

IPRP Report No. 3

Comments on PG&E's Enhanced Seismic Study Plans for Diablo Canyon Power Plant

Background

In 2006, the California Legislature enacted Assembly Bill (AB) 1632, which was codified as Public Resources Code Section 25303. AB 1632 directed the California Energy Commission (CEC) to assess the potential vulnerability of California's largest baseload power plants, which includes Diablo Canyon Power Plant (DCPP), to a major disruption due to a major seismic event and other issues. In response to AB 1632, in November 2008 the CEC issued its findings and recommendations in its AB 1632 Report, which was part of its 2008 Integrated Energy Policy Report Update.

In Pacific Gas and Electric Company's (PG&E) 2007 General Rate Case decision D.07-03-044, the California Public Utilities Commission (CPUC) directed PG&E to address and incorporate the recommendations from the AB 1632 Report into its feasibility study to extend the operating licenses of its Diablo Canyon Units 1 and 2 for an additional 20 years.

In November 2009, PG&E submitted its formal application with the Nuclear Regulatory Commission (NRC) to extend the licenses of DCPP Units 1 and 2. On January 15, 2010, PG&E filed A.10-01-014 with the CPUC for cost recovery of \$16.73 million associated with the enhanced seismic studies recommended by the CEC's AB 1632 Report. On September 23, 2011, PG&E filed a Motion to re-open A.10-01-014 to request additional funding for a total of \$64.25 million for increased costs of the enhanced seismic studies at DCPP. The Motion was subsequently approved at a Pre-Hearing Conference on November 30, 2011. Hearings in this proceeding will be held April 18-20, 2012. The comprehensiveness, completeness, and timeliness of these studies will be critical to the CPUC's ability to assess the cost-effectiveness of Diablo Canyon's proposed license renewal. As noted in the CEC's AB 1632 Report, a major disruption because of an earthquake or plant aging could result in a shutdown of several months or even cause the retirement of one or more of the plants' reactors. A long-term plant shutdown would have economic, environmental and reliability implications for California ratepayers. In response to the CPUC, CEC's and California Coastal Commission's direction to complete the AB 1632 Report- recommended seismic studies as part of license renewal reviews, PG&E is planning 2-D and 3-D seismic studies and analyses at its Diablo Canyon Power Plant. PG&E plans to perform these studies for on-shore and off-shore areas by using enhanced 2-D and 3-D seismic reflection mapping and other advanced geophysical techniques to explore fault zones in the vicinity of DCPP, as recommended by the CEC AB 1632 Report.

Independent Peer Review Panel (IPRP)

CPUC Decision D.10-08-003, issued on August 16, 2010, established that the CPUC would convene its own Independent Peer Review Panel (IPRP) and invite the CEC, the California Geologic Survey (CGS), the California Coastal Commission (CCC), and the California Seismic Safety Commission (CSSC) to participate on the panel. The County of San Luis Obispo and the California Emergency Management Agency (CalEMA) have since been added. Under the auspices of the CPUC, the IPRP is conducting an independent review of PG&E's on-shore and off-shore seismic studies including independently reviewing and commenting on PG&E's study plan and the findings of the study, which are expected to be completed in 2013.

The CPUC convened meetings on August 31, 2010, February 18, 2011, and May 3, 2011, and the CEC convened a meeting July 20, 2011. These meetings were attended by staff from the CEC, the California Coastal Commission, the California Geologic Survey, and the California Seismic Safety Commission. At these meetings, PG&E gave presentations on its proposed seismic survey study plans. The IPRP commented on PG&E's seismic study plans by issuing its IPRP Report No. 1 to PG&E on September 30, 2010 and IPRP Report No. 2 on September 7, 2011.

Previous reports by the IPRP were completed prior to completion of Interagency Agreements between CPUC and IPRP participating agencies in late 2011. Because the structure was not in place, meetings and reports were less formal and rigorous. After the Interagency Agreements were finalized in December 2011, CPUC convened and publicly noticed the first official meeting of the IPRP on January 23, 2012. That meeting focused on plans by PG&E to conduct high energy off-shore seismic surveys and the environmental impacts of such a survey. Due to the time constraints of the environmental impact report being prepared by the State Lands Commission, a second IPRP meeting was convened by CPUC on February 6, 2012 to continue discussions of the off-shore seismic survey. Further discussions of the high energy off-shore seismic surveys were the subject of a third meeting on February 21, 2012.

