interaction). [definition of vulnerability does not impact component capacities and the dominant fragilities were updated in Reference 6.7]
- As noted in Section 2.11 of this report, the seismic/fire interaction discussion in the Indian Point Unit 3 submittal (Section 3.2.2) states that the SRT identified several "seismic vulnerabilities," but no discussion is provided regarding their resolution. [IPEEE Section 3.1.4.4 describes the handling of outliers]

A review of major plant modifications performed since the completion of the Indian Point Unit 3 IPEEE in 1997 was performed in developing the Indian Point Unit 3 Response to 10CFR 50.54(f) Request for Information Recommendation 2.3: Seismic (Reference 6.9). No modifications were identified that could negatively affect IPEEE conclusions and the risk insights in the updated IPEEE analysis (Reference 6.7) remain valid.

4.0 Adequacy Demonstration

4.1 Structural Models and Structural Response Analysis

Methodology used:

Structural Models

Pertinent resources, including IPEEE (Reference 6.1), SER (Reference 6.8), Design Basis Document (DBD) (Reference 6.15), calculations (Reference 6.7) and drawings (References 6.16 to 6.26) were reviewed.

Major structures for the Indian Point Unit 3 site considered in the Seismic PRA are the Containment Structure, Inner Containment Structure, Primary Auxiliary Building, Control and Diesel Generator Building, and Intake Structure. Structural models were developed in the '70s for the purposes of generating modal properties for dynamic analysis. The Uniform Hazard Response Spectra (UHRS) for the IPEEE PRA is anchored at 0.23g and documented in NUREG-1488 (Reference 6.6).

The dynamic models were developed such that they can accurately predict the building response, including in-structure response spectra, in the frequency range of interest. The Indian Point Unit 3 dynamic models of the structures are adequate to represent frequencies in excess of 20 Hz and, as such, are adequate for the assessments focused on the 1 Hz to 10 Hz range.
The structural models for these buildings consist of massless beam elements and lumped masses at major floor elevations. The massless beam elements represent the stiffness properties of concrete walls. The beam elements, in general, are rigidly linked to each other and to a lumped mass at each major floor elevation. Thus, each floor elevation acts as a rigid body. For structures where there are no major floors, such as the Containment Building, the mass is modeled uniformly along the height of the structure. The Containment Structure, Control and Diesel Generator Building, and Intake Structure do not have any significant structural eccentricity between the center of mass and center of rigidity. The Inner Containment Structure and Primary Auxiliary Building have some torsional irregularities. However, the structural models are detailed enough to capture the overall structural responses for both the horizontal and vertical components of ground motion.
The Indian Point Unit 3 structures are founded on rock, which is typical of the area and consists primarily of fractured, seamy limestone and dolomite. Rock excavations for the entire plant were carried out until firm rock was uncovered and fill concrete was added to bring the excavated areas to appropriate foundation level. The rock at the Indian Point Unit 3 site has a shear wave velocity in excess of 9,300 ft/second.
The seismic analysis of the structures was performed using a fixed base.

Compliance with NUREG-1407:
This methodology meets the guidance and requirements of EPRI NP-6041 (Reference 6.4) and the enhancements specified in NUREG-1407 (Reference 6.5).

Adequate for Screening:
The IPEEE methodology and structural modeling are in compliance with NUREG-1407 (Reference 6.5) and are adequate for screening purposes.

4.2 In-Structure Demands and ISRS

Methodology used:

The Indian Point Unit 3 in-structure response spectra (ISRS) were generated using a direct generation methodology. This is one of the two methods deemed acceptable in NP-6041 (Reference 6.4, page 4-25) for development of floor response spectra; the other method is time history analysis. The Uniform Hazard Spectrum was converted to a power spectral density (PSD) and that PSD was applied to the existing design basis structural dynamic models. Random vibration analysis techniques were then used to obtain floor PSDs, and the floor PSDs were converted to ISRS.

Based on a review of the resulting spectra and acceleration levels utilized in individual component assessments, the approach utilized to determine ISRS resulted in significant amplified response at some structure elevations. The ISRS direct generation approach resulted in instances of over-estimation of in-structure floor amplification. This resulted in underestimating component HCLPFs for equipment evaluated in those structures.
During the 2011 SCDF Reassessment (Reference 6.7), a spectral amplification method was used for the structures and floor elevations where the low capacity components selected for assessment are located. The scaling approach utilized is associated with a method as defined in EPRI NP-6041 (Reference 6.4). This approach utilizes the dominant mode frequency of the structure to define control acceleration values from the design ground response spectrum and the applicable UHS. The ratio of these spectral accelerations defines a scaling factor. The design basis floor response spectra were then amplified by the developed scaling factor to obtain ISRS associated with the LLNL Hazard Curves. Seismic demand may be reduced to account for ground motion incoherence and factors based on ASCE 4 were used to adjust the ISRS used in the Reassessment.

