Application: 10-01-014
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Exhibit No.: (PG&E-3)
Date: March 23, 2012
Witnesses: Loren D. Sharp
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Joseph F. O'Flanagan

PACIFIC GAS AND ELECTRIC COMPANY

APPLICATION OF PACIFIC GAS AND ELECTRIC COMPANY FOR APPROVAL OF RATEPAYER FUNDING TO PERFORM ADDITIONAL SEISMIC STUDIES RECOMMENDED BY THE CALIFORNIA ENERGY COMMISSION

REBUTTAL TESTIMONY

PACIFIC GAS AND ELECTRIC COMPANY

DIABLO CANYON SEISMIC STUDIES

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A. Introduction

This rebuttal testimony responds to testimony submitted by the Alliance for Nuclear Responsibility (A4NR) addressing Pacific Gas and Electric Company's (PG&E) Prepared Testimony in its Application for Approval of Ratepayer Funding to Perform Additional Seismic Studies Recommended by the California Energy Commission (CEC) (Application 10-01-014) (the Application). As this Commission is aware, after the CEC issued its report, California Public Utilities Commission (CPUC or Commission) President Michael R. Peevey directed PG&E to address the CEC's recommendations, including its recommendation to perform additional seismic studies at and around Diablo Canyon Power Plant (Diablo Canyon) using advanced technologies.[1] In response to Commissioner Peevey's direction, PG&E requested and was granted $16.73 million in funding for detailed onshore and offshore seismic studies, using two-dimensional (2-D) and three-dimensional (3-D) technologies, in the area surrounding Diablo Canyon in Decision 10-08-003. That decision also authorized funding for PG&E to install four ocean bottom seismometer units to supplement the existing twenty onshore stations, which will enable PG&E to locate offshore earthquakes more accurately. In this Application, PG&E is requesting that the Commission authorize for recovery in customer rates the increased cost of performing the seismic studies previously approved in Decision 10-08-003, but significantly expanded in scope.

Upon issuance of Decision 10-08-003, PG&E proceeded to implement the seismic studies. Implementation included the presentation of study plans to and feedback from the Independent Peer Review Panel (IPRP) established by the Commission in Decision 10-08-003. Prior to filing the motion to re-open Application 10-01-014, PG&E had already completed the survey design and data acquisition phases of the onshore 2-D seismic studies and the survey design and data acquisition for two of the three survey phases of the offshore

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1 Commissioner Michael Peevey letter to then PG&E Chief Executive Officer Peter Darbee dated June 25, 2009.

low energy 2-D/3-D seismic studies. As PG&E undertook this work, PG&E determined that the geographical area from which data should be collected in order to optimize the collection of information should be expanded significantly. The broader geographical area allows for the integrated tectonic assessment of the interaction of faults in the area and improves the evaluation of potential seismic hazards at Diablo Canyon. PG&E made this decision in the context of input from third-party vendors and the IPRP, preliminary lessons learned from the accident at the Fukushima Daiichi nuclear power plant in Japan, and comments by the United States Geological Survey (USGS) questioning regional fault characterizations along the central coast of California.

As the scope of the seismic studies expanded, the cost to perform the 2-D and 3-D studies onshore and offshore increased, prompting PG&E to request that the Commission re-open Application 10-01-014 to consider the increased cost of the proposed seismic studies. Given the significantly expanded scope of the studies, the cost to complete the seismic studies has increased from $16.73 million to $64.25 million.

A4NR opposes any additional funding for the expanded seismic studies proposed by PG&E. In addition, through testimony submitted by Dr. Douglas H. Hamilton, A4NR recommends that the Commission order a complete re-evaluation of the seismic hazard at Diablo Canyon. As set forth in more detail in Section B below, the majority of Dr. Hamilton's testimony, which is premised entirely on the assumption that the existing Nuclear Regulatory Commission (NRC)-approved seismic evaluation of Diablo Canyon is inadequate, is outside the scope of this proceeding. In recommending/directing PG&E to perform *additional* seismic studies using advanced technology, neither the CEC nor the CPUC identified any deficiencies with the *existing* seismic evaluation of Diablo Canyon or the ongoing work performed in the context of PG&E's Long-Term Seismic Program (LTSP).

In this proceeding, the Commission is considering whether to authorize the funding and recovery in rates of the costs of doing the enhanced seismic studies described in this application. And, while Dr. Hamilton's concerns are not within the scope of this proceeding, PG&E believes that the seismic studies described in the application will enhance the seismic assessment of features such as those

identified by Dr. Hamilton. Accordingly, the Commission should reject A4NR's recommendations.

As an alternative to the outright denial of additional funding, A4NR recommends, in testimony submitted by Rochelle Becker, that the Commission adopt a cost-sharing mechanism, apportioning the costs of PG&E's seismic studies (presumably, the seismic studies proposed by Dr. Hamilton) between PG&E's shareholders and customers. As explained in Section C, this cost-sharing mechanism is inconsistent with established ratemaking policy for Diablo Canyon and should be rejected.

Ms. Becker's testimony also attacks the IPRP's membership and processes, asserting that the IPRP is not functioning as the Commission intended in Decision 10-08-003. As explained in Section F, PG&E has met with the IPRP several times to present and explain the study plans for the seismic studies. Additionally, the IPRP has issued two reports commenting on the study plans presented to it to date.[2]

Read together, the testimony of Dr. Hamilton and Ms. Becker can be seen as suggesting that this Commission supplant the NRC as the government agency with oversight responsibility for ongoing seismic studies, analysis and peer review of the seismic hazard at Diablo Canyon. As mentioned above, and as explained further in Sections B, C and G below, seismic hazard analyses and risk assessments are part of the ongoing, exclusive jurisdiction of the NRC.

