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(ACCELERATED RIDS PROCESSING)

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FACIL:50-323 Diablo Canyon Nuclear Power Plant, Unit 2, Pacific Ga 05000323
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SUBJECT: LER 94-006-01:on 940624,determined that throttled component cooling water flow rate to CCP skids may not have been high enough to maintain post-accident CCP operability.Caused by human error.Calculations revised.W/950615 ltr.

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June 15, 1995

PG&E Letter DCL-95-121

U.S. Nuclear Regulatory Commission
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Docket No. 50-275, OL-DPR-80
Docket No. 50-323, OL-DPR-82
Diablo Canyon Units 1 and 2
Licensee Event Report 1-94-006-01
Centrifugal Charging Pump Outside Design Basis Due to Throttling of Component Cooling Water to Subcomponents

Gentlemen:

Pursuant to 10 CFR 50.73(a)(2)(ii)(B), PG&E is submitting the enclosed revision to Licensee Event Report 1-94-006 regarding throttled component cooling water flow to the centrifugal charging pumps. This revision is submitted to report the results of root cause analysis, safety significance, and corrective action determination. Due to extensive changes, this revision effectively replaces the previous submittal in its entirety; therefore, revision bars are not included.

The health and safety of the public were not adversely affected by this condition.

Sincerely,

Greg Rueger

Gregory M. Rueger

cc: L. J. Callan
Melanie A. Miller
Kenneth E. Perkins
Michael D. Tschiltz
Diablo Distribution
INPO

Enclosure

DC0-94-EN-N018

260063 6734S/ALN/2246

JE22 /1

LICENSEE EVENT REPORT (LER)

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Diablo Canyon Unit 1	0 5 0 0 0 2 7 5	1 OF 11

TITLE (4) Centrifugal Charging Pump Outside Design Basis Due to Throttling of Component Cooling Water to Subcomponents

EVENT DATE (5) MON	DAY	YR	LER NUMBER (6) YR	SEQUENTIAL NUMBER	REVISION NUMBER	REPORT DATE (7) MON	DAY	YR	OTHER FACILITIES INVOLVED (8) FACILITY NAMES	DOCKET NUMBER (S)
									Diablo Canyon Unit 2	0 5 0 0 0 3 2 3
6	24	94	94	- 0 0 6 -	0 1	06	15	95		0 5 0 0 0

OPERATING MODE (9): 1

POWER LEVEL (10): 1 0 0

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR: (11)

X 10 CFR 50.73(a)(2)(ii)(B)

OTHER - (Specify in Abstract below and in text, NRC Form 366A)

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER AREA CODE	
Donald H. Behnke	805	545-2629

COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS	CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS

SUPPLEMENTAL REPORT EXPECTED (14)

[ ] YES (If yes, complete EXPECTED SUBMISSION DATE) [X] NO

EXPECTED SUBMISSION DATE (15) MONTH DAY YEAR

ABSTRACT (16)

On June 24, 1994, at 1700 PDT, with both Units 1 and 2 in Mode 1 (Power Operation) at 100 percent power, PG&E determined that the throttled component cooling water (CCW) flow rate to the centrifugal charging pump (CCP) skids may not have been high enough to adequately cool the CCP skid subcomponent heat exchangers and, therefore, maintain post-accident CCP operability. As a result, a 1-hour, non-emergency notification was made to the NRC on June 24, 1994, at 1739 PDT in accordance with 10 CFR 50.72(b)(1)(ii)(B).

The CCP skid throttle valves were opened to the full-open position. A test was developed and performed to determine actual CCW flow rates to the CCP skid subcomponents under throttled conditions. CCP skid flow balancing was performed to determine optimum flow conditions. Following testing, the valves were returned to the full-open position pending determination of the final valve throttling position.

The cause of throttling of CCW flow to the CCPs was human error, inadequate understanding of design basis. Corrective actions include calculation revisions and establishment of a method to control flow to the CCP skid such that each subcomponent heat exchanger receives sufficient flow to perform its design basis function.

