# Exhibit 2

Letter from Dr. Michael Peck to Senator Barbara Boxer (January 22, 2015)

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[redacted]
January 22, 2015

Honorable Barbara Boxer
Ranking Member, Senate Committee on Environment and Public Works
112 Hart Senate Office Building
United States Senate
Washington, D.C. 20510

SUBJECT: Continued Failure of the United States Nuclear Regulatory Commission to Enforce Nuclear Safety Rules at the Diablo Canyon Nuclear Power Plant

Honorable Senator Boxer,

I am writing to you today to provide specific examples detailing the failure of the U.S. Nuclear Regulatory Commission (NRC) to enforce nuclear safety rules and license requirements at the Diablo Canyon Power Plant. These requirements include the regulatory safeguards that protect your California constituents from a radiation release following a major earthquake. The NRC's failure to enforce these requirements results in an unacceptable level of public risk and represents a serious breach of the public trust placed in the agency. I request your consideration of these issues as you provide congressional oversight of the NRC.

Pacific Gas and Electric (PG&E) completed a reevaluation of Diablo Canyon seismology in January 2011. This reevaluation concluded that three local faults were capable of exceeding equipment seismic qualification limits established by the facility design basis.[1] In September 2014, PG&E completed an additional reevaluation as mandated by California Assembly Bill 1632.[2] This latest reevaluation revealed that several of these faults are even more capable than previously considered.

PG&E created the appearance that the facility design basis remained satisfied by presenting the reevaluation results using less conservative methods than specified in the facility license. While these new methods and assumptions may or may not be technically justifiable, NRC rules required that PG&E first obtain an amendment to the Operating License before they were used in facility safety analyses. When applying the licensed methodology, the new seismic data results in stress levels on important safety equipment well in excess of safety limits. As a result, key safety barriers protecting the public from a radiation release may fail following a major earthquake.

The NRC failed to enforce Diablo Canyon Operating License requirements to immediately shutdown the reactors when the function of important safety equipment cannot be assured using approved methods. The NRC also has allowed, and at times actively encouraged, PG&E to encroach on these limits without first obtaining the required amendment to the Operating License. The amendment process would have preserved nuclear safety by ensuring that these

[1] Report on the Analysis of the Shoreline Fault Zone, Central Coast California to the USNRC, PG&E , January 2011, Figure 6-19, page 6-51, US NRC Agencywide Documents Access and Management System (ADAMS), Accession Number ML110140400, (http://www.nrc.gov/reading-rm/adams.html)
[2] PG&E, Central Coastal California Seismic Imaging Project Report, September 2014, (http://www.pge.com/en/safety/systemworks/dcpp/seismicsafety/report.page)

new methodologies were consistent with established NRC acceptance criteria before they were used. The amendment process also would have provided public notice and hearing opportunities for these changes that directly affected the facility's principle safety barriers.

These issues were brought to the attention of NRC management and internal agency processes for dispositioning nuclear safety concerns have been fully exhausted.[3] In response, the NRC was more focused on justifying past decisions rather than addressing the specific issues raised using these processes. In the end, the NRC justified inaction based on a lack of immediate safety significance represented by these issues. While major earthquakes only infrequently occur, the NRC's willingness to allow PG&E's continued encroachment on important safety barriers remains a significant concern.

The Diablo Canyon licensing history is complex. However, the issues described in this letter are not. NRC rules that define the current design and licensing bases, the threshold establishing when an amendment to the Operating License is required, and how operability of plant equipment is assessed are well understood processes. Applying these processes to the Diablo Canyon seismic issues results in an answer than does not support continued reactor operation. Rather than enforcing these regulatory requirements, agency personnel justify continued reactor operation based on the "complexity of the facility's licensing history."

Review of the NRC Licensing Process

A common understanding of the NRC licensing process is needed to provide context for the Diablo Canyon seismic requirements. The licensing process began with PG&E submitting a License Application to the NRC.[4] This application included the Final Safety Analyses Report (FSAR). As required by regulation,[5] the FSAR included PG&E's written commitments describing how regulatory requirements would be met, the proposed facility design basis, and the safety analyses demonstrating that the design basis was satisfied.

The NRC reviewed the application. During this review, the agency identified gaps between PG&E's written commitments and agency acceptance criteria.[6] Based on agency feedback in the form of safety evaluation reports, letters, and meetings, PG&E amended and resubmitted the application for additional review. This process was repeated 85 times before the NRC was satisfied that all requirements were met. The FSAR, as amended, became the facility licensing basis when the NRC issued the Operating License in 1984.

The regulatory requirements applicable to Diablo Canyon, PG&E's written commitments for meeting those requirements, and the design basis define the facility current licensing basis (CLB).[7] The NRC's role was to either approve or disapprove the License Application, or license amendment requests, based on those written commitments. Some have incorrectly asserted that information included in safety evaluation reports and transcripts from the Atomic Safety and

[3] DPO-2013-002, Diablo Canyon Seismic Issues (Public) Case File, ADAMS ML14252A743
[4] PG&E submitted the License Application in 1971 to the Atomic Energy Commission, the predecessor to the NRC. The Atomic Energy Commission became the NRC as a result of the 1974 Energy Reorganization Act.
[5] 10 CFR 50.34, Contents of applications; technical information. Requires the License Application to include the facility specific design basis and supporting safety analyses (http://www.nrc.gov/reading-rm/doc-collections/cfr/part050/part050-0034.html)
[6] NRC acceptance criteria for License Application/FSARs are provided in NUREG-800, Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition (http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr0800/)
[7] 10 CFR 54.3 defined the current licensing basis as the "set of NRC requirements applicable to a specific plant and a licensee's written commitments for ensure compliance with and operation within applicable NRC requirements and the plant-specific deign bases" (over the life of the license), (http://www.nrc.gov/reading-rm/doc-collections/cfr/part054/part054-0003.html) and NRC Inspection Manual, Manual Chapter 0326, Operability Determinations & Functionality Assessments for Conditions Adverse To Quality or Safety, Page 2, ADAMS ML1327A578

Licensing Broad established the CLB.[8] While this information provided insight and the bases for approving a regulatory action, this information did not alter the CLB.

The facility design basis is an important subset of the CLB. NRC regulations[9,10] specifically limit facility operation within the design basis as specified in the License Application (FSAR). The design basis was derived from the General Design Criteria (GDC) currently maintained in Appendix A to Title 10 of the Code of Federal Regulations (CFR), Part 50.[11]

Diablo Canyon Seismic Design and Licensing Bases

The Diablo Canyon seismic design basis was explicitly tied to satisfying GDC-2, "Design Bases for Protection against Natural Phenomena." The FSAR included two safety analyses that demonstrated that the seismic design basis was met. The first analysis implemented the Operational Basis Earthquake (OBE) requirement. The OBE demonstrated that certain important safety equipment would remain functional following the maximum earthquake potential that is reasonably expected to occur during the life of the facility. The FSAR Design Earthquake (0.2 g) safety analysis implemented the Diablo Canyon OBE.

The second analysis implemented the Safe Shutdown Earthquake (SSE) requirement. The SSE was required to demonstrate that the reactor can be safely shutdown; equipment needed to prevent or mitigate and accident would remain functional; and critical reactor piping would remain intact following the maximum earthquake potential (producing the maximum amount of ground motion) for the plant site**.** The SSE was developed based on an evaluation of all "capable" earthquake faults located within 75 miles of the facility. PG&E doubled the Design Earthquake response spectrum to create the Double Design Earthquake. The FSAR Double Design Earthquake (0.4 g) safety analysis implemented the Diablo Canyon SSE.

The License Application included a third evaluation called the Hosgri Event. The FSAR stated that the Hosgri Event was prepared in response a NRC question during the licensing process. This evaluation specifically addressed a potential 7.5 Magnitude (M) earthquake on the Hosgri fault. The application described the Hosgri as "a hypothetical case only for review purposes and as a condition beyond credibility based upon the historical record and physical evidence."[12] PG&E used less conservative methods and assumptions for the Hosgri than required for the SSE. For example, PG&E incorporated the "tau" effect, permitting about a 20% relaxation of the acceleration response spectrum applied to structures, a larger damping value to reduce amount of seismic stress transmitted to the facility, and dispensation from certain Code requirements for material strength. The Hosgri was not part of the facility design basis because the evaluation was not required by NRC regulations. However, PG&E's written commitments associated with this "beyond design basis event" are included in the CLB.

