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- Six areal source zones scenario (Z6): In the six areal source zones scenario, Cuba is divided into six zones largely on the basis of observed patterns in seismicity (Figure 2.5.2-271). The seismicity *b*-value is constant across all six zones and equivalent to that used in the Z1 scenario; the seismicity *a*-values vary from zone to zone, are uniform within each zone, and are based on the observed seismicity within each zone. For the six-zone scenario (Z6), the *a*-values were determined by counting the number of events in each subzone greater than or equal to M_w 3.0. The *b*-value in base case Z1 is used for all six subzones. The Z6 scenario results in the lowest contribution to hazard from the three zone scenarios (Table 2.5.2-233).

All areal source scenarios are given equally weighted maximum moment magnitudes, M_w, of 7.0 and 7.3 with uniformly distributed seismicity parameters (complete smoothing) determined from the earthquakes within each zone. Values for Z1 and Z11% are shown in Table 2.5.2-234, using the completeness table for Cuba from Garcia et al. (Reference 255) (Table 2.5.2-235). Focal depth for all areal sources is the same as was implemented in Subsection 2.5.2.4.6, which uses a three-point distribution to represent the 0-15 kilometer (0–9 mile) seismogenic thickness: 2.5, 7.5, and 12.5 kilometers (1.6, 4.7, and 7.8 miles), equally weighted.

The input parameters for the Cuba sensitivity fault sources are described below and are summarized in Table 2.5.2-236 and Figure 2.5.2-272:

- Fault sources and geometries: Intraplate Cuba fault sources include Cotilla-Rodríguez et al.'s (Reference 321) seismoactive faults in Cuba plus the Pinar fault (Figure 2.5.2-272). For the purpose of the hazard sensitivity calculation, it is assumed that all of these faults are capable tectonic sources. The Nortecubana fault is divided into three sensitivity fault sources, the Nortecubana West, Nortecubana Central, and Nortecubana East fault sources. The Baconao fault is divided into two sensitivity fault sources, the Baconao Northwest and the Baconao Southeast fault sources. Seismogenic depth for all fault sources in the hazard sensitivity calculation extends from 0-15 kilometers (0-9 miles). All fault sources are modeled with vertical dip angle, except the three Nortecubana fault sources, all of which are modeled as dipping 30 degrees to the south.

- Probability of activity: For the purpose of the hazard sensitivity calculation, it is assumed that each of the Cuba faults listed in Table 2.5.2-236 is a capable tectonic source with a probability of activity of 1.0. This is a conservative decision given the available geologic data.

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- Maximum magnitude assessment: Modeled magnitude distribution [and weight] for all of the Cuba sensitivity fault sources is M_w 7.0 [0.5], 7.3 [0.5]. These values and weights are the same as those used in the Cuba areal source zone (Subsection 2.5.2.4.4.3.2.1). The maximum magnitude (Mmax) values for the sensitivity fault sources are higher than those presented in published literature. For example, Garcia et al.'s (Reference 254) Table 4 shows the range of Mmax values for fault sources in intraplate Cuba (their sources 1 through 24) from their study and previous studies, which range from M_w 5.0 to 7.0, with many at the middle to low end of this range.

- Slip rate assessment: There are no data to directly determine late Quaternary slip rates for potential Cuba sensitivity fault sources. For most sensitivity fault sources, slip rates in millimeters/year [and weights] are assigned as 0.001 [0.33], 0.01 [0.34], 0.1 [0.33]. For the three sensitivity fault sources most proximal to the modern plate boundary, higher slip rates are assigned as 0.01 [0.1], 0.1 [0.5], 1.0 [0.4]. These slip rate distributions span orders of magnitude, reflecting the lack of data and considerable uncertainty. It is assumed that all slip is seismogenic (i.e., fully coupled).

- Recurrence model: For the purpose of the hazard sensitivity calculation, a characteristic earthquake recurrence model is assumed for the Cuba sensitivity fault sources, but with no contribution from the exponential portion of the recurrence curve at lower magnitudes.

For the hazard sensitivity calculations, there are three scenarios for fault sources, as shown in Table 2.5.2-233 and summarized below:

- No fault sources scenario: This scenario excludes fault sources from the hazard sensitivity calculations. This is consistent with the seismic source characterization used for the PSHA presented in Subsection 2.5.2.4.6.

- Full fault model scenario (FF): The full fault model scenario includes 15 fault sources, as summarized in Table 2.5.2-236.

- Scaled fault model scenario (SF): The SF scenario is derived from the FF scenario such that the total seismic moment rate from the fault sources is equivalent to the seismic moment rate from the observed seismicity (Z1 scenario). The SF scenario results in a contribution to hazard that is lower than that from the FF fault source scenario (Table 2.5.2-233).

A total of eleven possible combinations of areal and fault scenarios are shown in Table 2.5.2-233. The results of hazard sensitivity calculations using these scenarios is presented in Subsection 2.5.2.4.4.3.4.2.2. The hazard sensitivity calculations for both the areal and fault source scenarios use ground motion attenuation relationships developed for Caribbean crustal seismic sources described in Subsection 2.5.2.4.5.2. PTN RAI 02.05.02-4

2.5.2.4.4.3.4.2.2 Results of Cuba Hazard Sensitivity Calculations

This section describes the results of hazard sensitivity calculations for individual areal and fault source scenarios as well as scenarios that combine areal and fault sources. A total of eleven possible combinations of areal and fault scenarios are shown in Table 2.5.2-233. One of these (Z1) is the base case used in the PSHA (Subsection 2.5.2.4.6). In addition to Z1, five of these scenarios are evaluated quantitatively (Z6, Z11%, SF, Z1+SF, and FF) and are described below in this subsection. Figures 2.5.2-273 and 2.5.2-274 present 1 Hz and 10 Hz hazard curves for these five scenarios. These figures also present the corresponding total hazard curves that include each of these Cuba scenarios.

- The Z6 scenario results in a decrease in hazard relative to the Z1 base case.
- The Z11% scenario results in an increase in hazard relative to the Z1 base case.
- The SF scenario results in a lower hazard relative to the Z1 base case.
- The Z1+SF scenario results in a higher hazard relative to the Z1 base case.
- The FF scenario results in a higher hazard relative to the Z1 base case.

Of these five scenarios, four are judged by the TI team to be most likely to encompass the center, body, and range of the views of the informed technical community (Z6, Z11%, SF, and Z1+SF). In contrast, the FF scenario is judged as overly conservative and therefore technically indefensible. The rationale for this assessment is based on the discrepancy between the observed historical rate of large earthquakes in Cuba and that predicted by the moment rate for the FF scenario. The moment rate for the FF scenario is derived from the weighted mean of slip rate distributions for the 15 Cuba fault sources. The bottom row of Table 2.5.2-237 illustrates that the moment rate for the weighted mean slip rate (FF model) yields a return period of 124 years for M_w 7.0 events. The completeness period for earthquakes in Cuba in the M_w 6.0 to 7.0 range is given

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as about 500 years according to Garcia et al. (Reference 255) (Table 2.5.2-234). In the approximately 500-year record of observed seismicity in Cuba, there are no magnitude 7 events, and the largest earthquake in that time in the Phase 2 earthquake catalog from intraplate Cuba is approximately M_w 6.3 (Subsection 2.5.2.4.4.3.2.1). Another way to examine the overly conservative rate derived from the FF scenario is to compare the ratio of moment rate derived from seismicity to moment rate derived from the assumed fault slip rates in the middle column of Table 2.5.2-237. That comparison shows that the FF scenario moment rate is 367 percent greater (3.67 factor in Table 2.5.2-237) than the moment rate derived from historical seismicity. While the individual FF scenario is presented in Figures 2.5.2-273 and 2.5.2-274, it is not considered further. Likewise, combinations involving the FF scenario are also eliminated and not presented, as they would be overly conservative and technically indefensible.

The remaining five combination scenarios (Z6+FF, Z1+FF, Z11%+FF, Z6+SF, and Z11% +SF) are discarded from further consideration based on the rationale provided below:

- Three combination scenarios, Z6+FF, Z1+FF, and Z11%+FF, are discarded due to the inclusion of the FF scenario as described above.
- The Z6+SF combination scenario is judged to lie within the likely center, body, and range of the views of the informed technical community, but would result in an intermediate hazard not useful for this sensitivity analyses because SF is also combined with the Z1 scenario. The Z1+SF scenario results in higher hazard (Figures 2.5.2-273 and 2.5.2-274).
- The Z11%+SF combination scenario includes an areal zone scenario that is based on an arbitrary activity rate increase applied to the entire zone.

To assess the impact of various Cuba sensitivity scenarios on the Turkey Point Units 6 & 7 site hazard, based on the evaluation of the hazard results presented in Figures 2.5.2-273 and 2.5.2-274, four sensitivity scenarios (Z6, Z11%, SF, and Z1+SF) were selected to represent the Cuba hazard in lieu of the Z1 base case scenario used for the original base case hazard total. Total hazard curves that include these four scenarios are presented in Figure 2.5.2-275, along with the original total hazard.

Detailed comparisons of the differences in total hazard for the four scenarios with respect to the base case total hazard are compiled in Tables 2.5.2-238 and 2.5.2-239. Two acceleration spectral response frequencies (1 Hz and 10 Hz) and two

MAFE levels (10^{-4} and 10^{-5}) are considered. Table 2.5.2-238 shows the percent differences in MAFE for each scenario at the respective base case amplitudes. Negative values indicate lower hazard levels than the base case levels, positive values are higher. The base case values are shown in the first pair of columns, and the subsequent four scenarios increase in hazard level from left to right. Differences for the Z6 scenario range from -8.8 percent to -1.1 percent of the base case total. Differences for the SF scenario range from -12 percent to 1.0 percent. The Z11% scenario is based on an increased seismicity rate for the entire areal zone compared to the base case and results in differences which range from -0.1 percent to 2.5 percent. For the Z1+SF scenario, differences are the greatest, ranging from 1.4 percent to 13.1 percent. Note that the apparent decrease (0.1 percent) in 10 Hz MAFE at the 10^{-5} MAFE amplitudes for scenario Z11% is due to the limited number of significant digits presented in the base case for total mean hazard, the process of interpolation, and rounding. That this is only an apparent decrease is supported by the fact that the 10^{-5} MAFE amplitudes for scenario Z11% match the base case amplitudes exactly to three significant figures (Table 2.5.2-239). PTN RAI 02.05.02-4

Table 2.5.2-239 shows the changes in rock motion amplitude for the four scenarios. The largest of these changes is negative relative to the base case amplitudes. These are shown as absolute and percent differences in amplitudes. The largest percent increase is 4.4 percent and results from the Z1+SF scenario and the greatest decrease is -6.9 percent from the SF scenario. Of greater importance than the percentages is the maximum increase in rock motion amplitude from the different scenarios. None of the increases in rock motions from all scenarios exceeds 0.004 g.

The scenarios presented in Figure 2.5.2-275 are derived from a reasonable range of technically defensible seismic source characterizations for intraplate Cuba. As shown in Table 2.5.2-239, this range of seismic source characterizations results in only small changes in hazard at the Turkey Point Units 6 & 7 site. Based on the results of these hazard sensitivity calculations, it is concluded that the use of a single areal source zone and the parameters used to characterize it as presented in Subsection 2.5.2.4.6 gives a reasonably conservative estimate of the contribution to site hazard from intraplate Cuba seismic sources.

2.5.2.4.4.4 Implementation Notes on Incorporation of New Seismic Source Parameterization into PSHA

Subsections 2.5.2.2 through 2.5.2.4 review new geological, geophysical, and seismological information from Subsection 2.5.1 as related to seismic source

characterization as the basis for updating the PSHA at the Units 6 & 7 site. New seismic sources (or extensions of existing seismic sources) were developed as follows:

Gulf of Mexico and Atlantic

Seismicity was added in degree cells offshore of the Florida Peninsula (west in the Gulf of Mexico and east in the Atlantic), using seismicity rates smoothed over the Florida Peninsula (Figure 2.5.2-210) using the updated earthquake catalog through mid-February 2008. The completeness of earthquake catalogs offshore is problematic and based on similar crust and tectonic history the rates of activity offshore appear identical to average rates onshore. The degree cells for which seismicity was added are discussed in Subsection 2.5.2.2.

Caribbean South of Florida

Seismicity was added in degree cells south of Florida, because latitude 25° N was the southernmost extent of the EPRI completeness regions (Figure 2.5.2-210). As for the Gulf of Mexico and Atlantic Ocean, the seismicity in these degree cells was assigned the same rate as calculated for the Florida Peninsula, using the updated earthquake catalog through mid-February 2008. The supplemental source for each EPRI team was given a geometry that completely filled the region between that team's Florida source and the Cuba area (described below).

Cuba Areal Source Zone

A single areal source zone represents earthquake occurrences on the island of Cuba and slightly offshore. Parameters of this source are described in Subsection 2.5.2.4.4.3.2.

North America-Caribbean Fault Sources

Nine faults were identified in the North America-Caribbean plate boundary region, and the geometries and parameters of these faults are described in Subsection 2.5.2.4.4.3.2.

Charleston Seismic Source

An updated model for the Charleston seismic zone was adopted that reflects current scientific evidence on recurrence rates for large magnitude earthquakes in the Charleston, South Carolina region and on the magnitudes of those earthquakes. This Charleston source was used rather than the EPRI team sources for Charleston because if reflects current thinking on both recurrence

rates and magnitude values. The Charleston source is summarized in Subsection 2.5.2.4.4.2.

2.5.2.4.5 Ground Motion Attenuation Models

The PSHA was conducted by combining the hazard from EPRI-SOG seismic sources with the hazard from Cuban and Caribbean sources to the south. The location of the Units 6 & 7 site at the very southeastern extremity of EPRI-SOG study region and the occurrence of recent moderate-large earthquakes in the Caribbean region indicate the potential for contributions to seismic hazard at the site from sources in both the CEUS and Caribbean regions. This subsection provides a review of the methods used to characterize ground motions within the original EPRI-SOG seismic sources in the CEUS region, and then summarizes the new attenuation models that were developed for the Caribbean seismic sources as the basis for updating the PSHA at the Units 6 & 7 site.

2.5.2.4.5.1 Attenuation Models for the CEUS Region

Since the 1989 EPRI study (Reference 245), researchers have continued to evolve ground motion attenuation models for the CEUS and a number of alternative models have been published. An EPRI project was conducted to summarize these studies regarding CEUS ground motions, and results were published in a 2004 EPRI report (Reference 242). These updated attenuation equations estimate median spectral acceleration and its uncertainty as a function of earthquake magnitude and distance.

Epistemic uncertainty is modeled using multiple ground motion attenuation relationships with weights, and multiple estimates of aleatory uncertainty, also with weights. Different sets of equations are recommended for seismic sources that represent rifted vs. non-rifted regions of the earth's crust. Equations are available for hard rock site conditions at spectral frequencies of 100 Hz (which is equivalent to peak ground acceleration, PGA), 25 Hz, 10 Hz, 5 Hz, 2.5 Hz, 1 Hz, and 0.5 Hz. All ground motion estimates are for spectral acceleration with 5 percent of critical damping.

Aleatory uncertainties published in the 2004 EPRI (Reference 242) model were reexamined by Abrahamson and Bommer (Reference 203) because it was thought that the 2004 EPRI aleatory uncertainties were probably too large, resulting in over-estimates of seismic hazard. The Abrahamson and Bommer (Reference 203) study recommends a revised set of aleatory uncertainties and

weights that can be used to replace the original 2004 EPRI (Reference 242) estimates of aleatory uncertainty.

The ground motion attenuation models used in the seismic hazard calculations for CEUS seismic sources consisted of the median equations from 2004 EPRI (Reference 242) combined with the updated aleatory uncertainties of the Abrahamson and Bommer study (Reference 203).

2.5.2.4.5.2 New GMPE Models for the Cuba and Caribbean Region

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The incorporation of additional seismic sources developed for the Caribbean region in the PSHA requires applicable ground motion prediction equation (GMPE) models. Although much of the Caribbean has experienced large, damaging earthquakes, there are very few recorded strong ground motion data from the region, and this has prevented the development of a regional empirical GMPE, specifically one for attenuation of ground motion between sources in the northern Caribbean and the Turkey Point Units 6 & 7 site location in southern Florida. Moreover, the use of ground motion prediction equations (GMPEs) from other regions, such as the 2004 EPRI (Reference 242) GMPEs, cannot be uncritically adopted for PSHA analysis because of the observed differences in crustal properties between the CEUS and Caribbean.

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No studies have been found modeling attenuation of strong ground motion between earthquakes in the Caribbean and sites in the CEUS so that no experts could be identified who could be characterized as a proponent, which SSHAC (Reference 318) defines as "an expert who advocates a particular hypothesis or technical position." The absence of a proponent or proponents made it difficult to categorize the level of the study in accordance with the SSHAC (Reference 318) guidelines. However, what has been done in this regard is otherwise fully consistent with industry practice in general and the SSHAC (Reference 318) guidelines in particular.

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Initial development of a suite of specific GMPEs was performed by, what in SSHAC (Reference 318) nomenclature would be called the TI team of two Bechtel seismologists: Drs. Nick Gregor and Behrooz Tavakoli, both with significant experience in generating and evaluating GMPEs. Peer review was provided by a Technical Advisory Group (TAG) at several points throughout the GMPE development process. A resource expert, Dr. Dariush Motazedian of Carleton University, Ottawa, Canada, was also consulted during this time.

The GMPE development reflects the uniquely challenging situation that exists with regard to the seismic characterization of Cuba and the adjacent northern Caribbean region in that, for this region, empirical ground motion data is limited or unavailable, there are no calibrated GMPEs predicting ground motions in southern Florida arising from earthquakes in Cuba or the northern Caribbean, and there are no experts identified that can be characterized as proponents as defined in SSHAC (Reference 318). PTN RAI 02.05.02-2 LDP-CS564

SSHAC (Reference 318) characterizes a Level 2 study as one in which the TI reviews the literature and then interacts with proponents and resource experts to identify issues and interpretations and, on the basis of these interactions, "estimates community distribution," that is, develops "a representation . . . of the diversity of interpretations and their uncertainties" (see Table 3-1 and Sections 3.1.3.5 and 3.2.1 of Reference 318). SSHAC (Reference 318) also acknowledges (in Section 3.1.3.3) that the "choice of the level of [study] is often driven by . . . the amount of resources available for the study." LDP-CS564

Initially, a literature review was performed with the goal of retrieving acceptable GMPEs for the Cuba and Caribbean region. However, this literature review only retrieved one GMPE developed recently by Motazedian and Atkinson (Reference 287). In addition to the interaction with the TAG members, correspondence was conducted with Professor Motazedian during the initial development of the Caribbean GMPEs. These initial technical discussions were for the possible application of the published Motazedian and Atkinson (Reference 287) GMPE for the PSHA study. However, based on the limitations of this GMPE (e.g., incomplete suite of necessary spectral frequencies, limited application for distances greater than 500 kilometers [311 miles], and site-specific ground conditions of soft rock), it was determined that the published GMPE was not directly acceptable for use in the PSHA.

The process described is generally consistent with a Level 2 study as described in SSHAC (Reference 318) where it states (in Section 3.2.1): ". . . the TI would communicate with the authors of published studies and other local experts who have expertise in the region or in regional ground motions . . . to hear and understand the technical positions taken by various proponents of particular hypotheses . . . In effect, the TI is . . . attempting to provide an overall assessment that would represent the informed scientific community's view of the subject, if the community were to make such an assessment."

Motazedian and Atkinson (Reference 287) analyzed a dataset of approximately 300 earthquakes recorded by stations in Puerto Rico. This dataset spanned the

M_w range of 3 to 5.5 and distances from about 20 to 500 kilometers. Motazedian and Atkinson acknowledge that their ground motion dataset consisted of recorded ground motions from both crustal and subduction zone earthquakes and that the separation of the earthquakes used in their dataset into crustal and subduction events was not possible because of the limited station coverage for the region. Based on these data, Motazedian and Atkinson developed a set of regional anelastic attenuation and source parameters. Finally, Motazedian and Atkinson used these regional parameters within a stochastic simulation process to create an artificial dataset for larger earthquakes at near distances to fit a GMPE to these generated data. PTN RAI 02.05.02-2

To address this possible concern about the influence of using both subduction and crustal events to estimate the regional attenuation and source parameters, Motazedian and Atkinson (Reference 287) provide a comparison of their GMPE with representative GMPEs for the CEUS (Reference 210), California (Reference 357), and an empirically based GMPE based on the global ground motion dataset for subduction zones (Reference 358). They conclude that, overall, the Puerto Rico relations agree well with the stochastic relations for California and eastern North America and are quite different from those calculated by the global subduction relations. This comparison and noted results provide a technical justification for using the source and attenuation parameters from the Puerto Rico ground motion dataset (Reference 287) as the starting point for the development of applicable GMPEs for the Caribbean seismic sources. PTN RAI 02.05.02-2

The Motazedian and Atkinson (Reference 287) study focused on GMPEs most useful for the evaluation of PSHA results for Puerto Rico. For the purposes of an evaluation of potential contributions to PSHA at the Turkey Point Units 6 & 7 site from Caribbean earthquakes, GMPE results from somewhat larger and significantly more distant earthquakes are needed. PTN RAI 02.05.02-2

Beginning with the suite of regional anelastic attenuation and source parameters of Motazedian and Atkinson, and following the stochastic simulation methodology, region-specific GMPE models for the Cuba and Caribbean region were developed. Ground motions were estimated for seven spectral frequencies on hard rock for earthquakes with magnitudes between M_w 4.75 and 8.75 and for a distance range of 150 to 2000 kilometers. PTN RAI 02.05.02-2 PTN RAI 02.05.02-2

To account for the expected uncertainty associated with the application of regional attenuation and source parameters estimated from earthquakes in and around Puerto Rico and their application to other regions within the Caribbean (e.g., Cuba), the stress parameter of the source and the anelastic attenuation models

from Motazedian and Atkinson (Reference 287) were varied in the stochastic ground motion simulation analysis. {The regional attenuation and source parameters from the Motazedian and Atkinson (Reference 287) study and the specific values used for the development of the suite of applicable GMPE models are listed in Table 2.5.2-231.} The variation of the stress parameter was defined to be normally distributed with a standard deviation (sigma value) of 0.7 (in natural log units) given in the EPRI 1993 study (Reference 244). The variation of the regional anelastic attenuation constant term was based on an assumed sigma value of 0.4 (in natural log units) given in the 2003 Silva et al. study (Reference 342). In addition, three separate seismic source models were used in the analysis: single corner with constant stress parameter (1CC model), single corner with magnitude dependent stress parameter (1CV model), and double corner source (2C model) based on the analysis of CEUS ground motion data. These three seismic source models are part of the larger set of source models that are included in the 2004 EPRI (Reference 242) ground motion models. SOF 2.5.2-9 PTN RAI 02.05.02-2

A linear regression was performed on the simulated datasets to estimate the regression coefficients for the Caribbean regional GMPEs for use in the PSHA. A nonlinear GMPE functional form and regression, generally needed to successfully predict saturation of strong ground motion at small distances, were not required because of the large minimum distance of 150 kilometers separating Caribbean earthquakes from the Turkey Point Units 6 & 7 site. An aleatory sigma value of 0.645 (in natural log units) was selected following the Motazedian and Atkinson study (Reference 287) and was assigned to each Caribbean GMPE model for use in the PSHA for all frequencies. PTN RAI 02.05.02-2 PTN RAI 02.05.02-2

To capture the epistemic uncertainty in ground motion models in the hazard analysis, a number of GMPEs from the different seismic source models were included along with model-dependent weights. The weights for these new GMPE models were assessed based on the family class weights used in the 2004 EPRI ground motion model study and the family class (that is, 1CC, 1CV, or 2C) of the seismic source model (Reference 242). {Figure 2.5.2-255 shows the suite of Caribbean PGA GMPE curves for a magnitude M_w 7 earthquake over the applicable distance range of 150 - 2000 kilometers.} Within a given seismic source model type (e.g., single corner constant stress parameter), the difference between the GMPE models based on the low, base, and high stress parameter values resulted in a constant scaling of the GMPE curves. This scalar variation was captured by combining the datasets from these stress parameter values for the regression analysis leading to a combined suite of nine ground motion GMPE models (i.e., heavy lines) that were adopted for use in the PSHA with the PTN RAI 02.05.02-2 SOF 2.5.2-9 PTN RAI 02.05.02-2 PTN RAI 02.05.02-2 PTN RAI 02.05.02-2

Caribbean seismic sources. As a check, the complete suite of GMPE curves is shown in Figure 2.5.2-255 and the resulting nine adopted GMPE span the general range of values from the complete suite of curves. {Figures 2.5.2-256 and 2.5.2-257 plot the GMPE curves for the periods of 0.1 and 1.0 seconds, respectively.} PTN RAI 02.05.02-2 SOF 2.5.2-9 PTN RAI 02.05.02-2

At the suggestion of TAG members over the course of the three TAG meetings, a {sensitivity analysis} was performed to examine the effect on epistemic uncertainty of alternative GMPEs for use in the PSHA. The alternative relationships considered adopted a double corner (2C) seismic source model, such as might be expected to occur in a more active tectonic environment such as the western United States (WUS) rather than the double corner seismic source model of the less active tectonic environment of the CEUS, and a Gulf Coast region lower amplitude but higher (less rapidly attenuating) anelastic attenuation factor (Q) model rather than the Puerto Rico region-specific (higher amplitude but more rapidly attenuating) Q model from Motazedian and Atkinson (Reference 287) recognizing that much of the propagation path from the Caribbean sources to the Turkey Point Units 6 & 7 site is through the Gulf Coast crust. It was found that adoption of these alternatives (i.e., different suite of regional attenuation and seismic source parameter values) led to ground motion values that were equal to (at large distances based on the anelastic attenuation rates) or lower than (based on the different magnitude scaling from the WUS-based double corner model) the suite of original nine new GMPE models adopted for the Cuba and Caribbean region. A comparison of the weighted combination of the original nine GMPE models and the inclusion of these additional sensitivity models resulted in a slightly lower weighted mean GMPE curve over the magnitude and distance range needed for the PSHA. Therefore, their incorporation into the final PSHA results would have slightly lowered the already low hazards, and, thus, the use of the original nine GMPE models was accepted by the TAG members because the inclusion of these additional GMPE models would be expected to lead to lower, and less conservative, ground motion results. PTN RAI 02.05.02-2 SOF 2.5.2-19 PTN RAI 02.05.02-2

After the suite of GMPEs was developed, two additional sensitivity analyses were performed to further validate the technical assessment of the stochastic Caribbean GMPE models developed for Turkey Point Units 6 & 7. These analyses sought additional empirical data with which to compare the GMPEs for Turkey Point Units 6 & 7 and examined the effect of alternate suites of GMPEs on the PSHA results at the site. The results of these two additional sensitivity studies are presented here. LDP-CS564

The first supplemental sensitivity analysis compared the suite of GMPEs used in the Turkey Point Units 6 & 7 PSHA with empirical regional ground motion data. To

assist in the technical evaluation of the current Caribbean GMPE models developed for Turkey Point Units 6 & 7, a comparison of empirical ground motions from five regional earthquakes occurring since 2004 in the Gulf of Mexico and northern Caribbean region were analyzed. These earthquakes were selected from among those available as being most representative of earthquakes whose tectonic settings and locations might be expected to be like those of future earthquakes contributing to the overall PSHA at the site under the source model adopted. Specifically, these were shallow crustal earthquakes in the northern Caribbean or Gulf of Mexico. PTN RAI 02.05.02-2 LDP-CS564

Regional broadband empirical data from selected Incorporated Research Institutions for Seismology (IRIS) stations were obtained, processed and compared to the suite of Caribbean GMPE models and the suite of EPRI (References 242 and 203) GMPE models for both the mid-continent and Gulf Coast regional models. Based on these comparisons, a technical assessment can be made on the applicability of using the Caribbean GMPE for the Turkey Point Units 6 & 7 PSHA.

Note that the current PSHA results were developed using the suite of EPRI (References 242 and 203) mid-continent GMPE models for other non-Caribbean sources. In this comparison, all of the GMPE curves are for the assumed CEUS hard rock site conditions with *Vs*= 2.83 kilometers/second (1.76 miles/second), whereas the empirical IRIS data are for the individual unknown site conditions of each station which is expected to be less than *Vs*= 2.83 kilometers/second (1.76 miles/second). Based on a simplified site response analysis, it was computed that adjustment factors for the station-specific site conditions to the more stable CEUS hard rock site conditions required a reduction factor in the observed empirical ground motion values, especially for the longer spectral frequencies of interest (e.g., 1 or 2.5 Hz).

The current deaggregation of seismic hazard at the Turkey Point Units 6 & 7 site from all sources—Cuban, Caribbean, and southeast United States—is shown in Figures 2.5.2-226 and 2.5.2-228 for longer period motions (for which the relative contribution of the larger, more distant Cuban and Caribbean sources would be expected to have their greatest relative contribution) and for the 10^{-4} and 10^{-5} mean annual frequency of occurrence probabilities used to develop design ground motions under NRC regulatory guidance. The relative contribution for the higher frequency cases of 5 Hz and 10 Hz (Figures 2.5.2-227 and 2.5.2-229) from the more distant Caribbean sources is significantly reduced relative to the closer local seismic sources. For this sensitivity comparison, the empirical ground LDP-CS564

motions for 1 Hz and 2.5 Hz are presented for each of the five regional earthquakes and ground motion prediction equations. PTN RAI 02.05.02-2

For each event, acceleration response spectra for a spectral damping of 5 percent at each station were computed. The geometric mean of the two horizontal components was computed and amplitudes for the 1 Hz and 2.5 Hz spectral frequencies were generated and compared to the suite of GMPE models (i.e., both of the EPRI 2004 GMPE models (Reference 242) and the Caribbean GMPE models). LDP-CS564

Note that based on the hypocentral location and geographical location relative to tectonic plate boundary, all five of these earthquakes are considered to be shallow crustal events and are not associated with any regional subduction zones. For each event, a standard time history processing methodology was applied with the final results being a dataset of the acceleration response spectra for a spectral damping of 5 percent at each station. The geometric mean of the two horizontal components was computed and comparison plots for the 1 Hz and 2.5 Hz spectral frequencies were generated showing the empirical data (both as recorded and adjusted for consistent CEUS hard rock site conditions) and the suite of GMPE models (i.e., both of the EPRI 2004 GMPE models [Reference 242] and the Caribbean GMPE models). Both the individual GMPE curves and the weighted mean GMPE curve for a given set are shown in the comparison plots for each spectral frequency and earthquake. LDP-CS564

These five events were as follows:

- December 14, 2004 - Caribbean Sea Region (M_w6.8, 19.05 N, -81.52 W, hypocenter depth 12.0 kilometers), Fault Plane 1 (Strike, Dip, Rake): 258.0, 84.0, -2.0; Fault Plane 2 (Strike, Dip, Rake): 349.0, 88.0, -174.0. The fault plane solution implies almost pure strike-slip motion on a nearly vertically dipping fault.

  This event occurred in the Caribbean Sea region and its epicenter is shown in Figure 2.5.2-258a along with the Turkey Point Units 6 & 7 site location and the location of the IRIS stations that recorded this earthquake. Based on the observed station distribution, the IRIS station DWPF located in central Florida has the most applicable source to site path for this comparison. The GMPE curves and empirical data are shown in Figures 2.5.2-258b and 2.5.2-258c for the 1 Hz and 2.5 Hz spectral frequencies. The data point from the DWPF station is highlighted as a solid blue symbol. Overall, the empirical data falls below the median Caribbean GMPE curve (heavy red line) and has values that are in the lower distribution range of Caribbean GMPE curves.

- September 10, 2006 - Gulf of Mexico (M_w5.9, 26.32 N, -86.84 W, hypocenter depth 29.6 kilometers), Fault Plane 1 (Strike, Dip, Rake): 324.0, 28.0, 117.0; Fault Plane 2 (Strike, Dip, Rake): 114.0, 65.0, 77.0. The fault plane solution implies composite strike-slip and reverse-slip motion on a moderately steeply dipping fault. PTN RAI 02.05.02-2

  This event occurred in the Gulf of Mexico and its epicenter is shown in Figure 2.5.2-259a along with the Turkey Point Units 6 & 7 site location, and the location of the IRIS stations that recorded this earthquake and were analyzed. Based on the observed station distribution, the IRIS station DWPF located in central Florida has the most applicable source to site path for this comparison. Out of the five earthquakes considered in this analysis, this event has the most consistent tectonic structure between the earthquake and the Turkey Point Units 6 & 7 site and can be considered as the best representative event for events occurring in and around the island of Cuba and being observed in southern Florida. The distribution of stations in the central United States has a less applicable travel path azimuth and may show different attenuation properties based on these different tectonic travel paths. The GMPE curves and empirical data are shown in Figures 2.5.2-259b and 2.5.2-259c for the 1 Hz and 2.5 Hz spectral frequencies. The data point from the DWPF station is highlighted as a solid blue symbol. In general, the empirical observations fall within the range of the Caribbean GMPE curves with the single exception of station LRAL (i.e., at a distance of approximately 750 kilometers [466 miles]) for 2.5 Hz in which the unadjusted empirical data exceeds the highest Caribbean GMPE curve. For this station and frequency, however, the CEUS hard rock adjusted ground motions fall within the range of Caribbean GMPE models which are defined for CEUS hard rock site conditions. It can also be concluded from the comparison plots in Figures 2.5.2-259b and 2.5.2-259c that the distribution of the current Caribbean GMPE curves adequately captures the range of the empirical data. In addition, the observation from the DWPF station is in the lower range of the Caribbean GMPE curves.

- February 4, 2007 - Cuba Region (M_w6.2, 19.49 N, -78.34 W, hypocenter depth 12.0 kilometers), Fault Plane 1 (Strike, Dip, Rake): 257.0, 76.0, -9.0; Fault Plane 2 (Strike, Dip, Rake): 349.0, 81.0, -166.0. The fault plane solution implies almost pure strike-slip motion with a small normal component on a steeply dipping fault.

This event occurred south of the island of Cuba and its epicenter is shown in Figure 2.5.2-260a along with the Turkey Point Units 6 & 7 site location and the location of the IRIS stations that recorded this earthquake and were analyzed. Only three IRIS stations were analyzed from this earthquake and their station locations are shown in Figure 2.5.2-260a. Based on the observed station distribution, the IRIS station DWPF located in central Florida has the most applicable source to site path for this comparison. The GMPE curves and empirical data are shown in Figures 2.5.2-260b and 2.5.2-260c for the 1 Hz and 2.5 Hz spectral frequencies. The data point from the DWPF station is highlighted as a solid blue symbol. Overall, the empirical data falls below the median Caribbean GMPE curve (heavy red line) and has values that are in the lower distribution range of Caribbean GMPE curves. In addition, the observation from the DWPF station is similar to the lowest Caribbean GMPE curve or lower. PTN RAI 02.05.02-2

- May 28, 2009 - North of Honduras (M_w7.3, 16.50 N, -87.17 W, hypocenter depth 12.0 kilometers), Fault Plane 1 (Strike, Dip, Rake): 63.0, 60.0, -7.0; Fault Plane 2 (Strike, Dip, Rake): 156.0, 84.0, -150.0. The fault plane solution implies predominantly strike-slip with a smaller normal component on a moderately to steeply dipping fault.