Compliance with NUREG-1407:

This methodology meets the guidance and requirements of EPRI NP-6041 (Reference 6.4) and the enhancements specified in NUREG-1407 (Reference 6.5).

Adequate for Screening:

The methodology used is in compliance with NUREG-1407 (Reference 6.5) and the IPEEE in-structure demands and ISRS results are adequate for screening purposes.

4.3 Selection of Seismic Equipment List (SEL)

Methodology used:

The EPRI methodology (References 6.4 and 6.10) and PRA procedures guide (Reference 6.3) were used as guidance along with previous seismic probabilistic risk assessments and the Indian Point Unit 3 Individual Plant Examination (IPE) (Reference 6.2) to develop the list of structures, systems and components that would be used for the safety functions required to establish and maintain a safe shutdown condition, including primary and alternate success paths. The following safety functions were satisfied by the IPEEE success paths: reactivity control, reactor coolant pressure control, reactor coolant inventory control, decay heat removal, and containment function.

The Indian Point Unit 3 IPE component database was used to generate an initial equipment list. Support system requirements for the above functions were included. A list of components was developed for each system with an indication of the component location. The location of equipment was used to ensure that the list of structures was complete for seismic capability screening and analysis.

The type of components considered under the civil/structural review (passive components) were those required to remain intact and provide physical support for mechanical and electrical components.

The passive and active components included in the IPEEE scope are identified in Tables in the Indian Point Unit 3 IPEEE submittal.

Compliance with NUREG-1407:

This methodology meets the guidance and requirements of EPRI NP-6041 (Reference 6.4), NUREG/CR-2300 and the enhancements specified in NUREG-1407 (Reference 6.5). Section 3.2.5.1 of NUREG-1407 (Reference 6.5) requires a complete set of potential success paths be identified and the narrowing/elimination of paths to be documented in detail. Section 3.1.3 of the Indian Point Unit 3 IPEEE (Reference 6.1) documents in detail the system analysis and the elimination of success paths.

Adequate for Screening:

The methodology used is in compliance with NUREG-1407 (Reference 6.5) and the IPEEE seismic equipment selection results are adequate for screening purposes.

4.4 Screening of Components

Methodology used:

The SRT screened from further review structures and components for which the SRT could document HCLPFs at or above the specified screening level HCLPF (0.38g) based on their combined experience and judgment and use of earthquake experience data.

The screening guidance given in the Generic Implementation Procedure (GIP) for Seismic Verification of Nuclear Power Plant Equipment (Reference 6.11) was used except for anchorage. This is the same procedure used for the resolution of USI A-46. Also, EPRI-TR-103595(Reference 6.10) and EPRI NP-6041-SL (Reference 6.4) were used as guidance in screening.

Equipment that could not be screened was further evaluated as documented in the IPEEE submittal and back up calculations/evaluations. All back up calculations have not been found; however, key components such as the CST, RWST, and block walls do have fragility calculations available. Also, Reference 6.7 updated the anchorage calculations for risk important equipment.

Screening evaluations included spatial interactions, such as assessment of the effects of seismic induced flooding, proximity to other structures or components, etc. (see also walkdown methodology discussion below).

Compliance with NUREG-1407:

The above methodology meets the requirements of NUREG-1407 Section 3.2.5.5 Screening Criteria (Reference 6.5) which states that screening guidance given in the GIP may be used provided review/screening is performed at the appropriate RLE, caveats included in the margins report are observed and use of the generic equipment ruggedness spectrum are observed. NUREG-1407 (Reference 6.5) also requires that spatial interaction evaluations such as assessing the effects of flooding as noted in EPRI NP-6041 (Reference 6.4) be performed.

Adequate for Screening:

The methodology used is in compliance with NUREG-1407 (Reference 6.5) and the IPEEE screening of component results are adequate for screening purposes.

4.5 Walkdowns

Methodology used:

Although a number of seismic walkdowns were performed as part of the A-46 evaluation, additional walkdowns were performed in support of the IPEEE. The IPEEE scope included passive components and structures, containment isolation and performance and seismic interactions. Walkdowns are documented in the IPEEE and the Screening and Evaluation Walkdown Sheets (SEWS) in accordance with EPRI NP-6041 (Reference 6.4) and Seismic Qualification Utility Group (SQUG).