I. Plant Conditions

Units 1 and 2 have operated in various modes and at various power levels with the condition described below.

II. Description of Problem

A. Summary

On June 24, 1994, at 1700 PDT, with both Units 1 and 2 in Mode 1 (Power Operation) at 100 percent power, PG&E determined that the throttled component cooling water (CCW) (CC) flow rate to the centrifugal charging pump (CCP) (CB)(P) skids may not have been high enough to adequately cool the CCP skid subcomponent heat exchangers and, therefore, maintain post-accident CCP operability. As a result, a 1-hour, non-emergency notification was made to the NRC on June 24, 1994, at 1739 PDT in accordance with 10 CFR 50.72(b)(1)(ii)(B).

B. Background

The Diablo Canyon Power Plant (DCPP) CCW system is a safety-related system designed to remove heat from safety-related and nonsafety-related components and transfer it to the ultimate heat sink via the auxiliary saltwater (ASW) system (BS). The safety-related components cooled by the CCW system include the containment fan cooler units (CFCUs) (CC)(FAN), the residual heat removal (RHR) heat exchangers (BP)(HX), and the lube oil and/or seal heat exchangers for the RHR pumps (BP)(P), safety injection (SI) pumps (BQ)(P) , CCW pumps (CC)(P), and CCPs. The maximum continuous supply temperature of the CCW system is 120°F, with an allowable transient to 132°F for a maximum of 20 minutes. During normal operation, the CCW system supply temperature is approximately 60°F. Following a loss-of-coolant accident (LOCA), or main steam line break (MSLB) inside containment, the heat input into the CCW system from the CFCUs increases significantly.

Diablo Canyon has two CCPs per unit. There are six heat exchangers on each CCP skid, one for the gearbox oil, one for lube oil, two in series for the mechanical seal, and two in series for the seal plate. CCW is provided to the CCP skid heat exchangers to maintain CCP cooling during both normal and post-accident operation. Westinghouse design information specified a minimum CCW flow rate of 62 gpm to the CCP skid, with 20 gpm apportioned to the lube oil heat exchanger, 32 gpm to the gearbox oil heat exchanger, and 10 gpm to the mechanical seal water heat exchangers (2 in series). The seal

plate heat exchangers have no minimum flow requirement. A header provides CCW flow to the CCP skid, and a common discharge header throttle valve exists downstream of the lube oil heat exchanger (see Figure 1).

C. Event Description

In 1972, Revision 1 of Startup Test Procedure (SUTP) 14.6, "Component Cooling Water System Performance Test," specified that the CCP skid throttling valves should be open to permit full CCW flow to the CCP skid subcomponent heat exchangers. In 1976, the Westinghouse design flow rate requirements for the subcomponent heat exchangers were incorporated into Revision 2 of SUTP 14.6.

In 1983, the requirement for 62 gpm CCW flow to the CCP skid header was used as an input to PG&E Calculation M-305, which was performed to verify the heat removal requirements for the CCW system. Also in 1983, PG&E performed a Safety System File review for the CCW system which identified the discrepancy between the 62 gpm minimum flow requirements and the DCPP practice of throttling CCW flow to maintain lube oil temperature by use of the valve downstream of the lube oil heat exchanger. As part of the Safety System File review, PG&E reviewed Calculation M-305 as well as Calculation M-299, which calculated CCW system pressure drops, pressures, and temperatures. PG&E incorrectly concluded that, since both M--299 and M-305 used the CCW flow requirements specified by Westinghouse as an input, the flows to the CCP skid subcomponent heat exchangers were acceptable.

In 1984, PG&E performed initial CCW system startup testing using Revision 2 of SUTP 14.6. No instrumentation was available to measure flow to the individual CCP skid heat exchangers. Therefore, PG&E controlled flow to the skid heat exchangers based on maintaining vendor-specified lube oil temperatures when the CCP was in operation (typically 100°F to 120°F). After initial plant start-up, the CCP lube oil temperature during normal operation was found to be lower than the vendor-recommended 100°F to 120°F CCP lube oil temperature range for an operating CCP. To maintain a higher CCP lube oil temperature, operator round sheets were revised to indicate an acceptable lube oil temperature band of 100 to 120°F, and operators were instructed to throttle the CCW flow to the CCP skids to maintain lube oil temperature in this range for an operating CCP.

