Independent Peer Review Panel

A multi-agency panel of seismic hazard specialists
established by the California Public Utilities Commission

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

IPRP Report No. 13

Summary of IPRP Public Meeting on May 23, 2018

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. The California Public Utilities Commission (CPUC) decision D. 10-08-003 approved funding for the proposed seismic hazard studies and established the Independent Peer Review Panel (IPRP). The IPRP members represent the California Geological Survey, Coastal Commission, Seismic Safety Commission, County of San Luis Obispo, as well as the CEC and the CPUC. Since 2011, the IPRP has held public meetings and issued reports to comment on seismic hazard studies proposed by PG&E

Studies conducted in response to AB1632 are described in a series of reports collectively known as the Central Coastal California Seismic Imaging Project (CCCSIP). Reviews and comments on these studies are contained in IPRP reports. The CCCSIP studies also served as input to the evaluation prepared for the U.S. Nuclear Regulatory Commission (NRC) using the Senior Seismic Hazard Analysis Committee (SSHAC) process. The SSHAC evaluations of seismic hazard were submitted to the NRC in September 2014. In a letter dated December 22, 2016, the NRC concluded that the reports prepared under the SSHAC process were suitable for use in further seismic risk evaluation.

Following the completion of studies authorized by AB1632 and submission of the CCCSIP report to the NRC, the California Legislature passed and the Governor signed AB361, which authorized continuation of the IPRP to review seismic studies of the DCPP area through the term of the plant's operating license. Although the studies authorized by AB1632 and IPRP review of those studies have been completed, this and future IPRP reports will include follow-up discussion of issues raised by the CCCSIP

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studies as part of discussion and recommendations for studies conducted under the Long-Term Seismic Program (LTSP) for DCPP.

This report summarizes material presented by PG&E at the IPRP meeting on May 23, 2018.

DIABLO CANYON NUCLEAR POWER PLANT SEISMIC PROBABILISTIC RISK ASSESSMENT

PG&E gave a briefing to the IPRP regarding the status of the Seismic Probabilistic Risk Assessment (SPRA) conducted for the Diablo Canyon Nuclear Power Plant (DCNPP). This status update was motivated by the submittal of an updated SPRA to the NRC in April 2018. The primary objectives of the SPRA is to assess the likelihood of: 1.) A seismically induced Core Damaging Accident (SCDF) and 2.) Assess the likelihood of a seismically induced accident that results in a large, early release of radiation (SLERF). The three elements of this process include: 1.) Seismic Hazard Analysis; 2.) Seismic Fragility Response, and 3.) Seismic Probabilistic Risk Assessment. Of these three elements, the Seismic Hazard Analysis, which includes the Seismic source characterization, Ground motion characterization and the Central Coastal California Seismic Imaging Project seismic studies conducted under AB1632, have previously been reviewed by the IPRP. Both the Seismic Fragility Response and Seismic Probabilistic Risk Assessment are engineering in nature and beyond the expertise of the current makeup of the IPRP, therefore these aspects of the SPRA will not be reviewed by the IPRP.

PG&E LONG TERM SEISMIC PROGRAM UPDATE

At the May 23, 2018 IPRP meeting, PG&E provided an update regarding 2017 activities of the Long Term Seismic Program (LTSP). Current research activities of the LTSP include:

- Ground motion characterization
- Seismic and geodetic monitoring
- Seismic source characterization
- Hazard methodology, testing and validation
- Fault rupture hazard model development

Research priorities are currently driven by topics that contribute the most to uncertainties in the Probabilistic Seismic Hazard Analysis (PSHA), as depicted on the “tornado” diagram shown by PG&E. PG&E’s presentation was essentially a status report regarding ongoing research projects. Specific 2017 accomplishments and updates are summarized below.

