FPL

March 27, 2014
L-2014-085

U. S. Nuclear Regulatory Commission
Attn.: Document Control Desk
Washington, D.C. 20555-0001

Re: Turkey Point Units 3 and 4
Docket Nos. 50-250 and 50-251

Florida Power & Light Company's, Turkey Point Units 3 and 4 Seismic Hazard and Screening Report (CEUS Sites), Response 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

References:

1. NRC Letter, 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, ADAMS Accession No. ML12053A340

2. NEI Letter, Proposed Path Forward for NTTF Recommendation 2.1: Seismic Reevaluations, dated April 9, 2013, ADAMS Accession No. ML13101A379

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, ADAMS Accession No. 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, ADAMS Accession No. ML12333A170

5. NRC Letter, Endorsement of EPRI Final Draft Report 1025287, "Seismic Evaluation Guidance," dated February 15, 2013, ADAMS Accession No. ML12319A074

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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 and Screening Report 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 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.

Reference 4 contains industry guidance and detailed information to be included in the Seismic Hazard and Screening Report submittals. NRC endorsed this industry guidance in Reference 5.

The attached Seismic Hazard and Screening Report for Turkey Points Units 3 and 4 provide the information described in Section 4 of Reference 4 in accordance with the schedule identified in Reference 2.

This letter contains no new regulatory commitments.

Should you have any questions regarding this submittal, please contact Mr. Robert J. Tomonto, Turkey Point Licensing Manager, at (305) 246-7327.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on March 27, 2014

Sincerely,

Michael Kiley
Site Vice President
Turkey Point Nuclear Plant

Enclosure

cc: USNRC Regional Administrator, Region II
USNRC Project Manager, Turkey Point Nuclear Plant
USNRC Senior Resident Inspector, Turkey Point Nuclear Plant

L-2014-085

Enclosure

Florida Power & Light Company's, Turkey Point Units 3 and 4 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

Seismic Hazards and Screening Report

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 NRC Commission 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 (Reference 7.1) that requests information to assure that these recommendations are addressed by all U.S. nuclear power plants. The 50.54(f) letter 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 this information, 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 pertaining to NTTF Recommendation 2.1 for Turkey Point Nuclear Generating Station Units 3 & 4, located in Miami-Dade. In providing this information, FPL 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 Report 1025287 (Reference 7.2). The site information is provided by Florida Power & Light using the format and content prescribed in the seismic hazard template. The technical content of the report was developed by EPRI.

The original geologic and seismic siting investigations for Turkey Point Units 3 and 4 were performed in accordance with the 1967 proposed version of General Design Criterion (GDC) 2 that relates to earthquake natural phenomena. As such, the Safe Shutdown Earthquake (SSE) was developed based on historical data, building codes geological conditions, and earth quake probabilities for the region surrounding the site as described in Turkey Point Units 3 and 4 UFSAR Chapter 2 Section 2.11 (Reference 7.3). 10CFR100.10 discusses the general considerations for siting a nuclear plant. Appendix A to 10CFR100 deals with the specific investigations required to determine the seismic characteristics of the site. It also discusses the methods which should be used to analyze the effect of a safe shutdown earthquake (SSE) and an operating basis earthquake (OBE) on the plant structures. These earthquakes are equivalent to the Maximum Hypothetical Earthquake and Design Basis Earthquake, respectively, as described in Appendix 5A of the Turkey Point Unit 3 and 4 UFSAR (Reference 7.4).

In response to the 50.54(f) letter and following the guidance provided in the SPID (Reference 7.2), a seismic hazard reevaluation was performed. For screening purposes, a Ground Motion Response Spectrum (GMRS) was developed.

2.0 Seismic Hazard Reevaluation

The Turkey Point plant property is located within Miami-Dade County, Florida, approximately 25 miles south of Miami, 8 miles east of Florida City, and 9 miles southeast of Homestead, Florida. The plant property is located within the Southern Slope sub-province of the Southern Zone physiographic subregion of the Florida Platform within the Atlantic Coastal Plain physiographic province.

The south Florida area is a broad, gently sloping plain with poor drainage; most of the area is below the piezometric surface in saltwater marshes and swamps overlain by peat. The site is bordered on the east by Biscayne Bay, on the west by Florida City and Homestead, on the south by Key Largo, and on the north by Miami. There are numerous canals to the west within an Everglades mitigation bank. The physiographic features bordering the plant property are the Everglades, Florida Keys, and the Atlantic Continental Slope.

The surface geology at the site area is characterized by organic muck (peaty soil) and Miami Limestone. The organic muck is the dominant surficial sediment type, whereas the Miami Limestone is exposed in the northern and western parts of the site area. The Miami Limestone is a marine carbonate consisting predominantly of oolitic facies of white to gray limestone with fossils (mollusks, bryozoans, and corals). The overlying organic muck located near the rivers in the site area is a light gray to dark gray to pale brown sapric muck (strongly decomposed organic peaty soil) with trace amounts of shell fragments that have little or no reaction to hydrochloric acid.

The area surrounding the site is at or near sea level with an existing elevation of -2.4 to 0.8 feet. The area is generally flat and uniform throughout with the exception of vegetated depressions.

Records show that there have been no more than 7 shocks in the past 200 to 250 years with epicenters located in Florida. Two of these had epicentral intensities of no more than VI (Modified Mercali). Neither of these was felt in southern Florida. Five others were exceedingly small and may have been caused by explosions or submarine slides rather than earthquakes. Other shocks have had epicenters in Cuba. The closest to southern Florida was approximately 250 miles to the south at San Cristobal, Cuba. The largest shock nearest the area was the Charleston, South Carolina earthquake in 1886, with an epicentral intensity of X (Modified Mercali).

On the basis of historical or statistical seismic activity, Turkey Point is located in a seismically inactive area, far from any recorded damaging shocks. Even though several of the larger historical earthquakes may have been felt in southern Florida, the amount of ground motion caused by them was not great enough to cause damage to any moderately well-built structure. The Uniform Building Code (1964 edition, Volume 1, as approved by the International Conference of Building Officials) designates the area as Zone 0 on the map entitled "Map of the United States Showing Zones of Approximately Equal Seismic Probability."

Limestone bedrock is at or near the ground surface at the site. The site area is far from any folded or deformed sediments, and surface faults are unknown. Predicated on history, building codes (which do not require consideration of seismic loading), geologic conditions, and earthquake probability, the design earthquake SSE has been conservatively established as 0.15 g horizontal ground acceleration.

2.1 Regional and Local Geology

2.1.1 Regional Geology

The tectonic history of the site region begins with the late Paleozoic Alleghany orogeny, in which Gondwana (including South America and Africa) and Laurentia (ancestral North America) collided to form the supercontinent Pangea. Pangea was rifted apart during the Triassic and the Florida peninsula became part of North America. In the Jurassic, the southern edge of the North American plate was subducting southwestward beneath the Caribbean plate. In the Eocene Epoch, the Greater Antilles arc collided with the Bahama platform and contractional structures developed north of Cuba to accommodate this strain. After the Eocene, the crustal plate containing Cuba was transferred to the southern edge of the North American Plate, thus ending tectonic activity in the site region.

The Florida peninsula has been a stable carbonate platform since the Eocene. The dominantly carbonate strata of the subsurface Florida peninsula exhibits a series of sedimentary arches, uplifts, basins, and embayments developed in response to minor warping, regional tilting, sedimentary compaction, and sea level changes. These structures are not associated with faulting or tectonic events. No tectonic features younger than Miocene have been identified within the site region.

The site lies within the Floridian Plateau, which is the partly submerged southeastern peninsula of the North American continental shelf. The Plateau, which separates the Atlantic deep from the deep waters of the Gulf of Mexico, has been described as a large horst which may be bounded by high-angle fault scarps at the edge of the shelf. In the vicinity of the site, the edge of the shelf is located some 18 miles offshore to the east. The peninsula is underlain by a thick series of sedimentary rocks, which in the southern part of the state consist essentially of gently dipping or flat-lying limestones and associated formations. Beneath these sedimentary formations are igneous and metamorphic basement rocks which correspond to those which underlie most of the eastern North American continent. The sedimentary rocks overlying the basement complex range from 4,000 ft thick in the northern part of the state to more than 15,000 ft thick in southern Florida. The strata range in age from Paleozoic to Recent. Deep borings indicate that in southern Florida the rock in the uppermost 5,000 ft is predominantly calcareous and ranges in age from late Cretaceous to Pleistocene. Mesozoic limestones, chalk and sandstones are underlain by Paleozoic shales and sandstones and Pre-Cambrian granitic basement.

The region is characterized by very simple geologic structures. The predominant structure affecting the thickness and attitude of the sedimentary formations in southern Florida is the Ocala antic line of Tertiary age. This gentle flexure is some 230 miles long and 70 miles wide. The sedimentary formations comprising the flanks of the anticline dip gently away from its crest, the slope becoming less pronounced with successively younger formations. The most recent Pleistocene formations are nearly horizontal. Pleistocene shorelines have been traced as far north as New Jersey, with elevations essentially the same as those in Florida.
It can, therefore, be concluded that no tilting or structural deformation associated with tectonic activity has occurred during the past one-half million years. The closest geologic structure to the

north of the site is a gentle, low syncline near Fort Lauderdale, some 50 miles away. The great thickness of Tertiary carbonates indicates that the region has been slowly subsiding for many millions of years. Faults are not common because the strata are undeformed. No fault or structural deformation is known or suspected in the bedrock in the site area.

2.1.2 Local Geology

The Turkey Point Nuclear Generating Station is located within Miami-Dade County, Florida, approximately 25 miles (40 km) south of Miami, 8 miles (13 km) east of Florida City, and 9 miles (14.5 km) southeast of Homestead, Florida. The plant property is located within the Southern Slope sub-province of the Southern Zone physiographic sub-region of the Florida Platform within the Atlantic Coastal Plain physiographic province.

The south Florida area is a broad, gently sloping plain with poor drainage; most of the area is below the piezometric surface in saltwater marshes and swamps overlain by peat. The site is bordered on the east by Biscayne Bay, on the west by Florida City and Homestead, on the south by Key Largo, and on the north by Miami. There are numerous canals to the west within an Everglades mitigation bank. The physiographic features bordering the plant property are the Everglades, Florida Keys, and the Atlantic Continental Slope.

The predominant surface feature near the site is the Atlantic Coastal Ridge, which represents an area of bedrock outcrop of the Miami oolite. This Pleistocene formation underlies the site, where it is overlain by organic, mangrove swamp soils which average 4 to 8 ft in thickness. Pockets of silt and clay are encountered locally, separating the organic soils and the limestone bedrock.

Local depressions, some of which attain depths as great as 16 feet, are occasionally encountered in the surface of the limestone bedrock at the site. Such depressions are not sinkholes associated with collapse above an underground solution channel, but rather potholes, which are surficial erosion or solution features. These features probably developed during a former period of lower sea level when the rock surface was subjected to weathering and the effects of fresh water.

The Miami oolite, a deposit of highly permeable limestone, extends to about 20 ft below sea level. The rock contains random zones of harder and softer rock and heterogeneously distributed small voids and solution channels, many of which contain secondary deposits. Recrystallized calcite on the surfaces of many of the voids and solution channels is indicative of secondary deposition. This limestone lies unconformably upon the Ft. Thompson formation, which is a complex sequence of limestones and calcareous sandstones.

The upper 5 to 10 ft of the limestone beneath the Miami oolite contains much coral which may represent the Key Largo formation, a coralline reef rock. This formation is contemporaneous in part with both the Ft. Thompson formation and the Miami oolite.

Prior to deposition of the Miami oolite, the surface of the Ft. Thompson formation was subjected to erosion and weathering. The Miami oolite, therefore, fills in irregular depressions in (lies unconformably upon) the surface of the underlying formation. Much of the Ft. Thompson formation is riddled with small voids and cavities resulting from solution action, and is, therefore, extremely permeable. The results of solution activity evident in both the Miami oolite and Ft. Thompson formations are derived from solution by fresh ground water at a former period of lower sea level. The Ft. Thompson formation, together with the Miami oolite, comprises the bulk of the Biscayne aquifer.

At a depth of about 70 ft. below sea level, the Ft. Thompson formation unconformably overlies the Tamiami formation, a predominantly clayey and calcareous marl, locally indurated to limestone. The Tamiami formation also contains beds of silty and shelly sands, and is relatively impermeable. The Tamiami and underlying Hawthorne and Tampa formations, all of which are Miocene in age, comprise a relatively impermeable hydrogeologic unit called the Floridian aquiclude, which is roughly 500 to 700 ft. thick in southern Florida.

