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SUBJECT: Forwards info NRC requested during 990610 telcon re questions resulting from Aug/Sept 1997 design insp at Diablo Canyon Power Plant.Proposed FSAR changes in response to question 7 are in attachment B.

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September 29, 1999

PG&E Letter DCL-99-127

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

Docket No. 50-275, OL-DPR-80
Docket No. 50-323, OL-DPR-82
Diablo Canyon Units 1 and 2
Additional Information Regarding August/September 1997 Design Inspection

Dear Commissioners and Staff:

On June 10, 1999, PG&E held a conference call with the NRC staff to discuss questions resulting from the August/September 1997 design inspection at Diablo Canyon Power Plant. The NRC staff requested that PG&E submit the information discussed during the call. That information is included in Attachment A. Proposed Final Safety Analysis Report changes in response to Question 7 of Attachment A are included in Attachment B.

If there are any questions regarding this information, please contact Patrick Nugent at (805) 545-4872.

Sincerely,

Lawrence F. Womack

cc:
Edgar Bailey, DHS
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Attachment

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PG&E Response to NRC Questions Regarding August/September 1997 Design Inspection

NRC Question 1

With regard to potential overheating scenarios involving the CCW and ASW, initiation of containment spray from the containment emergency sump, and RHR operation:

1. *Please describe operator mitigation actions with respect to location (inside or outside the control room) and complexity.*
2. *How much time is available for mitigation action?*
3. *What indications will alert an operator to initiation of the scenarios of concern and what is the estimated operator reaction time?*

PG&E Response

The following sections discuss various recirculation phase failures.

Residual heat removal (RHR) pump failure:

As stated in PG&E letter DCL-98-045, License Amendment Request 98-03, “Containment Spray During the Recirculation Phase of a LOCA," dated March 16, 1998, CS is only required to be in service during the injection phase of an accident. Containment spray (CS) is not required for the recirculation phase of an accident. If determined to be warranted by the Technical Support Center (TSC), CS can be initiated by closing Valve 8809A (which shuts off RHR flow from that pump to the cold legs) and opening Valve 9003A, which initiates recirculation spray. Failure of an RHR pump would require the operator to diagnose which pump had failed by inspecting amperage, breaker, and flow indication in the control room. Operator action and response time would depend on which RHR pump fails. If an RHR pump supplying cold leg injection fails, adequate core cooling is provided even if the second pump is aligned to provide recirculation spray. If the TSC determines that recirculation spray is no longer required, the operator would then take action to align the operating RHR pump for cold leg injection. This can be done from the control room by securing RHR recirculation spray (shut Valve 9003A) and reopening Valve 8809A. As stated below in the response to Question 5, a single RHR pump can provide enough flow to both safety injection (SI) pumps and both centrifugal charging pumps (CCP) while injecting to the reactor coolant system (RCS) without experiencing damage through run out.

Auxiliary saltwater (ASW) pump failure:

Control room alarms would alert the operator to the loss of an operating ASW pump. Procedural guidance is provided in Operating Procedure (OP) AP-11, "Malfunction of Component Cooling Water System," to diagnose the failure and reduce heat loads. The operator would have to be aware that the procedure is not specifically written for cold leg recirculation, so he will have to consider the restrictions in Emergency Operating Procedure (EOP) E-1.3, "Transfer to Cold Leg Recirculation," for two RHR train operation without two complete trains of ASW/component cooling water (CCW) in service. The operator will shut down one of the RHR pumps and two of the five containment fan cooler units (CFCU) to reduce heat load on the system. All actions can be accomplished from the control room. The above actions are required by procedure; however, analyses performed by PG&E show that without operator action, the CCW system supply temperature remains below post accident temperature limit of 140°F. It should be noted that postulating the failure of the second running ASW pump is not within PG&E's licensing bases. If an ASW pump fails prior to the recirculation phase of the loss-of-coolant accident (LOCA), no operator action is required as the ASW trains are cross-tied and one ASW pump to one CCW heat exchanger (HX) is sufficient to remove the injection phase heat load.

CCW pump failure:

Three CCW pumps start on an SI. Two CCW pumps provide adequate flow for the CCW system. No operator action is required to mitigate this failure while the CCW system vital loops are cross-tied.

Conclusion:

In summary, operator actions are either not required to mitigate the above failures, or operator actions can be accomplished from the control room, and are not time constrained. Operators would rely on existing control room instrumentation for indication of pump failure.

