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December 14, 2009

PG&E Letter DCL-09-086

10 CFR 50.90

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

Diablo Canyon Units 1 and 2
Docket No. 50-275, OL-DPR-80
Docket No. 50-323, OL-DPR-82
License Amendment Request 09-06, Critical Damping Value for Structural Dynamic Qualification of the Control Rod Drive Mechanism Pressure Housings

Pursuant to 10 CFR 50.90, Pacific Gas and Electric (PG&E) hereby requests approval of the enclosed proposed amendments to Facility Operating License Nos. DPR-80 and DPR-82, for Diablo Canyon Power Plant Units 1 and 2, respectively. This license amendment request (LAR) would change the design basis and Final Safety Analysis Report Update (FSARU) to allow use of a damping value of 5 percent of critical damping for the structural dynamic qualification of the control rod drive mechanism (CRDM) pressure housings on the replacement reactor vessel head for the design earthquake (DE), double design earthquake (DDE), Hosgri earthquake (HE), and loss of coolant accident (LOCA) loading conditions. The 5 percent damping value for the CRDMs has been accepted by the NRC staff at several other plants with equivalent CRDMs and seismic support structures. The current documented design basis for the installed CRDMs describes the use of lower damping values.

The enclosure contains a description of the proposed changes, the supporting technical analyses, and the no significant hazards consideration determination. Attachment 1 contains marked-up FSARU pages.

PG&E has determined that this LAR does not involve a significant hazard consideration as determined per 10 CFR 50.92. Pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment needs to be prepared in connection with the issuance of this amendment.

PG&E requests approval of this LAR by June 1, 2010, to support the Unit 1 head replacement during the refueling outage beginning on October 4, 2010. Also, PG&E requests the license amendment(s) be made effective upon NRC issuance, to be implemented within 180 days from the date of issuance.

The proposed amendments have been reviewed by the Plant Staff Review Committee and approved by the Station Director. Pursuant to 10 CFR 50.91, a copy

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of this proposed amendment is being sent to the California Department of Public Health.

PG&E makes no regulatory commitments (as defined by NEI 99-04) in this letter. This letter includes no revisions to existing regulatory commitments.

If you have any questions or require additional information, please contact Tom Baldwin at (805) 545-4720.

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

Executed on December 14, 2009.

Sincerely,

James R. Becker
Site Vice President

tcg5 SAPN50276288
Enclosure
cc: Gary W. Butner, California Department of Public Health
Elmo E. Collins, NRC Region IV
Diablo Distribution
cc/enc: Michael S. Peck, NRC, Senior Resident Inspector
Alan B. Wang, NRC Project Manager, Office of NRR

Evaluation of the Proposed Change

Subject: License Amendment Request 09-06
Critical Damping Value for Structural Dynamic Qualification of the Control Rod Drive Mechanism Pressure Housings

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ATTACHMENT:

1. Final Safety Analysis Update Pages

1. SUMMARY DESCRIPTION

This evaluation supports a request to amend Facility Operating License Nos. DPR-80 and DPR-82 for Diablo Canyon Power Plant (DCPP), Units 1 and 2, respectively.

This LAR would change the design basis and FSARU to allow use of a damping value of 5 percent of critical damping for the structural dynamic qualification of the CRDM pressure housings on the replacement reactor vessel head for the design earthquake (DE), double design earthquake (DDE), Hosgri earthquake (HE), and Loss of Coolant Accident (LOCA) loading conditions. The 5 percent damping value for the CRDMs has been accepted by the NRC staff at several other plants with equivalent CRDMs and seismic support structures. The current documented design basis for the installed CRDMs describes the use of lower damping values.

2. DETAILED DESCRIPTION

Proposed Amendment

The proposed change would revise FSARU Section 3.7.1.3, Critical Damping Values, to allow a damping value of 5 percent of critical damping for the seismic/LOCA qualification of the CRDM pressure housings for the DE, DDE, and HE.

Purpose for Proposed Amendment

The purpose of this proposed change is to obtain NRC staff approval for the use of a damping value of 5 percent of critical damping for the structural dynamic qualification of the CRDM pressure housings on the replacement reactor vessel head for the DE, DDE, and HE, and LOCA loading conditions. The 5 percent damping value has been accepted by the NRC staff for CRDM dynamic analysis at several other plants with DCPP-equivalent CRDMs and seismic support structures.

Risk-Informed Licensing Change

The requested change in the LAR is not a risk-informed licensing change.