PG&E's Seismic Study Plans for DCPD

PG&E provided descriptions of their proposed high energy off-shore seismic survey and recently completed Shoreline fault studies in a briefing to the IPRP on July 20, 2011. They also provided updated descriptions of their seismic study plans at briefings to the IPRP on January 23 and February 6, 2012. Following the July 20, 2011 meeting, PG&E provided to the IPRP, at its request, PG&E's memo report entitled, "Response to IPRP Request for Hazard Sensitivities for Targets for the DCPD Geophysical Surveys" dated August 8, 2011. This memo report discusses the "geological targets" for the proposed studies and the sensitivity of hazard analyses to alternate models that the planned studies may help to

distinguish. The IPRP understands that the proposed survey plans, and possible alternatives, are being discussed by PG&E and the State Lands Commission (SLC) as part of the environmental review process preceding an SLC permit hearing in mid-2012.

The IPRP review of survey plans has to date focused on the “geologic targets” of the surveys and the potential impact of the information from the surveys on the seismic hazard evaluation for the Diablo Canyon Power Plant.

The IPRP’s discussions of the high energy off-shore seismic surveys in January and February 2012 also focused on the need for detailed review of PG&E’s proposed data acquisition and data processing techniques. The IPRP recognizes that the success of these surveys depends on the interaction and quality of data acquisition and data processing. The IPRP has therefore asked PG&E for a copy of their Request For Proposal (RFP) including the RFP for the high-energy off-shore seismic surveys, so that the IPRP can fully understand: 1) how the survey geologic targets have been characterized to potential bidders, and 2) how the specific parameters of the proposed survey acquisition and processing techniques were chosen. The IPRP received copies of the RFPs for the high energy off-shore seismic surveys on March 2, 2012. These RFPs provided needed information on the study approach and major parameters of the seismic studies. However, the members and staff of the IPRP do not have the expertise to review the techniques used in acquiring and processing the data from the high energy off-shore seismic surveys. These techniques are most commonly used by seismic exploration contractors working for the oil industry. The IPRP has suggested that CPUC consider an additional contract to review this aspect of the seismic studies for DCP.

In the following section, the IPRP provides updated comments regarding the geologic targets of interest and the proposed survey techniques. The conclusions from IPRP Report No. 2 for each target are included for reference.

IPRP comments on the Hazard Sensitivity for the DCP Geophysical Survey Targets

The survey targets considered in this report remain the same as those discussed in IPRP Report No. 2.

PG&E numbered the planned study targets 2.1 to 2.10; this numbering scheme is retained in the IPRP comments below. IPRP Report No. 2 briefly summarized the goals of each of the studies, as stated by PG&E and the IPRP’s opinion of the potential for achieving those goals. The comments then describe the IPRP’s current understanding of the relative importance of the goals and provide some recommendations for additional aspects of the studies to further refine our understanding of the potential seismic hazard at DCP.

Additional comments dated February, 2012 reflect IPRP review and discussion from the meetings on January 23, February 6, and February 21, 2012.

2.1 Hosgri-San Simeon Step-Over

September 7, 2011 comment:

- ✓ The IPRP agrees that more closely spaced seismic surveys within the step-over zone will allow better resolution of the faulting and enable better estimates of the potential for ruptures involving both the Hosgri and San Simeon faults.

February 2012 comment:

- ✓ Ongoing investigation and more closely spaced seismic survey lines by USGS have shown that the direct connection between the San Simeon and Hosgri faults is by far the most likely explanation from the available data. Although the recent data is from low energy seismic surveys, and thus only shows the fault in the upper few hundred meters, it appears very unlikely that additional data from high energy survey of this area would significantly change the seismic hazard analysis results based on these faults. The IPRP has suggested in the meeting on February 6 that the northern “racetrack” of the proposed high-energy seismic survey (“Box 3” on attached map from PG&E) has such a low likelihood of generating data that would change the existing seismic hazard analysis that the additional cost and impacts of this part of the survey probably cannot be justified.

2.2 Hosgri – Shoreline Intersection

September 7, 2011 comment:

- ✓ The plans described by PG&E appear to be well conceived and have as good a chance as currently feasible of providing data on the intersection of the Hosgri and Shoreline faults.

