U.S. NUCLEAR REGULATORY COMMISSION

OFFICE OF NUCLEAR REACTOR REGULATION

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Report No.:	50-275/97-202 and 50-323/97-202
Licensee:	Pacific Gas and Electric Company
Facility:	Diablo Canyon Nuclear Power Plant, Units 1 and 2
Location:	7 ½ miles NW of Avila Beach Avila Beach, California
Dates:	August 4 – September 11, 1997
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EXECUTIVE SUMMARY

From August 4 through September 11, 1997, the staff of the U.S. Nuclear Regulatory Commission (NRC), Office of Nuclear Reactor Regulation (NRR), Special Inspection Branch, conducted a design inspection at Diablo Canyon Power Plant (DCPP). The inspection team consisted of a team leader from NRR and five contractor engineers from Sargent and Lundy Corporation (S&L).

The purpose of the inspection was to evaluate the capability of the selected systems to perform the safety functions required by their design bases, the adherence of the systems to their design and licensing bases, and the consistency of the as-built configuration and system operations with the updated final safety analysis report (UFSAR). For the purpose of this inspection, the team selected the auxiliary salt water (ASW) and the containment cooling systems including both containment spray (CS) and containment fan cooler units (CFCU), on the basis of their importance in mitigating design-basis accidents (DBAs). In particular, the inspection focused on the safety functions of these systems and their interfaces with other systems.

For guidance in performing the inspection, the team followed the applicable engineering design and configuration control portions of Inspection Procedure (IP) 93801, "Safety System Functional Inspection" (SSFI). The team reviewed portions of the plant's UFSAR, design-basis documents, drawings, calculations, modification packages, surveillance procedures, and other documents pertaining to the selected systems.

Overall, the team determined that the systems are capable of performing their safety functions. However, two issues identified may involve potential unreviewed safety questions and the NRC needs to evaluate them further.

The first issue involved single failure design issues that affects the CCW, ASW, and RHR systems. Because of the design of the electrical distribution system, these mechanical systems are operated with both trains cross-tied. These systems are vulnerable to passive failure when they are cross-tied and to active failures when trains are split. The safety evaluation for changing emergency operating procedures (EOPs) to resolve LER 97-001 conditions did not consider the failure of these systems to meet single failure design criteria as a potential unreviewed safety question (USQ).

The second issue involved the availability of containment spray during containment recirculation. Because of a discovery in 1991 involving system heat load concerns under design basis (single failure) conditions, the EOPs were modified to prohibit use of the residual heat removal (RHR) containment recirculation spray system. The corrective actions in 1991 involved administrative controls, such as manual operator action and guidance from the technical support center, but the UFSAR and TS were not updated accordingly. Chapter 6 and section 3.1.8.16 of the UFSAR and TS 3.6.2.1 still discuss the containment spray function during containment recirculation. The licensee's safety evaluation (10 CFR 50.59), dated September 4, 1997, to support not requiring the ability to spray from the containment sump under design basis conditions, did not identify the need to change technical specifications (TS).

Issues were identified with the current ASW pump testing method that results in pump and heat exchanger unavailability. The licensee is changing their testing program to eliminate the need to make the heat exchanger or pump inoperable for testing.

The ASW system supply path from the demusseling line is credited in the UFSAR since the single ASW intake bay screen is not qualified. However, this alternate supply line is not being maintained or tested. Pacific Gas and Electric Company's (PG&E) response to Generic Letter 89-13, "Service Water System Problems Affecting Safety-Related Equipment" and its actions to implement the maintenance rule failed to resolve this issue.

Generally, calculations reviewed by the team were good. However, it was not always clear as to what calculations were current and relevant to existing plant design. Several calculational assumptions were not conservative, but the overall calculational results were not adversely affected. No maximum allowable sea water temperature had been previously calculated. This calculation is currently being developed to evaluate the possible effects of the "El-Nino" weather condition, which increases the ocean temperature.

The UFSAR was revised in 1997 regarding commitments for the emergency diesel generator's (EDG) response to transient loading. Clarification is needed as to the capability of the EDG to satisfy Regulatory Guide 1.9 requirements regarding frequency response during loading.

Prior to the inspection, the PG&E staff performed their own review of documents associated with the systems being inspected. That review identified many issues and approximately 50 action requests (ARs) were written to document specific findings. It is important that the AR review of the specific finding considers generic applicability so that the licensee's efforts can realize the most benefit. Additionally, during the course of the inspection the licensee documented many of the team identified issues in their corrective action program.

DCPP staff took immediate remedial actions for issues identified by the team and no immediate operability concerns currently exist. However, further review by NRR staff of the potential USQs may result in additional needed actions. The DCPP and PG&E staffs are addressing long term actions for team and licensee identified issues through the corrective action process.

