PG&E Letter No.: DCL-88-014

ENCLOSURE

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

In the Matter of PACIFIC GAS AND ELECTRIC COMPANY Diablo Canyon Power Plant Units 1 and 2	Docket No. 50-275 Facility Operating License No. DPR-80 Docket No. 50-323 Facility Operating License No. DPR-82 License Amendment Request No. 88-01

Pursuant to 10 CFR 50.90, Pacific Gas and Electric Company (PG&E) hereby applies to amend its Diablo Canyon Power Plant (DCPP) Facility Operating License Nos. DPR-80 and DPR-82 (Licenses).

The proposed changes amend the Technical Specifications (Appendix A of the Licenses) as regards Technical Specifications 3.4.1.4.2, 4.9.8.1, 4.9.8.2, and Bases 3/4.9.8.

Information on the proposed changes is provided in Attachments A and B.

These changes have been reviewed and are considered not to involve a significant hazards consideration as defined in 10 CFR 50.92 or require an environmental assessment in accordance with 10 CFR 51.22(b). Further, there is reasonable assurance that the health and safety of the public will not be endangered by the proposed changes.

Subscribed in San Francisco, California, this 22nd day of January 1988.

Respectfully submitted,

Pacific Gas and Electric Company

By J. D. Shiffer
J. D. Shiffer
Vice President
Nuclear Power Generation

Subscribed and sworn to before me this 22nd day of January 1988.

Nancy J. Lemaster
Nancy J. Lemaster, Notary Public in and for the City and County of San Francisco, State of California

My commission expires April 2, 1990

OFFICIAL SEAL
NANCY J. LEMASTER
NOTARY PUBLIC - CALIFORNIA
CITY & COUNTY OF SAN FRANCISCO
My Commission Expires April 27, 1990

SEAL

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ATTACHMENT A

RESIDUAL HEAT REMOVAL SYSTEM FLOWRATE REDUCTION
FOR REACTOR COOLANT SYSTEM PARTIAL DRAIN OPERATIONS,
TECHNICAL SPECIFICATIONS 3.4.1.4.2, 4.9.8.1, 4.9.8.2, AND BASES

A. DESCRIPTION OF AMENDMENT REQUEST

This license amendment request (LAR) proposes to amend Technical Specification (TS) 4.9.8.1, "Residual Heat Removal and Coolant Circulation High Water Level," and TS 4.9.8.2, "Residual Heat Removal and Coolant Circulation Low Water Level," to revise the currently required minimum residual heat removal (RHR) system flowrate of 3000 gpm during Mode 6 (Refueling). TS 4.9.8.1 and 4.9.8.2 are proposed to require verification of an RHR flowrate of 3000 gpm once per 12 hours when the reactor has been subcritical less than 57 hours and to require verification of an RHR flowrate of 1300 gpm once per 12 hours when the reactor has been subcritical greater than 57 hours. Bases 3/4.9.8 is proposed to be revised to indicate that a reduced RHR flow can provide adequate decay heat removal and also additional margin to vortexing in the RHR system. TS 3.4.1.4.2, "Cold Shutdown - Loops Not Filled," which is applicable to Mode 5 partial drain operations, allows the operating RHR pump to be deenergized for one hour. TS 3.4.1.4.2 is proposed to be amended to not allow deenergization of the RHR pump unless reactor vessel water level is above the vessel flange.

The changes to the Technical Specifications of Operating License Nos. DPR-80 and DPR-82 are noted in the marked-up copy of the applicable Technical Specifications (Attachment B).

B. BACKGROUND

1. Experience During RCS Partial Drain Operation

A number of nuclear plants have experienced degradation or loss of RHR flow while the reactor coolant system (RCS) loops were partially drained. NRC IE Information Notice 86-101, "Loss of Decay Heat Removal due to Loss of Fluid Levels in Reactor Coolant System," and Institute of Nuclear Power Operations (INPO) Significant Operating Experience Report (SOER) 85-4, "Loss or Degradation of Residual Heat Removal Capability in PWRs," are two examples of reports issued to the industry addressing the problem of controlling RHR flow during RCS partial drain operations.

