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PG&E Letter DCL-16-094

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

10 CFR 50.90

Docket No. 50-275, OL-DPR-80
Docket No. 50-323, OL-DPR-82
Diablo Canyon Units 1 and 2
<u>Response to NRC Request for Additional Information Regarding "License Amendment Request 16-02, License Amendment Request to Revise Technical Specification 3.4.12, 'Low Temperature Overpressure Protection (LTOP) System'"</u>

References:

1. PG&E Letter DCL-16-028, "License Amendment Request 16-02, License Amendment Request to Revise Technical Specification 3.4.12, 'Low Temperature Overpressure Protection (LTOP) System,'" dated March 23, 2016 (ADAMS Accession No. ML16083A564)
2. E-mail from NRC Project Manager Balwant K. Singal, "Request for Additional Information - License Amendment Request to Revise Technical Specification 3.4.12 (CAC Nos. MF7501 and MF7502)," dated August 18, 2016

Dear Commissioners and Staff:

In Reference 1, Pacific Gas and Electric Company (PG&E) submitted a License Amendment Request to modify Technical Specification (TS) 3.4.12, "Low Temperature Overpressure Protection (LTOP) System."

In Reference 2, the NRC staff requested additional information required to complete the review of LAR 16-02. PG&E's responses to the staff's questions are provided in the Enclosure.

This information does not affect the results of the technical evaluation or the no significant hazards consideration determination previously transmitted in Reference 1.

PG&E makes no new 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 Mr. Hossein Hamzehee at (805) 545-4720.

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

Executed on September 28, 2016.

Sincerely,

James M. Welsch
Vice President, Nuclear Generation

rntt/4231/50868138
Enclosure
cc: Diablo Distribution
cc/enc: Kriss M. Kennedy, NRC Region IV Administrator
Christopher W. Newport, NRC Senior Resident Inspector
Gonzalo L. Perez, Branch Chief, California Department of Public Health
Balwant K. Singal, NRR Project Manager

PG&E Response to NRC Request for Additional Information (RAI) Regarding "License Amendment Request 16-02, License Amendment Request to Revise Technical Specification 3.4.12, 'Low Temperature Overpressure Protection (LTOP) System'"

RAI-1

Attachment 4, "LTOP Orifice – Key Design Features," to the Enclosure of letter dated March 23, 2016, states that the positive displacement pump (PDP) had a flowrate that was fairly constant near 100 gpm for all the reactor coolant system (RCS) operating pressure conditions. The replacement centrifugal pump (referred to as the normal charging pump or NCP) is stated to have a maximum flow of 120 gpm through the LTOP orifice. Table 1, "LTOP Maximum Injection Flows," and Figure 1, "LTOP Maximum Flows (gpm) vs. RCS Pressure (psia)," of Enclosure to letter dated March 23, 2016 show that the maximum flow is reduced (on the order of 40 gpm) when changing from the PDP to the NCP, however, the flowrate can be larger with the NCP. Please provide additional details on how the injection curves were determined and explain how the original maximum injection flow curve is still bounding now that there is the possibility of larger flowrates with the NCP.

PG&E Response

Reference: 1. PG&E Letter DCL-16-028, "License Amendment Request 16-02, License Amendment Request to Revise Technical Specification 3.4.12, 'Low Temperature Overpressure Protection (LTOP) System,'" dated March 23, 2016 (ADAMS Accession No. ML16083A564)

In Attachment 4 of Reference 1, Pacific Gas and Electric Company (PG&E) stated that "PG&E designed and installed a LTOP flow choking orifice (called the LTOP orifice) to limit the flow to less than 120 gpm," and, "From the results presented in Figure 3, it can be observed that LTOP orifice limits the flow to less than 120 gpm."

The reference to 120 gpm was a design input for the LTOP orifice and is not representative of the maximum flow of the normal charging pump (NCP) aligned to the LTOP orifice as installed at Diablo Canyon Power Plant (DCPP). The flow through the LTOP orifice from the NCP is lower than 120 gpm, due to the actual installed configuration and the flow-induced backpressure from the downstream flow path (piping, valves, etc.) during applicable LTOP analysis conditions.

Table 1 of the Enclosure in Reference 1, shows the calculated maximum flows for configurations with the NCP and centrifugal charging pump (CCP), and the PDP and CCP under LTOP analysis conditions.

The original maximum LTOP injection flows were calculated using a steady state fluid hydraulics computer code that explicitly models the detailed physical configuration of the DCPP Chemical and Volume Control System (CVCS). The computer model includes all piping lengths, fittings, valves, and flow elements for the CVCS geometry of interest. The model also includes the flow versus pressure characteristics of the CCP and PDP. For each calculated flow case presented in Table 1, the RCS pressure listed was applied as a fixed boundary condition as input into the hydraulics model. Then the computer code iterated on the relative flows and pressure throughout the CVCS model until a steady state solution was achieved where the calculated system pressure drops and flow into the RCS were consistent with parallel performance of the CCP curve (flow versus total differential head (TDH)) and the PDP flow.