Because of their composition, the soils and the rock in the site area have negligible base exchange capacity and, therefore, will not affect any significant ion exchange. The bedrock beneath the site is competent with respect to foundation conditions and is capable of supporting heavy loads.
During construction of Units 3 & 4, the building site area was backfilled to the existing grade at elevation 18.0 feet MLW-Site.

2.1.3 Site Datum

There are two types of vertical datums: tidal and fixed. Fixed datums are reference level surfaces that have a constant elevation over a large geographical area. Tidal datums are standard elevations that are used as references to measure local water levels.

- Mean Low Water (MLW): the average of all the low water heights observed over the National Tidal Datum Epoch (Reference 7.5).

- North American Vertical Datum of 1988 (NAVD88): fixed vertical control datum, referenced to the tide station and benchmark at Pointe-au-Pere, Rimouski, Quebec, Canada (Reference 7.5).

Survey drawings are typically referenced to Mean Low Water vertical datum (MLW), to which site benchmarks are referred. During a recent survey of the Turkey Point site for flooding evaluations it was determined that the site's Mean Low Water (MLW) datum is 2.307 feet below the NAVD88 datum.

For the purposes of this Seismic Hazards Screening Report, the site's MLW datum is used.

2.2 Probabilistic Seismic Hazard Analysis

2.2.1 Probabilistic Seismic Hazard Analysis Results

In accordance with the 50.54(f) letter and following the guidance in the SPID, 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 (Reference 7.6) together with the updated EPRI Ground-Motion Model (GMM) for the CEUS (Reference 7.7). For the PSHA, a lower-bound moment magnitude of 5.0 was used, as specified in the 50.54(f) letter.

For the PSHA, the CEUS-SSC background seismic sources out to a distance of 400 miles (640 km) around Turkey Point were included. This distance exceeds the 200 mile (320 km) recommendation contained in USNRC Reg. Guide 1.208 (Reference 7.8) and was chosen for completeness. Background sources included in this site analysis are the following:

1. Extended Continental Crust—Atlantic Margin (ECC_AM)
2. Extended Continental Crust—Gulf Coast (ECC_GC)
3. Gulf Highly Extended Crust (GHEX)
4. Mesozoic and younger extended prior – narrow (MESE-N)
5. Mesozoic and younger extended prior – wide (MESE-W)
6. Study region (STUDY_R)

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

1. Charleston

For each of the above background sources, Gulf versions of the updated CEUS EPRI GMMs are used to model the seismic wave travel path. For the Charleston RLME source, a combination of Gulf (75%) and mid-continent (25%) GMMs is created based on the relative fraction of the seismic wave travel path through these regions from the center of the Charleston Local zone to the site.

2.2.2 Base Rock Seismic Hazard Curves

Consistent with the SPID, base rock seismic hazard curves are not provided as the site amplification approach referred to as Method 3 has been used. Seismic hazard curves are shown below in Section 3 at the Safe Shutdown Earthquake (SSE) control point elevation.

2.3 Site Response Evaluation

Following the guidance contained in Enclosure 1 of Reference 7.1 and in the SPID for nuclear power plant sites that are not founded on hard rock (defined as 2.83 km/sec), a site response analysis was performed for Turkey Point.

2.3.1 Description of Subsurface Material

The surface geology at the site area is characterized by organic muck (peaty soil) and Miami Limestone. The organic muck is the dominant surficial sediment type, whereas the Miami Limestone is exposed in the northern and western parts of the site area. The Miami Limestone is a marine carbonate consisting predominantly of oolitic facies of white to gray limestone with fossils (mollusks, bryozoans, and corals). The overlying organic muck located near the rivers in the site area is a light gray to dark gray to pale brown sapric muck (strongly decomposed organic peaty soil) with trace amounts of shell fragments that have little or no reaction to hydrochloric acid. The muck varies in thickness across the site from 2 to 6 feet (0.6 to 1.8 meters).

The Florida peninsula has been a stable carbonate platform since the Eocene. The dominantly carbonate strata of the subsurface Florida peninsula exhibits a series of sedimentary arches, uplifts, basins, and embayments developed in response to minor warping, regional tilting, sedimentary compaction, and sea level changes. These structures are not associated with faulting or tectonic events. No tectonic features younger than Miocene have been identified within the site region.

Limestone bedrock occurs close to the ground surface at the site. The rock surface is irregular. To great depths beneath the site, the predominantly limestone strata are essentially horizontally bedded. No deformation or faulting is known or suspected. The bedrock in the upper 70 ft is riddled with small voids and solution channels and contains random zones of harder and softer rock.

The information used to create the site geologic profile at the Turkey Point Nuclear Generating Station was previously provided to the NRC in Reference 7.9 and was developed in Reference 7.10. Reference 7.9 was considered an interim work product. This information is now considered final and is provided in Table 2.3.1-1 below. The profile was developed using information from the Turkey Point Units 3 and 4 Updated Safety Analysis Report (UFSAR), the FSAR for the COL Application Part 2 for Units 6 and 7, Table 2.5.4-209, and other related design information. The following provides a description of near-surface material from Turkey Point Units 3 and 4 Chapter 2.9:

> The subsurface soils at the site consist of a limerock fill, sand and silt fill layer, underlain by limerock.

Description Elevation	ft MLW
Very dense limerock, sand, and silt fill	+18 to - 5
Limestone, sand and silt fill	- 5 to -10
Fossiliferous limerock (Miami Oolite)	-10 to -35

The geophysical survey indicated the following two basic units for the subsurface conditions:

Description Elevation,	ft MLW
Limerock fill	+18 to -10
Miami Oolite	-10 to -35

For Turkey Point Units 3 and 4 the SSE Control Point is defined at elevation +18 ft MLW site (5.5 m). The SSE Control Point is in the limerock fill stratum. Below the fill are soils of the Miami Oolite that overlay two limestone (firm rock) formations named the Key Largo and Ft. Thompson. These limestones overlay the soils of the Tamiami and Peace River. The deepest stratum reported in Table 2.3.1-1 is the limestone rock of the Arcadia unit. Table 2.3.1-1 shows the shear-wave velocities (Vs) for each site layer from Turkey Point 6 and 7 FSAR which were developed based on core samples and testing.

Table 2.3.1-1
Summary of Site Geotechnical Profile for Turkey Point Units 3 and 4
(Reference 7.9 and 7.10)

Stratum[a]	1[a]	2	3	4	5	6	7	8	Fill
Description	Muck	Miami	Key Largo	Ft. Thompson	Upper Tamiami	Lower Tamiami	Peace River	Arcadia	—
Elevation of top of layer (ft)	-1.2	-4.5	-26.7	-49.4	-115.1	-159.0	-215.2	-452.1	—
USCS symbol	ML, MH	GM, GP-GM, SM, SW-SM, SW, SP-SM	Limestone	Limestone	SM, SP-SM	ML	SM	Limestone	—
Total unit weight, γ (pcf)	80	125	136	139	120	120	120	130	130
Natural water content, w, (%)	>80	—	—	—	—	30	—	—	33
Fines content (%)	>60	18	—	—	28	62	16	—	15
Atterberg limits									
Liquid limit, LL	—	—	—	—	—	24	—	—	—
Plastic limit, PL	—	—	—	—	—	20	—	—	—
Plasticity index, PI	—	—	—	—	—	4	—	—	—
SPT N_{60}-value (blows/ft)	~0	20	—	—	40	32	75	—	30
Undrained properties									
Undrained shear strength, s_u (ksf)	—	—	—	—	—	4	—	—	—
Internal friction angle, φ, (deg)	—	—	—	—	—	—	—	—	—
Drained properties									
Effective cohesion, c' (ksf)	—	—	—	—	0	1.7	0	—	—
Effective friction angle, φ, (deg)	—	—	—	—	35	20	40	—	33
Average Rock core recovery (%)	—	—	83 to 96	41 to 98	—	—	—	63 to 100	—
Average RQD (%)	—	—	54 to 81	16 to 91	—	—	—	32 to 90	—
Unconfined compressive strength, U (psi)	—	200	1,500	2,000	—	—	—	100	—
Elastic modulus (high strain), E_H	—	630 ksi	2,600 ksi	1,500 ksi	1,500 ksf	2,500 ksf	2,700 ksf	980 ksi	1,100 ksf
Elastic modulus (low strain), E_L	—	950 ksi	2,600 ksi	1,500 ksi	19,700 ksf	25,750 ksf	27,400 ksf	980 ksi	9,100 ksf
Shear modulus (high strain), G_H	—	230 ksi	1,000 ksi	550 ksi	550 ksf	900 ksf	1,000 ksf	360 ksi	420 ksf

Stratum[a]	1[a]	2	3	4	5	6	7	8	Fill
Shear modulus (low strain), G_L	—	350 ksi	1,000 ksi	550 ksi	7,300 ksf	9,500 ksf	10,150 ksf	360 ksi	3,500 ksf
Shear wave velocity, V_s, (ft/sec)	—	3,600	5,800	4,250	1,400	1,600	1,650	3,600	860
Compression wave velocity, V_c, (ft/sec)	—	8,000	11,000	8,700	2,900	3,300	3,450	7,850	1,600
Coefficient of sliding	—	0.6	0.7	0.7	0.4	0.3	—	—	0.5
Poisson's ratio, μ	—	0.37	0.31	0.34	0.35	0.35	0.35	0.36	0.3
Static earth pressure coefficients									
Active, K_a	—	0.3	—	—	0.27	0.5	—	—	0.3
At-rest, K_o	—	0.5	—	—	0.5	0.66	—	—	0.5

(a) Properties of Stratum 1 (muck) are not provided as this stratum was removed prior to construction.

(b) USCS = Unified Soil Classification System (ML = silt; MH = silt of high plasticity; GM = silty gravel; GP = poorly graded gravel; SM = silty sand; SW = well graded sand.

2.3.2 Development of Base Case Profiles and Nonlinear Material Properties

Table 2.3.2-1 shows the thicknesses, depths and shear-wave velocity profiles that were derived from Reference 7.10. In summary, the highest geologic unit in the profile is the limerock fill (very dense limerock, sand and silt fill), which is 28 ft (8.5 m) in thickness (from depth below the SSE Control Point of 0 to 28 ft (0 to 8.5 m)) and is modeled with a best-estimate Vs of 860 ft/s (262 m/s). This velocity was measured at the site using geophysical surveys (Reference 7.4). The next deeper geologic unit is the Miami Oolite, which is 25 ft (7.6 m) thick (extending from depth below the SSE Control Point of 28 to 53 ft (8.5 to 16.2 m)) and is modeled with a best-estimate Vs of 3,600 ft/s (1,097 m/s). This velocity was also measured at the site (Reference 7.4).

Deeper shear-wave velocity estimates are taken from Reference 7.10 that were measured at the nearby COL site. The limestone Key Largo formation which is modeled using a shear-wave velocity of 5,800 ft/s 1,767 m/s) (Reference 7.10). Stratum 4 is the limestone Ft. Thompson formation that is modeled with a best-estimate Vs of 4,250 ft/s (1,295 m/s). Stratum 5 is the Upper Tamiami soil unit has a best-estimate shear-wave velocity of 1,400 ft/s (427 m/s). Strata 6 and 7 are also soil units named the Lower Tamiami and Peace River. These are modeled with a shear velocity of 1,600 and 1,650 ft/sec (488 and 503 m/s), respectively. Stratum 8 is the limestone Arcadia unit that is modeled with an estimated thickness of 236.9 ft (72.2m), down to a depth of 714 ft (218m). This unit is modeled with a best-estimate Vs of 3,600 fps (1,097 m/s). For deeper units, the profile is modeled with layers that have monotonically increasing Vs values, down to a depth of about 4000 ft (1,219 m), where the profile is estimated to have Vs of 9,285 ft/s (2,830 m/s). This interpretation of the deep Vs properties follows the general trends of the estimated shear-wave velocity in Southern Florida as shown in Figure 2.5.4-211 of Reference 7.10. These shear-wave velocities were taken as the mean base-case profile (P1) in the top 3,964 ft (1,208m). The depth of about 4,000 ft (1,218m) was considered to reflect an adequate range in period for the amplification calculation.

Lower (P2)- and upper (P3)- range profiles were developed with a scale factor of 1.57 based on velocity measurements as well as estimates at the nearby COL site. The scale factor of 1.57 reflect a $\sigma_{\mu ln}$ of about 0.35 respectively based on the SPID 10th and 90th fractiles which implies a scale factor of 1.28 on $\sigma_{\mu ln}$. Profile P3, the stiffest profile was taken to encounter hard reference rock at a depth of 2,464 ft (751 m). Depth to Precambrian basement was taken at 3,964 ft (1,208m) randomized ± 1,190 ft (362 m). The three shear-wave velocity profiles are shown in Figure 2.3.2-1 and listed in Table 2.3.2-1 below. The depth randomization reflects ± 30% of the depth and was included to provide a realistic broadening of the fundamental resonance at deep sites in addition to reflect actual random variations in depth to basement shear-wave velocities across a footprint.