TEXT (17)

In 1990, after several years of operation, PG&E performed a safety system functional audit and review. The audit team asked if the practice of throttling flow to the CCP skids reduced the CCW flow rate to less than the 62 gpm required to remove adequate heat from the CCP following a design basis LOCA. PG&E initiated a nonconformance report to investigate and resolve the issue. PG&E determined that the root cause for the practice of throttling was conflicting design information; the FSAR Update and other design basis documents specified a flow rate to the CCP skid based on LOCA conditions, while the CCP vendor information specified that cooling water flow should be controlled to maintain CCP lube oil temperatures in a specific operating band.

As part of the corrective actions, PG&E Engineering performed Calculation M-877 to demonstrate the acceptability of throttling the CCW flow to the CCP skid by use of the valve downstream of the lube oil heat exchanger to control outlet lube oil temperature instead of measuring flow to the skid subcomponents. Calculation M-877 did not determine the acceptability of the throttling practice by determining actual flow rates. The acceptability of throttling was based on an estimate of the impact of the increased post-LOCA CCW temperature on the CCP lube oil temperature. Calculation M-877 determined that throttling the CCW flow to the CCP skid to control lube oil temperature between 85 to 95°F during normal operation would ensure that the vendor-specified maximum lube oil temperature of 180°F would not be exceeded following an accident that could result in a CCW system supply temperature up to 120°F. The calculation credited a Westinghouse evaluation that had demonstrated acceptability of CCW supply temperatures to 132°F for a duration up to 20 minutes. However, as identified in 1993, the Westinghouse evaluation assumed a 62 gpm flow rate to the CCP skid, and this assumption was not consistent with the practice of throttling flow to the skid components. Operator round sheets were also revised to indicate an acceptable CCP lube oil temperature band of 85 to 95°F during normal operation.

In 1993, during an investigation of the ASW and CCW system design bases in support of LER 1-93-012, "Auxiliary Saltwater System Outside Design Basis Due to Fouling," PG&E determined that Calculation M-877 was incorrect in concluding that throttling the CCW flow to the lube oil heat exchangers was acceptable. As a result, the CCPs might not have been able to meet their post-accident design basis function.

On May 28, 1994, the CCP lube oil heat exchanger throttle valves on the four CCP skids were fully opened as a conservative action taken on the basis that throttled flow might not provide adequate cooling for design basis conditions.

TEXT (17)

On June 24, 1994, PG&E performed a test on CCP 2-2 that demonstrated that flow rates in the throttled condition, when controlling lube oil temperature to 100°F, were approximately 17 gpm to the CCP skid. This degraded CCW flow did not meet the Westinghouse specified skid subcomponent flow rates. Therefore, throttled CCW flow may not have been sufficient to support post-LOCA CCP operation. A 1-hour, non-emergency notification was made to the NRC on June 24, 1994, at 1739 PDT in accordance with 10 CFR 50.72(b)(1)(ii)(B).

Subsequent testing of the other CCPs demonstrated that throttled flow rates to the CCP skid before 1990, when controlling lube oil temperature to as high as 120°F, could have been as low as 12 gpm.

D. Inoperable Structures, Components, or Systems that Contributed to the Event

None.

E. Dates and Approximate Times for Major Occurrences

1.	May 26, 1994:	The potential for low flow to the CCP skid subcomponents was identified.
2.	May 28, 1994:	The CCP lube oil heat exchanger throttle valves were fully opened.
3.	June 24, 1994, at 1700 PDT:	Event/Discovery date. Testing confirmed that flow rates in the throttled condition may not have been sufficient to support the long-term post-LOCA CCP operation.
4.	June 24, 1994, at 1739 PDT:	A 1-hour, non-emergency notification was made to the NRC in accordance with 10 CFR 50.72(b)(1)(ii)(B).