The NCP was designed with a "flat" pump performance curve which is characterized as generating a significant reduction in flow for a minimal discharge pressure increase. The fixed minimum flow resistance of the LTOP orifice (which results in the maximum flow for a given resistance) and the NCP performance curve (which reduces injection flow with increased backpressure) were then modeled with the same type of steady state hydraulics computer code described above to calculate the maximum injection flow based on the net discharge pressures of the CCP and NCP operating in parallel. The net NCP discharge pressure is the summation of the RCS pressure plus the system hydraulic pressure losses (e.g., valves, piping, flow element, fittings, etc.) throughout the CVCS that exist during an LTOP mass injection event. Both the Table A and Table B LTOP injection flows were calculated assuming all valves were fully open, minimum line resistances, and for the NCP configuration, a minimum LTOP orifice resistance.

These calculated flows were then compared to the calculated flows for the original PDP configuration to ensure that net NCP and CCP flow would be less for a given RCS pressure. Since both the NCP and CCP operate on a pump curve of TDH versus discharge pressure, their parallel operation is significantly different than with the PDP and CCP parallel operation since the PDP is designed to inject 101 gpm of flow independent of discharge pressure.

In order to clarify how the NCP flow through the LTOP orifice is less during LTOP injection conditions, the Reference 1, Enclosure, Table 1, "LTOP Maximum Injection Flows," has been expanded to provide additional details associated with the individual flow contributions from each pump as presented in Table A and Table B below.

Table A presents the original calculated flow contributions of the safety-related CCP and the PDP which provides a constant flow input of 101 gpm at the full range of RCS pressures applicable to the LTOP analysis. Note that the total flow values assumed for the LTOP analysis were conservatively increased (an LTOP analysis penalty) to provide operating margin to the actual calculated values. Table B presents the calculated flow contributions of the safety-related CCP and the NCP through the LTOP orifice which resulted in the total flow values previously presented in Table 1 of the Enclosure in Reference 1.

Table A: Safety-Related CCP and PDP Calculated Flow Values (computer model)

RCS Pressure (psig)	Safety-Related CCP Flow (gpm)	PDP Flow (gpm)	Calculated Total Flow (gpm)	Analysis Total Flow with Margin Added (gpm)
0	365.56	101	466.56	473
100	356.98	101	457.98	463
200	348.29	101	449.29	454
300	339.5	101	440.5	446
400	330.61	101	431.61	437
500	321.61	101	422.61	428
600	312.5	101	413.5	419
700	303.28	101	404.28	409
800	293.93	101	394.93	401
900	284.39	101	385.39	391
1000	274.36	101	375.36	381

Table B: Safety-Related CCP and NCP via LTOP Orifice Calculated Flow Values (computer model)

RCS Pressure (psig)	Safety-Related CCP Flow (gpm)	NCP Aligned to LTOP Orifice Flow (gpm)	Calculated Total Flow (gpm) *	Total Flow with Margin Added (gpm)
0	327.1	82.4	409.5	430
100	320.3	81.1	401.4	421
200	313.4	79.8	393.2	413
300	306.4	78.4	384.9	405
400	299.3	77.0	376.4	396
500	292.2	75.6	367.7	388
600	284.9	74.0	358.9	379
700	277.6	72.4	350.0	370
800	270.1	70.7	340.8	361
900	262.5	69.0	331.5	352
1000	254.8	67.2	322.0	342

* Calculated flow values have been rounded to nearest 0.1 gpm.

Since the charging pumps are all located outside containment, there is a significant length of pipe and hydraulic resistance between the charging pumps and where the charging injection flow enters the RCS. The sum of this hydraulic resistance and the RCS pressure is the backpressure to the LTOP orifice discharge. Since the NCP is also a centrifugal pump like the CCP, the discharge is routed through the LTOP orifice and the flow control valve, FCV-128, in order to be able to regulate the normal charging flow. This configuration is different when compared to the configuration of the PDP (which provides a fixed flow independent of discharge pressure) that was routed downstream of FCV-128 (i.e., bypassing FCV-128). The net effect of the CCP and NCP operating in parallel with their respective TDH curves and the LTOP orifice ensures that the relative discharge pressure seen by the two pumps is greater, and the combined flow is less than that generated by the PDP and CCP configuration. This ensures that the flow through the LTOP orifice is always well below 120 gpm and also shifts the CCP performance on the flow versus the TDH curve due to the effect of the higher common discharge pressure.