3 TECHNICAL EVALUATION

System Design Basis

The CRDMs are Code Class I components designed and qualified to meet the requirements of the ASME Code, Section III. All design, operating and accident conditions are included.

Basis for damping value for CRDM component analysis

Regulatory Guide 1.61, "Damping Values for Seismic Design of Nuclear Power Plants," (Reference 2) provides *acceptable damping values to be used in the elastic dynamic seismic analysis and design of SSCs, where energy dissipation is approximated by viscous damping unless otherwise specified.* RG 1.61 does not explicitly specify damping values for CRDMs. Piping is the closest approximation to CRDM structure; however, the specified piping damping values do not account for the significant damping inherent to the CRDM design (i.e., internal mechanical components and more importantly, the gapped seismic support plate structure).

RG 1.61 does allow the use of damping values higher than those provided in the regulatory guide if documented test data support the higher values. Damping is a property of the structure or system being excited by earthquake motion rather than of the earthquake itself. It varies as a function of material and configuration.

The CRDM damping values used in the seismic qualification analyses of the original equipment manufacturer (OEM), Westinghouse, were established via testing conducted by Westinghouse. The tests were performed on a full size CRDM and seismic support system (Type L-105 CRDM) with nonfunctioning rod position indication coils with an operating coil stack installed. Latches were disengaged from the drive shaft for the tests. A weight was included at the bottom of the drive shaft to simulate the weight of the control rods. All tests were run at an internal pressure of 2250 pounds per square inch (psi) and a temperature of 400°F.

The testing program consisted of transient vibration tests in which the CRDM was deflected a specified initial amount and suddenly released. The effect on damping of variations in the drive shaft axial position, upper seismic support clearance and initial deflection amplitude was investigated. The effective damping was determined by calculating the logarithmic decrement for one cycle and for five cycles.

This testing is discussed in WCAP-7921-AR, "Damping Values of Nuclear Power Plant Components." WCAP 7921-AR presents and evaluates damping values and data from tests of nuclear power plant components and other structures.

The NRC (then AEC) in a letter dated May 14, 1974, stated that WCAP-7921-AR *is acceptable for reference as a topical report, on license applications for which the construction permit application was docketed after April 1, 1973, when it is used in support of damping values for Westinghouse primary coolant loop system components and large piping with a configuration similar to that defined in the report.* The acceptability did not apply to damping values for reactor internals.

The Westinghouse test results described in WCAP 7921-AR state that CRDM damping varied from 2.5 percent to 17 percent of critical damping depending on the number of cycles of decay used in the calculation and on the size of the gap between the seismic support plates. The gap between seismic support plates had the largest effect on the CRDM damping with the damping increasing with increasing clearance. With a gap of 0.060-inch, the measured damping was approximately 8 percent. The gap between typical CRDM seismic support plates is a minimum of 0.100-inch.

The replacement CRDM design provides a 0.070-inch (cold)/0.100-inch (hot) gap between the CRDM seismic support plates. This gap would result in damping equal to or greater than the 8 percent damping discussed in WCAP 7921-AR. Therefore, the use of 5 percent critical damping is conservative for the DCPP DE, DDE, HE, and LOCA events.

Similarity Evaluation

Several operating Westinghouse PWRs of design and vintage similar to DCPP have qualified CRDMs using the 5 percent damping value on the basis of similarity between the Type L-106A CRDM and the tested CRDM. The design of the AREVA-supplied CRDMs and supporting structure was specified as an equivalent replacement for the OEM CRDMs (Type L-106A) in fit, form and function. In comparison with the OEM CRDMs, the as-built configuration of the AREVA-supplied replacement CRDMs provide the similarity in geometry, seismic support elevation and physical interfaces, etc. required to maintain virtually identical structural characteristics.

The following provides the basis of similarity between the OEM CRDM and the AREVA-supplied CRDM, as depicted in Figure 1:

1. *Gap at the seismic support plates.* The CRDM testing that supports the 5 percent damping value was based on a seismic support plate gap of 0.060-inch. The seismic support plates / seismic support structure for the replacement CRDM design provides a 0.070-inch (cold)/0.100-inch (hot) gap between the CRDM seismic support plates, consistent with the gap between the OEM CRDM seismic support plates.

2. *CRDM length.* The OEM and AREVA supplied replacement CRDMs are the same in length.