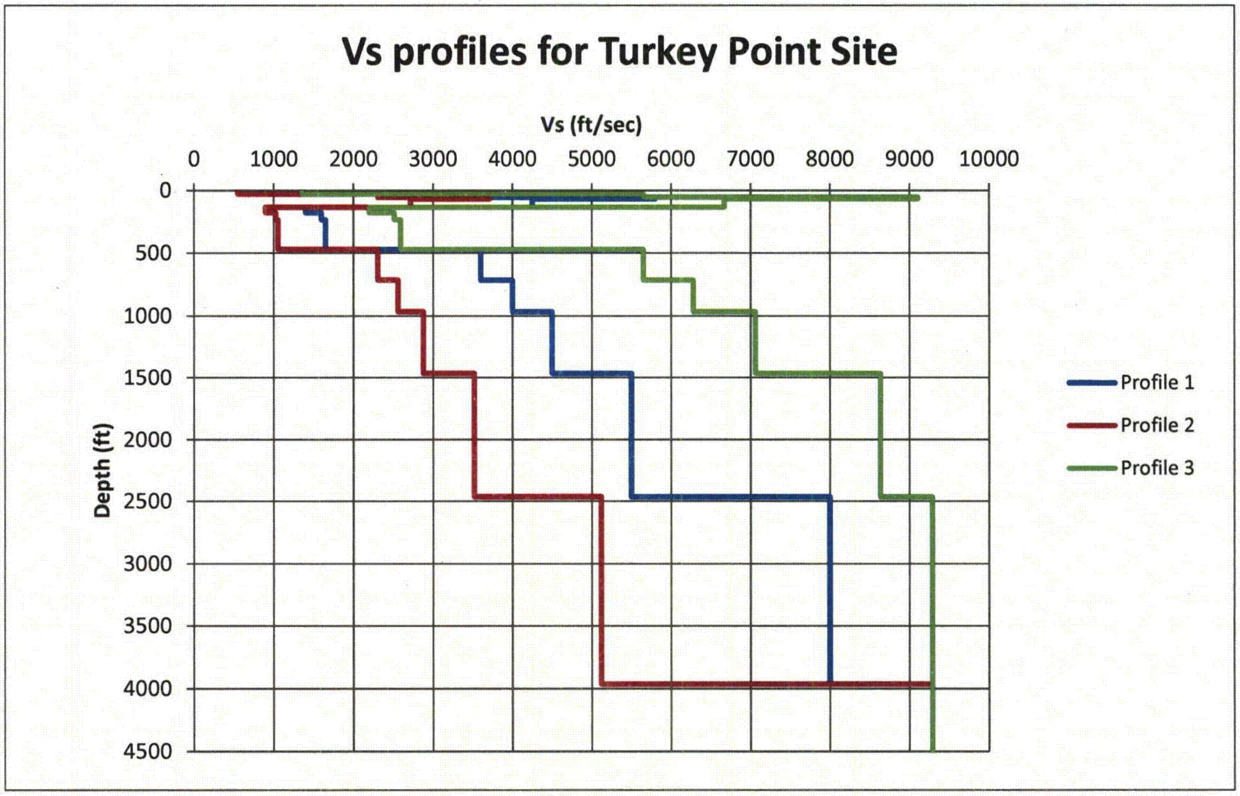


Figure 2.3.2-1. Shear-wave velocity profiles for Turkey Point site.

Table 2.3.2-1
Layer thicknesses, depths, and shear-wave velocities (Vs) for 3 profiles, Turkey Point site
(Reference 7.9)

Profile 1			Profile 2			Profile 3		
thickness(ft)	depth (ft)	Vs(ft/s)	thickness(ft)	depth (ft)	Vs(ft/s)	thickness(ft)	depth (ft)	Vs(ft/s)
	0	860		0	550		0	1350
7.0	7.0	860	7.0	7.0	550	7.0	7.0	1350
7.0	14.0	860	7.0	14.0	550	7.0	14.0	1350
7.0	21.0	860	7.0	21.0	550	7.0	21.0	1350
7.0	28.0	860	7.0	28.0	550	7.0	28.0	1350
8.3	36.3	3600	8.3	36.3	2304	8.3	36.3	5652
8.3	44.6	3600	8.3	44.6	2304	8.3	44.6	5652
5.4	50.0	3600	5.4	50.0	2304	5.4	50.0	5652
3.0	53.0	3600	3.0	53.0	2304	3.0	53.0	5652
7.0	60.0	5800	7.0	60.0	3712	7.0	60.0	9106
7.0	67.0	5800	7.0	67.0	3712	7.0	67.0	9106
6.6	73.6	4250	6.6	73.6	2720	6.6	73.6	6672
6.6	80.1	4250	6.6	80.1	2720	6.6	80.1	6672
6.6	86.7	4250	6.6	86.7	2720	6.6	86.7	6672
6.6	93.2	4250	6.6	93.2	2720	6.6	93.2	6672
6.6	99.8	4250	6.6	99.8	2720	6.6	99.8	6672
6.6	106.4	4250	6.6	106.4	2720	6.6	106.4	6672
6.6	112.9	4250	6.6	112.9	2720	6.6	112.9	6672
6.6	119.5	4250	6.6	119.5	2720	6.6	119.5	6672
6.6	126.0	4250	6.6	126.0	2720	6.6	126.0	6672
6.6	132.6	4250	6.6	132.6	2720	6.6	132.6	6672
8.8	141.4	1400	8.8	141.4	896	8.8	141.4	2198
8.8	150.2	1400	8.8	150.2	896	8.8	150.2	2198
8.8	159.0	1400	8.8	159.0	896	8.8	159.0	2198
8.8	167.8	1400	8.8	167.8	896	8.8	167.8	2198
8.8	176.6	1400	8.8	176.6	896	8.8	176.6	2198
14.0	190.6	1600	14.0	190.6	1024	14.0	190.6	2512
14.0	204.7	1600	14.0	204.7	1024	14.0	204.7	2512
14.0	218.7	1600	14.0	218.7	1024	14.0	218.7	2512
14.0	232.7	1600	14.0	232.7	1024	14.0	232.7	2512
17.3	250.0	1650	17.3	250.0	1056	17.3	250.0	2590
30.1	280.1	1650	30.1	280.1	1056	30.1	280.1	2590
23.7	303.8	1650	23.7	303.8	1056	23.7	303.8	2590

Profile 1			Profile 2			Profile 3		
thickness(ft)	depth (ft)	Vs(ft/s)	thickness(ft)	depth (ft)	Vs(ft/s)	thickness(ft)	depth (ft)	Vs(ft/s)
23.7	327.5	1650	23.7	327.5	1056	23.7	327.5	2590
23.7	351.2	1650	23.7	351.2	1056	23.7	351.2	2590
23.7	374.9	1650	23.7	374.9	1056	23.7	374.9	2590
23.7	398.6	1650	23.7	398.6	1056	23.7	398.6	2590
23.7	422.2	1650	23.7	422.2	1056	23.7	422.2	2590
23.7	445.9	1650	23.7	445.9	1056	23.7	445.9	2590
23.7	469.6	1650	23.7	469.6	1056	23.7	469.6	2590
25.0	494.6	3600	25.0	494.6	2304	25.0	494.6	5652
5.3	500.0	3600	5.3	500.0	2304	5.3	500.0	5652
39.3	539.3	3600	39.3	539.3	2304	39.3	539.3	5652
25.0	564.3	3600	25.0	564.3	2304	25.0	564.3	5652
25.0	589.3	3600	25.0	589.3	2304	25.0	589.3	5652
25.0	614.3	3600	25.0	614.3	2304	25.0	614.3	5652
25.0	639.3	3600	25.0	639.3	2304	25.0	639.3	5652
25.0	664.3	3600	25.0	664.3	2304	25.0	664.3	5652
25.0	689.3	3600	25.0	689.3	2304	25.0	689.3	5652
25.0	714.3	3600	25.0	714.3	2304	25.0	714.3	5652
25.0	739.3	4000	25.0	739.3	2560	25.0	739.3	6279
25.0	764.3	4000	25.0	764.3	2560	25.0	764.3	6279
25.0	789.3	4000	25.0	789.3	2560	25.0	789.3	6279
25.0	814.3	4000	25.0	814.3	2560	25.0	814.3	6279
25.0	839.3	4000	25.0	839.3	2560	25.0	839.3	6279
25.0	864.3	4000	25.0	864.3	2560	25.0	864.3	6279
25.0	889.3	4000	25.0	889.3	2560	25.0	889.3	6279
25.0	914.3	4000	25.0	914.3	2560	25.0	914.3	6279
25.0	939.3	4000	25.0	939.3	2560	25.0	939.3	6279
25.0	964.3	4000	25.0	964.3	2560	25.0	964.3	6279
100.0	1064.3	4500	100.0	1064.3	2880	100.0	1064.3	7064
100.0	1164.3	4500	100.0	1164.3	2880	100.0	1164.3	7064
100.0	1264.3	4500	100.0	1264.3	2880	100.0	1264.3	7064
100.0	1364.3	4500	100.0	1364.3	2880	100.0	1364.3	7064
100.0	1464.3	4500	100.0	1464.3	2880	100.0	1464.3	7064
100.0	1564.3	5500	100.0	1564.3	3520	100.0	1564.3	8634
100.0	1664.3	5500	100.0	1664.3	3520	100.0	1664.3	8634
100.0	1764.3	5500	100.0	1764.3	3520	100.0	1764.3	8634
100.0	1864.3	5500	100.0	1864.3	3520	100.0	1864.3	8634

Profile 1			Profile 2			Profile 3		
thickness(ft)	depth (ft)	Vs(ft/s)	thickness(ft)	depth (ft)	Vs(ft/s)	thickness(ft)	depth (ft)	Vs(ft/s)
100.0	1964.3	5500	100.0	1964.3	3520	100.0	1964.3	8634
100.0	2064.3	5500	100.0	2064.3	3520	100.0	2064.3	8634
100.0	2164.3	5500	100.0	2164.3	3520	100.0	2164.3	8634
100.0	2264.3	5500	100.0	2264.3	3520	100.0	2264.3	8634
100.0	2364.3	5500	100.0	2364.3	3520	100.0	2364.3	8634
100.0	2464.3	5500	100.0	2464.3	3520	100.0	2464.3	8634
200.0	2664.3	8000	200.0	2664.3	5120	200.0	2664.3	9285
200.0	2864.3	8000	200.0	2864.3	5120	200.0	2864.3	9285
200.0	3064.3	8000	200.0	3064.3	5120	200.0	3064.3	9285
200.0	3264.3	8000	200.0	3264.3	5120	200.0	3264.3	9285
200.0	3464.3	8000	200.0	3464.3	5120	200.0	3464.3	9285
500.0	3964.2	8000	500.0	3964.2	5120	500.0	3964.2	9285
3280.8	7245.1	9285	3280.8	7245.1	9285	3280.8	7245.1	9285

2.3.2.1 Shear Modulus and Damping Curves

Recent nonlinear dynamic material properties were not available for the Turkey Point Nuclear Generating Station for the fill, soils, or firm rock. The fill and soil material in the upper 500 ft (152 m) was assumed to have behavior that could be modeled with either EPRI cohesionless soil or Peninsular Range G/G_{max} and hysteretic damping curves (Reference 7.2). The firm rock (limestone) in the 500 ft (152m) was assumed to have behavior that could be modeled as either non-linear (model M1) or linear (model M2). Two sets of shear modulus reduction and hysteretic damping curves were used. Consistent with the SPID, the EPRI soil and rock curves (model M1) were considered to be appropriate to represent the upper range nonlinearity likely in the materials at this site and Peninsular Range (soil) and linear analyses (firm rock, limestone) (model M2) was assumed to represent an equally plausible alternative soil and rock response across loading level. For the linear analyses of the firm rock material, the low strain damping from the EPRI rock curves were used as the constant damping values in the upper 500 ft (152 m).

2.3.2.2 Kappa

For the Turkey Point profile of about 3,500 ft (1,066 m) of soil and firm rock over hard reference rock, the kappa value of 0.006s for hard rock (Reference 7.2) was combined with the low strain damping in the hysteretic damping curves along with a Q_S of 40 (damping 1.25%) below 500 ft (152 m) to give the values listed in Table 2.3.2-2. The range in kappa about the average base-case value of 0.027s from 0.020 to 0.039 s was considered to adequately reflect epistemic uncertainty in low strain damping (kappa) for the profile. In addition, the full epistemic uncertainty in overall profile damping has contributions from kappa at low strain in the soil and rock but also the wide range in hysteretic damping curves at higher loading levels of significance to design.