Ergodic and Non-Ergodic Ground Motions

Active research regarding ergodic and non-ergodic ground motions at DCNPP continues to be a major focus of the LTSP due to the large contribution of uncertainties in the hazard analysis. Two priorities for the ergodic ground motion analysis is the validation of the Southern California Earthquake Center (SCEC) kinematic broadband platform, which has been expanded from seven simple earthquakes to 13+ earthquakes that use more complicated multi-segment earthquakes. The purpose of this exercise is to increase confidence that the ground motion simulations are producing realistic results. The second priority is the validation of Fourier Amplitude Spectrum (FAS) from simulations. This validation involves the comparison of FAS correlation structure between simulated and recorded ground motions. The results of the simulations show that they have less correlation than observed ground motions, which is significant because the correlation influences how structures respond to seismic loading and less correlation results in lower structural demand. Therefore, it is important to understand the reasons for less correlation in the ground motion simulations due to the implied lesser effects of ground motions on structures.

Efforts to understand and apply non-ergodic ground motion models to the DCNPP continue, with a focus on the development of a new 3D crustal model of Central California. This includes the collection and processing of seismic data as well as the development of an improved velocity model derived from 3D tomography. The development of spatial correlation models for path effects is another aspect of the non-ergodic ground motion model that is being developed for DCNPP.

These ongoing efforts are expected to result in new ground motion models that will incorporate non-ergodic parameters and updated hazard codes. No timeline when these models would be made available was provided by PG&E.

Seismic Monitoring

2017 marked the end of the current Ocean Bottom Seismometer (OBS) deployment of autonomous seismographs that were initially deployed in 2014. The goal of this program was to improve earthquake detection, locations, and obtain better constraints on earthquake focal mechanisms. PG&E indicated that the program lead to improved depth control and focal mechanisms. However, the instruments suffered from issues such as poor coupling to the seafloor, environmental noise, poor time corrections, and power issues that limited the usefulness of the OBS network. The OBS array program was suspended in 2017 and there are currently no plans to redeploy the OBS instruments.

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SmartMeters

The next generation of PG&E “SmartMeters” (electric meters with onboard telemetry for data uploads) will be outfitted with accelerometers, effectively turning each meter into a seismographic station. Despite some potential issues such as location of the SmartMeter on a building, environmental and cultural noise, this expanded network of seismographs will significantly densify the number of recordings and help address seismological research topics such as site and path effects. This type of data is especially valuable for developing non-ergodic ground motion models, which currently is one of the largest contributors to uncertainty in the PSHA.

Seismic Source Characterization

Data collected from the CCCIP-related project has been integrated into the seismic source characterization and several of these studies are in press or in review for publication in peer-reviewed scientific journals. This includes the San Luis Bay 3D Seismic Reflection Mapping, which is in review at the Bulletin for the Seismological Society of America. Post-processing of single channel USGS sparker data offshore of central California is documented in a USGS summary report released this year.

Other ongoing seismic source characterization activities are summarized in the PG&E presentation. No details regarding when these studies would be complete was provided.

Fault Rupture Hazard

PG&E continues to support research into fault rupture hazard analysis. Current models are limited by data sets that are small, with quality and completeness issues. Updated models will focus on including site effects (e.g. soil vs rock), unbiased sampling, new models for distributed ruptures and standardized software. PG&E is partially sponsoring an effort to improve these models and databases and work in this area is expected to continue through 2019.

SUMMARY

Since 2011, the IPRP has focused on review of seismic hazard studies prepared in response to AB1632. IPRP comments and review helped evaluate the CCCSIP and their incorporation into seismic hazard evaluations submitted to the NRC. Following completion of the CCCSIP and acceptance of the seismic hazard evaluation by the NRC, the IPRP will continue to review seismic hazard studies prepared under the DCPP Long-Term Seismic Program. PG&E provided the IPRP with a summary of the LTSP at the IPRP meeting on May 23, 2018. Based on the presentation, there are several areas of ongoing research that could lead to enhanced understanding of the seismic hazard at Diablo Canyon. The IPRP will continue to review LTSP projects as they become

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available, and are most interested in projects that can have significant impact on the overall calculation of seismic hazard for DCPP.

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