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[8] LIC-100, Control of Licensing Bases for Operating Reactors, "page 6.4, defined the relationship between NRC SERs and the current licensing basis: "The staff should not attempt to establish licensing bases information in SEs or SERs." Nonpublic ADAMS ML033530249

[9] 10 CFR 50.54, Conditions of licenses, Section (a)(1), required PG&E to meet 10 CFR 50, Appendix B (http://www.nrc.gov/reading-rm/doc-collections/cfr/part050/part050-0054.html).

[10] 10 CFR 50, Appendix B, Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants, Criterial III, Design Control, required licensees to assure that applicable regulatory requirements and the design basis, as specified in the license application, are maintained, (http://www.nrc.gov/reading-rm/doc-collections/cfr/part050/part050-appb.html)

[11] NEI 97.04, "Guidance and Examples for Identifying 10 CFR 50.2 Design Bases, Appendix B, page B21, "Seismic Topical Design Bases." ADAMS ML003678532, Endorsed by Regulatory Guide 1.186, "Guidance and Examples for Identifying 10 CFR 50.2 Design Bases," (http://www.nrc.gov/reading-rm/doc-collections/reg-guides/power-reactors/rg/division-1/division-1-181.html)

[12] Diablo Canyon License Application, Amendment 60, Hosgri Evaluation, Appendix I-1, March 1978

NRC regulations[13] required the SSE safety analysis to include the maximum vibratory ground motion that could affect certain safety equipment. The Diablo Canyon SSE excluded seismic input from the Hosgri fault. PG&E justified excluding the Hosgri based on an argument that fault was not "capable" as defined by NRC regulations.[14] In other words, PG&E did not consider the Hosgri an active fault during plant licensing.

The Diablo Canyon seismic qualification, as described in the approved License Application (FSAR), included the Design Earthquake (0.2 g), providing the basis for plant design and satisfying the OBE design basis requirement; the Double Design Earthquake (0.4 g), satisfying the SSE design basis requirement for protection against the maximum earthquake potential from all "capable" faults; and the Hosgri (0.75 g), a beyond design bases event prepared in response to an NRC question.

Peak ground accelerations associated with each evaluation (0.2 g, 0.4 g, & 0.75 g) were included for reference only. Some have incorrectly asserted that the Hosgri was bounding for seismic qualification based on the larger ground motion. Comparison of ground accelerations alone is meaningless for seismic qualification. The stress levels used for seismic qualification were based on the methods, assumptions, spectrum, analytical inputs, load combinations, and acceptance criteria associated with each analysis. The qualification of some plant structures and equipment was more limited by the Design Earthquake, others by the Double Design Earthquake, and still others by the Hosgri.[15] The CLB requires PG&E to maintain <u>all</u> three qualification bases.

PG&E has stated that the facility was extensity retrofitted to accommodate the larger Hosgri earthquake. PG&E's statement is very misleading. This retrofit was primarily a paper exercise. PG&E completed calculations that demonstrated the existing facility would survive the beyond design basis Hosgri earthquake. The Hosgri evaluation compensated for higher ground motions by using less conservative methods and assumptions. This resulted in less seismic stress on plant equipment than produced by the SSE in many cases. Since most safety equipment was already qualified for the SSE, no additional retrofitting was required.

Physical plant modifications associated with the retrofit were primarily limited to the turbine building.[16] The NRC license review identified that the turbine building had not been qualified for the SSE. SSE design basis required the structure to be seismically qualified because the building house important to safety equipment, including component cooling water and the emergency diesel generators. In other words, the majority of the physical Hosgri retrofits may have been required even without discovery of the Hosgri fault.

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[13] 10 CFR 100, Appendix A, Seismic and Geologic Siting Criteria for Nuclear Power Plants, defines inputs for the Safe Shutdown Earthquake, defined as the maximum v bratory ground motion than can affect the site (http://www.nrc.gov/reading-rm/doc-collections/cfr/part100/part100-appa.html)

[14] 10 CFR 100, Appendix A, Seismic and Geologic Siting Criteria for Nuclear Power Plants, defined the criteria for considering a fault "capable:" Movement near the surface within the past 35,000 years, movement within the past 500, 000, or evidence of macro-seismicity. The Safe Shutdown Earthquake (max vibratory ground motion) based on an evaluation of "capable" faults" near the facility (http://www.nrc.gov/reading-rm/doc-collections/cfr/part100/part100-appa.html)

[15] The DPO-2013-002 (public) Case File) ADAMS ML14252A743, includes many examples of the SSE more limiting that the HE. For example, consider the control rod drive mechanisms located on top of the reactor. These mechanisms are welded extensions of the reactor coolant pressure boundary. Based on PG&E calculations, the DDE/SSE (0.4 g) predicts about 80,000 lbs/in stress on the mechanisms while the Hosgri only produced about 40,000 lbs/in stress at the same locations (pages 19 and 20 of

[16] Supplemental Safety Evaluation Report Number 7, pages 3-13 through 3-70, and Supplemental Safety Evaluation Report Number 8, pages 3-6 thought 3-40, includes a detailed description of the calculations and physical modifications PG&E completed for the Hosgri Event

NRC Requirements for Ensuring Fidelity of the Facility Design Basis

NRC regulations[17,18] restrict reactor operation within design basis limits as specified in the approved License Application, including the boundaries established by FSAR safety analyses. Other regulations[19] require licensees to update the FSAR with new information developed that affect either the design basis or supporting safety analyses. These regulations also require licensees to take prompt corrective action when new information adversely affects the methods or assumptions used to demonstrate that the design basis was met. These corrective actions may involve restoring the facility back to within safety analyses boundaries, modifying safety analyses, or a combination of both.

Title 10 of the Code of Federal Regulations, Part 50.59, establishes when a licensee may make changes to the ***facility as described in the FSAR*** (CLB) without first obtaining an amendment to the Operating License. This Rule establishes the threshold for NRC approval, not for determining if a particular action is safe or not. The NRC assesses the safety of a proposed change by comparing information provided in a license amendment request against definitive agency acceptance criteria.

This Rule applies to changes affecting the facility analytical bases and safety analyses as well as physical changes to the plant. Prior NRC approval is required for any change that:

> *"(viii) Result in a departure from a method of evaluation **described in the FSAR** used in establishing the **design basis or in the safety analyses"** (emphasis added)*

This threshold specifically includes cases when a licensee gains margin in a safety analysis result by changing one or more inputs (elements) or assumptions used in the evaluation.[20]

These Regulations, along with the License Application (FSAR) provide the framework of complementary controls that ensure fidelity of the design and licensing basis over the life of the facility. This framework requires that licensees obtain an amendment to the Operating License before exceeding any safety analysis boundary approved by the NRC during original plant licensing. In addition, these Rules also required public notice and hearing opportunities before a licensee may encroach on any of these key safety boundaries or assumptions associated with facility safety analyses.

To avoid any misunderstanding of the Diablo Canyon seismic license requirements, I have attached the applicable FSAR sections. Appendix A includes sections from the original FSAR (approved License Application). Appendix B includes the FSAR revision in affect (CLB) when

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[17] 10 CFR 50.54, Conditions of licenses, Section (a)(1), requires PG&E to meet 10 CFR 50, Appendix B (http://www.nrc.gov/reading-rm/doc-collections/cfr/part050/part050-0054.html).

[18] 10 CFR 50, Appendix B, Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants, Criterial III, Design Control, required licensees to assure that applicable regulatory requirements and the design basis, as specified in the license application, is maintained, (http://www.nrc.gov/reading-rm/doc-collections/cfr/part050/part050-appb.html)

[19] 10 CFR 50.71 Maintenance of records, making of reports. http://www.nrc.gov/reading-rm/doc-collections/cfr/part050/part050-0071.html

[20] NEI 96-07,Rev 1 "Guidelines for10 CFR 50.59 Evaluations," ML003636043. Section 4.3.8, Pages 56 - 63, Endorsed by Regulatory Guide 1.187, Guidance for Implementation of 10 CFR 50.59, Changes, Tests, and Experiments, http://pbadupws.nrc.gov/docs/ML0037/ML003759710.pdf)

PG&E developed the new seismic information.[21] These FSAR sections clearly establish that the Double Design Earthquake safety analysis is used to satisfy the GDC-2 SSE design basis.

