



**Pacific Gas and  
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PG&E Letter DCL-11-037

U.S. Nuclear Regulatory Commission  
ATTN: Document Control Desk  
Washington, DC 20555-0001

Docket No. 50-275, OL-DPR-80  
Docket No. 50-323, OL-DPR-82  
Diablo Canyon Units 1 and 2

Response to Telephone Conference Calls Held on February 2 and 4, 2011,  
Between the U.S. Nuclear Regulatory Commission and Pacific Gas and Electric  
Company Concerning Responses to Requests for Additional Information Related to  
the Diablo Canyon Nuclear Power Plant, Units 1 and 2, License Renewal  
Application.

Dear Commissioners and Staff:

By PG&E Letter DCL-09-079, "License Renewal Application," dated November 23, 2009, Pacific Gas and Electric Company (PG&E) submitted an application to the U.S. Nuclear Regulatory Commission (NRC) for the renewal of Facility Operating Licenses DPR-80 and DPR-82, for Diablo Canyon Power Plant (DCPP) Units 1 and 2, respectively. The application included the license renewal application (LRA), and Applicant's Environmental Report – Operating License Renewal Stage.

On February 2 and 4, 2011, telephone conference calls between the NRC and representatives of PG&E were held to obtain clarification on PG&E's response to request for additional information (RAI) submitted to the NRC in PG&E Letter DCL-10-167, "Response to NRC Letter dated December 20, 2010, Request for Additional Information (Set 36) for the Diablo Canyon License Renewal Application," dated January 12, 2011, regarding the Flux Thimble Tube Inspection Program.

PG&E's supplemental information to the RAI response for which the staff requested information is provided in Enclosure 1. PG&E makes new commitments in amended LRA Table A4-1, License Renewal Commitments, shown in Enclosure 2.

If you have any questions regarding this response, please contact Mr. Terence L. Grebel, License Renewal Project Manager, at (805) 545-4160.



I declare under penalty of perjury that the foregoing is true and correct.

Executed on March 25, 2011

Sincerely,

James R. Becker  
*Site Vice President*

TLG/50383424

Enclosures

cc: Diablo Distribution

cc/enc: Elmo E. Collins, NRC Region IV Regional Administrator  
Nathanial B. Ferrer, NRC Project Manager, License Renewal  
Kimberly J. Green, NRC Project Manager, License Renewal  
Michael S. Peck, NRC Senior Resident Inspector  
Alan B. Wang, NRC Licensing Project Manager

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**RAI B2.1.21-2 Request 2 (follow up)**

2. Describe how the trending of thimble tube wear rates accounts for the possibility of a non-linear or accelerating wear rate.

*In its response, PG&E stated that the possibility of non-linear or accelerating wear rates was addressed by STP R-22 FTT enhanced acceptance criteria which it listed in the response. PG&E previously committed to limiting repositioning of any tube to one time, and stated that there are currently no tubes in either unit that have been repositioned more than once.*

*With regard to request 2, the staff's concern is that the applicant's current procedure may not be conservative in predicting accelerated wear rates that may occur non-linearly. The staff asked the applicant to make wear rate data (predicted and actual) available for audit to confirm if the wear rates are occurring in a linear or non-linear fashion. The applicant agreed to make its wear rate data available to the staff for audit.*

**PG&E Response to RAI B2.1.21-2 Request 2 (follow up)**

**Procedural Requirements for Measurement Uncertainty**

In 1990, Westinghouse issued a DCPD-specific calculation, MED-PCE-8649, as the basis for flux thimble tube (FTT) inspection criteria.

PG&E will revise the plant procedure on FTT inspections to reference this letter and WCAP-12866 to clarify the technical basis (as discussed below) for an adequate margin of safety to ensure that the integrity of the reactor coolant system pressure boundary is maintained. The procedure revision is currently scheduled to be completed prior to December 2011, but will be completed prior to the period of extended operation. See amended license renewal application (LRA) Table A4-1.

**Procedural Requirements for Non-linear Wear Rate**

The NRC requested additional information regarding the acceptance criteria in the plant FTT inspection procedure for requiring capping or replacing tubes to ensure these acceptance criteria adequately address potential nonlinear wear rates. PG&E's current acceptance criteria to address nonlinear wear include capping or replacing FTTs that meet any of the following criteria: (1) greater than 25 percent wear per year, (2) any tubes that had to be repositioned more than once, (3) any tube with multiple wear scars - any two that measured greater than 40 percent, (4) any tubes that had to be repositioned more than a total of 6 inches, or (5) any tube that cannot be inspected.

