TECHNICAL SUMMARY

Between 2010 and 2012, the Pacific Gas and Electric Company (PG&E) performed a series of three-dimensional (3D) and two-dimensional (2D) low-energy and high-energy seismic-reflection surveys, along with other geological and geophysical investigations, to explore fault zones near the Diablo Canyon Power Plant (DCPP), as recommended in the California Energy Commission's (CEC) 2008 report "An Assessment of California's Nuclear Power Plants: AB 1632 Report" (referred to herein as the "AB 1632 Report"). PG&E has documented its activities performed in accordance with the CEC recommendation in the "Central Coastal California Seismic Imaging Project Report" ("CCCSIP Report"), and compares the results with the deterministic seismic hazard assessment presented in the 2011 Shoreline Fault Zone Report (PG&E, 2011a).

Background

The following reviews the regulatory history of Assembly Bill 1632 (AB1632), the CCCSIP, and the role of the California Public Utility Commission's Independent Peer Review Panel.

Regulatory

Assembly Bill 1632 (Blakeslee, Chapter 722, Statutes of 2006) directed the CEC to assess the potential vulnerability of California's large-baseload power-generation facilities (1,700 megawatts or greater) to a major disruption due to a seismic event or plant aging. The AB 1632 Report contained a recommendation from the CEC that PG&E use 3D geophysical seismic-reflection mapping and other advanced techniques to explore fault zones near the DCPP. This recommendation was made to supplement PG&E's Long Term Seismic Program (LTSP) and help resolve uncertainties surrounding the seismic hazard at the DCPP (CEC, 2008).

PG&E filed Application (A.) 10-01-014 with the California Public Utilities Commission (CPUC) on 15 January 2010 for cost recovery of $16.73 million associated with the enhanced seismic studies recommended by the AB 1632 Report. PG&E proposed the following three programs of the CCCSIP:

- Marine 2D/3D seismic-reflection surveys: low-energy and high-energy.
- Land 2D/3D seismic-reflection surveys: shallow- (low-energy) and deep-penetration (high-energy).
- Ocean bottom seismometer (OBS) array installation.

The CPUC issued Decision (D.) 10-08-003 to perform these studies on 12 August 2010. On 13 September 2011, PG&E filed a motion to reopen A. 10-01-014 to request additional funding for increased costs of conducting enhanced seismic studies at the DCPP. The CPUC issued D.12-09-008 on 12 September 2012 authorizing PG&E to recover an additional $47.5 million above the $16.73 million already approved in D. 10-08-003, for a total of $64.25 million.

Independent Peer Review Panel

CPUC D. 10-08-003 established an Independent Peer Review Panel (IPRP) to evaluate and report on PG&E's study plans and review the findings and/or results associated with the seismic studies, and D. 12-09-008 ordered the CPUC Energy Division Director to coordinate these tasks. The IPRP is composed of representatives from the following state agencies:

- California Coastal Commission
- California Emergency Management Agency
- California Energy Commission
- California Geological Survey
- California Public Utilities Commission
- California Seismic Safety Commission

A representative from the County of San Luis Obispo was added to the IPRP in 2012.

Technical

The following sections summarize the identification and selection of CCCSIP survey activities to address and reduce the uncertainty for specific hazard-significant parameters, and the key findings and results of the CCCSIP effort with regard to those hazard-significant parameters.

Previous Geologic/Geophysical Studies

Following the initial identification of the Shoreline fault offshore of the DCPP in 2008 (PG&E, 2010), PG&E conducted an extensive program in 2009 and 2010 to acquire, analyze, and interpret new geologic, geophysical, seismologic, and bathymetric data as part of the ongoing PG&E LTSP Update. The Shoreline Fault Zone Report (PG&E, 2011a) focused on constraining four main source-characterization parameters needed for a seismic hazard assessment: geometry (fault length, fault dip, down dip width), segmentation, distance offshore from DCPP, and slip rate. Probabilistic seismic hazard analysis (PSHA) determined that the Hosgri Fault Zone (HFZ) was the largest contributor to seismic hazard at the DCPP, with lesser, but significant contributions from the Los Osos, Shoreline, and San Luis Bay faults (PG&E, 2011a).

CCCSIP Geologic/Geophysical Studies

Geologic and geophysical surveys conducted by PG&E as part of the CCCSIP between 2010 and 2012 provided new geologic and geophysical data to further improve the source characterization of the Hosgri, Los Osos, San Luis Bay, and Shoreline fault zones. Marine and land survey activities were prioritized with input from the IPRP. The prioritization was based on (1) identification of the key seismic source parameters that had a significant impact to probabilistic seismic hazard at the DCPP site and (2) the overall likelihood that information from the proposed survey would reduce the uncertainty associated with each parameter. The following hazard-significant parameters were considered for investigation:

1. HFZ slip rate
2. HFZ dip
3. Shoreline fault zone slip rate
4. Hosgri–San Simeon fault zone step-over
5. Los Osos fault zone dip
6. Los Osos fault zone sense of slip
7. Los Osos fault zone slip rate
8. Hosgri/ Shoreline fault zone rupture
9. Shoreline fault zone southern end
10. Shoreline fault zone segmentation

A series of 2D and 3D offshore and onshore low-energy and high-energy seismic surveys (LESS and HESS, respectively) were proposed to collect information related to these parameters. Onshore and offshore LESS studies targeted shallow geologic structures and recent geomorphic features in order to evaluate recent fault activity. Onshore high energy studies imaged the deeper crustal structure of the Irish Hills. Offshore HESS studies were proposed to image deeper crustal structure to further constrain the geometry of and interactions between the Hosgri, Shoreline, and other offshore faults. The California State Lands Commission (CSLC) granted the Geophysical Survey Permit needed to conduct the HESS activities in August 2012; however, the California Coastal Commission (CCC) denied PG&E's application in November 2012 due to concerns about the environmental impact of these studies. In lieu of conducting the HESS, data from other geophysical investigations were used to constrain fault geometries and interactions at depth.

PG&E installed an array of four three-component broadband ocean bottom seismometers and accelerometers in the region offshore of the DCPP in 2013. The objective of the OBS array is to improve earthquake detection capability and location accuracy for earthquakes on the continental shelf adjacent to the Hosgri and Shoreline fault zones as well as constrain the path effects from these offshore events to the DCPP. Data are streamed in real time to the PG&E Central Coast Seismic Network for distribution to the U.S. Geological Survey (USGS) and the California Integrated Seismic Network.

Besides the investigations conducted as described above, two issues were raised during the course of the CCCSIP. The first issue was related to testimony submitted by the Alliance for Nuclear Responsibility on behalf of Dr. Douglas H. Hamilton concerning the Diablo Cove fault and the postulated San Luis Range/ Inferred Offshore fault. PG&E committed to addressing Dr. Hamilton's concerns using the data collected by the CCCSIP (CPUC D.12-09-008). The second issue concerned site response at the DCPP and was raised in IPRP Report #6 (IPRP, 2013). The IPRP requested that PG&E validate the shear-wave-velocity profile under the DCPP and justify the site factors used to develop the ground motions provided in the Shoreline Fault Zone Report (PG&E, 2011a).

The CCCSIP report, along with all associated data, will be provided to the DCPP Seismic Source Characterization (SSC) Level 3 Senior Seismic Hazard Analysis Committee (SSHAC) Technical Integration Team to evaluate and integrate into an SSC model for input into the NRC-required March 2015 probabilistic seismic hazard analysis (PSHA) update for the DCPP. The 2D and 3D marine seismic data collected by the CCCSIP are available from the USGS National Archive for Marine Seismic Surveys at http://walrus.wr.usgs.gov/NAMSS/. The 2D and 3D land seismic data are available from the Data Management Center of the Incorporated Research Institutions for Seismology at www.iris.edu/dms/nodes/dmc/.

Study Results

This section summarizes the key findings and results of the CCCSIP effort with regard to the hazard-significant parameters. CCCSIP Report chapters are identified that contain further discussion. Table 1 compares the SSC parameters used in the 2011 Shoreline Fault Zone Report and Hazard Sensitivity Study Report (PG&E, 2011a, 2011b) with the revised parameters presented in this report.

1. Hosgri Fault Slip Rate

- The preferred slip rate for the Hosgri fault, based on the LESS mapping, is 1.6 to 1.8 mm/yr. This range is similar to, but less than, the preferred slip rate of 2.25 mm/yr used in the Shoreline Fault Zone Report (see Chapter 3).

Reducing the uncertainty in the rate of fault slip of the Hosgri Fault Zone (HFZ) was ranked highest of all the study targets identified. High-resolution 3D LESS mapping of marine channels offset by the HFZ at two locations (western Estero Bay and offshore Point Sal) was used to measure fault offsets and estimate fault slip rates. Although there are only broad constraints on the ages of the offset channels in western Estero Bay and offshore Point Sal, the data preclude a maximum slip rate of 6 mm/yr. that was used in the Shoreline Fault Zone Report and, instead, favor a slip rate that is slightly lower than the slip rate used in that report.

2. Hosgri Fault Dip

- Potential field and seismicity studies support the range of dip angles (80°- 90° NE) for the HFZ used in the Shoreline Fault Zone Report (see Chapter 6).

Potential field mapping in Estero Bay (north of the DCPP) and Point Sal (south of the DCPP) and earthquake relocations (Hardebeck, 2010, 2013) indicate that the HFZ has a vertical to steep dip in the upper 12 km of crust. Older deep-penetration common-depth-point (CDP) seismic-reflection and seismic-refraction data also indicate a vertical to steeply (>75°) east-dipping Hosgri fault at shallower depths (< 5 km).

