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PG&E Letter DCL-03-079

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
Response to NRC Request for Additional Information Regarding License Amendment Request 02-05, "Revision to Technical Specification Table 3.3.1-1, 'Reactor Trip System Instrumentation,' and Revised Reactor Coolant System Flow Measurement"

Dear Commissioners and Staff:

On May 20, 2003, May 21, 2003, and June 2, 2003, respectively, the NRC staff identified additional information required to complete the evaluation associated with PG&E License Amendment Request (LAR) 02-05 for Diablo Canyon Power Plant (DCPP) Units 1 and 2.

LAR 02-05 proposes to revise the term "minimum measured flow per loop" to "measured loop flow" in the allowable value and nominal trip setpoint columns for the Reactor Coolant Flow-Low reactor trip function contained in Technical Specification 3.3.1 Table 3.3.1-1, "Reactor Trip System Instrumentation." In addition, LAR 02-05 proposes to allow an alternate method for the measurement of reactor coolant system (RCS) total volumetric flow rate through measurement of the elbow tap differential pressures on the RCS primary cold legs. LAR 02-05 was submitted by PG&E letter DCL-02-097, "License Amendment Request 02-05, Revision to Technical Specification Table 3.3.1-1, 'Reactor Trip System Instrumentation,' and Revised Reactor Coolant System Flow Measurement," dated August 27, 2002.

Previously, PG&E provided responses to NRC requests for additional information in PG&E letter DCL-03-056, "Response to NRC Request for Additional Information Regarding License Amendment Request 02-05, "Revision to Technical Specification Table 3.3.1-1, 'Reactor Trip System Instrumentation,' and Revised Reactor Coolant System Flow Measurement," dated May 15, 2003.

PG&E's responses to the May 20, 2003, May 21, 2003, and June 2, 2003, requests for additional information are included in Enclosure 1.

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The additional information does not affect the results of the safety evaluation or no significant hazards consideration determination previously transmitted in PG&E letter DCL-02-097.

As discussed with the NRC project manager, PG&E has requested approval of LAR 02-05 by July 15, 2003, to address the current low flow margin for DCPP Unit 2 resulting from steam generator tube plugging during the recent DCPP Unit 2 refueling outage.

If you have any questions regarding this response, please contact Stan Ketelsen at 805-545-4720.

Sincerely,

D. H. Oatley

David H. Oatley
Vice President and General Manager - Diablo Canyon

kjs/4328
Enclosures

cc:	Edgar Bailey, DHS
	Thomas P. Gwynn
	David L. Proulx
	Diablo Distribution
cc/enc:	David H. Jaffe
	Girija S. Shukla

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

	)	Docket No. 50-275
In the Matter of	)	Facility Operating License
PACIFIC GAS AND ELECTRIC COMPANY	)	No. DPR-80
	)	
Diablo Canyon Power Plant	)	Docket No. 50-323
Units 1 and 2	)	Facility Operating License
	)	No. DPR-82

AFFIDAVIT

David H. Oatley, of lawful age, first being duly sworn upon oath says that he is Vice President and General Manager - Diablo Canyon of Pacific Gas and Electric Company; that he has executed this response to the NRC request for additional information on License Amendment Request (LAR) 02-05 on behalf of said company with full power and authority to do so; that he is familiar with the content thereof; and that the facts stated therein are true and correct to the best of his knowledge, information, and belief.

D.H. Oatley

David H. Oatley
Vice President and General Manager - Diablo Canyon

Subscribed and sworn to before me this 26th day of June 2003.

Chuck Mackey

Notary Public
County of San Luis Obispo
State of California

CHUCK MACKEY
Commission # 1397547
Notary Public - California
San Luis Obispo County
My Comm. Expires Feb 1, 2007

PG&E Response to NRC Request for Additional Information Regarding License Amendment Request 02-05, "Revision to Technical Specification Table 3.3.1-1, 'Reactor Trip System Instrumentation,' and Revised Reactor Coolant System Flow Measurement"

Question Received on May 20, 2003

NRC Question 1

Provide the cycle flows that were used to determine the baseline calorimetric flow (BCF) for each Unit.

PG&E Response

For Diablo Canyon Power Plant (DCPP) Unit 1, the BCF value of 376656 gpm is the average of the following hydraulically corrected individual flows: 375926 gpm (Cycle 1), 377440 gpm (Cycle 1), 375568 gpm (Cycle 2), and 377690 gpm (Cycle 2). Table 6-4 of WCAP-15113, Revision 1, shows the hydraulic corrections for DCPP Unit 1.