PG&E evaluated actual plant-specific wear data versus wear projections for Unit 1 outages 1R11 through 1R16 and Unit 2 outages 2R11 through 2R15. This data shows a maximum non-conservative wear projection of 5 percent for wear above 40 percent. The majority of the non-conservative wear projections for wear less than 40 percent were less than 10 percent, but did have several readings of non-conservative wear projections of up to 18.6 percent. In conclusion, for wear above 40 percent, an additional predictability allowance of 5 percent is adequate to ensure that actual nonlinear wear does not exceed projected wear.

WCAP-12866 is a Westinghouse topical report that was based on conservative burst tests for Westinghouse FTT designs. WCAP-12866 recommended an 80 percent through wall acceptance criterion. This value includes an additional safety margin established by Westinghouse for allowable wear in the thimble tube. WCAP-12866 did not require adding an allowance for eddy current testing (ECT) instrument uncertainties. The NRC staff accepted the 80 percent acceptance criterion for Farley license renewal (Safety Evaluation Report Related to the License Renewal of the Joseph M. Farley Nuclear Plant, Units 1 and 2, Docket Nos. 50-348 and 50-364, March 2005, Accession # ML050630571), but required that an additional 5 percent be added for ECT instrument uncertainty.

PG&E will revise its plant procedure to include a 5 percent allowance for predictability and a 10 percent allowance to account for instrument and wear scar uncertainty. This procedure will also be revised to include an 80 percent through wall acceptance criterion based upon its plant-specific FTT data wear and NRC acceptance of this 80 percent criterion. In conclusion, based on the WCAP-12866 80 percent acceptance criterion, including 5 percent predictability uncertainty and 10 percent for ECT instrument and wear scar uncertainty, PG&E will use a net acceptance criterion of 65 percent. The plant procedure revision is currently scheduled to be completed prior to December 2011, but will be completed prior to the period of extended operation. See amended LRA Table A4-1.

In addition, PG&E will update the Diablo Canyon Power Plant Final Safety Analysis Report (FSAR) in accordance with 10 CFR 50.71(e) to include the FTT acceptance criterion. The update is currently scheduled to be included in the next FSAR Update, but will be completed prior to the period of extended operation. See amended LRA Table A4-1.

PG&E will revise its plant procedure to require the actual plant FTT specific wear data versus wear projections be evaluated every refueling outage to ensure it remains consistent with a maximum non-conservative wear projection of 5 percent for wear above 40 percent. If the wear projection for a tube is determined to exceed the 5 percent under prediction and has over 40 percent wear the previous cycle, PG&E will enter it into the corrective action program for evaluation and disposition. This procedure revision is currently scheduled to be completed prior to December 2011, but

will be completed prior to the period of extended operation. See amended LRA Table A4-1.

**RAI B2.1.21-2 Request 3 (follow up)**

*3. Identify all aging effects and mechanisms that contributed to the degradation in Unit 2 flux thimble tube L13 over time (i.e., as detected during ROs 2R11, 2R12, and 2R13) and discuss the failure analysis activities that were performed at the site or were contracted out to confirm the apparent cause of the degradation that had occurred in the tube and the rapid progression of the degradation mechanism that lead to the relative rapid leak in 2006 (i.e., the leak occurred within four months of returning to power).*

*In its response, PG&E stated that it sent a portion of the Unit 2 L-13 tube to Westinghouse for destructive analysis. It further stated that “[t]he piece had several wear scars on it but none were through wall. The wear scars conformed to the scars Westinghouse had seen during development of the WCAP-12866. Their determination was that the event was caused by flow induced vibration of the thimble tube against the lower internals, core plate, or bottom nozzle. This was similar to other failures they had previously analyzed.”*

*With regard to request 3, the staff explained that it could not determine the root cause of the flux thimble tube failure based on the information presented in the January 12th response provided by the applicant. During the call, PG&E explained that it sent a portion of the flux thimble tube to Westinghouse for analysis, and PG&E performed eddy current testing on the portion of the flux thimble tube that failed. Based on the information from Westinghouse and the results of the eddy current test, PG&E determined that the root cause of the failure of the tube was wear, and that no cracks were detected. The staff asked the applicant to amend its previous response to explain this. The applicant agreed to amend its response and explain how it arrived at the conclusion that no cracks occurred.*

**PG&E Response to RAI B2.1.21-2 Request 3 (follow up)**

**Additional Information on the Evaluation Performed to determine the cause of the 2L13 Flux Thimble Tube (FTT) Through Wall Failure**