Table 2.3.2-2
Kappa Values and Weights Used for Site Response Analyses
(Developed from Reference 7.2 Appendix B)

Velocity Profile	Kappa(s)
P1	0.027
P2	0.039
P3	0.020
	Weights
P1	0.4
P2	0.3
P3	0.3
G/G_{max} and Hysteretic Damping Curves	
M1	0.5
M2	0.5

2.3.3 Randomization of Base Case Profiles

To account for the aleatory variability in dynamic material properties that is expected to occur across a site at the scale of a typical nuclear facility, variability in the assumed shear-wave velocity profiles has been incorporated in the site response calculations. For the Turkey Point site, random shear wave velocity profiles were developed from the base case profiles shown in Figure 2.3.2-1. Consistent with the discussion in Appendix B of the SPID, the velocity randomization procedure made use of random field models which describe the statistical correlation between layering and shear wave velocity. The default randomization parameters developed in Reference 7.11 for USGS "A" site conditions were used for Turkey Point. Thirty random velocity profiles were generated for each base case profile. These random velocity profiles were generated using a natural log standard deviation of 0.25 over the upper 50 ft and 0.15 below that depth. As specified in the SPID, correlation of shear wave velocity between layers was modeled using the footprint correlation model. In the correlation model, a limit of +/- 2 standard deviations about the median value in each layer was assumed for the limits on random velocity fluctuations.

2.3.4 Input Spectra

Consistent with the guidance in Appendix B of the SPID, input Fourier amplitude spectra were defined for a single representative earthquake magnitude (**M** 6.5) using two different assumptions regarding the shape of the seismic source spectrum (single-corner and double-corner). A range of 11 different input amplitudes (median peak ground accelerations (PGA) ranging from 0.01 to 1.5 g) were used in the site response analyses. The characteristics of the seismic source and upper crustal attenuation properties assumed for the analysis of the Turkey Point site were the

same as those identified in Tables B-4, B-5, B-6 and B-7 of the SPID as appropriate for typical CEUS sites.

2.3.5 Methodology

To perform the site response analyses for the Turkey Point site, a random vibration theory (RVT) approach was employed. This process utilizes a simple, efficient approach for computing site-specific amplification functions and is consistent with existing NRC guidance and the SPID. The guidance contained in Appendix B of the SPID on incorporating epistemic uncertainty in shear-wave velocities, kappa, non-linear dynamic properties and source spectra for plants with limited at-site information was followed for the Turkey Point Nuclear Generating Station site.

2.3.6 Amplification Functions

The results of the site response analysis consist of amplification factors (5% damped pseudo absolute response spectra) which describe the amplification (or de-amplification) of hard reference rock motion as a function of frequency and input reference rock amplitude. The amplification factors are represented in terms of a median amplification value and an associated standard deviation (sigma) for each oscillator frequency and input rock amplitude. Consistent with the SPID a minimum median amplification value of 0.5 was employed in the present analysis. Figure 2.3.6-1 illustrates the median and +/- 1 standard deviation in the predicted amplification factors developed for the eleven loading levels parameterized by the median reference (hard rock) peak acceleration (0.01g to 1.50g) for profile P1 and EPRI soil and rock G/G_{max} and hysteretic damping curves (Reference 7.2). The variability in the amplification factors results from variability in shear-wave velocity, depth to hard rock, and modulus reduction and hysteretic damping curves. Appendix A Table A-2b1 provides the source data representing figure 2.3.6-1. To illustrate the effects of more linear response at the Turkey Point site, Figure 2.3.6-2 shows the corresponding amplification factors developed with PR curves for soil and linear analyses for rock (model M2). Appendix A Table A-2b2 provides the source data representing figure 2.3.6-2. Between the more nonlinear (equivalent-linear, model M1) and more linear analyses (model M2), Figures 2.3.6-1 and 2.3.6-2 respectively, show only minor difference for 0.4g loading level and below. Above about the 0.4g loading level the differences increase primarily above about 1 Hz.

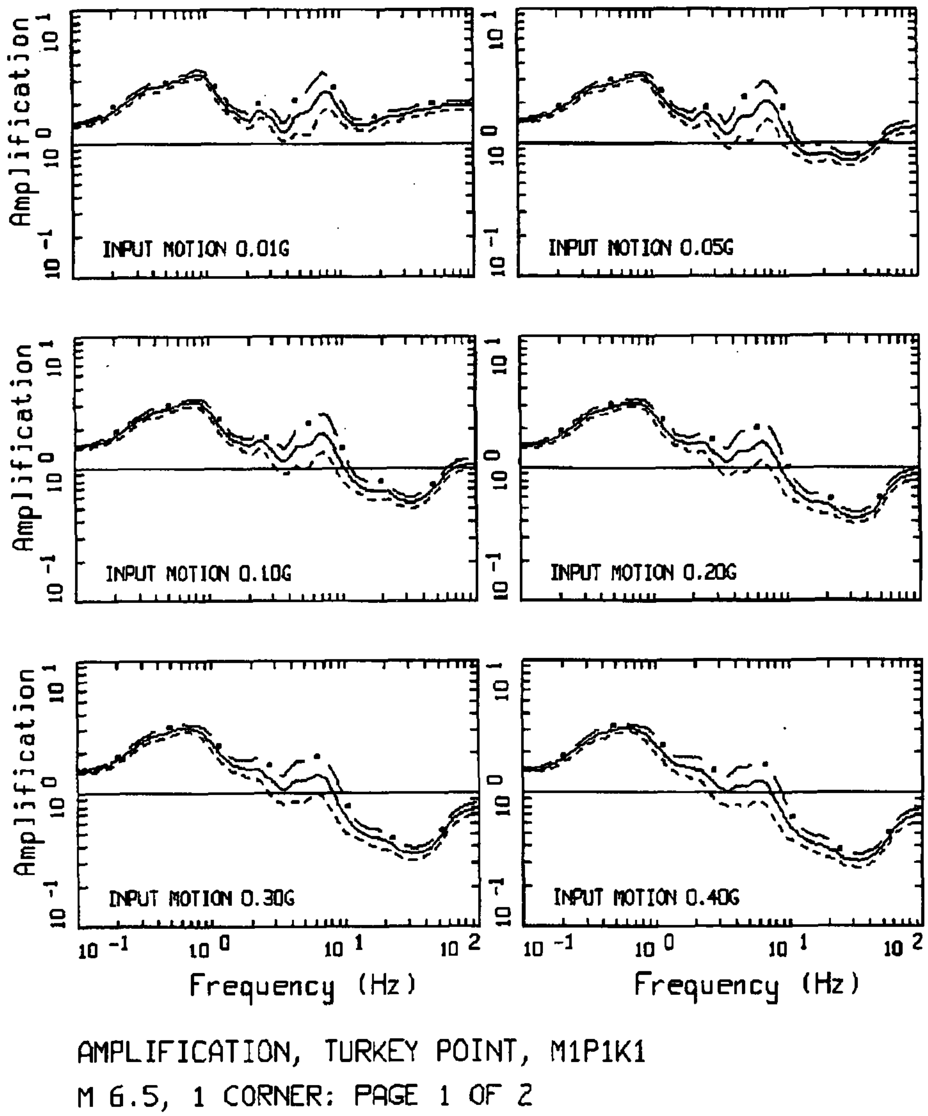
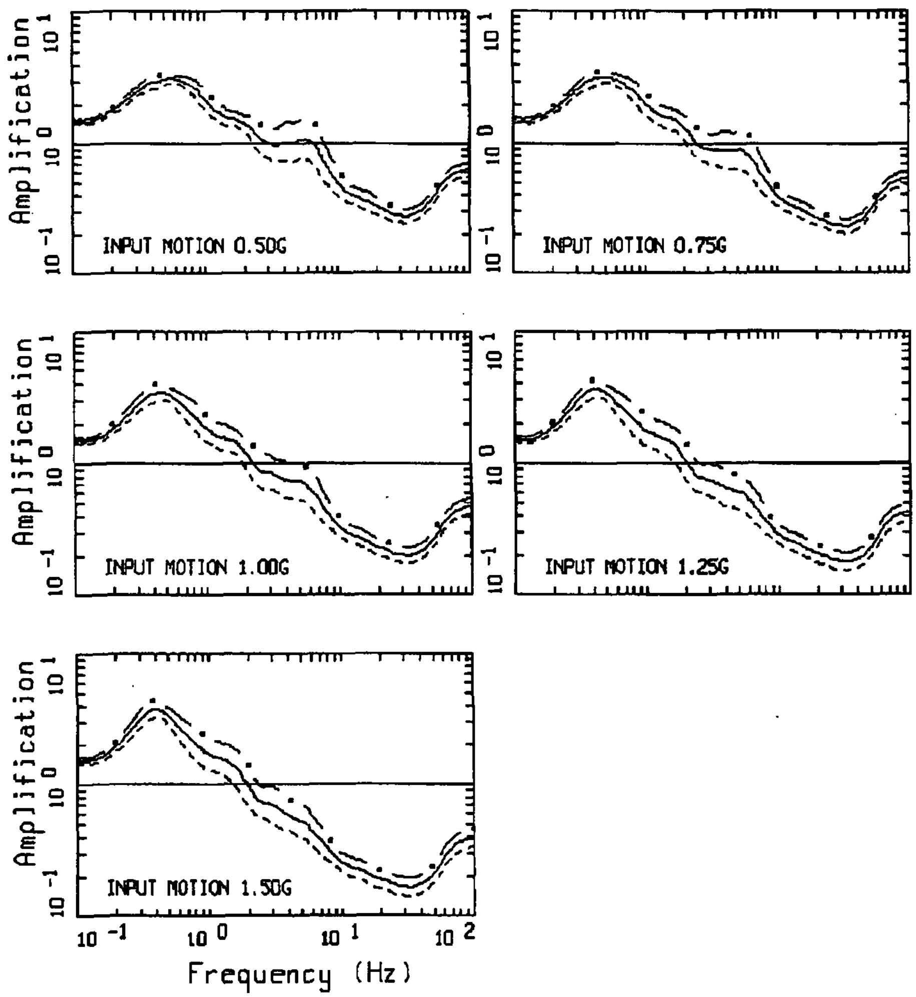


Figure 2.3.6-1. Example suite of amplification factors (5% damping pseudo absolute acceleration spectra) developed for the mean base-case profile (P1), EPRI soil and rock modulus reduction and hysteretic damping curves (model M1), and base-case kappa at eleven loading levels of hard rock median peak acceleration values from 0.01g to 1.50g. **M** 6.5 and single-corner source model (Reference 7.2).



AMPLIFICATION, TURKEY POINT, M1P1K1
M 6.5, 1 CORNER: PAGE 2 OF 2

Figure 2.3.6-1. (Continued)