B. The Existing Seismic Evaluation for Diablo Canyon Was Reviewed and Approved by the NRC

Q 1 What agency is responsible for regulating the safety of nuclear power plants?

A 1 Under the Atomic Energy Act of 1954, the federal government created a comprehensive and exclusive federal program for the licensing and regulation of nuclear power plants—including Diablo Canyon. The responsibility for assuring public health and safety with respect to radiological hazards related to those nuclear plants is vested in the NRC.

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[2] A4NR's complaint regarding the membership of the IPRP is that the USGS is not a member. PG&E notes that the USGS has declined the Commission's invitation to be a member of the IPRP on two occasions, most recently by letter to CPUC Commissioner Mike Florio dated March 1, 2012.

The United States Supreme Court emphasized, in *Pacific Gas and Electric Co. v. State Energy Res. Conserv. & Dev. Comm'n*, 461 U.S. 190, 207 (1983), that the Atomic Energy Act gave the federal government "exclusive jurisdiction to license the transfer, delivery, receipt, acquisition, possession and use of nuclear materials" and, on these matters, "no role was left to the states." This federal preemption of the field of nuclear safety has been confirmed in several subsequent court decisions, most recently in the decision of the United States District Court for the District of Vermont, *Energy Nuclear Vermont, LLC, et al. v. Shumlin, et al.*, issued on January 19, 2012.

Q 2 Does the NRC consider seismic safety in the context of its licensing authority?

A 2 Yes. The NRC's authority to license and regulate nuclear safety specifically includes the issue of seismic safety. Accordingly, the NRC has established regulatory requirements to ensure that nuclear plant structures, systems, and components important to safety are designed and maintained to withstand seismic events. For example, 10 Code of Federal Regulations (CFR) Part 50, Appendix A, General Design Criterion (GDC) 2 requires that nuclear plant structures, systems and components be designed to withstand natural phenomena, including earthquakes and tsunamis, and that that design consider historical records and provide for a sufficient safety margin. Both in the original NRC licensing of Diablo Canyon and in subsequent reviews, the seismic hazards applicable to Diablo Canyon have been subjected to substantial NRC scrutiny. Seismic issues continue to be the subject of ongoing federal reviews in the aftermath of the earthquake and tsunami that crippled the nuclear plant at Fukushima in Japan.

The issues raised by Dr. Hamilton have been considered by the NRC in the past and continue to be evaluated by PG&E and the NRC in the context of PG&E's NRC operating license. Seismic issues remain subject to NRC regulatory oversight as discussed further below. The issue in the scope of and funding for additional seismic studies. Any seismic design considerations associated with the results of the studies will be addressed by PG&E and the NRC.

Q 3 Does the NRC provide avenues for public input on seismic safety at Diablo Canyon?

A 3 Yes. The Atomic Energy Act and NRC regulations provide for public participation in agency actions resulting from its evaluation of seismic events, such as any rulemakings, orders, or licensing actions. Additionally, any person is permitted, under NRC regulations in 10 CFR § 2.206, to file a request to modify, suspend, or revoke a license where the person believes that the NRC or one of its licensees has not adequately addressed a safety or environmental issue. Any person who seeks the imposition of stricter requirements than those currently applied to a facility may also file a petition under 10 CFR § 2.802.

C. The NRC-Approved Seismic Evaluation for Diablo Canyon Has Not Been Found Deficient

Q 4 Has the NRC reviewed and approved PG&E's seismic evaluations for Diablo Canyon in the past?

A 4 Yes. The NRC has consistently found that Diablo Canyon is safe. During the course of the design, construction, and operation of Diablo Canyon, the NRC reviewed and found PG&E's seismic evaluations acceptable, including evaluations during construction permit reviews, operating license reviews, the various stages of the LTSP required by the NRC license and, most recently, with respect to the Shoreline fault.

Q 5 Can you please summarize the NRC's review of PG&E's initial seismic evaluations associated with licensing Diablo Canyon?

A 5 Yes. Before the NRC issued the construction permits for Diablo Canyon, PG&E conducted geological and seismic investigations to validate the acceptability of the site. These investigations included regional studies and detailed onshore site investigations consisting of trenching, core drilling, and geological mapping in the vicinity of the site. As explained in the original NRC Staff Safety Evaluation Report for the operating license, the plant was originally designed—and a construction permit was issued—based on the agency's proposed GDC published in July 1967.[3] As noted above, GDC 2 required that plant structures, systems, and components be designed to

[3] PG&E subsequently modified the design to respond to the final GDC issued in February 1971.

withstand earthquakes, considering historical earthquake records and providing for sufficient safety margins. Several specific earthquakes were considered in the original Diablo Canyon design construction permit review. As explained in the Supplemental Safety Evaluation Report (SSER) 4, these included large magnitude earthquakes and large aftershocks along the San Andreas fault 48 miles from the site; the Nacimiento fault 20 miles from the site; and the Santa Ynez fault 50 miles from the site.

Q 6 Did the NRC accept PG&E's evaluation of these earthquakes?