Sometimes a licensee will make changes to the facility or to a FSAR safety analyses without first obtaining the required Operating License amendment. This encroachment adversely affects the NRC's ability to perform their regulatory oversight function to ensure that facility's principle safety barriers have not degraded. As described in the NRC Enforcement Policy, the agency enforces the 50.59 Rule by issuing violations for these types of CLB encroachments.[22]

PG&E has a long history of CLB encroachment.[23,24] Because of this history, the CLB (FSAR) should be compared against the approved License Application to ensure PG&E has not made unauthorized changes. Any changes that required prior NRC approval, but were made without a license amendment, are invalid. In these cases, the CLB reverts back to the pre-changed state. For example, the original FSAR established the earthquake design basis as Design Earthquake[25] consistent with GDC-2. A subsequent FSAR change to add the Hosgri to this design basis would be invalid without an approved amendment to the Operating Licensee.

NRC Regulations[26] also require licensees to control design basis requirements, including seismic qualification, down to the component level. At Diablo Canyon, this requirement is implemented by the Q-List (Attached Appendix C, Q-List Classification Sheet). The Diablo Canyon Q-List also clearly shows that the seismic qualification of plant components for the SSE is based on the Double Design safety analysis.

Failure of the NRC to Enforce Diablo Canyon Design and Licensing Bases Requirements

Agency personnel allowed, and at times actively encouraged, PG&E to encroach upon key safety boundaries established by facility safety analyses. As a result, PG&E has not assessed the effect of the new seismic information against the methods and assumptions approved by the NRC for the SSE design basis. PG&E was required to compare the new seismic information against the Double Design Earthquake safety analysis because:

- The FSAR stated that the Double Design Earthquake safety analysis implemented the facility GDC-2 SSE design basis requirement.[27,28]

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[21] FSAR and FSAR, Rev 20, Sections were previously approved for public released by the NRC as part of the Differing Professional Opinion (public) Case File, DPO Appeal, ADAMS ML14252A743. PG&E as subsequently released FSAR Rev 21.
[22] NRC Enforcement Policy, 10 CFR 50.59 Violations, pages 9, 23, 41, & 52, ADAMS ML13228A199
[23] NRC identified adverse trend in PG&E's licensing and design basis management, Inspection Report IR 2009-03, pages 21 -23, ADAMS ML092170781
[24] Recent NRC issued violations associated with PG&Es encroachment of the CLB included: Inadequate Corrective Actions to Update the FSAR Update with Required Information, 11/13/2012, ADAMS ML12318A385; Failure to Update the FSARU with Current Plant Design Criteria, 11/13/2012, ADAMS ML 12318A385; Less than Adequate Change Evaluation to the Facility as Described in the UFSAR, 12/31/2009 ADAMS ML100341199; Inadequate 50.59 Evaluation for Unit 1 Containment Sump Modification, 12/31/2007, ADAMS ML080360630; Failure to Evaluate a Change to the Facility as Described in the FSAR Update Associated with 500 kV Offsite Power Source, 06/30/2009, ADAMS ML092170781; Inadequate 50.59 Evaluation for Steam Generator Tube Rupture Analysis, 12/31/2009, ADAMS ML100341199; Failure to Evaluate a Change to the Facility as Described in the FSAR Update Associated with the Addition of Manual Actions in the Safety Analysis, 01/25/2010, ADAMS ML100700281; Failure to Adequately Evaluate Changes to the Diesel Testing as Described in the UFSAR, 06/10/2010, ADAMS ML102040823; Less Than Adequate Change Evaluation to the Facility as Descr bed in the UFSAR 06/10/2010, ADAMS ML102040823; Failure to Perform a 50.59 Evaluation, 06/22/2012, ADAMS ML12216A105.
[25] FSAR (Rev 0), Section 2.5.4.9, Earthquake Design Basis
[26] 10 CFR 50, App B, Criterion I and III, (http://www.nrc.gov/reading-rm/doc-collections/cfr/part050/part050-appb.html)
[27] FSAR (Rev 0), Sections 3.2.1, Seismic Classification; 3.1.2.2, Criterion 2 – Performance Standard; 2.5 Geology and Seismology; & 3.7.1, Seismic Input
[28] FSAR (Rev 20) Sections 3.2.1, Seismic Classification; 3.7.1, Seismic Input; & 3.7.6.1, Post Hosgri Shutdown Requirements and Assumed Conditions

- The FSAR stated that Double Design Earthquake safety analysis includes all "capable" faults within 75 miles of the facility[29] (excluding the Hosgri).

- PG&E concluded that the Shoreline, Los Osos and San Luis Bay faults were "capable" and located within 75 miles of the facility (but were not associated with the Hosgri fault).

- The FSAR stated that Double Design Earthquake safety analysis was used to ensure that all important safety equipment, including the reactor coolant pressure boundary, would remain functional following the maximum ground motions that could affect the facility.

- PG&E concluded that ground motion from any one of the three faults could significantly exceed the maximum ground motion used to seismically qualify important plant structures and safety equipment required for the SSE design basis.

Ground motion from the San Luis Bay fault had the most significant effect on the Double Design safety analysis. NRC regulations[30] required PG&E to take prompt corrective action to restore the SSE safety analyses within the bounds of the GDC-2 design basis. Adding the San Luis Bay seismic inputs to the existing Double Design analysis would have resulted in stress levels far exceeding equipment qualification limits. In other words, the safety analysis would no longer demonstrate that the key safety barriers, relied on for the protection against the release of radiation, would remain intact following a major San Luis Bay earthquake.

PG&E Proposed Using a New Methodology for the Safe Shutdown Earthquake

In October 2011, PG&E submitted License Amendment Request 11-05 to change the facility's SSE safety analysis methodology from the Double Design Earthquake to the Hosgri Event.[31] PG&E argued that the Hosgri Event could accommodate the higher equipment stress levels represented by the new seismic information while demonstrating that acceptance limits were not exceeded. This amendment also requested dispensation from NRC operability requirements for new seismic information. Unfortunately, agency technical staff concluded that the Hosgri methodology failed to satisfy NRC SSE review requirements.[32,33] Rather than rejecting the license amendment outright, the agency allowed PG&E to withdraw the request.

The failure of the amendment request should have resulted in the NRC issuing PG&E a Shutdown Order. Diablo Canyon no longer met SSE qualification requirements as defined by the design basis. As an alternative, the NRC could have used agency statutory authority to waive these requirements.[34] However, the waiver process required PG&E to demonstrate that plant safety could be assured at the higher seismic stress levels. Demonstration of this safety

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[29] 10 CFR 100, Appendix A, Seismic and Geologic Siting Criteria for Nuclear Power Plants, defines "capable" fault. (http://www.nrc.gov/reading-rm/doc-collections/cfr/part100/part100-appa.html). FSAR 3.2.1, Seismic Classification, stated that Double Design Earthquake was in compliance with the criteria for the SSE as required by 10 CFR 100, Appendix A. 10 CFR 100, Appendix A provided the criteria for implementing GDC-2 design basis for earthquakes.
[30] 10 CFR 50, App B, Criteria XVI. Corrective Action, (http://www.nrc.gov/reading-rm/doc-collections/cfr/part050/part050-appb.html)
[31] License Amendment Request 11-05, "Evaluation Process for New Seismic Information and Clarifying the Diablo Canyon Power Plant Safe Shutdown Earthquake" October 20, 2011 (ADAMS ML11312A166)
[32] Standard Review Plan Comparison Tables for License Amendment Request 11-05, "Evaluation Process for New Seismic Information and Clarifying the Diablo Canyon Power Plant Safe Shutdown Earthquake" December 6, 2011, PG&E Letter DCL-1 1-24 (ADAMS ML11342A23866). Includes 66 attachments and 331 pages details gaps between the Hosgri Evaluation and NRC requirements for the safe shutdown earthquake.
[33] Records released under the Freedom of Information Act, FOIA/PA NO: 2014-0065 (Group B), ADAMS ML13354B992. Details NRC technical reviewer's concerns related to LAR 11-05.
[34] 10 CFR 50.12 provides the NRC with statutory authority to waive certain license requirements.

case in a public forum would have been difficult given that the NRC had just rejected the proposed new safety analysis methodology.