3. *Latch housing and Rod Travel Housing (RTH) materials.* The OEM and replacement CRDMs materials for the latch housing and RTH are the same type 304 stainless steel.

4. *Section properties.* The OEM and replacement CRDM geometry is essentially the same by design. Differences in tolerances are insignificant to damping.

5. *Operating parameters.* The operating parameters are the same.

6. *Appurtenances.* The existing Westinghouse Type L-106A control rod drive coil assemblies and digital rod position indicator coil stacks have been or will be installed on the replacement CRDMs

7. *Specific design differences.* The design enhancements are shown in the circled areas in Figure 1. Alloy 690 is substituted for Alloy 600 for its superior resistance to PWSCC. These materials' physical properties are equivalent and with no change in the effect on damping. Threaded joints with canopy seal welds at the top and lower positions have been eliminated in favor of one-piece construction. The OEM fine-threaded joint connections are pressure-loaded and designed to minimize or eliminate relative displacement between the joined parts; therefore, any difference in damping effects of these joint connections and the one-piece design are negligible.

Therefore, based on the similarity of the AREVA-supplied replacement CRDMs to the OEM CRDMs, 5 percent critical damping is a conservative value to use for dynamic analysis.

4. REGULATORY EVALUATION

4.1 Applicable Regulatory Requirements/Criteria

Regulatory Guide 1.61, "Damping Values for Seismic Design of Nuclear Power Plants," provides *acceptable damping values to be used in the elastic dynamic seismic analysis and design of SSCs, where energy dissipation is approximated by viscous damping unless otherwise specified.* RG 1.61 does not specify damping values for CRDMs; however, the use of damping values higher than those provided in the regulatory guide is specifically allowed if documented test data support the higher values. The use of damping values for non-specified structural components based upon documented test data is therefore presumed acceptable for use with prior approval.

The proposed damping values are based on testing conducted by Westinghouse. This testing is discussed in WCAP-7921-AR. The use of 5 percent of critical damping has been approved by the NRC for structural dynamic qualification of similar CRDMs at several plants.

4.2 Precedent

The use of 5 percent damping has been accepted by the NRC staff in the licensing review of several plants of design and construction similar to DCPP, including Watts Bar and Comanche Peak. These plants have similar CRDMs to the DCPP OEM and replacement CRDMs.

The testing on which the acceptance is based is discussed in WCAP-7921-AR. WCAP 7921-AR presents and evaluates damping values and data from tests of nuclear power plant components and other structures, and was approved for use by the AEC.

4.3 No Significant Hazards Consideration

Pacific Gas and Electric (PG&E) has evaluated whether or not a significant hazards consideration is involved with the proposed amendment by focusing on the three standards set forth in 10 CFR 50.92, "Issuance of amendment," as discussed below:

1. *Does the change involve a significant increase in the probability or consequences of an accident previously evaluated?*

The proposed change revises the design basis and Final Safety Analysis Report Update (FSARU) to reflect a damping value of 5 percent of critical damping for the structural dynamic qualification of the control rod drive

mechanism (CRDM) pressure housings for the replacement reactor vessel head for the design earthquake (DE), double design earthquake (DDE), Hosgri earthquake (HE), and loss of coolant accident (LOCA). The 5 percent damping value has been accepted by the NRC staff at several other plants with equivalent CRDMs and seismic support structures.

The damping value is an element of the structural dynamic analysis performed to confirm the CRDMs' ability to function under a postulated seismic disturbance or LOCA while maintaining resulting stresses under ASME Code Section III allowable values. Because the ASME Code requirements continue to be met, this proposed change to the damping value could not result in an increase in the probability or consequences of an accident previously evaluated

Therefore, the proposed change does not involve a significant increase in the probability or consequences of an accident previously evaluated.

2. *Does the change create the possibility of a new or different kind of accident from any accident previously evaluated?*

The proposed change revises the design basis and FSARU to reflect a damping value of 5 percent of critical damping for the structural dynamic qualification of the CRDM pressure housings for the replacement reactor vessel head for the DE, DDE, HE, and LOCA. The 5 percent damping value has been accepted by the NRC staff at several other plants with equivalent CRDMs and seismic support structures and is a conservative value based on the testing performed by the OEM.

The damping value is an element of the structural dynamic analysis performed to confirm the CRDMs' ability to function under a postulated seismic disturbance or LOCA while maintaining resulting stresses under ASME Code Section III allowable values. Because the ASME Code requirements continue to be met, this proposed change to the damping value could not create the possibility of a new or different kind of accident from any accident previously evaluated.