3. Shoreline Fault Slip Rate

- The LESS study determined slip rates for the southern Shoreline fault in San Luis Obispo Bay. Although there are only broad constraints on the ages of the offset channels used to define these slip rates, the data preclude a slip rate as high as 1 mm/yr and support a lower rate of 0.06 m/yr. (Chapter 3).

As with the HFZ, uncertainty in the rate of fault slip along the Shoreline fault zone has a significant impact on hazard (PG&E, 2011b). High-resolution 3D LESS mapping in San Luis Obispo Bay identified the Shoreline fault as a through going structure and identified a number of piercing points (buried fluvial channels and paleoshorelines) for offset measurements and slip rate estimates (Chapter 3).

4. Hosgri–San Simeon Step-Over

- Connectivity between the Hosgri and San Simeon fault zones could accommodate the occurrence of longer, more infrequent earthquakes with a potentially larger magnitude (M 7.3) than was previously considered in the Shoreline Fault Zone Report (M 7.1). The ground motions resulting from these larger earthquakes are discussed in Chapter 13.

The LTSP Report (PG&E, 1988) identified a step-over or segmentation point between the Hosgri and San Simeon faults, offshore of Point Estero, which was interpreted to be a barrier to through going earthquake rupture. Consequently, the maximum length of a Hosgri fault earthquake was limited to 110 km, and the corresponding maximum magnitude was M 7.2. Review of recently collected 2D LESS data by the USGS and older deep-penetration CDP marine seismic-reflection profiling data in Chapter 4 indicates that while a structural connection most likely exists between the eastern strand of the Hosgri fault and the San Simeon fault, the evidence for recent fault rupture at this intersection is not well imaged. Nevertheless, possible linkage between the San Simeon and Hosgri faults is addressed in Chapter 13, *Hazard Sensitivity and Impact Evaluation.*

5. Los Osos Fault Dip

- Steep (55°–82°) south-dipping faults are interpreted in seismic-reflection profiles to project updip along the northeastern front of the Irish Hills to mapped surface traces of the Los Osos fault. These fault dips are generally consistent with the range of Los Osos fault dip angles (45°–75°) used in the Shoreline Fault Zone Report, but with a steeper minimum dip (55° verses 45°). Seismic-reflection data indicate that the Los Osos fault becomes a blind or buried fault beneath the north-central and northwestern Irish Hills, and that it may die out westward beneath a west-plunging anticline.

Chapter 7 discusses the land 2D and 3D low- and high-energy seismic-reflection results for the Los Osos fault zone. In addition to reducing the parametric uncertainty in the hazard sensitivity study discussed in Chapter 13, the seismic-reflection data for the Los Osos fault will be considered in the update to the SSC SSHAC model.

6. Los Osos Fault Sense of Slip

- The sense-of-slip values used in the Shoreline Fault Zone Report for a reverse-oblique slip fault were retained for use in the sensitivity presented in Chapter 13.

Geologic mapping performed in support of the onshore seismic studies (Chapter 9) reviewed and refined the earlier mapping of the Los Osos fault by Lettis and Hall (1994). Among the topics addressed by mapping was an assessment of whether the Los Osos fault zone may be a strike-slip fault instead of a reverse-oblique slip fault, as previously interpreted. LiDAR- and field-reconnaissance-based evaluation of streams crossing lineaments and faults associated with the east central reach of the Los Osos fault zone along the northeastern margin of the Irish Hills show no systematic lateral deflection of streams crossing the lineaments or bedrock fault traces.

7. Los Osos Fault Slip Rate

- The Los Osos fault slip rates used in the Shoreline Fault Zone Report were retained for use in this study.

While fault slip-rate data are not used in the deterministic hazard sensitivity analysis (Chapter 13), the Los Osos fault slip rates are being evaluated based on other data as part of the SSHAC program.

8. Hosgri/ Shoreline Fault Zone Rupture

The high-resolution 2D and 3D LESS study offshore of Point Buchon (Chapter 2) shows that, with in resolution of a few hundred meters, the Hosgri and Point Buchon-Shoreline faults intersect. The high-resolution 2D and 3D LESS study offshore of Point Buchon (Chapter 2) mapped the Point Buchon fault zone (identified as the N40°W fault in PG&E, 2011a) and its relationship to the Hosgri fault zone, the northern Shoreline seismicity lineament (Hardebeck, 2010, 2013; PG&E, 2011a) and the Shoreline fault. Fault splays at the northern end of the Point Buchon fault were mapped to link with a north-south-trending graben, about 400 to 500 m east of the Hosgri fault zone, that is truncated at its northwestern extent by a north trending fault that may be part of the HFZ.

Global examples (Wesnousky, 2006) suggest that the Hosgri and Point Buchon-Shoreline faults may rupture together given their close proximity in the near surface and at depth (Hardebeck, 2010, 2013). The Shoreline Fault Zone Report concluded that the branching geometry between the Shoreline and Hosgri faults offshore of Point Buchon inhibited joint rupture. Dynamic rupture modeling showed that if rupture on the Hosgri stepped on to the Point Buchon-Shoreline fault, the rupture would continue for only a few kilometers at most. Similarly, ruptures on the Shoreline fault stepping onto the Hosgri fault would continue for only a few kilometers (Kame et al., 2003; PG&E, 2011a, Appendix J).