  This event occurred north of Honduras in Central America and is the largest earthquake in the suite of five events analyzed in this sensitivity study. The location of its epicenter is shown in Figure 2.5.2-261a along with the Turkey Point Units 6 & 7 site location and the location of the three IRIS stations that were analyzed. Based on the azimuths from the earthquake to the three IRIS stations, none of the associated seismic ray travel paths are ideal for this comparison study. The attenuation curves and empirical data are shown in Figures 2.5.2-261b and 2.5.2-261c for the 1 Hz and 2.5 Hz spectral frequencies. The comparisons provided in the figures indicate that the empirical data from this earthquake are lower than any of the Caribbean attenuation curves.

- January 12, 2010 - Haiti (M_w7.0, 18.61 N, -72.62 W, hypocenter depth 12.0 kilometers), Fault Plane 1 (Strike, Dip, Rake): 250.0, 71.0, 22.0; Fault Plane 2 (Strike, Dip, Rake): 152.0, 69.0, 159.0. The fault plane solution implies composite strike-slip with a moderate reverse component on a steeply dipping fault.

The Haiti earthquake is the most recent event in this suite of five earthquakes analyzed. The epicentral location and the suite of IRIS stations analyzed are shown in Figure 2.5.2-262a. Note that the data from the DWPF was not available for this earthquake. For the SDV station, only one single horizontal component was available and thus was not included in the comparison which was based on the geometric mean of two horizontal component ground motions. The large distance and undesirable azimuthal direction away from southern Florida for this station from this earthquake provides an additional justification for not including this station in the comparison. The GMPE curves and empirical data are shown in Figures 2.5.2-262b and 2.5.2-262c for the 1 Hz and 2.5 Hz spectral frequencies. The data point from the OTAV station is highlighted as a solid blue circle. Overall, the empirical data falls in the lower range or lower than the Caribbean attenuation curves. In addition, the observation from the OTAV station is significantly lower than the entire range of the Caribbean GMPE curves. PTN RAI 02.05.02-2 LDP-CS564

The results of these comparisons demonstrated that the suite of Caribbean GMPE models used in the current PSHA predicts larger ground motions on average than the observed empirical data from these five earthquakes for the spectral frequencies of 1 Hz and 2.5 Hz, especially when considering the adjustment to a common CEUS hard rock site condition. In addition, for the subset of data from just those stations that have a more appropriate source to site travel paths in particular, this conclusion can be extended to state that the use of the Caribbean GMPE models should provide conservative (i.e., higher) ground motion predictions compared to the available empirical data from the region.

The second supplemental sensitivity determined the sensitivity of the GMRS at the Turkey Point Units 6 & 7 site to the GMPEs used for the Caribbean seismic sources, which include the Cuba areal source plus nine fault sources. Five sets of seismic hazard calculations for five different GMPE suites were used to develop the corresponding GMRS. The GMPEs used for Caribbean seismic sources are: those of the base case which is (1) the Caribbean GMPE models developed for Turkey Point Units 6 & 7 (Subsection 2.5.2.4.5.2), (2) EPRI mid-continent region (References 242 and 203) equations, (3) EPRI mid-continent region "mod1" (References 242 and 203) equations, (4) EPRI Gulf region (References 242 and 203) equations, and (5) EPRI Gulf region "mod 1" (References 242 and 203) equations. The modification of the EPRI GMPEs for both the mid-continent and Gulf Coast cases was to exclude the GMPE which predicts significantly higher ground motions for large distance, such as those from the contributing Cuba and Caribbean sources. All seismic hazard calculations were made for the hard rock site conditions and include the other non-Caribbean sources in the PSHA. Thus, the observed differences are based solely on the use of different GMPE models LDP-CS564

PTN RAI 02.05.02-2

for the Caribbean seismic sources. For each of the five cases, ground motion values were estimated from the mean hazard curves for the seven standard spectral frequencies. Site-specific horizontal GMRS are plotted in Figure 2.5.2-263 and are developed using the site amplification factors. In general, the GMRS results using the EPRI Gulf Coast GMPEs are equal to or lower than the results using the Caribbean GMPE (i.e., indicated as Base Case in Figure 2.5.2-263). For the EPRI Mid-Continent GMPE, the opposite result is concluded in which the GMRS values exceed the GMRS values using the Caribbean GMPE models. However, based on the previous additional sensitivity, the EPRI Mid-Continent models predict higher ground motions than the empirical ground motions and, as such, may not be applicable for the modeling of ground motion attenuation for seismic sources in this Caribbean region and the Turkey Point Units 6 & 7 site location in southern Florida. In addition, the tectonic structure and potential attenuation of ground motions for Caribbean sources might be more consistent with the EPRI Gulf Coast GMPE models based on the southern region of Florida being located in the Gulf Coast tectonic region of the eastern United States, especially for events that would occur in and around the island of Cuba and the Gulf of Mexico. For events occurring further south of the island of Cuba, the tectonic regime and subsequent seismic ray travel paths and associated attenuation may be more complex based on the more complex tectonic environment located south of the island of Cuba and may not be as consistent with the Gulf Coast GMPE. However, based on the results of the first sensitivity analysis, the empirical data indicates that the Caribbean GMPE is conservative in its estimation of ground motions and, based on the results shown in Figure 2.5.2-263, the use of the EPRI Gulf Coast GMPE for the PSHA gives similar or lower GMRS values.

These two supplemental sensitivity analyses indicate that the suite of GMPEs used to characterize contributions to hazard at the site from Caribbean earthquakes, and the resulting GMRS at the site from these earthquakes, are conservative.

Next, six ground motion attenuation experts were asked to review and comment on both the methodology and results of the Caribbean GMPE models. These six experts were:

- Dr. Norman Abrahamson (Consultant)
- Dr. Yousef Bozorgnia (University of California, Berkeley, PEER)
- Dr. Kenneth Campbell (EQECAT)
- Dr. Shahram Pezeshk (University of Memphis)

- Dr. Paul Somerville (URS Corporation) PTN RAI 02.05.02-2

- Dr. Robert Youngs (AMEC-Geomatrix)

In reviewing and summarizing the responses from the experts, it is concluded that the use of the Caribbean GMPE models in the PSHA is acceptable. As noted by the six experts, based on the comparison between the Caribbean GMPE model and the empirical IRIS data, these GMPE models may be conservative in their estimation of ground motions in the region. In addition, the assignment of an aleatory uncertainty value of 0.645 in natural log units was acceptable based on the consensus of the six experts.

When asked about the applicability of the EPRI Mid-Continent or Gulf Coast models, the consensus of the six experts was that the suite of Gulf Coast GMPE models are closer to the empirical data than the Mid-Continent suite. However, this did not indicate that the EPRI Gulf Coast models are preferable over the Caribbean GMPE models. Based on the polling and summary of the responses from the six experts, the ultimate use of the specific Caribbean GMPEs in the PSHA for the Turkey Point Units 6 & 7 site location for seismic sources in the Cuba and Caribbean region falls within the range of the informed technical community and actually may produce slightly larger ground motions than would be estimated from the center, body, and range of the informed technical community. The experts' opinions support the development of the final Caribbean GMPEs. There were no conflicting opinions among the experts regarding the suitability of the final Caribbean GMPEs for use in the PSHA analysis for Turkey Point Units 6 & 7. LDP-CS564

Mean GMPE plots are provided for the EPRI Mid-Continent (References 242 and 203) and Caribbean GMPEs in Figures 2.5.2-264 through 2.5.2-270 for the seven defined frequencies. Note that EPRI (Reference 203) is only a recommendation for the associated aleatory uncertainty and therefore does not impact the comparison plots of the weighted mean GMPE curve. The plotted mean GMPE curve is the weighted mean of the individual median GMPE curves as defined in EPRI 2004 (Reference 242) and for the Caribbean GMPE models. These GMPE plots are provided for three specific M_W values: 6, 7, and 8 for distances between 200 kilometers (124 miles) and 1000 kilometers (621 miles). Note that the EPRI 2004 GMPE model (Reference 242) is defined as a function of epicentral distance, whereas the Caribbean GMPE model is defined as a function of hypocentral distance. For these comparison plots, the GMPE curves are plotted as a function of epicentral distance and for the Caribbean GMPE curves an assumed hypocentral depth of 8 kilometers (5 miles) was used. LDP-CS564 LDP-CS564

2.5.2.4.6 Updated Probabilistic Seismic Hazard Analysis and Deaggregation for Rock

An updated PSHA for the Units 6 & 7 site was conducted using as inputs the following:

- EPRI team sources with extended regions in the Gulf of Mexico and Atlantic
- Supplemental sources between Florida Peninsula and Cuba
- Cuba areal source zone
- North America-Caribbean fault sources
- Updated Charleston source
- Updated ground motion attenuation models for the CEUS
- New ground motion attenuation models for the Cuba and Caribbean region

The site-specific PSHA was for hard rock site conditions consistent with the 2004 EPRI ground motion attenuation models (Reference 242).

A PSHA consists of calculating annual frequencies of exceeding various ground motion amplitudes at a site for all possible earthquakes that can occur within the parameters of the seismic hazard model for the site. The seismic sources model incorporates the rates of occurrence of earthquakes as a function of magnitude and location, and the regional ground motion model estimates the distribution of ground motions at the site for each earthquake.

Multiple weighted hypotheses on seismic sources characteristics, including rates of occurrence and magnitude distribution, and ground motions (characterized by the median ground motion amplitude and its uncertainty) result in multiple weighted seismic hazard curves. From this family of weighted curves, the mean and fractile seismic hazard can be determined. The calculation is made separately for each of the six EPRI teams, and the seismic hazard distribution for the teams is combined, weighting each team equally. This combination gives the overall mean and distribution of seismic hazard at the site.

{Figures 2.5.2-218 through 2.5.2-224 show mean and fractile (5th, 16th, median, 84th, and 95th) seismic hazard curves for hard rock from this calculation for the spectral frequencies of 100, 25, 10, 5, 2.5, 1, and 0.5 Hz, respectively. SOF 2.5.2-10
Table 2.5.2-223 documents the digital fractile and mean seismic hazard curves for

the seven spectral frequencies. Table 2.5.2-209 documents the UHRS values for this calculation. Figure 2.5.2-225 plots the mean and median UHRS for 1E-04, 1E-05, and 1E-06 annual frequencies of exceedance.}

As a sensitivity check, the potential contribution of the New Madrid seismic source to seismic hazard was examined for 1 Hz spectral acceleration. It was determined that the New Madrid seismic source's mean hazard was less than 0.1 percent of the mean hazard from other sources, so the New Madrid seismic source was not included in the overall hazard calculations.

Also, the potential contribution of small earthquakes (smaller than the characteristic earthquakes, that is up to m_b 6.8) in the Charleston seismic source was examined for 1 Hz spectral acceleration. It was determined that these earthquakes (which are modeled with an exponential magnitude distribution) contributed a mean hazard that was less than 0.1 percent of the mean hazard from other sources. As a result, the smaller magnitude earthquakes were not included in the overall hazard calculations.

The rock hazard was deaggregated to identify the magnitudes and distances appropriate to represent rock spectral shapes for site response calculations. This deaggregation procedure followed the guidelines of RG 1.208. Specifically, the mean contributions to seismic hazard for 1 Hz and 2.5 Hz spectral accelerations (low frequencies, or LF) were deaggregated by magnitude and distance for the mean 1E-04 ground motion amplitude at 1 Hz and at 2.5 Hz, and these deaggregations were combined (contributions for each magnitude and distance bin were averaged). {Figure 2.5.2-226 shows this combined deaggregation. SOF 2.5.2-11
Similar deaggregations of the mean hazard were performed for 5 and 10 Hz spectral accelerations (high frequencies, or HF), and the combined deaggregation is shown in Figure 2.5.2-227.}

Deaggregations of the HF and LF mean hazard for 1E-05 and 1E-06 ground motions are shown in Figures 2.5.2-228 through 2.5.2-231. Table 2.5.2-224 shows the percent contributions for various magnitude and distance bins for the six deaggregations, {and Table 2.5.2-225 summarizes the mean magnitudes and SOF 2.5.2-12
distances resulting from these deaggregations, for all contributions to hazard and for contributions with distances exceeding 100 kilometers}.

For the HF controlling earthquakes, the magnitudes and distances from all distances are used (the light grey shaded cells in Table 2.5.2-225). For the LF controlling earthquakes, the magnitudes and distances from distances greater than 100 kilometers are used (the dark grey shaded cells in Table 2.5.2-225),

because the contribution to hazard for distances greater than 100 kilometers is more than 5 percent of the total hazard. This follows the guidelines in RG 1.208. For Figures 2.5.2-226 through 2.5.2-231 and Tables 2.5.2-224 and 2.5.2-225, deaggregation results are given in terms of moment magnitude.

The deaggregation plots in Figures 2.5.2-226 through 2.5.2-231 indicate that local earthquakes are a contributor to seismic hazard at the site for high frequencies, but that distant sources also make an important contribution. Distant sources contribute because the seismicity rate of local earthquakes in the Florida Peninsula is very low. For LF, distant sources have the major contribution to seismic hazard, with the Cuba areal source zone, Caribbean faults, and Charleston source contributing most of the hazard.

Smooth rock UHRS were developed from the UHRS amplitudes in Table 2.5.2-209, using controlling earthquake M and R values shown in Table 2.5.2-225 and using the hard rock spectral shapes for CEUS earthquake ground motions recommended in NUREG/CR-6728 (Reference 308). Separate spectral shapes were developed for HF and LF. In creating these spectral shapes, the single-corner and double-corner source models recommended in NUREG/CR-6728 (Reference 308) were weighted equally.

In order to reflect accurately the UHRS values calculated by the PSHA as shown in Table 2.5.2-209, the HF spectral shape was anchored to the UHRS values from Table 2.5.2-209 at 100 Hz, 25 Hz, 10 Hz, and 5 Hz. In between these frequencies, the spectrum was interpolated using shapes anchored to the next higher and lower frequency and using weights on the two shapes equal to the inverse logarithmic difference between the intermediate frequency and the next higher or lower frequency. Below 5 Hz, the HF shape was extrapolated from 5 Hz. For the LF spectral shape a similar procedure was used except that the LF spectral shape was anchored to the UHRS values at all seven frequencies for which UHRS values are available from Table 2.5.2-209 (100 Hz, 25 Hz, 10 Hz, 5 Hz, 2.5 Hz, 1 Hz, and 0.5 Hz).

The reason that the LF spectral shape was anchored to all seven frequencies, including the HF, was that, if this anchoring were not done, the LF spectrum would exceed the HF spectrum at high frequencies, which would not be realistic. The UHRS at all frequencies accounts for all earthquakes, small and large, close and distant, and the UHRS amplitudes should not be exceeded by spectra representing the controlling earthquakes.

For frequencies below 0.5 Hz, the spectral shapes for both the HF and LF spectra were extrapolated from the value at 0.5 Hz assuming a constant spectral velocity (i.e., spectral accelerations were assumed to scale linearly with frequency) down to 0.125 Hz (8 seconds). From 0.125 Hz to 0.1 Hz, spectral accelerations were assumed to scale as $(frequency)^2$. This follows the recommendation of Building Seismic Safety Council (Reference 219) for long periods.

{Figures 2.5.2-232 through 2.5.2-234 show the horizontal HF and LF spectra calculated in this way for 1E-04, 1E-05, and 1E-06 annual frequencies of exceedance, respectively. As mentioned previously, these spectra were appropriately anchored to accurately reflect the rock UHRS amplitudes in Table 2.5.2-209 that were calculated for the seven spectral frequencies at which PSHA calculations were done.} SOF 2.5.2-12

2.5.2.4.7 Hazard Sensitivity Analyses Using the CEUS SSC Model PTN RAI 01.05-1

This subsection describes sensitivity analyses performed using the CEUS SSC seismic source model presented in NUREG-2115 (Reference 353) and presents comparisons of the CEUS hard rock hazards and UHRS computed using the CEUS SSC model with the results presented in Subsection 2.5.2.4.6.

2.5.2.4.7.1 Summary of CEUS SSC Model Sources

This section summarizes the CEUS SSC model. Details are provided in NUREG-2115 (Reference 353). The model for seismic sources in the CEUS consists of two types of seismic sources. The first type is seismic source zones used to model future distributed seismicity throughout the CEUS. As shown on Figures 2.5.2-280 and 2.5.2-281, two approaches are used to define the distributed seismicity sources. The seismotectonic approach (Figure 2.5.2-280) subdivides the CEUS into different source zones on the basis of differences in geology and tectonic history. The Mmax Zones approach (Figure 2.5.2-280) subdivides the CEUS into regions that are expected to have different values of the maximum magnitude that can occur. The second type of seismic source is used to model the recurrence of repeated large magnitude earthquakes (RLMEs) that have been identified from the historical and paleoseismic record. The RLME sources are additional sources of large magnitude earthquakes added to the hazard computed from the distributed seismicity sources—either the Mmax source zones or the Seismotectonic source zones. The location of the RLME sources is shown on Figure 2.5.2-282. The nearest RLME source to the Turkey Point Units 6 & 7 site is the Charleston RLME source.

2.5.2.4.7.2 Description of CEUS SSC Model Sensitivity Analysis

PTN RAI 01.05-1

Comparison of the areal extent of the CEUS SSC model shown on Figures 2.5.2-280 and 2.5.2-281 with the region encompassed by the updated EPRI-SOG seismic sources shown on Figures 2.5.2-204 through 2.5.2-209 indicates that the two source models cover the same region. In addition, Charleston RLME source in the CEUS SSC model, shown on Figure 2.5.2-282 occupies the same general location as the UCSS shown on Figure 2.5.2-212. Thus, the CEUS SSC model can be considered as a replacement for the updated EPRI-SOG model, including the UCSS source and the supplemental sources between Florida and Cuba in their entirety. As a consequence, an assessment of the effect of the CEUS SSC model on the total hazard for the site can be evaluated by subtracting from the total mean hazard presented in Subsection 2.5.2.4.6 and Table 2.5.2-223 the contributions of the updated EPRI-SOG sources and then adding the hazard contributed by the CEUS SSC model sources. Comparing the resulting values against the total hazard listed in Table 2.5.2-223 shows the sensitivity of the site rock hazard to use of the CEUS SSC model sources in place of the updated EPRI-SOG sources.

The CEUS SSC model was used to compute hard rock hazard at the Turkey Point site. The hazard was computed using the contributions from those portions of all of the CEUS SSC seismic source zones within 1000 kilometers (620 miles) of the site. In addition, the hazard from the Charleston RLME source (Figure 2.5.2-282) was included. Consistent with the calculations presented in Subsection 2.5.2.4, the hazard calculations for the seismic source zones and the Charleston RLME used the mid-continent versions of the EPRI (Reference 242) ground motion models. Similar to the analyses presented in Subsection 2.5.2.4, the contribution from the New Madrid RLME (Figure 2.5.2-282) was found to be negligible, and this source was not included in the hazard calculations. Also, as documented in Chapter 8 of NUREG-2115 (Reference 353), the other RLME sources in the vicinity of the New Madrid RLME were found to have negligible contribution to the hazard at the Chattanooga demonstration site, and thus would not contribute to the hazard at Turkey Point, which is much further way from these sources. Therefore, only the Charleston RLME source was included in the sensitivity calculations.

Calculations were performed for PGA and spectral accelerations at structural frequencies of 25, 10, 5, 2.5, 1, and 0.5 Hz using the CEUS SSC model sources. These results were used to develop total mean hazard for the site by adding the hazard from the Caribbean sources described in Subsection 2.5.2.4.6.

2.5.2.4.7.3 CEUS SSC Model Sensitivity Analysis Results

PTN RAI 01.05-1

Figures 2.5.2-283 and 2.5.2-284 compare the hazard results obtained using the CEUS SSC model with those presented in Subsection 2.5.2.4.6 using the updated EPRI-SOG model for 10 Hz and 1 Hz spectral accelerations, respectively. The solid curves show the total mean hazard for the combined updated EPRI-SOG plus Caribbean sources and the mean hazard from the three major source types: the EPRI-SOG distributed seismicity sources, the Charleston (UCSS) source, and the Caribbean sources. The dashed curves show the total hazard for the combined CEUS SSC plus Caribbean sources and the mean hazard from the CEUS SSC distributed seismicity sources and the Charleston RLME source (the hazard from the Caribbean sources is the same for the two analyses).

The results for 10 Hz (Figure 2.5.2-283) indicate that the total hazard computed using the CEUS SSC sources is lower than that computed using the updated EPRI-SOG sources in the important annual exceedance frequency range of 1E-04 to 1E-06. As shown on the figure, the hazard computed using the Charleston RLME source is essentially the same as that computed using the Charleston UCSS source. Thus, the difference in the hazard is due to differences in the characterization of the distributed seismicity sources in the CEUS. As the hazard in both models is computed using the same ground motion models, difference in hazard is due to a difference in the predicted frequency of earthquakes in the site region with the CEUS SSC model predicting a lower rate of earthquakes than the updated EPRI-SOG model.

The results for 1 Hz (Figure 2.5.2-284) indicate that the total hazard computed using the CEUS SSC sources is slightly higher than that computed using the updated EPRI-SOG sources in the important annual exceedance frequency range of 1E-04 to 1E-06. The increase in computed hazard is about 3 percent at 1E-04 and about 11 percent at 1E-06. Again, as shown on the figure, the hazard computed using the Charleston RLME source is essentially the same as that computed using the Charleston UCSS source and the difference in the hazard is due to differences in the characterization of the distributed seismicity sources in the CEUS. The larger hazard at low structural frequencies from the CEUS SSC distributed seismicity sources is attributed to the larger on average maximum magnitudes for these sources in the CEUS SSC model as compared to the values for the distributed seismicity sources in the updated EPRISOG model. The differences in hazard for 1 Hz spectral accelerations shown on Figure 2.5.2-284 are less than the suggested tolerances for hazard accuracy presented in Chapter 9 of NUREG-2115 (Reference 353).

The total mean hazard obtained by combining the hazard from the CEUS SSC model with that from the Caribbean sources was used to compute hard rock UHRS. Figure 2.5.2-285 compares these UHRS to those computed using the updated EPRI-SOG source model presented in Table 2.5.2-209. For structural frequencies of 2 Hz and higher, the UHRS based on the CEUS SSC sources are lower than those based on the updated EPRI-SOG source model. At lower structural frequencies, the UHRS based on the CEUS SSC source model are about 1 percent higher at 1E-04 mean annual exceedance frequency, about 2 to 2.5 percent higher at 1E-05 mean annual exceedance frequency, and 3 to 5 percent higher at 1E-06 mean annual exceedance frequency. These small differences at low structural frequencies are considered to be negligible because they are similar in magnitude to differences in computed ground motions that are obtained from implementation of the CEUS SSC model by two different software packages, as documented in hazard calculation for the seven NUREG-2115 (Reference 353) demonstration sites documented in Table 2.5.2-232 of Attachment C to the Progress Energy supplemental response for Levy Nuclear Units 1 and 2 to the RAI concerning the Fukushima Near-Term Task Force recommendations contained in SECY-12-0025 (Reference 354). PTN RAI 01.05-1

Thus, the conclusion of the sensitivity calculations is that ground motions for the site computed using the CEUS SSC seismic source model presented in NUREG-2115 (Reference 353) are similar to or enveloped by ground motions computed using the updated EPRI-SOG seismic source model presented in Subsection 2.5.2.4.6.

2.5.2.5 Seismic Wave Transmission Characteristics of the Site

The UHRS described in the previous subsection are defined on hard rock. Hard rock is characterized with minimum shear-wave velocity (V_S) = 9200 feet per second (fps), {which at the site is located at about 10,000 feet (3050 meters) below the ground surface}. This subsection describes the development of the site amplification factors that result from the transmission of the seismic waves through the thick site-specific geologic column above hard rock, referred to as "soil column" thereafter. {The effect of variability in material properties of the geologic column is modeled by randomizing over the range of properties and layer thicknesses extending from the finished ground surface (including structural fill) to randomized hard rock depths varying between 7400 feet (2256 meters) and 11,400 feet (3476 meters)}, and randomizing over the range of shear modulus reduction and damping within the column, as well as an adjustment to the soil column damping to represent the anelastic attenuation of ground motion by the entire column (the "kappa" value). SOF 2.5.2-13 SOF 2.5.2-14

The development of the site amplification factors is performed in the following steps:

1. Develop a model of the base case soil column, using site-specific geotechnical and geophysical data to a depth of about 636 feet (194 meters), and from 636 feet to a depth of about 12,000 feet (3658 meters) using deep velocity profiles taken from industry, as described in Subsection 2.5.2.5.1. The model for the upper 636 feet (194 meters) is based on mean shear-wave velocities measured at the site, except for the upper 30.5 feet (9.3 meters) of structural fill. Strain-dependent in situ shear modulus and damping are obtained from generic curves based on Resonant Column Torsional Shear (RCTS) of in situ samples (Subsection 2.5.4.7). The deeper layers are assumed to behave linearly. This model provides the base case representation for evaluation of the dynamic behavior of materials beneath the site to hard rock with V_S = 9200 fps under seismic loading.

2. Calculate strain-independent (linear-elastic) material damping values for the deep strata (between 636 feet and 9200 fps hard rock), which experience small levels of strain during the earthquake, to ensure that the base case model accurately accounts for the dissipation of energy in this depth interval. This is done by constraining the damping within these deeper strata to replicate the estimate of the kappa for the site.

3. Generate a set of 60 randomized profiles by using the base soil column, and develop a probabilistic model that includes the uncertainties in the above material properties, location of layer and hard rock boundaries, correlation between the velocities in adjacent layers, and the overall dissipation of energy in the site-specific column.

4. Use the 1E-04 and 1E-05 annual-frequency-of-exceedance smooth LF and HF hard rock spectra of Subsection 2.5.2.4 for input into the base of the randomized profiles, calculate dynamic response of the site for each of the 60 randomized profiles by using an equivalent-linear site-response formulation together with Random Vibration Theory (RVT), and calculate the mean site response. Time histories for the site response analysis are not required for the frequency-domain RVT approach to site response analysis. This step is repeated for each of the four input motions (1E-04 and 1E-05 annual frequencies, HF and LF smooth spectra). {Note that the GMRS horizon is defined at elevation -35 feet. To calculate the site SOF 2.5.2-15

response at GMRS horizon, two consecutive site response analyses are conducted. In the first analysis, the randomized profiles with full column height up to finished grade at elevation +25.5 feet are analyzed. In the second analysis, the strain-compatible properties of the columns, provided by the first analysis, are used without iteration, the layers above the GMRS horizon are omitted, and the amplification factors at elevation -35 feet (corresponding to zero depth in this case) are calculated.}

Details of the implementation of these steps are described in the following subsections. The resulting site-specific amplification factors are used with the hard rock spectra of Subsection 2.5.2.4 to develop the GMRS in Subsection 2.5.2.6.

2.5.2.5.1 Base Case Site-specific Column and Uncertainties

Development of a base case site-specific column is described in detail in Subsection 2.5.4. Summaries of the low strain shear-wave velocity, material damping, and strain-dependent properties of the base case strata are provided below in this subsection. These parameters serve as input for the generation of randomized profiles and for site response analyses.

The Units 6 & 7 site is a limestone and sand site covered with a 5-foot thick layer of muck (Subsection 2.5.4). The existing upper approximately 611 feet (186 meters) of the site-specific column were investigated using test borings, Cone Penetration Testing (CPT), test pits, and geophysical methods. {The soil layers and approximate thicknesses encountered at the boring and CPT locations consist of, in descending order: SOF 2.5.2-16

- Five feet of muck, consisting of peat and silt (during construction, structural fill is designed to replace the 5 feet of muck)
- Miami Limestone (25 feet)
- Key Largo Limestone (20 feet)
- Fort Thompson Formation (70 feet)
- Tamiami Formation (100 feet)
- Upper Hawthorn sand (230 feet)

- Lower Hawthorn Group consisting of limestone, mudstone, dolomite, dolosilt, shells, quartz sand, clay, and mixtures of these materials.}

The GMRS, at elevation -35 feet, is located near the top of the Key Largo Limestone, below the Miami Limestone. The Primary-Secondary (P-S) suspension measurements and CPT results provided shear and compression wave velocities of the soil and rock at 1.6 feet (0.5 meters) intervals. These data were used to develop a mean shear-wave profile for the upper 611 feet (186 meters) of in situ materials. Note that the estimated mean shear-wave velocity values of 650 fps at the ground surface to 1100 fps at a depth of 30.5 feet were assigned to the structural fill layer (uppermost 30.5 feet, 9.3 meters) (Subsection 2.5.4).

In order to capture the uncertainty in this estimate, a coefficient of variation of 1.5 applied to the shear modulus was used to provide upper and lower bounds. These values are based on an assumed unit weight of 130 pounds per cubic foot (pcf) and a normalized Standard Penetration Test (SPT) resistance of N_1 = 30 for the fill. Unit weights for the upper 636 feet (194 meters) soil and rock, i.e., including fill, are in the range of 120 pcf to 130 pcf.

Information used for defining the site-specific geologic column for depths exceeding 636 feet (194 meters) below top of fill was obtained from available industry resources (Subsection 2.5.4). A total of eight deep sonic logs of compression wave velocity were located within about a 115-mile radius of the Units 6 & 7 site: six were obtained in digitized format at 0.5 feet (0.15 meters) intervals, and two were digitized manually at 10 feet (3 meters) intervals. The compression wave velocities were converted to shear-wave velocities using values of Poisson ratios based on near surface measurements taken at the site and values published by the U.S. Army Corps of Engineers (Subsection 2.5.4). In this manner, shear-wave velocity data at varying depths ranging from 500 feet to 11,920 feet were determined. Unit weights of the deep strata (below approximately 636 feet [194 meters]) were assumed to be 130 pcf (Subsection 2.5.4).

As part of the construction of the Class V exploratory well EW-1 at the Turkey Point Units 6 & 7 site, additional sonic log data was collected after the conclusion of the site response analysis (Subsection 2.5.4.2.1.2.10). This data provides additional shear-wave velocities for depths between 1100 feet and 3200 feet. An evaluation was conducted with the aim of assessing the impact of the new shear-wave velocity information on the site amplification. The evaluation concludes that the newly acquired data does not change the site amplification results LDP-CS535

documented in this section and that the site response analysis results are not affected. LDP-CS535

As described in Subsection 2.5.4.7, RCTS testing was conducted on seven samples obtained from the Tamiami Formation sands. These results were matched to the closest fitting generic EPRI material shear modulus and damping degradation curves for sandy soils (Reference 244). The remaining materials consist of hard limestones, which are treated as elastic materials with 1 percent damping. Analyses for the development of site-specific amplification factors were therefore conducted using measured shear wave velocity profiles combined with shear modulus and damping degradation curves for the sands and elastic properties for the limestone.

Generic EPRI curves (Reference 244) were adopted to describe the strain dependencies of shear modulus and damping for the sands occurring between depths of about 120 feet (37 meters) and 450 feet (137 meters). Materials above the GMRS elevation, forming the 30.5-foot (9.3-meter) thick fill layer, are to be derived from crushed limestone during construction. EPRI shear modulus and damping degradation curves for gravel (Reference 317) are used to model the fill layers, as shown in Subsection 2.5.4.7.

Damping values were developed for the linear deep layers to maintain the total kappa (κ) for the site-specific geologic column as described below. Low-strain kappa value, a near surface damping parameter for modeling site-dependent effects, is used as a measure of the total dissipation of energy in the soil column during the small strain events. The site-specific kappa value accounts for damping of the layers and scattering of the waves at layer interface boundaries. The kappa representing soil layer damping is additive for all layers. The following expression shows the relationship between kappa (κ_i) and the damping coefficient, (ζ_i) of the layer (i):

$$\kappa_i = \frac{2H_i\xi_i}{V_{Si}} \qquad \text{Equation 2.5.2-11}$$

where, H_i is the thickness and V_{Si} is the shear-wave velocity of the layer (i).

Total kappa value of the site associated with material damping equals the sum of the κ_i values of all layers included in the model:

$$\kappa = \sum_i \kappa_i$$ Equation 2.5.2-12

Total kappa is directly evaluated from recordings of earthquakes (Reference 209), of which there are too few in the site vicinity to obtain an explicit site-specific estimate of kappa. Therefore, when total kappa is not available from near or applicable earthquake recordings, an alternative is to estimate total kappa directly using the correlation with average rock shear-wave velocity, V_S, from Reference 241:

$$\log(\kappa) = 2.2189 - 1.0930 \times \log(V_S[ft/\sec])$$ Equation 2.5.2-13

Based on review of EPRI, (Reference 241), the average shear-wave velocity to use with Equation 2.5.2-13 appears to be representative of the uppermost approximate 100 feet of rock. The average velocity of the Key Largo Limestone and Fort Thompson Formation (which totals about 86 feet thick) is used for this analysis. {The average shear-wave velocity of the 86 feet of Key Largo Limestone and Fort Thompson Formation was calculated to be 4239 fps, which, using Equation 2.5.2-13, corresponds to a total kappa of 0.018 second.} By inspection of {Figure 2.5.2-235}, the shear-wave velocities determined in the upper 1000 feet of rock vary between about 4000 fps and 5000 fps, which correspond to total kappa values of 0.019 second and 0.015 second, respectively. Therefore, a total kappa value of 0.018 second is used for the soil/rock column with a standard deviation of 0.4 natural log units. SOF 2.5.2-17 SOF 2.5.2-14

{A kappa value of 0.006 second applies to the CEUS hard rock (Reference 244), leaving a total kappa value of 0.012 second for the damping of the full depth of the soil column. SOF 2.5.2-17

EPRI, 1993 (Reference 244) recommends a standard deviation of 0.4 natural log units to be appropriate for total kappa values of sites within the eastern U.S. This is consistent with EPRI, 2005 (Reference 241) in considering 50 percent variation about the base case value of kappa for Mississippi Embayment sites.

Therefore, a base case kappa value of 0.012 second is used for the Units 6 & 7 site-specific geologic column with a standard deviation of 0.4 natural log units.}

The following procedure is used to assign the damping to the models of the materials at depths below 636 feet (194 meters) in order to match the assigned kappa value:

1. From Equations 2.5.2-11 and 2.5.2-12, kappa associated with material damping is calculated for the top approximately 600 feet (183 meters) of strata, i.e., excluding top fill, by using small strain damping for each layer.