A 6 Yes. The response spectra from two of these postulated earthquakes was accepted by the Atomic Energy Commission (now the NRC) as representing the maximum vibratory ground motion at Diablo Canyon, and served as the basis for the Design Earthquake (DE) (0.2g). In order to assure adequate reserve for seismic resisting capability of safety related structures, systems, and components, an earthquake producing two times the acceleration values of the DE, described as the Double Design Earthquake (DDE) (0.4g), was also defined. The postulated ground motions associated with the DE and DDE served as the basis for the design response spectra used by PG&E to design the plant structures, systems, and components. PG&E also concluded at that time that there was no surface displacement hazard (capable fault) at the site. This conclusion was based on the absence of any displacement of the 80,000 year old and 120,000 year old marine terraces underlying the site area. The NRC Staff found these analyses and conclusions acceptable and issued construction permits for Diablo Canyon, Units 1 and 2, in 1968 and 1970.

Q 7 Did the NRC require new seismic analyses after discovery of the Hosgri fault before issuance of the operating license for Diablo Canyon?

A 7 Yes. The seismic design and licensing bases for Diablo Canyon evolved throughout the extended period of design, licensing, and construction of the plant. The evolution was the result of advances over that time in geotechnical information for the surrounding region, additional site-specific seismic and structural analyses, and the parallel development of NRC regulations and guidelines. Specifically, while geological investigations in support of the Diablo Canyon operating license applications were under way, oil company geoscientists discovered that a zone of faulting existed a

few miles off shore from the plant site. The USGS and PG&E subsequently conducted surveys of the area, and PG&E and the NRC Staff evaluated the earthquake potential on the fault. From these surveys the NRC Staff concluded that a 7.5 magnitude earthquake should be assumed to occur on the Hosgri fault and that an effective horizontal ground motion acceleration of 0.75g at Diablo Canyon should be utilized for design response spectra.

Q 8 Did PG&E evaluate the implications of the Hosgri fault on the Diablo Canyon design?

A 8 Yes. The NRC Staff specifically requested a new evaluation of the plant's capability to withstand those ground motions. As a result, PG&E undertook a complete re-evaluation of the seismic design of Diablo Canyon and implemented significant modifications to the existing plant systems, structures, and components in order to address this increase in ground motion level. PG&E's new evaluations were reviewed and accepted in several subsequent NRC safety evaluations prior to issuance of an operating license. As explained in NRC SSER 7, issued in May 1978, the NRC Staff accepted a Hosgri Earthquake (HE) (magnitude 7.5 earthquake and horizontal ground acceleration of 0.75g at the site) "as the safe shutdown earthquake for the site." All safety-related systems, structures, and components at Diablo Canyon were designed to remain functional if the safe shutdown earthquake occurs, including systems, structures, and components necessary to assure: (1) the integrity of the reactor coolant pressure boundary; (2) the capability to shut down the reactor and maintain it in a safe shutdown condition; or (3) the capability to prevent or mitigate the consequences of accidents which could result in potential offsite exposures comparable to the guideline exposures of 10 CFR Part 100. Following the additional analyses and upgrades related to the identification of the Hosgri fault, the site-specific seismic design and licensing bases for Diablo Canyon were accepted by the NRC for issuance of the operating licenses for Units 1 and 2.

Q 9 Did the NRC require additional seismic analyses following issuance of the operating license for Diablo Canyon?

A 9 Yes. The Diablo Canyon Unit 1 operating license was originally issued on September 22, 1981. Subsequently, on April 14, 1984, the NRC issued

Amendment 9 to the operating license that imposed License Condition 2.C.(7), requiring PG&E to develop and implement a program to reevaluate the seismic design basis considering all relevant geologic and seismic data that became available subsequent to initial licensing. PG&E responded by developing the LTSP. The NRC Staff documented in SSER 27 that the LTSP would include a deterministic seismic margin assessment and a seismic probabilistic risk assessment/seismic hazard analysis in which "ground motion levels beyond the design are assumed and the consequences investigated." PG&E also performed, at the NRC's request, a comparison between the LTSP Earthquake and the HE. PG&E submitted the final LTSP report on July 31, 1988.

Q 10 Did the NRC find the LTSP evaluations acceptable?

A 10 Yes. Following its review of the LTSP report, as well as reviews by the NRC's Advisory Committee on Reactor Safeguards, the NRC Staff issued SSER 34, on June 30, 1991, accepting the results of the LTSP. The NRC Staff found that the geological, seismological, and geophysical investigations and analyses conducted by PG&E and its consultants for the LTSP were the most extensive, thorough, and complete ever conducted for a nuclear facility in the U.S., and that the work had advanced the state of knowledge in these disciplines significantly.

The LTSP and NRC review specifically took place from April 1984 to September 1991, a total of seven years and five months. During this time, over 60 noticed public meetings were held, including with the NRC, NRC consultants, the USGS, University of Nevada professors and graduate students, a Ground Motion Panel consisting of four distinguished professors, a Soil Structure Interaction Panel consisting of four distinguished professors, a Fragility Panel consisting of distinguished engineers from the Brookhaven and Sandia National Laboratories, and engineers from EQE, Inc. and a Probabilistic Risk Assessment (PRA) Advisory Panel consisting of distinguished engineers from Brookhaven Laboratory. In addition, independent studies for the NRC were conducted by Dr. David B. Slemmons, University of Nevada, on geology, seismology, and tectonics; Dr. Kenneth Campbell of EQE, Inc., on empirical ground motions; Dr. Anestis S. Veletsos on soil/structure interaction; Dr. Michael Bohn,

Sandia National Lab, on seismic risk; Dr. James Johnson, EQE, Inc., and Dr. M. K. Ravinda, EQE, Inc., on fragility; and the Brookhaven National Laboratory on probabilistic risk assessment. All of these activities were reviewed at a series of public meetings.