Rather than implement either of these two options, agency personnel took the unprecedented action to direct PG&E to work around the failed amendment. The NRC directed PG&E to add the Shoreline fault to the FSAR as lesser case of the Hosgri. This direction attached all of the exceptions associated with the Hosgri to the Shoreline fault. PG&E and NRC informally adapted this position to also justify treating the more limiting San Luis Bay and Los Osos faults as a lesser cases of the Hosgri. These actions functionally changed the facility SSE methodology from the Double Design to the Hosgri. This was the very action that NRC technical reviewers concluded was inappropriate based on gaps between the Hosgri methodology and NRC safety standards. As a result of this CLB encroachment, PG&E has not corrected the non-conforming Double Design Earthquake safety analysis and continues to operate the facility outside of the design basis.

In September 2014, PG&E submitted to the NRC the results of an additional seismic reevaluation mandated by California Assembly Bill 1632.[35] PG&E concluded that the Diablo Canyon seismic design basis remained intact because all new ground motions were bounded by the 1977 Hosgri Spectrum. PG&E's statement was misleading for two reasons:

- PG&E used new methods, including ground motion prediction equations and wave velocities,[36] when presenting the data. As a result, the new ground motion spectra appeared to decrease (Figure 1) even though the faults lengths increased (faults were

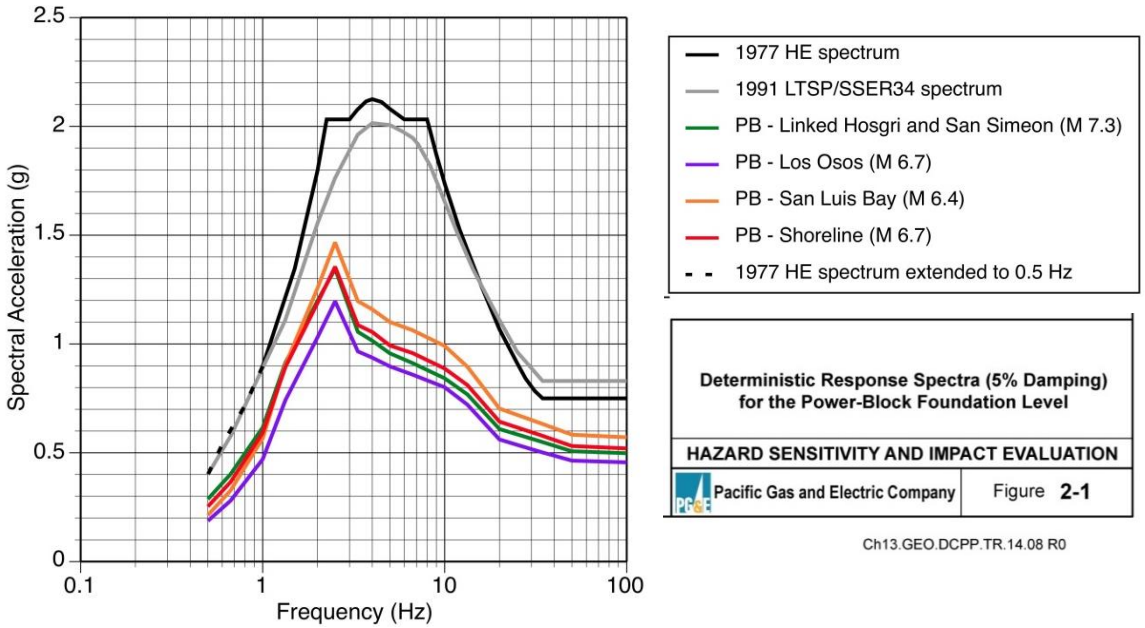


**Figure 1**
**Comparison of New Gounod Motions with the 1977 Hosgri and 1991 LTSP**

[35] PG&E, Central Coastal California Seismic Imaging Project Report, September 2014, (http://www.pge.com/en/safety/systemworks/dcpp/seismicsafety/report.page)
[36] PG&E, Central Coastal California Seismic Imaging Project Report, September 2014, Chapter 13, page 9, stated PG&E used new shear-wave velocity relationships and ground motion prediction equations (http://www.pge.com/en/safety/systemworks/dcpp/seismicsafety/report.page)

more capable). These new methods and assumptions were less conservative than those approved for use in the 1977 Hosgri Spectrum.[37]

The 1977 Hosgri Spectrum was developed using a 145 km fault length. The new evaluation concluded that the Hosgri has a 171 km fault length.[38] The increase in fault length correlates to an increase in earthquake capability. Using CLB methods, the new "PB – Hosgri Linked Spectrum" (shown in green on Figure 1), should have exceeded the 1977 Hosgri Spectrum based on the increased fault length alone.

These new methods were also less conservative when compared to the "1991 LTSP/SSER 34 Spectrum." The 1991 Spectrum (shown on Figure 1) was based on a 7.2 M Hosgri earthquake with a 110 km fault length. The "PB – Hosgri Linked Spectrum" should have exceeded the 1991 LTSP/SSER 34 Spectrum based on the increased Hosgri fault length, if the LTSP Report methods and assumptions had been used.

Without making a judgment of the technical adequacy of the methods reflected in the spectra (Figure 1), these new methods clearly resulted in the analytical results to gain margin. In other words, PG&E's new methods predicted less seismic stress on plant equipment even though the earthquakes are now more severe. The 50.59 Rule required NRC approval of an amendment to the Operating License **before** PG&E was permitted to apply these less conservative methodologies and inputs to facility safety analyses.

- The San Luis Bay and Shoreline faults also exceed the 1977 Hosgri Spectrum using CLB methods. PG&E reported that the "PM-San Luis Bay" (0.63 g) and the "PM-Shoreline fault" (0.57 g) spectra both exceeded the "PB – Hosgri Linked Spectrum" (0.50 g).[39] Given that the reported "PB - Linked Hosgri Spectrum" (green) actually exceeds the 1977 Hosgri Spectrum, using CLB methods and assumptions, then the San Luis Bay and Shoreline faults also exceed the1977 Hosgri Spectrum.

  PG&E's reported peak ground accelerations (new methods) for the San Luis Bay (0.63 g) and the Shoreline fault (0.57 g) power block foundation accelerations also exceed the peak Hosgri accelerations for the plant complex (0.50 g) as reported in the 1977 Hosgri Report.[40]

This discussion is academic since the CLB (FSAR) clearly defined the Double Design Earthquake as the facility SSE.[41,42] As in the case of the 2011 re-evaluation results, the 2014 re-evaluation also concludes that the Shoreline, Los Osos, and San Luis Bay faults all significantly exceed the SSE design basis when the CLB methods are used to determine ground

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[37] PG&E descr bed attenuation equations, assumptions, and methods, including USGS Circular 672, "Near-fault horizontal ground motion." used to develop the 1977 Hosgri Spectrum, Diablo Canyon License Application, Amendment 50, D-LL42, Hosgri Report D43.1, Discussion of Attenuation Equations, October 1977. This information was incorporated into the FSAR by reference, FSAR Section 3.7, Seismic Design, Reference 15, "Evaluation for Postulated 7.5 M Hosgri Earthquake, DCPP Units 1 and 2

[38] PG&E, Central Coastal California Seismic Imaging Project Report, September 2014, Chapter 13, page 7 (http://www.pge.com/en/safety/systemworks/dcpp/seismicsafety/report.page)

[39] PG&E, Central Coastal California Seismic Imaging Project Report, September 2014, Chapter 13, Table 2-9. Deterministic 84th Percentile Site-Specific Ground Motions for the Turbine-Building Foundation Level, page 21

[40] A Rationale For Development of Design Spectra For Diablo Canyon Reactor Facility, Appendix C, page C-20, SSER 5, September 1976.