2. The kappa value of the top approximately 600 feet (183 meters) of soil/ rock is deducted from the total kappa value, and a constant damping value is assigned to deep layers. The process of the randomization of velocity profiles introduces additional scattering of upward propagating shear waves (S-waves) in such a manner that the median response of all randomized profiles is lower than the response obtained from the analyses of the median profile. These scattering effects are accounted for by decreasing the damping value of the deep layers in the randomized profiles, and therefore reduce total kappa for the site. In this case, however, because damping in the deep layers was very small (median of 0.3 percent), no reduction was applied.

3. The damping of each deep layer is randomized with consideration given to the mean and variation of the total kappa.

The input motion for site amplification analysis was specified at the bottom of the site-specific geologic column, below which {the halfspace was modeled with shear-wave velocity of 9200 fps and a damping ratio of 1 percent, hard rock}. SOF 2.5.2-14

As described in Subsection 2.5.2.5.2, the properties for each layer in the column were randomized to account for the inherent natural variability, as well as the (epistemic) uncertainty associated with the choice of curves to capture the variation of shear modulus and damping with strain level. Therefore, the actual site response analysis comprised a range of properties for each layer, and in particular, a range of initial small strain shear modulus and degradation curves. Because of different properties in each of the randomized profiles, the site response analysis generated a range of results, as reported in Subsection 2.5.2.5.3.

2.5.2.5.2 Capturing Site-Specific Geologic Column Properties, Uncertainties, and Correlations

To account for variations in shear-wave velocity across the site, 60 randomized profiles were generated using the stochastic model discussed in Reference 319, with some modifications to account for the site-specific conditions at the Units 6 & 7 site. These randomized profiles represent the truncated column from the top of

hard rock with shear-wave velocity of 9200 fps to the ground surface. This model uses as inputs the following quantities:

1. A shear-wave velocity profile, which is equal to the base-case profile described above.

2. The standard deviation of ln(V_S) (the natural logarithm of the shear-wave velocity) as a function of depth.

3. {The correlation coefficient between ln(V_S) in adjacent layers, which is taken from generic studies using the inter-layer correlation model for category USGS "A" soils (Reference 319), with modifications to some of the parameters to increase the correlation in order to reduce the number of V_S reversals. SOF 2.5.2-14

4. The probabilistic characterization of layer thickness is accomplished using a function that describes the rate of layer boundaries as a function of depth. This study used a form of this function, taken from Reference 319, but modified to allow for sharp changes and discontinuities in the adopted base-case velocity profile, especially near the surface.

5. The profiles of the median and plus/minus one standard deviation of the shear-wave velocity profile are shown in Figure 2.5.2-236. The variation was used in the randomization of the shear-wave velocity profile.

6. For each randomized profile, hard rock is defined to occur at the depth where the randomization algorithm calculates a V_S that exceeds 9200 fps (excluding depths shallower than 7000 feet).

7. Median value of shear stiffness (G/GMAX) and damping for each geologic unit are described in Subsection 2.5.4. Uncertainties in the strain-dependent properties for each unit are characterized using the values in Reference 320. Figures 2.5.2-237 and 2.5.2-238 illustrate the shear stiffness and damping curves generated for natural materials found at less than 150 foot depth, described in Subsection 2.5.4.

Figure 2.5.2-239 illustrates the 60 V_S random profiles generated, using the median, logarithmic standard deviation, and correlation model described above.} The same figure compares the median of these 60 V_S profiles (randomized median) to the input median V_S profile described in the previous subsection, indicating good agreement. At depths greater than 7000 feet, the randomized

median appears lower than the input median because, when a random V_S profile exceeds 9200 fps, the profile is truncated at that depth. The randomized median curve in Figure 2.5.2-239 does not include these truncated profiles but shows the median of only the remaining profiles (with V_S < 9200 fps) at each depth. Therefore, the median of these filtered profiles (with V_S < 9200 fps) is lower than the overall median at deep locations in the profile.

This set of 60 random profiles, consisting of V_S versus depth, depth to hard rock, stiffness, and damping, are used to calculate and quantify site response and its uncertainty, as described in the following subsections.

2.5.2.5.3 Site Response Analysis

The site response analysis performed for the Units 6 & 7 site is conducted using the program P-SHAKE, which uses a procedure based on RVT (References 232 and 306) with the following assumptions:

- Vertically propagating shear waves are the dominant contributor to site response.
- An equivalent-linear formulation of nonlinearity is appropriate for the characterization of site response.

These are the same assumptions that are implemented in the SHAKE program (Reference 263). With respect to RVT implementation, the major steps used in P-SHAKE are as follows:

1. The input motion is provided in terms of an acceleration response spectrum (ARS) and associated spectral damping instead of spectrum-compatible acceleration time histories. The input ARS is converted to an acceleration power spectral density (PSD) using the RVT based procedure with the peak factor function.
2. From the frequency domain computation (following SHAKE approach), the transfer function for shear strain in each layer of the profile is obtained and convolved with the PSD of input motion to get the PSD and the maximum strain in each layer. The effective strain is obtained from the maximum strain and is used to obtain new properties (shear modulus and damping) for the next iteration.
3. The iterations are repeated until convergence limit set by the analyst is reached in all layers.

4. Once the final frequency domain solution is obtained, the ARS at each layer interface can be computed from the solution using an inverse process of obtaining PSD from the ARS.

The site-response analysis procedure, as described above, requires the following additional parameters:

- Strong-motion duration. The RVT methodology requires this parameter, but results are not very sensitive to it. These are calculated from the mean magnitudes from the deaggregation. Table 2.3.1 in ASCE 4-98 (Reference 206) provides strong motion duration values as a function of magnitude. {Accordingly, strong motion durations were assigned for each of the cases considered (1E-04 and 1E-05 annual frequencies, HF and LF smooth spectra) and are presented in Table 2.5.2-226}. SOF 2.5.2-15

- Effective strain ratio. A value of 0.65 is used. Effective strain ratio is defined as the ratio between the peak acceleration of earthquake time history and the equivalent harmonic wave going through the layers (Reference 316).

As discussed earlier, the GMRS horizon is defined at elevation -35 feet. To calculate the site response at the GMRS horizon, two consecutive site response analyses are conducted. In the first analysis, the full soil column height up to finished grade at elevation +25.5 feet is analyzed. In the second analysis, the strain-compatible properties of the column, provided by the first analysis, are used without iteration after omitting the layers above the GMRS horizon, and the amplification factors at elevation -35 feet (corresponding to zero depth in this case) are calculated.

{Figure 2.5.2-240 shows as a thick red line the logarithmic mean (median) of site amplification factors at the GMRS horizon from the analysis of the 60 random profiles with the 1E-04 LF input motion. Amplifications are largest at low frequencies (below 6.0 Hz) and de-amplification occurs at high frequencies because of damping. The maximum strains in the column are low for this motion. This is shown in Figure 2.5.2-241, which plots the maximum strains versus depth that are calculated for the 60 profiles and their logarithmic mean (as a red thick line). SOF 2.5.2-15

The median of maximum strains does not exceed 0.020 percent. The maximum strain calculated from the analyses of all 60 profiles is 0.070 percent in the structural fill layers. The maximum strains in the deep strata at depths below 636 feet (194 meters) are very small and do not exceed a value of 0.005 percent.

Figures 2.5.2-242 and 2.5.2-243 show similar plots of amplification factors and maximum strains obtained from the analyses with 1E-04 HF motion. The maximum strain results show that the site-specific column exhibits a lower level of straining under this motion with maximum strains being less than 0.04 percent.

Figures 2.5.2-244 through 2.5.2-247 show comparable plots of amplification factors and maximum strains from the analyses performed with the 1E-05 input motion, both LF and HF. For this higher motion, larger maximum strains are observed, but the maximum median does not exceed 0.045 percent. From all of 1E-05 analyses, a maximum strain of 0.23 percent is calculated at the top structural fill layers. The maximum strain in the deep layers, below 636 feet (194 meters), is very small, less than 0.01 percent.

Comparison of the profiles of median maximum strains for the full site-specific column and the upper 800 feet in Figure 2.5.2-248 clearly shows that strains under the LF motions are larger than under HF motions. Figure 2.5.2-249 shows the median profiles for the strain-compatible damping resulting from the four input rock motions as well as the low-strain damping, for the full site-specific geologic column and the upper 800 feet.

Damping is a measure of energy dissipation in the profile during the shaking. Corresponding to the strains, a maximum damping value of 5 percent for depths above 636 feet (194 meters) are calculated for the analyses with the 1E-05 LF motion. The strain compatible damping calculated for 1E-04 LF motion is small and does not exceed 3 percent.

A comparison of the envelopes of median site amplification factors at GMRS horizon for LF and HF 1E-04 and 1E-05 input motions is shown in Figure 2.5.2-250. The amplifications at 1E-04 level of input motion are larger due to LF input motion than the ones due to HF input motion. De-amplification occurs at higher frequencies and is smaller for the LF input motion, followed by amplification of the peak ground acceleration starting at about 80 Hz and reaching about 1.3 at 100 Hz. The amplification due to 1E-05 level of input motion is smaller than for the 1E-04 level of input motion at frequencies larger than 3 Hz, due to the higher strain levels and nonlinearity in the column. At these higher frequencies, amplification factors for the LF and HF 1E-05 motions are very close.}

{The corresponding numerical values of the site amplification factors are tabulated in Tables 2.5.2-210 and 2.5.2-227. These tables show values for just 38 frequencies, but site amplification factors and site spectra were calculated for 301 frequencies between 0.1 and 100 Hz.} SOF 2.5.2-18

2.5.2.6 Performance-based Ground Motion Response Spectra

PTN COL 2.5-2
PTN COL 2.5-3

This subsection presents the development of performance-based ground motion response spectra (GMRS) for the Units 6 & 7 site. The site-specific horizontal GMRS are developed for the site following the guidelines described in RG 1.208, and then the vertical GMRS are constructed from the horizontal spectra using V/H response spectral ratios appropriate for the site.

2.5.2.6.1 Horizontal Spectra

With the site-specific amplification calculations described in the previous subsection, the site GMRS were determined as follows.

{Figure 2.5.2-251 shows the 1E-04 and 1E-05 horizontal HF and LF spectra, obtained at -35 feet plotted on a linear spectral acceleration scale. These HF and LF 1E-04 and 1E-05 horizontal spectra were enveloped and smoothed to remove small frequency-to-frequency variations, using smoothing function that averaged over spectral accelerations at adjacent frequencies. Figure 2.5.2-252 shows the smoothed, enveloped spectra calculated in this way plotted on a linear spectral acceleration scale. SOF 2.5.2-18

The horizontal GMRS was calculated at each frequency using the following equations:

$$A_R = SA(10^{-5})/SA(10^{-4}) \quad \text{Equation 2.5.2-14}$$

$$DF = 0.6 \times A_R^{0.8} \quad \text{Equation 2.5.2-15}$$

$$GMRS = \mathit{max}[SA(10^{-4}) \times \mathit{max}(1.0, DF), 0.45 \times SA(10^{-5})] \quad \text{Equation 2.5.2-16}$$

where, $SA(10^{-4})$ is the spectral acceleration for the 1E-04 envelope spectrum at each spectral frequency (and similarly for 1E-05), and GMRS is the Ground Motion Response Spectrum at that spectral frequency. These equations follow the procedure in RG 1.208 to determine the GMRS from the 1E-04 and 1E-05 spectra.

Figure 2.5.2-253 shows the GMRS calculated with the above equations at each spectral frequency, and shows the 1E-04 and 1E-05 horizontal spectra, plotted on a logarithmic spectral acceleration scale. At low spectral frequencies (2 Hz and below), the hazard curves are steep, so A_R in Equation 2.5.2-14 above is low, and the GMRS from Equation 2.5.2-16 is equal to the 1E-04 UHRS.

Tables 2.5.2-210 and 2.5.2-227 document the 1E-04 and 1E-05 spectra, respectively, including the hard rock spectra, site amplification factors, and site spectra.

The method described above corresponds to Approach 2A in Reference 308. Thus hazard curves were not generated for the GMRS elevation; only the 1E-04, 1E-05, and 1E-06 site spectra were generated at the GMRS elevation. Table 2.5.2-228 documents the 1E-04 and 1E-05 spectral amplitudes, the calculation of A_R and DF from Equations 2.5.2-14 and 2.5.2-15, and the GMRS calculated according to Equation 2.5.2-16. Table 2.5.2-229 documents the 1E-04, 1E-05, and 1E-06 site spectra, with smoothing for the 1E-06 spectrum conducted with the same function as described above for the 1E-04 and 1E-05 spectra.}

2.5.2.6.2 Vertical Spectra

{To calculate vertical spectra, V/H ratios from RG 1.60 were adopted. The V/H ratios were applied to the 1E-04 and 1E-05 horizontal spectra to calculate 1E-04 and 1E-05 vertical spectra, and Equations 2.5.2-14 through 2.5.2-16 were applied to the 1E-04 and 1E-05 vertical spectral accelerations to calculate a vertical GMRS. The resulting vertical 1E-04 and 1E-05 spectra and GMRS are plotted in Figure 2.5.2-254. SOF 2.5.2-18

Table 2.5.2-230 documents the V/H ratios, the 1E-04 and 1E-05 vertical spectra, values of A_R and DF from Equations 2.5.2-14 and 2.5.2-15, and the calculated vertical GMRS from Equation 2.5.2-16.}

2.5.2.7 References

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PTN COL 2.5-2

**Table 2.5.2-201 (Sheet 1 of 25)
Earthquake Catalog for the Phase 1 Investigation Region [22°N to 35°N, 100°W to 65°W] for which the Events are Rmb Magnitude Greater than or Equal to 3.0 or Intensity [Int] Greater than or Equal to IV(4)**

Catalog Reference[a]	Year	Month	Day	Hour	Min	Sec	Lat	Lon	Depth (km)	Int	Emb	Smb	Rmb	Epicenter (km)[b]
SEUSN	1698	3	5	0	0	00.00	32.900	–80.000	0	3	2.70	0.56	3.06	828
SEUSN	1699	12	25	19	0	00.00	34.900	–90.300	0	4	3.10	0.56	3.46	1421
SEUSN	1754	5	19	16	0	00.00	32.900	–80.000	0	3	2.70	0.56	3.06	828
SEUSN	1755	11	0	0	0	00.00	33.400	–79.300	0	3	2.70	0.56	3.06	888
SEUSN	1757	2	7	0	0	00.00	32.900	–80.000	0	3	2.70	0.56	3.06	828
CUBA	1762	11	13	0	0	00.00	22.980	–82.370	10	—	3.97	0.56	4.33	339
CUBA	1777	7	7	9	29	00.00	22.830	–82.030	10	—	4.41	0.56	4.77	333
EPRIm	1780	2	6	0	0	00.00	30.400	–87.200	0	6	4.30	0.55	4.65	869
EPRIm	1799	4	4	0	0	00.00	32.900	–80.000	0	5	3.70	0.56	4.06	828
CUBA	1810	0	0	0	0	00.00	23.130	–82.400	10	—	3.97	0.56	4.33	328
CUBA	1812	0	0	0	0	00.00	23.050	–81.580	10	—	3.97	0.56	4.33	290
EPRIm	1820	9	3	8	30	00.00	33.400	–79.300	0	4	3.11	0.56	3.47	888
CUBA	1824	0	0	0	0	00.00	22.810	–80.080	10	—	3.97	0.56	4.33	289
SEUSN	1843	2	7	15	0	00.00	32.900	–80.000	0	3	2.70	0.56	3.06	828
CUBA	1843	2	21	0	0	00.00	23.130	–82.400	10	—	4.41	0.56	4.77	328
CUBA	1843	3	5	0	0	00.00	23.050	–81.580	10	—	3.53	0.56	3.89	290
SEUSN	1843	4	11	0	0	00.00	34.200	–80.600	0	3	2.70	0.56	3.06	972
CUBA	1846	10	10	0	0	00.00	23.000	–82.080	10	—	3.75	0.56	4.11	320
FD02	1847	2	14	2	0	00.00	29.600	–98.000	0	5	3.60	0.56	3.96	>1609
CUBA	1849	0	0	0	0	00.00	22.710	–83.060	15	—	4.12	0.56	4.48	407
CUBA	1849	8	30	0	0	00.00	22.150	–80.450	10	—	3.97	0.56	4.33	361
CUBA	1852	0	0	0	0	00.00	23.050	–81.580	10	—	4.41	0.56	4.77	290
CUBA	1852	7	7	14	59	00.00	22.420	–79.970	10	—	3.97	0.56	4.33	333
EPRIm	1853	5	20	0	0	00.00	34.000	–81.200	0	6	4.30	0.55	4.65	953
CUBA	1854	9	9	0	0	00.00	23.050	–81.580	10	—	4.41	0.56	4.77	290
CUBA	1857	7	7	0	0	00.00	22.810	–80.080	10	—	3.75	0.56	4.11	289
EPRIm	1857	12	19	14	4	00.00	32.900	–80.000	0	5	3.70	0.56	4.06	828

PTN COL 2.5-2

Table 2.5.2-201 (Sheet 2 of 25)
Earthquake Catalog for the Phase 1 Investigation Region [22°N to 35°N, 100°W to 65°W] for which the Events are Rmb Magnitude Greater than or Equal to 3.0 or Intensity [Int] Greater than or Equal to IV(4)

Catalog Reference[a]	Year	Month	Day	Hour	Min	Sec	Lat	Lon	Depth (km)	Int	Emb	Smb	Rmb	Epicenter (km)[b]
CUBA	1858	3	7	12	29	00.00	22.480	–79.550	10	—	4.26	0.56	4.62	334
CUBA	1858	8	14	6	29	00.00	22.480	–79.550	10	—	4.26	0.56	4.62	334
CUBA	1859	8	15	2	59	00.00	22.480	–79.550	10	—	3.97	0.56	4.33	334
CUBA	1859	10	4	0	0	00.00	23.130	–82.400	10	—	3.97	0.56	4.33	328
EPRIm	1860	1	19	23	0	00.00	32.900	–80.000	0	5	3.70	0.56	4.06	828
SEUSN	1860	10	0	0	0	00.00	32.900	–80.000	0	3	2.70	0.56	3.06	828
SEUSN	1860	10	22	0	0	00.00	34.200	–82.400	0	3	2.70	0.56	3.06	992
SEUSN	1860	12	19	0	0	00.00	32.900	–80.000	0	3	2.70	0.56	3.06	828
CUBA	1861	5	27	13	59	00.00	22.810	–80.080	10	—	3.75	0.56	4.11	289
CUBA	1861	6	27	0	0	00.00	22.810	–80.080	10	—	4.48	0.56	4.84	289
CUBA	1862	0	0	0	0	00.00	23.130	–82.400	10	—	3.53	0.56	3.89	328
CUBA	1862	8	0	0	0	00.00	23.130	–82.400	10	—	3.53	0.56	3.89	328
CUBA	1868	3	25	0	0	00.00	23.130	–82.400	10	—	4.41	0.56	4.77	328
CUBA	1868	5	1	0	0	00.00	22.360	–79.580	10	—	3.97	0.56	4.33	346
EPRIm	1869	0	0	0	0	00.00	32.900	–80.000	0	4	3.11	0.56	3.47	828
EPRIm	1871	4	16	5	0	00.00	34.300	–78.000	0	5	3.70	0.56	4.06	1008
CUBA	1872	0	0	0	0	00.00	22.910	–81.860	10	—	3.53	0.56	3.89	317
CUBA	1872	0	0	0	0	00.00	22.710	–83.060	15	—	3.68	0.56	4.04	407
CUBA	1872	6	0	0	0	00.00	22.510	–79.470	10	—	4.77	0.56	5.13	333
EPRIm	1872	6	17	20	0	00.00	33.100	–83.300	0	5	3.70	0.56	4.06	896
EPRIm	1873	5	1	4	30	00.00	30.200	–97.700	0	4	2.81	0.56	3.17	>1609
CUBA	1873	8	12	3	29	00.00	22.480	–79.550	10	—	4.99	0.56	5.35	334
SEUSN	1875	7	28	23	5	00.00	33.100	–83.300	0	3	2.70	0.56	3.06	896
EPRIm	1875	11	2	2	55	00.00	33.800	–82.500	0	6	4.30	0.55	4.65	950
SEUSN	1876	10	0	0	0	00.00	32.900	–80.000	0	3	2.70	0.56	3.06	828
EPRIm	1876	12	12	0	0	00.00	32.900	–80.000	0	4	3.11	0.56	3.47	828
EPRIm	1879	1	13	4	45	00.00	29.500	–82.000	0	6	4.30	0.55	4.65	479
CUBA	1879	9	21	0	0	00.00	22.710	–83.060	15	—	4.12	0.56	4.48	407
SEUSN	1879	10	27	1	0	00.00	34.400	–81.100	0	3	2.70	0.56	3.06	997

PTN COL 2.5-2

Table 2.5.2-201 (Sheet 3 of 25)
Earthquake Catalog for the Phase 1 Investigation Region [22°N to 35°N, 100°W to 65°W] for which the Events are Rmb Magnitude Greater than or Equal to 3.0 or Intensity [Int] Greater than or Equal to IV(4)

Catalog Reference[a]	Year	Month	Day	Hour	Min	Sec	Lat	Lon	Depth (km)	Int	Emb	Smb	Rmb	Epicenter (km)[b]
CUBA	1880	1	23	4	39	00.00	22.700	–83.000	15	—	6.09	0.56	6.45	404
CUBA	1880	6	12	1	29	00.00	22.420	–79.630	10	—	3.97	0.56	4.33	339
EPRIm	1882	1	8	22	10	00.00	34.600	–76.500	0	4	3.11	0.56	3.47	1081
EPRIm	1882	10	22	22	15	00.00	33.600	–95.600	0	8	5.39	0.28	5.48	>1609
EPRIm	1884	1	18	13	0	00.00	34.300	–78.000	0	5	3.70	0.56	4.06	1008
SEUSN	1884	3	31	10	0	00.00	33.100	–83.300	0	3	2.70	0.56	3.06	896
EPRIm	1885	10	17	22	30	00.00	33.000	–83.000	0	4	3.11	0.56	3.47	877
CUBA	1886	0	0	0	0	00.00	22.810	–80.080	10	—	3.97	0.56	4.33	289
EPRIm	1886	2	5	1	0	00.00	32.800	–88.000	0	5	3.70	0.56	4.06	1104
CUBA	1886	8	31	22	20	00.00	22.940	–80.010	15	—	4.48	0.56	4.84	276
EPRIm	1886	9	1	0	0	00.00	30.400	–81.700	0	4	3.11	0.56	3.47	565
EPRIm	1886	9	1	2	51	00.00	32.900	–80.000	0	X[c]	6.75	0.20	6.80	828
CUBA	1886	9	3	0	0	00.00	22.940	–80.010	15	—	4.19	0.56	4.55	276
CUBA	1887	0	0	0	0	00.00	22.900	–83.330	20	—	4.77	0.56	5.13	411
SEUSN	1887	1	5	17	57	00.00	30.150	–97.060	0	5	3.60	0.56	3.96	>1609
SEUSN	1887	1	31	22	14	00.00	30.530	–96.300	0	4	3.10	0.56	3.46	>1609
CUBA	1889	4	12	2	19	00.00	22.810	–80.080	10	—	3.97	0.56	4.33	289
EPRIm	1891	1	8	6	0	00.00	31.700	–95.200	0	7	3.70	0.30	3.80	1606
EPRIm	1891	10	13	5	55	00.00	32.900	–80.000	0	4	3.11	0.56	3.47	828
EPRIm	1893	6	21	7	7	00.00	30.400	–81.700	0	4	3.11	0.56	3.47	565
EPRIm	1893	7	5	8	10	00.00	32.900	–80.000	0	4	3.11	0.56	3.47	828
CUBA	1894	7	29	0	0	00.00	22.020	–75.840	15	—	4.19	0.56	4.55	590
EPRIm	1895	10	6	6	25	00.00	32.900	–80.000	0	4	3.11	0.56	3.47	828
CUBA	1896	0	0	0	0	00.00	22.750	–83.560	20	—	4.77	0.56	5.13	440
CUBA	1896	4	25	0	0	00.00	22.510	–79.470	10	—	4.55	0.56	4.92	333
SEUSN	1897	5	9	0	0	00.00	33.900	–81.600	0	3	2.70	0.56	3.06	946
EPRIm	1898	1	27	1	35	00.00	34.600	–90.600	0	4	3.11	0.56	3.47	1417
EPRIm	1899	3	10	5	45	00.00	32.900	–80.000	0	4	3.11	0.56	3.47	828
CUBA	1899	9	16	0	0	00.00	22.710	–83.060	15	—	4.12	0.56	4.48	407

PTN COL 2.5-2

Table 2.5.2-201 (Sheet 4 of 25) Earthquake Catalog for the Phase 1 Investigation Region [22°N to 35°N, 100°W to 65°W] for which the Events are Rmb Magnitude Greater than or Equal to 3.0 or Intensity [Int] Greater than or Equal to IV(4)

Catalog Reference[a]	Year	Month	Day	Hour	Min	Sec	Lat	Lon	Depth (km)	Int	Emb	Smb	Rmb	Epicenter (km)[b]
SEUSN	1899	11	4	0	0	00.00	34.300	–82.800	0	3	2.70	0.56	3.06	1011
EPRIm	1899	12	4	12	48	00.00	32.900	–80.000	0	4	3.11	0.56	3.47	828
SEUSN	1899	12	19	0	0	00.00	34.300	–81.400	0	3	2.70	0.56	3.06	988
EPRIm	1900	10	31	16	15	00.00	30.400	–81.700	0	5	3.70	0.56	4.06	565
EPRIm	1901	12	2	0	26	00.00	32.900	–80.000	0	4	3.11	0.56	3.47	828
SEUSN	1902	6	10	0	0	00.00	34.200	–81.700	0	3	2.70	0.56	3.06	981
FD02	1902	10	9	19	0	00.00	30.100	–97.600	0	5	3.90	0.56	4.26	>1609
CUBA	1903	0	0	0	0	00.00	22.680	–81.110	18	—	4.70	0.56	5.06	312
EPRIm	1903	1	24	1	0	00.00	32.900	–80.000	0	4	3.11	0.56	3.47	828
SEUSN	1903	1	24	1	15	00.00	32.100	–81.100	0	6	4.10	0.56	4.46	742
CUBA	1905	0	0	0	0	00.00	22.750	–83.700	20	—	4.26	0.56	4.62	450
EPRIm	1905	2	3	0	0	00.00	30.500	–91.100	0	5	3.70	0.56	4.06	1194
SEUSN	1905	9	4	9	0	00.00	27.500	–82.600	0	3	2.70	0.56	3.06	321
CUBA	1905	10	12	0	0	00.00	23.050	–82.010	10	—	3.97	0.56	4.33	312
CUBA	1906	0	0	0	0	00.00	22.650	–83.200	15	—	3.53	0.56	3.89	421
CUBA	1906	1	15	0	0	00.00	22.600	–80.330	10	—	4.04	0.56	4.40	311
CUBA	1906	5	6	20	29	00.00	22.710	–83.060	15	—	3.68	0.56	4.04	407
CUBA	1906	5	8	0	0	00.00	22.710	–83.060	15	—	3.68	0.56	4.04	407
CUBA	1906	5	26	20	29	00.00	22.710	–83.060	15	—	3.68	0.56	4.04	407
CUBA	1906	6	5	5	59	00.00	22.880	–80.380	10	—	4.48	0.56	4.84	280
CUBA	1906	10	0	0	0	00.00	22.200	–84.090	20	—	4.12	0.56	4.48	521
CUBA	1907	2	19	0	0	00.00	23.130	–82.400	10	—	4.41	0.56	4.77	328
CUBA	1907	4	15	0	0	00.00	23.130	–82.400	10	—	3.97	0.56	4.33	328
EPRIm	1907	4	19	8	30	00.00	32.900	–80.000	0	5	3.70	0.56	4.06	828
CUBA	1908	1	0	0	0	00.00	22.480	–79.550	10	—	3.82	0.56	4.19	334
EPRIm	1909	10	8	10	0	00.00	34.900	–85.000	0	4	3.11	0.56	3.47	1142
CUBA	1910	0	0	0	0	00.00	22.630	–83.370	15	—	3.90	0.56	4.26	435
FD02	1910	5	8	17	18	00.00	30.100	–96.000	0	4	3.80	0.56	4.16	>1609
EPRIm	1911	3	31	16	57	00.00	34.000	–91.800	0	7	4.10	0.30	4.20	1458

PTN COL 2.5-2

Table 2.5.2-201 (Sheet 5 of 25)
Earthquake Catalog for the Phase 1 Investigation Region [22°N to 35°N, 100°W to 65°W] for which the Events are Rmb Magnitude Greater than or Equal to 3.0 or Intensity [Int] Greater than or Equal to IV(4)

Catalog Reference[a]	Year	Month	Day	Hour	Min	Sec	Lat	Lon	Depth (km)	Int	Emb	Smb	Rmb	Epicenter (km)[b]
EPRIm	1911	3	31	18	10	00.00	33.800	–92.200	0	4	3.70	0.30	3.80	1474
CUBA	1912	5	6	0	0	00.00	22.510	–79.690	10	—	3.97	0.56	4.33	328
EPRIm	1912	6	12	10	30	00.00	32.900	–80.000	0	7	4.90	0.56	5.26	828
EPRIm	1912	6	20	0	0	00.00	32.000	–81.000	0	5	3.70	0.56	4.06	730
EPRIm	1912	10	23	1	15	00.00	32.700	–83.500	0	4	3.11	0.56	3.47	861
CUBA	1913	0	0	0	0	00.00	22.340	–84.390	0	—	4.26	0.56	4.62	533
CUBA	1913	0	0	0	0	00.00	22.150	–80.450	10	—	3.97	0.56	4.33	361
EPRIm	1913	1	1	18	28	00.00	34.700	–81.700	0	8	4.94	0.30	5.04	1036
EPRIm	1913	3	13	5	0	00.00	34.500	–85.000	0	4	3.11	0.56	3.47	1101
CUBA	1914	0	0	0	0	00.00	22.150	–80.450	10	—	4.26	0.56	4.62	361
EPRIm	1914	3	5	20	5	00.00	33.500	–83.500	0	6	4.30	0.55	4.65	945
EPRIm	1914	3	7	1	20	00.00	34.200	–79.800	0	4	3.11	0.56	3.47	973
CUBA	1914	5	27	6	59	00.00	22.710	–82.280	10	—	3.97	0.56	4.33	358
CUBA	1914	5	28	3	29	00.00	22.710	–82.280	10	—	4.41	0.56	4.77	358
EPRIm	1914	12	30	1	0	00.00	30.500	–95.900	0	4	3.40	0.30	3.50	>1609
EPRIm	1916	3	2	5	2	00.00	34.500	–82.700	0	4	3.11	0.56	3.47	1031
EPRIm	1916	10	18	22	3	40.00	33.500	–86.200	0	7	4.90	0.56	5.26	1059
EPRIm	1917	6	30	1	23	00.00	32.700	–87.500	0	5	3.70	0.56	4.06	1063
EPRIm	1918	10	4	9	21	00.00	35.000	–91.100	0	4	4.30	0.30	4.40	1482
CUBA	1920	0	0	0	0	00.00	22.510	–79.710	10	—	3.82	0.56	4.19	327
CUBA	1921	9	23	0	0	00.00	22.910	–82.610	10	—	3.97	0.56	4.33	360
EPRIm	1923	3	27	8	0	00.00	34.600	–89.700	0	4	3.80	0.30	3.90	1358
SEUSN	1923	10	28	16	15	00.00	34.900	–88.100	0	3	2.90	0.56	3.26	1288
EPRIm	1923	12	31	20	6	00.00	34.800	–82.500	0	4	3.11	0.56	3.47	1060
EPRIm	1924	10	20	8	30	00.00	35.000	–82.600	0	5	3.70	0.56	4.06	1084
CUBA	1925	0	0	0	0	00.00	22.350	–83.500	10	—	3.97	0.56	4.33	466
CUBA	1926	0	0	0	0	00.00	22.600	–80.330	10	—	4.04	0.56	4.40	311
CUBA	1927	1	0	0	0	00.00	22.770	–81.020	18	—	4.34	0.56	4.70	301
EPRIm	1927	6	16	12	0	00.00	34.700	–86.000	0	5	3.70	0.30	3.80	1163

PTN COL 2.5-2

Table 2.5.2-201 (Sheet 6 of 25)
Earthquake Catalog for the Phase 1 Investigation Region [22°N to 35°N, 100°W to 65°W] for which the Events are Rmb Magnitude Greater than or Equal to 3.0 or Intensity [Int] Greater than or Equal to IV(4)

Catalog Reference[a]	Year	Month	Day	Hour	Min	Sec	Lat	Lon	Depth (km)	Int	Emb	Smb	Rmb	Epicenter (km)[b]
EPRIm	1927	10	8	12	56	00.00	35.000	–85.300	0	5	3.70	0.56	4.06	1164
EPRIm	1927	11	13	16	21	00.00	32.300	–90.200	0	4	3.80	0.30	3.90	1224
EPRIm	1927	11	23	0	50	00.00	33.900	–78.000	0	4	3.11	0.56	3.47	965
EPRIm	1927	12	15	4	30	00.00	28.900	–89.400	0	4	3.80	0.30	3.90	973
SEUSN	1928	5	23	10	15	00.00	30.800	–83.300	0	3	2.70	0.56	3.06	661
CUBA	1928	6	5	0	0	00.00	22.770	–81.020	18	—	3.90	0.56	4.26	301
CUBA	1929	0	0	0	0	00.00	22.290	–84.290	20	—	3.82	0.56	4.19	529
EPRIm	1929	1	3	12	5	00.00	33.900	–80.300	0	4	3.11	0.56	3.47	938
SEUSN	1929	6	13	14	44	00.00	30.700	–88.000	0	3	2.90	0.56	3.26	950
EPRIm	1929	7	28	17	0	00.00	28.900	–89.400	0	4	3.80	0.30	3.90	973
EPRIm	1929	10	28	2	15	00.00	34.300	–82.400	0	4	3.11	0.56	3.47	1003
EPRIm	1930	7	19	18	53	00.00	25.800	–81.400	0	5	3.70	0.56	4.06	114
EPRIm	1930	10	19	12	12	00.00	30.100	–91.000	0	6	4.20	0.30	4.30	1167
EPRIm	1930	11	16	12	30	00.00	34.300	–92.800	0	5	3.20	0.30	3.30	1552
EPRIm	1930	12	10	0	2	00.00	34.300	–82.400	0	4	3.11	0.56	3.47	1003
EPRIm	1930	12	26	3	0	00.00	34.500	–80.300	0	4	3.11	0.56	3.47	1005
CUBA	1931	0	0	0	0	00.00	22.230	–79.330	10	—	3.97	0.56	4.33	366
EPRIm	1931	5	5	12	18	00.00	33.700	–86.600	0	6	4.30	0.55	4.65	1098
CUBA	1931	8	12	18	0	00.00	22.810	–80.080	10	—	3.97	0.56	4.33	289
ISSv	1931	8	16	8	6	18.00	28.800	–65.200	0	—	5.76	0.10	5.77	1538
EPRIm	1931	12	17	3	36	00.00	34.100	–89.800	0	6	4.60	0.30	4.70	1325
CUBA	1932	0	0	0	0	00.00	22.980	–80.590	10	—	3.75	0.56	4.11	270
CUBA	1932	0	0	0	0	00.00	23.130	–82.400	10	—	3.97	0.56	4.33	328
EPRIm	1932	4	9	10	15	00.00	31.700	–96.400	0	6	3.50	0.30	3.60	>1609
CUBA	1933	0	0	0	0	00.00	22.050	–79.460	10	—	3.97	0.56	4.33	382
EPRIm	1933	6	9	11	30	00.00	33.300	–83.500	0	4	3.11	0.56	3.47	924
EPRIm	1933	12	23	9	40	00.00	32.900	–80.000	0	5	3.70	0.56	4.06	828
CUBA	1934	0	0	0	0	00.00	22.660	–80.190	10	—	3.97	0.56	4.33	305
EPRIm	1934	4	11	17	40	00.00	33.900	–95.500	0	5	3.80	0.30	3.90	>1609