During the LTSP review, the issue of the seismic source characterization for the Diablo Canyon site was again carefully evaluated, including the mechanism of the limiting fault (some of which is addressed in Dr. Hamilton's testimony). The NRC also reviewed PG&E's empirical ground-motion attenuation model and numerical modeling studies and performed an independent attenuation study to estimate ground motion at the Diablo Canyon site. After the NRC Staff and PG&E reached different conclusions regarding the ground motions expected at certain frequencies for both horizontal and vertical ground motions, PG&E submitted additional analyses to confirm LTSP conclusions that the seismic margins for structures and equipment at Diablo Canyon were sufficient to accommodate the NRC Staff's spectral estimates of horizontal and vertical ground motions. The NRC concluded that the seismic margins of the structures, systems, and components were adequate even after considering the NRC's estimate of increased seismic ground motions. The NRC also concluded, based on PG&E's deterministic analysis and the PRA, that the Diablo Canyon seismic margins were acceptable.

Notwithstanding the successful completion of the LTSP, PG&E committed to the NRC to retain an ongoing, robust geosciences program, which keeps current with new geological, seismic, and seismic engineering information and evaluates it with respect to its significance to Diablo Canyon, with appropriate reporting to and oversight by the NRC. PG&E has met that commitment and continues to implement the LTSP to the present day.

Q 11 Has PG&E performed other evaluations to address new seismic information since the initial LTSP report?

A 11 Yes. As part of the ongoing LTSP, PG&E anticipates and responds in a timely manner to new issues and concerns as they arise. PG&E has, for example, performed seismic evaluations following actual seismic events in the region (e.g., San Simeon earthquake) or when new seismic information

was discovered (e.g., Shoreline fault). PG&E has provided that information and its analyses to the NRC.

Q 12 Did the NRC accept PG&E's evaluation of the San Simeon earthquake?

A 12 Yes. PG&E and the NRC reviewed seismic issues potentially relevant to Diablo Canyon after the magnitude 6.5 earthquake northeast of San Simeon on December 22, 2003. PG&E issued Special Report 03-04 on January 5, 2004. This report was later supplemented, on March 29, 2004 and on June 7, 2004. A final report was issued in June 2005. The NRC conducted special inspection activities at Diablo Canyon between December 22, 2003 and January 9, 2004, including walk downs and visual examinations of structures, systems and components. The NRC also specifically reviewed Special Report 03-04 and the subsequent PG&E supplements. PG&E's analysis determined that the free field ground motion during the San Simeon Earthquake was less than 24 percent of the Diablo Canyon original design earthquake and less than 7 percent of the Diablo Canyon licensing basis HE ground motion. The NRC confirmed that there was no system or structural damage at Diablo Canyon, and that no site ground effects were observed at Diablo Canyon. Following subsequent reviews of the event and reports, the NRC found, through its independent inspections and review, that the Diablo Canyon response to the earthquake was well within the design and licensing bases of the plant. The NRC's conclusion and ongoing seismic reviews with respect to Diablo Canyon were specifically discussed in an NRC public meeting on June 9, 2004.

Q 13 Did PG&E submit analyses regarding the Shoreline fault to the NRC?

A 13 Yes. In November 2008, PG&E notified the NRC of the results of its preliminary evaluations of the Shoreline fault zone, located approximately 1 kilometer offshore from Diablo Canyon. PG&E concluded that the potential ground motions at Diablo Canyon from the Shoreline fault were bounded by the licensing basis ground motion spectra previously determined for earthquakes on the Hosgri fault. In addition, PG&E determined that the tsunami hazard from the potential new fault is bounded by the plant's design basis tsunami hazard. The NRC Staff performed an independent assessment of the geophysical information and, on April 8, 2009, documented its conclusion that "design and licensing basis

evaluations of the DCPP structures, systems, and components are not expected to be adversely affected and the current licensing basis remains valid and supports continued operability of the DCPP site."

Subsequent to the preliminary evaluation and the NRC Staff's independent review, PG&E completed a more thorough Shoreline Fault Zone Report in January 2011. In addition to addressing the Shoreline fault, the seismological/geological studies included updated earthquake ground motions for three previously identified faults, the Los Osos Fault, the San Luis Bay Fault, and the Hosgri fault. Based on the LTSP methodology, but using state-of-the-art seismic information and ground motion models, PG&E reached conclusions consistent with the preliminary evaluation. The NRC Staff review of that report is ongoing.

Q 14 Did PG&E and the NRC perform any evaluations following the March 2011 earthquake and subsequent tsunami in Japan?