NRC Question 2

PG&E has stated that sufficient core cooling is provided with one RHR pump in operation if the cold leg injection path from the RHR is completely closed because the HPI and CCP paths are adequate under this condition. Is this correct for both cold and hot leg injection conditions? With and without containment spray during recirculation cooling?

PG&E Response

Cold Leg Recirculation:

For cold leg recirculation, the limiting case is that with recirculation spray flow. In this case, the total flow to the core from one SI pump, one CCP, and one RHR pump would be at least 1200 gpm. This is significantly more than the minimum flow of 756 gpm required at changeover (assuming the highest decay heat due to the earliest time to changeover). The following conditions were considered in the evaluation:

- pump performance (developed head) is degraded to the minimum allowed by Technical Specifications,
- the three intact legs produce the lowest flow (i.e., the highest flow leg is broken), and
- containment spray flow is assumed at a maximum to divert flow from the core (i.e., spray flow to the lower headers)

Hot Leg Recirculation:

CS is expected to be isolated during the hot leg recirculation phase. Again, by assuming the broken loop is one of the two loops to which the operating emergency core cooling system (ECCS) pumps are delivering flow, the intact loop will provide at least the 300 gpm flow required during hot leg recirculation.

Conclusion:

Therefore, adequate core cooling is provided during both the cold leg and hot leg recirculation phases.

NRC Question 3

What is the CCW and ASW status with respect to overheating if there have been no equipment failures?

PG&E Response

During the injection phase, the maximum possible heat input to the CCW system occurs when all five CFCUs are operating in slow speed, and all ECCS pumps (RHR, SI pump and CCP lube oil and/or seal coolers) start. Three CCW pumps would also be running, which increases the CCW system heat load by removing more heat from the CFCUs. Assuming no ASW failures, there is more than sufficient energy rejection capability from the CCW system consisting of two ASW pumps supplying one CCW HX. This is

bounded by a Westinghouse evaluation of peak CCW temperature scenarios for Diablo Canyon Power Plant, which shows that with the same energy input and only one ASW pump and one CCW HX to reject heat, the CCW system does not overheat.

During the recirculation phase, the maximum possible heat input to the CCW system occurs when all five CFCUs are operating in slow speed, all the ECCS pumps are operating, and with the heat loads from both RHR HXs. The EOP E-1.3 prerequisite for aligning two RHR HXs and running five CFCUs in the recirculation phase is two complete trains of ASW/CCW, that is, two ASW pumps and two CCW HXs. If only one complete train of ASW/CCW is available, EOP E-1.3 directs operators to limit the number of RHR HXs to one and the number of operating CFCUs to three. In this restricted condition, the Westinghouse evaluation demonstrates that the CCW system will not overheat. This clearly bounds the "no failure" case of two trains of ASW/CCW with two RHR HXs, five CFCUs, and the ECCS pumps, since the heat rejection capability has doubled and the heat input has less than doubled.

Therefore, the CCW/ASW systems can accommodate the maximum possible heat input with all equipment operating (no equipment failures).

NRC Question 4

If a CCW or ASW condition occurs where it is necessary to stop one (of two) operating RHR pumps, do the procedures address which pump should be stopped?

PG&E Response

With respect to the need to secure a specific RHR pump following an ASW or CCW system condition in the post-LOCA recirculation alignment, there is ample control room indication to determine which pump to secure. Each cooling system train is fully instrumented for independent operation, such that abnormal conditions will be input to the annunciator alarm system as well as displayed on the control boards for either train. The operator will not have difficulty determining which train of cooling equipment has been affected by the condition.

In the post-LOCA recirculation alignment with possible equipment failures, operator judgment may be needed to determine the best corrective action. However, the operating procedures assist the operator in making corrective action decisions based on alarm and control board indications. When an alarm is received, the annunciator response procedure for that alarm window is consulted. Based on the particular input received, corrective action is directed, or the operator is referred to the next higher tier of procedures, the abnormal procedures (AP). The APs provide a flow path based

approach to diagnosis and corrective actions based on the symptoms determined from the control board indications.

NRC Question 5

Assume both the CCW and ASW systems are operating without a failure and both RHR pumps are running with containment spray in operation during recirculation. If an RHR pump subsequently fails, thus placing the remaining RHR pump in a runout condition, how is the single failure criterion met?

PG&E Response

During post-LOCA hot leg recirculation, if Valves HCV-637 and HCV-638 were to fail to the maximum open position with only one RHR pump operating and supplying flow to two CCPs, two SI pumps, and two hot legs, the maximum RHR system flow could be as high as 4900 gpm. An analysis of this case showed the available net positive suction head (NPSH) was greater than the NPSH required. Therefore, the pump is capable of operating at the maximum flow rate.