February, 2012 comment:

- ✓ The intersection between the Hosgri and Shoreline faults remains one of the primary targets of the high energy off-shore seismic survey for the reasons outlined in the IPRP Report No. 2. Comments in the meetings on February 6 and 21 focused on the need for coverage of the area immediately off-shore of Point Buchon where the Hosgri and Shoreline faults may intersect and the area immediately to the north, where the Los Osos fault trends off-shore and may intersect the other two faults. The IPRP has noted that there appears to be a small area that the surveys would not directly cover in the layout of the high energy off-shore surveys proposed by

PG&E in submittals to the SLC (Between “Box 2”, “Box 4” and the shoreline on the attached map). Although this area is smaller than gaps in PG&E’s previous survey map layouts, but may still leave a gap or area of lower resolution. The IPRP recommends that the survey orientation be slightly adjusted and extended to the northeast to give more complete coverage of this area.

2.3 Hosgri Slip Rate

September 7, 2011 comment:

- ✓ The IPRP recommends further studies to decrease the uncertainty in the seismic hazard at Diablo Canyon by better constraining the slip rate on the Hosgri fault.

February, 2012 comment:

- ✓ Data to constrain the slip rate on the Hosgri fault may be developed from on-shore geologic studies, marine bathymetric surveys and from seismic surveys of the upper few meters of sediments below the sea floor. High energy seismic surveys will not help constrain this important factor. Because slip rate on the Hosgri fault is one of the most important factors influencing seismic hazard at Diablo Canyon, the IPRP will be reviewing the currently available data and providing comments and recommendations to PG&E regarding further studies to constrain slip rate. The IPRP requests future briefings by PG&E on results of on-shore and low energy off-shore seismic surveys and bathymetric surveys that may help to constrain slip rate on the Hosgri fault as additional data becomes available.

2.4 Hosgri Dip

September 7, 2011 comment:

- ✓ The plans described by PG&E appear to have as good a chance as currently feasible of providing data on the dip the Hosgri fault near the intersection of the Shoreline and the Hosgri faults.

February, 2012 comment:

- ✓ The dip of the Hosgri fault remains one of the primary targets of the high energy off-shore seismic survey for the reasons outlined in the IPRP Report No. 2.

2.5 Shoreline Fault Segmentation

September 7, 2011 comment:

- ✓ The plans described by PG&E appear to have as good a chance as currently feasible of providing data on the orientation and continuity of the Shoreline fault at depth.

February, 2012 comment:

- ✓ The continuity of the Shoreline fault at depth is currently inferred from seismicity. The high energy seismic survey may provide further constraints on the continuity of the Shoreline fault. The geometry and continuity of the Shoreline fault are the primary targets of one set of survey “racetracks” (“Box 1” on attached map). Imaging the detailed geometry and continuity of the Shoreline fault will be especially sensitive to the quality of data acquisition and processing techniques in the shallow water overlying its trace. Surveys of such ‘transition zones’ are more challenging than purely on-shore or deeper-water off-shore surveys. The IPRP is particularly interested in acquiring expert review of the data acquisition geometry and data processing sequence proposed in this area.

2.6 Shoreline Fault Slip Rate

September 7, 2011 comment:

- ✓ The IPRP recommends further studies to decrease the uncertainty in the seismic hazard at Diablo Canyon by better constraining the slip rate on the Shoreline fault.

February, 2012 comment:

- ✓ Data to constrain the slip rate on the Shoreline fault can be developed from marine bathymetric surveys and from seismic surveys of the upper few meters of sediments below the sea floor. High energy seismic surveys will not help constrain this

important factor. The IPRP requests future briefings by PG&E on the results of low energy seismic surveys that they have conducted to constrain slip rate on the Shoreline fault. The general outline of surveys conducted in December 2011 was described by PG&E at the meeting on February 21. The IPRP requests detailed reports of the results of those surveys.

2.7 Southeast End of Shoreline Fault

September 7, 2011 comment:

- ✓ The plans described by PG&E appear to have as good a chance as currently feasible of providing data on the orientation and continuity of the southeast end of the Shoreline fault. The IPRP recommends that a secondary focus of these studies should be to constrain any potential connections to faults on-shore.

February, 2012 comment:

- ✓ PG&E reports that acquisition of low energy seismic surveys of the southeast end of the Shoreline fault have recently been completed. The general outline of surveys conducted in December 2011 was described by PG&E at the meeting on February 21. The IPRP requests that PG&E provide detailed reports of the results of those surveys. The high energy seismic survey proposal does not appear to be designed to collect additional data about the southeast end of the Shoreline fault and could potentially be extended somewhat in that direction. The data acquisition geometry and processing sequence in the shallow water of this area should receive expert review, as seismic imaging in such “transition zones” is particularly challenging.