For DCPP Unit 2, the BCF value of 379089 gpm is the average of the following hydraulically corrected individual flows: 379844 gpm (Cycle 1), 379843 gpm (Cycle 1), 378665 gpm (Cycle 2), and 378004 gpm (Cycle 2). Table 6-5 of WCAP-15113, Revision 1, shows the hydraulic corrections for DCPP Unit 2.

For both units, the inclusion of the Cycle 2 flows brings the average down, i.e., it is conservative to include Cycle 2. For DCPP Unit 2 the difference between Cycles 1 and 2 is greater than for DCPP Unit 1. This is consistent with the greater decrease observed for DCPP Unit 2 calorimetric flow following the introduction of low leakage loading patterns. As explained in Section 6.4 of WCAP-15113, Revision 1, a conservative bias of approximately 0.5 percent was expected in Cycle 2 relative to Cycle 1 because of hot leg streaming changes. For DCPP Unit 2, the Cycle 2 flows were approximately 0.4 percent lower than for Cycle 1. Therefore, the Cycle 1 flows are thought to be closer to reality. In either case, for both units the observed variation between the four hydraulically corrected baseline flows is well within the calculated uncertainty of 1.9 percent given on Table A-3 of page A-6 of WCAP-15113, Revision 1.

Questions received on May 21 regarding May 15, 2003 PG&E Response (DCPP letter DCL-03-056) to NRC questions of March 18, 2003.

NRC Question 1 on PG&E DCL-03-056 Response to Question 1

Discuss the values and modeling regarding the RTD manifold removal.

PG&E Response

The Westinghouse reactor coolant system (RCS) flow analyses were based on the assumption that elimination of the small resistance temperature detector (RTD) bypass manifold flows had a negligible effect on RCS flows. Since calculations determined that the elbow taps would measure about 0.15 percent more flow after removal of the hot leg manifolds, elbow tap flows have been adjusted to avoid measuring a nonconservative flow. During the preparatory work for the DCPP elbow tap flow program, Westinghouse performed detailed RCS flow calculations to confirm the above assumption. These calculations, specifically applicable to DCPP, defined differences in flow resistances with and without the parallel bypass flow paths. The calculation with parallel bypass flow paths defined a closed solution, and no trial-and-error calculations were required. Details of this calculation are presented below.

The original best estimate flow calculation did not consider the effect of the RTD bypass manifold flow paths, so this calculation is appropriate for the case with RTD bypass manifolds removed. Expressed in units of E-10 feet/gallons per minute $(gpm)^2$, the flow calculation was based on the following hydraulic flow resistances:

Flow resistances:	Steam generator	114.77
(at loop flow)	Reactor coolant piping	24.0
	Reactor vessel nozzles	36.74
	Reactor internals	46.24
	Reactor core	87.52
	Total	309.27

Based on this total flow resistance and reactor coolant pump (RCP) flow coefficients, loop flow equals 94,619 gpm at 276.91 feet.

The above flow resistances were divided into groups that were parallel to the bypass manifold flow paths. The hot leg bypass manifold flow is parallel to the flow through the hot leg elbow, steam generator, 40 degrees and 90 degrees elbows and part of the piping in the crossover leg. The cold leg bypass manifold flow is parallel to the flow through the cold leg piping, reactor vessel, hot leg straight piping, and the combined path through the hot leg bypass manifold and steam generator. The total flow resistance applied at the RCP considers flow through the remaining 90 degree elbow and straight pipe in the crossover leg, the RCP weir inside the RCP discharge nozzle, and the combined path through the cold leg bypass manifold, reactor vessel and steam generator.

Expressed in units of E-10 feet/gpm^2, the RCS flow resistance groups are listed as follows:

Hot leg 50 degrees elbow	Steam generator bypass	3
Steam generator		114.77
Crossover 40 degrees elbow		2
Crossover 90 degrees elbow		3
Crossover piping		1
Total		123.77
Cold leg piping	Reactor vessel bypass	2
Cold leg 22 degrees elbow		2
Reactor vessel		170.5
Hot leg piping		1
Total		175.50
Crossover piping	RCP flow	1
Crossover 90 degrees elbow		3
RCP weir		6
Total		10

