

ADDITIONAL BRANCH CHIEF COMMENTS RELATED TO NCP 2012-001 WITH ANNOTATIONS

Background: The purpose of this document is to provide detailed comments and context associated with Non-concurrence Package 2012-001 (ADAMS ML12151A173) because the topics discussed in NCP-2012-001 were complex and not fully explained. The action taken in response to NCP-2012-001 was to indicate that the NRC would address the operability question through a change to the current licensing basis, not through the enforcement process as proposed. However, as the branch chief responsible for Diablo Canyon Power Plant, I felt it was important to provide additional information on some of the details raised in NCP-2012-001 so that readers would have additional perspective on the issues and be able to recognize that the details described in NCP-2012-001 were reviewed, understood, and considered prior to taking action on NCP-2012-001. The following was cut and pasted from the original NCP-2012-001 (without the diagrams), and has not been altered except to include comments in the margins. – Neil O’Keefe

Issue: Pacific Gas and Electric (PG&E) completed a deterministic reevaluation of the local seismology.¹ This reevaluation concluded that three local faults could produce about 70% greater vibratory ground motion than described in the Final Safety Analysis Report Update (FSARU) for the double design/safe shutdown earthquake. The licensee completed a **prompt operability determination (POD)**² to assess the effect on the capability of plant structures, systems and components (SSCs) to perform the specified safety functions at the higher vibratory motions.

The inspection report documented the results of the NRC inspection of the seismic POD.³ The report stated that the POD provided an initial basis for concluding a reasonable assurance that plant equipment would withstand the potential effect of the new vibratory ground motion. The inspector non-concurs with the report because the POD failed to meet either the licensee’s procedural requirements or the NRC standard for operability. As a result, the licensee failed to demonstrate a reasonable assurance that all Diablo Canyon SSCs were capable of performing the specified safety functions as described in the plant design bases.

The POD was inadequate because the licensee failed to demonstrate that the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code acceptance limits were met for reactor coolant pressure boundary components at the higher structural stress levels represented by the new seismic information. As defined in 10 CFR 50.55a, “Codes, and Standards,” the Code acceptance limits established a minimum standard for operability.

The POD was also inadequate because the licensee failed to demonstrate that all seismically qualified plant SSCs would continue to function at the higher vibratory motion associated with new seismic information in accordance with the double design (safe shutdown) earthquake design basis.

Background - Current Seismic Design and Licensing Basis (CLB)

Seismic qualification for Diablo Canyon SSCs were developed from three design bases⁴ events:

- Design Earthquake (DE): This safety analysis implemented the 10 CFR 100 requirements for the Operational Basis Earthquake. The DE (0.2 g)⁵ represented the maximum vibratory ground motion that could reasonably be expected during the

Comment [n1]: Throughout this document, the phrase “prompt operability determination” has the specific connotation that the licensee was done evaluating operability. The staff has taken the position that the licensee had completed an immediate operability determination (IOD) as described in Part 9900, and still needed to seek NRC approval to be able to complete a final operability evaluation.

Comment [n2]: These ASME Code limits pertain to acceptance criteria contained in the current licensing basis for the Design Earthquake and Double Design Earthquake, but not in the larger Hosgri Event. The NRC specified different acceptance criteria for the HE.

Comment [n3]: Contrary to this statement, 10 CFR 50.55a does not contain operability requirements. It requires compliance with the Code except where proposed alternatives that are accepted by the NRC provide an acceptable level of quality and safety. The NRC approved the HE with alternative measures to the Code.

Comment [n4]: This earthquake analysis is considered to be approximately equivalent to the OBE, but was not proposed or approved to meet the 10 CFR 100 requirements, since the plant design predated Part 100.

operating life of the plant. The DE ensured the seismic qualification for which those plant features necessary for continued operation remain functional without undue risk to the health and safety of the public.

