14 Report Findings and Conclusions

14.1 Findings and Conclusions

Pacific Gas and Electric Company (PG&E) has completed its advanced seismic studies to further document the seismic characteristics of the fault zones in the region surrounding the Diablo Canyon Power Plant (DCPP) in San Luis Obispo County. These studies have given PG&E, as well as scientists and regulators, an unprecedented view into the earth's crust that significantly and fundamentally increases understanding of the seismic characteristics near the DCPP. These studies confirm previous analyses that the plant and its major components are designed to withstand—and perform their safety functions during and after—a major seismic event.

PG&E performed these studies following the recommendation of the California Energy Commission (CEC) in a report issued in response to state legislation (Assembly Bill 1632, or AB 1632). AB 1632 (Blakeslee, Chapter 722, Statutes of 2006) directed the CEC to assess the potential vulnerability of California's largest baseload power-generation facilities (1,700 megawatts or greater) to a major disruption due to a seismic event or plant aging. Upon completing that assessment, the CEC issued a report in 2008 "An Assessment of California's Nuclear Power Plants: AB 1632 Report" that contained findings and recommendations concerning the seismic vulnerability of the DCPP. These recommendations have been addressed in the Central Coastal California Seismic Imaging Project (CCCSIP) report (this report) as follows:

- *PG&E should use three-dimensional geophysical seismic reflection mapping and other advanced techniques to explore fault zones near Diablo Canyon.*

The AB 1632 Report specifically identified the use of seismic imaging to resolve questions about the tectonic style and geometry of the Hosgri fault zone, the subsurface structure at the DCPP, and the deep geometry, continuity and interaction of poorly expressed faults that comprise the structural boundaries of the San Luis – Pismo block to address the possibility of a 2003 San Simeon-type earthquake occurring beneath the plant.

Studies conducted as part of the CCCSIP have reduced a number of the parametric uncertainties associated with the key faults identified in both the Shoreline fault zone (PG&E, 2011) and AB 1632 reports. New information about the structural boundaries of the San Luis-Pismo block, including slip rates of the Hosgri and Shoreline faults, the overall length of the Shoreline fault, possible linkages between the San Simeon, Hosgri, Shoreline and Southwest Boundary fault zones, as well as the internal fault structure of the San Luis-Pismo block have been presented based on both high – and low-energy 2D and 3D seismic-reflection surveys and other geologic and geophysical studies.

The reduction of uncertainty due to the additional data collected by the CCCSIP study is shown in Figure 1-1. The probabilistic hazard sensitivity presented in

Chapter 1 (Figure 1-2) was repeated using the updated ranges of the source parameters developed in the CCCSIP study. The sensitivities to the new ranges are shown by the red points in Figure 1-1. The tighter range of the red points for the parameters near the top of the plot show the reduction of uncertainty. In particular, there is a significant reduction in uncertainty due to the improved constraints on the Hosgri slip rate, Hosgri dip, Shoreline slip rate, and Los Osos dip. The additional information on linking of ruptures (Hosgri with San Simeon and Shoreline with Hosgri) do not have a significant impact on the uncertainty for the probabilistic hazard. Also, the extension of the Shoreline fault to the south does not have a significant impact on the uncertainty for the probabilistic hazard. For other parameters (Los Osos slip rate, Los Osos sense of slip, and Shoreline segmentation), new models were not developed, so the change is not shown.

Long-term seismic and geodetic monitoring of the DCPP region using the PG&E Central Coast Seismic Network (CCSN, including the Point Buchon Ocean Bottom Seismometer (OBS) network), and the USGS Central California Coast Region (CCCR) geographic positioning system (GPS) arrays will continue as part of PG&E LTSP.

CCCSIP studies have also addressed the testimony of Dr. Douglas Hamilton concerning a previously recognized fault mapped under the DCPP turbine building and the Unit 1 containment (Diablo Cove fault), and a proposed fault named the San Luis Range/Infererd Offshore Fault (SLR/IOF). Through review of previously collected information about the Diablo Cove fault from the original siting and pre-construction activities supplemented with recently collected geologic map data and high-resolution 3D seismic –reflection data collected as part of the CCCSIP indicate that the Diablo Cove fault does not represent a seismic hazard (e.g. vibratory ground motion or surface faulting) to the DCPP. Analysis of high-resolution 2D and 3D seismic-reflection data, seismicity and potential field data does not support the SLR/IOF as proposed by Dr. Hamilton. The general aspects of Dr. Hamilton's SLR/IOF model will, however, be considered in a probabilistic seismic hazard analysis as part of the PG&E SSHAC Level 3 process.

- *As ground motion models are refined to account for a greater understanding of the motion near an earthquake rupture, it will be important for PG&E to consider whether the models indicate larger than expected seismic hazards at Diablo Canyon and if so, whether the plant was built with sufficient design margins to continue operating reliably after experiencing these large ground motions*.

Deterministic ground motions based on the new seismic source characterizations for the Shoreline and Hosgri faults developed by the CCCSIP (Executive Summary, Table 1-1) and new ground motion models developed as part of the PEER NGA program (PEER, 2014) are compared relative to the PG&E (2011) deterministic hazard model results. For the Shoreline fault, the length is extended farther to the south than in the Shoreline Fault Report (PG&E, 2011), 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 then separately (PG&E, 1988; 2011), increasing the magnitude from M 7.1 to M 7.3. Source characterization for the Los Osos and San Luis Bay faults are modified slightly from PG&E (2011).