2.8 Los Osos Fault Dip

September 7, 2011 comment:

- ✓ The current plans for on-shore seismic surveys appear to be adequate to image reverse faults beneath the hills. The IPRP will be interested in reviewing the results that show the Los Osos fault, but also any other geologic structure or structures beneath the hills.

February, 2012 comment:

- ✓ Based on presentations on January 23, it appears that it is possible to configure the high energy seismic survey to image the off-shore strands of the Los Osos fault. The IPRP recommends that the high energy off-shore seismic survey be configured so that it complements, as much as possible, the on-shore surveys, including providing as continuous as possible imaging of the areas between the on-shore and off-shore surveys.

2.9 Los Osos Sense of Slip and 2.10 Los Osos Slip Rate

September 7, 2011 comment:

- ✓ The IPRP believes that a broader goal of the on-shore seismic surveys should be for PG&E to develop a tectonic model of the Irish Hills that includes defining the locations and slip rates on all faults beneath the hills that can be checked against rates of uplift and surface deformation.

February, 2012 comment:

- ✓ The broad goal of developing a tectonic model of the Irish Hills would be enhanced by integrating the results of the off-shore high energy seismic survey with the results of the on land survey. This includes imaging the near-shore area on the south and west margins of the Irish Hills as completely as possible.

IPRP Authority and Review Process

In 2006, AB 1632 (Blakeslee) was enacted requiring the California Energy Commission (CEC) to conduct a comprehensive study of the seismic vulnerability of Diablo Canyon and directed the CEC to perform subsequent updates in the IEPR as new data or new understanding of potential seismic hazards emerge. In 2008, the CEC published its AB 1632 Report, which recommended that PG&E complete several seismic studies including that PG&E should use three-dimensional geophysical reflection mapping and other advanced techniques to explore fault zones near Diablo Canyon. The California Public Utilities Commission in 2009 and 2010 directed PG&E to complete the advanced seismic studies recommended in the CEC's AB 1632 Report and have an Independent Peer Review Panel review these seismic studies (CPUC letter to PG&E on June 25, 2009 and CPUC Decision 10-08-003).

The IPRP expects that:

- PG&E will provide its study plans prior to initiating the study and provide draft completed study findings to the IPRP for review and comment. These studies are summarized in CPUC Decision 10-08-003 including off-shore, on-shore, and ocean bottom studies, and seismic studies recommended in the AB 1632 Report.
- The IPRP, coordinated by the California Geological Survey (CGS), will review and provide comments on PG&E's study plans. The goal will be, if possible, to provide comments on the proposed plans within 30 days of receipt.
- The IPRP, coordinated by the CGS, will review and provide comments on PG&E's draft completed study findings presented to the CPUC. The goal will be to provide comments as promptly as possible.

- PG&E will review and, if possible, within 30 days incorporate the IPRP's recommendations and comments in PG&E's revised study plans and revised completed study findings and prepare for the IPRP a "Response to Comments" for the IPRP to document scientifically why PG&E accepted or rejected the IPRP's comments.
- PG&E and the IPRP will participate in quarterly meetings/briefings to review the status of PG&E's seismic studies, all changes in the study plans, and all preliminary study findings.
- PG&E and the IPRP will prepare a master schedule incorporating the major milestones for the IPRP's review process and PG&E will include these milestones in their monthly progress reports and their schedule to the NRC and the Atomic Safety and Licensing Board.
- The CPUC and CEC will address any major scientific or technical issues that have not been resolved informally between the IPRP and PG&E. CPUC Decision 10-08-003 states that, "Should a dispute arise it should be resolved informally but if that is not attainable the Commission has authority to halt the associated rate recovery." In addition, the CEC may report on any seismic issues and updates through its IEPR process. However, we anticipate that any major scientific or technical issue that may arise can be addressed and resolved informally.

The quarterly briefings/meetings mentioned above will allow PG&E to report on its progress and help facilitate a productive informal exchange of scientific viewpoints. The IPRP would like to schedule the next briefing in the near future.

IPRP membership:

California Geological Survey
California Coastal Commission
California Emergency Management Agency
California Energy Commission
California Seismic Safety Commission
California Public Utilities Commission
County of San Luis Obispo