A 14 Yes. PG&E took action to (1) verify the capability to mitigate conditions that result from severe adverse events, including the loss of significant operational and safety systems due to natural events; (2) verify the capability to mitigate a total loss of electric power to a nuclear power plant; (3) verify the capability to mitigate flooding and the impact of floods on systems inside and outside the plant; and (4) identify the potential for loss of equipment functions during seismic events appropriate for the site and the development of mitigating strategies to address potential vulnerabilities. For its part, the NRC inspected the readiness of nuclear power plant operators to implement severe accident management guidelines. The NRC inspections were completed by April 15, 2011. The minor or low safety significance issues that were identified posed no imminent threat to public health and safety and were entered into licensee corrective action programs. Following these actions and reviews by the NRC's Fukushima Near-Term Task Force (NTTF), the NRC confirmed that "continued operation and continued licensing activities [at nuclear power plants] do not impose an imminent risk to the public health and safety and are not inimical to the common defense and security."

Q 15 Do you expect further NRC review of seismic evaluations for Diablo Canyon in the near-term?

A 15 Yes. The NRC's NTTF recommended that the agency take several actions focused on seismic safety. Recommendation 2.1, as amended by the Commission, is for licensees to reevaluate the seismic hazards at their sites against present day NRC requirements and guidance, and identify actions that have been taken, or are planned, to address plant-specific issues associated with the updated seismic hazards. Recommendation 2.3 is for licensees to perform seismic and flood protection walk downs to identify and address plant-specific vulnerabilities and verify the adequacy of monitoring and maintenance for protection features such as water tight barriers and seals in the interim period until longer-term actions are completed to update the design basis for external events. These recommendations were accepted by the NRC. After accepting input from the public and holding a series of public meetings, the NRC Staff issued letters, referred to as 50.54(f) letters, on March 12, 2012, requiring all licensees, including PG&E, to provide information within the scope of Recommendations 2.1 and 2.3. The analyses and evaluations necessary to respond to the 50.54(f) letters will be performed and submitted to the NRC in phases, as directed in the letters. The NRC Staff will evaluate licensee responses to the 50.54(f) letters and document its conclusions in a safety evaluation. PG&E expects to incorporate the results of its reviews of the Shoreline fault and the ongoing seismic studies into the NRC's process for responding to the 50.54(f) letters and updating the seismic hazards analysis and plant licensing basis.

D. PG&E's Onshore and Offshore Seismic Studies Will Acquire Additional Data to Address Seismic Hazards at and Around Diablo Canyon

Q 16 In what context did PG&E develop and propose the seismic studies described in this application?

A 16 PG&E developed the offshore and onshore 2-D and 3-D seismic studies and OBS studies described in this application in response to the following recommendations made by the California Energy Commission in its Assembly Bill (AB) 1632 Report:[4]

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[4] California Energy Commission Report, An Assessment of California's Nuclear Power Plants: AB 1632 Report (California Energy Commission, Nov. 2008), at 6-7.

The Energy Commission acknowledges PG&E's ongoing efforts to understand the seismic hazards affecting the Diablo Canyon site through its Long Term Seismic Program (LTSP), and recommends that this work continue. As part of future IEPR assessments, beginning with the 2009 IEPR, PG&E should report to the Energy Commission on the overall status and results of its research efforts. 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 larger ground motions.

The California Energy Commission recommends that PG&E should use three-dimensional geophysical seismic reflection mapping and other advanced techniques to explore fault zones near Diablo Canyon.

PG&E should report on their progress and their most recent seismic vulnerability assessment for Diablo Canyon in the 2009 IEPR. This action will supplement PG&E's Long Term Seismic Program and help resolve uncertainties surrounding the seismic hazard at Diablo Canyon.

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.

As contemplated and recommended by the CEC, PG&E designed the additional seismic studies to supplement the ongoing seismic work undertaken by PG&E's LTSP, a program and work the CEC expressly recommended PG&E continue. PG&E did not propose to re-do the NRC—approved seismic evaluation of Diablo Canyon. Instead, PG&E proposed seismic studies using the advanced technologies recommended by the CEC to supplement the existing and ongoing seismic evaluation of Diablo Canyon performed in the LTSP. With the seismic studies completed under the LTSP from 1984 to 1991, the seismic hazard in the DCPP region is already better understood than at other nuclear power plants in the U.S. However, new data collection and analysis methods provide an opportunity to improve our understanding of the seismic hazard. The data that will be collected as a result of these enhanced seismic studies have the potential to help PG&E to further reduce the uncertainty of the seismic hazard in the DCPP region.

Q 17 Dr. Hamilton's testimony discusses a number of his views concerning the past evaluations of the seismic safety at Diablo Canyon. For example, he asserts that PG&E's past and proposed seismic studies fail to consider or acknowledge any seismic implication from the progressive late Quaternary

uplift of the Irish Hills and the occurrence of frequent small earthquakes in the crust beneath these hills. What is PG&E's response?

A 17 First, as discussed above, the past, present, and future seismic safety of Diablo Canyon (and all other nuclear power plants in the United States) is part of the NRC's ongoing exclusive jurisdiction. That said, with respect to this particular concern, PG&E notes that the Quaternary uplift of the Irish Hills is part of the contemporary tectonic model for Diablo Canyon. The uplift of the Irish Hills is accommodated and addressed in PG&E's existing model by the Los Osos reverse fault on the northeastern margin of the range and the Southwestern Boundary fault zone, including the San Luis Bay reverse fault, on the southwestern margin of the range. The current tectonic model, described in the 2011 Shoreline Fault Report, includes an M 6.8 earthquake (larger than the M 6.5 San Simeon earthquake) occurring beneath the Irish Hills.