Therefore the proposed change does not create the possibility of a new or different kind of accident from any accident previously evaluated.

3. *Does the change involve a significant reduction in a margin of safety?*

The proposed change revises the design basis and FSARU to reflect a damping value of 5 percent of critical damping for the structural dynamic qualification of the CRDM pressure housings for the replacement reactor

vessel head for the DE, DDE, HE, and LOCA. The 5 percent damping value for CRDMs has been accepted by the NRC staff at several other plants with equivalent CRDMs and seismic support structures.

The damping value is an element of a structural dynamic analysis performed to confirm the CRDMs ability to function under a postulated seismic disturbance or LOCA while maintaining resulting stresses under ASME Code, Section III, allowable values. The margin of safety is maintained by meeting the ASME Code requirements.

Therefore, the proposed change does not involve a significant reduction in a margin of safety.

Based on the above evaluation, PG&E concludes that the change proposed by this License Amendment Request (LAR) satisfies the no significant hazards consideration standards of 10 CFR 50.92(c), and accordingly a no significant hazards finding is justified.

4.4 Conclusions

In conclusion, based on the considerations discussed above: (1) There is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) such activities will be conducted in compliance with the Commission's regulations, and (3) the issuance of the amendment will not be inimical to the common defense and security or to the health and safety of the public.

5. ENVIRONMENTAL CONSIDERATION

PG&E has evaluated the proposed amendment and has determined that the proposed amendment does not involve: (1) a significant hazards consideration, (2) a significant change in the types or significant increase in the amounts of any effluents that may be released offsite, or (3) a significant increase in individual or cumulative occupational radiation exposure. Accordingly, the proposed amendment meets the eligibility criterion for categorical exclusion set forth in 10 CFR 51.22(c)(9). Therefore, pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the proposed amendment.