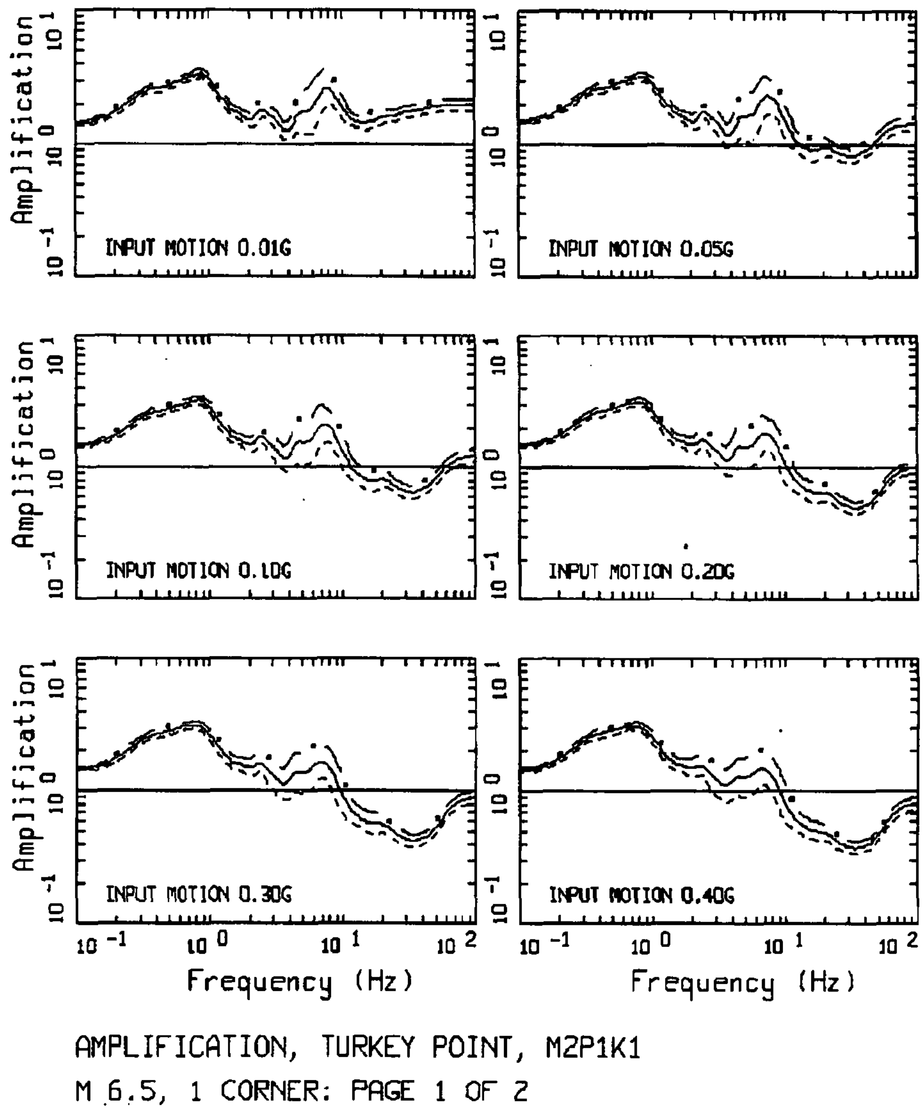
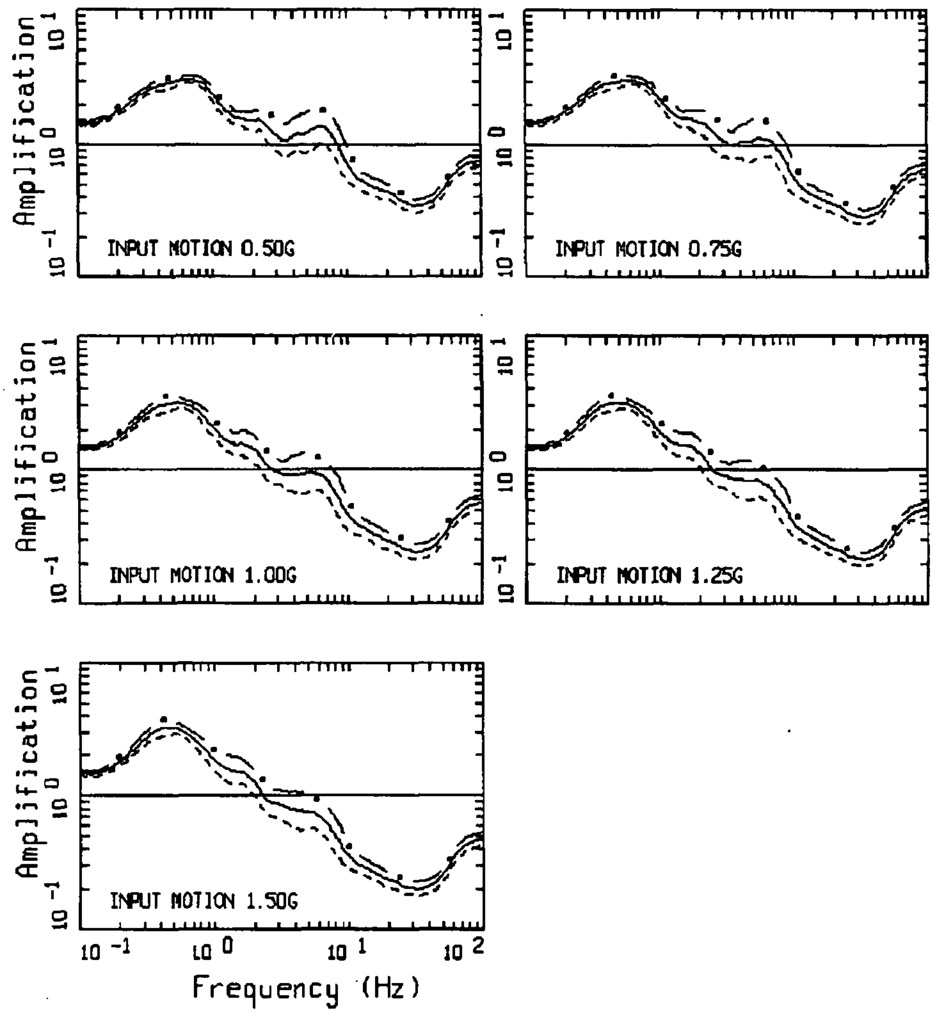


Figure 2.3.6-2. Example suite of amplification factors (5% damping pseudo absolute acceleration spectra) developed for the mean base-case profile (P1), PR curves for soil and linear site response for rock (model M2), and base-case kappa at eleven loading levels of hard rock median peak acceleration values from 0.01g to 1.50g. **M** 6.5 and single-corner source model (Reference 7.2).



AMPLIFICATION, TURKEY POINT, M2P1K1
M 6.5, 1 CORNER: PAGE 2 OF 2

Figure 2.3.6-2. (Continued)

2.3.7 Control Point Seismic Hazard Curves

The procedure to develop probabilistic site-specific control point hazard curves used in the present analysis follows the methodology described in Section B-6.0 of the SPID. This procedure (referred to as Method 3) computes a site-specific control point hazard curve for a broad range of spectral accelerations given the site-specific bedrock hazard curve and site-specific estimates of soil or soft-rock response and associated uncertainties. This process is repeated for each of the seven spectral frequencies for which ground motion equations are available. The dynamic response of the materials below the control point was represented by the frequency- and amplitude-dependent amplification functions (median values and standard deviations) developed and described in the previous section. The resulting control point mean hazard curves for Turkey Point are shown in Figure 2.3.7-1 for the seven spectral frequencies for which ground motion equations are defined. Tabulated values of mean and fractile seismic hazard curves and site response amplification functions are provided in Appendix A, Tables A-2a1 through A-2a7.

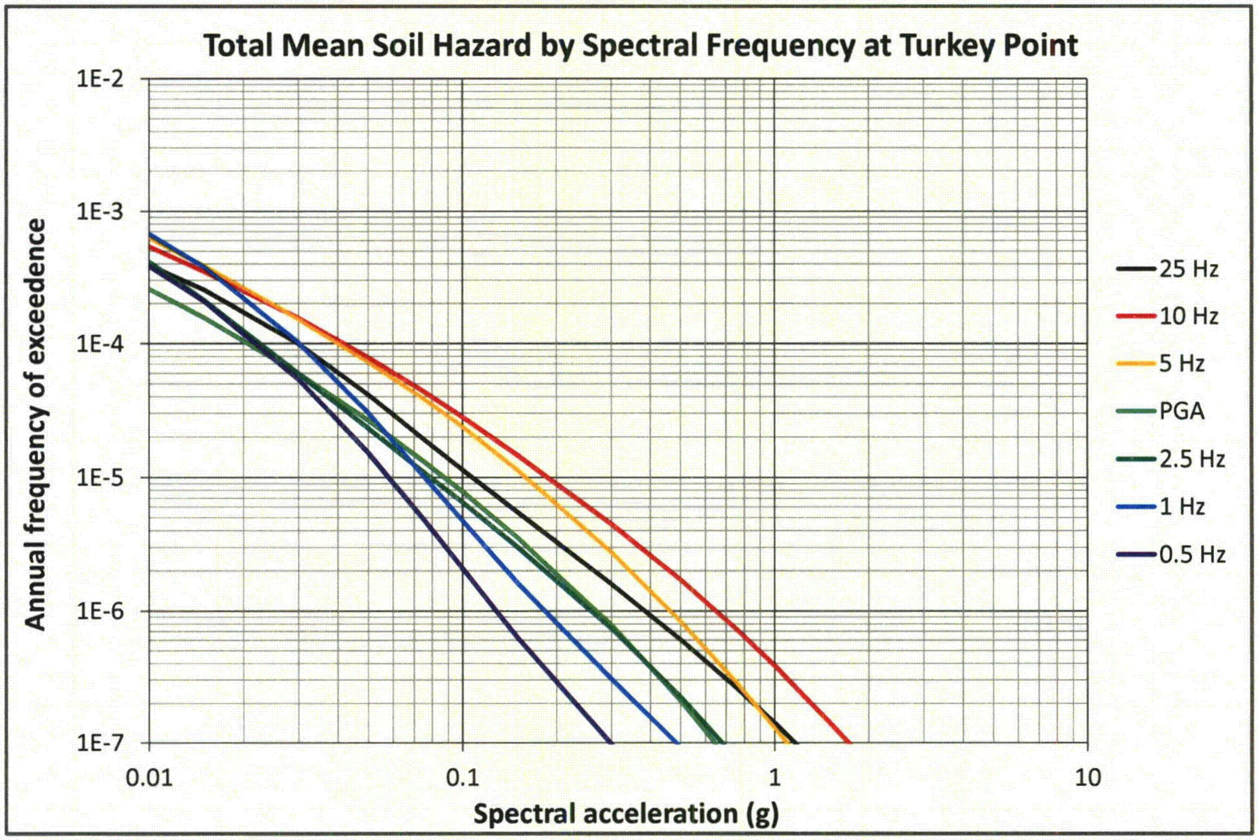


Figure 2.3.7-1. Control point mean hazard curves for spectral frequencies of 0.5, 1, 2.5, 5, 10, 25 and 100 Hz at Turkey Point.

2.4 Ground Motion Response Spectrum

The control point hazard curves described above have been used to develop uniform hazard response spectra (UHRS) and the ground motion response spectrum (GMRS). The UHRS were obtained through linear interpolation in log-log space to estimate the spectral acceleration at each spectral frequency for the 1E-4 and 1E-5 per year hazard levels. Table 2.4-1 below shows the UHRS and GMRS accelerations for a range of frequencies.

Table 2.4-1. UHRS and GMRS for Turkey Point

Freq. (Hz)	10^{-4} UHRS (g)	10^{-5} UHRS (g)	GMRS (g)
100	2.07E-02	8.74E-02	3.93E-02
90	2.12E-02	8.74E-02	3.95E-02
80	2.17E-02	8.74E-02	3.97E-02
70	2.23E-02	8.76E-02	4.00E-02
60	2.31E-02	8.82E-02	4.05E-02
50	2.41E-02	8.96E-02	4.14E-02
40	2.55E-02	9.51E-02	4.39E-02
35	2.66E-02	9.91E-02	4.57E-02
30	2.79E-02	1.03E-01	4.76E-02
25	3.00E-02	1.07E-01	4.99E-02
20	3.04E-02	1.18E-01	5.38E-02
15	3.40E-02	1.43E-01	6.45E-02
12.5	4.01E-02	1.80E-01	8.12E-02
10	4.17E-02	1.87E-01	8.40E-02
9	4.27E-02	1.85E-01	8.32E-02
8	4.46E-02	1.92E-01	8.64E-02
7	4.27E-02	1.87E-01	8.43E-02
6	3.79E-02	1.57E-01	7.09E-02
5	4.01E-02	1.59E-01	7.25E-02
4	3.32E-02	1.35E-01	6.12E-02
3.5	2.86E-02	1.10E-01	5.05E-02
3	2.67E-02	9.51E-02	4.43E-02
2.5	2.25E-02	7.91E-02	3.69E-02
2	2.33E-02	7.24E-02	3.46E-02
1.5	2.69E-02	7.65E-02	3.73E-02
1.25	2.80E-02	7.65E-02	3.76E-02
1	3.02E-02	7.58E-02	3.79E-02
0.9	3.00E-02	7.60E-02	3.79E-02
0.8	2.79E-02	7.21E-02	3.58E-02
0.7	2.59E-02	6.70E-02	3.32E-02
0.6	2.48E-02	6.38E-02	3.17E-02
0.5	2.18E-02	5.81E-02	2.87E-02
0.4	1.74E-02	4.65E-02	2.29E-02
0.35	1.53E-02	4.07E-02	2.01E-02
0.3	1.31E-02	3.49E-02	1.72E-02
0.25	1.09E-02	2.91E-02	1.43E-02
0.2	8.72E-03	2.32E-02	1.15E-02
0.15	6.54E-03	1.74E-02	8.60E-03
0.125	5.45E-03	1.45E-02	7.16E-03
0.1	4.36E-03	1.16E-02	5.73E-03

The 1E-4 and 1E-5 UHRS are used to compute the GMRS at the control point and are shown in Figure 2.4-1.