Walkdowns were conducted by a combination of SRT, who were SQUG trained and certified, and individuals responsible for preparation of the IPE/IPEEE.

The Seismic Equipment List based on the SPRA model was used to define the walkdown scope.

Major structures and components were walked down. Emphasis was placed on IPEEE scope not within the A-46 evaluation scope. With the exception of some anchorage, equipment walked down and accepted for the A-46 evaluation was judged to screen at the HCLPF screening value. Outliers from the A-46 assessment and some new IPEEE scope components were noted as requiring further analysis, HCLPF calculations or modification. Outliers were found acceptable based on further analysis or were modified or were assigned a conservative nominal capacity of 0.1g PGA HCLPF (0.22g median).

The potential for spatial system interactions was considered during seismic walkdowns. System interaction issues were considered and noted on the SEWS for the IPEEE. The following provides examples of what was considered either previously as part of A-46 walkdowns or as part of the IPEEE:

- Proximity: The proximity of structures to components and components to components was considered during walkdowns. For example, the proximity of valve operators to structures and other components was considered. It was noted during the walkdowns that the capacity of block walls near important equipment would have to be evaluated.
- Seismic II over I: Examples include consideration of instrument lines and the proximity of block walls to equipment.
- Seismic Spray & Flooding: The possibility of water spray and flooding impact on systems was considered during the walkdown.
- Seismic Fires: The capacity of hydrogen piping and other fire hazards was considered as well as proximity to important equipment.

The above spatial interactions were evaluated and found acceptable.

Compliance with NUREG-1407:

Walkdowns were conducted and documented in accordance with EPRI NP-6041 (Reference 6.4) as required by Section 3.2.5.2 of NUREG-1407 (Reference 6.5).

Adequate for Screening:

The methodology used is in compliance with NUREG-1407 (Reference 6.5) and the IPEEE walkdown results are adequate for screening purposes.

4.6 Fragility Evaluations

Methodology used:

The fragility data required for the seismic PRA were developed using the approach outlined in Section 5 of EPRI TR-103959 (Reference 6.10). This approach recognized that it is impractical to perform a detailed fragility analysis for every component in the PRA model and that, in previous seismic PRAs, only a few components were found to control the core damage frequency, the other components being either relatively strong or screened out by systems considerations. Fragilities were therefore developed as follows:

- Components were screened using the criteria contained in Tables 2-3 and 2-4 of EPRI NP-6041 (Reference 6.4). Components that meet the screening criteria were modeled by a single surrogate element.

- Tables 2-3 and 2-4 of EPRI NP-6041 (Reference 6.4) contain screening criteria for three ranges of peak spectral acceleration. For Indian Point Unit 3, the least severe criteria for a peak spectral acceleration < 0.8 g were used. A component that meets these criteria has a HCLPF (High Confidence Low Probability of Failure) capacity of 0.8g peak spectral acceleration (psa). This HCLPF is equivalent to a 0.38g PGA HCLPF.

- Conservative Deterministic Failure Margin (CDFM) HCLPF capacity calculations were typically required for equipment anchorages, large tanks, and air-handling equipment mounted on vibration isolators.

All the Class I Structures were screened out based on the EPRI NP-6041 (Reference 6.4) screening criteria as the structures were designed for a 0.15g PGA DBE.

During the reassessment of the Indian Point Unit 3 SCDF performed in June 2011 (Reference 6.7), conservatisms in the IPEEE component fragility values which affect plant-level fragility significantly were removed by performing more refined evaluations.

Compliance with NUREG-1407:

Indian Point Unit 3 calculated HCLPFs for all outlier components in accordance with the guidance of EPRI NP-6041 (Reference 6.4) and NUREG-1407 Section 3.2.5.7 (Reference 6.5).

Adequate for Screening:

The methodology used is in compliance with NUREG-1407 (Reference 6.5) and the IPEEE fragility evaluation results are adequate for screening purposes.

4.7 System Modeling

Methodology used:

The IPE (PRA) event tree models were used to develop the SPRA model and to identify systems needed to mitigate the consequences of an earthquake. The functions in the IPE/SPRA include front line systems and the associated support systems that can be used for the safety functions required to establish and maintain a long term safe shutdown condition (i.e., reactivity control, pressure and inventory control and decay heat removal).

