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PG&E Letter DCL-06-088

U.S. Nuclear Regulatory Commission  
ATTN: Document Control Desk  
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Docket No. 50-275, OL-DPR-80  
Docket No. 50-323, OL-DPR-82  
Diablo Canyon Units 1 and 2  
10 CFR 50.46 Annual Report for 2005 of Emergency Core Cooling System Evaluation  
Model Changes

Dear Commissioners and Staff:

Pursuant to 10 CFR 50.46, this letter provides an annual report of changes in the Westinghouse emergency core cooling system (ECCS) evaluation models that affect peak cladding temperature (PCT) calculations for Pacific Gas and Electric Company (PG&E) Diablo Canyon Power Plant (DCPP), Units 1 and 2.

These PCT margin allocations include those Unit 2 changes recently identified in the 30-day report in PG&E Letter DCL-06-079 dated June 20, 2006. These changes were made due to two reactor vessel design changes implemented during the Unit 2 thirteenth refueling outage. The Upflow Conversion (UC) design change converted the Unit 2 reactor vessel from a downflow barrel/baffle configuration to an upflow configuration, while the Upper Head Temperature Reduction (UHTR) design change reduced the upper head temperature to a value corresponding to the Reactor Coolant System cold leg temperature ( $T_{cold}$ ). The UC design change resulted in a 17°F and a 40°F decrease in the best estimate large break loss-of-coolant accident (BELOCA) PCT results for the Reflood 1 and Reflood 2 periods, respectively. The UHTR design change resulted in a 159°F and a 124°F decrease in the BELOCA PCT results for the Reflood 1 and Reflood 2 periods, respectively. These PCT changes are with respect to the last annual report submitted via PG&E Letter DCL-05-086, dated July 25, 2005.

It should be noted that the UC/UHTR design changes also resulted in an increase of 69°F in the Unit 2 small-break loss-of-coolant accident (SBLOCA) PCT to a new value of 1375°F. This PCT margin allocation was inadvertently omitted from the 30-day report provided in PG&E Letter DCL-06-079. There have been no changes in the Unit 1 BELOCA or SBLOCA PCT results and the results are as presented in DCL-05-086.

Per the commitment identified in PG&E Letter DCL-00-134, dated October 19, 2000, PG&E has performed a BELOCA reanalysis for Unit 1. The reanalysis was performed

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using the Westinghouse superposition step methodology approved by the NRC on March 11, 2004. PG&E Letter DCL-05-146, "License Amendment Request 05-07, Revision to Technical Specification 5.6.5, 'Core Operating Limits Report (COLR)'," dated December 16, 2005, submitted a license amendment request which would revise the Unit 1 Technical Specifications (TS) 5.6.5 to incorporate the Westinghouse superposition step methodology into the licensing basis and establish a new BELOCA analysis of record. Additionally, as discussed in the enclosed report, PG&E has also performed a plant-specific analysis for Unit 2 using the accepted methodology established in WCAP-12945-P-A, "Code Qualification Document for Best Estimate LOCA Analysis," dated 1998, and WCAP-16009-P-A, "Realistic Large-Break LOCA Evaluation Methodology Using the Automated Statistical Treatment Uncertainty Method (ASTRUM)," dated 2005. This analysis explicitly incorporates the Unit 2 reactor vessel design changes and has been submitted for NRC review in PG&E Letter DCL-06-006, "License Amendment Request 06-02 Revision to Technical Specification 5.6.5, 'Core Operating Limits Report (COLR)'," dated January 13, 2006. PG&E will update the DCCP Unit 1 and Unit 2 BELOCA analysis-of-record PCT values after the license amendment requests (LARs) are approved.

The summary of the updated PCT margin allocations and their bases are provided in the enclosure, and the final net PCT values are listed below for each unit. It should be noted that two PCT values are reported for the BELOCA consistent with the current Westinghouse PCT tracking methodology. The two large-break PCT values are labeled Reflood 1 and Reflood 2, as they represent the two distinctive PCT peaks that occur during the reflood phase for the BELOCA methodology.