III. Engineering

E1. CONDUCT OF ENGINEERING

E1.1 Inspection Scope and Methodology

The purpose of this inspection was to evaluate the capability of the selected systems to perform safety functions required by their design bases, adherence to the design and licensing bases, and consistency of the as-built configuration with the updated final safety analysis report (UFSAR). The systems selected for inspection were Auxiliary Salt Water and Containment Heat Removal, which included the Containment Spray and Containment Fan Cooler systems. These systems were selected on the basis of their importance in mitigating design basis accidents at Diablo Canyon.

The inspection was performed in accordance with NRC Inspection Procedure 93801, "Safety System Functional Inspection." The engineering design and configuration control section of the procedure was the primary focus of the inspection.

The open items resulting from this inspection are included in Appendix A. The acronyms used in this report are listed in Appendix C.

E1.2 Auxiliary Salt Water System Design Review

E1.2.1 Mechanical

E1.2.1.1 Scope of Review

The team evaluated the capability of the auxiliary salt water (ASW) system to remove the required heat load from the plant through the component cooling water (CCW) system to the Ultimate Heat Sink (UHS), i.e., the ocean. To determine plant total heat load, the team reviewed the Westinghouse Containment Integrity Analysis for a Loss-of-Coolant-Accident (LOCA) and Main Steam Line Break (MSLB). The team also reviewed portions of the CCW system analysis that dealt with heat transfer from the Containment Fan Cooler Units (CFCUs), residual heat removal (RHR) heat exchangers and safety-related equipment lube-oil coolers. As described in UFSAR Section 9.2.7.1, the ASW and CCW systems are essentially considered a single heat removal system for the purpose of assessing the plant ability to perform design bases heat removal.

Plant design drawings, calculations, modification packages, UFSAR, the design criteria manual (DCM), technical specifications (TS), operating procedures (OP), maintenance and surveillance tests, selected NRC Bulletins and generic letters, and engineering evaluations associated with the system were reviewed.

E1.2.1.2 Findings

a. Overall System Design Capabilities and General Operating Practices

The team's review determined that the ASW system was capable of removing the plant heat load for plant normal, abnormal and accident conditions. However, the manner in which the system is currently operated is not the way it was originally designed. Discoveries by the licensee that questioned some of the original calculational assumption have resulted in two increases in CCW temperature which have impacted other system operations such as the RHR, CS, and ASW systems. At the conclusion of the inspection, the final analysis/calculations to document the most recent changes to the design bases temperature for the ASW and CCW systems were not available for review by the inspection team. Additionally, the effects of "El Nino" on the ocean temperature were being reviewed by the licensee since there was no upper ASW system temperature limit established in design basis documents.

The ASW and CCW systems at DCPP are currently configured to operate with both their trains tied together for all plant conditions unless otherwise determined by the Technical Support Center (TSC). The recently revised EOP 1.3 specifies that the trains should only be separated during long term post-LOCA recirculation in cases of a single passive failure in one train. For the purpose of determining the ASW and CCW system heat removal capability each train of the system was evaluated for heat load removal of the combined trains. Though this configuration provides flexibility, it also challenges the system design capability since a single failure in the ASW or CCW systems would require operator action to reduce heat loads to the capacity of a single train. This aspect of system operation was not considered in the original design. As stated in UFSAR Section 9.2.7 and DCM S-17B, Revision 04, the original intent of the ASW system design was to be able to operate the ASW system as two separate trains during long term post-LOCA recirculation.

b. History of Changes to Design Requirements for ASW/CCW Systems

Both the ASW and CCW systems were originally sized to remove the heat load based on the minimum acceptable number of safeguards equipment in operation, i.e., 3 CFCUs, 1 containment spray (CS) pump and 1 RHR heat exchanger, to maintain containment and reactor/fuel integrity. However, as described in the licensee's 1991 LER (1-91-018), with both trains tied together, the limiting condition for design of the CCW system should be based on maximum heat addition to the CCW train with the maximum amount of safeguards equipment in operation and minimum heat transfer to the ASW system. As described in the LER, if maximum heat was added to the CCW system, the CCW temperatures could increase from the original assumed 125°F to a one time peak of 132°F for a duration of 20 minutes during the LOCA injection phase. Administrative controls, which limit system heat loads, would then maintain CCW temperature at 120°F for the remainder of the event.

In 1995 the licensee discovered (LER 1-95-013) that although the CCW and ASW temperature analysis performed after the 1991 discovery assumed worst case heat inputs the analysis would be further impacted by changing the assumed fouling factor for the CFCUs, RHR, and the

CCW/ASW heat exchangers. Specifically, the licensee's analysis assumed that the CFCUs and RHR heat exchangers were fouled, which was nonconservative since actual testing indicated that they were essentially clean. Therefore, the heat input to the CCW system would be more than assumed. This discovery resulted in another CCW temperature increase, which impacted the ASW system heat input as well.

c. Determine Heat Removal Capability of the ASW System

The limiting condition for design of the ASW system is minimum ASW flow and maximum CCW flow through the CCW heat exchanger with maximum heat transfer from the CCW system to the ASW system.