NRC Question 6

Prior to 1991, were the ASW and CCW trains cross-connected during normal operation and reconfigured at ~10½ hours post-LOCA to ASW and CCW trains separated?

PG&E Response

The FSAR was revised in 1997 to require a TSC determination based on plant conditions in order to reconfigure the ASW and CCW systems. Prior to that time, operating procedures specified that the ASW and CCW trains were cross-connected during normal operation and reconfigured at approximately 10½ hours post-LOCA to separate the ASW and CCW trains.

NRC Question 7

Does PG&E wish to further address meeting the single failure criterion for the condition of ASW trains separated with the CCW trains cross connected? ASW and CCW trains both separated? (Note IN 97-78.)

PG&E Response

The decision to split the ASW/CCW systems into separate trains is the responsibility of the TSC. Due to its vulnerability to a loss of inventory, the CCW system would be split into separate trains as soon as possible after the transfer to hot leg recirculation, if plant conditions are acceptable. However, due to the potential for a loss of the CCW system function in the event of a bus failure, the ASW system is not split into separate trains unless it is believed that a loss of the ASW system pressure boundary is imminent. Guidance is provided in Plant Engineering Procedure EN-1, "Plant Accident Mitigation Diagnostic Aids and Guidelines," to assist the TSC in making these determinations.

The capacity of the ASW pumps is such that only a major failure of the system's piping would significantly degrade the ASW system's performance. Such a failure following a LOCA is not required to be assumed since a major failure of the system's piping following the pipe break associated with a LOCA is extremely unlikely and not credible; however, guidance is provided to the TSC for mitigation of the consequences of such a failure. A precursor passive failure would have had to occur in order for a major failure of the ASW piping to be imminent. If the ASW system is aligned into separate trains for this reason, an additional active failure is not required to be assumed. FSAR 3.1.1 states that during the short-term period following a LOCA, the single failure is limited to a failure of an active component to complete its function as required. Should the single failure occur during the long-term period rather than the short-term, the related engineered safety system is designed to tolerate an active failure or a passive failure, but not both. Since the ASW and CCW systems would only be aligned in the above configurations if a major failure of the system's piping is believed to be imminent given a precursor passive failure, the single failure criterion is met. Therefore, crediting operator action to mitigate a subsequent active failure is not required, since that failure need not be postulated. A proposed FSAR revision discussing realignment of the ASW and CCW systems is included in Attachment B.

PROPOSED FINAL SAFETY ANALYSIS REPORT CHANGES

(Pages 9.2-7, 9.2-25, 9.2-26 and 9.2-29)

Predicted CCW temperatures during both normal and accident conditions are within the limits of the CCW system temperature qualification.

The CCWS may be realigned in accordance with ~~EOP E-1.4~~ Technical Support Center guidance based on plant conditions for long-term postaccident recirculation by manually realigning the vital headers into two redundant trains. This long-term postaccident alignment provides further assurance of the capability to withstand a passive failure.

Cooling water for the CCW heat exchangers is supplied from the ASWS which also functions as an engineered safety system, thereby ensuring a continuous source of cooling. The CCWS, therefore, serves as an intermediate system between the RCS and ASWS, ensuring that any leakage of radioactive fluid from the components being cooled is contained within the plant.

Design data for some major CCWS equipment are listed in Table 9.2-3. The CCWS consists of the following major pieces of equipment.

9.2.2.2.1 Component Cooling Water Pumps

The three component cooling water pumps that circulate component cooling water through the CCWS are horizontal, double suction, centrifugal units. The pumps operate on electric power from the vital 4.16 kV buses that can be supplied from either normal or emergency sources.

9.2.2.2.2 Component Cooling Water Heat Exchangers

The two component cooling water heat exchangers are shell and tube type. Seawater circulates through the tube side. The shell is carbon steel, and the tubes are 90-10 Cu-Ni.

9.2.2.2.3 Component Cooling Water Surge Tank

The CCW surge tank, which is connected by two surge lines to the vital headers near the pump suction, is constructed of carbon steel. The tank is internally divided into two compartments by a partial height partition to hold two separate volumes of water. This arrangement provides redundancy to accommodate a passive failure when the CCWS is manually realigned into two trains.