- Double Design Earthquake (DDE): This safety analysis implemented the 10 CFR 100 requirements for the safe shutdown earthquake. The DDE (0.4 g) represented the maximum earthquake potential (producing the maximum vibratory ground motion) for all earthquake epicenters within 200 miles and faults within 75 miles of the plant. The DDE established the seismic qualification requirements for plant SSCs necessary to:
 - Ensure the integrity of the reactor coolant pressure boundary,
 - Prevent or mitigate design basis accidents, and
 - Safely shutdown the plant.
- Hosgri Event (HE): This safety analysis implemented a PG&E commitment to the NRC to demonstrate that the plant could be safely shutdown following a postulated 7.5 M earthquake on the Hosgri Fault line (0.75 g).

The HE represented the largest ground motion of the three design basis events. However, SSC seismic qualification was limited by each of the three design basis earthquakes. For example, the safety analysis predicted higher vibratory motion for DE and DDE than the HE at the steam generators, as shown in Figure 1. The bounding vibratory motion (shaking), used to seismically qualify individual plant components, was a function of the component location. As shown in Figure 2, the DDE provided the limiting floor response spectrum for the 88 foot level of the containment building. The seismic qualification of plant structures was also limited by both the DDE and HE, dependant on location. For example, the seismic qualification of the lower levels of the containment structure were limited by the HE design basis while the upper levels were dominated by the larger DDE spectrum. Portions of the reactor coolant pressure boundary were more limited by the DE and DDE than HE. These differences in qualification requirements resulted from different assumptions, methods, design basis values/inputs, and acceptance criteria approved for each seismic safety analysis.

Figure 1 [Not included - See NCP-2012-001]
Comparison of DE, DDE, & HE Horizontal Response Spectrum at the Steam Generators

The Diablo Canyon Long Term Seismic Program (LTSP)

Several groups raised seismic safety concerns during the original Diablo Canyon licensing process. A major concern was related to the faulting style assumed in the HE safety analysis. To address these concerns, the NRC included Condition 2.C(7) with the original plant License. This license condition required PG&E to identify, examine, and evaluate all relevant geological and seismic data and information that became available since the 1979 Atomic Safety and Licensing Board hearing. From this information, the licensee was required to complete probabilistic and deterministic studies to assure the adequacy of seismic margins. This re-evaluation became known as the LTSP.

PG&E completed the LTSP and submitted the final report to the NRC in 1988.⁶ The licensee concluded that the original seismic design basis (DE & DDE) plus the HE was adequate and no changes were necessary. In 1991 the NRC accepted the LTSP final report and closed the

Comment [n5]: Similarly, the DDE is considered to be approximately the equivalent to the SSE, but was not proposed or approved to meet the Part 100 requirements.

Comment [n6]: This is a list of requirements from Part 100, not from the plant's actual design and licensing basis documentation. The licensee designed all of the quality class components that are safety-related to be able to withstand the DDE. This provides conceptual overlap without providing clear documentation to show alignment to 10 CFR 100.

Comment [n7]: This was treated as a special case by the NRC. The postulated ground motion has no clear relationship to requirements of 10 CFR 100.

Comment [n8]: This is a key point to the argument being made, but it misrepresents the physical situation. The simple physics would show that larger ground motion will produce more shaking at any location. However, the CLB included specific calculational requirements for the licensee to use when demonstrating that a component would withstand each of the three earthquakes. The DE and DDE use very conservative calculations, so they set up more restrictive acceptance criteria. The HE was approved to use a more realistic calculation, which was approved for use in a Regulatory Guide. The opinion stated in this NCP is that the licensee ought to have applied the new ground motion from the Shoreline Fault Report to all three of the earthquake calculations in order to properly assess operability. This would be inconsistent with the design and licensing basis of the plant. However, the unique nature of the CLB did not make it readily apparent how the new data from the Shoreline fault fits into the CLB.

Comment [n9]: There is no real "bounding" seismic case in the DCPD seismic design and licensing basis because the larger HE ground motion was allowed to use less conservative acceptance criteria, while the smaller DDE ground motion was required to use more conservative acceptance criteria. Therefore, there is no one case that bounds the design.

Comment [n10]: The data in this graph was not verified as part of our review. However, the reader should understand that the three curves used different ground motion and different damping values in the separate calculations. As a result, the curve that used the largest ground motion shows the lowest acceleration. This demonstrates that the output of the calculations are sensitive to the damping value approved by the NRC.