[41] FSAR Sections clearly defined the Double Design Earthquake as the SSE: 2.5, Geology and Seismology; 3.2.1, Seismic Classification; 3.7.1.1, Design Response Sprctra3.7.6.1, Post Hosgri Shutdown Requirements and Assumed Conditions. (attached Appendix B)

[42] PG&E Classification of Structures, Systems and Components for Diablo Canyon Power Plant (Q-List), Section 2, Classification Systems (attached Appendix C)

motion. The latest reevaluation also indicated that Hosgri, San Luis Bay, and Shoreline faults also exceed the seismic loads bounded by the 1977 Hosgri and the 1991 LTSP/SSER 34 spectra. In other words, the new re-evaluation revealed that the seismic potential affecting Diablo Canyon is worse than previously considered.

Some have incorrectly asserted that the Hosgri is an additional design basis SSE. This assertion is clearly unsupported by the CLB. These individuals have constructed "hybrid" ground motion spectra by combining the Double Design with the Hosgri. These individuals argued that the seismic design basis remained satisfied if new spectra are bonded by the least of the limiting values of these "hybrid" spectra. This approach results in neither of the two evaluations to be satisfied. NRC regulations[43] require the **entire** design basis to be satisfied. If the Hosgri is considered a design basis event, then the entire Hosgri evaluation must be satisfied in addition the **entire** Double Design safety analysis. A simple comparison of ground motion spectra alone ignores the other important attributes use to establish the safety analysis boundaries. Application of new "hybrid" spectra is a clear departure from the "method of evaluation described in the FSAR" used to establish the GDC-2 seismic design basis and would require an amendment to the Operating License **before use**.

Use of Plant Technical Specifications to Preserve Key Safety Analyses Assumptions

The NRC regulatory framework relies on the Diablo Canyon Technical Specifications to ensure that key assumptions used in safety analyses are preserved. These specifications are part of the Operating License.[44] The Technical Specifications require PG&E to shut down the reactors whenever certain important safety equipment is not "operable." To be considered "operable," this equipment must be capable of performing the safety functions credited in **all** FSAR safety analyses, including the design basis SSE. The new seismic information challenged the presumption of operability because the maximum vibratory ground motion that could affect Technical Specifications required plant equipment has significantly increased.

NRC Operability Policy[45] includes provisions for continued reactor operation during the corrective action period following discovery of non-conforming safety analyses. This policy requires that the licensee promptly demonstrate that affected equipment is still capable of performing required safety functions given the non-conforming condition. This policy allows use of available design margin beyond the minimal functional requirements established by facility safety analyses. Technical Specifications generally required a reactor shutdown if a licensee fails to adequately demonstrate that non-conforming equipment remains operable.

Failure of the NRC to Enforce Diablo Canon Technical Specification Operability Requirements

In November 2008, PG&E notified the NRC of discovery of a new line of epicenters. This line of epicenters subsequently became known as the Shoreline fault. PG&E reported that the maximum ground motion that could be produced from this potential fault was less than assumed in the limiting facility design basis as defined by the Long Term Seismic Program (LTSP). The NRC initially concluded that an operability evaluation was not required based on the information provided by PG&E.

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[43] 10 CFR 50, Appendix B, Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants, Criterial III, Design Control, required licensees to assure that design basis is maintained, (http://www.nrc.gov/reading-rm/doc-collections/cfr/part050/part050-appb.html)

[44] Diablo Canyon Nuclear Power Plant, Facility Operating License, DRP-80 & DRP-82, Section 2.C(2), "…PG&E shall operate the facility in accordance with the Technical Specifications…"

[45] NRC Inspection Manual, Manual Chapter 0326, Operability Determinations & Functionality Assessments for Conditions Adverse to Quality or Safety, ADAM ML1327A578 (http://pbadupws.nrc.gov/docs/ML1327/ML13274A578.pdf)

In late 2010, the Diablo Canyon NRC senior resident inspector identified that the FSAR explicitly excluded the LTSP from the facility design basis.[46] Also, PG&E's initial characterization of the fault indicated that a Shoreline earthquake was capable of inducing significantly greater seismic stress on important safety equipment than described in the SSE safety analysis. An operability evaluation was immediately required to support continued reactor operation. The senior resident inspector requested that PG&E to perform the evaluation." PG&E refused, maintaining that the LTSP represented a "special agreement" with the NRC, superseding FSAR design basis requirements.

In January 2011, PG&E confirmed that Shoreline, Los Osos, and San Luis Bay faults were each capable of significantly exceeding the bounding stress used to qualify important to safety plant equipment.[47] The SSE safety analysis contained insufficient margin to accommodate the higher seismic loads represented by the new information. PG&E would have likely been unsuccessful demonstrating operability given the lack of margin. This is a safety concern because the facility is operating outside of the design basis limits that provides confidence PG&E could successfully mitigating a major earthquake.

In February 2011, senior resident inspector recommended that the agency initiate enforcement action against PG&E. This enforcement action would have addressed the licensee's continued operation outside of the plant design basis and for providing the NRC incomplete and inaccurate information regarding the LTSP. NRC Region IV management did not accept the recommendation.

In August 2011, the NRC concluded that PG&E's use of the LTSP was inadequate to ensure that the design basis was satisfied.[48] PG&E subsequently completed an operability evaluation. However, this evaluation failed to satisfy NRC operability standards. The senior resident inspector recommended additional enforcement actions associated with the inadequate operability assessment during the last two quarters of 2011. Again, NRC Region IV management did not accept the recommendation.

PG&E's evaluation concluded that all components were operable for the SSE because the new ground motions were less than the 1977 Hosgri Spectrum. The NRC calls this operability approach use of an "alternate analytical method." The NRC allows use of alternate methods provided that the new method does not create margin (over-predict equipment performance) when compared to CLB methods. This operability policy provides licensees latitude by allowing use of simplified calculations to approximate the results of more complex engineering analyses specified in the CLB. However, the results of these simplified methods must be consistent with the safety analyses. The NRC prohibits use of "alternate methods" for the purpose of gaining additional margin to safety analysis boundaries. In other words, PG&E may not choose an alternate method because it provides a more desirable outcome when compared to the CLB.

NRC Operability Policy states:[49]

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[46] FSAR, Rev 20, Sections 2.5, Geology and Seismology, and 3.7.1, Seismic Input

[47] Report on the Analysis of the Shoreline Fault Zone, Central Coast California to the NRC," January 7, 2011, Submitted on the NRC Docket, ADAMS ML110140400

[48] Task Interface Agreement, Diablo Canyon Seismic Qualification Current Licensing and Design Basis, TIA 2011-010, August 1, 2011 ADAMS ML112130655

[49] NRC Inspection Manual, Manual Chapter 0326, Operability Determinations & Functionality Assessments for Conditions Adverse to Quality or Safety, Page C.4, ADAM ML1327A578

*"(1) If the analytic method in question is described in the CLB (current licensing basis), the licensee should evaluate the situation-specific application of this method, including the differences between the CLB-described analyses and the proposed application in support of the operability determination process."*

*"(5) Acceptable alternative methods such as the use of "best estimate" codes, methods, and techniques. In these cases, the evaluation should ensure that the SSC's (structures, systems, and component) performance is not over-predicted by performing a benchmark comparison of the non-CLB analysis methods to the applicable CLB analysis methods."*

For any given seismic input, the Hosgri evaluation will always produce a less conservative result than the Double Design Earthquake safety analysis. Since the Double Design/SSE is also more limiting for seismic qualification in many cases, use of the Hosgri did not meet NRC limitations for use as an alternative method. Specifically, the operability evaluation was inadequate because PG&E failed to include sufficient benchmarking to verify that the Hosgri did not create margin (over-predict equipment performance) when compared to the SSE design basis. This discussion is also academic since the sole reason PG&E chose the Hosgri as an alternate method was to create the appearance of seismic margin to avoid a Technical Specification required reactor shutdown.