The limiting heat loads differ for the accident type and the time period after the initiation of the event. For example, maximum safeguards equipment in operation and a single active failure of an ASW pump with only one CCW heat exchanger in operation was the worst case for a Main Steam Line Break (MSLB) and during the injection phase of a LOCA. However, during the LOCA recirculation phase, the limiting design condition was determined to be operation of all 5 CFCUs and both RHR heat exchangers with a limiting single active failure of a solid state protection system (SSPS).

ASW system temperature is controlled by TS 3/4.7.12 which requires that the second CCW heat exchanger be placed in operation when the ocean temperature exceeds 64°F. Flow requirements are verified through regular surveillance testing (see section E1.2.1.f). Because of the effects of "EL Nino" on ocean temperature, the team questioned the licensee as to maximum ocean temperature limits that would continue to allow safe operation. DCPP could not identify the maximum ocean temperature at which the plant could be operated with both CCW heat exchangers in operation to maintain CCW and ASW systems within their existing design limits. At the time of exit, DCPP was preparing a calculation to determine the maximum UHS temperature at which the plant could be operated, and this has been left as a follow-up item. This item is identified as IFI 50-275/97-202-01, Review of UHS Calculation.

The following analyses were reviewed by the team to ensure that the heat generated by the different accident scenarios could be transferred to the UHS by the CCW/ASW systems:

Containment Analysis

Westinghouse analyses WCAP-13907, "Analysis of Containment Response Following Loss-Of-Coolant Accidents for Diablo Canyon Units 1 and 2," 12/93

WCAP-13908, "Analysis of Containment Response Following Main Steamline Break Accidents for Diablo Canyon Units 1 and 2," 12/93

DCPP calculation M-938, "CCW Data Input for 1993 Containment Analysis Program (CAP)," Revision 02 dated 2/22/95

CCW System Heat Transfer and Pressure Analysis

Westinghouse analysis WCAP-14282, "Evaluation of Peak CCW Temperature Scenarios for Diablo Canyon Units 1&2," 3/95 (injection phase)

DCPP calculation M-910, "CCW post LOCA (recirculation phase) analysis," Revision 02 dated 2-10-97

Westinghouse letter PGE-96-503 to DCPP, Analysis for the CCW system with lower fouling factors for the RHR heat exchangers and the CFCUs coolers.

DCPP calculation M-305, "CCW Temperatures and Pressures for Operating Modes," Rev. 12 dated 7/8/97

ASW System Heat Transfer and Pressure Analysis

DCPP calculation M-784, "To Determine the Maximum System Pressures and Temperatures for Various Modes of Operation," Revision 01 dated 1/28/97

WCAP-12526, "Auxiliary Salt Water and Component Cooling Water Flow and Temperature Study for Diablo Canyon Units 1 and 2," 6/92

DCPP calculation 52.27.55.41, "Evaluate Effect on ASW Discharge Pipeline due to 155°F Discharge Temperature as a Result of Higher CCW Temperature during a Design Bases Accident," Revision 01 dated 11/6/96

E1.2.1.2.c.1 Containment Heat Transfer

The team determined that the energy/ heat added to the containment from a MSLB for Case 10A of the WCAP-13908 MSLB analysis exceeded the heat from a double ended hot leg break LOCA in the WCAP-13907 analysis. The CCW temperature transient analysis for the MSLB Case 10A would, therefore, envelop any CCW analysis for the LOCA injection phase. For the LOCA recirculation phase, the maximum heat was added to the containment from the reactor coolant pump suction break scenario.

In WCAP-14282, the containment structures and the containment shell were considered as heat sinks in the Westinghouse model for long term cooling. The team determined that during the MSLB/LOCA injection phase, the CCW return temperatures from the CCW heat exchanger reached the system peak design temperature of 132°F for a duration of about 20 minutes. Review of calculation M-910 showed that with only 1 ASW pump and 1 CCW heat exchanger in operation, and all CFCUs and both RHR heat exchangers in operation during the recirculation phase, the CCW system would overheat and exceed its design limits. EOP E 1.3 provided operator instructions to control the heat load on the CCW system during the recirculation phase. The procedure specified that at the start of containment recirculation with only 1 ASW pump and 1 CCW heat exchanger available, only 3 CFCUs and 1 RHR heat exchanger could be in operation.