As seen in Chapter 13, Figures 2-1 and 2-2, the 84^{th} percentile deterministic ground motions for the Hosgri-San Simeon, Shoreline, Los Osos, and San Luis Bay faults are bounded by the 1977 Hosgri Earthquake (HE) and 1991 LTSP/SSER 34 spectrums for both 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 HE and 1991 LTSP/SSER 34 spectrums in Chapter 13, Figure 3-1 for both the DCPP power block and the turbine building.

- *PG&E should assess the implications of a San Simeon-type earthquake beneath Diablo Canyon. This assessment should include expected ground motions and vulnerability assessments for safety-related and non-safety related plant systems and components that might be sensitive to long period motions in the near field of an earthquake rupture.*

The Shoreline Fault Report (2011) included a San Simeon-type earthquake beneath the Irish Hills and the DCPP where the San Luis Bay fault (dipping 50° -80° N) and the Los Osos fault (dipping 45° to 75° SW) intersect at depth. The SSC SSHAC logic trees will consider various fault models to explain the uplift of the Irish Hills, including a San Simeon-type earthquake model.

In conclusion, PG&E has addressed the recommendations in the AB 1632 Report and has confirmed previous analyses that the plant and its major components are designed to withstand—and perform their safety functions during and after—a major seismic event.

In addition, the Nuclear Regulatory Commission has instructed all U.S. nuclear power plants to perform site reevaluations using current NRC requirements and guidance for probabilistic seismic hazards analysis (PSHA) (NRC, 2012). All new information from the CCCSIP studies will be evaluated and integrated into the tectonic models being developed as part of the Senior Seismic Hazard Analysis Committee (SSHAC) process. The SSC model will be input into the PSHA that will be submitted to the NRC in March 2015.

REFERENCES

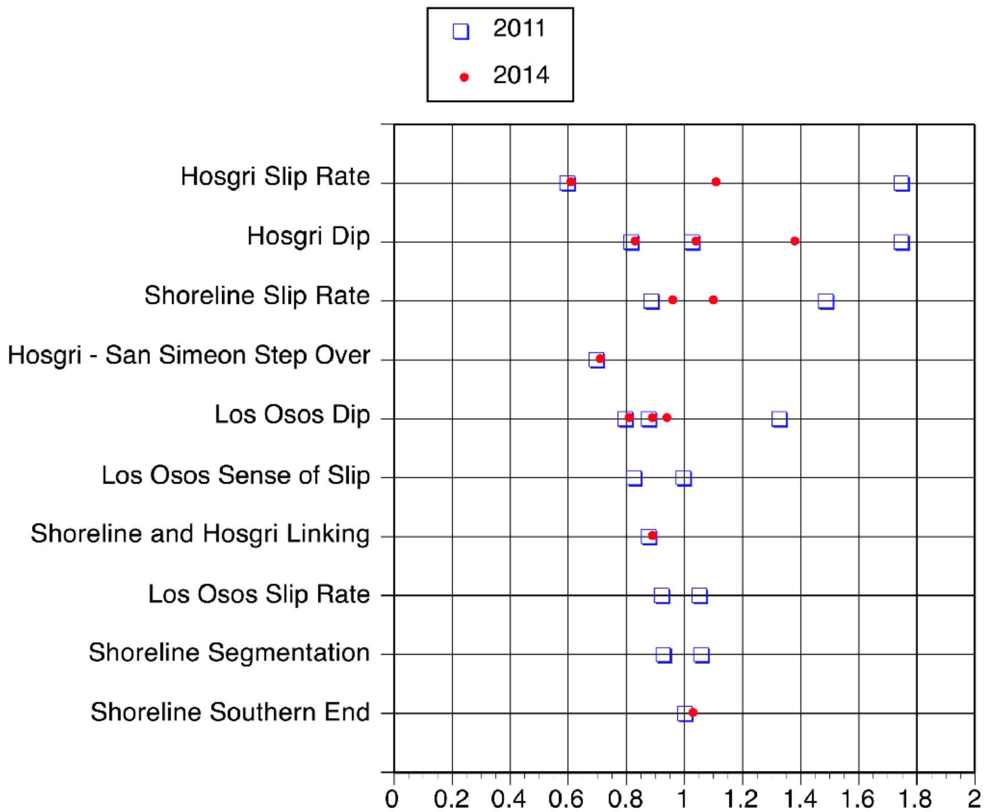
California Energy Commission, 2008. *An Assessment of California's Nuclear Power Plants: AB1632 Report*, CEC-100-2008-009-CMF, 42 pp.

Pacific Earthquake Engineering Center (PEER), 2014. NGA-West2 Ground Motion Models, available at http://peer.berkeley.edu/ngawest2/final-products/

Pacific Gas and Electric Company (PG&E), 1988. *Final Report of the Diablo Canyon Long Term Seismic Program*, U.S. Nuclear Regulatory Commission Enclosure 1, PG&E letter DCL-05-002, Docket No. 50-275 and No. 50-323.

Pacific Gas and Electric Company (PG&E), 2011. *Report on the Analysis of the Shoreline Fault Zone, Central Coastal California*, report submitted to the U.S. Nuclear Regulatory Commission.

U.S. Nuclear Regulatory Commission (NRC), 2012, Request for Information Pursuant to Title 10 of the Code of Federal Regulations 50.54 (f) Regarding Recommendations 2.1, 2.3, and 9.3 of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident, ADAMS Accession No. ML12056A046, Washington, D.C.



Tornado Diagram Comparison of 2011 and 2014 Hazard Significant Parameter Uncertainties

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