PTN COL 2.5-2

Table 2.5.2-201 (Sheet 7 of 25)
Earthquake Catalog for the Phase 1 Investigation Region [22°N to 35°N, 100°W to 65°W] for which the Events are Rmb Magnitude Greater than or Equal to 3.0 or Intensity [Int] Greater than or Equal to IV(4)

Catalog Reference[a]	Year	Month	Day	Hour	Min	Sec	Lat	Lon	Depth (km)	Int	Emb	Smb	Rmb	Epicenter (km)[b]
EPRIm	1935	11	14	3	10	00.00	29.600	–81.700	0	4	3.11	0.56	3.47	480
CUBA	1936	0	19	15	30	00.00	22.340	–79.340	15	—	4.26	0.56	4.62	354
EPRIm	1936	3	14	17	20	00.00	34.000	–95.200	0	5	3.50	0.30	3.60	>1609
CUBA	1936	12	19	15	30	00.00	22.340	–79.340	15	—	4.26	0.56	4.62	354
CUBA	1937	1	1	16	0	00.00	22.290	–79.200	10	—	3.97	0.56	4.33	364
CUBA	1937	1	8	0	0	00.00	22.330	–79.260	10	—	3.97	0.56	4.33	358
CUBA	1937	4	17	0	0	00.00	22.710	–83.060	15	—	3.68	0.56	4.04	407
CUBA	1937	5	14	0	0	00.00	22.780	–80.080	10	—	4.34	0.56	4.70	293
CUBA	1937	5	20	15	35	00.00	22.710	–83.060	15	—	4.99	0.56	5.35	407
CUBA	1937	12	20	15	35	00.00	22.710	–83.060	15	—	4.99	0.56	5.35	407
CUBA	1937	12	21	16	30	00.00	22.710	–83.060	15	—	4.12	0.56	4.48	407
CUBA	1938	1	0	0	0	00.00	22.300	–79.730	10	—	3.82	0.56	4.19	350
EPRIm	1938	4	26	5	42	00.00	34.200	–93.500	0	4	3.11	0.56	3.47	1598
SEUSN	1938	6	24	9	0	00.00	34.700	–86.600	0	—	3.00	0.10	3.01	1191
CUBA	1938	6	30	0	0	00.00	22.510	–79.470	10	—	3.75	0.56	4.11	333
CUBA	1938	7	29	0	0	00.00	22.480	–79.550	10	—	3.75	0.56	4.11	334
CUBA	1938	10	0	0	0	00.00	22.300	–79.730	10	—	3.82	0.56	4.19	350
CUBA	1938	11	0	0	0	00.00	22.310	–79.240	10	—	3.97	0.56	4.33	361
CUBA	1939	1	1	14	0	00.00	22.310	–79.240	10	—	3.82	0.56	4.19	361
CUBA	1939	1	13	9	20	00.00	22.510	–79.470	10	—	4.48	0.56	4.84	333
CUBA	1939	1	13	9	30	00.00	22.420	–79.350	10	—	4.04	0.56	4.40	346
CUBA	1939	1	13	9	35	00.00	22.310	–79.240	10	—	3.75	0.56	4.11	361
CUBA	1939	2	15	0	0	00.00	22.310	–79.240	10	—	3.97	0.56	4.33	361
CUBA	1939	2	15	16	45	00.00	22.600	–83.300	15	—	3.68	0.56	4.04	432
ISSv	1939	3	5	15	12	09.00	23.100	–69.400	160	—	5.80	0.10	5.81	1133
CUBA	1939	5	0	0	0	00.00	22.510	–79.470	10	—	3.97	0.56	4.33	333
EPRIm	1939	5	5	2	45	00.00	33.700	–85.800	0	5	3.70	0.56	4.06	1057
EPRIm	1939	6	1	7	30	00.00	35.000	–96.400	0	4	4.30	0.30	4.40	>1609
EPRIm	1939	6	19	21	43	12.00	34.100	–92.600	0	5	4.30	0.30	4.40	1524

PTN COL 2.5-2

Table 2.5.2-201 (Sheet 8 of 25)
Earthquake Catalog for the Phase 1 Investigation Region [22°N to 35°N, 100°W to 65°W] for which the Events are Rmb Magnitude Greater than or Equal to 3.0 or Intensity [Int] Greater than or Equal to IV(4)

Catalog Reference[a]	Year	Month	Day	Hour	Min	Sec	Lat	Lon	Depth (km)	Int	Emb	Smb	Rmb	Epicenter (km)[b]
EPRIm	1939	6	24	10	27	00.00	34.700	–86.600	0	4	3.40	0.30	3.50	1191
CUBA	1939	8	15	3	50	00.00	22.720	–75.550	10	—	3.75	0.56	4.11	568
ISSv	1939	8	15	3	52	31.00	22.500	–79.000	0	—	5.80	0.10	5.81	349
EPRIm	1940	10	19	5	54	00.00	34.700	–85.100	0	4	3.40	0.30	3.50	1125
EPRIm	1940	12	2	16	16	00.00	33.000	–94.000	0	4	3.11	0.56	3.47	1567
CUBA	1941	0	0	0	0	00.00	22.080	–78.500	10	—	3.97	0.56	4.33	413
CUBA	1941	0	0	0	0	00.00	23.130	–82.400	10	—	3.97	0.56	4.33	328
CUBA	1941	4	24	20	30	00.00	22.810	–80.080	10	—	3.97	0.56	4.33	289
CUBA	1941	4	25	2	15	00.00	22.850	–80.100	15	—	4.12	0.56	4.48	285
EPRIm	1941	6	28	18	30	00.00	32.300	–90.800	0	4	2.81	0.56	3.17	1270
CUBA	1942	0	0	0	0	00.00	22.410	–83.720	15	—	4.12	0.56	4.48	477
EPRIm	1942	1	19	0	0	00.00	26.500	–81.000	0	4	3.11	0.56	3.47	136
CUBA	1942	3	9	18	10	00.00	22.940	–80.010	15	—	4.19	0.56	4.55	276
CUBA	1942	4	11	5	40	00.00	22.480	–79.550	10	—	3.97	0.56	4.33	334
CUBA	1942	6	4	6	0	00.00	22.810	–80.080	10	—	3.75	0.56	4.11	289
CUBA	1942	8	0	0	0	00.00	22.340	–80.560	10	—	4.26	0.56	4.62	341
CUBA	1942	8	18	0	0	00.00	23.130	–82.400	10	—	3.97	0.56	4.33	328
CUBA	1942	12	18	0	0	00.00	23.130	–82.400	10	—	3.97	0.56	4.33	328
CUBA	1943	0	0	0	0	00.00	22.810	–80.080	10	—	3.82	0.56	4.19	289
CUBA	1943	1	1	0	0	00.00	22.810	–80.080	10	—	3.82	0.56	4.19	289
CUBA	1943	7	0	0	0	00.00	22.210	–79.240	10	—	3.82	0.56	4.19	371
CUBA	1943	7	31	2	0	00.00	22.150	–79.970	10	—	3.97	0.56	4.33	363
CUBA	1943	7	31	3	15	00.00	22.110	–79.720	10	—	3.75	0.56	4.11	370
CUBA	1943	12	0	0	0	00.00	22.210	–79.240	10	—	3.82	0.56	4.19	371
EPRIm	1943	12	28	10	25	00.00	33.000	–80.200	0	4	3.11	0.56	3.47	838
CUBA	1944	0	0	0	0	00.00	22.060	–79.400	10	—	4.04	0.56	4.40	383
CUBA	1944	1	0	0	0	00.00	22.350	–79.230	10	—	3.97	0.56	4.33	357
CUBA	1944	1	1	3	0	00.00	22.330	–79.260	10	—	4.48	0.56	4.84	358
CUBA	1944	1	1	19	0	00.00	22.800	–80.100	10	—	4.04	0.56	4.40	290

PTN COL 2.5-2

Table 2.5.2-201 (Sheet 9 of 25)
Earthquake Catalog for the Phase 1 Investigation Region [22°N to 35°N, 100°W to 65°W] for which the Events are Rmb Magnitude Greater than or Equal to 3.0 or Intensity [Int] Greater than or Equal to IV(4)

Catalog Reference[a]	Year	Month	Day	Hour	Min	Sec	Lat	Lon	Depth (km)	Int	Emb	Smb	Rmb	Epicenter (km)[b]
CUBA	1944	10	12	15	0	00.00	22.710	–83.060	15	—	4.63	0.56	4.99	407
CUBA	1945	0	0	0	0	00.00	22.680	–79.710	10	—	3.97	0.56	4.33	309
EPRIm	1945	6	14	3	25	00.00	35.000	–84.500	0	5	3.90	0.30	4.00	1134
EPRIm	1945	7	26	10	32	16.40	33.750	–81.380	5	4	4.30	0.30	4.40	927
SEUSN	1945	12	22	15	25	00.00	25.800	–80.000	0	3	2.70	0.56	3.06	53
CUBA	1946	0	0	0	0	00.00	22.000	–79.360	10	—	4.04	0.56	4.40	390
CUBA	1946	0	0	0	0	00.00	22.600	–83.310	15	—	4.12	0.56	4.48	433
CUBA	1947	5	9	0	0	00.00	22.660	–76.030	10	—	4.04	0.56	4.40	531
CUBA	1947	9	0	0	0	00.00	22.030	–78.300	10	—	3.97	0.56	4.33	427
EPRIm	1947	9	20	21	30	00.00	31.900	–92.600	0	4	3.40	0.56	3.76	1392
EPRIm	1947	11	2	4	30	00.00	32.900	–80.000	0	4	3.11	0.56	3.47	828
EPRIm	1947	12	27	19	0	00.00	35.000	–85.300	0	4	3.11	0.56	3.47	1164
CUBA	1948	9	0	0	0	00.00	22.810	–80.080	10	—	3.97	0.56	4.33	289
EPRIm	1948	11	8	17	44	00.00	26.500	–82.200	0	4	3.11	0.56	3.47	221
EPRIm	1949	2	2	10	52	00.00	32.900	–80.000	0	4	3.11	0.56	3.47	828
EPRIm	1949	7	9	18	44	43.00	32.250	–70.750	0	—	5.61	0.20	5.66	1199
CUBA	1950	0	0	0	0	00.00	22.800	–80.280	10	—	3.97	0.56	4.33	289
CUBA	1950	1	1	0	0	00.00	22.800	–80.280	10	—	3.97	0.56	4.33	289
EPRIm	1950	3	20	13	24	00.00	33.500	–97.100	0	4	3.11	0.56	3.47	>1609
CUBA	1951	1	12	11	0	00.00	22.480	–79.550	10	—	3.97	0.56	4.33	334
EPRIm	1951	3	4	2	55	00.00	32.900	–80.000	0	4	3.11	0.56	3.47	828
EPRIm	1951	12	30	7	55	00.00	32.900	–80.000	0	4	3.11	0.56	3.47	828
CUBA	1952	2	3	6	30	00.00	22.790	–80.160	10	—	4.26	0.56	4.62	291
CUBA	1952	2	3	16	30	00.00	22.880	–80.280	15	—	4.63	0.56	4.99	280
SEUSN	1952	2	6	15	12	00.00	33.500	–86.900	0	4	3.30	0.56	3.66	1096
CUBA	1952	3	10	14	0	00.00	22.110	–78.630	15	—	4.63	0.56	4.99	404
EPRIm	1952	10	17	15	48	00.00	30.100	–93.700	0	4	3.11	0.56	3.47	1409
EPRIm	1952	11	18	20	12	00.00	30.600	–84.600	0	4	3.11	0.56	3.47	708
EPRIm	1952	11	19	0	0	00.00	32.900	–80.000	0	5	3.70	0.56	4.06	828

PTN COL 2.5-2

Table 2.5.2-201 (Sheet 10 of 25)
Earthquake Catalog for the Phase 1 Investigation Region [22°N to 35°N, 100°W to 65°W] for which the Events are Rmb Magnitude Greater than or Equal to 3.0 or Intensity [Int] Greater than or Equal to IV(4)

Catalog Reference[a]	Year	Month	Day	Hour	Min	Sec	Lat	Lon	Depth (km)	Int	Emb	Smb	Rmb	Epicenter (km)[b]
CUBA	1953	0	0	0	0	00.00	22.410	–83.720	15	—	4.12	0.56	4.48	477
CUBA	1953	0	0	0	0	00.00	22.980	–80.590	10	—	3.82	0.56	4.19	270
CUBA	1953	1	1	11	20	00.00	22.150	–78.600	15	—	4.85	0.56	5.21	401
CUBA	1953	1	1	15	0	00.00	22.980	–80.590	10	—	3.82	0.56	4.19	270
CUBA	1953	1	2	15	0	00.00	22.800	–80.020	10	—	3.97	0.56	4.33	291
EPRIm	1953	3	26	0	0	00.00	28.600	–81.400	0	4	3.11	0.56	3.47	366
CUBA	1953	5	16	0	0	00.00	23.030	–82.130	10	—	4.48	0.56	4.84	320
EPRIm	1953	6	6	17	40	00.00	34.700	–96.700	0	4	3.11	0.56	3.47	>1609
CUBA	1954	0	0	0	0	00.00	22.500	–79.600	10	—	4.04	0.56	4.40	331
CUBA	1954	1	1	0	0	00.00	22.500	–79.600	10	—	4.04	0.56	4.40	331
EPRIm	1954	4	11	0	0	00.00	35.000	–96.400	0	4	3.11	0.56	3.47	>1609
EPRIm	1955	2	1	14	45	00.00	30.400	–89.100	0	5	4.30	0.30	4.40	1020
CUBA	1956	0	0	0	0	00.00	22.810	–80.080	10	—	3.75	0.56	4.11	289
EPRIm	1956	1	5	8	0	00.00	34.300	–82.400	0	4	3.11	0.56	3.47	1003
EPRIm	1956	1	8	0	35	00.00	29.300	–94.800	0	4	3.11	0.56	3.47	1487
EPRIm	1956	4	2	16	3	18.00	34.200	–95.600	0	5	3.70	0.30	3.80	>1609
EPRIm	1956	9	27	14	15	00.00	31.900	–88.400	0	4	3.11	0.56	3.47	1063
EPRIm	1957	3	19	16	37	38.00	32.600	–94.700	0	5	4.20	0.30	4.30	1604
EPRIm	1957	4	23	9	23	39.00	33.770	–86.720	5	6	4.11	0.20	4.16	1111
CUBA	1957	9	11	23	30	00.00	22.180	–83.650	10	—	4.63	0.56	4.99	491
EPRIm	1957	11	24	20	6	17.00	35.000	–83.500	0	6	3.90	0.30	4.00	1104
CUBA	1958	0	0	0	0	00.00	22.710	–83.060	15	—	4.12	0.56	4.48	407
EPRIm	1958	3	5	11	53	43.00	34.200	–77.800	0	5	3.70	0.56	4.06	1002
SEUSN	1958	4	8	17	0	00.00	31.500	–83.500	0	3	2.70	0.56	3.06	739
EPRIm	1958	10	20	6	16	00.00	34.500	–82.700	0	5	3.70	0.56	4.06	1031
EPRIm	1958	11	6	23	8	00.00	29.900	–90.100	0	4	3.11	0.56	3.47	1079
EPRIm	1958	11	19	18	15	00.00	30.500	–91.200	0	5	3.20	0.30	3.30	1203
EPRIm	1959	6	15	12	45	00.00	34.700	–96.700	0	5	3.90	0.30	4.00	>1609
FD02	1959	6	17	16	27	07.00	34.500	–98.500	0	—	4.70	0.10	4.71	>1609

PTN COL 2.5-2

Table 2.5.2-201 (Sheet 11 of 25)
Earthquake Catalog for the Phase 1 Investigation Region [22°N to 35°N, 100°W to 65°W] for which the Events are Rmb Magnitude Greater than or Equal to 3.0 or Intensity [Int] Greater than or Equal to IV(4)

Catalog Reference[a]	Year	Month	Day	Hour	Min	Sec	Lat	Lon	Depth (km)	Int	Emb	Smb	Rmb	Epicenter (km)[b]
EPRIm	1959	8	3	6	8	36.80	33.050	−80.130	1	6	4.31	0.20	4.36	844
EPRIm	1959	8	12	18	6	01.40	34.790	−86.560	5	6	3.71	0.20	3.76	1198
EPRIm	1959	10	15	15	45	00.00	29.800	−93.100	0	4	3.70	0.30	3.80	1344
EPRIm	1959	10	27	2	7	28.00	34.500	−80.200	0	6	4.30	0.55	4.65	1005
CUBA	1960	0	0	0	0	00.00	22.080	−78.340	10	—	3.97	0.56	4.33	420
EPRIm	1960	5	4	16	31	32.00	34.200	−92.000	0	4	3.11	0.56	3.47	1486
CUBA	1960	5	25	15	30	00.00	22.580	−79.480	15	—	4.63	0.56	4.99	325
CUBA	1960	7	0	0	0	00.00	22.480	−79.550	10	—	3.97	0.56	4.33	334
CUBA	1960	7	18	13	35	00.00	22.480	−79.550	10	—	3.75	0.56	4.11	334
USN	1960	7	28	3	37	30.00	32.800	−82.700	0	5	3.70	0.56	4.07	847
CUBA	1960	12	0	0	0	00.00	22.480	−79.550	10	—	3.97	0.56	4.33	334
CUBA	1961	0	0	0	0	00.00	22.330	−79.260	10	—	3.97	0.56	4.33	358
CUBA	1961	1	0	0	0	00.00	22.980	−80.590	10	—	3.97	0.56	4.33	270
EPRIm	1961	1	11	1	40	00.00	34.900	−95.500	0	5	3.70	0.30	3.80	>1609
EPRIm	1961	4	26	7	5	00.00	34.600	−95.000	0	3	3.70	0.30	3.80	>1609
EPRIm	1961	4	27	7	30	00.00	34.900	−95.300	0	5	4.00	0.30	4.10	>1609
STO	1962	8	10	20	47	19.00	34.800	−97.400	0	—	3.25	0.41	3.45	>1609
STO	1962	9	7	22	53	44.00	34.700	−98.400	0	—	3.25	0.41	3.45	>1609
STO	1962	10	23	17	55	58.00	35.000	−98.500	0	—	3.01	0.41	3.20	>1609
CUBA	1963	1	0	0	0	00.00	22.480	−79.550	10	—	3.97	0.56	4.33	334
STO	1963	2	2	16	57	39.00	34.700	−98.200	0	—	2.93	0.41	3.12	>1609
EPRIm	1963	2	7	21	18	36.00	34.400	−92.100	0	—	3.31	0.20	3.36	1507
EPRIm	1963	4	11	17	45	00.00	34.900	−82.400	0	4	3.11	0.56	3.47	1069
STO	1963	5	7	20	3	29.00	34.300	−96.400	0	—	3.09	0.41	3.28	>1609
CUBA	1963	8	26	0	0	00.00	22.480	−79.550	10	—	3.75	0.56	4.11	334
SEUSN	1963	10	8	6	1	43.40	33.900	−82.500	0	—	3.20	0.10	3.21	961
EPRIm	1963	11	5	22	45	03.40	27.490	−92.580	15	—	4.71	0.20	4.76	1236
EPRIm	1964	2	18	9	31	10.40	34.670	−85.390	1	5	4.18	0.10	4.19	1134
EPRIm	1964	3	13	1	20	17.50	33.190	−83.310	1	5	4.38	0.10	4.39	906

PTN COL 2.5-2

Table 2.5.2-201 (Sheet 12 of 25)
Earthquake Catalog for the Phase 1 Investigation Region [22°N to 35°N, 100°W to 65°W] for which the Events are Rmb Magnitude Greater than or Equal to 3.0 or Intensity [Int] Greater than or Equal to IV(4)

Catalog Reference[(a)]	Year	Month	Day	Hour	Min	Sec	Lat	Lon	Depth (km)	Int	Emb	Smb	Rmb	Epicenter (km)[(b)]
CUBA	1964	3	27	0	0	00.00	22.070	–81.040	10	—	4.41	0.56	4.77	377
EPRIm	1964	4	20	19	4	44.10	33.840	–81.100	3	5	3.48	0.10	3.49	935
EPRIm	1964	4	24	7	33	51.90	31.420	–93.810	5	4	3.58	0.10	3.59	1472
EPRIm	1964	6	3	9	37	00.00	31.000	–94.000	0	4	2.81	0.56	3.17	1470
PDEnp	1965	3	29	13	10	22.30	33.900	–65.000	10	—	4.20	0.10	4.21	>1609
EPRIm	1965	9	9	14	42	20.00	34.700	–81.200	0	—	3.82	0.41	4.01	1031
SEUSN	1965	11	8	12	58	01.00	33.200	–83.200	0	—	3.30	0.10	3.31	904
CUBA	1966	0	0	0	0	00.00	22.640	–80.280	10	—	3.90	0.56	4.26	307
CUBA	1966	1	1	0	0	00.00	22.640	–80.280	10	—	3.90	0.56	4.26	307
SEUSN	1966	2	13	6	29	43.00	33.600	–87.000	0	—	3.50	0.10	3.51	1111
CUBA	1966	7	29	0	0	00.00	22.310	–79.240	10	—	3.97	0.56	4.33	361
CUBA	1966	7	29	15	0	00.00	22.310	–79.240	10	—	3.75	0.56	4.11	361
ISC	1966	12	15	8	16	00.00	23.130	–69.010	32	—	5.70	0.10	5.71	1171
PEREZ	1967	2	4	14	8	50.00	24.000	–65.700	1	—	6.55	0.10	6.56	1480
ISC	1967	3	13	0	58	48.10	24.290	–65.390	280	—	4.60	0.10	4.61	1507
ISC	1967	3	21	20	41	27.00	24.000	–97.000	33	—	3.90	0.10	3.91	>1609
EPRIm	1967	6	4	16	14	12.60	33.550	–90.840	6	6	4.28	0.10	4.29	1356
ISC	1967	6	20	3	57	18.00	22.000	–96.000	33	—	4.00	0.10	4.01	>1609
ISC	1967	10	4	2	45	45.00	27.000	–94.000	33	—	3.20	0.10	3.21	1369
EPRIm	1967	10	23	9	4	02.50	32.800	–80.220	19	5	3.78	0.10	3.79	816
CUBA	1968	1	1	0	0	00.00	22.980	–80.590	10	—	3.97	0.56	4.33	270
EPRIm	1968	1	4	22	30	00.00	34.850	–95.550	0	4	3.11	0.56	3.47	>1609
EPRIm	1968	7	12	1	12	00.00	32.800	–79.700	0	4	3.11	0.56	3.47	818
EPRIm	1968	9	22	21	41	18.20	34.110	–81.480	1	4	3.68	0.10	3.69	968
EPRIm	1968	10	14	14	42	54.00	34.000	–96.800	0	6	3.48	0.10	3.49	>1609
EPRIm	1968	11	25	20	0	00.00	34.100	–77.900	0	4	3.11	0.56	3.47	989
EPRIm	1969	1	1	23	35	38.70	34.990	–92.690	7	6	4.38	0.10	4.39	1591
EPRIm	1969	4	13	6	27	51.00	34.200	–96.300	0	—	3.48	0.10	3.49	>1609
CUBA	1969	5	0	0	0	00.00	22.140	–78.980	10	—	3.97	0.56	4.33	387

PTN COL 2.5-2

Table 2.5.2-201 (Sheet 13 of 25)
Earthquake Catalog for the Phase 1 Investigation Region [22°N to 35°N, 100°W to 65°W] for which the Events are Rmb Magnitude Greater than or Equal to 3.0 or Intensity [Int] Greater than or Equal to IV(4)

Catalog Reference[a]	Year	Month	Day	Hour	Min	Sec	Lat	Lon	Depth (km)	Int	Emb	Smb	Rmb	Epicenter (km)[b]
EPRIm	1969	5	18	0	0	00.00	33.950	–82.580	0	—	3.50	0.41	3.69	968
CUBA	1969	6	0	0	0	00.00	22.180	–78.980	10	—	3.97	0.56	4.33	383
CUBA	1969	6	1	3	0	00.00	22.140	–78.980	10	—	3.97	0.56	4.33	387
CUBA	1969	12	0	0	0	00.00	22.180	–78.980	10	—	3.97	0.56	4.33	383
EPRIm	1970	2	3	0	0	00.00	31.000	–97.000	0	4	3.11	0.56	3.47	>1609
CUBA	1970	4	27	11	55	00.00	23.050	–81.580	10	—	3.97	0.56	4.33	290
CUBA	1970	7	24	0	0	00.00	22.900	–83.160	20	—	3.90	0.56	4.26	399
CUBA	1970	10	16	13	7	22.00	23.100	–82.900	10	—	4.34	0.56	4.70	364
EPRIm	1971	3	14	17	27	54.60	33.180	–87.840	12	3	3.88	0.10	3.89	1125
EPRIm	1971	3	15	14	53	22.00	32.800	–88.300	0	—	3.48	0.10	3.49	1124
EPRIm	1971	5	19	12	54	03.60	33.360	–80.660	1	4	4.08	0.10	4.09	879
EPRIm	1971	7	13	11	42	26.00	34.800	–83.000	0	5	3.78	0.10	3.79	1070
EPRIm	1972	8	14	15	5	19.00	33.200	–81.400	0	3	3.14	0.33	3.27	866
CUBA	1973	0	0	0	0	00.00	22.660	–83.580	20	—	3.75	0.56	4.11	448
CUBA	1973	1	1	0	0	00.00	22.660	–83.580	20	—	3.75	0.56	4.11	448
EPRIm	1973	1	8	9	11	37.00	33.800	–90.600	0	3	3.48	0.10	3.49	1357
CUBA	1973	8	11	0	38	35.00	22.600	–74.000	0	—	4.82	0.41	5.01	712
EPRIm	1973	10	27	6	21	02.00	28.480	–80.650	5	5	3.48	0.10	3.49	338
EPRIm	1973	12	25	2	46	00.00	29.000	–98.300	0	4	3.11	0.56	3.47	>1609
CUBA	1974	0	0	0	0	00.00	22.700	–81.200	18	—	4.19	0.56	4.55	313
EPRIm	1974	2	15	22	32	38.20	34.040	–92.980	17	3	3.48	0.10	3.49	1548
EPRIm	1974	8	2	8	52	11.10	33.910	–82.530	4	6	4.28	0.10	4.29	963
ISC c	1974	9	13	17	29	57.80	23.782	–96.428	0	—	3.60	0.10	3.61	>1609
EPRIm	1974	11	5	3	0	00.00	33.730	–82.220	0	3	3.68	0.10	3.69	937
EPRIm	1974	11	22	5	25	56.70	32.920	–80.160	6	6	4.28	0.10	4.29	829
SEUSN	1974	12	9	18	40	00.00	34.200	–77.200	0	3	2.70	0.56	3.06	1018
CUBA	1975	0	0	0	0	00.00	22.700	–79.690	10	—	3.97	0.56	4.33	307
EPRIm	1975	4	1	21	9	00.00	33.200	–83.200	0	—	3.82	0.41	4.01	904
EPRIm	1975	6	24	11	11	36.60	33.700	–87.840	4	4	3.78	0.10	3.79	1168

PTN COL 2.5-2

Table 2.5.2-201 (Sheet 14 of 25)
Earthquake Catalog for the Phase 1 Investigation Region [22°N to 35°N, 100°W to 65°W] for which the Events are Rmb Magnitude Greater than or Equal to 3.0 or Intensity [Int] Greater than or Equal to IV(4)

Catalog Reference[a]	Year	Month	Day	Hour	Min	Sec	Lat	Lon	Depth (km)	Int	Emb	Smb	Rmb	Epicenter (km)[b]
EPRIm	1975	8	29	4	22	52.10	33.660	–86.590	4	6	3.48	0.10	3.49	1094
PDE	1975	10	12	2	58	11.20	34.816	–97.406	20	—	3.20	0.10	3.21	>1609
EPRIm	1975	10	18	4	31	00.00	34.900	–83.000	0	4	3.11	0.56	3.47	1081
EPRIm	1975	11	7	23	39	31.70	33.310	–87.330	4	—	3.48	0.10	3.49	1104
EPRIm	1975	11	29	14	29	44.90	34.680	–97.420	14	4	3.48	0.10	3.49	>1609
EPRIm	1975	12	4	11	57	00.00	29.200	–81.000	0	4	3.29	0.33	3.42	422
CUBA	1976	0	0	0	0	00.00	22.550	–79.720	10	—	3.75	0.56	4.11	323
EPRIm	1976	2	4	19	53	53.00	34.970	–84.700	14	6	3.58	0.10	3.59	1138
CUBA	1976	3	9	16	5	00.00	22.650	–83.010	15	—	3.68	0.56	4.04	408
CUBA	1976	3	10	15	40	00.00	22.650	–83.010	15	—	3.68	0.56	4.04	408
CUBA	1976	3	15	18	50	00.00	22.650	–83.010	15	—	3.68	0.56	4.04	408
CUBA	1976	10	20	8	15	00.00	22.300	–79.450	10	—	3.97	0.56	4.33	356
CUBA	1976	11	0	0	0	00.00	22.000	–79.370	5	—	3.90	0.56	4.26	390
CUBA	1976	11	1	0	0	00.00	22.000	–79.370	5	—	3.90	0.56	4.26	390
EPRIm	1976	12	27	6	57	15.20	32.060	–82.500	14	5	3.68	0.10	3.69	763
CUBA	1977	0	0	0	0	00.00	22.680	–80.150	10	—	3.75	0.56	4.11	303
EPRIm	1977	3	30	8	27	47.80	32.950	–80.180	8	5	4.17	0.27	4.25	832
EPRIm	1977	5	4	2	0	24.30	31.960	–88.440	0	5	3.58	0.10	3.59	1070
EPRIm	1977	6	2	23	29	10.60	34.560	–94.170	10	6	3.58	0.10	3.59	>1609
ISC	1977	9	27	20	56	03.70	33.880	–97.480	5	—	3.00	0.10	3.01	>1609
CUBA	1977	10	7	5	36	55.00	22.350	–76.100	0	—	4.26	0.41	4.45	546
SLU	1977	11	4	11	21	06.80	34.010	–89.220	2	—	3.40	0.10	3.41	1280
CUBA	1978	0	0	0	0	00.00	23.050	–81.580	10	—	3.53	0.56	3.89	290
CUBA	1978	0	0	0	0	00.00	22.240	–83.580	10	—	3.97	0.56	4.33	481
CUBA	1978	1	1	0	0	00.00	23.050	–81.580	10	—	3.53	0.56	3.89	290
CUBA	1978	1	1	10	0	00.00	22.240	–83.580	10	—	3.97	0.56	4.33	481
SEUSN	1978	1	12	21	10	00.00	28.100	–81.600	0	4	3.30	0.56	3.66	321
EPRIm	1978	3	24	0	42	36.30	29.800	–67.400	20	—	6.08	0.10	6.09	1359
SLU	1978	4	11	8	51	02.43	34.693	–95.681	5	—	3.00	0.10	3.01	>1609

PTN COL 2.5-2

Table 2.5.2-201 (Sheet 15 of 25)
Earthquake Catalog for the Phase 1 Investigation Region [22°N to 35°N, 100°W to 65°W] for which the Events are Rmb Magnitude Greater than or Equal to 3.0 or Intensity [Int] Greater than or Equal to IV(4)

Catalog Reference[a]	Year	Month	Day	Hour	Min	Sec	Lat	Lon	Depth (km)	Int	Emb	Smb	Rmb	Epicenter (km)[b]
SLU	1978	4	20	8	13	04.00	34.586	−96.293	5	—	3.00	0.10	3.01	>1609
CUBA	1978	5	31	16	2	00.00	23.500	−82.100	0	—	3.77	0.41	3.96	277
PDE	1978	6	9	23	15	19.10	32.094	−88.580	10	—	3.30	0.10	3.31	1089
EPRIm	1978	7	24	8	6	16.90	26.380	−88.720	15	—	4.88	0.10	4.89	842
SEUSN	1978	11	6	23	0	00.00	30.200	−82.650	0	4	3.30	0.56	3.66	574
EPRIm	1978	12	11	2	6	50.10	31.910	−88.470	3	5	3.48	0.10	3.49	1068
CUBA	1979	0	0	0	0	00.00	22.640	−79.750	10	—	3.97	0.56	4.33	312
SEUSN	1979	2	27	8	25	00.00	34.200	−92.000	0	4	3.10	0.10	3.11	1486
SLU	1979	7	13	7	48	13.44	34.033	−95.087	5	—	3.00	0.10	3.01	>1609
DNA	1979	8	7	19	32	17.20	34.333	−81.358	3	—	3.00	0.10	3.01	992
SEUSN	1979	8	13	5	19	25.20	33.900	−82.540	23	—	3.97	0.30	4.08	962
DNA	1979	8	26	1	31	45.00	34.916	−82.956	1	—	3.70	0.10	3.71	1082
DNA	1979	10	8	23	20	11.00	34.306	−81.344	1	—	3.01	0.41	3.20	989
CUBA	1979	11	19	6	0	00.00	22.480	−79.550	10	—	3.97	0.56	4.33	334
EPRIm	1980	1	10	19	16	23.50	24.130	−85.710	15	—	3.88	0.10	3.89	559
DNA	1980	4	24	6	16	57.20	34.329	−81.324	3	—	2.97	0.30	3.08	991
ISC	1980	7	18	1	34	44.10	34.000	−97.350	5	—	3.00	0.10	3.01	>1609
STO	1980	7	25	15	30	12.50	33.940	−87.440	0	—	3.10	0.10	3.11	1166
DNA	1980	7	29	1	10	22.70	34.351	−81.364	1	—	3.16	0.30	3.26	994
EPRIm	1980	9	1	5	44	42.20	32.980	−80.190	7	4	3.29	0.33	3.42	836
SLU	1980	9	7	1	50	14.23	34.953	−97.258	5	—	3.48	0.10	3.49	>1609
CUBA	1980	10	18	0	0	00.00	22.600	−83.710	20	—	3.68	0.56	4.04	462
CUBA	1980	10	24	0	0	00.00	22.600	−83.710	20	—	3.68	0.56	4.04	462
SLU	1980	12	4	23	48	43.22	33.942	−97.352	5	1	3.60	0.10	3.61	>1609
CUBA	1981	0	0	0	0	00.00	22.900	−83.160	20	—	3.75	0.56	4.11	399
CUBA	1981	1	1	0	0	00.00	22.900	−83.160	20	—	3.75	0.56	4.11	399
SEUSN	1981	2	13	2	15	00.00	30.000	−91.800	0	4	3.10	0.56	3.46	1233
CUBA	1981	6	9	23	3	00.00	22.280	−83.840	15	—	3.90	0.56	4.26	496
CUBA	1981	6	11	18	35	00.00	22.200	−83.480	10	—	4.41	0.56	4.77	477