The team's detailed review, with the assistance of a Westinghouse representative, of the LOCA and MSLB analysis, including calculational notes, determined that overall the bases of the input data (mainly constituted by PG&E calculation notes) for the containment integrity analyses were available, accessible and controlled. Notwithstanding, the team identified an error in calculation (193-DC) associated with CFCU start times which supported both LOCA and MSLB analyses and found that an uncompleted calculation (M-939 Revision 0) had been used in the MSLB analysis. Additionally, the RCS flow assumptions used by Westinghouse were not conservative. These

discrepancies were analyzed by PG&E during the inspection and proved not to have adversely impacted the accident analyses results. In conclusion, the inspection confirmed that the current containment integrity analyses demonstrate that the plant's response to a LOCA or a MSLB will remain within the plant's design safety limits.

E1.2.1.2.c.2 CCW System Heat Transfer

WCAP-14282 did not use conservative fouling factors for maximum heat transfer to the CCW system from both the CFCU coolers and the RHR heat exchangers. Performance tests on the RHR heat exchangers and the CFCUs coolers determined lower fouling factors than considered in the analysis for heat transfer to the CCW system. Additionally, CCW/ASW heat exchanger tube plugging was not considered in the heat transfer analysis even though tests have shown plugging from marine life (AR A0440748). The team's review of the new analysis, performed by Westinghouse (Ref. Westinghouse letter PGE-96-503 to DCPP), for the CCW system with lower fouling factors for the RHR heat exchangers and CFCUs coolers determined that for both MSLB and the LOCA injection phase, the CCW temperatures exceeded the 132°F maximum CCW design temperature. The CCW system maximum design temperature limits were revised by DCPP to a value of 140°F for 6 hours. The team's review of CCW calculation M-305 determined that a maximum CCW temperature of 240°F would be reached in the CCW return line from the RHR heat exchanger. This temperature is within the temperature limitation allowed by the ASME code for the class of piping. The team also reviewed DCPP safety evaluation, DCP M-49291, "Change Design Bases Temperature of CCW System," Revision 0 dated 4/25/97 to determine if DCPP had addressed the effect of the temperature change on all interfacing equipment. The team determined that the effect of the temperature change on all interfacing equipment and systems had been adequately addressed.

DCPP's response to not considering heat exchanger tube plugging in the above analysis was that a higher fouling factor than what was determined from performance tests had been considered in the heat transfer analysis for the CCW heat exchangers, and in addition the manufacturer's specification (PGE DC-663212-26-1) allowed a maximum of 2% tube plugging without affecting heat transfer area; therefore, further consideration of tube plugging would make the analysis overly conservative. The team determined that the plant was operating with some of the tubes plugged, and requested DCPP to provide information on how design control was maintained on tube plugging. The team reviewed the tube plugging map drawing DC-663212, Sheet 66 Revision 01 and DCPP procedure MP M-56.21, "Salt Water Heat Exchanger Tube and Tube Plugging," Revision 3A, to assess design control on the number of heat exchanger tubes to be plugged. Though the map drawing indicated that a maximum of 2% or 24 tubes could be plugged, the team could not identify in the procedure any controls or restrictions on the allowable number of tubes to be plugged to remain within CCW system design bases. The team did not consider that strict controls were in place to prevent more than 2% of tubes being plugged, or that engineering would evaluate CCW system design and plant operation if more than 2% of tubes were required to be plugged. AR A0443543 was initiated by DCPP to evaluate the CCW heat exchanger tube plugging procedure to add the limit on the maximum number of tubes to be plugged.

At the time of the inspection, WCAP-14282 was in revision to finalize the preliminary analysis done in PGE-96-503 and to also capture the history and the effect of the CCW system changes on all interfacing systems. Issue of the revised WCAP-14282 will also supersede/revise a number of calculations and design documentation including DCMs and the UFSAR. The

changes necessary to incorporate revised WCAP-14282 into design bases documentation is being tracked by DCPP under AR A0439116. Review of revised WCAP-14282, and closure of AR A0439116 is identified as IFI 50-275/97-201-02.

E1.2.1.2.c.3 <u>ASW System Heat Transfer</u>

The team's review of Westinghouse analysis WCAP-12526 determined that with only one CCW heat exchanger in operation, a minimum of 10,300 gpm ASW flow at a maximum ocean temperature of 64°F was required to maintain the CCW temperature within its above design limits. This ASW flow and temperature forms the design bases for the ASW system, and has been used in all Westinghouse's analyses.

The team's review of calculation M-784 determined that with an initial CCW supply temperature of 140°F and CCW heat exchanger fouling factor of 0.0002, the ASW system discharge temperature from the CCW heat exchanger could reach 149°F for the MSLB/LOCA injection phase. A review was performed of calculation 52.27.55.41. The review determined that for the encased portion of the piping, the radial growth/stress in the piping would cause the concrete to crack and relieve the stress, preventing any buckling of the pipe. The team considered this to be acceptable as the concrete in question performed no safety or seismic function and would not affect plant safety or operation of the ASW system.