<u>Small-Break LOCA</u>	<u>Best Estimate Large-Break LOCA</u>	
	<u>Reflood 1</u>	<u>Reflood 2</u>
Unit 1: 1352°F (no change)	1981°F (no change)	1969°F (no change)
Unit 2: 1375°F	1805°F	1805°F

The new PCT values remain within the 2200°F limit specified in 10 CFR 50.46. The Unit 1 SBLOCA and BELOCA PCT Margin Utilization sheets are provided in Attachment A. The Unit 2 SBLOCA and BELOCA PCT Margin Utilization Sheets are provided in Attachment B. The ECCS evaluation model changes for Unit 2 that have occurred since the last annual report are summarized in Attachment C. The PCT Margin Utilization Sheets for Unit 1 and Unit 2 in Attachment D contain PCT information for the two pending LARs. The PCT summaries labeled "Pending Analysis of Record," represent the PCT allocation utilizing the LAR's analyses.

Sincerely,

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Enclosure

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**ANNUAL REPORT OF EMERGENCY CORE COOLING SYSTEM  
EVALUATION MODEL CHANGES THAT AFFECT PEAK CLADDING  
TEMPERATURE**

Pursuant to 10 CFR 50.46, this enclosure provides an annual report of changes in the Westinghouse emergency core cooling system (ECCS) evaluation models that affect peak cladding temperature (PCT) calculations for Pacific Gas and Electric Company (PG&E) Diablo Canyon Power Plant (DCPP), Units 1 and 2. This report is based on changes described in the following Westinghouse 10 CFR 50.46 notification letter:

Westinghouse Letter LTR-LIS-06-117, dated March 6, 2006, "10 CFR 50.46 Annual Notification and Reporting for 2005."

Attachment A to this enclosure provides DCPP Unit 1 small-break loss-of-coolant accident (SBLOCA) and best estimate large-break loss of coolant accident (BELOCA) PCT Margin Utilization Sheets. Attachment B to this enclosure provides DCPP Unit 2 SBLOCA and BELOCA PCT Margin Utilization Sheets. There have been no changes to the Unit 1 BELOCA or SBLOCA PCT results presented in PG&E Letter DCL-05-086 dated July 25, 2005.

As identified in the 30-day report in PG&E Letter DCL-06-079 dated June 20, 2006, there have been PCT allocation changes made to the Unit 2 BELOCA results associated with two reactor vessel design changes implemented during the Unit 2 thirteenth refueling outage. The Upflow Conversion (UC) design change converted the Unit 2 reactor vessel from a downflow barrel/baffle configuration to an upflow configuration, while the Upper Head Temperature Reduction (UHTR) design change reduced the upper head temperature to a value corresponding to the Reactor Coolant System cold leg temperature ( $T_{cold}$ ). The UC design change resulted in a 17°F and a 40°F decrease in the BELOCA PCT results for the Reflood 1 and Reflood 2 periods, respectively. The UHTR design change resulted in a 159°F and a 124°F decrease in the BELOCA PCT results for the Reflood 1 and Reflood 2 periods, respectively. It should be noted that the UC/UHTR design changes also resulted in an increase in the Unit 2 SBLOCA PCT by 69°F to a new value of 1375°F. These PCT changes are with respect to the last annual report submitted in PG&E Letter DCL-05-086. The ECCS evaluation model changes that have resulted in this new PCT margin allocation are summarized in Attachment C.