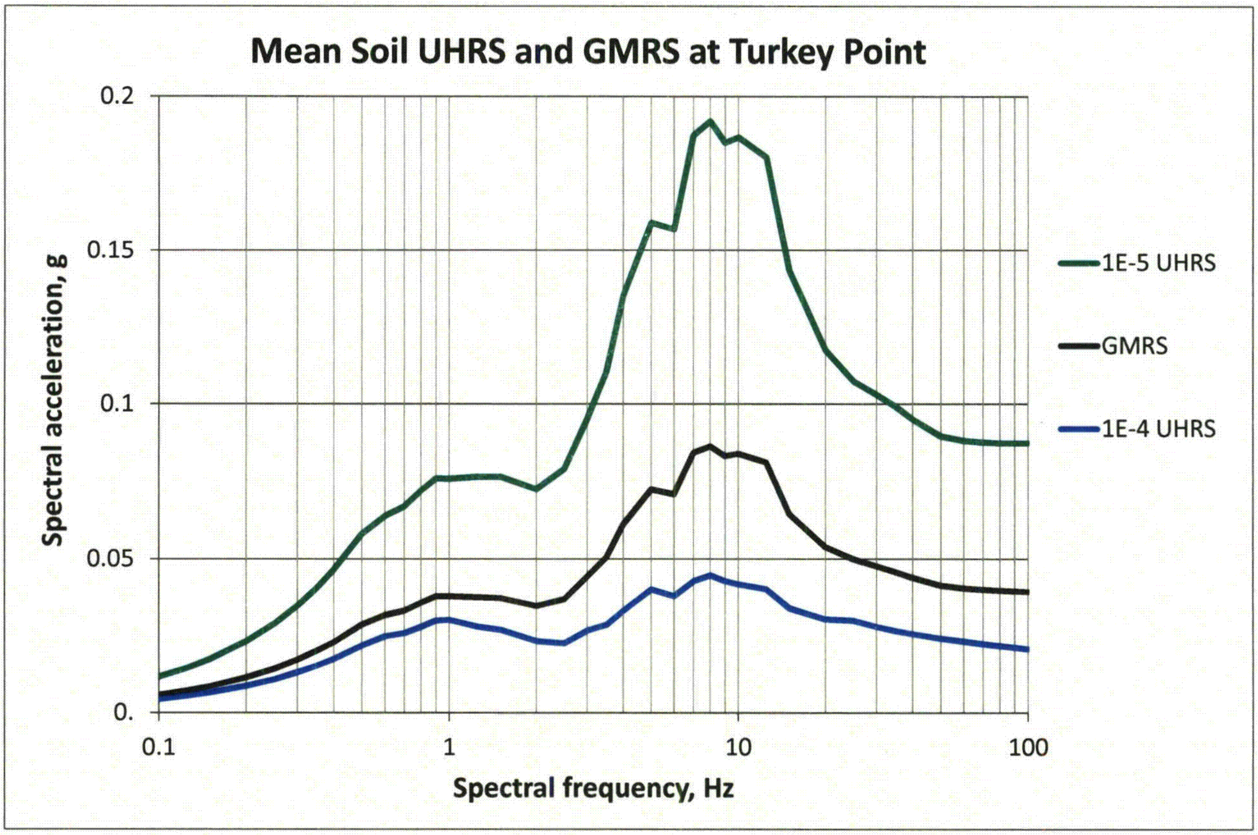


Figure 2.4-1. Plots of 1E-4 and 1E-5 uniform hazard spectra and GMRS at control point for Turkey Point (5%-damped response spectra).

3.0 Plant Design Basis and Beyond Design Basis Evaluation Ground Motion

The design basis for Turkey Point is identified in the Updated Final Safely Evaluation Report (UFSAR) Chapter 5, Appendix A, Figures 5A-1 & 5A-2. The curves were derived from the "Housner Spectrum" normalized to 0.05g for the design basis earthquake and 0.15g for the maximum hypothetical earthquake. The UFSAR maximum hypothetical earthquake was determined at a time when probabilistic definition of seismic input had not been developed with any degree of consistency or confidence. Therefore, the 0.15g PGA was conservatively estimated based on very limited data available at the time.

3.1 SSE Description of Spectral Shape

Turkey Point Nuclear Plant is committed to the 1967 proposed version of General Design Criterion (GDC) Number 2 that relates to earthquake natural phenomena. As such, the SSE was developed based on historical data, building codes geological conditions, and earth quake probabilities for the region surrounding the site. Site seismicity is discussed in the UFSAR, Chapter 2, Section 2.11 and Chapter 5A. 10 CFR 100.10 discusses the general considerations for

siting a nuclear plant. Appendix A to 10CFR100 deals with the specific investigations required to determine the seismic characteristics of the site. It also discusses the methods which should be used to analyze the effect of a safe shutdown earthquake (SSE) and an operating basis earthquake (OBE) on the plant structures. These earthquakes are equivalent to the Maximum Hypothetical Earthquake and Design Basis Earthquake, respectively, as described in Appendix 5A of the Turkey Point Unit 3 and 4 UFSAR (Reference 7.4). On the basis of historical or statistical seismic activity, Turkey Point is located in a seismically inactive area, far from any recorded damaging shocks. Even though several of the larger historical earthquakes may have been felt in southern Florida, the amount of ground motion caused by them was not great enough to cause damage to any moderately well-built structure.

The SSE is defined in terms of a PGA and a design response spectrum. Table 3.1-1 shows the spectral acceleration values as a function of frequency for the 5% damped horizontal SSE from Reference 7.4 Figure 5A-2.

Table 3.1-1. SSE for Turkey Point

Freq. (Hz)	SA (g)
0.30	0.049
0.50	0.075
1.00	0.13
2.00	0.19
2.50	0.21
5.00	0.25
10.00	0.18
20.00	0.15
25.00	0.15
33.00	0.15

3.2 Control Point Elevation

Based on SPID Figure 2-2 guidance for soil sites, the SSE control point elevation is defined at elevation +18 ft MLW.

Note: Refer to Section *2.1.3 Site Datum* for more details on vertical datum.

3.3 IPEEE Description and Capacity Response Spectrum

Turkey Point was classified as a reduced-scope plant in NUREG-1407 and was only required to conduct a walkdown to ensure compliance with the design basis. As a reduced-scope plant, completion of the USI A-46 requirements satisfied the other requirements for the Individual Plant Examination of External Events (IPEEE) program and a capacity response spectrum was not required. Plant actions, analyses or enhancement were undertaken to address all identified A-46 outliers.

4.0 Screening Evaluation

In accordance with SPID 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 SSE exceeds the GMRS. Therefore, a risk evaluation will not be performed.

4.2 High Frequency Screening (> 10 Hz)

Above 10 Hz, the SSE exceeds the GMRS. Therefore, the high frequency confirmation will not be performed.

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

In the 1 to 10 Hz part of the response spectrum, the SSE exceeds the GMRS. Therefore, a spent fuel pool evaluation will not be performed.

5.0 Interim Actions

Based on the screening evaluation described above, there are no Interim Actions required to be performed at Turkey Point.

6.0 Conclusions

In accordance with the 50.54(f) request for information, a seismic hazard and screening evaluation was performed for Turkey Point Nuclear Generating Station Units 3 & 4. A GMRS was developed solely for purpose of screening for additional evaluations in accordance with the SPID.

Based on the results of the screening evaluation, no further evaluations will be performed.

7.0 References

7.1 NRC Letter, 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, ADAMS Accession No. ML12053A340

7.2 Seismic Evaluation Guidance Screening, Prioritization and Implementation Details (SPID) for the Resolution of Fukushima Near-Term Task Force Recommendation 2.1: Seismic, Elec. Power Res. Inst. Report 1025287, November 2012, ML12333A170

7.3 Turkey Point UFSAR Units 3 and 4, Chapter 2 Site & Environment, Rev. 426.

7.4 Turkey Point UFSAR Units 3 and 4, Chapter 5 Structures, Rev. 426.

7.5 National Oceanic and Atmospheric Administration, http://www.noaa.gov/.

7.6 NUREG-2115, Central and Eastern United States Seismic Source Characterization for Nuclear Facilities, U.S. Nuclear Regulatory Commission Report, EPRI Report 1021097, 6 Volumes; DOE Report# DOE/NE-0140.

7.7 EPRI Report. 3002000717, Ground-Motion Model (GMM) Review Project, Elec. Power Res. Inst, Palo Alto, CA, , June, 2 volumes.

7.8 USNRC Regulatory Guide 1.208, A performance-based approach to define the site-specific earthquake ground motion

7.9 FPL Letter, L-2013-265, Florida Power & Light Company's, Turkey Point Units 3 and 4 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 ADAMS Accession No.ML13267A162

7.10 Turkey Point Units 6 & 7 COLA (Final Safety Analysis Report) - Part 2 - FSAR - Chapter 2 - Site Characteristics - Section 2.5.4 STABILITY OF SUBSURFACE MATERIALS AND FOUNDATIONS. ADAMS Accession No. ML13008A438

7.11 Appendix of: Silva, W.J., Abrahamson, N., Toro, G., and Costantino, C. (1997). "Description and validation of the stochastic ground motion model", Report Submitted to Brookhaven National Laboratory, Associated Universities, Inc., Upton, New York 11973, Contract No. 770573.

Appendix A

Table A-1a. Mean and Fractile Seismic Hazard Curves for PGA at Turkey Point

AMPS(g)	MEAN	0.05	0.16	0.50	0.84	0.95
0.0005	3.38E-03	9.24E-04	1.67E-03	3.09E-03	5.12E-03	6.83E-03
0.001	2.49E-03	4.90E-04	1.02E-03	2.22E-03	3.95E-03	5.35E-03
0.005	5.89E-04	4.98E-05	1.32E-04	4.37E-04	1.07E-03	1.64E-03
0.01	2.57E-04	1.23E-05	3.84E-05	1.74E-04	4.43E-04	8.00E-04
0.015	1.56E-04	4.83E-06	1.74E-05	1.05E-04	2.68E-04	5.12E-04
0.03	5.98E-05	8.00E-07	3.47E-06	3.68E-05	1.07E-04	2.10E-04
0.05	2.65E-05	1.69E-07	8.85E-07	1.49E-05	4.83E-05	9.65E-05
0.075	1.32E-05	4.19E-08	2.72E-07	7.03E-06	2.39E-05	4.90E-05
0.1	7.82E-06	1.27E-08	1.13E-07	4.01E-06	1.38E-05	2.88E-05
0.15	3.56E-06	1.87E-09	3.47E-08	1.74E-06	6.45E-06	1.31E-05
0.3	7.87E-07	7.03E-11	4.56E-09	3.47E-07	1.44E-06	3.01E-06
0.5	2.11E-07	3.79E-11	8.85E-10	8.12E-08	3.79E-07	8.35E-07
0.75	6.42E-08	3.01E-11	2.13E-10	2.16E-08	1.16E-07	2.68E-07
1.	2.59E-08	3.01E-11	8.60E-11	7.66E-09	4.56E-08	1.11E-07
1.5	6.69E-09	3.01E-11	5.05E-11	1.46E-09	1.08E-08	3.01E-08
3.	5.34E-10	2.01E-11	3.01E-11	8.12E-11	6.83E-10	2.80E-09
5.	6.31E-11	2.01E-11	3.01E-11	5.05E-11	9.24E-11	3.90E-10
7.5	9.46E-12	2.01E-11	3.01E-11	4.01E-11	5.05E-11	8.60E-11
10.	2.22E-12	2.01E-11	3.01E-11	4.01E-11	5.05E-11	5.05E-11

Table A-1b. Mean and Fractile Seismic Hazard Curves for 25 Hz at Turkey Point

AMPS(g)	MEAN	0.05	0.16	0.50	0.84	0.95
0.0005	3.56E-03	1.08E-03	1.84E-03	3.28E-03	5.27E-03	7.13E-03
0.001	2.72E-03	6.45E-04	1.25E-03	2.46E-03	4.19E-03	5.75E-03
0.005	7.84E-04	8.35E-05	2.04E-04	6.00E-04	1.40E-03	2.13E-03
0.01	3.91E-04	2.42E-05	6.93E-05	2.72E-04	6.83E-04	1.16E-03
0.015	2.53E-04	1.10E-05	3.42E-05	1.72E-04	4.31E-04	7.89E-04
0.03	9.98E-05	2.10E-06	8.00E-06	6.73E-05	1.77E-04	3.28E-04
0.05	4.12E-05	4.43E-07	2.04E-06	2.60E-05	7.45E-05	1.40E-04
0.075	1.93E-05	1.13E-07	6.09E-07	1.16E-05	3.63E-05	6.54E-05
0.1	1.14E-05	3.90E-08	2.53E-07	6.73E-06	2.10E-05	3.95E-05
0.15	5.48E-06	7.34E-09	8.00E-08	3.23E-06	1.02E-05	1.95E-05
0.3	1.59E-06	4.07E-10	1.57E-08	9.65E-07	3.09E-06	5.58E-06
0.5	6.04E-07	7.13E-11	4.77E-09	3.73E-07	1.20E-06	2.10E-06
0.75	2.65E-07	4.77E-11	1.72E-09	1.60E-07	5.12E-07	9.11E-07
1.	1.42E-07	3.47E-11	7.77E-10	8.12E-08	2.72E-07	4.98E-07
1.5	5.50E-08	3.01E-11	2.57E-10	2.76E-08	1.05E-07	2.04E-07
3.	8.51E-09	3.01E-11	5.12E-11	3.23E-09	1.60E-08	3.52E-08
5.	1.70E-09	3.01E-11	3.42E-11	4.98E-10	3.01E-09	7.55E-09
7.5	4.06E-10	2.01E-11	3.01E-11	1.11E-10	6.93E-10	1.92E-09
10.	1.35E-10	2.01E-11	3.01E-11	5.27E-11	2.35E-10	6.83E-10