d. Capability to Isolate ASW System Trains for Long Term Post-LOCA Cooling

The team reviewed the ability of the ASW system to be separated into two redundant trains for long term post-LOCA cooling as described in UFSAR section 9.2.7.2, and as was the intent of the original design. The team determined that the ASW system, in combination with CCW system, could withstand a single active failure during all phases of accident mitigation as long as the trains remained mechanically cross-tied. The ASW system is currently configured to operate with both trains tied together. DCPP EOP E-1.4, "Transfer to Hot Leg Recirculation," originally required separation of the ASW and the CCW systems into isolated trains approximately 10 ½ hours after the LOCA. The EOP was revised as part of LER 97-001-00 corrective action and the trains are now separated during long term cooling based on a decision to be made by the TSC to separate the trains to be able to withstand a single passive failure in the fluid system. The team determined that this ASW system operation did not form the original bases for the ASW system design or licensing, and was a potential unreviewed safety question (USQ) that needed to be further evaluated by the NRC. This item is identified as URI 50-275/97-202-03, Determine if Current Approach to Single Failure Design Represents a USQ.

Typically, plants are designed where most of the mechanical systems have two trains to meet redundancy criteria, and normally with two electric buses all components of interfacing mechanical trains are powered from the same electrical train such that failure of one bus would remove the safety function provided by one train, but the other train would be available to perform the function. At DCPP there are three safety-related electrical buses, F,G and H. The components in the ASW, CCW, RHR and CFCUs are powered from a mix of these three buses such that a loss on one electrical bus could affect the systems from performing their safety functions. The team determined that a postulated loss of Bus F following completion of the post-LOCA long term system separation, results in the loss of CCW flow in one cooling loop (B) and the loss of ASW cooling flow in the other cooling loop (A) resulting in a complete loss of plant cooling. A postulated loss of power to Bus G results in the loss of ASW cooling flow to one loop

(B) such that the RHR heat exchanger on that loop is not cooled, and the other RHR loop (A) is not available as the RHR pump is powered from this bus resulting in a total loss of RHR function. Preliminary analysis performed by DCPP showed that the CCW system would exceed design limits within a short time (approximately about 4 minutes). The inability of the ASW and CCW system design to withstand a single active failure of an electrical bus after train separation was detected by DCPP on January 31, 1997 when LER 97-001-00 was issued. Emergency Operating Procedure (EOP) E-1.4, "Transfer to Hot Leg Recirculation," that allowed train separation approximately 10 ½ hours after a LOCA was revised to no longer require immediate separation of the ASW and CCW systems into separate trains after the transfer to hot leg recirculation. The decision to separate was transferred to the Technical Support Center (TSC) where a decision would be made after an evaluation of plant conditions. When questioned by the team, the licensee could not provide any analysis to support their change to the single passive failure design (i.e., no longer separating the trains). Several scenarios could be postulated during the long term cooling period where no failure mode analysis or consequence assessment was available.

e. ASW Pump Net Positive Suction Head

The following calculations were reviewed:

- M-953, "Determine if Adequate NPSH is available for 1 pump supply 2 Heat Exchanger," Revision 01
- M-885, "To Determine ASW Pump Change in Flow when Switching ASW/CCW Configuration," Revision 02
- M-988, "To evaluate the effects of the new ASW bypass piping," Revision 03

The team reviewed calculations M-953, M-885, and M-988 to verify the available net positive suction head (NPSH) for the ASW pumps from the intake bay at various tide levels including the design case tsunami drawdown below sea level. The team did note that calculation M-953 contained several conservative assumptions, which in some cases indicated that cavitation may occur, under non design basis conditions. DCPP initiated AR A0440920 to revise calculation M-953 to reflect more realistic assumptions. The team concluded that for the ASW design flow, sufficient NPSH was available for the ASW pumps when taking suction from the intake bay for the case of 1 pump supplying 1 heat exchanger and 1 pump supplying 2 heat exchangers.

f. ASW System Flow Rate and Pump Surveillance Testing

The team reviewed the licensee's calculations for ASW system hydraulic resistance, effects of the new ASW bypass piping, pump surveillance testing, test procedures, and acceptance criteria to evaluate ASW system capability to provide the minimum design flow of 10,300 gpm when the ASW pump is aligned with the heat exchanger of the other train.

Calculations M-885, M-186, "Estimate the friction loss of the ASW system," Revision 04, and M-988, "To evaluate the effects of the new ASW bypass piping," Revision 03, determine the ASW system flow rates. Calculation M-186 determines the frictional losses in the ASW system due to piping, fittings and equipment. This frictional loss data was used as the basis for the flows determined in calculation M-885. The ASW system bypass piping modification has been completed for Unit 1, and is expected to be completed for Unit 2 at the next refueling outage. Calculation M-988 evaluates ASW system flow rates for both Units 1&2. This calculation forms

the design basis for evaluating ASW system flow rates for Unit 1. However, until completion of Unit 2 bypass modifications, calculations M-885 and M-186 form the design bases for Unit 2. On completion of the Unit 2 bypass, both these calculations will need to be superseded or archived and M-988 will form the design bases for both units. AR A0439116 was initiated by DCPP to review and update ASW system flow calculations.