On April 10, 1987, Diablo Canyon Power Plant (DCPP) Unit 2 experienced an interruption of RHR system flow to the RCS while in Mode 5 (Cold Shutdown) with the reactor coolant loops partially drained. The interruption of flow occurred when operators secured the RHR pumps to prevent damage from cavitation due to air entrainment. The air entrainment was attributed to vortexing at the RHR pump suction piping due to the combination of RHR pump flowrate and reactor vessel water level.

As a result of the April 10, 1987, Unit 2 interruption of RHR flow event and in response to NRC Generic Letter 87-12 (PG&E letter DCL-87-233), PG&E committed to evaluating the reduction of the RHR flowrate during operation with the RCS partially drained. NUREG-1269, "Loss of Residual Heat Removal System at Diablo Canyon Unit 2," stated:

> Vortexing at the suction of the RHR pumps is a function of RHR flowrate, and, thus, could have been reduced by reducing the RHR flowrate. The reduction in RHR flow would, however, require an amendment to the technical specifications.

Both the NRC and the industry recognize that RCS partial drain operation represents a substantial challenge to plant operators. It is the intent of this license amendment to decrease the susceptibility of the RHR system to vortexing and thus to enhance the reliability and availability of the RHR system during RCS partial drain operations.

2. <u>Description of the Residual Heat Removal System</u>

The RHR system consists of a single inlet line from the reactor coolant system loop 4 hot leg, connecting two parallel and identical trains, each consisting of an RHR pump, an RHR heat exchanger, and the associated piping, valves, and instrumentation required for operational control. The return lines are connected to the cold legs of each of the reactor coolant loops. During system operation, reactor coolant flows from the RCS to the RHR pumps, through the tube side of the RHR heat exchangers, and back to the RCS. The heat is transferred in the RHR heat exchangers to the component cooling water circulating through the shell side of the heat exchanger.

3. <u>Current Technical Specifications 4.9.8.1, 4.9.8.2, and 3.4.1.4.2 Requirements and Bases</u>

TS 4.9.8.1 and 4.9.8.2, applicable in Mode 6, require verification that at least one RHR train is in operation and circulating reactor coolant at a flowrate greater than or equal to 3000 gpm. The 3000-gpm minimum flow requirement is conservative for the purpose of removing decay heat and uniform boron mixing and was chosen to be consistent with RHR system design for normal operation. The Technical Specification Bases 3/4.9.8 specifies that at least one RHR train be in operation to ensure that: (1) sufficient cooling capacity is available to remove decay heat and maintain the water in the reactor vessel below 140 degrees F as required during the refueling mode, and (2) sufficient coolant circulation is maintained through the reactor core to minimize the effects of a boron dilution incident and prevent boron stratification.

TS 3.4.1.4.2 is applicable in Mode 5 with reactor coolant loops not filled. The footnote to the current specification allows the operating RHR pump to be deenergized for up to one hour provided that no operations are permitted that would cause dilution and that core outlet temperature is maintained at least 10 degrees F below saturation temperature. The footnote provides for

postmaintenance and surveillance testing of RHR components that require deenergization of the RHR pump. Since the reactor coolant loops are considered unfilled whenever the steam generator U-tubes are drained, some testing may be needed when TS 3.4.1.4.2 is applicable.

The DCPP Units 1 and 2 Technical Specifications do not contain provisions to minimize the potential for vortexing and air entrainment in the RHR system which may occur during RCS partial drain operation under certain conditions. Although the current requirement for a minimum 3000-gpm flowrate is conservative for decay heat removal and uniform boron mixing, it is clear that minimizing the potential for vortexing was not considered when the minimum flowrate requirement was established.

C. JUSTIFICATION

Operation with the RCS partially drained in Modes 5 and 6 is necessary for required inspection and maintenance on RCS components such as reactor coolant pumps and steam generators. A reduced RHR flowrate would provide a greater margin to vortexing and preclude an inadvertent loss of decay heat removal capability due to air entrainment and cavitation of the RHR pumps. As previously stated, NUREG-1269 indicated that the likelihood of vortexing at the suction of the RHR pumps could be lowered by reducing the RHR flowrate.