F. Other Systems or Secondary Functions Affected

None.

G. Method of Discovery

The discrepancy between the Westinghouse design basis flow to the CCP lube oil heat exchangers and the design calculations used to establish the acceptability of the current throttling practice for cooling water to the heat exchangers was identified during an investigation of the ASW and CCW system design basis as part of the investigative actions associated with LER 1-93-012.

H. Operator Actions

None required.

I. Safety System Responses

None required.

III. Cause of the Event

A. Immediate Cause

The immediate cause of this event was the throttling of CCW flow to the CCP skid subcomponent heat exchangers.

B. Root Cause

The root cause of this event was human error, in that there was an inadequate understanding of design basis. The PG&E start-up testing organization did not understand that acceptable cooling for normal CCP operation (using the throttling valves) would not provide adequate cooling flow for post-accident operation conditions.

C. Contributory Causes

1. Human error (cognitive). The 1983 Safety System File review by PG&E Engineering for CCW used Calculations M-299 and M-305 as the basis for determining the acceptability of throttled flows to meet the required flow rates for all modes of operation. These calculations used the CCW skid subcomponent heat exchanger flow requirements specified by Westinghouse as input to the calculations and did not actually demonstrate that these flow rates would be achieved; therefore, the calculations should not have been used to evaluate a throttled condition without further investigation.

2. Human error (cognitive). Calculation M-877 demonstrated that the CCW throttling practice for the CCP lube oil cooling was sufficient for a CCW supply temperature of 120°F. However, PG&E Engineering was not aware of the bases of some Westinghouse information used in Calculation M-877 and consequently used the information inappropriately. Also, PG&E did not request Westinghouse concurrence on acceptability of throttling to a given lube oil temperature as an alternate cooling method, and PG&E did not request the basis for the Westinghouse evaluation.

IV. <u>Analysis of the Event</u>

Following a design basis accident (LOCA or MSLB) inside containment, the CCW temperature is predicted to rise rapidly from an initial temperature of approximately 60°F to a peak temperature as high as 132°F for 20 minutes, followed by long-term operation below 120°F. The cooling flow requirement of 62 gpm to the CCPs is based on an assumed CCW temperature of 120°F with an excursion to 132°F for 20 minutes. Design basis accidents other than a large-break LOCA or MSLB will also result in energy releases into containment. However, the energy releases from these accidents would be smaller and do not result in as significant a CCW temperature transient.

Based on a qualitative Westinghouse analysis, Westinghouse concluded that the CCPs would have been able to operate and perform their required function through the worst-case post-LOCA injection phase for high CCW temperature, which is estimated to last approximately 780 seconds, and which assumes single failure of an ASW pump with both CCPs, both SI pumps, both containment spray pumps, and both RHR pumps in operation. Other large-break LOCA scenarios would result in lower CCW temperatures, but could extend the injection phase beyond the 780-second interval analyzed by Westinghouse. Although no formal analyses have been

performed for these other large-break LOCA scenarios, the cooler CCW temperatures, in conjunction with DCPP-specific operating experience regarding operation of a CCP with less than design-basis cooling water flow rates, provides reasonable confidence that the CCPs would have performed their design function through an extended injection phase.

Following an MSLB inside containment, the CCPs are required to counteract reactor coolant system (RCS) (AB) shrinkage, as well as to inject boron into the RCS (concurrently with the SI pumps) to counteract the increased reactivity due to RCS cooldown with an assumed maximum negative moderator temperature coefficient. Because reactivity is reduced sufficiently to address criticality concerns within 250 seconds following an MSLB, the CCPs would have been able to operate and perform their required function following an MSLB by operating for approximately 780 seconds.