M-885 calculated flows "with" and "without" siphon effect. M-988, however, calculates flows with siphon effect. After exiting the CCW heat exchanger (EL. 93'), the ASW system discharges to a lower elevation (EL. 72.1' for Unit 1 and 68.6' for Unit 2) and a siphon is created in the discharge lines. The team agreed with the full siphon effect assumed in M-988. The team's review of the calculation determined that the pumps have the necessary capacity to provide the minimum ASW system design flow of 10,300 gpm through the cross-tie at a UHS temperature of 64°F at the low-low tide level. The above analysis to establish limiting flows did not consider pump performance degradation. Therefore, additional analysis will be necessary if pump degradation is noted.

The ASW system's ability to provide the required minimum design flow is demonstrated through regular surveillance testing performed under STP M-26, "ASW System Flow Monitoring." To demonstrate adequate flow under the most limiting condition, the test flow is corrected to account for a minimum tide level of -4.1', and heat exchanger differential pressure. The corrections used in the STP have been determined in M-988, and were verified by the inspection team. However, review of engineering evaluation procedure PEP M-229, "Evaluation to Allow Taking Credit for a Single Train ASW flow for a Specific Duration of Time for Maintenance/Operations Evolutions," for single train design bases capability (UFSAR Sec. 9.2.7.1) showed a different correction factor for tide level than determined in M-988. The correction factor used is conservative, even though it does not agree with the design bases. The team determined that PEP M-229 may not be needed after WCAP-14282 is revised. DCPP initiated AR A0443540 to track the review of PEP M-229 after the WCAP is revised.

As per the requirements of TS Bases Section 4.0.5, surveillance testing of the ASW pumps is performed under STP P-ASW-11, 12 , 21, 22 (11 for pump 1-1, 12 for pump 1-2, etc.), "Routine Surveillance Test of Auxiliary Salt Water Pump." The team reviewed the results of the routine surveillance test performed on July 24, 1997, on pump 1-1. The results indicated that the pumps were able to deliver 12,116 gpm at a discharge pressure of 50.542 psig or about 117 feet which lies on the original pump performance curve. The team witnessed the surveillance test performed on pump 2-2 on August 14, 1997. The pump was able to deliver 11,730 gpm at a discharge pressure of 51.876 psig or about 119 feet, which also lies on the original pump performance curve. The latest pump tests showed minimal degradation of the pump performance since its installation. The ASW pumps are tested to a specific point on the pump performance curve to establish the acceptance criteria. The specific point selected for the test requires throttling of the CCW heat exchanger ASW outlet valve of the opposite train (the pump is tested through the cross-tie to demonstrate adequate performance for the most limiting condition) to meet configuration requirements for the test. If the surveillance test is being performed as post maintenance testing (PMT), it could result in both the ASW pump and the opposite heat exchanger being inoperable at the same time (the heat exchanger is declared inoperable when its outlet valve is throttled). The team considered that rendering the CCW heat exchanger inoperable by throttling of the ASW outlet valve every time the surveillance test was performed was an undesirable practice, and that test modifications would correct this problem. DCPP initiated AR A0443221 to either (1) obtain relief from Section XI to allow testing the pump

at various flow rates or (2) re-baseline the test reference flow rate to a higher value so that the heat exchanger outlet valve does not need to be throttled from its normal position. The final resolution of this item is identified as IFI 50-275/97-202-04, Modification to ASW Pump Test Method.

g. **Piping Design Pressure and Temperature**

The team reviewed the ASW system piping schematic 102017 sheets 3 and 3B, Revision 83, DCM S-17B, DCM M-46, "Piping Pressures, Temperatures, and Operating Modes," Revision 23, and calculation M-784 to verify the piping design pressure and temperature classification for the discharge lines from the pump to the CCW heat exchanger and from the CCW heat exchanger to the ocean. The team determined that the pressure and temperature classification as determined in M-784 were acceptable. However the temperature classification in DCM S-17B did not reflect the classification in M-784. DCPP initiated AR A0438253 to revise DCM S-17B to reflect the classification in M-784. This discrepancy in design information is identified as example 1 of URI 50-275/97-202-05, Discrepancy in Design Documentation.