The head loss across the hot leg bypass manifold and the steam generator bypass path are assumed to be equal. This head loss, based on the steam generator bypass flow resistance defined above and a flow of 94,619 gpm, was calculated to be 110.808 feet. The hot leg bypass manifold flow resistance, based on a flow of 150 gpm and the head loss of 110.808 feet, was calculated to be 49.248 E-4 feet/gpm^2. The parallel flow path flow resistance is defined by adding the square root of the inverse flow resistances together using the equation: Total resistance equals (Km $^{-1/2}$) plus (Kb $^{-1/2}$), where Km is the main path flow resistance and Kb is the bypass flow resistance. The total resistance is then converted back to a parallel flow path flow resistance, calculated to be 123.38 E-10 feet/gpm^2. This flow resistance differs only slightly from that defined previously for the steam generator bypass (123.77 E-10 feet/gpm^2).

Using the same process as described above, the head loss across the cold leg bypass manifold, based on the reactor vessel bypass flow resistance of 175.5 E-10 feet/gpm^2 and the steam generator parallel path flow resistance of 123.38 E-10 feet/gpm^2 defined above and a flow of 94,619 gpm, was calculated to be 267.58 feet. The cold leg bypass manifold flow resistance, based on 100 gpm and the head loss of 267.58 feet, was calculated to be 267.58 E-4 feet/gpm^2. The parallel flow path flow resistance was calculated to be 298.25 E-10 feet/gpm^2. This flow resistance differs only slightly from the total steam generator bypass plus reactor vessel bypass flow resistance calculated previously (123.38 plus 175.50 equals 298.88 E-10 feet/gpm^2).

The total RCS flow resistance applied at the RCP is the sum of the parallel flow path flow resistance defined above (298.25 E-10 feet/gpm^2) and the remaining flow resistances (10 E-10 feet/gpm^2), which is 308.25 E-10 feet/gpm^2. When the RCP flow coefficients are applied, the RCP flow with RTD bypass manifolds installed was calculated to be about 94,704 gpm at 276.47 feet. Therefore, the RCP flow with RTD bypass manifolds installed is 85 gpm higher. Since the cold leg bypass manifold flow of

100 gpm bypasses the reactor vessel, the reactor vessel flow is 94,604 gpm per loop, or 15 gpm per loop less than calculated with RTD bypass manifolds removed (94,619 gpm/loop). Since the flow increase was negligible (less than 0.02 percent flow), adjustments to reactor flow were considered to be unnecessary.

NRC Question 2 on PG&E DCL-03-056 Response to Question 7 - Part 1

Discuss how the following flow rate terms interact:

(1) Indicated RCS total flow (surveillance requirement (SR) 3.4.1.3 Bases)

PG&E Response

"Indicated RCS total flow" contained in the SR 3.4.1.3 Bases for the 12-hour flow surveillance refers to the flow rate indicated by the RCS cold leg elbow taps, which are the installed flow instrumentation.

NRC Question 2 on PG&E DCL-03-056 Response to Question 7 - Part 2

(2) Measured RCS total flow (SR 3.4.1.3 Bases and SR 3.4.1.4 Bases)

PG&E Response

"Measured RCS total flow" and "measurement of RCS total flow rate" in the SR 3.4.1.3 Bases and SR 3.4.1.4 Bases refers to the 24-month measurement of the RCS total flow rate using cold leg elbow tap methodology or by performance of a precision flow calorimetric to normalize the elbow taps (installed flow instrumentation) and verify the actual RCS flow rate is greater than or equal to the minimum required RCS flow rate.

NRC Question 2 on PG&E DCL-03-056 Response to Question 7 - Part 3

(3) Minimum required RCS flow rate - mentioned in SR 3.4.1.4 Bases (see Item 2, above). The existing TSs contain a footnote that defines measured loop flow as 89,800 gpm per loop for DCPP Unit 1 and 90,625 gpm per loop for DCPP Unit 2. The footnote is deleted in the proposed TSs. Existing TS Tables 3.4.1-1 and 3.4.1-2 provide "RCS total flow" and "Acceptable Operating Region." How do these inter-relate?"