License Condition.⁷ The NRC concluded that the LTSP did not alter the plant seismic qualification or design basis. In 1991, PG&E made three commitments associated with closure of the LTSP:

- Use the LTSP data to maintain seismic margins for future modifications of certain plant equipment,
- Maintain a strong geosciences and engineering staff, and
- Continue to operate a strong-motion accelerometer array and coastal seismic network.

Figure 2 [Not included - See NCP-2012-001]
Comparison of DDE and HE Containments Floor Response at 88 Foot

Sequence of Events

- November 2008: The licensee notified the NRC of a new offshore seismic feature located about a mile from the plant. This offshore feature became known as the Shoreline fault. The licensee postulated that an earthquake on the Shoreline fault could produce between 0.69 to 0.74 g peak ground acceleration at the plant. The licensee concluded a POD was not required because the new ground motion was bound by the LTSP deterministic ground motion spectrum.
- September 2010: The NRC identified that an earthquake on the Shoreline Fault could produce about 70 percent greater peak ground motion assumed in the DDE/safe shutdown earthquake design basis.
- October 2010: The NRC requested that PG&E evaluate that capability (operability) of plant SSCs to perform the safety functions at the higher ground motions.
- December 2010: PG&E concluded that a POD was not required because of previous agreements reached with the NRC that new seismic information only needed to be evaluated by the LTSP.⁸
- January 2011: PG&E completed and submitted to the NRC a reevaluation of the local seismology. This report concluded that three local earthquake faults (Shoreline, San Luis Bay, and Los Oslo) could produce about 70% greater ground motion than the DDE.⁹
- March 2011: The NRC opened Diablo Canyon Unresolved Item: 05000275; 323/2011002-03, "Requirement to Perform an Operability Evaluation Following Receipt of New Seismic Information." This unresolved item was used to track NRC review of the licensee's conclusion that new seismic information did not have to be evaluated against the plant design basis.
- June 2011: PG&E concluded that the new seismic information was a nonconforming condition as defined by their corrective action program. The licensee completed a POD to assess the effect of the new information on the capability of plant equipment. The licensee concluded that all plant SSCs were operable because the new ground motions were enveloped by the HE ground motions. The licensee stated that NRC operability

Comment [n11]: The LTSP neither changed the CLB nor became a new part of the CLB. This is important to the operability question because the LTSP cannot be used as the basis of comparison. The licensee had initially concluded that no operability evaluation was needed since the new ground motion was below the LTSP ground motion. Prior to completion of the Shoreline Report, the LTSP actually contains the most modern and complete seismic information, but since it was not used to design or license the plant, it is not a legal part of the CLB.

Comment [n12]: The data in this graph was not verified as part of our review. However, the reader should understand that the two curves used very different damping values in the separate calculations. As a result, the curve that seems to show the larger acceleration is associated with much lower ground motion than the other curve. A comparison of the two curves shown is not meaningful except to illustrate that the DDE can produce much larger calculational results than the much larger Hosgri Earthquake because the DDE used very conservative calculational values.

Comment [n13]: This URI was issued in conjunction with Technical Interface Agreement 2011-010 (ML112130665).

Comment [n14]: An operability determination requires a comparison between the design and licensing requirements and the actual capability of structures, systems, and components. The licensee recognized that the CLB was not clear about which requirement should be used to compare to the new seismic ground motion, so they documented operability by comparing to the largest ground motion, and then submitted a license amendment request for NRC approval to proposed method to resolve the issue.

guidance allowed use of the HE safety analysis to demonstrate that the DDE design basis was met.¹⁰

- August 2011: The NRC concluded that new seismic information developed by the licensee was required to be evaluated against each of the three design basis earthquakes use to establish plant seismic qualification. Comparison only to the HE or LTSP (margin to Hosgri) was not sufficient to ensure all plant SSCs were capable of performing the specified safety functions.¹¹
- October 2011: PG&E revised the POD to reformat the information. The licensee did not make any substantive changes supporting operability.¹²
- October 2011: PG&E requested the NRC approve the HE design basis as the safe shutdown earthquake for Diablo Canyon.¹³
- December 2011: PG&E supplemented the October 2011 request with a detailed list of deviations and exceptions between the HE design basis and NRC Standard Review Plan.¹⁴

Comment [n15]: This statement reflects the conclusion from TIA 2011-010 dated August 1, 2011 (ML112130665). However, the TIA response did not directly address the topic of operability.