DCM M-46 was revised under AT-DCMC AR A0417076 to address the revised discharge temperatures of 155°F short term and 145°F long term during post-LOCA recirculation at the exit of the CCW heat exchangers. The team identified that the new bypass line was not designed for demusseling, though this operating mode was still indicated in DCM M-46. Deletion of ASW demusseling mode from all plant documents is being tracked by DCPP under AR A0431283.

h. **Intake Structure**

The team reviewed the intake structure to verify its design to support the safety function of the ASW pumps and associated piping and valves during a seismic event. The team determined that the ASW system was adequately supported and protected from external missiles to enable it to perform its function, except for the following:

- The ASW pumps for each unit have separate bays from which they take suction. As per UFSAR Section 9.2.7.2.3, "Each unit's pair of ASW pumps share a common traveling screen to remove floating debris from the incoming seawater. If the common screen for a unit becomes clogged with debris, seawater may be valved to the ASW pump bays from the unit's circulating water pump bays." The traveling screens at DCPP are designed as Class II, and are, therefore, neither seismically qualified or supported. The team determined that there is a potential for the screen to fail during a seismic event and restrict flow to the ASW pumps. The demusseling line flowpath is not tested or maintained on a routine basis to demonstrate its availability as an alternate flow path. The valves in the flowpath, however, are exercised to demonstrate their operability. The team identified that the inability to demonstrate an acceptable flowpath for ASW pump suction did not conform to the recommendation contained in GL 89-13. DCPP initiated AR A0443544 to reevaluate the need for testing or inspection of the flowpath. The team considered the fact that the UFSAR required flowpath was not being properly maintained (i.e., not in the maintenance rule) or tested to be contrary to the intent of GL 89-13 and a weakness in the licensee's program. This item is identified as URI 50-275/97-202-06, Availability of an Alternate Flowpath for the ASW System Suction.

i. System Modification

The team selected DCPP Modification DCPC-49207, "Auxiliary Saltwater System Piping Bypass Project" for review. This design change bypasses approximately 800 feet of Unit 1 and 200 feet of Unit 2 existing ASW piping which will be abandoned in place because of pitting/corrosion. This was essentially a piping/structural modification and the team's review was limited to verifying the impact of the bypass on the ASW system flow and how prevention of future pipe corrosion was addressed for the bypass. Mechanical calculation M-988 was prepared to address the effect on ASW flow due to the bypass. The team determined that the increase in head loss due to the additional length of piping was not significant, and the ASW system design flow would still be maintained. The team identified that no portion of the bypass piping was buried in saltwater which would significantly reduce pitting/corrosion in piping. A cathodic protection system to minimize pitting/corrosion has been or will be provided for all ASW system buried piping, and it will be maintained with a recurring task maintenance program. The above two design issues were adequately addressed by the modification. It should be noted here that the NRC is also currently reviewing this modification to determine its impact on other design and licensing issues.

E1.2.1.3 Conclusion

The team concluded, that with both ASW trains tied together, the ASW system design was adequate to remove the plant heat from the CCW system and transfer it to the UHS. The ASW system did not have the design ability to withstand a single active failure with the trains separated. The trains could only be separated during post-LOCA recirculation, if it became necessary based on guidance from the TSC, to withstand a single passive failure in the other train. This configuration of operation of the ASW system deviates from its original design and licensing bases and further review is required by the NRC. During post-LOCA recirculation, because of the reduced ability of the ASW system to remove the heat with only one CCW heat exchanger available, entry to the recirculation mode is restricted by EOP 1.3, which requires limiting operation for containment heat removal to only 3 CFCUs and 1 RHR heat exchanger. Even under low-low and tsunami tide levels, the ASW pumps have adequate NPSH to provide the minimum design flow through the bypass piping. The ability of the pump to provide flow is demonstrated through regular surveillance testing. The ASW pump intake screens are not seismically qualified and the alternate demusseling line path has not been demonstrated to be available. Recent changes to the ASW system design, because of the bypass modification and the CCW system design changes, require upgrading/superseding or archiving many of the ASW system calculations, DCM S-17B, the UFSAR, and other related design documents to maintain design configuration control.

E1.2.2 Electrical

E1.2.2.1 Scope of Review

The scope of review of the electrical inspection was the essential power supplies to the ASW, CS and CFCU systems. The following power supply areas were chosen for review: Emergency Diesel Generators, 4160 Volt AC buses, 480 Volt MCCs, 125 Volt DC System and Vital 120 Volt Instrumentation AC System. These areas were common to the three systems being assessed. The following attributes for the above areas of review were assessed by the team: equipment qualifications and sizing; regulation and standard compliance; channel separation; voltage drops;

controls, interlocks, alarms and indications; pump, fan and valve motor operations; protective device sizing, coordination and setpoints; field installations; cathodic protection; modifications; labeling and identification; and fire barrier penetrations.

The team reviewed UFSAR Chapter 8.3, "Onsite Power Systems," Technical Specification 3/4.8, "Electrical Power," Safety Limits Basis B 3/4.8, "Electrical Power Systems," various DCMs, calculations, procedures, drawings and other miscellaneous electrical documents.