Per the commitment identified in PG&E Letter DCL-00-134, dated October 19, 2000, PG&E has performed a BELOCA reanalysis for Unit 1. The reanalysis was performed using the Westinghouse superposition step methodology approved by the NRC on March 11, 2004. PG&E Letter DCL-05-146, dated December 16, 2005, "License Amendment Request 05-07, Revision to Technical Specification 5.6.5, 'Core Operating Limits Report (COLR),' " submitted a license amendment request which would revise the Technical Specifications (TS) 5.6.5 to incorporate

the Westinghouse superposition step methodology into the licensing basis and establish a new BELOCA analysis of record. Additionally, PG&E has also performed a plant-specific reanalysis for Unit 2 using the accepted methodology established in WCAP-12945-P-A, "Code Qualification Document for Best Estimate LOCA Analysis," 1998, and WCAP-16009 P-A, "Realistic Large-Break LOCA Evaluation Methodology Using the Automated Statistical Treatment Uncertainty Method (ASTRUM)," 2005. This analysis explicitly incorporates the Unit 2 reactor vessel design changes and has been submitted for NRC review in PG&E Letter DCL-06-006, "License Amendment Request 06-02 Revision to Technical Specification 5.6.5, 'Core Operating Limits Report (COLR),'" dated January 13, 2006.

Attachment D contains these future PCT values for Unit 1 and Unit 2 that are labeled "Pending Analysis of Record." It should be noted that the ASTRUM BELOCA methodology does not generate the two distinctive PCT peaks during the reflood period that are characteristic of the previous current BELOCA superposition methodology. Therefore, the pending Unit 2 BELOCA results report only one peak PCT value compared to the pending Unit 1 results, which will still report the Reflood 1 and Reflood 2 peak PCT values characteristic to the non-ASTRUM BELOCA methodology. PG&E will update the DCP Unit 1 and Unit 2 BELOCA analysis-of-record PCT values, after the pending license amendment requests are approved.

The final net PCT values that are reflected in Attachments A and B are listed below. It should be noted that two PCT values are reported for the BELOCA consistent with the current Westinghouse PCT tracking methodology. The two large-break PCT values are labeled Reflood 1 and Reflood 2, as they represent the two distinctive PCT peaks that occur during the reflood phase for the BELOCA methodology.

<b><u>Small-Break LOCA</u></b>	<b><u>Best Estimate Large-Break LOCA</u></b>	
	<u>Reflood 1</u>	<u>Reflood 2</u>
Unit 1: 1352°F (No change)	1981°F (No Change)	1969°F (No Change)
Unit 2: 1375°F	1805°F	1805°F

**DCPP UNIT 1 PEAK CLADDING TEMPERATURE MARGIN UTILIZATION**

**SMALL-BREAK LOCA**

**PG&E Letter<sup>1</sup>**

A.	ANALYSIS OF RECORD	PCT =	1304°F	DCL-99-096
B.	PERMANENT 10 CFR 50.46 ECCS MODEL ASSESSMENTS <sup>2</sup>			
1.	NOTRUMP Mixture Level Tracking/Region Depletion Errors	ΔPCT =	13°F	DCL-00-107
2.	NOTRUMP Bubble Rise/Drift Flux Model Inconsistency Corrections	ΔPCT =	35°F	DCL-04-094
C.	10 CFR 50.59 AND 10 CFR 50.92 SAFETY EVALUATIONS			
1.	None	ΔPCT =	0°F	
D.	OTHER MARGIN ALLOCATIONS			
1.	None	ΔPCT =	0°F	

**LICENSING BASIS PCT + MARGIN ALLOCATION PCT = 1352°F**

<sup>1</sup> For those issues that have been previously reported under 10 CFR 50.46, a PG&E letter number is listed.

<sup>2</sup> Only permanent assessments of peak cladding temperature (PCT) margin are included. Temporary PCT allocations that address current loss-of-coolant accident (LOCA) model issues are not considered with respect to 10 CFR 50.46 reporting requirements.