Table A-1c. Mean and Fractile Seismic Hazard Curves for 10 Hz at Turkey Point

AMPS(g)	MEAN	0.05	0.16	0.50	0.84	0.95
0.0005	3.93E-03	1.34E-03	2.13E-03	3.57E-03	5.75E-03	7.77E-03
0.001	3.22E-03	9.65E-04	1.64E-03	2.92E-03	4.83E-03	6.54E-03
0.005	1.10E-03	1.72E-04	3.52E-04	8.85E-04	1.87E-03	2.80E-03
0.01	5.42E-04	5.27E-05	1.32E-04	4.07E-04	9.37E-04	1.55E-03
0.015	3.48E-04	2.46E-05	6.83E-05	2.49E-04	6.00E-04	1.07E-03
0.03	1.54E-04	5.91E-06	1.90E-05	1.07E-04	2.72E-04	4.98E-04
0.05	7.87E-05	1.79E-06	6.73E-06	5.20E-05	1.44E-04	2.60E-04
0.075	4.36E-05	6.26E-07	2.68E-06	2.76E-05	8.12E-05	1.51E-04
0.1	2.80E-05	2.84E-07	1.36E-06	1.67E-05	5.27E-05	9.93E-05
0.15	1.45E-05	8.47E-08	4.98E-07	7.89E-06	2.72E-05	5.27E-05
0.3	4.44E-06	9.51E-09	8.00E-08	2.16E-06	8.35E-06	1.64E-05
0.5	1.71E-06	1.49E-09	1.95E-08	7.89E-07	3.09E-06	6.45E-06
0.75	7.36E-07	3.01E-10	6.17E-09	3.47E-07	1.38E-06	2.92E-06
1.	3.84E-07	1.04E-10	2.72E-09	1.72E-07	7.23E-07	1.53E-06
1.5	1.42E-07	4.70E-11	7.77E-10	5.50E-08	2.72E-07	5.66E-07
3.	2.45E-08	3.01E-11	7.66E-11	4.63E-09	4.63E-08	1.13E-07
5.	8.50E-09	3.01E-11	4.01E-11	5.35E-10	1.27E-08	4.63E-08
7.5	4.27E-09	2.01E-11	3.01E-11	1.07E-10	5.42E-09	2.49E-08
10.	2.70E-09	2.01E-11	3.01E-11	5.05E-11	3.09E-09	1.60E-08

Table A-1d. Mean and Fractile Seismic Hazard Curves for 5 Hz at Turkey Point

AMPS(g)	MEAN	0.05	0.16	0.50	0.84	0.95
0.0005	4.02E-03	1.38E-03	2.19E-03	3.68E-03	5.91E-03	8.00E-03
0.001	3.40E-03	1.02E-03	1.72E-03	3.09E-03	5.12E-03	6.93E-03
0.005	1.31E-03	2.01E-04	4.13E-04	1.05E-03	2.22E-03	3.33E-03
0.01	6.32E-04	6.54E-05	1.57E-04	4.56E-04	1.10E-03	1.82E-03
0.015	3.84E-04	3.01E-05	8.12E-05	2.64E-04	6.73E-04	1.18E-03
0.03	1.52E-04	6.64E-06	2.29E-05	9.93E-05	2.72E-04	4.90E-04
0.05	7.27E-05	1.95E-06	7.77E-06	4.70E-05	1.34E-04	2.35E-04
0.075	3.84E-05	7.13E-07	3.05E-06	2.46E-05	7.23E-05	1.27E-04
0.1	2.36E-05	3.33E-07	1.51E-06	1.46E-05	4.43E-05	8.00E-05
0.15	1.13E-05	1.08E-07	5.12E-07	6.83E-06	2.13E-05	3.90E-05
0.3	2.74E-06	1.16E-08	6.54E-08	1.60E-06	5.35E-06	9.65E-06
0.5	8.32E-07	1.51E-09	1.23E-08	4.43E-07	1.60E-06	3.05E-06
0.75	2.91E-07	2.60E-10	2.96E-09	1.40E-07	5.66E-07	1.13E-06
1.	1.30E-07	8.00E-11	1.01E-09	5.50E-08	2.53E-07	5.42E-07
1.5	3.86E-08	3.42E-11	2.16E-10	1.31E-08	7.13E-08	1.67E-07
3.	3.95E-09	3.01E-11	4.25E-11	8.72E-10	6.64E-09	1.79E-08
5.	6.43E-10	2.01E-11	3.01E-11	1.13E-10	1.01E-09	2.96E-09
7.5	1.45E-10	2.01E-11	3.01E-11	5.05E-11	2.16E-10	7.13E-10
10.	4.91E-11	2.01E-11	3.01E-11	5.05E-11	8.72E-11	2.68E-10

Table A-1e. Mean and Fractile Seismic Hazard Curves for 2.5 Hz at Turkey Point

AMPS(g)	MEAN	0.05	0.16	0.50	0.84	0.95
0.0005	3.94E-03	1.34E-03	2.16E-03	3.63E-03	5.75E-03	7.77E-03
0.001	3.27E-03	9.65E-04	1.67E-03	3.01E-03	4.90E-03	6.54E-03
0.005	1.08E-03	1.62E-04	3.52E-04	8.85E-04	1.82E-03	2.64E-03
0.01	4.17E-04	4.56E-05	1.10E-04	3.09E-04	7.23E-04	1.16E-03
0.015	2.10E-04	1.82E-05	4.83E-05	1.51E-04	3.68E-04	6.17E-04
0.03	5.91E-05	2.80E-06	9.37E-06	4.01E-05	1.05E-04	1.87E-04
0.05	2.31E-05	6.09E-07	2.35E-06	1.51E-05	4.25E-05	7.55E-05
0.075	1.10E-05	1.67E-07	7.34E-07	6.83E-06	2.04E-05	3.68E-05
0.1	6.49E-06	6.54E-08	3.19E-07	3.84E-06	1.21E-05	2.22E-05
0.15	3.02E-06	1.74E-08	9.65E-08	1.72E-06	5.75E-06	1.07E-05
0.3	7.38E-07	1.34E-09	1.16E-08	3.79E-07	1.38E-06	2.76E-06
0.5	2.25E-07	1.64E-10	2.22E-09	1.02E-07	4.25E-07	8.72E-07
0.75	7.72E-08	5.05E-11	5.42E-10	2.96E-08	1.42E-07	3.14E-07
1.	3.34E-08	3.05E-11	1.95E-10	1.07E-08	6.00E-08	1.40E-07
1.5	9.25E-09	3.01E-11	5.35E-11	2.01E-09	1.53E-08	4.19E-08
3.	8.37E-10	2.01E-11	3.01E-11	9.11E-11	1.07E-09	4.07E-09
5.	1.26E-10	2.01E-11	3.01E-11	5.05E-11	1.32E-10	6.00E-10
7.5	2.58E-11	2.01E-11	3.01E-11	4.01E-11	5.05E-11	1.34E-10
10.	7.86E-12	2.01E-11	3.01E-11	4.01E-11	5.05E-11	6.09E-11

Table A-1f. Mean and Fractile Seismic Hazard Curves for 1 Hz at Turkey Point

AMPS(g)	MEAN	0.05	0.16	0.50	0.84	0.95
0.0005	3.72E-03	1.21E-03	2.01E-03	3.42E-03	5.42E-03	7.23E-03
0.001	3.06E-03	8.35E-04	1.53E-03	2.84E-03	4.63E-03	6.00E-03
0.005	1.35E-03	1.38E-04	3.57E-04	1.18E-03	2.32E-03	3.23E-03
0.01	6.72E-04	4.50E-05	1.21E-04	5.05E-04	1.23E-03	1.90E-03
0.015	3.79E-04	2.07E-05	5.83E-05	2.49E-04	6.93E-04	1.18E-03
0.03	1.02E-04	4.25E-06	1.31E-05	5.42E-05	1.79E-04	3.68E-04
0.05	3.01E-05	1.01E-06	3.52E-06	1.51E-05	5.12E-05	1.10E-04
0.075	1.03E-05	2.60E-07	1.07E-06	5.05E-06	1.74E-05	3.84E-05
0.1	4.74E-06	9.11E-08	4.25E-07	2.25E-06	8.12E-06	1.77E-05
0.15	1.63E-06	1.82E-08	1.04E-07	7.34E-07	2.88E-06	6.26E-06
0.3	3.06E-07	9.24E-10	7.03E-09	1.10E-07	5.20E-07	1.23E-06
0.5	9.37E-08	9.79E-11	9.37E-10	2.68E-08	1.53E-07	4.01E-07
0.75	3.61E-08	3.95E-11	2.13E-10	8.23E-09	5.58E-08	1.62E-07
1.	1.79E-08	3.01E-11	8.47E-11	3.23E-09	2.64E-08	8.23E-08
1.5	6.41E-09	3.01E-11	4.90E-11	8.12E-10	8.72E-09	3.05E-08
3.	9.59E-10	2.01E-11	3.01E-11	7.55E-11	9.51E-10	4.25E-09
5.	2.04E-10	2.01E-11	3.01E-11	5.05E-11	1.62E-10	8.60E-10
7.5	5.33E-11	2.01E-11	3.01E-11	4.83E-11	5.66E-11	2.22E-10
10.	1.92E-11	2.01E-11	3.01E-11	4.01E-11	5.05E-11	9.37E-11

Table A-1g. Mean and Fractile Seismic Hazard Curves for 0.5 Hz at Turkey Point

AMPS(g)	MEAN	0.05	0.16	0.50	0.84	0.95
0.0005	2.80E-03	6.93E-04	1.38E-03	2.60E-03	4.25E-03	5.50E-03
0.001	2.19E-03	3.63E-04	8.85E-04	2.04E-03	3.42E-03	4.63E-03
0.005	8.40E-04	3.47E-05	1.11E-04	6.09E-04	1.62E-03	2.46E-03
0.01	3.85E-04	8.60E-06	2.96E-05	1.98E-04	7.66E-04	1.38E-03
0.015	2.08E-04	3.33E-06	1.21E-05	8.35E-05	4.07E-04	8.35E-04
0.03	5.35E-05	4.90E-07	2.07E-06	1.51E-05	9.11E-05	2.39E-04
0.05	1.52E-05	9.51E-08	4.77E-07	3.63E-06	2.29E-05	6.73E-05
0.075	4.90E-06	2.22E-08	1.36E-07	1.11E-06	7.03E-06	2.13E-05
0.1	2.09E-06	7.34E-09	5.35E-08	4.70E-07	3.01E-06	8.98E-06
0.15	6.29E-07	1.46E-09	1.29E-08	1.42E-07	9.11E-07	2.80E-06
0.3	9.78E-08	9.24E-11	9.11E-10	1.77E-08	1.32E-07	4.37E-07
0.5	2.95E-08	3.19E-11	1.31E-10	3.68E-09	3.42E-08	1.34E-07
0.75	1.18E-08	3.01E-11	5.05E-11	9.93E-10	1.16E-08	5.42E-08
1.	6.14E-09	3.01E-11	4.01E-11	3.79E-10	5.27E-09	2.80E-08
1.5	2.39E-09	2.01E-11	3.01E-11	1.05E-10	1.62E-09	1.05E-08
3.	4.17E-10	2.01E-11	3.01E-11	5.05E-11	1.84E-10	1.49E-09
5.	9.87E-11	2.01E-11	3.01E-11	4.77E-11	5.35E-11	3.01E-10
7.5	2.79E-11	2.01E-11	3.01E-11	4.01E-11	5.05E-11	9.37E-11
10.	1.06E-11	2.01E-11	3.01E-11	4.01E-11	5.05E-11	5.35E-11