The relatively low slip rate of the Shoreline fault zone and unfavorable branching geometry indicate that joint Hosgri/ Shoreline ruptures are infrequent events. As a sensitivity, a deterministic model with a full rupture of the Shoreline fault linked to a rupture of the Hosgri fault extending north to the end of the San Simeon fault is examined in Chapter 13. The frequency of joint Hosgri/ Shoreline ruptures will be addressed in the 2015 SSC SSHAC model, which will be input into an updated PSHA.

9. Shoreline Southern End

- The southern extension of the Shoreline fault in San Luis Obispo Bay is extended 22 km in length beyond the southern end point identified in the Shoreline Fault Zone Report.

Chapter 3 describes high-resolution 3D LESS mapping in San Luis Obispo Bay that identifies the Shoreline fault as a through going structure extending southeastward though the entire 3D survey area, 5.3 km south of the southern end (Node S1) identified in PG&E (2011a). The Shoreline fault is inferred to extend an additional 13.7 km from the southeast edge of the 3D LESS area toward an unnamed, 3 km long, fault mapped in the onshore Guadalupe Oil Field (CDOGGR, 1992) using lower-resolution USGS 2D LESS and older deep-penetration (CDP) marine seismic-reflection data.

10. Shoreline Segmentation

- The mapping described in Chapters 2 and 3 revises the overall length of the Shoreline fault from 23 to 45 km, based primarily on the mapping in San Luis Obispo Bay.

The Shoreline Fault Zone Report assigned a total length of up to 23 km to the Shoreline fault and subdivided the fault into three geometric segments (north, central, and south) based on similarities and differences in surface geology, geophysical characteristics, and seismicity that could limit rupture.

- Marine seismic-reflection data support the interpretation that the northern segment of the Shoreline fault zone is coincident with the main trace of the Point Buchon fault (Chapter 2). To the south, the Point Buchon fault may connect to the central segment of the Shoreline fault zone, although no identifiable connection has been observed in the 2D/3D seismic-reflection data.
- Farther south, marine seismic-reflection data indicate that the intersection of the Shoreline fault with two of the Southwest Boundary zone faults (Oceano and Los Berros) represents a zone of fault interaction and possible segmentation point (Chapter 3). The impact that this zone of fault interaction between the Shoreline and Southwest Boundary zone faults has on ground motions at the DCPP will be further evaluated in the SSHAC study.

Ocean Bottom Seismometer Array

- An array of four three-component broadband ocean bottom seismometers and accelerometers was successfully installed offshore of the DCPP in 2013.

The primary objectives of the Point Buchon OBS Project are to increase detection capability and provide full waveform recording for small ($M < 3$) earthquakes, as well as on-scale acceleration recordings of larger ($M > 3$) events in the offshore area. Broader azimuthal station coverage will improve earthquake locations and focal mechanisms in the region offshore of the DCPP and, in particular, will constrain the geometry and sense of slip of the Hosgri and Shoreline faults offshore of Point Buchon. These data will also be used to constrain the path effects from offshore earthquakes to the DCPP (Chapter 5).

Geophysical Surveys of the Hosgri Fault Zone

Chapter 6 addresses the AB 1632 Report comments concerning the tectonic setting of the HFZ, the characterization of the HFZ as either a strike-slip fault or a thrust fault and the geometry of the HFZ at depth. The role of the HFZ as an uplift rate boundary for the Irish Hills is discussed in Chapter 12.

- High-energy marine seismic-reflection, potential field, and seismicity data are all consistent with a steeply (>75°) northeast-dipping, right-lateral strike-slip HFZ in the vicinity of the DCPP.

A HESS investigation was proposed by PG&E to collect additional information related to the deep crustal geometry of the offshore faults (in particular, the dip of the HFZ) and interactions or linkages between the San Simeon, Hosgri, Shoreline, and other offshore and onshore faults. The CSLC granted the Geophysical Survey Permit needed to conduct the HESS activities in August 2012; however, the CCC denied PG&E's application in November 2012 due to concerns about the environmental impact of these studies. While no new deep penetration offshore HESS data were collected as part of the CCCSIP, older high-energy deep penetration marine seismic-reflection profiles as well as other geophysical survey data that have been collected or published since the LTSP Report (PG&E, 1988) were used extensively to constrain the key interpretations presented in this report.

- Although potential fault linkages are more appropriately addressed in a PSHA, a deterministic sensitivity analysis for linkage of the San Simeon, Hosgri, and Shoreline faults is provided in Chapter 13. Fault linkage scenarios will also be addressed as part of the SSC SSHAC model to develop an updated PSHA for the NRC in March 2015.