Some have incorrectly asserted that operability is satisfied if the new ground motions are bound by <u>either</u> the Hosgri <u>or</u> the Double Design spectra. As a minimum, Technical Specification required equipment, credited for meeting the design basis, **must be operable**. Operability is defined as the capability of performing the safety functions described in <u>all</u> safety analysis. As previously discussed, the approved License Application specifically credited the Design and Double Design safe analysis for the facility design basis (OBE and SSE). The 10 CFR 50.59 Rule required an approved License amendment before the Hosgri methodology could be used to satisfy these principle safety barriers.

<u>America Society of Mechanical Engineers Boiler and Pressure Vessel Code Requirements</u>

To be considered operable, the seismic stress on reactor coolant pressure boundary (Class 1) components must not exceed the limits established by the America Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code. NRC regulations[50] and the facility design basis specifically require that Code acceptance criteria be satisfied for the OBE (Design Earthquake) and the SSE (Double Design Earthquake)[51] for the following load combinations.[52]

(Case 1): Design Earthquake (OBE) + Pressure + Thermal + Dead Weight

(Case 2): Double Design Earthquake (SSE) + Pressure + Accident Dynamic Loads + Dead Weight

In addition, PG&E made CLB commitment to also ensure the following load combination satisfies Code acceptance limits:

(Case 3): Hosgri Earthquake + Pressure + Dead Weight

[50] 10 CFR 50.55a, Codes and standards (http://www.nrc.gov/reading-rm/doc-collections/cfr/part050/part050-0055a.html
[51] 10 CFR 100, Appendix A, Seismic and Geologic Siting Criteria for Nuclear Power Plants, defines the Operational Basis and Safe Shutdown Earthquake loads to be used in the ASME Code calculation's (http://www.nrc.gov/reading-rm/doc-collections/cfr/part100/part100-appa.html)
[52] Diablo Canyon FSARU, Table 5.2-6, Load Combinations and Stress Criteria for Westinghouse Primary Equipment

The NRC and PG&E have incorrectly concluded that all Code requirements remain satisfied because the new ground motions were bounded by the 1977 Hosgri Spectrum. This oversimplification was based on the assumption that seismic qualification and Code compliance was always more limited by the larger Hosgri earthquake. However, the stress levels use for seismic qualification were not based solely on ground motion. Ground accelerations alone provide a meaningless comparison for Code compliance. The methods, assumptions, analytical inputs, load combinations, and acceptance criteria associated with each analysis was just as important for seismic qualification.

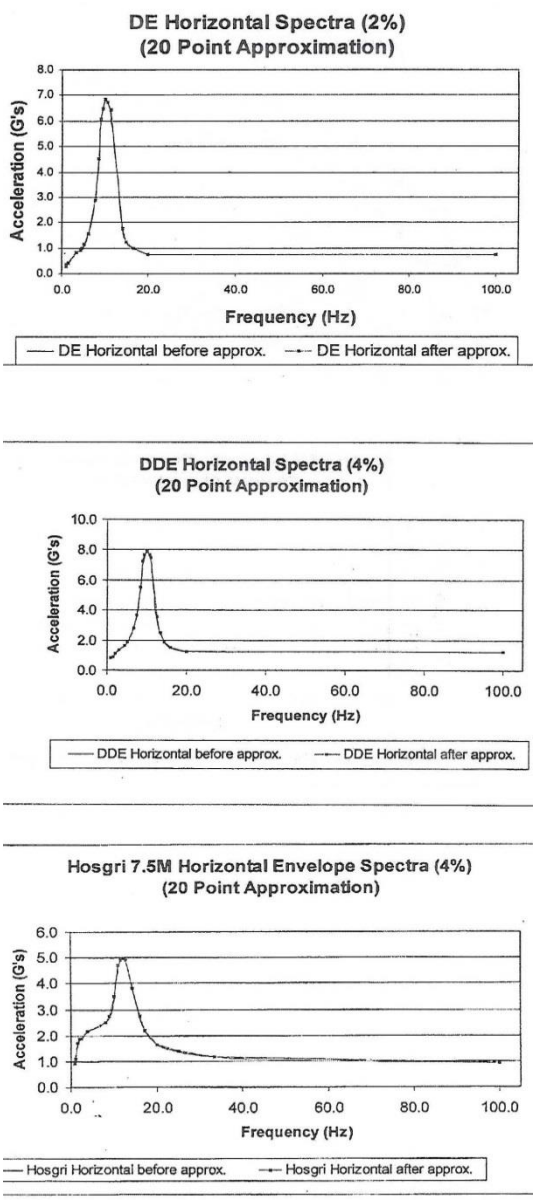


**Figure 2**
**Comparison of the Design, Double Design, and Hosgri Seismic Inputs for Steam Generator Qualification**

For example, consider qualification of the Diablo Canyon replacement steam generators. As with any plant modification, NRC regulations required that PG&E demonstrate that **all** Code requirements were satisfied before the reactors are restarted. This qualification process began with the Design, Double Design, and Hosgri ground motion spectra presented in the License Application. Using CLB methods and assumptions, engineers attenuated these seismic inputs to each steam generator. From these attenuation relationships, input spectra (Figure 2) were developed for each earthquake analysis. These spectra represent the levels of vibratory motion (acceleration/stress) affecting each steam generator as a function of harmonic frequency.

A comparison of these spectra indicate that the maximum vibratory motion affecting the steam generators was 8.0 g for the Double Design Earthquake; followed 6.9 g for the Design Earthquake; and 5.0 g for Hosgri. Reactor pressure boundary structural components are generally most affected by seismic energy in the 3 to 8.5 Hz range. In this range, the maximum vibratory motion is reduced to about 5.5 g, 4.5 g & 2.8 g respectively for each analysis. A simple comparison of these spectra would result in an incorrect conclusion that the Double Design analysis was more limiting (bounding) for steam generator seismic qualification due to the higher loading.

The next step in the qualification process was to add the seismic inputs (from Figure 2) to the load combinations specified by the CLB (Cases 1-3). The Double Design load combination (Case 2) results in the highest component stress levels. However, Code acceptance limits are different for the Design (OBE) and the Double Design (SSE) Earthquakes. In general terms, the Code requires that component stress for the OBE to be less than Service Level B, corresponding to about ½ of the critical buckling strength for material.

For the SSE Case, the Code imposes a more relaxed limit of Service Level D, generally equivalent to about ⅔ of the critical buckling strength. The Code does not specify limits for the Hosgri. However, PG&E committed to also apply Service Level D for the Hosgri load combination (Case 3).[53]

The completed Code calculations concluded that steam generator qualification was most limited by the Design, followed by the Double Design Earthquake analyses, not the Hosgri. This result reflected the larger seismic inputs and more restrictive load combinations associated with the Design and Double Design analyses. The larger Double Design seismic loading was offset by the more restrictive Design Earthquake Code acceptance limits.

The Design and Double Design seismic analyses provide very little margin to Code limits, not only for the steam generators but also for other Class 1 components. The unavailability of margin is due to the unusually large seismic loading associated with the original Design earthquake (0.2 g). This affect was also seen in calculations supporting qualification of the replacement reactor heads. For the new heads, the initial design exceeded Code allowable stress on some components for the Design and Double Design Earthquake cases, but not for Hosgri. As a result, PG&E was required to obtain an amendment to the Operating License to allow less conservative safety analysis inputs to complete the reactor head qualification.[54] The FSAR includes many examples where PG&E to omitted to perform Hosgri qualification calculations based on the much higher seismic loading represented by the Double Design analysis.

When the Double Design input spectrum is adjusted for the more limiting San Luis Bay seismic inputs (Case 4), the resulting load combination significantly exceed Code acceptance limits. The Double Design analysis must be used because the CLB defined this method for the facility SSE (design basis) and explicitly includes all "capable" fault located within 75 miles of site.

(Case 4): San Luis Bay[55] (new SSE input levels) + Pressure + Accident Dynamic Loads + Dead Weight

NRC operability policy states:[56]

> *"When ASME Class 1 components do not meet ASME Code or construction code acceptance standards, the requirements of an NRC endorsed ASME Code Case, or an NRC approved alternative,* ***then an immediate operability determination cannot conclude a reasonable expectation of operability exists and the components are inoperable****. Satisfaction of Code acceptance standards is the* ***minimum necessary for operability of Class 1 pressure boundary components because of the importance of the safety function being performed****" (emphasis added).*

The NRC failed to enforce the 10 CFR 50.55a regulatory and design basis requirements to satisfy ASME Code acceptance limits for the Diablo Canyon SSE. As specified by NRC Policy, the minimum requirement for operability has not been satisfied. The facility Operating License and Technical Specifications required PG&E to immediately shutdown down both reactors pending an NRC approved alterative.