PTN COL 2.5-2

Table 2.5.2-201 (Sheet 16 of 25)
Earthquake Catalog for the Phase 1 Investigation Region [22°N to 35°N, 100°W to 65°W] for which the Events are Rmb Magnitude Greater than or Equal to 3.0 or Intensity [Int] Greater than or Equal to IV(4)

Catalog Reference[a]	Year	Month	Day	Hour	Min	Sec	Lat	Lon	Depth (km)	Int	Emb	Smb	Rmb	Epicenter (km)[b]
SLU	1981	7	9	22	47	11.09	34.955	–97.651	5	—	3.72	0.10	3.73	>1609
EPRIm	1981	7	11	21	9	21.84	34.850	–97.730	5	5	3.48	0.10	3.49	>1609
SLU	1981	9	17	19	31	00.45	34.481	–96.823	5	—	3.72	0.10	3.73	>1609
CUBA	1981	9	30	0	54	00.00	22.350	–83.570	10	—	3.97	0.56	4.33	471
SLU	1981	11	6	19	28	25.31	34.676	–96.682	5	—	3.54	0.10	3.55	>1609
CUBA	1981	11	11	20	30	00.00	22.160	–84.100	15	—	4.55	0.56	4.92	525
CUBA	1982	0	0	0	0	00.00	22.660	–83.960	20	—	4.26	0.56	4.62	477
SLU	1982	1	12	23	40	25.00	34.742	–97.406	5	—	3.00	0.10	3.01	>1609
SEUSN	1982	1	28	4	52	51.90	32.982	–81.393	7	—	3.40	0.10	3.41	842
CUBA	1982	2	22	17	4	20.00	22.300	–83.200	0	—	3.28	0.41	3.47	450
CUBA	1982	2	26	18	23	47.00	22.300	–83.400	0	—	3.28	0.41	3.47	464
SLU	1982	3	15	21	39	10.98	34.832	–97.608	5	—	3.72	0.10	3.73	>1609
SLU	1982	3	18	9	51	52.95	34.175	–97.608	5	—	3.48	0.10	3.49	>1609
TEIC	1982	4	13	9	25	09.30	34.251	–81.260	12	—	3.17	0.41	3.37	982
SLU	1982	7	9	3	38	11.35	34.963	–97.432	5	—	3.54	0.10	3.55	>1609
SEUSN	1982	7	16	14	16	02.90	34.320	–81.550	2	3	3.06	0.27	3.15	992
SLU	1982	8	22	1	1	02.42	34.840	–96.936	5	—	3.72	0.10	3.73	>1609
TEIC	1982	9	2	21	52	05.30	34.917	–82.891	8	—	3.09	0.41	3.28	1080
CUBA	1982	11	0	0	0	00.00	22.590	–81.240	20	—	3.75	0.56	4.11	326
CUBA	1982	11	16	20	20	17.00	22.610	–81.230	30	—	5.36	0.56	5.72	323
EPRIm	1983	1	26	14	7	44.70	32.850	–83.560	0	—	3.48	0.10	3.49	879
SLU	1983	3	28	9	32	24.86	34.635	–96.561	5	—	3.60	0.10	3.61	>1609
EPRIm	1983	10	16	19	40	50.80	30.240	–93.390	5	3	3.78	0.10	3.79	1386
CUBA	1983	11	1	17	9	20.00	23.300	–82.800	0	—	3.24	0.41	3.43	342
EPRIm	1983	11	6	9	2	19.80	32.940	–80.160	10	5	3.51	0.27	3.59	831
CUBA	1983	11	30	17	15	13.00	22.200	–77.830	5	—	3.64	0.30	3.74	437
SLU	1983	12	9	20	52	11.04	33.227	–92.739	4	—	3.00	0.10	3.01	1479
CUBA	1984	0	0	0	0	00.00	22.510	–79.470	0	—	3.61	0.56	3.97	333
CUBA	1984	1	1	0	0	00.00	22.600	–83.710	20	—	3.82	0.56	4.19	462

PTN COL 2.5-2

Table 2.5.2-201 (Sheet 17 of 25)
Earthquake Catalog for the Phase 1 Investigation Region [22°N to 35°N, 100°W to 65°W] for which the Events are Rmb Magnitude Greater than or Equal to 3.0 or Intensity [Int] Greater than or Equal to IV(4)

Catalog Reference[a]	Year	Month	Day	Hour	Min	Sec	Lat	Lon	Depth (km)	Int	Emb	Smb	Rmb	Epicenter (km)[b]
CUBA	1984	1	16	18	41	27.00	22.300	–83.800	0	—	3.49	0.41	3.68	492
CUBA	1984	1	17	20	55	00.00	23.400	–83.700	0	—	3.20	0.41	3.40	406
ANSS	1984	1	23	0	11	59.38	26.716	–87.339	5	—	2.85	0.41	3.04	712
TEIme	1984	1	23	1	15	09.40	26.716	–87.339	5	—	2.85	0.41	3.04	712
NAOme	1984	4	9	23	8	20.00	22.600	–80.300	33	—	4.50	0.10	4.51	311
CUBA	1984	4	17	20	23	04.00	23.200	–83.600	0	—	3.17	0.41	3.36	411
CUBA	1984	4	19	19	54	39.00	23.100	–82.400	0	—	3.20	0.41	3.40	330
CUBA	1984	5	16	2	50	37.00	22.930	–80.500	15	—	4.19	0.56	4.55	275
EPRIm	1984	8	9	2	42	35.81	34.620	–86.300	8	—	3.15	0.30	3.25	1169
CUBA	1984	8	20	18	37	26.00	22.500	–79.740	10	—	3.53	0.30	3.64	328
SLU	1984	9	25	1	53	26.26	34.018	–89.835	5	—	3.00	0.10	3.01	1321
EPRIm	1984	10	9	11	54	26.97	34.750	–85.200	12	6	4.18	0.10	4.19	1134
CUBA	1984	11	7	7	42	22.00	22.510	–79.470	0	—	3.61	0.56	3.97	333
SLU	1984	11	16	11	50	04.51	34.641	–97.487	5	—	3.60	0.10	3.61	>1609
CUBA	1984	11	16	13	34	11.00	23.010	–79.320	27	—	3.68	0.30	3.78	285
CUBA	1984	11	22	18	35	56.00	22.960	–79.640	20	—	3.97	0.30	4.07	280
CUBA	1985	1	21	10	45	33.00	22.390	–83.550	0	—	3.17	0.41	3.36	467
CUBA	1985	2	0	0	0	00.00	22.600	–83.710	20	—	4.12	0.56	4.48	462
CUBA	1985	2	21	20	22	25.00	23.250	–83.400	0	—	3.93	0.30	4.04	391
CUBA	1985	2	28	12	52	21.00	22.070	–83.760	0	—	3.49	0.41	3.68	507
ISC	1985	5	6	2	11	13.60	34.875	–97.572	5	5	2.30	0.10	2.31	>1609
CUBA	1985	5	17	11	50	26.00	22.310	–83.180	0	—	3.49	0.41	3.68	448
CUBA	1985	5	17	11	53	20.00	22.330	–83.360	0	—	3.49	0.41	3.68	459
CUBA	1985	9	13	10	2	49.00	24.070	–76.970	0	—	3.59	0.30	3.69	370
CUBA	1985	9	13	17	49	45.00	23.360	–82.830	0	—	3.31	0.41	3.51	339
FD02	1985	9	18	15	54	04.00	33.470	–97.040	0	5	3.30	0.10	3.31	>1609
CUBA	1985	9	21	18	34	20.00	22.560	–83.880	0	—	3.24	0.41	3.43	478
CUBA	1986	0	0	0	0	00.00	22.480	–84.240	20	—	4.26	0.56	4.62	512
TEIC	1986	2	13	1	35	00.00	34.793	–82.938	1	—	3.25	0.41	3.45	1068

PTN COL 2.5-2

Table 2.5.2-201 (Sheet 18 of 25)
Earthquake Catalog for the Phase 1 Investigation Region [22°N to 35°N, 100°W to 65°W] for which the Events are Rmb Magnitude Greater than or Equal to 3.0 or Intensity [Int] Greater than or Equal to IV(4)

Catalog Reference[a]	Year	Month	Day	Hour	Min	Sec	Lat	Lon	Depth (km)	Int	Emb	Smb	Rmb	Epicenter (km)[b]
SLU	1986	2	13	11	35	47.05	34.816	–82.944	4	—	3.00	0.10	3.01	1071
SEUSN	1986	3	13	2	29	31.40	33.229	–83.226	5	4	3.30	0.27	3.38	908
PDE	1986	5	7	2	27	00.46	33.233	–87.361	1	—	4.50	0.10	4.51	1100
SLU	1986	5	12	4	18	48.31	30.902	–89.159	10	—	3.60	0.10	3.61	1054
SEUSN	1986	7	11	14	26	14.80	34.937	–84.987	13	6	3.80	0.10	3.81	1145
SEUSN	1986	9	17	9	33	49.50	32.931	–80.159	6	4	3.30	0.27	3.38	830
CUBA	1986	10	8	4	51	46.00	22.220	–78.700	0	—	3.90	0.56	4.26	390
PDE	1986	11	7	13	53	18.50	34.671	–70.896	10	—	4.00	0.10	4.01	1369
TEIC	1986	12	11	14	5	50.00	34.889	–82.887	9	—	2.93	0.41	3.12	1077
TEIC	1986	12	11	14	7	11.00	34.898	–82.880	9	—	3.09	0.41	3.28	1078
CUBA	1986	12	25	6	13	20.00	22.230	–79.030	0	—	3.24	0.30	3.34	376
CUBA	1986	12	30	8	16	27.00	22.350	–79.330	0	—	3.39	0.30	3.49	354
CUBA	1987	2	2	0	0	00.00	22.600	–83.710	20	—	3.68	0.56	4.04	462
NENG	1987	2	8	18	25	37.09	29.697	–67.634	12	—	4.70	0.10	4.71	1334
ISCwy	1987	2	21	2	17	52.40	29.560	–66.960	18	—	4.20	0.10	4.21	1392
SEUSN	1987	3	16	13	9	26.80	34.560	–80.948	3	—	3.06	0.30	3.17	1014
CUBA	1987	3	29	22	24	12.00	22.170	–77.930	5	—	3.14	0.30	3.24	433
PDE	1987	6	1	17	44	33.20	34.615	–97.380	5	4	2.90	0.10	2.91	>1609
TEIC	1987	12	12	3	53	28.00	34.154	–82.714	9	—	3.33	0.41	3.53	994
TEIC	1987	12	24	22	46	44.20	34.154	–82.723	6	—	3.09	0.41	3.28	994
CUBA	1988	1	4	10	33	30.00	22.320	–78.940	20	—	3.99	0.30	4.09	370
SEUSN	1988	1	23	1	57	16.40	32.935	–80.157	7	5	3.50	0.27	3.58	831
PRSN	1988	3	3	13	52	05.64	22.280	–70.270	5	—	4.10	0.23	4.16	1077
PRSN	1988	4	28	6	46	27.22	22.030	–67.510	25	—	3.80	0.23	3.86	1353
PRSN	1988	5	5	17	39	20.20	29.420	–71.660	54	—	5.40	0.23	5.46	961
PRSN	1988	5	9	0	31	29.37	22.320	–69.600	25	—	4.10	0.23	4.16	1140
CUBA	1988	6	0	0	0	00.00	22.650	–83.010	15	—	3.68	0.56	4.04	408
CUBA	1988	6	1	0	0	00.00	22.650	–83.010	15	—	3.68	0.56	4.04	408
PRSN	1988	8	15	5	46	56.00	23.850	–69.250	104	—	4.10	0.23	4.16	1129

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Table 2.5.2-201 (Sheet 19 of 25) Earthquake Catalog for the Phase 1 Investigation Region [22°N to 35°N, 100°W to 65°W] for which the Events are Rmb Magnitude Greater than or Equal to 3.0 or Intensity [Int] Greater than or Equal to IV(4)

Catalog Reference[a]	Year	Month	Day	Hour	Min	Sec	Lat	Lon	Depth (km)	Int	Emb	Smb	Rmb	Epicenter (km)[b]
PRSN	1988	12	20	7	24	27.76	22.090	–70.710	25	—	4.10	0.23	4.16	1042
PRSN	1988	12	21	19	18	37.07	22.560	–69.460	25	—	4.50	0.23	4.56	1145
SLU	1988	12	25	15	57	57.53	34.197	–92.718	15	—	3.42	0.41	3.61	1539
TAC c	1989	1	29	4	57	40.50	22.780	–99.470	20	—	4.52	0.10	4.53	>1609
SLU	1989	2	28	17	31	50.68	33.399	–87.118	0	—	3.50	0.10	3.51	1100
PRSN	1989	5	25	23	12	09.08	22.690	–67.170	25	—	3.80	0.23	3.86	1365
SEUSN	1989	6	2	5	4	34.00	32.934	–80.166	5	4	3.30	0.27	3.38	831
PDE	1989	8	13	20	16	02.90	33.632	–87.086	0	—	3.40	0.10	3.41	1118
SEUSN	1989	8	20	0	3	18.30	34.803	–87.596	6	6	3.90	0.10	3.91	1252
SLU	1989	11	26	22	41	09.90	34.763	–91.086	5	—	3.00	0.10	3.01	1463
CUBA	1990	3	14	11	56	37.00	22.180	–70.500	70	—	5.21	0.10	5.22	1059
CUBA	1990	6	2	23	54	18.00	23.420	–79.480	17	—	4.09	0.30	4.19	237
SEUSN	1990	6	23	20	44	02.10	33.720	–87.946	6	—	3.06	0.30	3.17	1176
CUBA	1990	7	19	12	36	03.00	22.470	–78.470	5	—	3.19	0.30	3.29	376
TEIC	1990	7	28	7	53	33.00	34.600	–93.376	4	—	3.01	0.41	3.20	>1609
TEIC	1990	8	23	8	23	11.00	34.036	–82.503	14	—	2.93	0.41	3.12	976
SEUSN	1990	9	2	4	35	40.20	33.758	–87.928	0	—	3.16	0.30	3.26	1179
PDE	1990	9	16	21	13	32.40	34.800	–95.530	5	4	2.50	0.10	2.51	>1609
TEIC	1990	9	19	5	36	56.00	34.838	–83.002	5	—	3.09	0.41	3.28	1074
TEIC	1990	9	19	8	14	04.00	34.868	–83.016	16	—	2.85	0.41	3.04	1078
SEUSN	1990	11	13	15	22	13.00	32.947	–80.136	3	5	3.50	0.10	3.51	832
PDE	1990	11	15	11	44	41.40	34.760	–97.590	5	5	3.90	0.10	3.91	>1609
TEIC	1991	1	15	8	48	22.50	33.204	–83.205	12	—	3.25	0.41	3.45	904
TEIC	1991	1	16	15	26	39.40	33.171	–83.264	22	—	2.85	0.41	3.04	903
TEIC	1991	1	27	2	20	34.90	33.230	–83.247	20	—	3.17	0.41	3.37	908
TEIC	1991	2	7	4	3	14.30	33.195	–83.183	8	—	3.17	0.41	3.37	903
TEIC	1991	2	11	15	36	44.40	34.108	–90.599	12	—	2.85	0.41	3.04	1380
SEUSN	1991	6	2	6	5	34.90	32.980	–80.214	5	5	3.50	0.27	3.58	836
PRSN	1991	7	3	14	39	24.42	22.160	–65.580	20	—	5.70	0.23	5.76	1538

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Table 2.5.2-201 (Sheet 20 of 25)
Earthquake Catalog for the Phase 1 Investigation Region [22°N to 35°N, 100°W to 65°W] for which the Events are Rmb Magnitude Greater than or Equal to 3.0 or Intensity [Int] Greater than or Equal to IV(4)

Catalog Reference[a]	Year	Month	Day	Hour	Min	Sec	Lat	Lon	Depth (km)	Int	Emb	Smb	Rmb	Epicenter (km)[b]
NENG	1991	7	9	6	53	36.00	23.217	–65.569	9	—	6.11	0.10	6.12	1509
CUBA	1991	9	26	8	27	35.00	22.500	–75.200	20	—	3.66	0.41	3.86	611
SEUSN	1991	10	30	14	54	12.60	34.904	–84.713	8	—	3.06	0.30	3.17	1132
TEIC	1991	11	17	21	11	31.70	34.987	–82.956	8	—	3.01	0.41	3.20	1089
SEUSN	1992	1	3	4	21	23.90	33.981	–82.421	3	5	3.50	0.27	3.58	969
ISC	1992	1	4	3	19	06.70	24.371	–65.279	10	—	4.20	0.10	4.21	1516
PDE	1992	2	22	4	21	34.65	26.356	–78.888	10	—	3.20	0.10	3.21	177
PDE	1992	3	31	14	59	39.64	26.019	–85.731	5	—	3.80	0.10	3.81	543
PDE	1992	7	30	14	40	55.87	24.705	–99.779	10	—	4.30	0.10	4.31	>1609
PDE	1992	8	10	20	3	04.20	34.982	–97.453	5	4	2.88	0.27	2.97	>1609
SEUSN	1992	8	21	16	31	56.10	32.985	–80.163	6	6	4.10	0.10	4.11	837
SEUSN	1992	9	11	16	34	11.70	33.171	–87.501	6	—	2.97	0.30	3.08	1103
CUBA	1992	9	25	0	51	43.00	22.650	–79.400	15	—	4.28	0.30	4.39	320
CUBA	1992	9	25	3	15	57.00	22.690	–79.300	15	—	3.54	0.30	3.64	319
TEIC	1992	9	27	17	2	25.70	27.225	–88.711	10	—	3.80	0.10	3.81	855
PDE	1992	11	30	8	33	01.48	23.251	–98.199	10	—	4.61	0.30	4.71	>1609
PDE	1992	12	6	5	39	22.15	31.442	–66.108	10	—	3.90	0.10	3.91	1538
PDE	1992	12	17	7	18	04.27	34.744	–97.581	5	4	3.60	0.10	3.61	>1609
PRSN	1993	1	3	6	8	10.98	22.150	–67.960	54	—	5.70	0.23	5.76	1305
PDE	1993	7	16	10	54	32.86	31.747	–88.341	5	6	3.70	0.10	3.71	1047
SEUSN	1993	8	8	9	24	32.40	33.597	–81.591	8	5	3.20	0.10	3.21	913
PDE	1993	8	23	12	5	43.40	22.405	–99.347	33	—	4.00	0.10	4.01	>1609
ISC	1993	10	20	8	37	14.10	22.137	–99.051	10	—	4.00	0.10	4.01	>1609
PDE	1994	3	26	21	33	35.25	28.913	–66.146	10	—	4.70	0.10	4.71	1451
SEUSN	1994	4	5	22	22	00.40	34.969	–85.491	24	5	3.20	0.10	3.21	1168
ISC	1994	4	16	7	20	20.00	34.660	–97.710	5	—	3.17	0.23	3.23	>1609
SEUSN	1994	5	4	9	12	03.40	34.222	–87.195	19	4	3.00	0.10	3.01	1178
PDE	1994	6	10	23	34	02.92	33.013	–92.671	5	3	3.20	0.10	3.21	1460
PDE	1994	6	30	1	8	24.22	27.911	–90.177	10	—	4.20	0.10	4.21	1013

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Table 2.5.2-201 (Sheet 21 of 25)
Earthquake Catalog for the Phase 1 Investigation Region [22°N to 35°N, 100°W to 65°W] for which the Events are Rmb Magnitude Greater than or Equal to 3.0 or Intensity [Int] Greater than or Equal to IV(4)

Catalog Reference[a]	Year	Month	Day	Hour	Min	Sec	Lat	Lon	Depth (km)	Int	Emb	Smb	Rmb	Epicenter (km)[b]
PRSN	1994	10	14	22	26	23.54	22.980	–66.720	25	—	3.90	0.23	3.96	1401
PRSN	1994	11	4	6	0	41.77	22.610	–67.270	50	—	3.90	0.23	3.96	1357
PDE	1995	1	4	1	46	14.09	29.450	–96.950	5	4	2.70	0.10	2.71	>1609
PDE	1995	1	18	15	51	39.42	34.774	–97.596	5	5	4.20	0.10	4.21	>1609
CUBA	1995	1	18	20	45	07.00	22.320	–71.930	20	—	4.58	0.30	4.69	917
CUBA	1995	3	9	18	29	13.00	22.900	–82.210	3	—	3.24	0.30	3.34	337
SEUSN	1995	4	17	13	46	00.00	32.997	–80.171	8	6	3.90	0.10	3.91	838
PRSN	1995	5	1	7	30	46.77	22.230	–72.160	25	—	4.20	0.23	4.26	900
SEUSN	1995	5	28	15	28	37.00	33.191	–87.827	1	F[c]	3.40	0.10	3.41	1125
PDE	1995	6	1	4	49	29.32	34.287	–96.732	5	5	3.00	0.10	3.01	>1609
NENG	1995	7	2	3	35	11.33	30.974	–65.234	2	—	4.71	0.10	4.72	1598
SEUSN	1995	7	15	1	3	28.40	33.478	–87.665	1	—	3.30	0.10	3.31	1139
PRSN	1995	9	12	15	15	03.04	22.170	–66.140	25	—	3.80	0.23	3.86	1482
PRSN	1996	3	17	5	59	09.10	22.280	–66.820	25	—	3.60	0.23	3.66	1412
PDE	1996	3	25	14	15	50.55	32.131	–88.671	5	—	3.50	0.10	3.51	1099
PDE	1996	4	11	21	54	57.63	34.969	–91.162	5	5	3.30	0.10	3.31	1483
PDE	1996	8	8	22	25	11.03	22.110	–80.184	10	—	3.80	0.10	3.81	366
PDE	1996	8	11	18	17	49.88	33.577	–90.874	10	—	3.50	0.10	3.51	1361
PDE	1996	12	22	20	13	53.55	32.224	–65.447	10	—	4.40	0.10	4.41	>1609
PDE	1997	3	16	19	7	27.95	34.209	–93.435	5	4	3.40	0.10	3.41	1594
PDE	1997	4	18	14	57	35.39	25.782	–86.552	33	—	3.90	0.10	3.91	623
SEUSN	1997	5	4	3	39	12.80	30.934	–87.494	0	4	3.10	0.10	3.11	928
SEUSN	1997	5	19	19	45	35.80	34.622	–85.353	2	4	2.90	0.10	2.91	1128
FD02	1997	5	31	3	26	41.00	33.200	–96.100	0	4	3.40	0.10	3.41	>1609
PDE	1997	7	1	21	12	20.59	33.136	–67.854	10	—	3.60	0.10	3.61	1479
SEUSN	1997	7	19	17	6	34.40	34.953	–84.811	2	4	3.50	0.10	3.51	1140
PDE	1997	9	6	23	38	00.91	34.660	–96.435	5	5	4.50	0.10	4.51	>1609
NENG	1997	10	24	8	35	18.75	31.123	–87.272	2	—	4.96	0.10	4.97	925
ISC	1997	12	6	11	11	23.60	34.895	–95.968	5	—	3.01	0.10	3.02	>1609

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Table 2.5.2-201 (Sheet 22 of 25)
Earthquake Catalog for the Phase 1 Investigation Region [22°N to 35°N, 100°W to 65°W] for which the Events are Rmb Magnitude Greater than or Equal to 3.0 or Intensity [Int] Greater than or Equal to IV(4)

Catalog Reference[a]	Year	Month	Day	Hour	Min	Sec	Lat	Lon	Depth (km)	Int	Emb	Smb	Rmb	Epicenter (km)[b]
PDE	1997	12	12	8	42	20.25	33.466	–87.306	1	—	4.00	0.10	4.01	1116
PRSN	1998	3	30	7	15	36.26	22.960	–66.360	25	—	3.90	0.23	3.96	1437
SEUSN	1998	4	13	9	56	15.60	34.471	–80.603	6	5	3.90	0.10	3.91	1002
FD02	1998	4	28	14	13	02.00	34.780	–98.420	0	—	4.20	0.10	4.21	>1609
SEUSN	1998	6	24	15	20	04.70	32.760	–87.759	2	—	3.40	0.10	3.41	1085
NENG	1998	6	30	20	19	15.68	22.351	–69.892	14	—	4.80	0.10	4.81	1110
PDE	1998	7	6	6	54	03.79	25.016	–93.633	10	—	3.40	0.10	3.41	1333
PDE	1998	7	7	18	44	44.46	34.719	–97.589	5	—	3.20	0.10	3.21	>1609
ISC	1998	8	14	17	5	11.80	27.744	–99.864	0	—	3.90	0.10	3.91	>1609
PRSN	1998	12	14	3	10	38.19	22.650	–70.240	25	—	3.90	0.23	3.96	1066
PDE	1999	1	18	7	0	53.47	33.405	–87.255	1	—	4.80	0.10	4.81	1108
SEUSN	1999	3	29	14	49	37.80	33.064	–80.140	10	3	2.97	0.27	3.06	845
ISC	1999	5	28	11	36	48.90	22.117	–75.228	33	—	4.63	0.10	4.64	633
MIDAS	1999	9	10	17	16	28.68	29.906	–70.976	56	—	4.96	0.10	4.97	1043
PDE	1999	11	28	11	0	09.30	33.416	–87.253	1	—	3.80	0.10	3.81	1109
ISC	2000	1	14	10	39	34.90	34.674	–95.095	18	—	3.09	0.23	3.15	>1609
SEUSN	2000	1	18	22	19	32.20	32.920	–83.465	19	5	3.50	0.10	3.51	883
SEUSN	2000	5	28	11	32	06.30	33.708	–87.811	0	3	3.00	0.10	3.01	1167
PDE	2000	9	20	6	24	59.00	24.622	–99.933	33	—	4.24	0.30	4.35	>1609
PDE	2000	12	9	6	46	09.12	28.027	–90.171	10	—	4.96	0.10	4.97	1015
PDE	2001	3	3	10	46	13.00	33.190	–92.660	5	—	3.00	0.10	3.01	1470
PDE	2001	3	16	4	39	07.68	28.361	–89.029	10	—	3.60	0.10	3.61	918
SEUSN	2001	3	21	23	35	34.90	34.847	–85.438	0	3	3.16	0.27	3.24	1154
ISC	2001	6	3	14	58	12.30	29.890	–79.480	0	—	3.30	0.10	3.31	500
PDE	2001	6	11	18	27	54.25	30.226	–79.885	10	—	3.30	0.10	3.31	532
PDE	2001	8	4	1	13	25.38	34.292	–93.213	5	3	3.10	0.10	3.11	1582
SEUSN	2001	12	8	1	8	22.40	34.710	–86.231	0	5	3.90	0.10	3.91	1175
NENG	2002	1	12	8	26	53.23	28.126	–69.615	5	—	5.60	0.10	5.61	1101
PDE	2002	2	8	16	7	13.60	34.727	–98.361	5	5	3.80	0.10	3.81	>1609

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Table 2.5.2-201 (Sheet 23 of 25)
Earthquake Catalog for the Phase 1 Investigation Region [22°N to 35°N, 100°W to 65°W] for which the Events are Rmb Magnitude Greater than or Equal to 3.0 or Intensity [Int] Greater than or Equal to IV(4)

Catalog Reference[a]	Year	Month	Day	Hour	Min	Sec	Lat	Lon	Depth (km)	Int	Emb	Smb	Rmb	Epicenter (km)[b]
SEUSN	2002	5	21	20	35	31.90	32.456	–88.221	27	3	2.97	0.27	3.06	1092
PDE	2002	5	27	0	28	16.99	27.117	–94.442	10	—	3.80	0.10	3.81	1414
PDE	2002	5	31	9	57	10.02	34.025	–97.619	5	3	3.30	0.10	3.31	>1609
SEUSN	2002	7	26	21	7	03.00	33.060	–80.195	10	—	2.97	0.30	3.08	845
PDE	2002	9	19	14	44	36.15	27.822	–89.135	10	—	3.70	0.10	3.71	911
PDE	2002	10	20	2	18	13.00	34.274	–96.079	5	5	3.40	0.10	3.41	>1609
PDE	2002	10	26	20	5	55.93	34.029	–90.683	5	—	3.10	0.10	3.11	1380
PDE	2002	11	8	13	29	03.19	32.422	–79.950	3	—	3.50	0.10	3.51	775
NENG	2002	11	11	23	39	29.62	32.456	–79.927	6	—	4.20	0.10	4.21	778
PDE	2002	11	21	11	17	22.61	22.947	–70.252	10	—	3.90	0.10	3.91	1055
PDE	2003	3	18	6	4	24.21	33.689	–82.888	5	4	3.50	0.10	3.51	948
PDE	2003	4	13	4	52	53.92	26.087	–86.085	10	—	3.20	0.10	3.21	579
SEUSN	2003	4	29	8	59	38.10	34.445	–85.620	9	6	4.60	0.10	4.61	1121
SEUSN	2003	5	5	10	53	49.90	33.055	–80.190	11	—	3.06	0.30	3.17	844
ISC	2003	6	22	20	47	40.90	23.016	–65.416	10	—	3.70	0.10	3.71	1530
PDE	2003	7	13	20	15	16.96	32.335	–82.144	5	3	3.60	0.10	3.61	784
SEUSN	2003	9	30	2	28	04.50	31.022	–87.462	12	—	2.97	0.30	3.08	931
NENG	2003	10	10	14	48	17.25	23.142	–84.932	15	—	4.30	0.10	4.31	528
SEUSN	2003	12	22	23	50	26.00	32.924	–80.157	5	—	2.97	0.30	3.08	830
SEUSN	2004	3	20	10	40	34.80	33.267	–86.955	0	3	2.97	0.27	3.06	1079
PDE	2004	4	6	19	1	02.70	25.172	–99.532	37	—	4.33	0.30	4.44	>1609
SEUSN	2004	5	9	8	56	10.40	33.231	–86.960	5	3	3.30	0.10	3.31	1076
PDE	2004	6	8	0	15	09.99	34.233	–97.254	5	4	3.50	0.10	3.51	>1609
ISC	2004	6	18	19	20	56.40	27.027	–86.997	10	—	3.50	0.10	3.51	685
SEUSN	2004	7	20	9	13	14.40	32.972	–80.248	10	—	3.06	0.30	3.17	835
ISC	2004	8	7	18	13	42.10	23.001	–70.239	0	—	3.68	0.10	3.69	1054
SEUSN	2004	8	19	23	51	49.40	33.203	–86.968	5	3	3.50	0.10	3.51	1074
NENG	2004	9	18	7	7	47.57	23.119	–67.594	5	—	5.70	0.10	5.71	1311
NENG	2004	11	7	11	20	22.19	32.700	–87.888	8	—	4.59	0.10	4.60	1088

PTN COL 2.5-2

Table 2.5.2-201 (Sheet 24 of 25)
Earthquake Catalog for the Phase 1 Investigation Region [22°N to 35°N, 100°W to 65°W] for which the Events are Rmb Magnitude Greater than or Equal to 3.0 or Intensity [Int] Greater than or Equal to IV(4)

Catalog Reference[a]	Year	Month	Day	Hour	Min	Sec	Lat	Lon	Depth (km)	Int	Emb	Smb	Rmb	Epicenter (km)[b]
PDE	2004	11	22	23	42	13.45	34.864	–97.672	5	—	3.00	0.10	3.01	>1609
PRSN	2005	1	11	8	9	38.09	22.803	–66.947	25	—	4.20	0.23	4.26	1384
PDE	2005	3	22	8	11	50.51	31.836	–88.060	5	4	3.30	0.10	3.31	1034
ISC	2005	3	30	2	22	57.70	22.572	–94.790	0	—	4.00	0.10	4.01	1496
PDE	2005	4	22	5	17	04.09	34.179	–95.192	5	5	3.00	0.10	3.01	>1609
ISC	2005	8	10	1	18	35.70	22.119	–98.731	25	—	4.10	0.10	4.11	>1609
PRSN	2005	9	2	21	12	00.87	22.833	–70.272	25	—	4.60	0.23	4.66	1056
PDE	2005	9	19	2	29	52.54	23.950	–66.442	15	—	4.52	0.30	4.62	1407
PDE	2005	12	20	0	52	20.51	30.258	–90.708	5	4	3.00	0.10	3.01	1149
PDE	2006	2	10	4	14	22.20	27.828	–90.210	5	3	5.58	0.10	5.59	1014
ISC	2006	2	18	15	59	56.70	22.426	–80.966	0	—	3.00	0.10	3.01	336
ISC	2006	4	3	2	30	13.00	22.455	–99.889	16	—	4.10	0.10	4.11	>1609
PDE	2006	4	5	18	46	23.14	34.069	–97.314	5	—	3.00	0.10	3.01	>1609
PRSN	2006	5	7	20	46	45.01	22.334	–66.804	126	—	4.20	0.23	4.26	1412
ISC	2006	6	19	5	31	54.10	23.111	–75.594	25	—	3.40	0.10	3.41	542
ISC	2006	9	8	12	24	06.80	23.605	–71.845	25	—	3.60	0.10	3.61	879
NENG	2006	9	10	14	56	07.75	26.258	–86.630	14	—	5.90	0.10	5.91	635
ISC	2006	9	15	8	39	33.20	22.196	–79.886	0	—	3.20	0.10	3.21	359
ISC	2006	9	20	20	53	33.20	22.966	–75.623	0	—	3.90	0.10	3.91	548
PDE	2006	9	22	11	22	00.28	34.551	–79.583	5	—	3.40	0.10	3.41	1014
PDE	2006	9	25	5	44	25.09	34.746	–79.876	5	4	3.70	0.10	3.71	1034
PDE	2006	10	6	22	13	16.78	34.122	–97.625	5	4	3.50	0.10	3.51	>1609
ISC	2006	11	5	14	1	41.60	22.628	–67.065	126	—	4.80	0.10	4.81	1377
ISC	2006	12	17	17	24	54.20	22.434	–76.982	0	—	3.10	0.10	3.11	473
ISC	2007	3	6	7	3	06.70	22.028	–71.023	20	—	4.20	0.10	4.21	1016
ISC	2007	4	26	22	13	50.10	22.692	–75.015	25	—	3.00	0.10	3.01	616
PDE	2007	5	4	16	16	28.18	33.797	–87.299	5	—	3.00	0.10	3.01	1145
PDE	2007	5	16	13	22	21.42	33.300	–92.587	5	4	3.00	0.10	3.01	1471
ISC	2007	5	23	19	9	14.40	22.049	–96.387	10	—	5.40	0.10	5.41	>1609

PTN COL 2.5-2

Table 2.5.2-201 (Sheet 25 of 25)
Earthquake Catalog for the Phase 1 Investigation Region [22°N to 35°N, 100°W to 65°W] for which the Events are Rmb Magnitude Greater than or Equal to 3.0 or Intensity [Int] Greater than or Equal to IV(4)

Catalog Reference[(a)]	Year	Month	Day	Hour	Min	Sec	Lat	Lon	Depth (km)	Int	Emb	Smb	Rmb	Epicenter (km)[(b)]
ISC	2007	6	1	4	49	19.10	22.738	−71.141	0	—	4.00	0.10	4.01	976
ISC	2007	8	22	6	19	23.00	22.236	−71.628	25	—	4.90	0.23	4.96	949
PDE-W	2007	12	27	20	51	57.49	27.679	−71.076	10	—	4.60	0.10	4.61	951

(a) "EPRIm" are the "MAIN" events from the EPRI catalog.
"***c" are constituent catalogs from IPGH catalog
"***wy" are constituent catalogs from Wysession et al. catalog (Reference 338)
"***me" are constituent catalogs from the Mexico Composite Catalog
"***np" are constituent catalogs from National Geophysical Data Center USGS "PDE" catalog

(b) Distance to epicenter ">1609" is greater than 1000 miles.