Both the type of faulting and dip of the HFZ have been determined based on the above data. Fault linkage scenarios were addressed deterministically and will be further addressed probabilistically. PG&E does not see the need to further pursue 3D HESS offshore studies and has concluded that the further reduction in SSC uncertainties would be outweighed by the potential effects of conducting these studies in environmentally sensitive areas.

DCPP Shear-Wave-Velocity Model

- The shear-wave velocity profile (V_{S30}) at the power block and turbine building were assumed to be the same (1,200 meters per second [m/s]) in the Shoreline Fault Zone Report. Chapter 10 demonstrates that there is significant variability in V_{S30} over the DCPP region due to variations in near surface geology. V_{S30} at the power-block foundation elevation (53 ft.) is 1,260 ± 100 m/s and 980 ± 100 m/s at the turbine-building foundation elevation (62 ft.).

Chapter 10 provides a 3D shear-wave (V_S) velocity model for the DCPP foundation area in response to IPRP Report #6 (IPRP, 2013). High-resolution seismic profiling data collected in 2012 were used to construct 3D acoustic-wave (V_P) velocity models and one-dimensional (1D) V_S depth profiles constrained by surface-wave dispersion. V_S profiles for the DCPP site region show variability that will be addressed as part of the soil-structure interaction analyses for determination of building fragility. Building fragility will be input into a future probabilistic seismic risk assessment.

DCPP Site Conditions Evaluation

Site amplification at the DCPP power-block and turbine-building foundation levels is computed in Chapter 11 using new shear-wave-velocity profiles (Chapter 10), recorded ground motions at the DCPP free-field sites, and new NGA-West2 ground-motion-prediction equations to account for the differences in the V_S profiles between the free-field sites and the power-block and the turbine-building foundations.

- DCPP site-specific data indicate that there is a site resonance in the 1.5 –2.5 hertz (Hz) range and that the DCPP site has stronger amplification at low frequencies and weaker amplification at high frequencies than an average rock site in California.

Hamilton Testimony

CPUC D.12-09-008 also included testimony from the Alliance for Nuclear Responsibility (A4NR) and Dr. Douglas Hamilton concerning a previously recognized fault mapped under the turbine building and Unit 1 containment structure (the Diablo Cove fault) and a proposed fault named the San Luis Range/Inferred Offshore fault. Chapter 12 presents an analysis of Dr. Hamilton's characterization of the two faults based on his testimony, presentations at technical conferences, and a presentation at a SSHAC workshop in November 2012. The major PG&E findings in Chapter 12 are that summarized in the following statements:

- The Diablo Cove fault does not represent a seismic hazard (i.e. vibratory ground motion or surface faulting) to the DCPP
- The geological and geophysical data supporting Dr. Hamilton's definition of San Luis Range/Inferred Offshore fault are equivocal. General aspects of his model will, however, will be considered in a probabilistic seismic hazard analysis.

Dr. Hamilton's proposes that the Diablo Cove fault is a seismic hazard, based on lateral continuity with the Shoreline fault, continuity at depth with the San Luis Range/Inferred Offshore fault, and association with microseismicity. Our evaluation showed that all three of these inferences are conjectural and not supported by the available data. Our analysis included a review of previously collected information about the Diablo Cove fault during the original siting and preconstruction activities, more recently collected and compiled geologic map (Chapter 9), recently collected high-resolution bathymetric data, and recently collected onshore high-resolution 3D seismic-reflection data (Chapter 8).

Trench and excavation mapping conducted before construction of the DCPP indicates that the Diablo Cove fault is discontinuous and that it does not displace marine terrace deposits that are 120,000 years ago. Geologic mapping onshore and mapping and analysis of high-resolution multibeam bathymetry offshore do not support connecting the Diablo Cove fault offshore to the Shoreline fault zone. Evaluation of the location and accuracy of microseismicity show that proposed connections between microseismicity and the Diablo Cove fault are not supported by the data. Geologic mapping and high-resolution seismic data support a model that the fault is related to shallow folds and is confined to depths no greater than several tens of meters to hundreds of meters below ground surface.

The analysis of the San Luis Range/ Inferred Offshore fault proposed by Dr. Hamilton interpreted 2D and 3D low-energy and high-energy land seismic-reflection data (Chapters 7 and 8), seismicity and potential field data (Chapter 6), and topographic and bathymetric data and analysis conducted recently during the Shoreline fault zone study (PG&E, 2011a). Interpretation of high-resolution 3D and lower-resolution 2D seismic data in the southwestern Irish Hills does not identify a moderately northeast-dipping fault at shallow depths as Dr. Hamilton proposed. The seismicity data beneath the Irish Hills show no clear alignments and are subject to several alternative interpretations, which are not a good basis for defining a fault plane with a high degree of confidence. The model proposed by Dr. Hamilton predicts boundaries of differential late Quaternary uplift rates that are not supported by available geologic data. In contrast, past seismic hazard models for the DCPP (PG&E, 2011a) do incorporate faults that are consistent with the available geologic data and late Quaternary uplift rate boundaries.