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[53] FSAR Table 5.2-7, Faulted Condition Stress Limits for Class A Components

[54] License Amendment Nos. 208 & 210, "Damping Values for the Seismic Design and Analysis of the Reactor Vessels Integrated Head Assemble," USNRC, September 29, 2010, ADAMS ML102530443; and License Amendment Nos. 207 & 209, "Critical Damping Valves for Control Rod Drive Mechanism Pressure Housings," USNRC, July 30, 2010

[55] San Luis Bay fault represented the highest seismic input affecting the SSE (Double Design) safety analysis

[56] NRC Inspection Manual, Manual Chapter 0326, Operability Determinations & Functionality Assessments for Conditions Adverse To Quality or Safety, Page C.11, ADAM ML1327A578

New Information Affecting the Hosgri Event

The September 2014 seismic reevaluation also called into question if the Hosgri load combination (Case 3) still satisfied Code limits. As previously discussed, the Hosgri fault length increased from 145 km (1977 Hosgri Spectrum) to 171 km.[57] Based on the increase in length, the Hosgri became a more capable fault than considered in the License Application. This new information calls into question if the Hosgri load combination still satisfied Code acceptance limits when the seismic input is adjusted for CLB methodology.

A simplified algebraic relationship may help to illustrate this operability concept. Consider a case where the CLB stated that certain equipment was qualified for a 0.75 g using the method: **M x A = 0.75 g**; were **M** was the seismic input at the fault and **A** was the attenuation relationship transmitting the seismic energy to the facility. If a licensee uses a different methodology, say a $\mathbf{M_{new}}$ and/or $\mathbf{A_{new}}$ to concluded that the 0.75 g qualification basis remained valid ($\mathbf{M_{new} \times A_{new} = 0.75\ g}$), then NRC policy requires that the operability evaluation include a benchmarking of $\mathbf{M_{new}}$ to **M** and $\mathbf{A_{new}}$ to **A**. This benchmarking verifies an "apples-to-apples" relationship exists and the alternate method did not create margin in the analysis results when compared to the CLB methods and assumptions. In other words, the alternate $\mathbf{M_{new}}$ or $\mathbf{A_{new}}$ did not result in over-predicting equipment performance compared to the CLB.

PG&E's new attenuation equations and inputs may or may not be technically justifiable. However, they clearly created margin in the ground motion results and were not part of the CLB. The 10 CFR 50.59 Rule required prior NRC approval before PG&E could add them to the CLB or be used in facility safety analyses. Also, these methods may not be used in operable evaluations unless PG&E includes benchmarking to ensure that they do not created margin when compared to the CLB safety analyses. Again, this discussion is academic since the sole reason PG&E used the new equations was to create the appearance of margin.

Simplified Operability Illustration

Consider a simplified operability example involving a Technical Specification required component. The facility safety analysis credits this component to limit off-site radiation exposure following the SSE. The CLB also credits this component in the Hosgri safe shutdown evaluation.

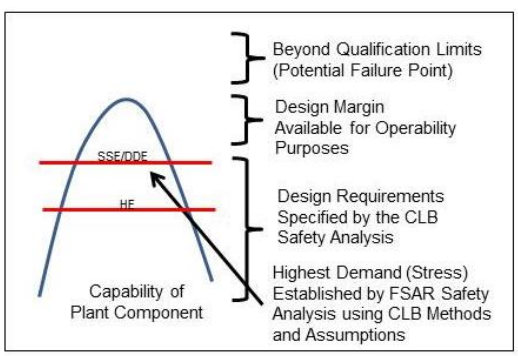


Figure 3a shows the design capability of the component (blue curve) and the level of demand (seismic stress) that the component must be capable of meeting for the Double Design and the Hosgri (red lines) evaluations. As demonstrated with the steam generators, Double Design places a higher demand on the component than the Hosgri. The area above the SSE/DDE demand but below the blue component capability curve is the design margin available for use in operability evaluations.

[57] [57] PG&E, Central Coastal California Seismic Imaging Project Report, September 2014, Chapter 13, page 7 (http://www.pge.com/en/safety/systemworks/dcpp/seismicsafety/report.page)

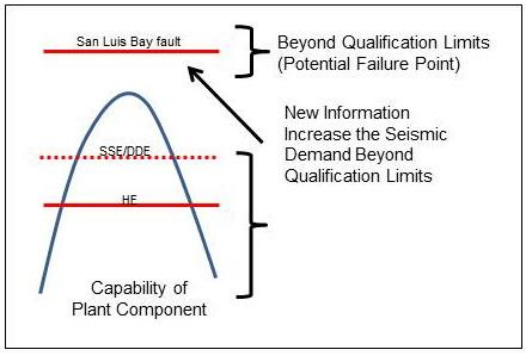


**Figure 3b**
**PG&E's Use of Hosgri as Alternate Method for Operability**

Figure 3.b shows that the San Luis Bay fault (new seismic information) places a higher demand on the component, exceeding the seismic qualification limit. Since the new demand is greater than available engineering margin, the licensee should have declared the component inoperable and applied the Technical Specification required remedial action (reactor shutdown).

PG&E used the Hosgri as an alternate method for demonstrating that the component was operable for the SSE. The operability evaluation stated that because the new San Luis Bay ground motions were less than those used for 1977 Hosgri, then the component was still operable for the Double Design earthquake, irrespective of the actual demand on the component.

PG&E's approach was problematic for two reasons. First, as shown with the steam generator example, seismic qualification is much more involved than just comparing ground motions. The fact that component remained qualified for the Hosgri did not mean that the SSE safety analysis was also satisfied. In fact, in this example the San Luis Bay earthquake (Double Design methods) far exceeded the capability/qualification of the component. Second, the required operability benchmarking would have clearly shown that the Hosgri, as an alternative method, would under-predict the required seismic stress placed on the component when compared to the Double Design methodology.

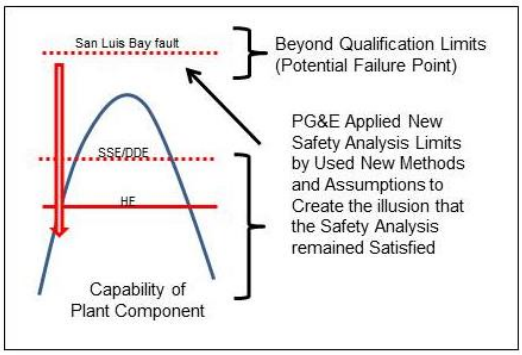


**Figure 3c**
**PG&E Redefined Safety Analysis Limits by Changing Methodology and Assumptions**

Figure 3.c illustrates the approach PG&E took for 2014 reevaluation. This new information indicated that the San Luis Bay fault also exceeded the Hosgri. PG&E used new ground motion prediction equations and inputs to reduce the amount of seismic energy that was considered to attenuate from the fault to the site. PG&E concluded that the component was operable because these new methods resulted in ground motions that appear less than the 1977 Hosgri Spectrum. Similar to the 2011 operability evaluation, PG&E's new methods inappropriately created the appearance of analytical margin while the actual new seismic loadings exceeded the qualification limits for the component.