All potential success paths in the IPE general transient and small LOCA models were evaluated and modified to meet the SPRA success criteria of 72-hour mission time. For example, the CST will not last 72 hours and this required alignment of Residual Heat Removal (RHR) shutdown cooling for long-term success in the general transient model. Also, equipment dependent on offsite power (low seismic capacity and assumed unavailable for 72-hours) are not included. The systems considered and the reasons for being eliminated are documented in the IPEEE (Reference 6.1).

The following steps were taken in developing the seismic PRA for Indian Point Unit 3:

- Both the LLNL and EPRI seismic hazard curves were used in quantifying the seismic PRA model. Note that the SPRA model has not been maintained and is not available for quantitative use. However, the Core Damage Frequency (CDF) was re-estimated in Reference 6.7 as part of an IPEEE update.
- Seismic fragilities were developed from the seismic-margin HCLPF values
- Non-seismic failure rates from the Indian Point Unit 3 IPE study were used
- Human error probabilities in the Indian Point Unit 3 IPE were adjusted to account for decrease in operator performance during a seismic event
- An event-tree model was developed from the Indian Point Unit 3 IPE to generate and quantify seismic accident sequences

The evaluation of non-seismic failures and human actions was considered in the IPEEE evaluation of seismic risk. The operator actions required to support the primary and alternate success path were identified and evaluated in the IPEEE.

Compliance with NUREG-1407:

NUREG-1407, Section 3.2.5.1 (Reference 6.5) states that for IPEEE purposes, it is desirable that to the maximum extent possible, the alternate path involve operational sequences, systems, piping runs and components different from those used in the preferred path. As indicated above and documented in the IPEEE, this requirement was met based on the design of Indian Point Unit 3 and use of the IPE model.

The treatment of non-seismic failures and human actions in the Indian Point Unit 3 IPEEE meets the requirements of Section 3.2.5.8 of NUREG-1407 (Reference 6.5).

Adequate for Screening:

The methodology used is in compliance with NUREG-1407 (Reference 6.5) and the IPEEE system modeling results are adequate for screening purposes.

4.8 Containment Performance

Methodology used:

Containment performance was evaluated from a structural, isolation and bypass perspective. The containment structure was evaluated using the methodology and guidance of EPRI NP-6041 (Reference 6.4). The structure was found to be seismically rugged. Containment penetrations, including hatches, fuel transfer canal and etc. were evaluated. Again, this part of the Structure is also seismically rugged.

For containment isolation and bypass, the containment penetration screening analysis in the IPE was utilized. It was determined that isolation valves are seismically rugged and/or the systems outside containment are seismically rugged and designed for high pressure. A review for interfacing LOCA scenarios was performed, including consideration of relay chatter causing spurious valve opening. Based on this analysis, the likelihood of a seismic-induced interfacing LOCA at Indian Point Unit 3 is considered an insignificant contribution to plant risk.

Walkdowns described previously also considered containment performance.

No containment vulnerabilities were found.

Compliance with NUREG-1407:

The review of containment meets the requirements of Section 3.2.6 of NUREG-1407 (Reference 6.5) to evaluate the containment integrity, isolation, bypass and suppression functions to identify vulnerabilities that involve early failure of the containment functions.

Adequate for Screening:

The methodology used is in compliance with NUREG-1407 (Reference 6.5) and the IPEEE containment performance results are adequate for screening purposes.

4.9 Peer Review

Methodology used:

An in-house independent review team was established outside the IPEEE team. The independent review team consisted of a cross disciplinary review by reactor engineering group staff, licensing, operations, site engineering and systems engineers. All reviewer comments were addressed by the IPEEE team.

In addition to the in-house review team, a formal independent peer review was made of the draft final report. The outside peer review team for the seismic IPEEE comprised:

- Mr. Robert J. Budnitz, President, Future Resources Associates, Inc.
- Dr. John D. Stevenson, Structural-Mechanical Consulting Engineer

Key comments and resolutions are summarized in the IPEEE.

Compliance with NUREG-1407:

The above review process, using a combination of IPEEE Team Members, an Independent In-house Review Team and an external consultants for seismic review, meets the requirements of Section 7 of NUREG-1407 (Reference 6.5) for peer review.

Adequate for Screening:

The methodology used is in compliance with NUREG-1407 (Reference 6.5) and the IPEEE peer review results are adequate for screening purposes.

5.0 Conclusion

The Indian Point Unit 3 IPEEE was a full scope analysis. A soil failure analysis is not necessary since the structures are founded on bed rock. A relay evaluation consistent with a full scope IPEEE, as described in NUREG-1407 (Reference 6.5), has been performed.

Based on the IPEEE adequacy review performed consistent with the guidance contained in EPRI 1025287 (Reference 6.28) and documented herein, the Indian Point Unit 3 IPEEE and its reassessment are considered adequate for screening and the risk insights gained from the IPEEE remain valid under the current plant configuration.