SSC efforts being conducted using the SSHAC process are considering a moderately north-to-northeast-dipping reverse fault beneath the southwestern margin of the Irish Hills that is a modification of the geometry being proposed by Dr. Hamilton; this alternative fault geometry may explain the current tectonic uplift beneath the DCPP.

Hazard Sensitivity and Impact Evaluation

Chapter 13 evaluates the sensitivity of deterministic ground motions to the new seismic source characterizations for the Shoreline and Hosgri faults developed by the CCCSIP (Table 1-1) and new ground-motion models developed as part of the PEER NGA-West2 program (PEER, 2013). For the Shoreline fault, the length is extended farther to the south than in the Shoreline Fault Zone Report, increasing the magnitude from M 6.5 to M 6.7. For the Hosgri fault, the step-over between the Hosgri and San Simeon faults is small enough that the two faults are assumed to rupture together rather than separately (PG&E, 1988, 2011a), with the magnitude increasing from M 7.1 to M 7.3. Seismic source characterizations for the Los Osos and San Luis Bay faults were slightly modified from the values used in the Shoreline fault zone study (PG&E, 2011a). An additional sensitivity study for a linked M 7.3 Shoreline and Hosgri–San Simeon fault rupture is also evaluated.

- The 84th percentile deterministic ground motions for the Hosgri–San Simeon, Shoreline, Los Osos, and San Luis Bay faults are bounded by the 1977 Hosgri earthquake and 1991 LTSP/SSER 34 spectra on Figures 1 and 2 for the DCPP power block and turbine building.
- A deterministic hazard sensitivity analysis for the case of a Shoreline fault rupture linked to the Hosgri–San Simeon faults remains bounded by the 1977 Hosgri earthquake and 1991 LTSP/SSER 34 spectra on Figure 3 for the DCPP power block and turbine building.

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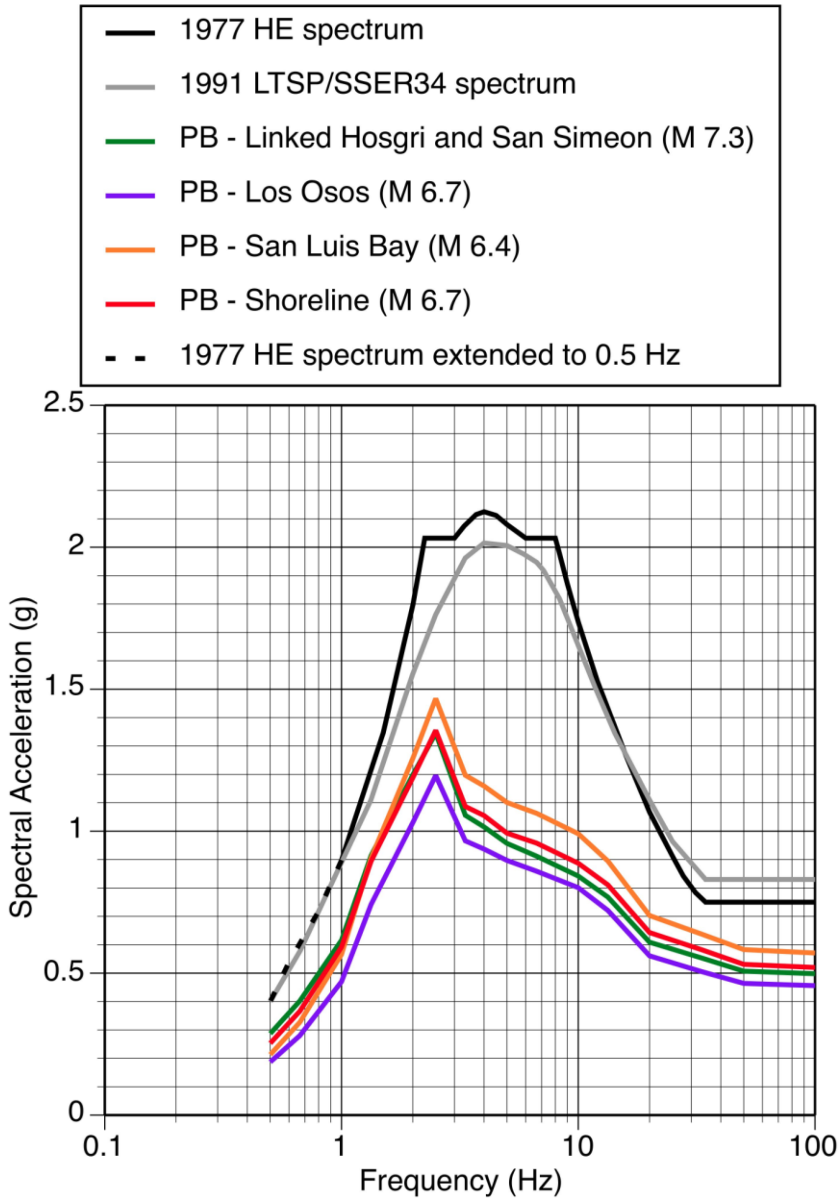
Table 1. Comparison of Seismic Source Parameters