(c) "X" indicates modified Mercalli Intensity of {Roman numeral} 10; "F" indicates the earthquake was felt.

PTN COL 2.5-2

Table 2.5.2-202
Conversion between Body-Wave (m_b) and Moment (M_w) Magnitudes[a]

Convert	To	Convert	To
m_b	M_w	M_w	m_b
4.00	3.77	4.00	4.28
4.10	3.84	4.10	4.41
4.20	3.92	4.20	4.54
4.30	4.00	4.30	4.66
4.40	4.08	4.40	4.78
4.50	4.16	4.50	4.90
4.60	4.24	4.60	5.01
4.70	4.33	4.70	5.12
4.80	4.42	4.80	5.23
4.90	4.50	4.90	5.33
5.00	4.59	5.00	5.43
5.10	4.69	5.10	5.52
5.20	4.78	5.20	5.61
5.30	4.88	5.30	5.70
5.40	4.97	5.40	5.78
5.50	5.08	5.50	5.87
5.60	5.19	5.60	5.95
5.70	5.31	5.70	6.03
5.80	5.42	5.80	6.11
5.90	5.54	5.90	6.18
6.00	5.66	6.00	6.26
6.10	5.79	6.10	6.33
6.20	5.92	6.20	6.40
6.30	6.06	6.30	6.47
6.40	6.20	6.40	6.53
6.50	6.34	6.50	6.60
6.60	6.49	6.60	6.66
6.70	6.65	6.70	6.73
6.80	6.82	6.80	6.79
6.90	6.98	6.90	6.85
7.00	7.16	7.00	6.91
7.10	7.33	7.10	6.97
7.20	7.51	7.20	7.03
7.30	7.69	7.30	7.09
7.40	7.87	7.40	7.15
7.50	8.04	7.50	7.20
—	—	7.60	7.26
—	—	7.70	7.32
—	—	7.80	7.37
—	—	7.90	7.43
—	—	8.00	7.49

(a) Average of relations given by References 210, 244, and 252.

PTN COL 2.5-2

Table 2.5.2-203 (Sheet 1 of 9)
Earthquake Catalog for the Phase 2 Investigation Region [15°N to 24°N, 100°W to 65°W] for which the Events are M_w Magnitude Greater than or Equal to 6.0

Catalog Reference[(a)]	Year	Month	Day	Hr	Min	Sec	Lat	Lon	Depth (km)	Int	M_w	Epicenter (km)[(b)]
CUBA	1502	0	0	0	0	0.00	18.400	–69.900	30	—	6.21	1324
{FELD	1539	11	24	0	0	0.00	16.750	–86.750	5	X[(c)]	7.69	1166}
CUBA	1562	12	3	1	0	0.00	19.600	–70.800	30	—	7.23	1168
CUBA	1578	8	0	0	0	0.00	19.900	–76.000	30	—	6.78	753
PM c	1591	3	14	0	0	0.00	16.000	–92.500	0	8	7.00	>1609
CUBA	1667	0	0	0	0	0.00	17.800	–77.000	30	—	6.78	909
CUBA	1673	5	9	11	30	0.00	18.400	–70.300	30	—	7.53	1291
CUBA	1678	2	11	14	59	0.00	19.900	–76.000	30	8[(d)]	6.78	753
CUBA	1684	0	0	0	0	0.00	18.400	–70.300	30	—	7.53	1291
NOAA	1691	0	0	0	0	0.00	18.300	–70.400	33	—	7.73	1289
CUBA	1692	6[(e)]	7[(e)]	0	0	0.00	18.200	–77.000	33	X[(c),(e)]	7.78	868
NOAA	1697	2	25	0	0	0.00	16.700	–99.200	0	—	7.83	>1609
CUBA	1701	11	9	0	0	0.00	18.700	–72.800	30	—	6.21	1072
SUARc	1711	8	15	0	0	0.00	19.000	–98.000	0	9	6.80	>1609
WHE c	1714	5	5	0	0	0.00	15.450	–92.200	10	7	6.23	>1609
WHE c	1728	0	0	0	0	0.00	15.755	–90.400	5	7	6.23	1496
WHE c	1741	2	15	0	0	0.00	15.750	–90.420	10	8	7.00	1497
W&C c	1743	5	30	0	0	0.00	16.750	–92.750	33	8	8.19	1603
WHE c	1750	3	8	0	0	0.00	15.450	–91.480	10	7	6.57	1600
CUBA	1751	9	16	3	29	0.00	18.600	–72.300	30	—	6.83	1117
CUBA	1751	10	18	20	0	0.00	18.400	–70.600	30	—	7.28	1266
NOAA	1754	9	1	0	0	0.00	16.700	–99.200	0	—	7.83	>1609
SAL c	1757	12	14	0	0	0.00	20.000	–75.833	10	—	6.23	755
CUBA	1760	7	11	0	0	0.00	19.900	–76.000	30	—	6.78	753
CUBA	1761	10	28	20	29	0.00	18.400	–69.900	30	—	6.21	1324
CUBA	1761	11	21	13	0	0.00	18.400	–70.800	30	—	6.64	1250
W&C c	1765	10	24	0	0	0.00	15.000	–91.916	0	8	7.59	>1609

SOF 2.5.2-23

SOF 2.5.1-24

PTN COL 2.5-2

Table 2.5.2-203 (Sheet 2 of 9)
Earthquake Catalog for the Phase 2 Investigation Region [15°N to 24°N, 100°W to 65°W] for which the Events are M_W Magnitude Greater than or Equal to 6.0

Catalog Reference[(a)]	Year	Month	Day	Hr	Min	Sec	Lat	Lon	Depth (km)	Int	M_W	Epicenter (km)[(b)]
CUBA	1766	6	12	5	14	0.00	19.900	–76.100	30	9[(f)]	7.53	747
CUBA	1770	6	4	0	15	0.00	18.600	–72.600	70	—	7.53	1095
SUARc	1776	4	21	0	0	0.00	16.800	100.000	0	9	7.70	>1609
CUBA	1783	2	11	0	0	0.00	19.700	–70.800	30	—	6.13	1162
SAL c	1784	7	29	0	0	0.00	19.780	–72.280	33	8	6.75	1033
NOAA	1785	0	0	0	0	0.00	16.700	–99.200	0	—	7.83	>1609
WHE c	1785	1	6	0	0	0.00	15.500	–89.700	5	9	7.40	1468
NOAA	1787	0	0	0	0	0.00	19.000	–66.000	33	—	8.03	>1609
SUARc	1787	3	28	0	0	0.00	16.000	–97.000	0	X[(c)]	8.40	>1609
CUBA	1793	4	0	0	0	0.00	18.400	–69.900	30	—	6.21	1324
WHE c	1795	12	29	0	0	0.00	15.375	–91.450	5	7	6.23	1604
SAL c	1798	5	28	0	0	0.00	18.800	–72.300	33	6	6.23	1102
WHE c	1798	7	2	0	0	0.00	15.080	–90.070	10	7	6.23	1529
W&C c	1804	0	0	0	0	0.00	16.500	–92.666	0	7	6.80	>1609
CUBA	1812	11	11	10	0	0.00	17.800	–77.000	20	—	6.13	909
NOAA	1816	7	22	0	0	0.00	15.500	–91.500	33	—	7.63	1598
SUARc	1820	5	4	0	0	0.00	16.500	–99.000	0	9	7.80	>1609
WHE c	1820	6	6	0	0	0.00	15.065	–90.320	5	7	6.23	1548
KSS c	1820	10	19	0	0	0.00	15.600	–88.050	10	8	6.44	1351
WHE c	1821	5	6	0	0	0.00	15.005	–91.165	15	8	6.37	>1609
SAL c	1826	9	18	9	8	0.00	19.500	–76.000	33	8	7.00	790
SAL c	1830	4	14	11	30	0.00	18.500	–72.300	10	7	6.57	1125
SUARc	1837	11	23	0	0	0.00	16.000	–98.000	0	—	7.70	>1609
CUBA	1842	5	7	22	15	0.00	19.800	–72.200	60	9[(d)]	8.23	1038
CUBA	1842	7	7	0	0	0.00	19.900	–76.000	30	—	6.13	753
CARIB	1844	4	16	13	20	0.00	18.300	–66.800	0	8	6.40	1599
SUARc	1845	8	7	0	0	0.00	16.800	100.000	0	X[(c)]	8.30	>1609
PM c	1851	5	17	0	0	0.00	15.083	–91.830	0	8	6.40	>1609
CUBA	1852	7	7	12	25	0.00	19.700	–79.700	30	9[(f)]	7.53	635

PTN COL 2.5-2

Table 2.5.2-203 (Sheet 3 of 9)
Earthquake Catalog for the Phase 2 Investigation Region [15°N to 24°N, 100°W to 65°W] for which the Events are M_W Magnitude Greater than or Equal to 6.0

Catalog Reference[a]	Year	Month	Day	Hr	Min	Sec	Lat	Lon	Depth (km)	Int	M_W	Epicenter (km)[b]
CUBA	1852	8	20	14	5	0.00	19.750	–75.320	30	—	7.33	809
CUBA	1852	11	26	8	44	0.00	19.900	–76.200	30	—	6.55	741
KSS c	1853	8	26	0	0	0.00	15.860	–86.265	0	7	6.03	1224
ROJ c	1856	5	5	0	0	0.00	16.400	–88.100	10	5	6.10	1282
KSS c	1856	8	4	22	47	0.00	16.750	–86.750	5	X[c]	7.69	1166
SAL c	1856	8	28	18	0	0.00	18.500	–65.000	33	6	6.40	>1609
CUBA	1858	1	28	10	14	0.00	19.900	–76.000	30	—	6.55	753
CUBA	1860	4	9	3	30	0.00	18.600	–73.200	50	—	6.73	1051
SAL c	1860	10	23	0	0	0.00	18.500	–67.500	33	7	6.57	1525
SUARc	1864	10	3	0	0	0.00	19.000	–97.000	0	9	7.40	>1609
SAL c	1865	8	30	0	0	0.00	18.000	–66.500	33	6	6.07	>1609
SAL c	1867	11	12	5	0	0.00	19.000	–76.250	10	6	6.40	823
SAL c	1867	11	18	20	0	0.00	18.500	–65.000	33	8	7.50	>1609
SAL c	1870	9	11	0	0	0.00	19.000	–77.000	10	6	6.23	787
SAL c	1874	8	26	11	15	0.00	19.000	–66.000	50	6	6.40	>1609
SAL c	1875	12	9	0	0	0.00	19.000	–67.000	50	7	6.40	1541
CUBA	1880	1	23	4	39	0.00	22.700	–83.000	15	8[f]	6.13	404
SAL c	1880	12	30	0	0	0.00	18.250	–76.500	10	6	6.07	885
KSS c	1881	4	23	0	0	0.00	16.550	–87.500	10	8	6.44	1230
SAL c	1882	0	0	0	0	0.00	18.500	–70.000	33	6	6.23	1309
SUARc	1882	7	19	0	0	0.00	18.000	–98.000	0	9	6.70	>1609
CUBA	1887	9	23	11	55	0.00	19.400	–73.400	60	9[d]	7.93	973
NOAA	1897	6	5	0	0	0.00	17.000	–96.300	0	—	7.03	>1609
CUBA	1897	12	29	11	32	0.00	20.100	–71.200	50	—	7.03	1102
NOAA	1899	1	24	23	43	0.00	17.000	–98.000	60	—	8.42	>1609
AMB c	1899	3	25	14	27	0.00	16.800	–92.800	35	—	6.26	1604
GUT c	1899	6	14	0	0	0.00	18.000	–77.000	0	—	7.80	888
CHA c	1902	1	16	0	0	0.00	17.620	–99.720	0	—	7.00	>1609
EV02	1902	2	17	0	31	0.00	20.000	–70.000	0	—	6.93	1214

PTN COL 2.5-2

Table 2.5.2-203 (Sheet 4 of 9)
Earthquake Catalog for the Phase 2 Investigation Region [15°N to 24°N, 100°W to 65°W] for which the Events are M_W Magnitude Greater than or Equal to 6.0

Catalog Reference[a]	Year	Month	Day	Hr	Min	Sec	Lat	Lon	Depth (km)	Int	M_w	Epicenter (km)[b]
EV02	1902	9	23	20	18	0.00	16.000	–93.000	0	—	7.80	>1609
EV02	1903	1	14	1	47	0.00	15.000	–98.000	0	—	7.40	>1609
GUT c	1903	8	16	0	0	0.00	20.000	–72.000	0	—	6.44	1041
MACRc	1906	6	22	0	0	0.00	19.500	–76.000	10	7	6.57	790
CUBA	1907	1	14	20	29	0.00	18.400	–76.800	20	—	6.64	856
EV02	1907	4	15	6	8	6.00	17.000	100.000	0	—	7.90	>1609
EV02	1908	3	26	23	3	30.00	18.000	–99.000	80	—	7.73	>1609
EV02	1910	1	1	11	2	0.00	16.500	–84.000	60	—	7.10	1057
CHA c	1911	2	3	0	0	0.00	18.200	–96.360	80	—	7.19	>1609
EV02	1911	10	6	10	16	12.00	19.000	–70.500	0	—	6.83	1233
CUBA	1912	4	9	8	32	29.00	19.000	–85.000	0	—	7.69	855
EV02	1912	6	12	12	43	42.00	17.000	–89.000	0	—	6.83	1292
EV02	1912	11	19	13	55	0.00	19.000	100.000	80	—	6.93	>1609
EV02	1912	12	9	8	32	24.00	15.500	–93.000	0	—	7.10	>1609
CUBA	1914	2	28	5	19	0.00	21.300	–76.200	50	—	6.29	619
ISSv	1914	3	30	0	41	11.00	19.000	–96.000	0	—	7.23	>1609
ISC	1914	8	3	11	25	30.00	18.500	–76.500	35	—	6.13	1136
CUBA	1914	8	25	5	19	0.00	19.530	–76.370	30	—	6.73	766
ISSv	1915	10	11	19	32	50.00	18.000	–69.500	0	—	6.83	1385
EV02	1916	6	2	13	59	24.00	17.500	–95.000	150	—	7.03	>1609
ISSv	1916	11	21	6	25	24.00	18.000	100.000	0	—	6.80	>1609
ISSv	1916	11	30	3	17	50.00	19.000	–70.000	0	—	7.00	1275
ISSv	1917	2	20	19	29	32.00	19.000	–80.000	0	6[d]	7.20	710
ISSv	1918	10	11	14	14	25.00	18.500	–68.000	0	—	7.30	1480
AMB c	1918	10	19	3	22	45.00	15.000	–91.000	35	—	6.24	1602
ISSv	1920	1	4	4	21	58.00	18.200	–97.500	0	—	7.83	>1609
ISSv	1920	4	19	21	6	25.00	18.400	–94.300	0	—	6.83	>1609
ISSv	1921	2	4	8	22	35.00	16.500	–89.500	0	—	7.43	1369
ISSv	1922	12	18	12	34	48.00	18.500	–68.000	0	—	6.29	1480

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Table 2.5.2-203 (Sheet 5 of 9)
Earthquake Catalog for the Phase 2 Investigation Region [15°N to 24°N, 100°W to 65°W] for which the Events are M_w Magnitude Greater than or Equal to 6.0

Catalog Reference[a]	Year	Month	Day	Hr	Min	Sec	Lat	Lon	Depth (km)	Int	M_w	Epicenter (km)[b]
ISSv	1923	11	3	8	37	40.00	19.000	–74.000	95	—	6.13	962
ISSv	1925	6	14	22	28	6.00	17.500	–83.000	0	—	6.55	917
ISSv	1925	12	10	14	14	42.00	15.500	–92.500	0	—	7.00	>1609
ISSv	1928	3	22	4	16	50.00	16.000	–96.000	0	—	7.50	>1609
ISSv	1928	4	17	3	25	12.00	17.500	–94.500	0	—	7.73	>1609
ISSv	1928	6	17	3	19	19.00	16.200	–97.200	0	—	7.70	>1609
ISSv	1929	8	17	23	40	36.00	16.300	–99.000	0	—	6.17	>1609
ISSv	1931	1	15	1	50	49.00	16.400	–96.300	0	—	7.80	>1609
ISSv	1931	7	17	9	13	50.00	16.200	–97.200	0	—	6.29	>1609
ISSv	1931	9	26	19	50	33.00	15.000	–91.500	0	—	6.13	>1609
ISSv	1932	2	3	6	16	3.00	19.700	–75.500	0	—	6.83	802
ISSv	1932	6	6	11	50	0.00	19.600	–76.500	0	—	6.13	753
ISSv	1934	1	28	19	10	10.00	16.900	–99.600	0	—	6.83	>1609
ISC	1934	7	27	2	25	45.00	16.000	–92.500	50	—	6.29	>1609
ISC	1934	12	3	2	38	29.00	15.000	–88.750	35	—	6.29	1449
ISSv	1937	5	28	15	35	51.00	17.100	–93.400	95	—	6.55	>1609
ISSv	1937	7	26	3	47	3.00	18.500	–95.700	0	—	7.23	>1609
ISSv	1937	12	23	13	17	54.00	16.300	–98.600	0	—	7.40	>1609
ISC	1938	6	28	19	17	42.00	18.000	100.000	110	—	6.55	>1609
ISSv	1939	6	12	4	5	9.00	20.500	–66.000	0	—	6.29	1559
ISC	1939	9	28	14	58	27.00	15.500	–91.500	110	—	6.29	1598
ISSv	1941	4	7	23	29	17.00	17.500	–78.400	0	—	7.03	897
ISSv	1941	6	27	17	11	37.00	17.100	–93.400	160	—	6.29	>1609
ISSv	1942	10	28	10	44	39.00	15.000	–96.100	0	—	6.29	>1609
ISSv	1942	11	12	4	55	25.00	16.500	–94.400	0	—	6.83	>1609
ISSv	1943	7	29	3	2	14.00	19.100	–67.100	0	—	7.60	1526
EV02	1943	9	23	15	0	44.00	15.000	–91.500	110	—	6.83	>1609
EV02	1944	6	28	7	58	54.00	15.000	–92.500	0	—	7.13	>1609
ISSv	1945	10	11	16	53	2.00	18.300	–97.600	95	—	6.55	>1609

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Table 2.5.2-203 (Sheet 6 of 9)
Earthquake Catalog for the Phase 2 Investigation Region [15°N to 24°N, 100°W to 65°W] for which the Events are M_W Magnitude Greater than or Equal to 6.0

Catalog Reference[a]	Year	Month	Day	Hr	Min	Sec	Lat	Lon	Depth (km)	Int	M_W	Epicenter (km)[b]
ISSv	1946	3	25	8	47	39.00	19.700	–74.700	0	—	6.13	855
ISSv	1946	5	15	22	10	34.00	15.500	–96.700	0	—	6.17	>1609
ISSv	1946	6	7	4	13	22.00	16.900	–94.200	95	—	6.93	>1609
ISSv	1946	8	4	17	51	4.00	18.900	–68.900	0	—	7.90	1377
ISSv	1946	8	8	13	28	28.00	19.600	–69.400	0	—	7.50	1290
ISSv	1947	8	7	0	40	20.00	19.900	–75.300	0	—	6.83	798
ISSv	1948	1	6	17	25	48.00	16.000	–98.400	0	—	7.03	>1609
ISSv	1948	8	11	10	36	18.00	17.700	–95.200	65	—	6.83	>1609
ISSv	1949	12	22	9	30	47.00	15.900	–93.000	65	—	6.57	>1609
ISSv	1950	8	3	6	14	55.00	18.100	–99.900	95	—	6.18	>1609
PDEnp	1950	10	23	17	5	25.00	15.000	–91.500	0	—	7.53	>1609
ISSv	1950	12	14	14	15	43.00	16.300	–98.600	0	—	7.30	>1609
ISSv	1951	12	12	1	37	40.00	16.500	–96.900	160	—	7.03	>1609
ISSv	1952	1	31	20	16	49.00	15.000	–93.800	95	—	6.34	>1609
ISSv	1952	5	14	21	11	35.00	16.500	–86.500	0	—	6.10	1175
ISSv	1952	10	28	4	29	52.00	18.300	–73.300	0	—	7.03	1069
ISSv	1953	5	31	19	58	39.00	19.400	–70.400	33	—	6.93	1215
PEREZ	1953	12	1	15	18	33.00	16.400	–98.850	0	—	6.70	>1609
ISC	1954	1	28	22	14	52.00	16.530	–99.720	0	—	6.04	>1609
ISSv	1954	5	13	14	46	39.00	16.900	–95.900	65	—	6.60	>1609
ISSv	1954	12	10	13	0	27.00	17.800	–81.800	0	—	6.37	855
ISSv	1955	9	26	8	28	31.00	15.900	–92.200	225	—	6.93	>1609
ISSv	1956	7	9	9	56	12.00	20.000	–72.950	40	—	6.93	963
ISSv	1956	11	9	13	6	15.00	17.450	–94.080	130	—	6.48	>1609
ISSv	1957	3	2	0	27	36.00	18.300	–78.150	0	—	6.61	818
ISSv	1957	4	10	5	12	7.00	15.530	–98.040	0	—	6.70	>1609
ISSv	1957	5	15	2	11	9.00	16.750	–93.510	125	—	6.03	>1609
ISSv	1957	7	28	8	40	7.00	17.070	–99.150	0	—	7.80	>1609
ISSv	1957	9	12	0	28	3.00	16.990	–85.600	0	—	6.04	1079

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Table 2.5.2-203 (Sheet 7 of 9)
Earthquake Catalog for the Phase 2 Investigation Region [15°N to 24°N, 100°W to 65°W] for which the Events are M_w Magnitude Greater than or Equal to 6.0

Catalog Reference[a]	Year	Month	Day	Hr	Min	Sec	Lat	Lon	Depth (km)	Int	M_w	Epicenter (km)[b]
ISSv	1959	1	27	0	20	24.00	18.080	–68.660	90	—	6.04	1450
ISSv	1959	2	20	18	16	20.00	15.940	–90.590	48	7	6.57	1494
ISSv	1959	4	12	9	54	56.00	17.070	–95.040	124	—	6.40	>1609
PEREZ	1959	4	28	11	9	46.00	15.830	–92.830	0	—	6.34	>1609
ISSv	1959	5	24	19	17	40.00	17.610	–97.170	63	—	6.37	>1609
ISSv	1959	8	26	8	25	31.00	18.260	–94.430	0	—	6.93	>1609
ISC	1961	10	12	13	53	28.00	18.800	–65.000	50	—	6.37	>1609
ISSv	1961	11	16	8	19	49.00	18.500	–69.260	78	—	6.13	1371
PEREZ	1961	12	4	7	36	22.00	18.200	–69.100	0	—	6.34	1404
ISSv	1962	1	8	1	0	19.00	18.480	–70.400	0	—	6.73	1277
ISSv	1962	4	20	5	47	52.00	20.500	–72.140	0	—	6.73	997
ISSv	1962	4	22	4	45	26.00	15.470	–93.080	113	—	6.13	>1609
ISSv	1962	5	11	14	11	55.00	17.260	–99.630	37	—	7.30	>1609
ISSv	1962	5	20	15	1	15.00	20.630	–65.800	0	—	6.52	1573
ISSv	1962	7	24	21	8	22.00	15.420	–92.490	134	—	6.06	>1609
ISSv	1962	7	25	4	37	42.00	18.900	–81.410	0	—	6.29	728
EV02	1965	4	3	11	29	12.66	16.024	–97.861	30	—	6.29	>1609
NENG	1965	8	23	19	46	1.63	16.176	–95.847	10	—	6.73	>1609
CUBA	1965	10	16	9	30	0.00	18.500	–77.900	10	—	6.13	804
PDEnp	1965	12	9	6	7	47.70	17.300	100.000	54	—	6.04	>1609
PEREZ	1967	2	4	14	8	50.00	24.000	–65.700	1	—	6.43	1480
NENG	1968	8	2	14	6	46.18	16.493	–97.771	49	—	6.37	>1609
W&C c	1970	4	29	0	0	0.00	15.000	–92.333	56	—	7.09	>1609
NENG	1971	6	11	12	56	6.75	17.983	–69.809	59	—	6.04	1360
NENG	1972	9	16	9	14	35.88	15.187	–96.263	32	—	6.04	>1609
NENG	1973	8	28	9	50	41.02	18.233	–96.608	80	—	6.73	>1609
NENG	1976	2	4	9	1	46.20	15.296	–89.145	12	—	7.50	1448
NENG	1977	8	20	3	51	56.50	16.720	–86.638	31	—	6.40	1162
NENG	1978	3	19	1	39	11.37	16.932	–99.782	11	—	6.60	>1609

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Table 2.5.2-203 (Sheet 8 of 9) Earthquake Catalog for the Phase 2 Investigation Region [15°N to 24°N, 100°W to 65°W] for which the Events are M_w Magnitude Greater than or Equal to 6.0

Catalog Reference[a]	Year	Month	Day	Hr	Min	Sec	Lat	Lon	Depth (km)	Int	M_w	Epicenter (km)[b]
NENG	1978	11	29	19	52	50.15	16.011	–96.603	24	—	7.80	>1609
NENG	1979	3	23	19	32	32.73	17.963	–69.077	81	—	6.70	1422
NENG	1979	6	22	6	30	56.37	17.008	–94.623	113	—	6.90	>1609
NENG	1979	10	1	14	14	12.04	15.762	–92.198	164	—	6.20	>1609
NENG	1980	8	9	5	45	10.49	15.912	–88.490	16	—	6.50	1350
NENG	1980	10	24	14	53	35.55	18.175	–98.235	64	—	7.20	>1609
NENG	1981	9	14	12	44	31.00	18.260	–68.919	169	—	6.10	1416
NENG	1982	4	10	16	25	37.53	17.502	–83.427	19	—	6.30	931
NENG	1982	6	7	6	52	33.45	16.407	–98.294	8	—	6.90	>1609
NENG	1983	1	24	8	17	40.21	16.131	–95.238	48	—	6.80	>1609
NENG	1983	9	15	10	39	4.02	16.088	–93.179	118	—	6.30	>1609
NENG	1984	6	24	11	17	16.32	17.981	–69.371	45	—	6.70	1397
NENG	1984	7	2	4	50	44.25	16.753	–98.493	34	—	6.20	>1609
NENG	1985	9	15	7	57	55.31	17.940	–97.185	68	—	6.00	>1609
NENG	1986	7	5	22	9	34.27	15.488	–92.523	72	—	6.00	>1609
NENG	1987	3	12	12	18	13.86	15.545	–94.618	45	—	6.10	>1609
NENG	1987	7	15	7	16	14.62	17.508	–97.153	64	—	6.20	>1609
NENG	1988	11	3	19	42	20.70	19.000	–67.329	40	—	6.00	1511
NENG	1989	4	25	14	29	2.07	16.779	–99.275	19	—	6.90	>1609
NENG	1989	9	16	23	20	54.80	16.463	–93.661	113	—	6.10	>1609
NENG	1992	5	25	16	55	5.82	19.618	–77.883	23	7[f]	6.80	688
PRSN	1992	11	20	22	13	21.00	19.060	–71.660	47	—	6.37	1134
NENG	1993	5	15	3	12	35.09	16.725	–98.325	25	—	6.10	>1609
NENG	1993	9	30	18	27	50.98	15.176	–94.851	19	—	6.50	>1609
NENG	1993	10	24	7	52	17.07	16.753	–98.758	21	—	6.60	>1609
NENG	1994	3	14	20	51	25.80	15.943	–92.403	164	—	6.90	>1609
NENG	1995	6	27	10	10	0.41	18.794	–81.767	15	—	6.00	746
NENG	1995	9	14	14	4	33.23	16.849	–98.608	23	—	7.40	>1609
NENG	1995	10	21	2	38	58.25	16.836	–93.465	159	—	7.20	>1609

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Table 2.5.2-203 (Sheet 9 of 9)
Earthquake Catalog for the Phase 2 Investigation Region [15°N to 24°N, 100°W to 65°W] for which the Events are M_w Magnitude Greater than or Equal to 6.0

Catalog Reference[a]	Year	Month	Day	Hr	Min	Sec	Lat	Lon	Depth (km)	Int	M_w	Epicenter (km)[b]
NENG	1997	7	19	14	22	7.07	16.203	–98.154	15	—	6.70	>1609
NENG	1998	2	3	3	2	0.63	15.900	–96.245	24	—	6.30	>1609
NENG	1998	6	7	23	20	14.04	15.966	–93.741	75	—	6.30	>1609
NENG	1999	6	15	20	42	6.60	18.381	–97.445	63	—	7.00	>1609
NENG	1999	7	11	14	14	18.97	15.791	–88.285	15	—	6.70	1348
NENG	1999	9	30	16	31	14.81	16.055	–96.905	40	—	7.50	>1609
NENG	1999	12	1	19	23	8.62	17.667	–82.370	15	—	6.30	882
NENG	2000	3	12	22	21	31.62	15.141	–92.411	53	—	6.30	>1609
ISC	2000	12	4	4	42	15.40	15.014	–93.833	36	—	6.13	>1609
NENG	2001	11	28	14	32	34.62	15.683	–93.118	84	—	6.40	>1609
NENG	2003	9	22	4	45	38.67	19.766	–70.693	14	—	6.40	1167
NENG	2004	12	14	23	20	13.77	18.939	–81.384	13	—	6.80	724
NENG	2005	3	17	13	37	36.93	15.183	–91.360	194	—	6.20	>1609
NENG	2007	2	4	20	56	58.82	19.326	–78.521	10	—	6.20	698
NENG	2007	7	6	1	9	18.50	16.493	–93.638	113	—	6.10	>1609
PDE-W	2008	2	12	12	50	18.49	16.360	–94.300	83	—	6.40	>1609

(a) "***c" are constituent catalogs from IPGH catalog
"***np" are constituent catalogs from National Geophysical Data Center USGS "PDE" catalog
(b) Distance to epicenter ">1609" is greater than 1000 miles.
(c) "X" indicates modified Mercalli Intensity of {Roman numeral} 10.
(d) McCann (Reference 282).
(e) DeMets and Wiggins-Grandison (Reference 229).
(f) Garcia et al. (Reference 254).

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Table 2.5.2-204
Seismicity Events Recommended for Recurrence Analysis within the Gulf of Mexico

Earthquakes in the Gulf of Mexico: MAIN [or equivalent] Events, Rmb ≥ 3.0 or Int ≥ IV(4)													
Source Catalog[(a)]	Year	Month	Day	Hour	Minute	Second	Lat	Lon	Depth (km)	Int	Emb	Smb	Rmb
EPRIm	1927	12	15	4	30	0.00	28.900	–89.400	0	4	3.80	0.30	3.90
EPRIm	1929	7	28	17	0	0.00	28.900	–89.400	0	4	3.80	0.30	3.90
EPRIm	1958	11	6	23	8	0.00	29.900	–90.100	0	4	3.11	0.56	3.47
EPRIm	1963	11	5	22	45	3.40	27.490	–92.580	15	—	4.71	0.20	4.76
ISC	1967	3	21	20	41	27.00	24.000	–97.000	33	—	3.90	0.10	3.91
ISC	1967	10	4	2	45	45.00	27.000	–94.000	33	—	3.20	0.10	3.21
ISC c	1974	9	13	17	29	57.80	23.782	–96.428	0	—	3.60	0.10	3.61
EPRIm	1978	7	24	8	6	16.90	26.380	–88.720	15	—	4.88	0.10	4.89
EPRIm	1980	1	10	19	16	23.50	24.130	–85.710	15	—	3.88	0.10	3.89
ANSS	1984	1	23	0	11	59.38	26.716	–87.339	5	—	2.85	0.41	3.04
TElme	1984	1	23	1	15	9.40	26.716	–87.339	5	—	2.85	0.41	3.04
PDE	1992	3	31	14	59	39.64	26.019	–85.731	5	—	3.80	0.10	3.81
TEIC	1992	9	27	17	2	25.70	27.225	–88.711	10	—	3.80	0.10	3.81
PDE	1992	11	30	8	33	1.48	23.251	–98.199	10	—	4.61	0.30	4.71
PDE	1994	6	30	1	8	24.22	27.911	–90.177	10	—	4.20	0.10	4.21
PDE	1997	4	18	14	57	35.39	25.782	–86.552	33	—	3.90	0.10	3.91
PDE	1998	7	6	6	54	3.79	25.016	–93.633	10	—	3.40	0.10	3.41
PDE	2000	12	9	6	46	9.12	28.027	–90.171	10	—	4.96	0.10	4.97
PDE	2001	3	16	4	39	7.68	28.361	–89.029	10	—	3.60	0.10	3.61
PDE	2002	5	27	0	28	16.99	27.117	–94.442	10	—	3.80	0.10	3.81
PDE	2002	9	19	14	44	36.15	27.822	–89.135	10	—	3.70	0.10	3.71
PDE	2003	4	13	4	52	53.92	26.087	–86.085	10	—	3.20	0.10	3.21
NENG	2003	10	10	14	48	17.25	23.142	–84.932	15	—	4.30	0.10	4.31
ISC	2004	6	18	19	20	56.40	27.027	–86.997	10	—	3.50	0.10	3.51
PDE	2006	2	10	4	14	22.20	27.828	–90.210	5	3	5.58	0.10	5.59
NENG	2006	9	10	14	56	7.75	26.258	–86.630	14	—	5.90	0.10	5.91

(a) "EPRIm" are the "MAIN" events from the EPRI catalog.
"***c" are constituent catalogs from IPGH catalog.
"***me" are constituent catalogs from the Mexico Composite Catalog.