PG&E performed an evaluation of the impact of the loss of the CCPs on reactor coolant pump (RCP) seal (AB)(P)(SEAL) performance following a large-break LOCA or MSLB and concluded that no significant seal leakage would have occurred. PG&E based this conclusion on the capability of the RCP seals to withstand short-term loss of cooling, guidance in Emergency Operating Procedures E-0, "Reactor Trip or Safety Injection," and E-1.1, "SI Termination," operator training on these procedures, and operator understanding of the need to re-establish RCP seal cooling.

As previously reported in LER 1-93-012-02, Westinghouse and PG&E analyses have determined that during the recirculation phase, other emergency core cooling system (ECCS) pumps are available to perform required long-term ECCS functions. Additionally, following an MSLB, the SI and RHR pumps are available to support the transition to RHR cooling of the RCS. PG&E has evaluated the acceptability of cooling, either by test or analysis, of the other ECCS pumps and concludes that all other ECCS pumps would have been available to fulfill the post-LOCA CCP design function because design basis cooling flow was being delivered to these pumps.

Therefore, the public health and safety were not affected by this event.

V. Corrective Actions

A. Immediate Corrective Actions

1. The throttle valve downstream of the CCP lube oil cooler on each skid was fully opened and sealed in position pending further investigation.

2. A test was performed to determine actual CCW flow to the CCP skid subcomponents under throttled conditions. Flow balancing was performed to determine optimum flow conditions. Following testing, the valves were returned to full-open conditions pending determination of long-term corrective actions.

3. Testing or analysis was performed that confirmed adequate CCW flows to skid subcomponents for the SI, RHR, and CCW pumps.

B. Corrective Actions to Prevent Recurrence

1. The PG&E procedure revision process has been enhanced since the late 1970s and early 1980s time frame such that adequate consideration is given to design basis information during procedure revisions. Also, PG&E management's expectations with regard to attention to detail (e.g., to assure adequate consideration of vendor information) have been reinforced over the past several years as a part of the resolution of other events.

2. A method to control flow to the CCP skid such that the Westinghouse subcomponent flows are satisfied will be evaluated and implemented. The evaluation will include investigation of throttling to optimize CCW flow to the CCP skid and revision of skid subcomponent flow requirements.

3. The affected calculations will be revised to make clear the required CCW skid and skid subcomponent flow rates.

VI. Additional Information

A. Failed Components

None.

B. Previous LERs on Similar Problems

1. LER 1-84-040, "CCW and ASW System Design Basis Requirements Not Incorporated into Plant Procedures Due to Inadequate Tracking of Resolution from Correspondence and Communication"

Engineering recommendations for plant operation to assure compliance with the design basis for the CCW and ASW systems were not incorporated into plant procedures. The root cause was determined to be inadequate tracking of resolution of correspondence and communications specific to engineering design basis constraints on plant operation. The current event involved plant practices (throttling) that were determined by PG&E Engineering to be acceptable; therefore, corrective actions taken to prevent recurrence could not have prevented the current event since they would not have affected the decision to throttle based on component temperature rather than monitor actual flow.

2. LER 1-91-018-01, "Component Cooling Water System Outside Design Basis Due to Personnel Error"

PG&E determined that the heat load on the CCW system during the cold-leg recirculation phase following a LOCA could potentially exceed the CCW system design basis temperature limits. Because the injection phase had previously been considered the limiting case for CCW temperature, this condition was considered to be outside the design basis of the CCW system. The root cause was attributed to personnel error, use of nonconservative data to calculate CCW system heat loads during the recirculation phase following a LOCA. The corrective actions to prevent recurrence included additional training for design engineers to emphasize that data known to be conservative for one application may be nonconservative for another application. Because this event did not address flow rates to individual skid components, the corrective actions taken would not have prevented the current event.