The surge tank accommodates thermal expansion and contraction, and in- or out-leakage of water from the system. The tank is normally pressurized with nitrogen to provide sufficient static head to prevent the CCW in the CFCUs from boiling during a postulated large break LOCA coincident with a loss of offsite power. The primary source of nitrogen is the Class II nitrogen system.

In the event of loss of the design Class II nitrogen supply, Design Class I nitrogen is supplied from dedicated bottles, or the plant instrument air system will be available to provide the required pressurization of the tank. In order to prevent the pressure in the surge tank from

temperature limits for normal and post-accident conditions. The ASW and CCW systems operate together to remove heat from containment and vital equipment heat loads following design basis accidents with a postulated single active or passive failure. The ASW/CCW system must be able to remove the minimum required heat in order to ensure that the containment design pressure and temperature is not exceeded. Additionally, the ASW system must be able to remove sufficient heat from the CCW system so as to not exceed the CCWS design basis temperature limits when the containment heat removal equipment is operating at maximum predicted heat removal rates. The adequacy of the heat sink provided by the ASW/CCW systems has been evaluated to ensure that the minimum heat removal function is satisfied following a LOCA or MSLB (References 5 and 6). The ability of the ASW/CCW system to support the maximum containment heat removal without exceeding the CCW system design basis temperature limits following LOCA or MSLB has also been demonstrated (Reference 3).

The ASW system capability to perform its design basis function assumes the ASW pumps are capable of providing the minimum required flow under conditions of low tide, high CCW heat exchanger tube side differential pressure and supply temperatures up to 64°F. As discussed in Section 9.2.5, the Technical Specifications require a second CCW heat exchanger be placed in service when UHS temperature exceeds 64°F. The ASW flow rate and minimum acceptable flow are a function of the number of ASW pumps and CCW heat exchangers in service based on operating conditions and assumed single failure.

INSERT A

~~The ASW and CCW systems are designed so that they may be aligned into two separate vital loops during post-LOCA recirculation by manual manipulation of various system valves. This provides totally redundant and separate trains, which ensures that a passive failure during the recirculation phase will not cause a total loss of ASW or CCW. However, during post-LOCA split train operation, operator action is required to recover from specific active failure scenarios, which could otherwise lead to a loss of all vital equipment cooling.~~

9.2.7.2 System Description

There is a separate ASW system for Unit 1 and Unit 2. Each unit is provided with two ASW trains with crosstie capability. Each train consists of a full capacity electric motor-driven pump, the tubeside of the CCW heat exchanger and associated supply and discharge piping for the CCW heat exchanger. Upstream of the pumps, there is a unit ASW traveling water screen and a suction bay gate for each pump. There is a vacuum relief system on each ASW supply header piping to prevent water hammer. In addition, the Unit 1 and Unit 2 ASW piping system is arranged with interunit crosstie capability.

Each train is designed with the capability of providing adequate cooling to the CCW system during normal operation, plant safe shutdowns following normal operation, and refueling modes. Equipment design margins and system redundancy allow either an active or a passive failure of any component without degrading the system's cooling function under all modes of operation, including a design basis accident.

All system equipment is located within the turbine building and the intake structure and connected via buried plastic-lined carbon steel pipes between these two structures. These locations provide access for inspection and maintenance during either normal or postaccident operation.

During normal operation, both auxiliary saltwater pumps and one supply header are aligned with the operating CCW heat exchanger. Only one pump is required to run; the second pump, being on standby, provides backup against an active failure. By means of unit and redundant supply header crosstie motor-operated valves, the standby pump for one plant unit may act as a second standby for the other unit.

During the cooldown phase of a routine plant shutdown, both ASW pumps and CCW heat exchangers are in operation. If one pump or supply header is inoperative during cooldown, cooling would be accomplished safely, but the cooldown time would be extended.

During the safety injection phase or upon loss of the offsite power supply, both auxiliary saltwater pumps receive a start signal. On a bus transfer with no SI signal or loss of the offsite power supply, the previously operating ASW pump will immediately be restarted and the standby pump will receive a start signal. This design ensures both pumps in operation following the event of accident or upset condition, excluding the condition of a vital F or G bus failure.