PG&E Response

The required RCS total flow at 100 percent reactor thermal power is equal to 4 times the minimum measured flow per loop (rounded off). The minimum required RCS flow rate mentioned in the SR 3.4.1.4 Bases refers to the RCS total flow rate limits in Technical Specification (TS) 3.4.1 Table 3.4.1-1 for DCPP Unit 1 and Table 3.4.1-2 for DCPP Unit 2, which are minimum RCS total flow rate limits. The performance of SR 3.4.1.3 every 12 hours and SR 3.4.1.4 every 24 months verifies that the RCS total flow rate is greater than the initial flow assumed in the accident analyses where a lower flow results in more severe results (e.g., departure from nucleate boiling (DNB) and higher RCS pressure for loss of flow transients, and peak cladding temperature for loss-of-coolant accidents).

TS 3.3.1 Table 3.3.1-1, "RTS Instrumentation," contains the reactor trip instrumentation that is credited to initiate a reactor trip in the accident analyses to shut down the reactor following the accident. TS 3.3.1 Table 3.3.1-1, "RTS Instrumentation," Function 10, "Reactor Coolant Flow-Low," contains the instrumentation that is credited to provide protection against violating the DNB ratio limit due to low flow in an RCS loop. Low flow in an RCS loop leads to a reduction in the RCS total flow which reduces core cooling, DNB margin, and RCS pressure boundary integrity. The reactor coolant flow-low reactor trip provides primary protection against a partial loss of flow accident (one or two RCPs coasting down) and a locked rotor accident, and provides secondary protection for a complete loss of flow event (four RCPs coasting down).

TS 3.4.1 ensures the RCS total flow is greater than the minimum initial RCS total flow assumed in the accident analyses. TS 3.3.1 Table 3.3.1-1 Function 10 ensures a reactor trip will occur on low RCS loop flow at a percentage (90 percent) of the RCS loop flow measured every 24 months by the RCS cold leg elbow taps or by a precision calorimetric. TS 3.3.1 and 3.4.1 are interrelated in that the nominal trip setpoint of 90 percent of measured loop flow in Function 10 of TS 3.3.1 Table 3.3.1-1 assumes that the RCS total flow is maintained within the limits of TS 3.4.1 prior to the initiation of the accident resulting in reduced RCS loop flow.

<u>NRC Question 2 on PG&E DCL-03-056 Response to Question 7 - Part 4</u>

(4) Measured loop flow (5/15/03 PG&E letter) - loop flow measured by cold leg elbow tap differential pressure channels. Letter contains a commitment to add the following sentence to Bases of TS 3.3.1, "RTS Instrumentation," Function 10, "Reactor Coolant Flow-Low": "The allowable value and nominal trip setpoint are based on a percentage of the loop flow measured by the RCS cold leg elbow tap differential pressure channels." Does this mean that measured loop flow is a variable - the value being whatever is obtained at the observation time? Where is allowable loop flow defined?

<u>PG&E Response</u>

The TS 3.3.1 Table 3.3.1-1, "RTS Instrumentation," Function 10, "Reactor Coolant Flow-Low," reactor trip allowable value and nominal trip setpoint are based on a percentage of the loop flow measured every 24 months by SR 3.4.1.4. The RCS cold leg elbow taps indicated flow is continuously compared to the reactor coolant flow-low nominal trip setpoint. With implementation of the change to the TS 3.3.1 Table 3.3.1-1, "RTS Instrumentation," Function 10, "Reactor Coolant Flow-Low," reactor trip nominal trip setpoint to 90 percent of measured loop flow, the setpoint will be based on 90 percent of the RCS loop flow measured every 24 months by the cold leg elbow taps or by a precision calorimetric. In order to preclude the interpretation that the measured loop flow is a variable, upon approval of the license amendment request (LAR), the following sentences will be added to the Bases of TS 3.3.1 Table 3.3.1-1, "RTS Instrumentation," Function 10, "Reactor Coolant Flow-Low": "The allowable value and nominal trip setpoint are based on a percentage of the loop flow measured every 24 months by SR 3.4.1.4. The RCS cold leg elbow taps indicated flow is continuously compared to the Reactor Coolant Flow-Low nominal trip setpoint." This change to the Bases of TS 3.3.1 Table 3.3.1-1, "RTS Instrumentation," Function 10, "Reactor Coolant Flow-Low," supersedes the change previously proposed in PG&E Letter DCL-03-056 dated May 15, 2003.