As the time after plant shutdown increases, decay heat removal requirements for the RHR system flow are reduced, since decay heat decreases as a function of time after initial reactor shutdown. However, continuous decay heat removal capability is still required. Since the consequences of a loss of decay heat removal during RCS partial drain conditions can be severe, PG&E believes that the RHR system flowrate should not only meet decay heat removal and uniform coolant boron mixing requirements, but should also consider minimizing the potential for loss of RHR flow by vortexing and air entrainment at the RHR pump suction.

TS 4.9.8.1 and 4.9.8.2 are proposed to be revised so that RHR system flowrate may be reduced to 1300 gpm after the reactor has been subcritical for 57 hours. Although a reduced flowrate is not required for prevention of vortexing and air entrainment for water level above the reactor vessel flange greater than 23 feet (TS 4.9.8.1), this change is being made for consistency to minimize operator confusion and human factors problems.

RHR flow instrumentation consists of a wide range and a narrow range flow indicator. The proposed flowrate of 1300 gpm provides operational flexibility during partial drain operations and ensures a sufficient margin to the 1000-gpm RHR flowrate assumed in the boron dilution analysis. This value will allow the operators to use the narrow-range (0- to 1500-gpm) flow indicator, which has a smaller instrument inaccuracy than the wide-range instrument.

The added restriction to the TS 3.4.1.4.2 footnote is proposed so that the operating RHR pump cannot be intentionally deenergized for one hour when reactor vessel water level is below the vessel flange. This will ensure that

the operating RHR pump will not be intentionally deenergized during operation with the RCS loops partially filled.

D. SAFETY EVALUATION

Westinghouse WCAP-11688 documents an evaluation of the effects of reduced RHR flow during partial drain operations for DCPP Units 1 and 2. The evaluation considered all applicable FSAR accident analyses and concluded that a reduction of RHR flow could potentially affect decay heat removal rate, boron stratification, and the boron dilution accident analysis. The evaluation further concluded that implementation of a reduced RHR flowrate during partial drain operations in Modes 5 and 6 would have no adverse impact on any applicable FSAR accident analyses. The effects of RCS water level on the susceptibility to vortexing at the RHR pump suction and resulting air entrainment that could lead to the loss of the RHR pump and RHR flow to the RCS were also considered. The following is an evaluation of decay heat removal requirements, boron stratification, boron dilution, and RHR system vortexing.

1. Decay Heat Removal Requirements

For a condition where the core has a mix of fuel consistent with the end of the third cycle, the decay heat removal flowrate necessary to maintain the RCS temperature constant or decreasing is a function of time after initial reactor shutdown. The required RHR flowrate as a function of time after shutdown required for decay heat removal is provided below.

TOTAL RHR FLOW REQUIREMENT CORRELATED TO TIME AFTER SHUTDOWN

Time After Shutdown (hr)	Total RHR Flow Required (gpm)
14	3000
32	1800
36	1675
44	1500
57	1300
62	1250
96	1000

The Diablo Canyon Technical Specification limit of 3000 gpm is sufficient to maintain RCS temperature as early as 14 hours after plant shutdown. An RHR flowrate of 1300 gpm is required at 57 hours after plant shutdown.

2. <u>Boron Stratification</u>

The basis for preventing boron stratification in the RCS is to minimize the potential for a boron dilution accident. Since no intentional changes in boron concentration are made during refueling, the most likely mechanisms that could induce a gradient in boron concentration are local mass evaporation and precipitation. However, the fluid temperature during Modes 5 and 6 operations is below 200 degrees F, and the evaporation effects are minimal. Also the fluid temperature is well above the precipitation value for the expected range of concentration.

The potential for boron stratification was evaluated by Westinghouse (WCAP 11688) for an RHR flowrate greater than 1000 gpm. A flowrate greater than 1000 gpm was determined to be acceptable to ensure that adequate mixing takes place within the RCS so that no significant amount of coolant with a boron content different from that in the core can accumulate in the coolant loops. Therefore, there is no concern for boron stratification at the proposed RHR minimum flowrate of 1300 gpm.

3. <u>Boron Dilution</u>

The current Diablo Canyon FSAR analyses for boron dilution do not rely on a specific RHR system flowrate. The analyses described in the FSAR are divided into three operational areas: refueling, startup, and power operation. The FSAR analysis for refueling is based on the amount of time to criticality, assuming one RHR pump operating with sufficient flow to ensure continuous mixing in the reactor vessel; however, no specific flowrate is assumed.