Comment [n16]: This statement is the opinion of the inspector. The TIA did not conclude this or make any other conclusion regarding operability.

Comment [n17]: This statement is the opinion of the inspector. The licensee revised the operability evaluation to add extensive documentation of their evaluation methods and a comparison to specific parts of the CLB in order to show alignment with the guidance in the NRC's Part 9900, Appendix C, Section C.4. These additions supported the basis but did not revise the conclusion.

Comment [n18]: This was in the form of a license amendment request. The intent was to gain NRC approval of the proposed way to compare the new Shoreline Report ground motion to plant components' seismic capabilities. This was expected to allow completion of the full operability evaluation.

Comment [n19]: The staff position is that using the evaluation that had the largest ground motion was appropriate to provide a reasonable assurance of safety pending resolution of the legal question about what the basis of comparison should be for assessing operability.

Pacific Gas and Electric Seismic Prompt Operability Determination

PG&E concluded that all SSCs were operable because the new seismic deterministic ground motion spectrums were bound by HE design basis. The POD stated that HE safety analysis, including methods, design basis values/inputs, and acceptance criteria, was an acceptable alternative method for concluding that all plant SSC met the specified safety functions for the DDE.

NRC Operability Standard^{15,16}

To be considered operable, plant SSCs must be capable of performing the specified safety functions specified by design and within the required range of design physical conditions, initiation times, and mission times. The specified function(s) are those safety functions described in the CLB for the facility and are based on safety analysis of specific design basis events.

Immediate operability determinations are made without delay, using the best available information. PODs are a follow-up to immediate determinations when additional information, such as supporting analysis, is needed to confirm the immediate determinations. In both cases, the available information should be sufficient to conclude that the SSC is operable. The scope of an operability determination must be sufficient to address the capability of SSCs to perform their specified safety function(s). The licensee should declare the SSC inoperable if at any time the available information is inadequate to support a reasonable assurance that degraded or nonconforming SSCs are capable of performing the specified safety function(s).

The failure to meet a General Design Criteria or a Regulation should be treated as a degraded or nonconforming condition and is an entry condition for an operability determination.

The operability determination should assess credible consequential failures previously considered in the design. For example, equipment described in the safety analysis needed to

Comment [n20]: This statement is the opinion of the inspector. The Part 9900 operability evaluation guidance does not state this. A lack of information is not necessarily a basis for concluding an SSC is inoperable. In this case, the "missing" information was lack of a clear set of requirements rather than a lack of information about SSC capability or quality. This opinion was an important element of the argument made in this NCP, and the staff disagreed with this opinion. Part 9900 provides guidance for consulting NRC management in such situations, and that was the path used to obtain a staff position on this issue.

Comment [n21]: A degraded or nonconforming condition would be a possible conclusion of an operability determination, not necessarily the entry condition.

mitigate a loss of coolant accident must be capable of performing those functions after the shaking associated with the DDE.]

Licensees may use alternative analytic methods (different methods than described in the CLB) when performing PODs. These alternative methods must be technically appropriate to the facility design and produce results consistent with the applicable acceptance criteria in the CLB. The alternative method should not over-predict SSC performance and licensees should perform benchmark comparisons with the CLB methods. Use of alternate methods does not include substitution of design basis, design basis functions or values/inputs. Use of alternative methods is not permitted in cases where a Regulation or license condition specifies the name of an analytic method for a particular application. In such cases, the application of the alternate analysis must be consistent with the licensing condition or Regulation. For example, ASME Boiler and Pressure Vessel Code methods and acceptance limits are specified by 10 CFR 50.55a. Licensees are not permitted use margins above the Code acceptance limits (or Code Cases) for demonstrating operability. These margins are reserved for the NRC.]

A SSC is either operable or inoperable. The guidance does not provide for an indeterminate conclusion of operability.