INSERT B

~~In the injection phase of the accident no operator action is required for operation or reconfiguration of the ASW system and its components. During the post-accident recirculation phase of the accident, the ASW system may be realigned after evaluation by the Technical Support Center based on conditions in containment and heat loads on the CCW system. In the long term post-accident recirculation, the ASWS may be aligned into two separate redundant trains, each consisting of a pump, supply header and a CCW heat exchanger. This configuration provides full protection against a passive failure and provides the minimum required long term cooling requirements. Refer to Section 9.2.7.2.7 for heat removal capability in this configuration.~~

9.2.7.2.1 Auxiliary Saltwater Pumps

The ASW pumps are powered from separate vital 4.16 kV buses, which can be energized by either the normal source or the emergency diesel generators. All loop components satisfy Design Class I criteria. The pumps are single stage, vertical, wet pit type driven by 4 kV motors. The design data for the ASW pumps are tabulated in Table 9.2-1. The piping and other essential lines (power, sensing, and control) that pass from the pumps to the main portion of the plant are shown in Figure 9.2-3.

structure is divided into two chambers (one for each unit) that are open to the ocean under all conditions. The two ASW return lines for each unit discharge into the chamber of that unit. The base slab of the discharge structure is keyed into and poured on sound rock. Where possible, the walls were formed directly against sound rock.

9.2.7.2.6 Heat Exchangers

The design details of the component cooling water heat exchangers are given in Table 9.2-3. Performance of the CCW heat exchanger is based on performance curves provided by the manufacturer. Design fouling is considered in accident analyses. Fouling is a combination of tube microfouling and tube flow blockage resulting from marine life. Mechanical tube plugging is limited to two percent of the tubes before the performance of the heat exchanger, as defined by the curves, is impacted. As noted in Section 9.2.7.2.3, provisions exist to control marine fouling on the tube side (ASW) of the CCW heat exchanger. Cathodic protection is provided on the tube side of the heat exchanger in the waterboxes.

9.2.7.2.7 Heat Rejection Capability

The capacity of the ASWS is based on post-design basis accident heat rejection requirements. The ASW and CCW systems operate together to remove heat from containment and safety-related loads following a design basis accident. Together the ASW and CCW systems must be able to remove the minimum required heat loads to ensure that the containment design pressure and temperature limits are not exceeded. Additionally, in accordance with GDC 44, the ASWS is designed to provide sufficient heat removal to maintain the CCWS within its design basis temperature limits for normal and post-accident CCWS conditions.

The ASWS and CCWS are essentially considered a single heat removal system for the purpose of assessing the ability to sustain either a single active or passive failure and still perform design basis heat removal. The heat removal capability of the ASW/CCW system has been evaluated to ensure that the minimum containment heat removal function is satisfied following a LOCA or MSLB (References 5 and 6). A single train of ASW (one ASW pump and one CCW heat exchanger) provides sufficient heat removal from containment to mitigate an MSLB or LOCA. The ability of the ASW and CCW systems to support the maximum containment heat removal without exceeding the CCW maximum supply temperature design basis limit following a LOCA or MSLB has also been demonstrated (Reference 3). The mechanistic analyses credited one or two ASW pumps, depending on the assumed single failure. A single CCW heat exchanger was assumed to be in service throughout the transient (except when the UHS temperature exceeds 64°F, two CCW heat exchangers are assumed in service). No credit was taken for operator action to align the second CCW heat exchanger or an ASW pump from the opposite unit. ~~In the split train configuration during post-accident operation, each separate train of ASW is capable of supplying the minimum heat removal capacity required and sustain a postulated passive failure. However, in this split train configuration, operator action may be required to realign the ASW and CCW systems to prevent loss of all cooling to containment and safety-related equipment following specific active failure scenarios.~~ INSERT C

Insert A (page 9.2-25)

The ASW system is designed so that it may be aligned into two separate vital loops by manual manipulation of various system valves following a passive failure. This provides totally redundant and separate trains, which ensures that a passive failure during the long term period following an accident will not cause a total loss of ASW. Due to the potential for a loss of CCW system function in the event of a bus failure, the ASW system should not be split into separate trains unless required to mitigate a passive failure.

Insert B (page 9.2-26)

In the injection phase of the accident no operator action is required for operation or reconfiguration of the ASW system and its components. During the long term period following the accident, the ASW system may be aligned, after evaluation by the Technical Support Center, into two separate redundant trains, each consisting of a pump, supply header and a CCW heat exchanger, to mitigate a passive failure. This configuration provides full protection against a passive failure and provides the minimum required long term cooling requirements. Refer to Section 9.2.7.2.7 for heat removal capability in this configuration.

Insert C (page 9.2-29)

If the ASW system is aligned in the split train configuration during long term post-accident operation because a passive failure has occurred, each separate train of ASW is capable of supplying the minimum heat removal capacity required.