The allowable loop flow is not defined because the accident analyses initial minimum RCS flow is based on minimum RCS total flow maintained by TS 3.4.1, rather than individual RCS loop flow. As described in section 4.1 of the PG&E LAR 02-05 for the revision to TS Table 3.3.1-1 contained in DCPP letter DCL-02-097, dated August 27, 2002, if the TS 3.4.1 minimum total RCS flow requirement is met but there is a loop flow asymmetry resulting in some loop(s) that are below the loop minimum measured flow (i.e., total RCS flow divided by 4), the remaining loop(s) will exceed the loop minimum measured flow. In this case, resetting the reactor coolant flow-low reactor trip setpoint in loops that are below the loop minimum measured flow does not improve the transient results for the design basis accidents, which credit the reactor coolant flow-low reactor trip setpoint. It is noted that the standard TS for Westinghouse plants in NUREG-1431, Revision 2, do not define or require a value for RCS loop flow.

Question Received on June 2, 2003

NRC Question 1

When installed, the DCPP RTD manifold flow rates were stated to be a cold leg bypass of 100 gpm and a hot leg bypass of 150 gpm per manifold. But we also have been told the values for Catawba are a cold leg flow rate of 172 gpm and a hot leg flow rate of 111 gpm. The stated flow rates are reversed between the two plants. Please confirm that the Diablo Canyon values are correct? As part of the response, it would be helpful if Westinghouse could provide the range of values (or actual values) applicable to reactor coolant systems designed by Westinghouse.

PG&E Response

All Westinghouse RTD bypass systems were designed to obtain flow rates of 150 gpm for each hot leg manifold and 100 gpm for each cold leg manifold. In some cases, the hot leg bypass flow was difficult to obtain, whereas the cold leg bypass flow would usually exceed 100 gpm due to the larger available Δp and an orifice was added to the cold leg bypass line to reduce the flow. During startup tests, the bypass flows were measured and compared with the generic values. If the bypass flow was less than the design objective, a transport/response time analysis was performed to confirm that the measured flow was acceptable relative to the plant transient analyses. In many cases, the hot leg bypass flow was less than 150 gpm but acceptable for response time, and the cold leg bypass flow exceeded 100 gpm, which improved response time.

When the elbow tap flow measurement procedure was defined, the design flow of 150 gpm (actually 0.15 percent) was used for the adjustment to the RCS flow measurement after the bypass system was removed, thus providing some margin on the RCS flow measurement if the measured bypass flow was less than 0.15 percent. No attempt was made to apply the measured flow since the correction was considered to be negligible.

When calculating the effect of removing the bypass system, as recently described for DCPP, no attempt was made to apply measured bypass flows for any plant, since the effect on RCS and reactor vessel flows would be negligible. The flows measured at DCPP and Catawba are thought to be representative of the range of flows measured at other plants. Specific ranges of flows for other Westinghouse plants cannot be obtained without extensive research of plant specific documents.

The measured bypass flows for DCPP Unit 1 differed from the design flows, while the measured flows for DCPP Unit 2 were essentially the same as the design flows. For DCPP Unit 1, the average hot leg bypass flow was 134 gpm and the average cold leg bypass flow was 128 gpm. For DCPP Unit 2, the average hot leg bypass flow was 148 gpm and the average cold leg bypass flow was 100 gpm. Loop bypass flows differed from these averages by less than 10 gpm.

An analysis of RCS flows using the DCPP Unit 1 measured bypass flows was performed. The results of this analysis are compared in the table below with the design bypass flow case described previously and with the case with the bypass system removed.

	Measured Bypass Flow	Design Bypass Flow	Bypass Removed
RCP flow	94720 gpm	94704 gpm	94619 gpm
Cold leg bypass	128	100	
Reactor vessel	94592	94604	94619
Hot leg bypass	134	150	
Steam generator flow (elbow tap flow)	94458	94454	94619

The table indicates that RCS flows based on measured bypass flows (versus design) increased by 16 gpm per loop for the RCP, decreased by 12 gpm per loop for the reactor vessel, and increased by 4 gpm per loop for the steam generator and elbow taps. These differences are considered to be negligible.

The table also indicates that the flow measured by the elbow taps increased from the measured flow case to the case with bypass manifolds removed by 161 gpm per loop, which is 20 gpm per loop more than the 0.15 percent correction. Since the reactor vessel flow increased by 27 gpm per loop, the net impact on reactor vessel flow is conservative and considered to be negligible.

It is noted that RCS calorimetric flow measurements (and BCFs for the elbow tap flow measurement procedure) are measuring flow through the reactor vessel, based on reactor power and the temperature difference across the reactor vessel. The calorimetric flow measurements are therefore not affected by differences in RCP flows or RTD bypass flows.