Parameter (or Issue)	PG&E (2011a, 2011b)	PG&E (2014)
Hosgri slip rate	Preferred slip rate of 2.25 mm/yr	Point Sal: preferred slip rate of 1.8 mm/yr Estero Bay: preferred slip rate of 1.6 mm/yr
Hosgri dip	Range: 70°–90° NE	Range: 75°–90° NE
Shoreline slip rate	Preferred slip rate of 0.27 mm/yr	San Luis Obispo Bay: preferred slip rate of 0.06 mm/yr
Could Hosgri fault ruptures continue north of San Simeon?	No; ruptures terminate at Hosgri–San Simeon step-over. Deterministic length = 110 km Magnitude = M 7.1	Yes; Hosgri–San Simeon step-over is not a permanent barrier to rupture. Deterministic length = 171 km Magnitude = M 7.3 * 1977 Hosgri Design = M 7.5
Los Osos dip	Range of 45°–75° SW	Northeastern Irish Hills: preferred range of 55°–82° SW in the upper 1–3 km
Los Osos rake	Reverse; Reverse/Oblique	Reverse; Reverse/Oblique
Could there be a linked Hosgri-Shoreline fault rupture?	No based on the unfavorable intersection angle between the Hosgri and Shoreline faults	Yes; Hosgri-Shoreline linked rupture cannot be precluded based on fault mapping, but remains unfavorable based on intersection angle. Deterministic length = 145 km Magnitude = M 7.3* 1977 Hosgri Design = M 7.5
Los Osos slip rate	*Reverse* V 0.2–0.4 mm/yr *Reverse/Oblique* V 0.2/ H 0.1 mm/yr to V 0.4/ H 0.2 mm/yr	No new direct information
Total Shoreline fault zone length (and corresponding deterministic earthquake magnitude)	23 km (M 6.5)	45 km (M 6.7)
Shoreline southern extension	PG&E (2011b) added 10 km to fault end in PG&E (2011a)	Added 22 km to fault end in PG&E (2011a)

* Deterministic sensitivity analysis of linkage of the Hosgri–San Simeon and Hosgri and Shoreline faults is provided in Chapter 13.



The 84th Percentile Deterministic Ground Motions for Four Fault Scenarios Compared to the 1977 Hosgri Earthquake (HE) and the 1991 LTSP/SSER 34 Spectra for the DCPP Power Block

CCCSIP REPORT

Pacific Gas and Electric Company | Figure **1-1**

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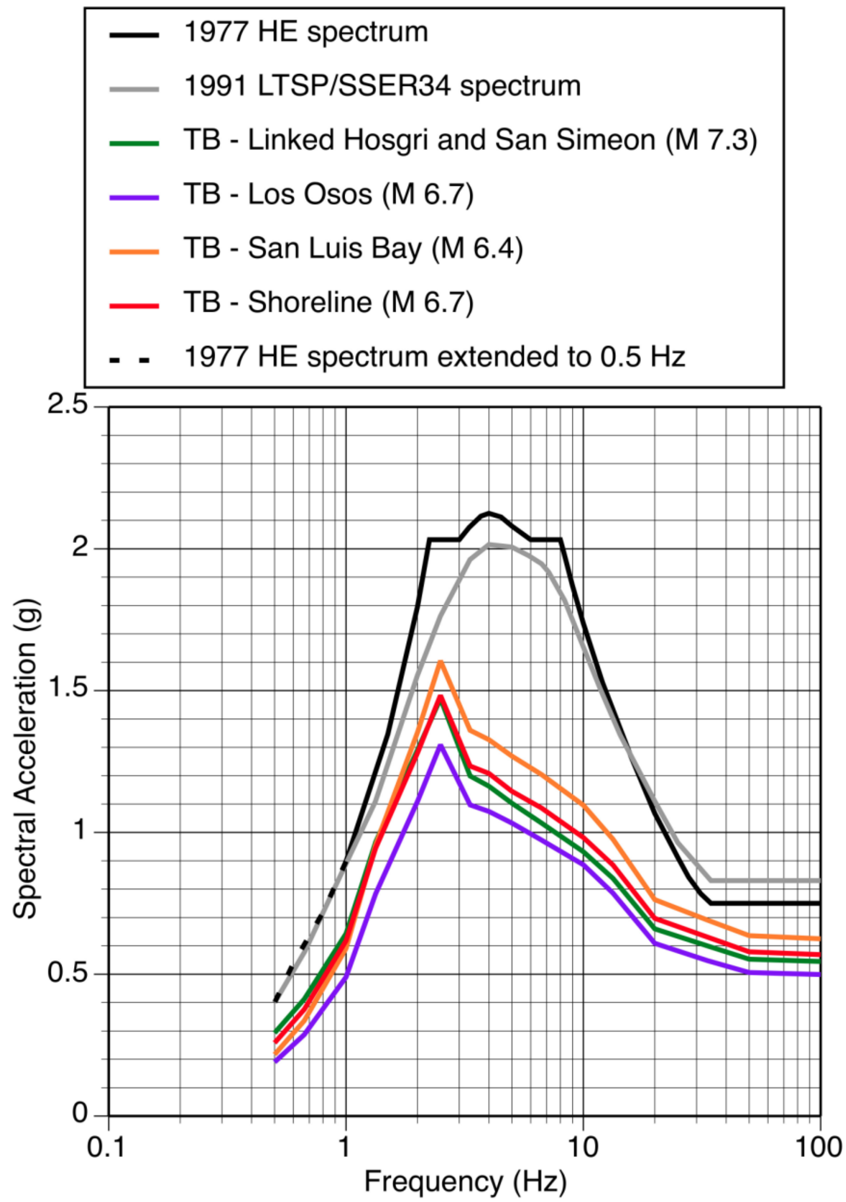