6.0 References

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6.2 New York Power Authority, "Indian Point 3 Nuclear Power Plant Individual Plant Examination," June 1994.
6.3 Nuclear Regulatory Commission, "PRA Procedures Guide," NUREG/CR-2300, January 1983.
6.4 Electric Power Research Institute, "A Methodology for Assessment of Nuclear Power Plant Seismic Margin," EPRI NP-6041-SL, Revision 1, August 1991.
6.5 United States Nuclear Regulatory Commission, "Procedural and Submittal Guidance for the Individual Plant Examination of External Events (IPEEE) for Severe Accident Vulnerabilities," NUREG-1407, June 1991.
6.6 United States Nuclear Regulatory Commission, "Revised Livermore Seismic Hazard Estimates for Sixty-Nine Nuclear Power Plant Sites East of the Rocky Mountains," NUREG-1488, April 1994.
6.7 Entergy Document IP-RPT-11-00012, Letter NL-13-084, "Reassessment of Indian Point 3 Seismic Core Damage Frequency," June 26, 2013.
6.8 Nuclear Regulatory Commission. "Review of Individual Plant Examination of External Events – Indian Point Nuclear Generating Unit No. 3 (TAC No. M83632)," February 15, 2001.
6.9 Entergy Document IP-RPT-12-00039, Letter NL-12-168, "Indian Point Unit No. 3 Seismic Walkdown Report," November 27, 2012.
6.10 Electric Power Research Institute, "Methodology for Developing Seismic Fragilities," EPRI-TR-103959, June 1994.
6.11 SQUG, "Generic Implementation Procedure (GIP) for Seismic Verification of Nuclear Plant Equipment," Revision 2, Corrected, February 1-4, 1992.
6.12 Electric Power Research Institute, "Seismic Ruggedness of Relays," Appendix E, EPRI-NP-7148-SL, August 1991.

6.13 Electric Power Research Institute, "Procedure for Evaluating Nuclear Power Plant Relay Seismic Functionality," Appendix D, EPRI-NP-7147-SL, December 1990.
6.14 NEI Letter, Kimberly A. Keithline to David L. Skeen, NRC "Relay Chatter Reviews for Seismic Hazard Screening," dated October 3, 2013.
6.15 Entergy Document, INDIAN POINT ENERGY CENTER Unit 3-DBD-318, Rev. 2, "Design Basis Document for Seismic Building and Structures."
6.16 Entergy Drawing, 9321-F-30523, Rev. 50, "Equipment Arrangement Control Building."
6.17 Entergy Drawing, 9321-F-25063, Rev. 11, "Containment Building – General Arrangement Section A-A Section J-J."
6.18 Entergy Drawing, 9321-F-25083, Rev. 12, "Containment Building – General Arrangement Section G-G."
6.19 Entergy Drawing, 9321-F-25033, Rev. 14, "Containment Building – General Arrangement Plan E-E – Above El. 46'-0" Plan F-F – Below El. 46'-0"."
6.20 Entergy Drawing, 9321-F-25023, Rev. 12, "Containment Building – General Arrangement Plan D-D – Above El. 68'-0"."
6.21 Entergy Drawing, 9321-F-25013, Rev. 12, "Containment Building – General Arrangement Plan C-C – Above El. 95'-0"."
6.22 Entergy Drawing, 502450, Rev. 1, "Overall Plot Plan."
6.23 Entergy Drawing, 9321-F-25113, Rev. 21, "Primary Auxiliary Building General Arrangement Sections Sheet No. 1."
6.24 Entergy Drawing, 9321-F-25153, Rev. 22, "Primary Auxiliary Building General Arrangement Plans at El. 55'-0" & 73'-0"."
6.25 Entergy Drawing, 9321-F-20123, Rev. 14, "Intake Structure General Arrangement Sections."
6.26 Entergy Drawing, 9321-F-20113, Rev. 15, "Intake Structure General Arrangement Plan."
6.27 United States Nuclear Regulatory Commission, "Individual Plant Examination of External Events (IPEEE) for Severe Accident Vulnerabilities - 10CFR 50.54(f) (Generic Letter No. 88-20, Supplement 4)," June 28, 1991.
6.28 Electric Power Research Institute, "Seismic Evaluation Guidance Screening, Prioritization and Implementation Details (SPID) for the Resolution of Fukushima Near-Term Task Force Recommendation 2.1: Seismic," Report 1025287, Feb. 2013.