The Westinghouse evaluation (WCAP 11688) demonstrates that an RHR system flowrate greater than 1000 gpm during Modes 5 and 6 operation has no impact on the FSAR evaluation time to dilute to criticality, which remains at approximately 41 minutes. The evaluation was based on the FSAR assumed dilution flowrate of 300 gpm, RCS water volume of 5717 ft^3, and boron concentrations used in the licensing basis analysis. The time to criticality, based on the FSAR analysis methodology with RCS level at the hot leg centerline (volume of approximately 3080 ft^3), is approximately 27 minutes. This amount of time applies for partial drain operation regardless of the RHR system flowrate and is adequate for operator action to terminate the event. The time to criticality during a postulated boron dilution event is a function of RCS volume and increases as RCS water level is raised above the hot leg centerline. The following information is available to the operator so that appropriate actions can be taken during that time interval to terminate a boron dilution event:

- High flux at shutdown alarm
- Audible count rate, to distinguish significant changes in flux
- Source range neutron flux level
- Indication of boric acid and makeup water flowrates

- CVCS valve position indication

- Makeup water pump status lights

4. Vortexing

To prevent vortexing at the RHR pump suction, which could lead to air entrainment in the RHR system and subsequent pump cavitation, flowrate as a function of reactor vessel water level must be considered. The Westinghouse evaluation shows that in order to avoid detrimental effects of vortexing while RCS water level is at the hot leg centerline (elevation 107 ft), RHR system flowrate must be maintained less than 1675 gpm. For an RHR flowrate of 1675 to 3000 gpm, the suction water level must be maintained at least 6 inches above the hot leg centerline. This increase in RCS water level has been determined to be conservative, with respect to prevention of vortexing, for the RHR system flow range of 1675 to 3000 gpm.

Although DCPP intends to operate at a minimum steady-state level of 6 inches above hot leg centerline during RCS partial drain operations, during draindown of the RCS, a level lower than 107 ft 6 in. may be required to drain the steam generator U-tubes. Also, during installation and removal of RCS loop nozzle dams, reactor vessel water level could occasionally fall below 107 ft 6 in. due to the demands of operation within a narrow level band. The Westinghouse evaluation shows that below 107 ft 6 in., vortexing in the RHR system is a concern if an RHR flowrate of greater than 1675 gpm is maintained. The PG&E evaluation and action taken to minimize the effects of vortexing are described in PG&E letters DCL-87-233, dated September 18, 1987, and DCL-87-099, dated May 4, 1987. This license amendment is needed to provide additional operational flexibility and margin to vortexing given the possible severe consequences of cavitation of the RHR pumps.

5. Conclusion

In summary, an RHR flowrate of greater than 1000 gpm mixes the reactor coolant sufficiently to prevent boron stratification and will not impact the boron dilution analysis. The RHR system flow of 1300 gpm selected for the proposed amendment to the Technical Specifications is based on: (1) sufficient flow for decay heat removal after the reactor is subcritical for 57 hours, and (2) a sufficient margin to prevent vortexing of the RHR system.

The revision to TS 3.4.1.4.2 will ensure that the operating RHR pump will not be intentionally deenergized for maintenance or testing when reactor vessel water level is below the reactor vessel flange.

From the information provided above, PG&E has concluded that there is reasonable assurance that the health and safety of the public will not be endangered by the revision of the RHR flowrate requirements in TS 4.9.8.1, TS 4.9.8.2, associated Bases, and TS 3.4.1.4.2.

E. NO SIGNIFICANT HAZARDS EVALUATION

PG&E has evaluated the hazard considerations involved with the proposed amendment, focusing on the three standards set forth in 10 CFR 50.92(c) as quoted below:

> The Commission may make a final determination, pursuant to the procedures in paragraph 50.91, that a proposed amendment to an operating license for a facility licensed under paragraph 50.21(b) or paragraph 50.22 or a testing facility involves no significant hazards considerations, if operation of the facility in accordance with the proposed amendment would not:
>
> (1) Involve a significant increase in the probability or consequences of an accident previously evaluated; or
>
> (2) Create the possibility of a new or different kind of accident from any accident previously evaluated; or
>
> (3) Involve a significant reduction in a margin of safety.