Even though the Table B NCP plus CCP values were increased by 20 gpm to provide conservative analysis margin, these total flow values remain about 40 gpm less than the original values established for the safety-related CCP and PDP. This confirms that the LTOP orifice design maintains the total mass injection capability within values that remain bounded by the current LTOP analysis which are based on the original safety-related CCP and PDP flow values.

RAI-2

Attachment 4 to the Enclosure of letter dated March 23, 2016 states, in part,

> *From the results presented in Figure 3, ["LTOP Orifice – Pressure Drop – vs – Flow Rate,"] it can be observed that LTOP orifice limits the flow to less than 120 gpm.*

While the data points for flowrate do not exceed 120 gpm on Figure 3 of Attachment 4, it is not clear that the LTOP orifice limits the flow to 120 gpm or if the testing just stopped at this point. Please provide additional information to demonstrate the pump is not capable of supplying more than 120 gpm through the LTOP orifice.

PG&E Response

Reference: 1. PG&E Letter DCL-16-028, "License Amendment Request 16-02, License Amendment Request to Revise Technical Specification 3.4.12, 'Low Temperature Overpressure Protection (LTOP) System,'" dated March 23, 2016 (ADAMS Accession No. ML16083A564)

The flow through the LTOP orifice from the NCP is lower than 120 gpm, due to the actual installed configuration and the flow induced backpressure from the downstream flow path (piping, valves, etc.) during applicable LTOP analysis conditions. Refer to RAI-1 Response for details.

The data that was presented in Figure 3 of Attachment 4 of the Enclosure in Reference 1 was collected at Wyle Lab. The test setup was configured with:

- a pressurized water tank to provide the motive force,
- the LTOP orifice with differential pressure (dP) gage across it,
- a downstream flow control valve,
- the flow discharged to the atmospheric pressure.

The objective of the test setup at Wyle Lab was to collect the LTOP orifice flow resistance as pressure drop versus flow rate data to model the LTOP performance. Based on the Wyle test data, the minimum flow resistance equation was obtained and is conservatively bounded in the LTOP analysis. The minimum flow resistance curve and the associated equation were presented in Figure 3 of Attachment 4 of the Enclosure in Reference 1.

RAI-3

Figure 4, "NCP aligned to LTOP Orifice – Acceptance Criteria," of Attachment 4 to the Enclosure of letter dated March 23, 2016 shows the pressure drop acceptance criteria for the LTOP orifice. This figure shows flowrates from 50 to 80 gpm, however, the maximum flowrate of the normal charging pump (NCP) through the LTOP orifice is stated to be 120 gpm. Please justify the use of 50 to 80 gpm (scaling on the X-axis) when the maximum flowrate is 120 gpm.

PG&E Response

Reference: 1. PG&E Letter DCL-16-028, "License Amendment Request 16-02, License Amendment Request to Revise Technical Specification 3.4.12, 'Low Temperature Overpressure Protection (LTOP) System,'" dated March 23, 2016 (ADAMS Accession No. ML16083A564)

The flow through the LTOP orifice from the NCP is lower than 120 gpm, due to the actual installed configuration and the flow induced backpressure from the downstream flow path (piping, valves, etc.) during applicable LTOP analysis conditions. Refer to RAI-1 Response for details.

The Preservice Surveillance Test (PST) acceptance criteria were presented in Figure 4 of Attachment 4 of the Enclosure in Reference 1. The objective of the PST was to verify that that the flow resistance of the LTOP orifice installed is greater than the flow resistance modelled in the LTOP analysis. A flow range of 50 to 80 gpm was specified based on the expected LTOP orifice backpressure for the PST condition.

The PST was conducted in Mode 6 with the LTOP orifice flow discharged into the open reactor vessel. During the PST, the flow rate and the differential pressure across the LTOP orifice was recorded. The PST results confirmed that the actual installed measured flow resistance is greater than the flow resistance that was modelled in the analysis.

RAI-4

Figure 1, "DCPP LTOP Mass Input Typical RCS Pressure Transient," of Attachment 5, Additional Information," to the Enclosure of letter dated March 23, 2016 shows a typical RCS pressure transient. In this figure, the Power Operated Relief Valve setpoint is given as 435 psig (gage), however, the curve (dotted line) is plotted as 435 psia (absolute). Given that the overshoot and undershoot values are based off of this value, please confirm that this is just an error on the example figure, rather than an error in any actual calculations.