In addition, the data collected from the 2-D and 3-D onshore seismic studies conducted in the fall of 2011 will provide additional constraints on the geometry and style of faulting beneath the Irish Hills. Using this data, PG&E will develop a 3-D model of the geologic structure beneath the Irish Hills to address the geometry and rate of uplift of the hills and the distribution of hypocenters beneath the range as Dr. Hamilton recommends.[5]

Q 18 Do PG&E's seismic studies address the Diablo Cove fault?

A 18 No.

Q 19 Why not?

A 19 Dr. Hamilton has speculatively "linked" an east-west striking bedrock fault mapped in the cliff in Diablo Cove with a series of discontinuous shears, fracture zones, and small faults across the Diablo Canyon site into a single fault. No such fault connected the mapped structures after extensive geologic mapping for both Diablo Canyon Units 1 and 2. Here again, however, the information collected by the seismic studies proposed in this application will allow PG&E to assess the seismic characterization of the area Dr. Hamilton refers to with greater specificity.

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5 Hamilton Testimony, at p. 53, Recommendation 2(c).

Q 20 Do PG&E's proposed seismic studies duplicate studies already done or being done by the USGS, as Dr. Hamilton asserts?

A 20 No. PG&E was a partner to, and funded, many of the USGS marine seismic studies as part of a Cooperative Research and Development Agreement. The proposed offshore seismic studies are more specific, and do not duplicate earlier work. PG&E has adopted a nested approach to data collection, which begins at a regional scale and progresses to more local and site-specific studies. The low-energy, single-channel, 2-D marine studies, conducted by the USGS in 2008 and 2009 at 400 meters (m) to 800 m line spacing, only penetrate the top few hundred meters of the seafloor and are spaced too far apart to constrain the connections of identified fault structures from line to line, or to identify recent geomorphic features that may be used to constrain rates of fault motion or fault slip. PG&E's multi-channel seismic studies, including high-resolution, low-energy 2-D and 3-D marine seismic mapping and the proposed high-energy 3-D marine seismic surveys, have been designed to provide the necessary spatial resolution to map both shallow and deeper structures in the area. Onshore, there have been no seismic reflection studies conducted in the Irish Hills region comparable to those conducted by PG&E in 2011 and those planned for 2012. As noted in Question 17, these onshore studies have been designed to provide data to improve the constraints on the mechanism responsible for the progressive late Quaternary uplift of the Irish Hills.

Q 21 Will PG&E re-calculate seismic margins using the results of these seismic studies?

A 21 PG&E will re-evaluate seismic margins following NRC guidelines as part of PG&E's response to the NRC 50.54(f) letter (dated March 13, 2012). In the 50.54(f) letter, the NRC requires existing power plants to evaluate the seismic ground motion and seismic capacities based on current methods used for the design of new power plants. This requires a probabilistic approach for computing the ground motion, not a deterministic approach as proposed by Dr. Hamilton. These seismic margin evaluations will not be part of the seismic studies for which PG&E requests funding in this

application, but they will reflect the results of these studies, to the extent applicable.

Q 22 Dr. Hamilton shows, in Figure 16 of his testimony, that the ground motion estimates from a thrust fault under Diablo Canyon, such as the IOF, would exceed the design ground motions for Diablo Canyon. Has PG&E compared the ground motion from a San Simeon style thrust fault directly under Diablo Canyon with the design ground motion?

A 22 Yes. As part of the original 1988 LTSP study and also as part of the 2011 Shoreline fault study, PG&E has evaluated the ground motions from both the Los Osos and San Luis Bay thrust faults which may project under DCPP. PG&E used the same Next Generation Attenuation ground motion models as used by Hamilton, but with site-specific adjustment factors based on observed ground motions at DCPP, as described in the 2011 Shoreline Fault Report.

Based on the improved 3-D tectonic model that will be developed, the ground motions at DCPP will be re-evaluated using the methodologies used for new plants as required in the NRC 50.54(f) letter. The methodology will lead to a probabilistically based Ground Motion Response Spectrum (GMRS). The GMRS will be compared to the current DCPP design ground motions as part of the seismic evaluation. If the resulting GMRS exceeds the 1977 Hosgri spectrum at any frequencies, the seismic margin will be addressed as part of the response to the NRC 50.54(f) letter.

E. The Commission Should Reject A4NR's Cost Sharing Proposal

Q 23 What is A4NR's ratemaking proposal?

A 23 A4NR proposes a cost-sharing mechanism that, by A4NR's estimation, would impose 61 or 62 percent of the costs of the proposed additional seismic studies on PG&E's shareholders.

Q 24 Does A4NR offer any rationale for its cost-sharing proposal?

A 24 There are only two sentences in A4NR's rebuttal testimony that offer any explanation for the proposal. In Ms. Becker's February 17, 2011 testimony, she states that: "Customers are on the hook to pay for the current operation of the plant, but the seismic study expenditures also relate to the investment and development cost of a relicensed Diablo Canyon as well. PG&E

shareholders ought to shoulder responsibility for that portion until the licenses are extended."

Q 25 Do you agree that it is appropriate to impose a portion of the seismic study costs on PG&E's shareholders?

A 25 No. The Commission should reject A4NR's proposal and should order that the costs of the seismic studies at issue in this proceeding be 100 percent recovered in rates.