PG&E has performed 100 percent eddy current testing of all FTTs that were not capped in every outage since 1R3/2R3. The only degradation mechanism that has been observed is wear scars caused by flow induced vibration. PG&E performed eddy current testing in 2R14 of FTT 2L13 following its through wall failure. The eddy current testing showed a through wall failure but did not identify any evidence of cracking. This test identified the following wear scars:

1. New 96 percent wear scar at the bottom nozzle.
2. New 85 percent wear scar at an intermediate support bracket approximately 24 inches below the bottom nozzle
3. New 92 percent wear scar at the lower core support plate
4. Previously existing 47 percent wear scar approximately 5 inches below the lower core support plate
5. Previously existing 42 percent wear scar approximately 10 inches below the lower core support plate

Wear scars 4 and 5 were repositioned during 2R13 and 2R12 respectively.

The eddy current signatures for all scars were similar in that they appeared to exhibit the same degradation mechanism. This was later confirmed to be flow-induced vibration by Westinghouse testing.

PG&E attempted to recover the piece of the 2L13 FTT from the bottom nozzle location during 2R14. Use of a remote camera visual inspection did not locate a through wall flaw at location 1. Location 3 was able to be physically inspected due to lower dose rates. The wear scar at this location was evident and suspected to be the through wall leak location. This piece was sent to Westinghouse for a destructive analysis. The piece had three wear scars (wear scars 3, 4 and 5 above) but none were through wall. The wear scars conformed to the scars Westinghouse had seen during development of WCAP-12866. The Westinghouse evaluation determined that these wear scars were caused by flow-induced vibration of the FTT against the lower internals.

The history of 2L13 FTT is that it was repositioned and capped in 2R3 after the first eddy current test. It was replaced in 2R10 with a tube having a 15-inch hardened chrome band centered around the fuel bottom nozzle. In 2R12, FTT 2L13 was repositioned approximately 5 inches following the development of a new 40 percent wear scar at the lower core support plate. In 2R13, FTT 2L13 was repositioned a second time after the development of a new 40 percent wear scar at the lower core support plate. By repositioning 2L13 FTT twice for a total of approximately 10 inches, the hardened chrome band had been moved below the fuel bottom nozzle.

PG&E concluded that wear scars 3, 4 and 5 within a 10-inch section of the tube, located approximately 5 ft below the core support plate, allowed that section of the tube to vibrate more than normal and the bare FTT at the fuel bottom nozzle wore until the FTT failed.

**Amendment 44**

<b>LRA Section</b>	<b>RAI</b>
Table A4-1	B2.1.21-2, Request 2

Table A4-1 License Renewal Commitments

Item #	Commitment	LRA Section	Implementation Schedule
65	<i>PG&amp;E will revise the plant procedure on flux thimble tube inspections to reference this letter and WCAP-12866 to clarify the technical basis for an adequate margin of safety to ensure that the integrity of the reactor coolant system pressure boundary is maintained. This procedure revision is currently scheduled to be completed prior to December 2011, but will be completed prior to the period of extended operation</i>	B2.1.21	<i>Prior to the period of extended operation</i>
66	<i>PG&amp;E will revise its plant procedure to include a 5 percent allowance for predictability and a 10 percent allowance to account for instrument and wear scar uncertainty. This procedure will also be revised to include an 80 percent through wall acceptance criterion based upon its plant-specific FTT data wear and NRC acceptance of this 80 percent criterion. In conclusion, based on the WCAP-12866 80 percent acceptance criterion, including 5 percent predictability uncertainty and 10 percent for eddy current testing instrument and wear scar uncertainty, PG&amp;E will use a net acceptance criterion of 65 percent. This procedure revision is currently scheduled to be completed prior to December 2011, but will be completed prior to the period of extended operation.</i>	B2.1.21	<i>Prior to the period of extended operation</i>
67	<i>PG&amp;E will update the FSAR in accordance with 10 CFR 50.71(e) to include the flux thimble tube acceptance criterion. This update is currently scheduled to be included in the next FSAR update, but will be completed prior to the period of extended operation.</i>	B2.1.21	<i>Prior to the period of extended operation</i>
68	<i>PG&amp;E will revise its plant procedure to require the actual plant FTT specific wear data versus wear projections be evaluated every refueling outage to ensure it remains consistent with a maximum non-conservative wear projection of 5 percent for wear above 40 percent. If the wear projection for a tube is determined to exceed the 5 percent under-prediction and has over 40 percent wear the previous cycle, PG&amp;E will enter it into the corrective action program for evaluation and disposition. This procedure revision is currently scheduled to be completed prior to December 2011, but will be completed prior to the period of extended operation.</i>	B2.1.21	<i>Prior to the period of extended operation</i>