NRC Operability Inspection

In December 2014, the NRC completed a Diablo Canyon seismic operability inspection[58] following release of the California Assembly Bill 1632 reevaluation.[59] The Inspection Team

[58] Diablo Canyon Focused Baseline Inspection Report - 2014-008, December 15, 2014, ADAMS ML14349A485.
[59] PG&E, Central Coastal California Seismic Imaging Project Report, September 2014, (http://www.pge.com/en/safety/systemworks/dcpp/seismicsafety/report.page)

concluded that all plant Technical Specification equipment remained operable because the new ground motion spectrums were (generally) bound by the 1977 Hosgri Spectrum and the LTSP. The report stated:

> *"Specifically, the licensee's operability determination documented that while seismic study results determined that the Shoreline Fault Zone may be more capable than summarized in the 2011 Shoreline Fault Zone, the deterministic response spectra developed in the CCCSIP Report are still bounded by those of the Hosgri fault and those that are analyzed in the licensee's Long Term Seismic Program (which are described in the current licensing basis). Therefore, the licensee concluded that all seismically qualified SSCs in the plant remain operable relative to the newly developed seismic information."*

The Inspection Team's conclusions were incorrect. The report did not address PG&Es failure to benchmark the new methods and assumptions against the CLB as required by NRC operability policy. The report was silent on the operability requirement to ensure that ASME Code acceptance limits were satisfied for <u>all</u> load combinations required by the regulations (10 CFR 50.55a) and the design basis. The report also did not address the CLB context for the either the Double Design or Hosgri evaluations.

<u>Seismic Hazard Evaluation - Insights from the Fukushima Daiichi Accident</u>

PG&E is engaged in a new seismic hazard evaluation mandated by the post-Fukushima Daiichi Orders.[60] This endeavor may or may not conclude that continued operation of the Diablo Canyon reactors presents an acceptable level of public risk. The NRC implied that the seismic design basis issues would be resolved with completion of this new evaluation.[61]

The issues identified in this letter reflect the NRC's failure to enforce current regulatory and license requirements. Satisfying these requirements provide confidence that the facility is safe to operate in the interim while PG&E completes the Post-Fukushima evaluation. Conversely, the Diablo Canyon Operating License requires PG&E to immediately terminate reactor operation when operability of Technical Specification equipment cannot be satisfactorily demonstrated. Short of waiving these license requirements, the regulatory framework does not provide dispensation based on the promise of future results. Development of a new seismic hazard evaluation does not provide an adequate substitute or justification for the NRC failing to enforce the current license requirements.

<u>Summary</u>

NRC regulations establish the necessary framework to ensure design and licensing basis fidelity over the life of the facility. These regulations require that the Operating License be amended before non-conservative changes are applied to safety analyses methodologies and inputs. Other regulations restrict plant operation within the design basis as established by the approved License Application and facility safety analyses. Licensees are required to evaluate new information against the CLB and take prompt corrective actions whenever any FSAR safety analyses fails to demonstrate that design basis is met.

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[60] 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 (ML12053A340)

[61] Diablo Canyon Power Plant, Unit Nos. 1 and 2 -NRC review of shoreline fault (TAC NOS. ME5306 AND ME5307) October 12, 2012 (ADAMS ML120730106)

The Diablo Canyon CLB includes three seismic qualification bases:

- The Design Earthquake, implements the OBE regulatory requirement for protection against the earthquake potential that is reasonably expected to occur during the life of the facility.

- The Double Design Earthquake, implements the GDC-2 regulatory requirement for the facility SSE design basis. This analysis insures that certain structures and safety equipment will remain functional following the maximum earthquake potential based on an evaluation of <u>all</u> "capable" earthquake faults located within 75 miles of the facility.

- The Hosgri Event, a beyond design basis evaluation, prepared to answer a NRC question during plant licensing. Provides confidence that the plant could safety shutdown following a potential 7.5 M earthquake on the Hosgri fault.

The seismic qualification of important plant structures and safety equipment is limited by each analysis. Comparison of ground motions alone between the seismic evaluations is meaningless. The methods, assumptions, required load combinations, and acceptance limits associated with each evaluation are equally important to ensure that the design and license bases remain satisfied.

PG&E developed new seismic information that concluded three local earthquake faults are more capable than described in the CLB for the bounding SSE safety analyses. Applying the new seismic inputs to the safety analysis methods resulted in stress levels exceeding established regulatory and safety limits for important safety equipment, including the reactor coolant pressure boundary. PG&E proposed changing the SSE methodology to the Hosgri Event as corrective action. NRC regulations required that PG&E first obtain an amendment to the Operating License because this action would have change the safety evaluation methodology used to demonstrate that the GDC-2 SSE design basis was met.

NRC reviewers concluded that the Hosgri methodology did satisfy NRC requirements for the SSE design basis. As the NRC's request, PG&E withdrew the license amendment request. Agency personnel encourage PG&E to work around the failed license amendment by adding the Shoreline fault directly to the FSAR as a lesser case of the Hosgri Event. This action functionally changed the facility GDC-2 SSE safety evaluation methodology to the Hosgri Event. Subsequently, PG&E and the NRC used this unauthorized change to justify omitted review of the new seismic information against the GDC-2 SSE design basis requirements.

The NRC continues to allow PG&E to work around seismic operability requirements. The PG&E operability evaluation was inadequate to support continued reactor operation. The PG&E operability evaluation:

- Failed to benchmark new methods, assumptions, and inputs used to model the attenuation of seismic energy from the earthquake to the plant site. Benchmarking was required to ensure that these new methods and assumptions did not add margin when compared to the results of the Double Design and Hosgri CLB safety analyses methods. Applying CLB methods to the new seismic data resulted in higher seismic loading on important safety equipment and structures than previously considered. As a result, the reevaluation of the new seismic loads only created the appearance of meeting facility design basis requirements while actual seismic loading far exceeded licensed limits.

- Failed to consider the effect of seismic loading from the San Luis Bay spectrum on the Double Design safety analysis. This higher seismic loading directly affected the safety analysis results used to conclude that the SSE design basis remained satisfied. As a result, important safety plant equipment may fail during a major earthquake due to seismic stress levels greater than qualification limits.

- Failed to ensure that ASME Code acceptance limits remained satisfied for all load combinations required by NRC regulations and the design basis. As a result, the reactor coolant pressure boundary may fail during a major earthquake due to seismic stress levels exceeding Code limits. The failure of this critical fission product barrier would directly impact off-site radiation dose consequences to the public following a major earthquake.

The NRC failed to enforce the Diablo Canyon Operating License requirement to immediate shutdown the reactors when the operability of important safety equipment cannot be assured using approved methods.

Some at the NRC have pointed to the complex facility licensing history to justify inaction on these concerns. However, the regulatory processes described in this letter are well understood. NRC Rules defined the CLB as the applicable NRC regulations and PG&Es written commitments for meeting those regulations and the design basis; NRC approval is required before PG&E may change safety analyses methods and inputs that that create new margin; and benchmarking against the CLB is required to ensure new margin is not created before alternate methods may be used to demonstrate operability.

Some at the NRC have stated that the new Diablo Canyon seismic information does not represent a safety issue based on the agency's acceptance of the Hosgri Event when the plant was licensed. These personnel may or may not be correct. However, the CLB does not define the Hosgri as the facility SSE nor is the Hosgri ground motion limiting for facility seismic qualification. Others have argued that PG&E's use of new earthquake attenuation relationships are technically justifiable. They also may or may not be correct. However, NRC regulations required that PG&E obtain an amendment to the Operating License before using these less conservative methods.

The license amendment process would have preserved nuclear safety by ensuring that these new methodologies and inputs were consistent with established NRC acceptance criteria before they were used. Changes in nuclear seismic qualification are highly complex and demand in-depth reviews by agency subject matter experts, using the structured and systematic license amendment review processes. Bypassing this regulatory framework was not only irresponsible but also a serious violation of the public trust. The amendment process also would have provided public notice and hearing opportunities for these facility safety analyses changes that directly affect the principle safety barriers for ensuring public protection from radiation.

These issues were brought to the attention of NRC management and the internal agency processes for dispositioning nuclear safety concerns have been fully exhausted. Unfortunately, the agency responses have not addressed the specific concerns raised in this letter. I request your consideration of these issues in your role of congressional oversight of this government agency.

Sincerely,

Michael S. Peck, Ph.D.

CC: Stephen Burns, Chairman US NRC
Michal Freedhoff, Senior Policy Advisor, Senate Committee on Environment and Public Works

Attachments:
Appendix A, Original Diablo Canyon Seismic Licensing Bases (FSAR)
Appendix B, Current Diablo Canyon Seismic Licensing Bases (FSAR, Revision 20)
Appendix C, PG&E Nuclear Power Generation, Classification of Structures, Systems, and Components for Diablo Canyon Power Plant Units 1 And 2 (Q-LIST), Revision 27