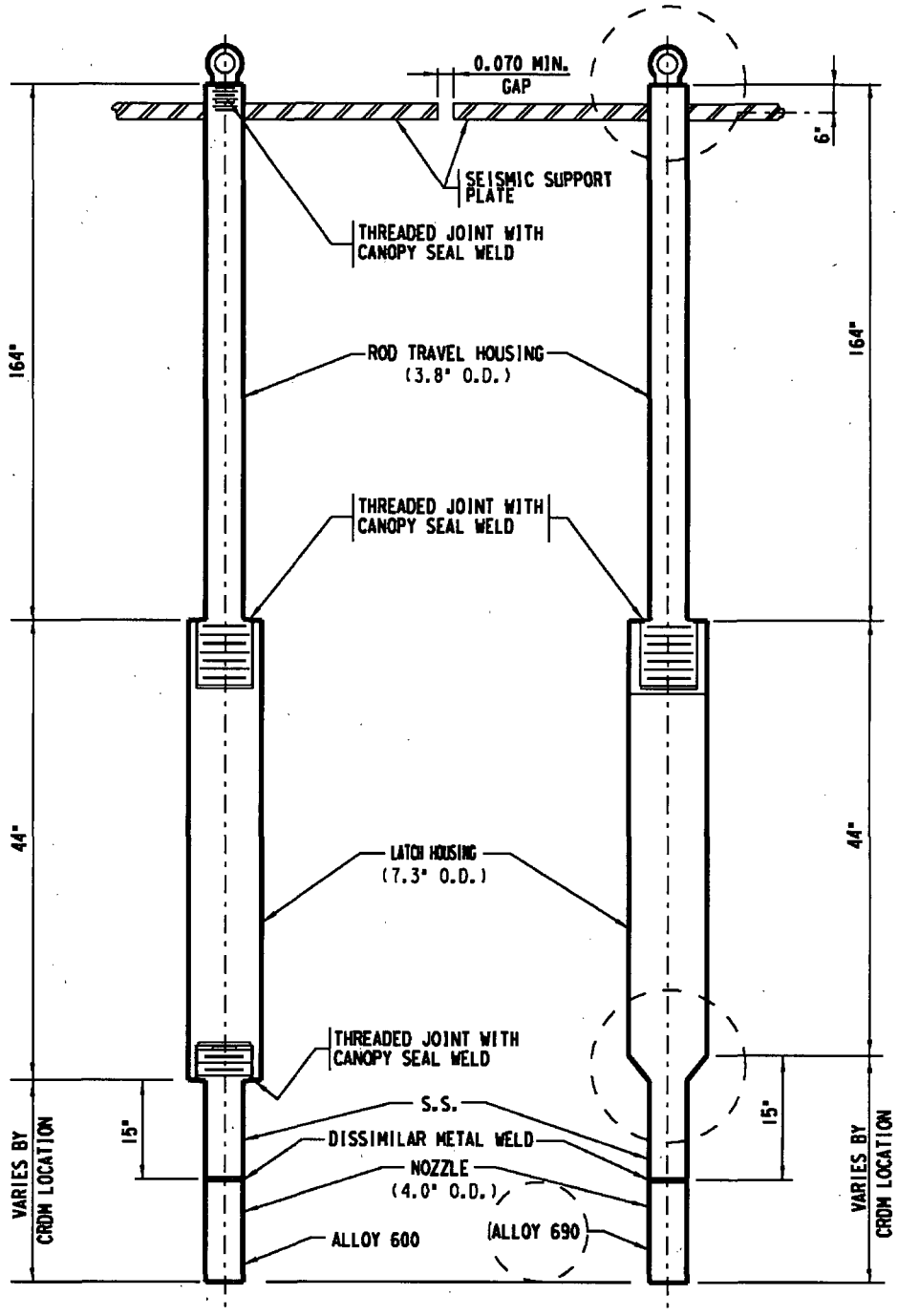
6. REFERENCES

1. WCAP-7921-AR, "Damping Values of Nuclear Power Plant Components," May 1974.

2. Regulatory Guide 1.61, "Damping Values for Seismic Design of Nuclear Power Plants," Revision 1, March 2007.

Figure 1

Structural Schematic
OEM CRDM vs. AREVA CRDM



STRUCTURAL SCHEMATIC

FIGURE 1

Marked up FSARU Pages

(Section 3.7.1.3, Critical Damping Values)

3.7.1.3 Critical Damping Values

The specific percentages of critical damping used for Design Class I SSCs, and the Design Class II turbine building and intake structure are listed in the following table:

Type of Structure	% of Critical Damping		
	DE	DDE	HE
Containment structures and all internal concrete structures	2.0	5.0	7.0
Other conventionally reinforced concrete structures above ground, such as shear walls or rigid frames	5.0	5.0	7.0
Welded structural steel assemblies	1.0	1.0	4.0
Bolted or riveted steel assemblies	2.0	2.0	7.0
Mechanical components (PG&E purchased)	2.0	2.0	4.0
Vital piping systems (except reactor coolant loop)[(a)]	0.5	0.5	3.0[(b)]
Reactor coolant loop[(a)(c)]	1.0	1.0	4.0
Replacement Steam Generators[(f)]	2.0	4.0	4.0
Foundation rocking (containment structure only)[(d)]	5.0	5.0	NA[(e)]
CRDMs	5.0	5.0	5.0

(a) ASME Code Case N-411 damping may be used provided it is applied to all earthquake cases and used in response spectrum modal superposition analysis. When used, pipe displacements are checked for adequacy of clearances and pipe mounted equipment accelerations are verified against project qualification criteria.
For equipment and components modeled inline, damping should be consistent with RG 1.61; a composite damping value may be used for the analysis of these piping systems. A log of calculations is kept that indicates which calculations have used Code Case N-411 damping.

Request for NRC approval for the use of ASME Code Case N-411 was made in letter DCL-86-009, dated January 22, 1986. NRC approval was granted by letter on April 7, 1986

(b) Two percent of critical damping is used for piping less than or equal to 12 inches in diameter.

(c) Although a damping value of 1 percent is used for the DE and DDE analyses of the reactor coolant loop (RCL), damping values of greater than 4 percent have been measured

experimentally for the RCL in full-size power plants (Reference 8). These testing programs have been reviewed and approved by the NRC. The damping values recommended in RG 1.61 are acceptable for use in analysis of mechanical equipment and systems. (References 24-26)

(d) Five percent of critical damping is used for structures founded on rock for the purpose of computing the response in the rocking mode, and 7 percent of critical damping is used for the purpose of computing the response in the translation mode.

(e) Analysis utilizes fixed base.

(f) These values are valid for replacement steam generator (RSG) internals and shell components up to the RSG nozzle to pipe/tube connections in the RCS, MS, and FW systems and the interface between the RSG shell and upper and lower lateral and lower vertical supports. The restrictions imposed by WCAP 7921-AR (Reference 8) shall be observed when applying these values. (Reference 27)