Pacific Gas and Electric's Operability Standard¹⁷

The PG&E operability procedure closely paralleled the NRC Technical Guidance. The licensee's process allowed use of margin between the actual capability of degraded/nonconforming SSCs and the specified safety functions as defined in the design basis. The licensee's POD may credit conservatism within the design or margin gained by using compensatory actions.

The specified safety function(s) are those functions the SSCs were designed to accomplish as described in the UFSAR and other CLB documents. When SSC capability is degraded to point where it cannot perform the specified safety function, with a reasonable expectation of reliability, then the system should be judged inoperable. Alternate methods (engineering judgment) apply to calculational methods and should not be used to change design inputs.]

Analysis of the Pacific Gas and Electric Seismic Prompt Operability Determination

The inspector concluded that the seismic POD did not meet either the NRC nor the licensee's standards:

- [The POD failed to demonstrate that the integrity of the reactor coolant system pressure boundary would be maintained following a DDE]

The reactor coolant system specified safety functions included that pressure boundary integrity would be maintained following the combined structural loading resulting from the DDE (safe shutdown earthquake) and a loss of coolant accident. This safety function is met by demonstrating that the ASME Boiler and Pressure Vessel Code, Section III, acceptance limits would be met. The licensee was required to calculate the resultant component stresses use the Code methodology, as specified in the plant design, including the specified DDE design basis values and design information. The POD was inadequate because the licensee failed to provide a reasonable assurance that the Code acceptance limits would not be exceeded for the DDE design basis case given the 70% increase in seismic vibratory ground motion.]

Comment [n22]: This statement is predicated on incorrectly considering the 10 CFR Part 100 requirements to apply directly to DCCP. The HE was approved to similar but modified criteria.

Comment [n23]: This statement is the opinion of the inspector. Neither the example nor the conclusion are supported by the actual guidance in Part 9900 Section C.4.

Comment [n24]: In discussions with the inspector, the opinion was given that the operability determination effectively relied upon changes to the design inputs. No design inputs were actually changed.

Comment [n25]: The inspector has the opinion that the new seismic information should be evaluated under the DDE using an operability determination. The staff position was that this question would be addressed in the license amendment request to clarify the CLB requirements to be used as a basis for comparison.

Comment [n26]: The licensee was required to do this calculation for 0.4g during licensing. There is no specific regulatory requirement to specify how new information needs to be addressed. Since DCCP has three earthquakes in the CLB and none could be considered to bound all circumstances, the staff position is that NRC approval is needed to decide how to evaluate the new ground motion information.

The licensee's substitution of the HE design basis for demonstrating the DDE Code acceptance criteria were met was not an acceptance approach by either the licensee's operability procedure or the NRC operability guidance. This was a concern because in many cases, the reactor coolant pressure boundary stress was more limiting for the DDE than HE (see Figure 1).

- The POD failed to demonstrate that equipment necessary to prevent or mitigate an accident would remain functional following a safe shutdown earthquake

In many cases the DDE safety analysis provided the bounding vibratory motion used to establish the seismic qualification for plant SSC. For example, the FSARU credited the containment fan coolers to mitigate the design basis loss of coolant and steam line break accidents. The design basis required these coolers to be qualified to function following the vibratory motion (shaking) associated with the DDE. These coolers are located on the 88 foot level of the containment building. As shown in Figure 2, the DDE vibratory motion was greater than HE at this location. The POD was inadequate because the licensee failed to demonstrate that the coolers would still function at the increased motion associated with the new seismic information for the DDE case.

Safety Consequence

The seismic design bases and FSARU safety analyses provide reasonable assurance that nuclear safety is maintained following postulated earthquakes. PG&E developed new seismic information that concluded the bounding DDE safety analysis was no longer in conformance with NRC Regulations.¹⁸ The licensee implemented corrective actions in the form of a license amendment request. This information is currently under NRC review. The operability process is used to determine if the licensee can continue to safely operate the plant pending completion of these corrective actions. The PG&E POD used to conclude that the operability threshold was met was inconsistent with the licensee's procedures and NRC Technical Guidance. As a result, the inspector was unable to conclude that key plant SSCs, including the reactor coolant pressure boundary, remain operable. An inoperable conclusion does not necessarily equate to an unsafe condition. However, a declaration of inoperable SSC would require additional NRC engagement before the licensee would be permitted operate the plant beyond the Technical Specification out of service times.