**DCPP UNIT 2 PEAK CLADDING TEMPERATURE MARGIN UTILIZATION**

**SMALL-BREAK LOCA**

**PG&E Letter<sup>1</sup>**

A.	ANALYSIS OF RECORD	PCT = 1293°F	DCL-99-096
B.	PERMANENT 10 CFR 50.46 ECCS MODEL ASSESSMENTS <sup>2</sup>		
1.	NOTRUMP Mixture Level Tracking/Region Depletion Errors	$\Delta$ PCT = 13°F	DCL-00-107
2.	Upflow Conversion / Upper Head Temperature Reduction	$\Delta$ PCT = 69°F	This Letter Attachment C
C.	10 CFR 50.59 AND 10 CFR 50.92 SAFETY EVALUATIONS		
1.	None	$\Delta$ PCT = 0°F	
D.	OTHER MARGIN ALLOCATIONS		
1.	None	$\Delta$ PCT = 0°F	

**LICENSING BASIS PCT + MARGIN ALLOCATION PCT = 1375°F**

<sup>1</sup> For those issues that have been previously reported under 10 CFR 50.46, a PG&E Letter number is listed.

<sup>2</sup> Only permanent assessments of peak cladding temperature (PCT) margin are included. Temporary PCT allocations that address current loss of coolant accident (LOCA) model issues are not considered with respect to 10 CFR 50.46 reporting requirements.

**DCPP UNIT 2 PEAK CLADDING TEMPERATURE MARGIN UTILIZATION**

<u>BEST ESTIMATE LARGE-BREAK LOCA</u>		Reflood	Reflood	<u>PG&amp;E Letter</u> <sup>1</sup>
		1	2	
A.	ANALYSIS OF RECORD	1976°F	1964°F	DCL-00-107
		<u>ΔPCT</u>	<u>ΔPCT</u>	
B.	PERMANENT 10 CFR 50.46 ECCS MODEL ASSESSMENTS <sup>2</sup>			
1.	Revised blowdown heatup uncertainty distribution	5°F	5°F	DCL-05-086
2.	Upflow Conversion (UC)	-17°F	-40°F	This Letter Attachment C
3.	Upper Head Temperature Reduction (UHTR)	-159°F	-124°F	This Letter Attachment C
C.	10 CFR 50.59 AND 10 CFR 50.92 SAFETY EVALUATIONS			
1.	None	0°F	0°F	
D.	OTHER MARGIN ALLOCATIONS			
1.	None	0°F	0°F	
<b>LICENSING BASIS PCT + MARGIN ALLOCATION PCT</b>		1805°F	1805°F	

<sup>1</sup> For those issues that have been previously reported under 10 CFR 50.46, a PG&E Letter number is listed.

<sup>2</sup> Only permanent assessments of peak cladding temperature (PCT) margin are included. Temporary PCT allocations that address current loss-of-coolant accident (LOCA) model issues are not considered with respect to 10 CFR 50.46 reporting requirements.



**CURRENT EMERGENCY CORE COOLING SYSTEM MODEL  
CHANGES AND ERRORS**

**Upflow Conversion (UC) and Upper Head Temperature Reduction (UHTR)**

**Best Estimate Loss-of-Coolant Accident (BELOCA)**

The impact of the reactor vessel internals changes performed prior to Cycle 14 operation (prior to the Unit 2 thirteenth refueling outage) on the current licensing basis BELOCA analysis for Diablo Canyon Power Plant (DCPP) Unit 2 was identified. The WCOBRA/TRAC program input deck used in the Unit 2 analysis of record was modified first to model the conversion of the Unit 2 barrel baffle region to the upflow configuration. The detailed thermal hydraulic parameters associated with the modified barrel baffle region flow were modeled, and the reference transient was then executed using the current approved version of WCOBRA/TRAC. The Unit 2 input deck was then further modified to model the reduction in the upper head temperature to the  $T_{\text{cold}}$  condition, and again the reference transient was executed. In this way the impact of each plant modification was evaluated individually for the DCPP Unit 2 10 CFR 50.46 peak cladding temperature (PCT) margin utilization sheet.