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6) YEAR		SEQUENTIAL NUMBER		REVISION NUMBER	PAGE (3)
Diablo Canyon Unit 1	0 5 0 0 0 2 7 5	94	-	0 0 6	-	0 1	11 OF 11

TEXT (17)

TYPICAL COMPONENT COOLING WATER SCHEMATIC FOR THE CENTRIFUGAL CHARGING PUMP SKID

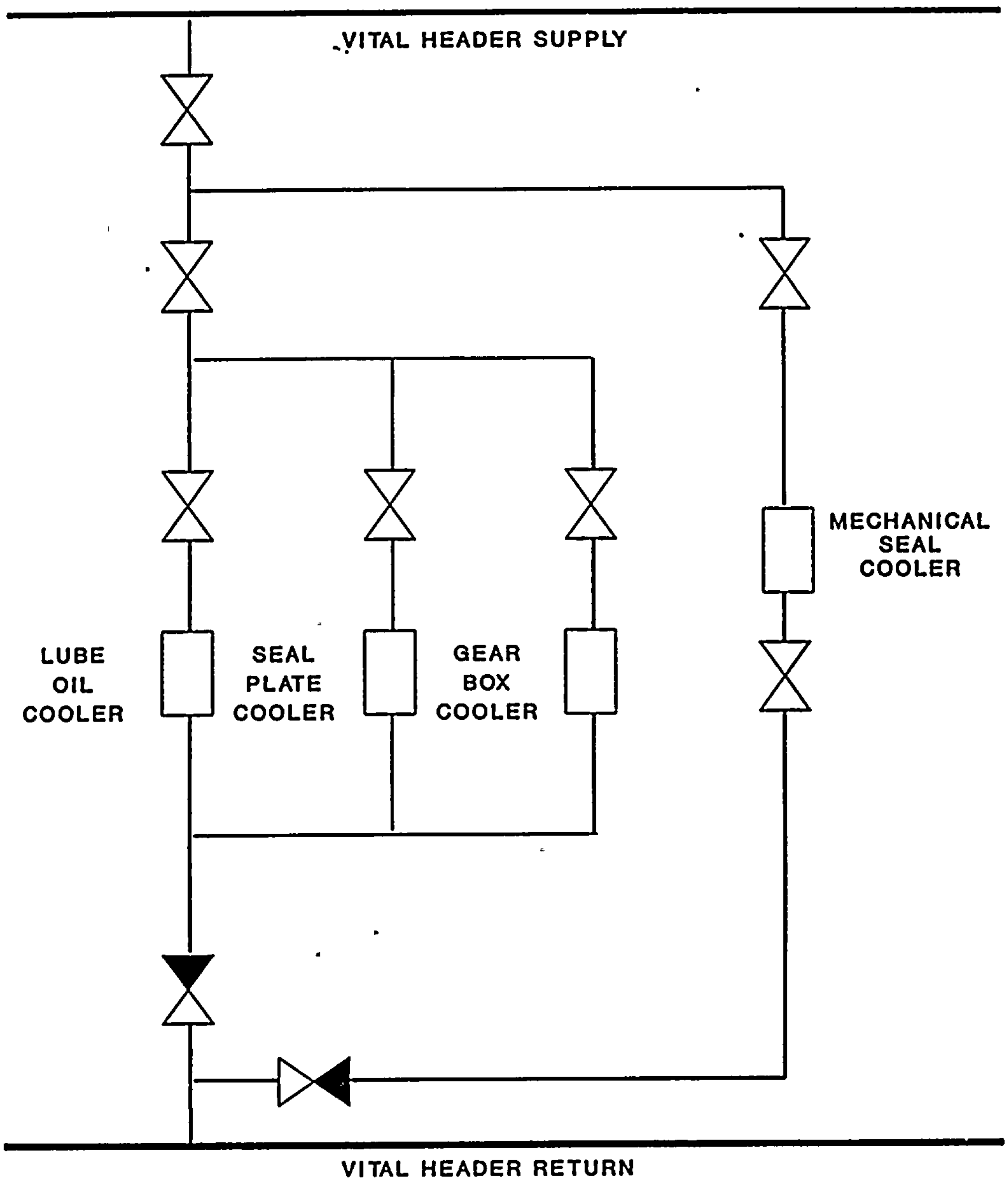

Figure 1