Established cost of service ratemaking principles provide that an investor-owned utility (IOU), such as PG&E, invests in projects beneficial to customers and earns an authorized rate of return on that investment. Customers provide funding required to operate and maintain the IOU's assets consistent with federal and state regulations and recommendations. The reasonableness of the funding is assessed in periodic general rate cases and special applications like this one. The data collected from the seismic studies will be used to help assess the seismic hazard at Diablo Canyon, contributing to the safe and reliable operation of the plant. Additionally, as described in PG&E's response to Question 25, PG&E proposed the seismic studies described in this application in response to the CEC recommendations in the AB 1632 Report and CPUC President Peevey's directive that the CEC-recommended studies be undertaken. PG&E's customers should bear the full cost of the seismic studies.

F. The Independent Peer Review Panel Has Reviewed and Commented on PG&E's Seismic Study Plans

Q 26 What is the purpose of the IPRP as presented in Decision 10-08-003?

A 26 Per Decision 10-08-003, the CPUC convened the IPRP to "…conduct a peer review of the seismic studies including independently reviewing and commenting on the study plan and completed study findings. Our order in this application will require PG&E to submit its study plans and completed study findings to the IPRP for review prior to implementation."

The decision specifically orders PG&E "to provide the Independent Peer Review Panel with its seismic study plans prior to the implementation of their seismic studies. The Independent Peer Review Panel shall review and

provide Pacific Gas and Electric Company written comments on the study plans within 30 days of receipt."

In addition, the decision also states that PG&E "shall provide the Independent Peer Review Panel the findings and/or results associated with the seismic studies upon finalizing those findings and/or results. The Independent Peer Review Panel shall review and provide Pacific Gas and Electric Company written comments on those findings and /or results within 30 days of receipt."

Q 27 Please describe PG&E's interactions with the IPRP and identify all information provided to the IPRP to date.

A 27 The PG&E staff has met with the IPRP, CPUC, and occasionally the CEC staff, on August 31, 2010; February 18, 2011; February 22, 2011; May 2, 2011; July 20, 2011; January 23, 2012; February 6, 2012; and February 21, 2012. In addition to these meetings, PG&E has also issued a series of documents in response to specific data requests from the IPRP including:

1. Project Description for Marine 3-D Seismic California State Lands Commission Geophysical Permit Application (requested at May 5, 2011 IPRP meeting, sent May 10, 2011).
2. Response to IPRP Request for Hazard Sensitivity for Targets for the DCPP Geophysical Surveys (requested at July 20, 2011 IPRP meeting, sent August 8, 2011).
3. Response to IPRP Report No. 2 (sent November 28, 2011).
4. Response to IPRP Questions on PG&E's Revised Seismic Study Plan for Diablo Canyon (requested December 20, 2011, sent January 24, 2012).
5. Response to Request for Alternate Offshore Survey Track-Potential Impact Changes (requested at January 23, 2012 IPRP meeting, sent January 24, 2012).
6. High Energy Seismic Survey Race-Track maps as submitted to California State Lands Commission for the Draft Environmental Impact Report document. (Requested February 28, 2012, following the February 21, 2012 IPRP meeting, delivered March 9, 2012).

G. The SSHAC Is a National, NRC-Endorsed Peer Review Process

Q 28 What is the SSHAC?

A 28 "SSHAC" stands for the "Senior Seismic Hazard Analysis Committee." This committee was formed in the 1990s to evaluate the cause of differences in major seismic hazard studies conducted in the eastern U.S. They found that the cause of the differences in seismic hazard estimates was mainly procedural and was related to how scientific uncertainties were addressed and evaluated. The committee developed a set of guidelines for conducting seismic hazard studies in a highly structured way to avoid the procedural problems identified in the previous studies. The main procedural change was to foster interaction between experts and provide feedback regarding the interpretations, rather than maintaining independence of experts. The SSHAC no longer exists as a committee, but the guidelines developed by this group are referred to as the SSHAC guidelines, and continue to be used.

The SSHAC guidelines apply to both seismic source characterization (sizes, locations, and rates of future earthquakes) and ground motion characterization (median and standard deviation of the ground motion for a given earthquake scenario).

The central concept behind the SSHAC methodology is to capture the center, body, and range of the technically defensible interpretations. That is, a SSHAC study develops a suite of alternative tectonic models that capture the scientific uncertainty and are technically defensible (consistent with the local data). Each interpretation is assigned a weight based on the evaluation of the models. This set of models and weights defines the "center, body, and range."

There are five types of participants in the SSHAC process: Technical Integrators, Peer Reviewers, Proponent Experts, Resource Experts, and observers. Technical Integrators are responsible for developing the final suite of models and weights; peer reviewers provide reviews throughout the process; Proponent Experts advocate a specific scientific model or approach; Resource Experts provide expertise on specialized topics; and observers are included to add transparency to the process.