The current DCPP Unit 2 licensing-basis 95<sup>th</sup> percentile PCT is reduced due to each of these plant changes. The UC leads to a 17°F decrease in the PCT during the Reflood 1 period, and the UHTR produces an additional 159°F decrease in the PCT during the Reflood 1 period. In addition, the conversion of the barrel baffle region to an upflow configuration leads to a 40°F decrease in the PCT during the Reflood 2 period, and the UHTR produces an additional 124°F decrease in the PCT during the Reflood 2 period.

**Small Break Loss-of-Coolant Accident (SBLOCA)**

An evaluation was also performed to assess the impact of the Diablo Unit 2 UC/UHTR on the current SBLOCA analysis of record to demonstrate continued conformance with the 10 CFR 50.46 requirements. For the SBLOCA evaluation, the limiting 3-inch cold leg break case was performed with the latest NOTRUMP Evaluation Model computer code versions. The evaluation was performed assuming an upflow core barrel/baffle configuration with a reduced upper head temperature. The calculations were performed assuming ZIRLO cladding at 200 MWD/MTU, corresponding to the highest fuel average temperatures from the PAD data inspection. The SBLOCA PCT was calculated to increase by 69°F to a value of 1375°F.

Pending Analysis of Record  
 DCCP UNIT 1 PEAK CLADDING TEMPERATURE MARGIN UTILIZATION

**BEST ESTIMATE LARGE-BREAK LOCA**

	Reflood 1	Reflood 2	
A. ANALYSIS OF RECORD	1900°F	1860°F	Reference 1
	<u>ΔPCT</u>	<u>ΔPCT</u>	
B. PERMANENT 10 CFR 50.46 ECCS MODEL ASSESSMENTS <sup>2</sup>			
1. Revised blowdown heatup uncertainty distribution.	5°F	5°F	DCL-05-086
C. 10 CFR 50.59 AND 10 CFR 50.92 SAFETY EVALUATIONS			
1. None	0°F	0°F	
D. OTHER MARGIN ALLOCATIONS			
1. None	0°F	0°F	
<b>LICENSING BASIS PCT + MARGIN ALLOCATION PCT</b>	<b>1905°F</b>	<b>1865°F</b>	

Reference 1: Westinghouse Letter PGE-03-33, "Diablo Canyon Unit 1 BELOCA Reanalysis Final Engineering Report," June 6, 2003

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Only permanent assessments of peak cladding temperature (PCT) margin are included. Temporary PCT allocations that address current loss-of-coolant accident (LOCA) model issues are not considered with respect to 10 CFR 50.46 reporting requirements.

**Pending Analysis of Record  
 DCCP UNIT 2 PEAK CLADDING TEMPERATURE MARGIN UTILIZATION**

**BEST ESTIMATE LARGE-BREAK LOCA**

	Reflood	
A. ANALYSIS OF RECORD	1872°F	Reference 1
	<u>ΔPCT</u>	
B. PERMANENT 10 CFR 50.46 ECCS MODEL ASSESSMENTS <sup>2</sup>		
1. Original Steam Generator (OSG) Evaluation	-23°F	(a)
C. 10 CFR 50.59 AND 10 CFR 50.92 SAFETY EVALUATIONS		
1. None	0°F	
D. OTHER MARGIN ALLOCATIONS		
1. None	<u>0°F</u>	
<b>LICENSING BASIS PCT + MARGIN ALLOCATION PCT</b>	<b>1849°F</b>	

Reference 1: Westinghouse WCAP-16443-P, "Diablo Canyon Unit 2 ASTRUM BE-LBLOCA Engineering Report," Rev. 1, November 2005.

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Only permanent assessments of peak cladding temperature (PCT) margin are included. Temporary PCT allocations that address current loss-of-coolant accident (LOCA) model issues are not considered with respect to 10 CFR 50.46 reporting requirements.

- a. The OSG evaluation line item will be removed upon installation of the new steam generators.