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Table 2.5.2-205 (Sheet 1 of 2)
Region 2 Matrix of Detection Probabilities; Modified to Extend the Matrix to Year 2007

Detection Probability Matrix: EPRI (Reference 243) Incompleteness Region 2 [Modified]								
	Year Intervals							
	1625–1779	1780–1859	1860–1909	1910–1949	1950–1974	1975–1084	1985–2007	
Magnitude Intervals	**155 years**	**80 years**	**50 years**	**40 years**	**25 years**	**10 years**	**23 years**	**Total Years**
3.3–3.89	0.00	0.00	0.10	0.51	0.63	1.00	1.00	74.2
3.9–4.49	0.00	0.00	0.15	0.90	1.00	1.00	1.00	101.5
4.5–5.09	0.00	0.00	0.24	0.98	1.00	1.00	1.00	109.2
5.1–5.69	0.00	0.00	0.24	0.98	1.00	1.00	1.00	109.2
5.7–6.29	0.00	0.00	0.70	1.00	1.00	1.00	1.00	133.0
6.3–7.5	0.00	0.01	1.00	1.00	1.00	1.00	1.00	148.8

Detection Probability Matrix: EPRI (Reference 243) Incompleteness Region 2 [Modified]												
	Year Intervals											
	1625–1779	**1780–1859**	**1860–1899**	**1900–1924**	**1925–1949**	**1950–1959**	**1960–1964**	**1965–1969**	**1970–1974**	**1975–1979**	**1980–2007**	
Magnitude Intervals	**155 years**	**80 years**	**40 years**	**25 years**	**25 years**	**10 years**	**5 years**	**5 years**	**5 years**	**5 years**	**28 years**	**Total Years**
3.3–3.89	0.00	0.00	0.10	0.31	0.51	0.55	0.60	0.65	0.80	1.00	1.00	73.1
3.9–4.49	0.00	0.00	0.15	0.53	0.90	0.99	1.00	1.00	1.00	1.00	1.00	99.5
4.5–5.09	0.00	0.00	0.24	0.61	0.98	0.99	1.00	1.00	1.00	1.00	1.00	107.3
5.1–5.69	0.00	0.00	0.24	0.61	0.98	0.99	1.00	1.00	1.00	1.00	1.00	107.3
5.7–6.29	0.00	0.00	0.70	0.85	1.00	1.00	1.00	1.00	1.00	1.00	1.00	132.3
6.3–7.5	0.00	0.01	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	148.8

PTN COL 2.5-2

Table 2.5.2-205 (Sheet 2 of 2)
Region 2 Matrix of Detection Probabilities; Modified to Extend the Matrix to Year 2007

Detection Probability Matrix: EPRI (Reference 243) Incompleteness Region 13 [Modified]												
	Year Intervals											
	1625–1779	1780–1859	1860–1899	1900–1924	1925–1949	1950–1959	1960–1964	1965–1969	1970–1974	1975–1979	1980–2007	
Magnitude Intervals	155 years	80 years	40 years	25 years	25 years	10 years	5 years	5 years	5 years	5 years	28 years	Total Years
3.3–3.89	0.00	0.00	0.24	0.48	0.71	0.80	0.88	0.93	0.98	1.00	1.00	94.2
3.9–4.49	0.00	0.00	0.24	0.51	0.77	0.90	0.97	0.98	0.99	1.00	1.00	98.2
4.5–5.09	0.00	0.00	0.30	0.61	0.92	0.97	0.99	1.00	1.00	1.00	1.00	107.9
5.1–5.69	0.00	0.03	0.69	0.84	0.99	0.99	1.00	1.00	1.00	1.00	1.00	133.7
5.7–6.29	0.11	0.54	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	207.2
6.3–7.5	0.51	0.90	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	299.1

PTN COL 2.5-2

Table 2.5.2-206
Matrix of Detection Probabilities for the Gulf of Mexico

Detection Probability Matrix: Gulf of Mexico and Near Atlantic												
	Year Intervals											
	1625–1779	1780–1859	1860–1899	1900–1924	1925–1949	1950–1959	1960–1964	1965–1969	1970–1974	1975–1979	1980–2007	
Magnitude Intervals	155 years	80 years	40 years	25 years	25 years	10 years	5 years	5 years	5 years	5 years	28 years	Total Years
3.3–3.89	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.30	8.4
3.9–4.49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.60	19.3
4.5–5.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.70	0.70	0.90	34.7
5.1–5.69	0.00	0.00	0.00	0.00	0.00	0.00	0.70	0.90	1.00	1.00	1.00	46.0
5.7–6.29	0.00	0.00	0.00	0.00	0.70	0.90	1.00	1.00	1.00	1.00	1.00	74.5
6.3–7.5	0.00	0.00	0.00	0.30	0.90	1.00	1.00	1.00	1.00	1.00	1.00	88.0

Detection Probability Matrix: Near Florida												
	Year Intervals											
	1625–1779	1780–1859	1860–1899	1900–1924	1925–1949	1950–1959	1960–1964	1965–1969	1970–1974	1975–1979	1980–2007	
Magnitude Intervals	155 years	80 years	40 years	25 years	25 years	10 years	5 years	5 years	5 years	5 years	28 years	Total Years
3.3–3.89	0.00	0.00	0.12	0.24	0.36	0.40	0.44	0.47	0.49	0.50	0.65	51.3
3.9–4.49	0.00	0.00	0.12	0.25	0.39	0.45	0.49	0.49	0.50	0.75	0.80	58.7
4.5–5.09	0.00	0.00	0.15	0.31	0.46	0.49	0.50	0.75	0.85	0.85	0.95	71.3
5.1–5.69	0.00	0.02	0.35	0.42	0.50	0.50	0.85	0.95	1.00	1.00	1.00	89.8
5.7–6.29	0.06	0.27	0.49	0.50	0.85	0.95	1.00	1.00	1.00	1.00	1.00	140.9
6.3–7.5	0.26	0.45	0.50	0.65	0.95	1.00	1.00	1.00	1.00	1.00	1.00	193.5

PTN COL 2.5-2

Table 2.5.2-207 (Sheet 1 of 2) Summary of EPRI Seismic Sources within the Site Region

Source	Description	Pa[a]	Mmax (m_b) and Weights[b]	Smoothing Options and Weights[c]	Interdependencies[d]	Largest Earthquake in Catalog (Emb)		New Data to Suggest Change in Source?			Updated Mmax (m_b) and Weights
						EPRI catalog (1627–1984)	Phase 1 Updated Catalog (1698–2007)	Geom.[e]	Mmax[f]	RI[g]	
Bechtel Group											
{BZ1	Gulf Coast	1.00	5.4 [0.10] 5.7 [0.40] 6.0 [0.40] 6.6 [0.10]	1 [0.33] 2 [0.34] 3 [0.33]	Background P_B=1.00	4.9	5.9	No	Yes	No	6.1 [0.10] 6.4 [0.40] 6.6 [0.10] 6.7 [0.40]}
Dames & Moore											
20	So. Coastal Marg.	1.00	5.3 [0.80] 7.2 [0.20]	1 [0.75] 2 [0.25]	None	4.6	5.6	No	Yes	No	5.6 [0.80] 7.2 [0.20]
Law Engineering											
126	South Coastal Block	1.00	4.6 [0.90] 4.9 [0.10]	1a [1.00]	Background P_B=0.49	4.4	5.0	No	Yes	No	5.6 [0.90] 5.7 [0.10]
Rondout Associates											
49-05	Appalachian Basement	1.00	4.8 [0.20] 5.5 [0.60] 5.8 [0.20]	2 [1.00]	Background P_B=1.00	4.4	5.0	No	Yes	No	5.0 [0.20] 5.5 [0.60] 5.8 [0.20]
51	Gulf Coast to Bahamas Fract. Zone	1.00	4.8 [0.20] 5.5 [0.60] 5.8 [0.20]	3 [1.00]	Background P_B=1.00	4.9	5.9	No	Yes	No	6.1 [0.30] 6.3 [0.55] 6.5 [0.15]
Weston Geophysical											
107	Gulf Coast	1.00	5.4 [0.71] 6.0 [0.29]	1a [0.20] 2a [0.80]	Background P_B=1.00	4.9	5.9	No	Yes	No	6.6 [0.89] 7.2 [0.11]
Woodward-Clyde Consultants											
BG-35	Turkey Point Background	N/A	5.8 [0.33] 6.2 [0.34] 6.6 [0.33]	1 [0.25] 6 [0.25] 7 [0.25] 8 [0.25]	N/A	3.7	6.1	Yes	No	No	5.8 [0.33] 6.2 [0.34] 6.6 [0.33]

SOF 2.5.2-20

PTN COL 2.5-2

Table 2.5.2-207 (Sheet 2 of 2)
Summary of EPRI Seismic Sources within the Site Region

Notes:

(a) Pa = Probability of activity (**Reference 243**)
(b) Maximum Magnitude (Mmax) and weights (**Reference 243**)
(c) Smoothing options are defined as follows (**Reference 243**):
Bechtel
1 = constant a, constant b (no prior); 2 = low smoothing on a, high smoothing on b (no prior); 3 = low smoothing on a, low smoothing on b (no prior)
Weights on magnitude intervals are all 1.0
Dames & Moore
1 = no smoothing on a, no smoothing on b (strong prior of 1.04); 2 = no smoothing on a, no smoothing on b (weak prior of 1.04)
Weights on magnitude units are [0.1, 0.2, 0.4, 1.0, 1.0, 1.0, 1.0]
Law Engineering
1a = high smoothing on a, constant b (strong prior of 1.05)
Weights on magnitude units are [0.0, 1.0, 1.0, 1.0, 1.0, 1.0, 1.0]
Rondout Associates
3 = low smoothing on a, constant b (strong prior of 1.0)
Weston Geophysical
1a = constant a, constant b (medium prior of 1.04); 2a = medium smoothing on a, medium smoothing on b (medium prior of 1.0)
Woodward-Clyde Consultants
1 = low smoothing on a, high smoothing on b (no prior); 6 = low smoothing on a, high smoothing on b (moderate prior of 1.0);
7 = low smoothing on a, high smoothing on b (moderate prior of 0.9); 8 = low smoothing on a, high smoothing on b (moderate prior of 0.8)
Weights on magnitude intervals are all 1.0
(d) P_B = the fraction of area of the background that is active (**Reference 243**)
(e) No, unless (1) new geometry proposed in literature or (2) new seismicity pattern.
(f) No, unless (1) new data suggest Mmax exceeds or differs significantly from the EPRI Mmax distribution or (2) exceeded by historical seismicity
(g) RI = recurrence interval; assumed no change if no new paleoseismic data or rate of seismicity has not significantly changed
N/A = Not Applicable

PTN COL 2.5-2

Table 2.5.2-208 (Sheet 1 of 2) Mean and Fractile Seismic Hazard Data for Crystal River Site from EPRI-SOG Study and Units 6 & 7 Study

PGA		Bechtel			Dames & More			Law Engineering		
Ampl. cm/s^2	Hazard	EPRI-SOG	Units 6 & 7 Study	% diff	EPRI-SOG	Units 6 & 7 Study	% diff	EPRI-SOG	Units 6 & 7 Study	% diff
100	mean	1.47E-05	1.48E-05	0%	1.57E-05	1.58E-05	1%	2.23E-07	8.72E-08	–61%
	0.15	6.70E-06	6.46E-06	–4%	3.93E-06	3.98E-06	1%	1.49E-10	3.39E-29	–100%
	0.5	1.25E-05	1.29E-05	3%	8.84E-06	9.12E-06	3%	1.53E-07	3.89E-29	–100%
	0.85	2.25E-05	2.24E-05	0%	1.74E-05	2.48E-05	43%	2.38E-07	5.25E-09	–98%
250	mean	1.83E-06	1.86E-06	1%	2.08E-06	2.11E-06	1%	1.08E-08	9.18E-10	–92%
	0.15	7.77E-07	8.13E-07	5%	3.11E-07	3.09E-07	–1%	1.49E-10	3.39E-29	–100%
	0.5	1.50E-06	1.62E-06	8%	8.35E-07	8.71E-07	4%	1.18E-08	3.89E-29	–100%
	0.85	2.93E-06	3.02E-06	3%	6.06E-06	4.27E-06	–30%	1.61E-08	6.46E-12	–100%
500	mean	1.82E-07	1.90E-07	4%	2.99E-07	3.06E-07	2%	3.80E-10	7.52E-12	–98%
	0.15	4.64E-08	5.13E-08	11%	1.24E-08	1.29E-08	4%	1.49E-10	3.39E-29	–100%
	0.5	1.20E-07	1.45E-07	20%	4.52E-08	5.13E-08	13%	5.74E-10	3.89E-29	–100%
	0.85	3.67E-07	3.55E-07	–3%	1.08E-06	7.85E-07	–27%	6.74E-10	6.46E-15	–100%

PTN COL 2.5-2

Table 2.5.2-208 (Sheet 2 of 2) Mean and Fractile Seismic Hazard Data for Crystal River Site from EPRI-SOG Study and Units 6 & 7 Study

PGA		Rondout			Weston			Woodward-Clyde			Total		
Ampl. cm/s^2	Hazard	EPRI-SOG	Units 6 & 7 Study	% diff	EPRI-SOG	Units 6 & 7 Study	% diff	EPRI-SOG	Units 6 & 7 Study	% diff	EPRI-SOG	Units 6 & 7 Study	% diff
100	mean	1.48E-05	1.48E-05	0%	2.47E-05	2.48E-05	0%	2.59E-05	2.60E-05	0%	1.60E-05	1.60E-05	0%
	0.15	5.27E-07	1.05E-08	–98%	7.94E-06	7.94E-06	0%	6.78E-07	4.96E-08	–93%	5.37E-06	5.37E-10	–100%
	0.5	1.55E-05	1.59E-05	3%	1.78E-05	1.82E-05	2%	1.65E-05	1.70E-05	3%	1.52E-05	1.20E-05	–21%
	0.85	2.71E-05	2.75E-05	1%	3.79E-05	3.89E-05	3%	4.97E-05	5.13E-05	3%	3.06E-05	3.06E-05	0%
250	mean	1.61E-06	1.63E-06	1%	2.79E-06	2.83E-06	1%	3.58E-06	3.62E-06	1%	1.98E-06	2.01E-06	2%
	0.15	2.60E-08	1.12E-11	–100%	6.72E-07	6.61E-07	–2%	4.44E-08	2.09E-11	–100%	5.40E-07	8.32E-14	–100%
	0.5	1.67E-06	1.74E-06	4%	1.79E-06	1.86E-06	4%	1.89E-06	2.00E-06	6%	1.67E-06	1.23E-06	–26%
	0.85	2.69E-06	2.82E-06	5%	5.17E-06	5.25E-06	2%	6.98E-06	6.92E-06	–1%	3.76E-06	3.35E-06	–11%
500	mean	1.19E-07	1.24E-07	4%	2.36E-07	2.46E-07	4%	4.52E-07	4.65E-07	3%	2.15E-07	2.22E-07	3%
	0.15	1.24E-09	9.12E-15	–100%	2.98E-08	2.95E-08	–1%	1.79E-09	4.42E-15	–100%	2.78E-08	1.64E-23	–100%
	0.5	1.11E-07	1.26E-07	14%	1.06E-07	1.18E-07	11%	1.40E-07	1.55E-07	11%	1.06E-07	7.76E-08	–27%
	0.85	1.81E-07	2.27E-07	25%	5.37E-07	5.75E-07	7%	8.74E-07	8.71E-07	0%	4.69E-07	3.67E-07	–22%

PGA = Peak ground acceleration
% diff = Percent difference between the 1989 calculations and the current hazard calculations at the Crystal River site

PTN COL 2.5-2

Table 2.5.2-209
Mean Hard Rock UHRS Accelerations (g)

Frequency, Hz	Mean 1E-04	Mean 1E-05	Mean 1E-06
PGA	0.0399	0.147	0.542
25	0.104	0.414	1.50
10	0.0822	0.278	0.932
5	0.0661	0.184	0.561
2.5	0.0499	0.110	0.275
1	0.0343	0.0663	0.131
0.5	0.0267	0.0519	0.104

UHRS = Uniform hazard response spectra
PGA = Peak ground acceleration

PTN COL 2.5-3

Table 2.5.2-210 (Sheet 1 of 2) HF and LF Horizontal 1E-04 Rock Spectra, Amplification Factors, Site Spectra, and Raw and Smoothed Envelope Spectra

Horizontal 1E-04 Rock and Site Spectra UHRS (g)								
Freq,	Rock UHRS		Transfer Function		Surface UHRS		Raw Envelope	Smooth Spectrum
Hz	LF SA(g)	HF SA(g)	LF Amp	HF Amp	LF SA(g)	HF SA(g)	SA(g)	SA(g)
100	3.99E-02	3.99E-02	1.302	0.870	5.20E-02	3.47E-02	5.20E-02	5.20E-02
90	4.39E-02	4.40E-02	1.186	0.793	5.21E-02	3.49E-02	5.21E-02	5.21E-02
80	5.05E-02	5.07E-02	1.035	0.693	5.23E-02	3.52E-02	5.23E-02	5.23E-02
70	6.06E-02	6.10E-02	0.871	0.587	5.28E-02	3.58E-02	5.28E-02	5.28E-02
60	7.36E-02	7.43E-02	0.730	0.500	5.37E-02	3.71E-02	5.37E-02	5.37E-02
50	8.66E-02	8.76E-02	0.636	0.445	5.51E-02	3.90E-02	5.51E-02	5.51E-02
45	9.20E-02	9.31E-02	0.612	0.440	5.64E-02	4.09E-02	5.64E-02	5.65E-02
40	9.65E-02	9.77E-02	0.607	0.455	5.85E-02	4.44E-02	5.85E-02	5.86E-02
35	9.98E-02	1.01E-01	0.619	0.491	6.18E-02	4.96E-02	6.18E-02	6.18E-02
30	1.02E-01	1.03E-01	0.642	0.540	6.57E-02	5.57E-02	6.57E-02	6.55E-02
25	1.04E-01	1.04E-01	0.642	0.542	6.67E-02	5.64E-02	6.67E-02	6.65E-02
20	1.00E-01	1.02E-01	0.644	0.523	6.44E-02	5.33E-02	6.44E-02	6.43E-02
15	9.34E-02	9.58E-02	0.677	0.544	6.32E-02	5.21E-02	6.32E-02	6.29E-02
12.5	8.86E-02	9.02E-02	0.710	0.575	6.29E-02	5.19E-02	6.29E-02	6.28E-02
10	8.22E-02	8.22E-02	0.821	0.701	6.74E-02	5.76E-02	6.74E-02	6.71E-02
9	8.01E-02	8.05E-02	0.869	0.755	6.96E-02	6.07E-02	6.96E-02	6.99E-02
8	7.75E-02	7.81E-02	0.950	0.847	7.37E-02	6.62E-02	7.37E-02	7.32E-02
7	7.45E-02	7.50E-02	1.010	0.897	7.52E-02	6.73E-02	7.52E-02	7.52E-02
6	7.07E-02	7.11E-02	1.100	0.994	7.78E-02	7.07E-02	7.78E-02	7.84E-02
5	6.61E-02	6.61E-02	1.310	1.216	8.65E-02	8.03E-02	8.65E-02	8.63E-02
4	5.96E-02	5.60E-02	1.437	1.302	8.57E-02	7.29E-02	8.57E-02	8.69E-02
3	5.29E-02	4.40E-02	2.147	2.047	1.14E-01	9.01E-02	1.14E-01	1.11E-01
2.5	4.99E-02	3.69E-02	2.060	1.888	1.03E-01	6.97E-02	1.03E-01	1.02E-01
2	4.54E-02	2.88E-02	1.787	1.625	8.11E-02	4.69E-02	8.11E-02	8.07E-02
1.5	4.05E-02	2.00E-02	1.988	1.828	8.06E-02	3.65E-02	8.06E-02	8.02E-02
1.25	3.71E-02	1.55E-02	2.376	2.213	8.82E-02	3.43E-02	8.82E-02	8.84E-02
1	3.43E-02	1.12E-02	3.022	2.859	1.04E-01	3.21E-02	1.04E-01	1.05E-01
0.9	3.41E-02	9.61E-03	3.461	3.325	1.18E-01	3.20E-02	1.18E-01	1.15E-01
0.8	3.32E-02	8.06E-03	3.401	3.247	1.13E-01	2.62E-02	1.13E-01	1.12E-01
0.7	3.18E-02	6.59E-03	3.019	2.867	9.59E-02	1.89E-02	9.59E-02	9.72E-02
0.6	2.96E-02	5.21E-03	3.014	2.877	8.92E-02	1.50E-02	8.92E-02	8.86E-02
0.5	2.67E-02	3.92E-03	2.752	2.653	7.34E-02	1.04E-02	7.34E-02	7.17E-02
0.4	2.14E-02	3.14E-03	2.057	1.967	4.39E-02	6.17E-03	4.39E-02	4.46E-02
0.3	1.60E-02	2.35E-03	1.864	1.784	2.99E-02	4.20E-03	2.99E-02	3.00E-02
0.2	1.07E-02	1.57E-03	1.888	1.771	2.02E-02	2.78E-03	2.02E-02	2.01E-02
0.15	8.01E-03	1.18E-03	1.599	1.519	1.28E-02	1.79E-03	1.28E-02	1.29E-02
0.125	6.64E-03	9.75E-04	1.421	1.377	9.44E-03	1.34E-03	9.44E-03	9.37E-03

PTN COL 2.5-3

Table 2.5.2-210 (Sheet 2 of 2) HF and LF Horizontal 1E-04 Rock Spectra, Amplification Factors, Site Spectra, and Raw and Smoothed Envelope Spectra

Horizontal 1E-04 Rock and Site Spectra UHRS (g)								
Freq,	Rock UHRS		Transfer Function		Surface UHRS		Raw Envelope	Smooth Spectrum
Hz	LF SA(g)	HF SA(g)	LF Amp	HF Amp	LF SA(g)	HF SA(g)	SA(g)	SA(g)
0.1	4.27E-03	6.27E-04	1.323	1.268	5.65E-03	7.95E-04	5.65E-03	5.65E-03

UHRS = Uniform hazard response spectra
LF = Low frequencies
HF = High frequencies
SA = Spectral acceleration
Amp = Amplitude

PTN COL 2.5-2

Table 2.5.2-211
Summary of Supplemental Sources and Truncated Woodward-Clyde Source

EPRI EST	New Source Area (km^2)[(a)]	New Source Total Earthquakes[(b)]	New Source Max Recorded Event (Emb)[(b)]	Mmax (m_b) and Weights
{Bechtel	136,769	1	4.09	6.1 [0.10] 6.4 [0.40] 6.6 [0.10] 6.7 [0.40]}
Dames & Moore	139,208	2	4.09	5.6 [0.80] 7.2 [0.20]
Law Engineering	97,273	1	4.09	5.6 [0.90] 5.7 [0.10]
Rondout Associates	103.436	1	4.09	6.1 [0.30] 6.3 [0.55] 6.5 [0.15]
Weston Geophysical	171,264	2	4.09	6.6 [0.89] 7.2 [0.11]
Woodward-Clyde[(c)] (truncated)	349,569	8	4.09	5.8 [0.33] 6.2 [0.34] 6.6 [0.33]

SOF 2.5.2-20

(a) Area calculated using North America Albers equal area conic projection.
(b) From updated earthquake catalog.
(c) Not a "supplemental" zone; Woodward-Clyde source BG-35 geometry is truncated by the northern boundary of the Cuba area and Northern Caribbean seismic source model.
EST = Earth Science Team

PTN COL 2.5-2

Table 2.5.2-212 (Sheet 1 of 2)
Geographic Coordinates of Supplemental Sources and Truncated Woodward-Clyde Source

Bechtel Group		Dames & Moore		Law Engineering		Rondout Associates		Weston Geophysical		Woodward-Clyde Consultants[a]	
Latitude	Longitude	Latitude	Longitude	Latitude	Longitude	Latitude	Longitude	Latitude	Longitude	Latitude	Longitude
27.512	–78.336	25.440	–83.228	25.026	–77.0478	26.630	–77.711	28.317	–80.311	26.006	–77.500
27.033	–77.927	26.133	–83.129	24.853	–77.495	26.531	–77.659	28.263	–79.768	25.420	–77.439
26.531	–77.659	25.030	–82.570	24.309	–77.662	25.986	–77.494	28.098	–79.223	24.840	–77.500
25.986	–77.494	25.000	–80.000	23.811	–77.930	25.420	–77.439	27.829	–78.721	22.400	–77.499
25.420	–77.439	25.020	–79.290	23.372	–78.292	24.853	–77.495	27.470	–78.285	22.400	–77.613
24.853	–77.495	25.620	–78.940	23.012	–78.733	24.309	–77.662	27.033	–77.927	22.760	–78.456
24.309	–77.662	27.100	–78.870	22.911	–78.923	23.811	–77.930	26.531	–77.659	22.911	–78.923
23.811	–77.930	28.032	–79.101	23.421	–80.497	23.372	–78.292	25.986	–77.494	23.421	–80.497
23.372	–78.292	27.829	–78.721	23.505	–81.043	23.012	–78.733	25.420	–77.439	23.505	–81.043
23.012	–78.733	27.470	–78.285	23.506	–82.095	22.911	–78.923	24.853	–77.495	23.506	–82.095
22.911	–78.923	27.033	–77.927	23.456	–82.445	23.421	–80.497	24.309	–77.662	23.456	–82.445
23.421	–80.497	26.531	–77.659	23.828	–82.748	23.505	–81.043	23.811	–77.930	23.304	–83.500
23.505	–81.043	25.986	–77.494	24.332	–83.014	23.506	–82.095	23.372	–78.292	28.400	–83.500
23.506	–82.095	25.420	–77.439	24.873	–83.175	23.456	–82.445	23.012	–78.733	28.400	–77.500
23.456	–82.445	24.853	–77.495	25.008	–83.188	23.828	–82.748	22.911	–78.923	26.006	–77.500
23.828	–82.748	24.309	–77.662	25.000	–79.999	24.332	–83.014	23.421	–80.497	—	—
24.332	–83.014	23.811	–77.930	25.026	–77.478	24.873	–83.175	23.505	–81.043	—	—
24.873	–83.175	23.372	–78.292	25.026	–77.478	25.000	–83.187	23.506	–82.095	—	—
25.182	–83.204	23.012	–78.733	—	—	25.000	–80.000	23.456	–82.445	—	—
25.150	–81.710	22.911	–78.923	—	—	25.030	–78.230	23.828	–82.748	—	—
25.070	–80.210	23.421	–80.497	—	—	25.160	–78.110	24.332	–83.014	—	—
25.440	–79.470	23.505	–81.043	—	—	25.520	–77.900	24.873	–83.175	—	—
26.240	–78.780	23.506	–82.095	—	—	25.980	–77.770	25.003	–83.187	—	—
27.150	–78.410	23.456	–82.445	—	—	26.630	–77.711	25.000	–80.000	—	—
27.512	–78.336	23.828	–82.748	—	—	—	—	26.620	–79.900	—	—

PTN COL 2.5-2

Table 2.5.2-212 (Sheet 2 of 2)
Geographic Coordinates of Supplemental Sources and Truncated Woodward-Clyde Source

Bechtel Group		Dames & Moore		Law Engineering		Rondout Associates		Weston Geophysical		Woodward-Clyde Consultants[a]	
Latitude	Longitude	Latitude	Longitude	Latitude	Longitude	Latitude	Longitude	Latitude	Longitude	Latitude	Longitude
—	—	24.332	–83.014	—	—	—	—	28.317	–80.311	—	—
—	—	24.873	–83.175	—	—	—	—	—	—	—	—
—	—	25.440	–83.228	—	—	—	—	—	—	—	—

(a) Not a "supplemental" zone; Woodward-Clyde source BG-35 geometry is truncated by the northern boundary of the Cuba area and Northern Caribbean seismic source model.

Note: Coordinates in decimal degrees.

PTN COL 2.5-2

Table 2.5.2-213
Geographic Coordinates of Updated Charleston Seismic Source (UCSS) Model Sources

UCSS Source	Longitude	Latitude
A	–80.707	32.811
A	–79.840	33.354
A	–79.527	32.997
A	–80.392	32.455
B	–81.216	32.485
B	–78.965	33.891
B	–78.3432	33.168
B	–80.587	31.775
B'	–78.965	33.891
B'	–78.654	33.531
B'	–80.900	32.131
B'	–81.216	32.485
C	–80.397	32.687
C	–79.776	34.425
C	–79.483	34.351
C	–80.109	32.614

Note: Coordinates in decimal degrees.

PTN COL 2.5-2

Table 2.5.2-214 Comparison of Post-EPRI Magnitude Estimates for the 1886 Charleston Earthquake

Study	Magnitude Estimation Method	Reported Magnitude Estimate	Assigned Weights	Mean Magnitude (M_w)
Johnston et al. (Reference 268)	Worldwide survey of passive-margin, extended-crust earthquakes	M_w 7.56 ± 0.35[a]	—	7.56
Martin and Clough (Reference 279)	Geotechnical assessment of 1886 liquefaction data	M_w 7–7.5	—	7.25
Johnston (Reference 267)	Isoseismal area regression, accounting for eastern North America anelastic attenuation	M_w 7.3 ± 0.26	—	7.3
Chapman and Talwani (Reference 223) (SCDOT)	Consideration of available magnitude estimates	M_w 7.1 M_w 7.3 M_w 7.5	0.2 0.6 0.2	7.3
Bakun and Hopper (Reference 211)	Isoseismal area regression, including empirical site corrections	M_I 6.4–7.2[b]	—	6.9[c]
Petersen et al. (Reference 300) (USGS)	Consideration of available magnitude estimates	M_w 6.8 M_w 7.1 M_w 7.3 M_w 7.5	0.20 0.20 0.45 0.15	7.2

(a) Estimate from Johnston et al. (Reference 268), Chapter 3.
(b) 95 percent confidence interval estimate; M_I (intensity magnitude) is considered equivalent to M_w (moment magnitude) (Reference 211).
(c) Bakun and Hopper's preferred estimate (Reference 211).

PTN COL 2.5-2

Table 2.5.2-215 Comparison of Talwani and Schaeffer and UCSS Age Constraints on Charleston-Area Paleoliquefaction Events

Liquefaction Event		Talwani and Schaeffer (Reference 223)[a]				
	Event Age (YBP)[b]	Scenario 1		Scenario 2		This Study
		Source	M[c]	Source	M[c]	Event Age (YBP)[b][d]
1886 A.D.	64	Charleston	7.3	Charleston	7.3	64
A	546 ± 17	Charleston	7+	Charleston	7+	600 ± 70
B	1,021 ± 30	Charleston	7+	Charleston	7+	1,025 ± 25
C	1,648 ± 74	Northern (Georgetown)	6+	—	—	—
C'	1,683 ± 70	—	—	Charleston	7+	1,695 ± 175
D	1,966 ± 212	Southern (Bluffton)	6+	—	—	—
E	3,548 ± 66	Charleston	7+	Charleston	7+	3,585 ± 115
F	5,038 ± 166	Northern (Georgetown)	6+	Charleston	7+	—
F'	—	—	—	—	—	5,075 ± 215
G	5,800 ± 500	Charleston	7+	Charleston	7+	—

(a) YBP = years before present, relative to 1950 A.D.
(b) Modified after Talwani and Schaeffer's (Reference 323) Table 2.
(c) Unspecified magnitude type.
(d) Event ages based upon our recalibration of radiocarbon ages to 2-sigma using OxCal 3.8, from data presented in Talwani and Schaeffer's (Reference 323) Table 2.

PTN COL 2.5-2

Table 2.5.2-216
List of Experts Contacted as part of Cuba and Northern Caribbean Source Model SSHAC Level 2 Process

Name	Affiliation	Response
Prof. Gail Atkinson	Carleton University, Ottawa, Canada	*[declined, lack of expertise]*
Prof. Eric Calais	Purdue University	Detailed response; email and telephone
Prof. Charles DeMets	University Wisconsin	Detailed response; email and telephone
Prof. James Dolan	University of Southern California	Detailed response; email and in-person
Dr. Art Frankel	U.S. Geological Survey	*[declined, conflict]*
Dr. Julio Garcia	National Institute of Oceanography and Experimental Geophysics (OGS), Trieste, Italy	Detailed response; email
Prof. Paul Mann	University of Texas	Detailed response; email
Dr. William McCann	Earth Scientific Consultants; TAG member	Detailed response; email, telephone, and in-person
Dr. James Pindell	Tectonic Analysis, Ltd.; Rice U.	*[declined, lack of expertise]*
Dr. Uri ten Brink	U.S. Geological Survey	*[declined, conflict]*
Dr. Marticia Tuttle	M. Tuttle & Associates	*[declined, conflict]*
Prof. Margaret Wiggins-Grandison	University of West Indies, Mona, Jamaica	Detailed response; email

SSHAC = Senior Seismic Hazard Analysis Committee

PTN COL 2.5-2

Table 2.5.2-217
Summary of Cuba and Northern Caribbean Seismic Source Parameters

PTN RAI 02.05.02-4

Area Source	Closest Distance to Units 6 & 7 (mi)	Annual Number of Earthquakes of M_w 5.0 and Greater	*b*-value	Mmax (M_w)
1. Cuba areal source zone	140	0.0592	0.839	7.0 [0.5] 7.25 [0.5][(a)]

(a) For the PSHA calculation, this value was rounded up to M_w 7.3.