There are four different levels in the SSHAC methodology (Levels 1, 2, 3, and 4). The NRC recommends a SSHAC Level 3 study for nuclear power plants (NUREG 2117). A SSHAC Level 3 study defines three types of

workshops (WS) and requires a minimum of one workshop of each type be held. Each WS will last from 3 to 5 days, and will involve from 30 to 50 participants, including Resource Experts and Proponent Experts from the technical community, a 6-member Participatory Peer Review Panel of acknowledged experts in the field of Probabilistic Seismic Hazards Assessment (PSHA), and a Technical Integration Team of 8 Evaluator Experts (4 for seismic source characterization and 4 for ground motion characterization). The WS types are listed below:

- WS type 1: Data Needs. At this workshop, the available data for evaluating the seismic hazard are reviewed and data needs are identified. The data needs may be for compilation and/or reformatting of existing data or it may include the recommendations for collection of new data.
- WS type 2: Proponent Models. At this workshop, alternative proponent models are presented and their strengths and weaknesses are discussed. The purpose of this workshop is to inform the Evaluation Team (called the Technical Integration Team) of all of the available candidate models and their strengths and weaknesses.
- WS type 3: Proposed model weights and hazard feedback. At this workshop, the Technical Integration Team presents their initial evaluation of the proponent models including the technical basis for the selection of models and weights. These evaluations are then subjected to scrutiny and questioning from outside (resource) experts and from the peer-review panel. To help focus the discussion, this workshop also includes a sensitivity analysis to identify those decisions made by the Technical Integration Team that are most significant to seismic hazard at Diablo Canyon.

Following WS3, the Technical Integration Team revises their evaluation based on the discussion from the workshop. The final evaluation is then subjected to a final peer review by the Participatory Peer Review Panel.

The workshops provide a transparent process for conducting the evaluation of the available scientific data for constraining the seismic hazard.

Q 29 What agency is responsible for oversight of the SSHAC process?

A 29 While there is no agency oversight of the SSHAC process, the SSHAC guidelines are endorsed by the NRC, and use of the process is mandated by the NRC. In each SSHAC study, the Participatory Peer Review Panel (PPRP) is a panel of experts with SSHAC methodology and/or PSHA experience and is responsible for oversight on the implementation of the SSHAC process. During the project, they provide ongoing reviews of the implementation and at the end of the project, they will provide a written evaluation of the implementation and determine if the project has met the SSHAC objectives. NRC representatives may attend the SSHAC workshops as observers to provide additional review of the implementation of the SSHAC process.

The SSHAC guidelines are summarized in NRC documents (NUREG/CR-6372 and NUREG-2117). In the 50.54(f) letters issued on March 12, 2012, the NRC directed that the seismic hazard evaluations required of the West Coast nuclear power plants go through a SSHAC Level 3 process. (The Central and East nuclear power plants have already completed the SSHAC Level 3 process at their sites.)

The findings from the SSHAC evaluations are reported to the NRC. The NRC will review the SSHAC reports and the PPRP reports to determine if the study has fulfilled the requirements for a SSHAC Level 3 study.

PACIFIC GAS AND ELECTRIC COMPANY

APPENDIX A

STATEMENTS OF QUALIFICATIONS

PACIFIC GAS AND ELECTRIC COMPANY
STATEMENT OF QUALIFICATIONS OF L. JEARL STRICKLAND

Q 1 Please state your name and business address.

A 1 My name is L. Jearl Strickland, P.E., and my business address is Diablo Canyon Power Plant, Pacific Gas and Electric Company, 142 Cross Street, Suite 200, San Luis Obispo, California.

Q 2 Briefly describe your responsibilities at Diablo Canyon Power Plant (Diablo Canyon).

A 2 I am the director of Nuclear Projects, with responsibilities over seismic studies permitting and implementation, as well as PG&E's responses to Nuclear Regulatory Commission orders associated with the Fukushima nuclear power plants.

Q 3 Please summarize your educational and professional background.

A 3 I have a bachelor of science degree in civil engineering from California State University, Chico, a masters of business administration in project and construction management from Golden Gate University, and completed graduate studies in civil and geotechnical engineering at University of California, Berkeley. I have 32 years of experience with PG&E ranging from design engineering, chief civil engineer, developer of Diablo Canyon's Spent Nuclear Fuel Storage Program, manager of Strategic Projects and senior region manager in Government Relations.

Q 4 What is the purpose of your testimony?

A 4 I am sponsoring Sections B, C, and G of the rebuttal testimony submitted in support of PG&E's Diablo Canyon Seismic Studies Application 10-01-014.

Q 5 Does this conclude your statement of qualifications?

A 5 Yes, it does.

PACIFIC GAS AND ELECTRIC COMPANY
STATEMENT OF QUALIFICATIONS OF JOSEPH F. O'FLANAGAN

Q 1 Please state your name and business address.

A 1 My name is Joseph F. O'Flanagan, and my business address is Pacific Gas and Electric Company, 77 Beale Street, San Francisco, California.

Q 2 Briefly describe your responsibilities at Pacific Gas and Electric Company (PG&E).

A 2 I am a director in the Energy Procurement Planning and Analysis organization and am responsible for various regulatory matters.

Q 3 Please summarize your educational and professional background.

A 3 I received a bachelor of science degree in marine engineering from the United States Merchant Marine Academy at Kings Point, New York, in 1975. I also attended the Harvard Graduate School of Business Administration, where I was a candidate for a master's degree in business administration.

Prior to joining PG&E in 1979, I served as an engineering officer on ocean-going merchant vessels. Prior to assuming my present position at PG&E, I held the positions of rate economist in the Rates Department, senior valuation engineer in the Valuation Department, supervisor in the Revenue Requirements Department, manager in the Rates, Market Planning and Research, and Revenue Requirements Departments, and director of the Budget, Tax, and Capital Accounting Departments.

Q 4 What is the purpose of your testimony?

A 4 I am sponsoring Section E of the rebuttal testimony submitted in support of PG&E's Diablo Canyon Seismic Studies Application 10-01-014.

Q 5 Does this conclude your statement of qualifications?

A 5 Yes, it does.