Table A-2a1. PGA Amplification Function for Turkey Point

PGA	Median AF	Sigma ln(AF)
1.00E-02	1.79E+00	1.14E-01
4.95E-02	1.28E+00	1.11E-01
9.64E-02	1.08E+00	1.09E-01
1.94E-01	8.88E-01	1.10E-01
2.92E-01	7.86E-01	1.13E-01
3.91E-01	7.14E-01	1.16E-01
4.93E-01	6.60E-01	1.20E-01
7.41E-01	5.68E-01	1.30E-01
1.01E+00	5.04E-01	1.39E-01
1.28E+00	5.00E-01	1.46E-01
1.55E+00	5.00E-01	1.52E-01

Table A-2a2. 25 Hz Amplification Function for Turkey Point

25 Hz	Median AF	Sigma ln(AF)
1.30E-02	1.44E+00	1.14E-01
1.02E-01	7.46E-01	1.38E-01
2.13E-01	5.99E-01	1.50E-01
4.43E-01	5.00E-01	1.58E-01
6.76E-01	5.00E-01	1.66E-01
9.09E-01	5.00E-01	1.72E-01
1.15E+00	5.00E-01	1.78E-01
1.73E+00	5.00E-01	1.87E-01
2.36E+00	5.00E-01	1.91E-01
3.01E+00	5.00E-01	1.90E-01
3.63E+00	5.00E-01	1.90E-01

Table A-2a3. 10 Hz Amplification Function for Turkey Point

10 Hz	Median AF	Sigma ln(AF)
1.90E-02	1.63E+00	2.79E-01
9.99E-02	1.31E+00	3.42E-01
1.85E-01	1.18E+00	3.53E-01
3.56E-01	1.02E+00	3.57E-01
5.23E-01	9.12E-01	3.54E-01
6.90E-01	8.31E-01	3.51E-01
8.61E-01	7.65E-01	3.52E-01
1.27E+00	6.42E-01	3.56E-01
1.72E+00	5.49E-01	3.65E-01
2.17E+00	5.00E-01	3.74E-01
2.61E+00	5.00E-01	3.90E-01

Table A-2a4. 5 Hz Amplification Function for Turkey Point

5 Hz	Median AF	Sigma ln(AF)
2.09E-02	1.81E+00	3.47E-01
8.24E-02	1.56E+00	3.50E-01
1.44E-01	1.43E+00	3.48E-01
2.65E-01	1.25E+00	3.32E-01
3.84E-01	1.14E+00	3.18E-01
5.02E-01	1.06E+00	3.12E-01
6.22E-01	9.93E-01	3.14E-01
9.13E-01	8.82E-01	3.26E-01
1.22E+00	7.91E-01	3.33E-01
1.54E+00	7.18E-01	3.35E-01
1.85E+00	6.67E-01	3.41E-01

Table A-2a5. 2.5 Hz Amplification Function for Turkey Point

2.5 Hz	Median AF	Sigma ln(AF)
2.18E-02	1.49E+00	1.61E-01
7.05E-02	1.47E+00	1.94E-01
1.18E-01	1.46E+00	2.09E-01
2.12E-01	1.40E+00	2.18E-01
3.04E-01	1.33E+00	2.43E-01
3.94E-01	1.26E+00	2.62E-01
4.86E-01	1.20E+00	2.72E-01
7.09E-01	1.08E+00	2.91E-01
9.47E-01	9.80E-01	2.88E-01
1.19E+00	9.03E-01	2.61E-01
1.43E+00	8.78E-01	2.63E-01

Table A-2a6. 1 Hz Amplification Function for Turkey Point

1 Hz	Median AF	Sigma ln(AF)
1.27E-02	2.64E+00	9.67E-02
3.43E-02	2.53E+00	1.02E-01
5.51E-02	2.47E+00	1.07E-01
9.63E-02	2.40E+00	1.16E-01
1.36E-01	2.35E+00	1.28E-01
1.75E-01	2.31E+00	1.49E-01
2.14E-01	2.27E+00	1.53E-01
3.10E-01	2.20E+00	1.80E-01
4.12E-01	2.14E+00	1.91E-01
5.18E-01	2.09E+00	1.97E-01
6.19E-01	2.06E+00	2.06E-01

Table A-2a7. 0.5 Hz Amplification Function for Turkey Point

0.5 Hz	Median AF	Sigma ln(AF)
8.25E-03	2.76E+00	7.52E-02
1.96E-02	2.70E+00	7.51E-02
3.02E-02	2.66E+00	8.27E-02
5.11E-02	2.60E+00	9.55E-02
7.10E-02	2.55E+00	1.07E-01
9.06E-02	2.51E+00	1.19E-01
1.10E-01	2.49E+00	1.23E-01
1.58E-01	2.47E+00	1.38E-01
2.09E-01	2.46E+00	1.48E-01
2.62E-01	2.45E+00	1.53E-01
3.12E-01	2.43E+00	1.57E-01

Table A-2b1. Median AFs and sigmas for Model 1, Profile 1, for 2 PGA levels

M1P1K1	Rock PGA=0.01			M1P1K1	PGA=0.0964		
Freq. (Hz)	Soil_SA	med. AF	sigma ln(AF)	Freq. (Hz)	Soil_SA	med. AF	sigma ln(AF)
100.0	0.019	1.903	0.086	100.0	0.106	1.096	0.093
87.1	0.019	1.900	0.086	87.1	0.106	1.075	0.094
75.9	0.019	1.895	0.086	75.9	0.106	1.040	0.094
66.1	0.019	1.886	0.086	66.1	0.106	0.974	0.094
57.5	0.019	1.868	0.086	57.5	0.107	0.861	0.094
50.1	0.019	1.836	0.086	50.1	0.108	0.736	0.095
43.7	0.019	1.791	0.086	43.7	0.109	0.635	0.096
38.0	0.019	1.735	0.086	38.0	0.111	0.581	0.096
33.1	0.020	1.670	0.086	33.1	0.113	0.554	0.098
28.8	0.020	1.625	0.086	28.8	0.118	0.568	0.095
25.1	0.021	1.578	0.087	25.1	0.127	0.596	0.112
21.9	0.021	1.552	0.092	21.9	0.137	0.665	0.126
19.1	0.022	1.475	0.106	19.1	0.141	0.685	0.169
16.6	0.022	1.408	0.112	16.6	0.135	0.674	0.145
14.5	0.022	1.381	0.095	14.5	0.137	0.704	0.137
12.6	0.024	1.406	0.079	12.6	0.146	0.766	0.144
11.0	0.029	1.556	0.144	11.0	0.172	0.915	0.236
9.5	0.037	1.930	0.198	9.5	0.215	1.184	0.309
8.3	0.046	2.366	0.257	8.3	0.264	1.563	0.331
7.2	0.047	2.389	0.351	7.2	0.291	1.821	0.336
6.3	0.038	1.930	0.412	6.3	0.263	1.739	0.349
5.5	0.034	1.692	0.364	5.5	0.219	1.502	0.386
4.8	0.034	1.626	0.302	4.8	0.209	1.457	0.357
4.2	0.029	1.319	0.214	4.2	0.183	1.311	0.284
3.6	0.028	1.246	0.151	3.6	0.155	1.134	0.224
3.2	0.033	1.499	0.162	3.2	0.166	1.284	0.222
2.8	0.037	1.650	0.099	2.8	0.181	1.463	0.175
2.4	0.036	1.694	0.156	2.4	0.188	1.640	0.149
2.1	0.030	1.486	0.116	2.1	0.157	1.499	0.144
1.8	0.030	1.587	0.097	1.8	0.144	1.531	0.111
1.6	0.029	1.716	0.087	1.6	0.133	1.620	0.097
1.4	0.030	1.949	0.114	1.4	0.126	1.789	0.115
1.2	0.033	2.349	0.103	1.2	0.132	2.112	0.114
1.0	0.037	2.875	0.091	1.0	0.145	2.548	0.111
0.91	0.041	3.321	0.068	0.91	0.157	3.020	0.085
0.79	0.038	3.268	0.081	0.79	0.149	3.150	0.067
0.69	0.033	3.113	0.061	0.69	0.132	3.103	0.058
0.60	0.029	2.986	0.074	0.60	0.112	3.024	0.071
0.52	0.024	2.814	0.065	0.52	0.092	2.870	0.065
0.46	0.020	2.701	0.082	0.46	0.074	2.748	0.077
0.10	0.001	1.411	0.029	0.10	0.002	1.486	0.029

Note: Tables A-2b1 and A-2b2 are tabular versions of the typical amplification factors provided in Figures 2.3.6-1 and 2.3.6-2. Values are provided for two input motion levels at approximately 10^{-4} and 10^{-5} mean annual frequency of exceedance. These factors are unverified and are provided for information only. The figures should be considered the governing information.

Table A-2b2. Median AFs and sigmas for Model 2, Profile 1, for 2 PGA levels

M2P1K1	PGA=0.01			M2P1K1	PGA=0.0964		
Freq. (Hz)	Soil_SA	med. AF	sigma ln(AF)	Freq. (Hz)	Soil_SA	med. AF	sigma ln(AF)
100.0	0.020	1.961	0.100	100.0	0.118	1.224	0.108
87.1	0.020	1.958	0.100	87.1	0.118	1.201	0.108
75.9	0.020	1.953	0.100	75.9	0.119	1.163	0.108
66.1	0.020	1.944	0.100	66.1	0.119	1.091	0.108
57.5	0.020	1.926	0.100	57.5	0.120	0.966	0.108
50.1	0.020	1.893	0.101	50.1	0.121	0.828	0.109
43.7	0.020	1.848	0.101	43.7	0.124	0.720	0.111
38.0	0.020	1.792	0.101	38.0	0.127	0.663	0.109
33.1	0.020	1.727	0.101	33.1	0.131	0.638	0.117
28.8	0.021	1.684	0.101	28.8	0.139	0.666	0.121
25.1	0.021	1.638	0.103	25.1	0.151	0.708	0.125
21.9	0.022	1.614	0.105	21.9	0.163	0.793	0.131
19.1	0.023	1.537	0.123	19.1	0.166	0.807	0.188
16.6	0.023	1.471	0.138	16.6	0.159	0.789	0.196
14.5	0.024	1.449	0.139	14.5	0.160	0.825	0.185
12.6	0.025	1.476	0.099	12.6	0.173	0.904	0.171
11.0	0.030	1.652	0.167	11.0	0.207	1.102	0.262
9.5	0.040	2.077	0.194	9.5	0.270	1.486	0.304
8.3	0.049	2.525	0.248	8.3	0.329	1.946	0.292
7.2	0.049	2.513	0.365	7.2	0.336	2.106	0.331
6.3	0.039	1.988	0.436	6.3	0.277	1.835	0.391
5.5	0.035	1.745	0.399	5.5	0.228	1.569	0.392
4.8	0.035	1.662	0.315	4.8	0.225	1.568	0.404
4.2	0.029	1.330	0.200	4.2	0.186	1.328	0.304
3.6	0.028	1.265	0.149	3.6	0.159	1.165	0.213
3.2	0.034	1.533	0.162	3.2	0.178	1.375	0.224
2.8	0.037	1.684	0.099	2.8	0.192	1.556	0.154
2.4	0.037	1.716	0.163	2.4	0.194	1.695	0.152
2.1	0.030	1.493	0.116	2.1	0.156	1.494	0.140
1.8	0.030	1.598	0.099	1.8	0.146	1.549	0.113
1.6	0.029	1.728	0.088	1.6	0.135	1.652	0.094
1.4	0.030	1.965	0.117	1.4	0.130	1.843	0.121
1.2	0.033	2.372	0.104	1.2	0.137	2.196	0.111
1.0	0.038	2.908	0.089	1.0	0.151	2.668	0.098
0.91	0.041	3.353	0.068	0.91	0.163	3.133	0.069
0.79	0.038	3.284	0.083	0.79	0.151	3.196	0.074
0.69	0.033	3.117	0.060	0.69	0.131	3.090	0.055
0.60	0.029	2.984	0.074	0.60	0.111	2.982	0.069
0.52	0.024	2.811	0.067	0.52	0.090	2.825	0.070
0.46	0.020	2.699	0.084	0.46	0.073	2.713	0.082
0.10	0.001	1.411	0.028	0.10	0.002	1.482	0.027

Note: Tables A-2b1 and A-2b2 are tabular versions of the typical amplification factors provided in Figures 2.3.6-1 and 2.3.6-2. Values are provided for two input motion levels at approximately 10^{-4} and 10^{-5} mean annual frequency of exceedance. These factors are unverified and are provided for information only. The figures should be considered the governing information.