Recommendation

The inspector recommends that the NRC issue a violation with this inspection report associated with the failure of PG&E to follow the station operability determination procedure.

Endnotes

1 "Report on the Analysis of the Shoreline Fault Zone, Central Coast California to the NRC," January 7, 2011, ADAMS ML110140400

2 PG&E Notification 50086062

3 Diablo Canyon Integrated Inspection Report 05000275/2011005 and 05000323/2011005, Section 1R15

4 FSARU Sections 2.5.2.9, "Maximum Earthquake," and 3.7.1.1, "Design Response Spectra,"

5 Peak ground acceleration- gravity

Comment [n27]: This statement represents the inspector's opinion. Neither document has specific guidance that would clearly support this conclusion, but Part 9900 Section C.4 does allow for alternate calculation methods in performing operability evaluations.

Comment [n28]: This is a 10 CFR 100 term that does not apply directly to DCPD because it was issued after PG&E applied for the DCPD licenses. The inspector's use of the term implies that the 10 CFR 100 requirements that go with the safe shutdown earthquake must be met, whereas DCPD is licensed to different requirements.

Comment [n29]: Same comment as Comment 25.

Comment [n30]: This statement is not factual. The DDE was never required to be in conformance with 10 CFR 100 (the reference given by note 18); the DDE cannot be considered bounding, since the HE has the potential to create a considerably larger ground motion; and while PG&E developed new seismic information, PG&E did not document any conclusion that agrees with this statement.

Comment [n31]: The inspector has stated the opinion here that the license amendment request constitutes corrective action. In discussions, he pointed out that the Part 9900 guidance states that corrective action must be separate from the assessment of operability. He therefore is raising the implication that the license amendment request should not be considered as part of the operability assessment process. The staff position is that the license amendment request was a necessary and appropriate step to clarify and resolve the appropriate basis of comparison to be used in the operability assessment.

Comment [n32]: Same comment as Comment 27.

Comment [n33]: This is a statement of the inspector's opinion. It is a conclusion based on the sum of the previous opinions, which are not consistent with the staff positions. The staff discussed this and concluded that the lack of a clear basis of comparison for assessment of operability made this situation a case (described in Part 9900) where NRC management involvement was needed to resolve the operability question. NRC management concluded that the CLB must first be clarified before the operability question could be completely addressed, and the NRC must agree on the clarification. The immediate operability determination provided an adequate basis to conclude that SSCs were capable of performing their specified safety functions.

6 PG&E Long Term Seismic Program Final Report, DCL-88-192, July 1988
7 SSER 34
8 Notification 50086062, Task 30
9 "Report on the Analysis of the Shoreline Fault Zone, Central Coast California to the NRC,"
January 7, 2011, ADAMS ML110140400
10 Notification 50410266
11 "Task Interface Agreement – Concurrence on Diablo Canyon Seismic Qualification Current
Licensing and Design Basis,"
August 1, 2011, ADAMS ML112130665
12 Notification 50410266
13 Pacific Gas and Electric, License Amendment Request 11-05, "Evaluation of Process for
New Seismic Information and Clarifying the
Diablo Canyon Power Plant Safe Shutdown Earthquake," ADAMS ML113112A166
14 Pacific Gas and Electric, "Standard Review Plan Comparison Tables for License Amendment
Request 11-05," ADAMS ML11312A166
15 NRC Inspection Procedure 71111.05, "Operability Determinations and Functionally
Assessments"
16 NRC Inspection Manual, Part 9900: Technical Guidance, "Operability Determinations &
Functionality Assessments for
Resolution of Degraded or Nonconforming Conditions Adverse to Quality or Safety," ADAMS
ML073440103
17 PG&E Procedure OM7.ID.12, Operability Determinations, Revision 22
18 10 CFR 100, Appendix A, "Seismic and Geologic Siting Criteria for Nuclear Power Plants."