The 84th Percentile Deterministic Ground Motions for Four Fault Scenarios Compared to the 1977 Hosgri Earthquake (HE) and the 1991 LTSP/SSER 34 Spectra for the DCPP Turbine Building

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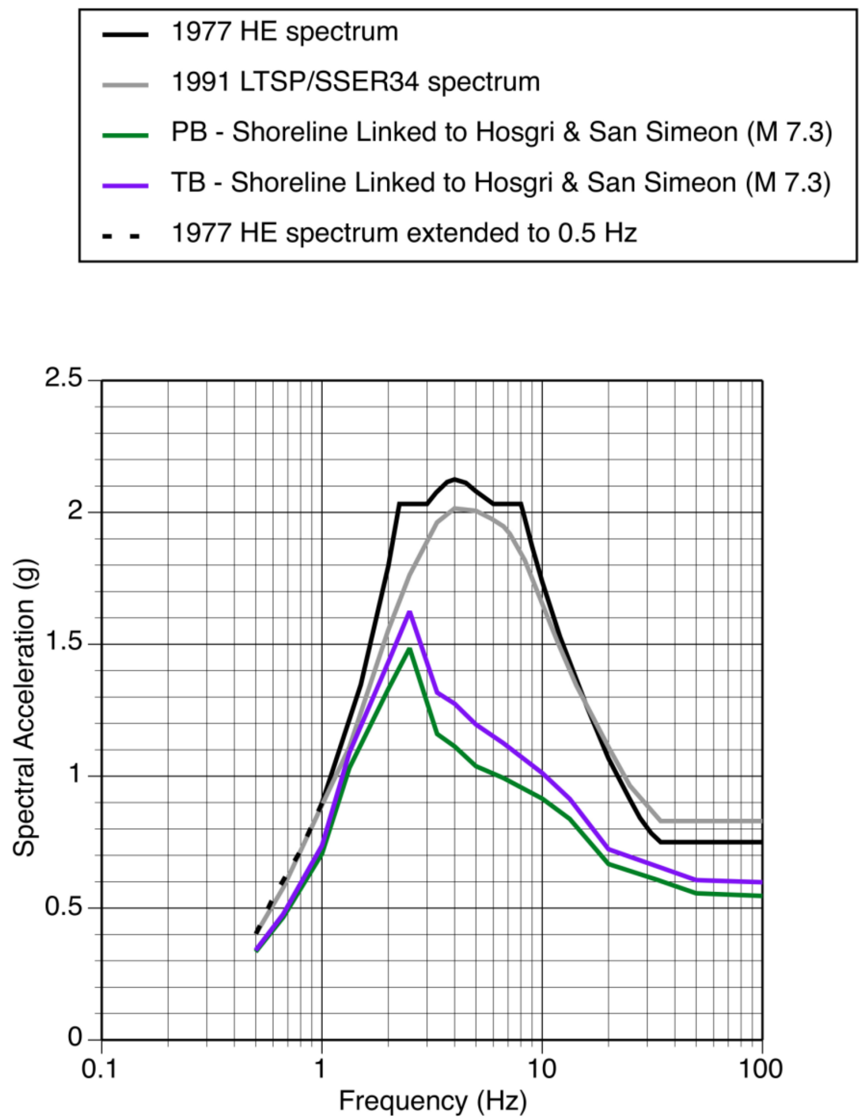
Pacific Gas and Electric Company | Figure **1-2**

File path: S:\1005\051\Figures\CCCSIP_Report\Figure_01-02.ai; Date: 08/01/2014; User: Serkan Bozkurt, LCI



The 84th Percentile Deterministic Ground Motions for Joint Shoreline and Hosgri-San Simeon Fault Rupture Compared to the 1977 Hosgri Earthquake and the 1991 LTSP/SSER 34 Spectra for the DCPP Power Block and Turbine Buildings

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File path: S:\1100\S051\Figures\CCCSIP_Report\Figure_01-03.ai; Date: 08/01/2014; User: Serkan Bozkurt, LCI