PTN RAI 02.05.02-4

Fault Source	Closest Distance to Units 6 & 7 (mi)	Fault Type/ Dip	Slip Rate (mm/r)	Seismic Coupling	Mmax (M_w)
2. Oriente – Western	420	Strike-slip/ 90°	8 [0.1] 11 [0.7] 13 [0.2]	0.6 [0.2] 0.8 [0.2] 1.0 [0.6]	7.5 [0.3] 7.7 [0.4] 8.0 [0.3]
3. Oriente – Eastern	445	Strike-slip/ 90°	8 [0.1] 11 [0.7] 13 [0.2]	1.0 [1.0]	7.5 [0.2] 7.7 [0.6] 7.9 [0.2]
4. Septentrional	545	Strike-slip/ 90°	6 [0.2] 9 [0.6] 12 [0.2]	1.0 [1.0]	8.0 [0.5] 8.25 [0.5]
5. Northern Hispaniola — Western	550	Thrust/ 20-25° south	4 [0.2] 6 [0.7] 8 [0.1]	1.0 [1.0]	7.8 [0.2] 8.0 [0.6] 8.3 [0.2]
6. Northern Hispaniola — Eastern	760	Thrust/ 20-25° south	4 [0.2] 6 [0.7] 8 [0.1]	1.0 [1.0]	8.0 [0.2] 8.3 [0.6] 8.6 [0.2]
7. Swan Islands — Western	620	Strike-slip/ 90°	18 [0.2] 19 [0.6] 20 [0.2]	1.0 [1.0]	7.8 [0.2] 8.0 [0.7] 8.3 [0.1]
8. Swan Islands — Eastern	540	Strike-slip/ 90°	18 [0.2] 19 [0.6] 20 [0.2]	0.6 [0.2] 0.8 [0.2] 1.0 [0.6]	7.2 [0.4] 7.5 [0.5] 7.7 [0.1]
9. Walton — Duanvale	490	Strike-slip/ 90°	6 [0.2] 8 [0.6] 10 [0.2]	0.8 [0.3] 1.0 [0.7]	7.3 [0.3] 7.6 [0.6] 7.8 [0.1]
10. Enriquillo-Plantain Garden	560	Strike-slip/ 90°	6 [0.2] 8 [0.6] 10 [0.2]	1.0 [1.0]	7.5 [0.2] 7.7 [0.6] 7.9 [0.2]

PTN RAI 02.05.02-4

PTN COL 2.5-2

Table 2.5.2-218
Geographic Coordinates of Cuba Areal Source Zone

Latitude	Longitude
21.207	–74.814
20.377	–73.219
19.834	–77.659
19.995	–77.919
20.506	–78.637
20.892	–79.345
21.259	–80.143
21.385	–80.609
21.429	–81.290
21.358	–82.724
21.295	–83.549
21.331	–84.024
21.483	–84.643
21.609	–84.975
21.686	–85.518
22.087	–85.457
22.251	–85.347
22.963	–84.450
23.179	–83.983
23.285	–83.634
23.506	–82.095
23.505	–81.043
23.421	–80.497
22.760	–78.456
21.207	–74.814

Note: Coordinates in decimal degrees.

PTN COL 2.5-2

Table 2.5.2-219
Geographic Coordinates of Cuba and Northern Caribbean Model Fault Sources

Source No.:	2		3		4	
Source Name	Oriente-Western		Oriente-Eastern		Septentrional	
	Latitude	Longitude	Latitude	Longitude	Latitude	Longitude
	18.951	–81.483	19.663	–77.134	19.990	–74.120
	19.247	–79.991	19.674	–77.037	20.005	–72.979
	19.563	–77.138	19.733	–76.518	19.936	–72.606
	—	—	19.819	–75.012	19.718	–71.775
	—	—	19.959	–74.472	19.562	–70.998
	—	—	19.982	–74.205	19.151	–69.689
	—	—	—	—	19.081	–68.741

Source No.:	5		6		7	
Source Name	Northern Hispaniola-Western		Northern Hispaniola-Eastern		Swan Islands-Western	
	Latitude	Longitude	Latitude	Longitude	Latitude	Longitude
	20.415	–73.267	19.843	–70.026	15.905	–88.280
	20.400	–72.755	19.555	–68.531	17.346	–84.602
	20.165	–71.530	19.759	–66.270	—	—
	19.907	–70.025	—	—	—	—

Source No.:	8		9		10	
Source Name	Swan Islands-Eastern		Walton-Duanvale		Enriquillo-Plantain Garden fault	
	Latitude	Longitude	Latitude	Longitude	Latitude	Longitude
	17.190	–84.572	17.740	–81.480	17.990	–76.672
	17.758	–81.940	18.335	–79.295	17.927	–76.188
	—	—	18.467	–78.244	18.174	–75.026
	—	—	18.351	–77.429	18.296	–74.420
	—	—	—	—	18.438	–71.807
	—	—	—	—	18.347	–71.104

Note: Coordinates in decimal degrees.

PTN COL 2.5-2

Table 2.5.2-220
Empirical Relations between Rupture Area (A) and Moment Magnitude (M_w) and Rupture Length (L) and M_w Used to Determine Mmax for Cuba and Northern Caribbean Sources

Source	Equation (A and M_w)	Use
Wells and Coppersmith (Reference 334), all slip types	$M_w = 0.98 \text{ Log } A + 4.07$	All faults
Wyss (Reference 339)[(a)]	$M_w = \text{Log } A + 4.15$	All faults
Hanks and Bakun (Reference 262)[(b)]	$M_w = 4/3 \text{ Log } A + 3.07$	Strike-slip faults
WGCEP (Reference 337), equation 4.5b	$M_w = \text{Log } A + 4.2$	Strike-slip faults
Abe (References 201 and 202)	$M_w = \text{Log } A + 3.99$	Subduction zones
Geomatrix (Reference 257)	$M_w = 0.81 \text{ Log } A + 4.7$	Subduction zones

Source	Equation (L and M_w)	Use
Wells and Coppersmith (Reference 334), all slip types	$M_w = 1.49 \text{ Log } L + 4.38$	All faults
Geomatrix (Reference 257)	$M_w = 1.39 \text{ Log } L + 4.94$	Subduction zones

(a) Valid for $M_w > 5.6$
(b) Valid for $A > 537 \text{ km}^2$

PTN COL 2.5-2

Table 2.5.2-221 (Sheet 1 of 2)
Significant Earthquakes in the Cuba and Northern Caribbean Region, 1500 to 2010

Date	Location	Seismic Source	MMI	M, high	M, low	M_w
November 1539	Western Caribbean Sea	Swan Islands fault — Western	{X}	~8[(a)]		7.69
1551	SE Cuba	Cuba	VIII[(b)]			5.98
August 1578	Cuba	Cuba		6.75[(b)]		6.78
February 1678	SE Cuba	Oriente fault — Eastern	VIII[(a)]	7.0[(a)]		6.78
June 1692	S Jamaica	Enriquillo-Plantain Garden fault	X[(c)]	7.5[(a)]		7.78
October 1751	SW of Dominican Republic	Enriquillo-Plantain Garden fault		8.0[(a)]		7.28
September 1751	Haiti, near Port-au-Prince	Enriquillo-Plantain Garden fault		7.5[(a)]		6.83
June 1766	SE Cuba	Oriente fault — Eastern	IX[(b)]	7.5[(b)]	7.0[(a)]	7.53
June 1770	Haiti, west of Port-au-Prince	Enriquillo-Plantain Garden fault		7.5[(a)]		7.53
November 1812	SE Jamaica	Enriquillo-Plantain Garden fault		6.8[(b)]		6.13
May 1842	Offshore Haiti to Dominican Republic	Septentrional fault	IX[(a)]	8.2[(d)]	8.0[(a)]	8.23
July 1852	North-Central Cayman Trough	Oriente fault — Western		6.6[(a)]		7.53
August 1852	Offshore Santiago de Cuba	Oriente fault — Eastern	IX[(a)]	7.5[(a)]	7.3[(b)]	7.33
August 1856	Offshore N Honduras	Swan Islands fault — Western		8.3[(a)]		7.69
April 1860	Haiti, near Port-au-Prince	Enriquillo-Plantain Garden fault				6.73
January 1880	North Cuba	Cuba	VIII[(b)]	6.6[(a)]	6.0[(b)]	6.13
September 1887	W offshore Haiti	Septentrional fault	IX[(a)]	7.9[(d)]	7.75[(a)]	7.93
January 1907	N Jamaica	Walton-Duanvale fault		7[(a)]	6.5[(c)]	6.64
January 1910	Caribbean Sea	Swan Islands — Western		7.0[(a)]		7.10
February 1914	East-Central Cuba	Cuba		6.2[(d)]		6.29
February 1917	Offshore S Cuba	Oriente fault — Eastern	VI[(a)]	7.1[(a)]	7.0[(e)]	7.20
February 1932	Offshore Santiago de Cuba	Oriente fault — Eastern		6.8[(a)]	6.75[(b)]	6.83
April 1941	Offshore SW Jamaica	Enriquillo-Plantain Garden fault		7[(a)]	6.9[(e)]	7.03
August 1946	Offshore Hispaniola	Northern Hispaniola — Eastern		8.1[(f)]	7.8[(a)]	7.90
August 1947	Offshore Santiago de Cuba	Oriente fault — Eastern		6.8[(a)]	6.6[(e)]	6.83
May 1953	Offshore Hispaniola	Northern Hispaniola — Western		7.0[(e)]	6.9[(a)]	6.93
March 1957	W Jamaica	Walton-Duanvale fault		6.9[(e)]	6.6[(a)]	6.61
May 1992	Cabo Cruz	Oriente fault — Western	VII[(b)]	7.0[(e)]	6.8[(b)]	6.80
January 2010	Haiti, near Port-au-Prince	Enriquillo-Plantain Garden fault	>IX[(h)]			7.0[(g)]

SOF 2.5.2-23

SOF 2.5.2-24

PTN COL 2.5-2

Table 2.5.2-221 (Sheet 2 of 2)
Significant Earthquakes in the Cuba and Northern Caribbean Region, 1500 to 2010

(a) McCann (Reference 282).
(b) Garcia et al. (Reference 254).
(c) DeMets and Wiggins-Grandison (Reference 229).
(d) Cotilla et al. (Reference 226).
(e) van Dusen and Doser (Reference 331).
(f) Dolan and Wald (Reference 236).
(g) U.S. Geological Survey (Reference 238).
(h) Pacific Disaster Center (Reference 260).

Notes:
MMI =Modified Mercalli Intensity
M, high=Upper estimate from literature (magnitude scale unspecified)
M, low=Lower estimate from literature (magnitude scale unspecified)
M_w =Estimate of moment magnitude from Phase 2 earthquake catalog. | LDP-CS564

Table 2.5.2-222
Comparison of Seismic Source Parameters with USGS Initial Seismic Hazard Maps for Haiti Region

Fault Source[(a)]	Slip Rate (mm/yr)	M_{char} or Mmax (M_w)[(b)]
Enriquillo [Enriquillo-Plantain Garden fault]	7 [6–10]	7.7 [7.5–7.9]
Septentrional [Septentrional fault]	12 [6–12]	7.8 [8.0–8.25]
Eastern and central portions of northern subduction zone [Northern Hispaniola fault - eastern]	11 [4–8]	8.0 [8.0–8.6]
Western portion of northern subduction zone [Northern Hispaniola fault - western]	2.5 [4–8]	8.0 [7.0–8.3]
Matheux Neiba [NA]	1 [NA]	7.7 [NA]
Muertos Trough subduction zone, Neiba segment [NA]	7 [NA]	8.0 [NA]
Muertos Trough subduction zone, central segment [NA]	7 [NA]	8.0 [NA]

(a) Reference 235 source listed, with equivalent Turkey Point Units 6 & 7 source shown in [square brackets].
(b) Reference 235 M_{char} (characteristic magnitude), with Turkey Point Units 6 &7 Mmax values shown in [square brackets].
NA Equivalent source not included in Turkey Point Units 6 & 7 source characterization.

PTN COL 2.5-2

Table 2.5.2-223 (Sheet 1 of 5)
Mean and Fractile Rock Seismic Hazard Curves

Ampl. (g)	MEAN (a.f.e.)	0.05 (a.f.e)	0.16 (a.f.e)	0.50 (a.f.e)	0.84 (a.f.e)	0.95 (a.f.e)
PGA Hazard Curves						
0.001	4.39E-02	1.38E-02	2.24E-02	4.17E-02	6.31E-02	7.24E-02
0.0015	3.14E-02	7.94E-03	1.38E-02	2.95E-02	4.79E-02	5.89E-02
0.002	2.34E-02	5.62E-03	9.77E-03	2.24E-02	3.89E-02	4.47E-02
0.003	1.42E-02	3.02E-03	5.25E-03	1.38E-02	2.40E-02	2.95E-02
0.005	6.45E-03	1.27E-03	2.14E-03	6.03E-03	1.12E-02	1.48E-02
0.007	3.51E-03	6.84E-04	1.15E-03	3.24E-03	5.62E-03	7.94E-03
0.01	1.73E-03	3.67E-04	6.17E-04	1.51E-03	2.82E-03	3.72E-03
0.015	7.42E-04	1.72E-04	2.69E-04	6.17E-04	1.15E-03	1.62E-03
0.02	4.04E-04	9.89E-05	1.45E-04	3.31E-04	6.17E-04	8.71E-04
0.03	1.75E-04	4.62E-05	6.31E-05	1.26E-04	2.51E-04	3.94E-04
0.05	6.44E-05	1.82E-05	2.40E-05	4.47E-05	8.91E-05	1.45E-04
0.07	3.49E-05	1.05E-05	1.48E-05	2.48E-05	5.13E-05	8.04E-05
0.1	1.89E-05	5.43E-06	7.94E-06	1.43E-05	2.75E-05	4.47E-05
0.15	9.67E-06	2.54E-06	3.98E-06	7.41E-06	1.48E-05	2.32E-05
0.2	6.02E-06	1.37E-06	2.46E-06	4.57E-06	9.12E-06	1.48E-05
0.3	3.02E-06	5.19E-07	1.00E-06	2.21E-06	4.57E-06	7.67E-06
0.5	1.18E-06	1.18E-07	2.51E-07	7.85E-07	2.14E-06	3.47E-06
0.7	5.92E-07	3.63E-08	8.32E-08	3.31E-07	1.15E-06	1.93E-06
1	2.65E-07	8.51E-09	2.40E-08	1.35E-07	5.37E-07	9.33E-07
1.5	9.39E-08	1.32E-09	4.90E-09	3.27E-08	1.66E-07	3.67E-07
2	4.10E-08	2.99E-10	1.23E-09	1.12E-08	6.31E-08	1.78E-07
3	1.09E-08	2.66E-11	1.35E-10	1.86E-09	1.59E-08	5.50E-08
5	1.49E-09	7.85E-13	6.03E-12	1.45E-10	2.00E-09	8.22E-09
7	3.26E-10	6.31E-14	6.61E-13	2.09E-11	3.55E-10	1.74E-09
10	5.30E-11	2.63E-15	4.79E-14	2.00E-12	5.13E-11	2.69E-10
25 Hz Hazard Curves						
0.001	5.06E-02	1.70E-02	2.75E-02	5.13E-02	7.24E-02	8.32E-02
0.0015	3.85E-02	1.05E-02	1.82E-02	3.89E-02	5.89E-02	7.24E-02
0.002	3.05E-02	7.41E-03	1.29E-02	3.16E-02	4.79E-02	5.89E-02
0.003	2.05E-02	4.57E-03	7.41E-03	2.09E-02	3.16E-02	4.17E-02
0.005	1.11E-02	2.29E-03	3.72E-03	1.12E-02	1.70E-02	2.24E-02
0.007	6.93E-03	1.41E-03	2.46E-03	6.92E-03	1.12E-02	1.38E-02
0.01	4.03E-03	9.02E-04	1.51E-03	3.72E-03	6.46E-03	7.94E-03
0.015	2.12E-03	5.19E-04	8.13E-04	1.74E-03	3.47E-03	4.42E-03
0.02	1.34E-03	3.43E-04	4.68E-04	1.07E-03	2.14E-03	2.82E-03
0.03	7.08E-04	1.66E-04	2.34E-04	5.37E-04	1.07E-03	1.57E-03
0.05	3.20E-04	7.24E-05	9.55E-05	2.19E-04	4.68E-04	7.08E-04
0.07	1.89E-04	4.17E-05	5.50E-05	1.18E-04	2.51E-04	4.37E-04
0.1	1.07E-04	2.40E-05	3.16E-05	6.31E-05	1.35E-04	2.34E-04
0.15	5.49E-05	1.25E-05	1.70E-05	3.16E-05	7.76E-05	1.18E-04
0.2	3.40E-05	7.67E-06	1.12E-05	2.02E-05	4.79E-05	7.24E-05
0.3	1.73E-05	3.72E-06	6.03E-06	1.12E-05	2.40E-05	3.89E-05

PTN COL 2.5-2

Table 2.5.2-223 (Sheet 2 of 5) Mean and Fractile Rock Seismic Hazard Curves

Ampl. (g)	MEAN (a.f.e.)	0.05 (a.f.e)	0.16 (a.f.e)	0.50 (a.f.e)	0.84 (a.f.e)	0.95 (a.f.e)
25 Hz Hazard Curves (cont.)						
0.5	7.26E-06	1.37E-06	2.29E-06	4.90E-06	1.20E-05	1.82E-05
0.7	4.06E-06	6.38E-07	1.15E-06	2.82E-06	6.92E-06	1.08E-05
1	2.14E-06	2.43E-07	4.68E-07	1.41E-06	3.72E-06	6.03E-06
1.5	9.98E-07	7.50E-08	1.55E-07	5.96E-07	2.00E-06	3.13E-06
2	5.60E-07	2.75E-08	6.31E-08	2.88E-07	1.15E-06	2.00E-06
3	2.33E-07	5.82E-09	1.59E-08	9.55E-08	4.37E-07	8.71E-07
5	6.73E-08	5.56E-10	1.86E-09	1.76E-08	1.02E-07	3.31E-07
7	2.68E-08	9.89E-11	3.80E-10	4.90E-09	3.16E-08	1.55E-07
10	8.99E-09	1.38E-11	5.13E-11	1.15E-09	8.51E-09	5.50E-08
10 Hz Hazard Curves						
0.001	5.99E-02	2.09E-02	3.63E-02	5.89E-02	8.32E-02	9.55E-02
0.0015	4.80E-02	1.38E-02	2.57E-02	4.79E-02	6.76E-02	8.32E-02
0.002	3.96E-02	1.05E-02	1.95E-02	3.89E-02	5.89E-02	7.24E-02
0.003	2.84E-02	6.46E-03	1.12E-02	2.75E-02	4.47E-02	5.50E-02
0.005	1.65E-02	3.47E-03	5.25E-03	1.59E-02	2.57E-02	3.63E-02
0.007	1.06E-02	2.00E-03	3.24E-03	1.05E-02	1.70E-02	2.24E-02
0.01	6.21E-03	1.19E-03	1.86E-03	6.03E-03	9.77E-03	1.38E-02
0.015	3.09E-03	6.17E-04	1.00E-03	2.82E-03	5.25E-03	6.46E-03
0.02	1.80E-03	3.80E-04	6.17E-04	1.51E-03	3.02E-03	3.72E-03
0.03	8.03E-04	1.97E-04	2.88E-04	6.61E-04	1.41E-03	1.74E-03
0.05	2.79E-04	7.24E-05	1.10E-04	2.04E-04	4.68E-04	5.96E-04
0.07	1.39E-04	3.76E-05	5.13E-05	1.10E-04	2.04E-04	2.99E-04
0.1	6.71E-05	1.88E-05	2.75E-05	5.13E-05	9.55E-05	1.45E-04
0.15	3.06E-05	9.77E-06	1.38E-05	2.40E-05	4.47E-05	7.00E-05
0.2	1.80E-05	5.62E-06	7.94E-06	1.48E-05	2.75E-05	4.17E-05
0.3	8.70E-06	2.63E-06	3.72E-06	6.92E-06	1.38E-05	2.09E-05
0.5	3.46E-06	8.41E-07	1.41E-06	2.72E-06	5.62E-06	8.51E-06
0.7	1.81E-06	3.67E-07	6.61E-07	1.37E-06	3.02E-06	4.42E-06
1	8.64E-07	1.40E-07	2.69E-07	6.17E-07	1.51E-06	2.21E-06
1.5	3.39E-07	3.63E-08	7.76E-08	2.19E-07	5.75E-07	9.33E-07
2	1.63E-07	1.25E-08	2.95E-08	9.55E-08	2.88E-07	4.68E-07
3	5.16E-08	2.29E-09	6.03E-09	2.57E-08	8.91E-08	1.72E-07
5	9.83E-09	1.97E-10	6.61E-10	3.98E-09	1.70E-08	3.76E-08
7	2.87E-09	3.06E-11	1.26E-10	1.00E-09	4.90E-09	1.29E-08
10	6.86E-10	3.72E-12	1.95E-11	1.78E-10	1.07E-09	3.24E-09
5 Hz Hazard Curves						
0.001	6.55E-02	2.75E-02	4.47E-02	6.31E-02	8.91E-02	9.55E-02
0.0015	5.32E-02	1.70E-02	3.16E-02	5.13E-02	7.76E-02	8.91E-02
0.002	4.43E-02	1.29E-02	2.40E-02	4.47E-02	6.31E-02	7.76E-02
0.003	3.21E-02	7.67E-03	1.48E-02	3.16E-02	5.13E-02	6.31E-02
0.005	1.88E-02	3.72E-03	6.92E-03	1.82E-02	3.16E-02	3.89E-02
0.007	1.20E-02	2.29E-03	3.98E-03	1.12E-02	2.09E-02	2.66E-02
0.01	6.86E-03	1.23E-03	2.00E-03	6.46E-03	1.20E-02	1.59E-02
0.015	3.24E-03	5.37E-04	8.71E-04	3.02E-03	5.62E-03	7.41E-03

PTN COL 2.5-2

Table 2.5.2-223 (Sheet 3 of 5)
Mean and Fractile Rock Seismic Hazard Curves

Ampl. (g)	MEAN (a.f.e.)	0.05 (a.f.e)	0.16 (a.f.e)	0.50 (a.f.e)	0.84 (a.f.e)	0.95 (a.f.e)
5 Hz Hazard Curves (cont.)						
0.02	1.77E-03	2.99E-04	5.01E-04	1.62E-03	2.82E-03	3.98E-03
0.03	6.98E-04	1.30E-04	2.19E-04	6.17E-04	1.15E-03	1.51E-03
0.05	1.99E-04	4.17E-05	7.24E-05	1.66E-04	3.09E-04	4.22E-04
0.07	8.67E-05	2.09E-05	3.39E-05	6.76E-05	1.35E-04	1.78E-04
0.1	3.72E-05	9.77E-06	1.38E-05	2.95E-05	5.50E-05	8.04E-05
0.15	1.52E-05	4.27E-06	6.03E-06	1.16E-05	2.24E-05	3.39E-05
0.2	8.39E-06	2.29E-06	3.24E-06	6.24E-06	1.20E-05	1.95E-05
0.3	3.71E-06	9.02E-07	1.32E-06	2.82E-06	5.62E-06	9.12E-06
0.5	1.29E-06	2.43E-07	3.80E-07	9.33E-07	2.14E-06	3.35E-06
0.7	6.11E-07	8.61E-08	1.55E-07	4.22E-07	1.07E-06	1.74E-06
1	2.59E-07	2.57E-08	5.13E-08	1.66E-07	4.37E-07	7.59E-07
1.5	8.87E-08	5.43E-09	1.20E-08	4.79E-08	1.55E-07	2.79E-07
2	3.87E-08	1.51E-09	4.27E-09	1.70E-08	7.76E-08	1.40E-07
3	1.09E-08	2.11E-10	6.61E-10	3.98E-09	2.09E-08	4.47E-08
5	1.80E-09	1.29E-11	4.79E-11	4.22E-10	2.82E-09	8.51E-09
7	4.86E-10	1.51E-12	7.41E-12	7.50E-11	7.08E-10	2.29E-09
10	1.08E-10	1.18E-13	7.59E-13	1.12E-11	1.35E-10	4.68E-10
2.5 Hz Hazard Curves						
0.001	6.52E-02	3.16E-02	4.47E-02	6.31E-02	8.32E-02	9.55E-02
0.0015	5.20E-02	1.95E-02	3.16E-02	5.13E-02	7.24E-02	8.32E-02
0.002	4.26E-02	1.29E-02	2.24E-02	4.17E-02	6.31E-02	7.24E-02
0.003	3.02E-02	7.41E-03	1.38E-02	2.75E-02	4.79E-02	5.50E-02
0.005	1.71E-02	3.24E-03	6.03E-03	1.38E-02	3.16E-02	3.63E-02
0.007	1.06E-02	1.74E-03	3.47E-03	7.94E-03	2.09E-02	2.40E-02
0.01	5.82E-03	8.41E-04	1.62E-03	4.27E-03	1.20E-02	1.48E-02
0.015	2.56E-03	3.31E-04	6.61E-04	1.86E-03	5.25E-03	6.46E-03
0.02	1.30E-03	1.72E-04	3.09E-04	1.00E-03	2.63E-03	3.47E-03
0.03	4.46E-04	6.10E-05	1.02E-04	3.55E-04	8.71E-04	1.15E-03
0.05	9.94E-05	1.53E-05	2.57E-05	7.76E-05	1.55E-04	2.19E-04
0.07	3.60E-05	6.03E-06	1.12E-05	2.75E-05	5.13E-05	7.00E-05
0.1	1.28E-05	2.37E-06	3.98E-06	9.12E-06	1.70E-05	2.57E-05
0.15	4.37E-06	7.33E-07	1.32E-06	2.82E-06	6.46E-06	1.05E-05
0.2	2.15E-06	2.88E-07	5.37E-07	1.37E-06	3.24E-06	5.82E-06
0.3	8.15E-07	7.50E-08	1.55E-07	4.84E-07	1.41E-06	2.46E-06
0.5	2.38E-07	1.12E-08	2.75E-08	1.26E-07	4.68E-07	8.41E-07
0.7	1.01E-07	2.72E-09	8.51E-09	4.47E-08	2.04E-07	4.07E-07
1	3.87E-08	5.01E-10	1.74E-09	1.38E-08	7.24E-08	1.78E-07
1.5	1.18E-08	5.69E-11	2.34E-10	2.92E-09	1.82E-08	5.89E-08
2	4.77E-09	1.05E-11	4.79E-11	9.02E-10	6.92E-09	2.24E-08
3	1.19E-09	7.85E-13	4.27E-12	1.45E-10	1.62E-09	5.25E-09
5	1.68E-10	1.88E-14	1.55E-13	1.12E-11	1.91E-10	6.84E-10
7	4.03E-11	1.04E-15	1.38E-14	1.51E-12	3.63E-11	1.45E-10
10	7.81E-12	4.47E-23	6.61E-16	1.55E-13	4.90E-12	2.40E-11

PTN COL 2.5-2

Table 2.5.2-223 (Sheet 4 of 5)
Mean and Fractile Rock Seismic Hazard Curves

Ampl. (g)	MEAN (a.f.e.)	0.05 (a.f.e)	0.16 (a.f.e)	0.50 (a.f.e)	0.84 (a.f.e)	0.95 (a.f.e)
1 Hz Hazard Curves						
0.0001	1.04E-01	8.91E-02	9.55E-02	1.02E-01	1.10E-01	1.18E-01
0.0003	8.45E-02	6.31E-02	7.24E-02	8.32E-02	9.55E-02	1.02E-01
0.0005	7.06E-02	4.79E-02	5.50E-02	7.24E-02	8.32E-02	8.91E-02
0.0006	6.53E-02	4.17E-02	5.13E-02	6.76E-02	7.76E-02	8.91E-02
0.0007	6.07E-02	3.63E-02	4.47E-02	6.31E-02	7.76E-02	8.32E-02
0.0008	5.67E-02	3.16E-02	3.89E-02	5.89E-02	7.24E-02	7.76E-02
0.001	5.01E-02	2.40E-02	3.16E-02	5.13E-02	6.31E-02	7.24E-02
0.0015	3.85E-02	1.38E-02	1.95E-02	3.89E-02	5.50E-02	6.31E-02
0.002	3.08E-02	8.51E-03	1.29E-02	2.95E-02	4.79E-02	5.50E-02
0.003	2.09E-02	4.27E-03	6.46E-03	1.82E-02	3.63E-02	4.17E-02
0.005	1.10E-02	1.41E-03	2.63E-03	7.41E-03	1.95E-02	2.95E-02
0.007	6.39E-03	6.61E-04	1.32E-03	3.72E-03	1.12E-02	2.09E-02
0.01	3.19E-03	2.60E-04	5.37E-04	1.74E-03	5.62E-03	1.20E-02
0.015	1.23E-03	7.76E-05	1.55E-04	7.08E-04	2.00E-03	5.62E-03
0.02	5.58E-04	3.16E-05	6.31E-05	3.31E-04	8.71E-04	2.63E-03
0.03	1.59E-04	7.67E-06	1.48E-05	8.32E-05	2.19E-04	8.13E-04
0.05	2.73E-05	1.11E-06	2.29E-06	1.12E-05	3.89E-05	1.26E-04
0.07	8.24E-06	2.79E-07	7.59E-07	2.82E-06	1.12E-05	2.75E-05
0.1	2.41E-06	6.10E-08	1.91E-07	7.08E-07	3.24E-06	5.43E-06
0.15	6.38E-07	7.94E-09	2.24E-08	1.91E-07	8.13E-07	1.74E-06
0.2	2.61E-07	1.68E-09	7.41E-09	6.31E-08	3.55E-07	9.33E-07
0.3	7.85E-08	1.50E-10	1.00E-09	1.48E-08	1.26E-07	3.80E-07
0.5	1.86E-08	5.62E-12	5.89E-11	2.00E-09	3.16E-08	9.23E-08
0.7	7.21E-09	5.56E-13	7.94E-12	5.01E-10	1.12E-08	3.16E-08
1	2.53E-09	3.63E-14	7.08E-13	8.91E-11	2.82E-09	1.01E-08
0.5 Hz Hazard Curves						
0.0001	8.85E-02	7.24E-02	7.76E-02	8.91E-02	9.55E-02	1.02E-01
0.0003	6.30E-02	4.47E-02	5.13E-02	6.31E-02	7.24E-02	7.76E-02
0.0005	5.14E-02	2.75E-02	3.89E-02	5.13E-02	6.31E-02	6.76E-02
0.0006	4.73E-02	2.24E-02	3.16E-02	4.79E-02	5.89E-02	6.31E-02
0.0007	4.39E-02	1.82E-02	2.75E-02	4.47E-02	5.89E-02	6.31E-02
0.0008	4.09E-02	1.48E-02	2.40E-02	4.17E-02	5.50E-02	5.89E-02
0.001	3.58E-02	1.05E-02	1.82E-02	3.63E-02	5.13E-02	5.50E-02
0.0015	2.69E-02	5.25E-03	1.05E-02	2.75E-02	4.47E-02	5.13E-02
0.002	2.09E-02	2.92E-03	6.92E-03	1.95E-02	3.89E-02	4.47E-02
0.003	1.35E-02	1.23E-03	3.24E-03	1.05E-02	2.95E-02	3.63E-02
0.005	6.60E-03	3.31E-04	9.33E-04	3.47E-03	1.48E-02	2.40E-02
0.007	3.64E-03	1.26E-04	3.55E-04	1.41E-03	7.94E-03	1.59E-02
0.01	1.71E-03	3.76E-05	1.02E-04	5.37E-04	3.72E-03	9.12E-03
0.015	6.07E-04	7.94E-06	2.40E-05	1.45E-04	1.15E-03	3.47E-03
0.02	2.60E-04	2.29E-06	8.51E-06	5.50E-05	4.37E-04	1.62E-03
0.03	6.84E-05	4.37E-07	1.74E-06	1.16E-05	8.32E-05	4.37E-04
0.05	1.13E-05	4.03E-08	1.78E-07	1.46E-06	1.12E-05	5.13E-05
0.07	3.62E-06	6.68E-09	3.89E-08	4.68E-07	2.82E-06	9.77E-06

PTN COL 2.5-2

Table 2.5.2-223 (Sheet 5 of 5)
Mean and Fractile Rock Seismic Hazard Curves

Ampl. (g)	MEAN (a.f.e.)	0.05 (a.f.e)	0.16 (a.f.e)	0.50 (a.f.e)	0.84 (a.f.e)	0.95 (a.f.e)
0.5 Hz Hazard Curves (cont.)						
0.1	1.13E-06	9.33E-10	7.94E-09	8.91E-08	8.13E-07	1.57E-06
0.15	2.91E-07	6.76E-11	9.33E-10	1.29E-08	1.35E-07	3.94E-07
0.2	1.06E-07	8.81E-12	1.26E-10	3.98E-09	4.79E-08	1.66E-07
0.3	2.42E-08	3.55E-13	1.20E-11	5.37E-10	1.38E-08	5.50E-08
0.5	4.02E-09	2.29E-15	1.66E-13	3.16E-11	2.14E-09	1.20E-08
0.7	1.36E-09	3.16E-17	8.51E-15	3.72E-12	5.75E-10	3.85E-09
1	4.46E-10	1.02E-28	1.91E-16	4.37E-13	1.26E-10	9.33E-10

a.f.e. = annual frequency of exceedance

PTN COL 2.5-2

Table 2.5.2-224 (Sheet 1 of 3)
Percent Contribution to Deaggregation

Percent Contribution to Low-Frequency Deaggregation for 1E-04								
	Percent Contribution By Moment Magnitude [M] — Distance [R, km] Bin							
R \ M	5.25	5.75	6.25	6.75	7.25	7.75	8.25	8.75
0–20	3.358	0.6060	0.2397	0.02748	8.323E-3	9.539E-4	1.104E-20	1.104E-20
20–40	2.196	0.8873	0.4379	0.05555	0.01653	1.935E-3	1.682E-20	1.682E-20
40–60	0.8486	0.6860	0.4743	0.06720	0.02084	2.372E-3	2.673E-20	2.673E-20
60–80	0.3818	0.4289	0.4089	0.07140	0.02415	2.839E-3	2.672E-20	2.672E-20
80–100	0.2062	0.3388	0.3626	0.07307	0.02675	3.208E-3	2.553E-20	2.553E-20
100–210	0.3826	0.8812	1.295	0.3402	0.1589	0.02034	6.516E-20	6.516E-20
210–330	0.07032	0.6397	3.239	8.021	3.472	0.01310	3.978E-20	3.978E-20
>330	4.096E-3	0.08651	0.9054	6.256	27.78	32.16	1.977	0.03270

Percent Contribution to High-Frequency Deaggregation for 1E-04								
	Percent Contribution By Moment Magnitude [M] — Distance [R, km] Bin							
R \ M	5.25	5.75	6.25	6.75	7.25	7.75	8.25	8.75
0–20	9.682	0.8214	0.2675	0.02847	8.420E-3	9.426E-4	5.424E-21	5.424E-21
20–40	12.53	1.835	0.6223	0.06477	0.01742	1.948E-3	1.236E-20	1.236E-20
40–60	7.102	1.940	0.8323	0.08947	0.02330	2.589E-3	2.163E-20	2.163E-20
60–80	3.856	1.452	0.8217	0.1040	0.02850	3.106E-3	2.235E-20	2.235E-20
80–100	2.539	1.306	0.7968	0.1130	0.03231	3.550E-3	2.268E-20	2.268E-20
100–210	5.533	3.894	3.092	0.5538	0.1957	0.02274	6.059E-20	6.059E-20
210–330	0.7292	2.440	6.396	9.927	3.393	0.01361	3.864E-20	3.864E-20
>330	0.02732	0.1954	1.027	3.831	8.740	3.003	0.06259	1.947E-4