The following evaluation is provided for the no significant hazards consideration standards.

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

The Westinghouse evaluation provided in WCAP-11688 for DCPP Units 1 and 2 demonstrates that throttling of the RHR system flowrate to between 1300 and 3000 gpm depending on RCS water level and time after shutdown does not increase the probability or consequences of the accidents analyzed in Chapter 15 of the FSAR. The boron dilution accident evaluation results concluded that there is a reduction in time to criticality during RCS partial drain operation; however, this reduction in time is independent of the RHR flowrate. The reduction in RHR system flowrate during RCS partial drain operation reduces the probability of a loss of decay heat removal due to vortexing and cavitation, while the probabilities of accidents analyzed in the FSAR are unaffected. The added restriction to the TS 3.4.1.4.2 footnote will prohibit intentional deenergization of the RHR pump when vessel water is below the reactor vessel flange. This added restriction will not increase the probability or consequences of any accident previously evaluated. Therefore, this proposed license amendment request does not involve a significant increase in the probability or consequences of an accident previously evaluated.

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

Implementation of the proposed reduction in RHR system flowrate during RCS partial drain operation does not introduce significant changes to the plant design basis. Throttling RHR system flow is manually controlled from the main control board and does not involve hardware modifications or irreversible actions when in effect. The added restriction to the TS 3.4.1.4.2 footnote to not allow deenergization of the operating RHR pump will enhance safety during operation with the RCS water level below the reactor vessel flange. Therefore, the proposed license amendment request 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 Westinghouse evaluation shows that an RHR flowrate reduced to 1300 gpm will meet the decay heat removal requirements when the reactor is subcritical for greater than 57 hours. An RHR flowrate of 1300 gpm during Modes 5 and 6 does not impact the FSAR analyses for the boron dilution accident and promotes sufficient reactor coolant mixing so that boron stratification is not a concern. The probability of a loss of RHR flow initiated by RHR system vortexing will be reduced, increasing the RHR system reliability. The added restriction to not allow deenergization of the operating RHR pump for one hour will enhance safety by requiring continuous RHR flow when reactor vessel water level is below the vessel flange. Therefore, the changes do not involve a significant reduction in the margin of safety.

F. NO SIGNIFICANT HAZARDS CONSIDERATION DETERMINATION

From the above safety evaluation, PG&E concludes that the activities associated with this license amendment request satisfy the no significant hazards consideration standards of 10 CFR 50.92(c) and, accordingly, a no significant hazards consideration finding is justified.

G. ENVIRONMENTAL EVALUATION

PG&E has evaluated the proposed changes and determined that the changes do not involve (i) a significant hazards consideration, (ii) a significant change in the types or significant increase in the amounts of any effluents that may be released offsite, or (iii) a significant increase in individual or cumulative occupational radiation exposure. Accordingly, the proposed changes meet the eligibility criterion for categorical exclusion set forth in 10 CFR 51.22(c)(9). Therefore, pursuant to 10 CFR 51.22(b), an environmental assessment of the proposed changes is not required.

H. REFERENCES

1. "Westinghouse Engineering Services Report for Diablo Canyon Power Plant Units 1 and 2 Concerning a RHRS Minimum Flow Rate Reduction While in Mid-Loop Operation," WCAP-11688, December 1987.

2. NUREG-1269, "Loss of Residual Heat Removal System at Diablo Canyon Unit 2."

3. NRC Generic Letter 87-12, "Loss of Residual Heat Removal (RHR) While the Reactor Coolant System (RCS) is Partially Filled," July 9, 1987.

4. NRC IE Information Notice 86-101, "Loss of Decay Heat Removal due to Loss of Fluid Levels in Reactor Coolant System," December 12, 1986.

5. INPO SOER 85-4, "Loss or Degradation of Residual Heat Removal Capability in PWRs," August 28, 1985.

6. Diablo Canyon Power Plant Units 1 and 2 FSAR Update, Revision 3, Chapter 15, September 1987.