PG&E Response

Reference: 1. PG&E Letter DCL-16-028, "License Amendment Request 16-02, License Amendment Request to Revise Technical Specification 3.4.12, 'Low Temperature Overpressure Protection (LTOP) System,'" dated March 23, 2016 (ADAMS Accession No. ML16083A564)

Figure 1 presented in Attachment 5 of Reference 1 was provided as an informational typical plot of a LTOP mass injection pressure response. While the pressure plot is correctly based on psia, and power operated relief valve (PORV) setpoint value was correctly labeled as 435 psig, the informational line was incorrectly placed on the 435 psia value. The revised Figure 1 provided correctly shows the PORV setpoint as being 450 psia relative to the pressure plot and for the purposes of characteristically showing the overshoot and undershoot values relative to the PORV setpoint. The actual overshoot and undershoot values were not determined graphically, but were obtained directly from the tabular RETRAN computer code output data for each LTOP case analyzed. As shown in the Table 2: "Peak Pressure Results for LTOP mass Injection Events" presented in Attachment 5 of Reference 1, the peak pressure values and the overshoot values were appropriately determined based on a 450 psia PORV setpoint as used in the RETRAN computer code.

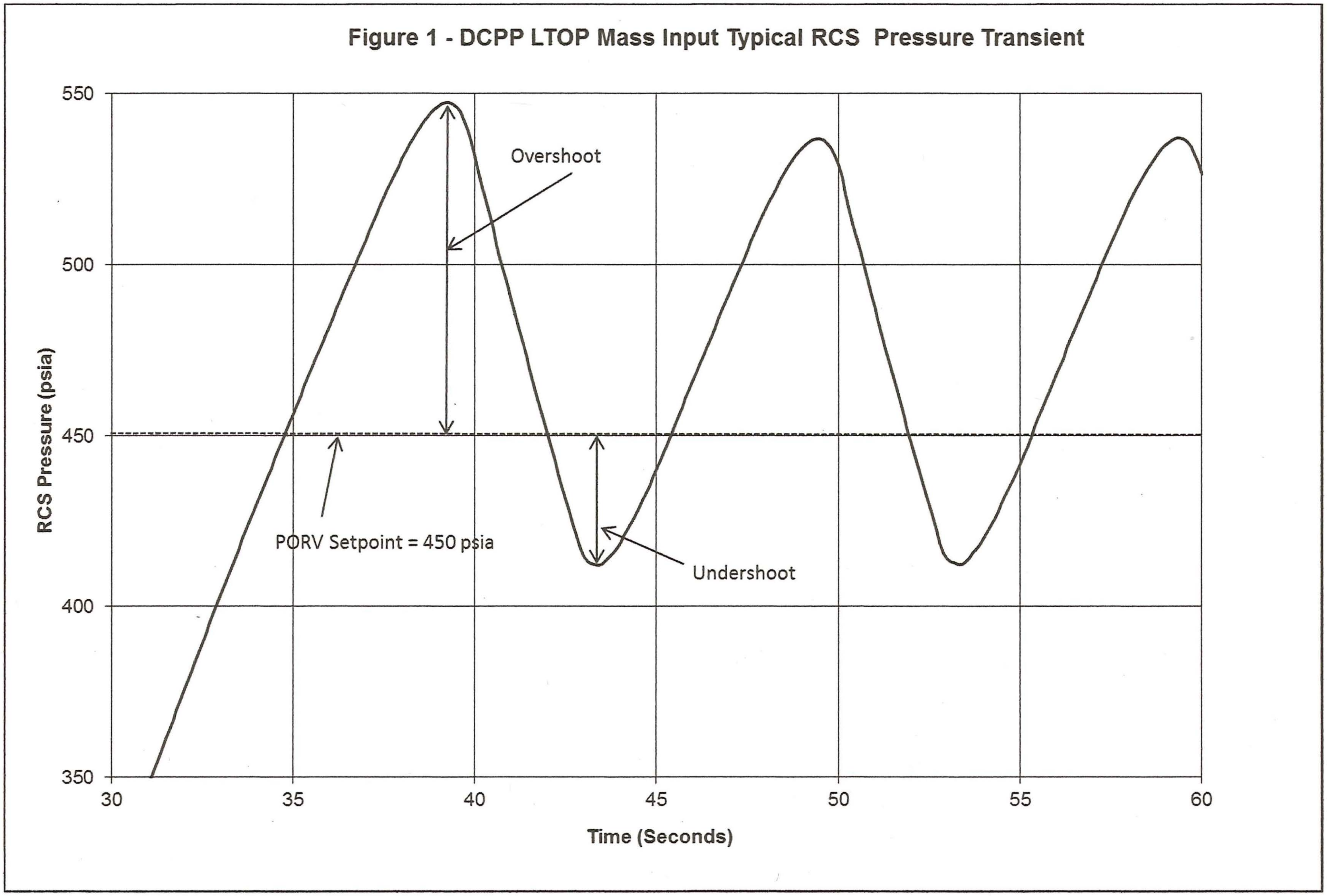
Figure 1 - DCPP LTOP Mass Input Typical RCS Pressure Transient
550
500
450
400
350
30
35
40
45
50
55
60
RCS Pressure (psia)
Time (Seconds)
Overshoot
PORV Setpoint = 450 psia
Undershoot