E1.2.2.2 Findings

a. Emergency Diesel Generators

The team's assessment of the emergency diesel generator (EDG) standby electrical power system determined that adequate capacity to supply the predicted essential load profile sequences for Loss of Offsite Power (LOOP), occurring with other abnormal conditions, was provided. The computer simulated study for the EDG's responses to the application of the load sequences was not well documented and led to confusion regarding the diesel's performance. This assessment was based on the team's review of DCM S-21, schematic and single line diagrams, protective relay setpoints, the 015 series calculations including calculation 015-DC, "Diesel Generators, Vital Load Centers, 4 kV Switchgear Buses F, G and H - To Demonstrate the Emergency Diesel Generator's Worst Case Maximum Steady-State Loading is Within the Capabilities of the Diesel Generators," Revision 13. Some of the diesel protective relays only required during diesel testing were erroneously identified in Revision 01 of DCM T-18 as being required to perform a safety function. Revision 0 of the DCM had correctly identified these relays as being required during testing of diesels only. The team determined that a sentence from Revision 0 was inadvertently omitted from Revision 01 causing the error. AR A0442586 was issued by DCPP to revise DCM T-18 and evaluate the issue for root cause and generic implications.

Paragraph 4.3.1.j of DCM S-21 stated that, "Each diesel-generator set is designed so that at no time during the loading sequence will the frequency decrease to less than 95 percent of nominal frequency. [R.G. 1.9]." Paragraph 4.3.1.n stated that "The diesel-generator sets are designed to ensure that nominal frequency is restored within 2 percent of nominal in less than 40 percent of each load sequence time interval. [R.G. 1.9]." Regulatory Guide 1.9 Revision 1 revised the 40 percent criteria to 60 percent but the DCM did not reflect this allowance. UFSAR section 8.3.1.1.13.1 has similar descriptions of capability. When the team questioned the licensee as to their commitment for bus frequency and recovery time the licensee pointed out that EDG loading had been discussed with the NRC in PG&E Letter DCL-85-132, dated March 29, 1985. In that letter, the licensee described how testing demonstrated that their equipment met "the intent of" Safety Guide 9 or Reg Guide 1.9 Revision 0. The licensee also pointed out that it was not clear from docketed correspondence that the NRC responded to their 1985 letter about "intent of" since the original SAR indicated that Reg Guide 1.9 was met.

The team reviewed calculation 215-DC, Revision 1 dated 12/26/96, "EDG Loading Capability Study without KWS Relay." In this study, a computer simulation was used to analyze the machine's transient responses. The results for four of the six diesel generators showed the frequency dropping to 56.8 Hz. or slightly below the 57 Hertz minimum criteria during design basis loading. The frequency dip occurred during the initial load block when none of the ECCS motors were loaded, and the only load on the diesels were the 480 volt transformers. Also,

during this initial load block, one machine had a frequency recovery time of 2.54 seconds, which slightly exceeded the 2.4 second (60%) criteria of NRC Regulatory Guide 1.9. The Integrated Test of Engineered Safeguards and Diesel Generators (Surveillance Test Procedure STP M-15) conducted on the diesels to monitor their performance, however, do not show any dip in frequency below 57 Hz. or recovery time greater than 2.4 seconds. This difference between the computer study and actual tests was determined to be due to the slow governor response modeled in the analysis. The study also showed that for the non-design-bases case when three motors were loaded simultaneously the frequency dipped to 55.68 Hz.

The team's review determined that the computer simulation study results and EDG design requirement for transient loading were not well documented and led to confusion during the inspection. DCPP initiated AR A0444243 to evaluate current system capabilities, to resolve the discrepancies in their commitment to EDG response transient loading, and to revise calculation 215-DC as necessary. This item is identified as URI 50-275/97-202-07, EDG Transient Analysis Response Capability.

b. 4,160 Volt System

The team reviewed the 4160 Volt system and determined that the 4,160 Volt supply to the ASW pump motors was adequate. The ASW pump motor rating was increased from 400 horsepower to 465 horsepower to accommodate the ASW pump change to a larger size impeller.

For the 4,160 Volt system, the team reviewed DCM No. S-63, "4160V System," Revision 2, drawings, protective relay setpoints and coordination calculations. The team also conducted a walkdown of 4160V equipment rooms. The focus was on the under voltage protection schemes and the automatic bus transfers to the 230 kiloVolt off-site supply upon loss of power from the main generator or the 500 kiloVolt transmission system. The first level under voltage is set at approximately 69% of bus voltage, which is just below the level at which vital motors are designed to operate without breakdown. [Calculation 114-DC "Protection Relay Settings for Bus and Feeders (Class 1E 4.16kiloVolt Switchgear)," Revision 4A]. The second level of under voltage tripping is set at just above 90% of the vital motor terminal voltages. This assures that essential motors will start. [Calculation 357K-DC "4.16 kV Second Level Under voltage Relay & Timer Setpoint Calculation (DE&S Calculation No. 0017-00301.C002) ," Revision 0]. Upgraded timers are provided to prevent spurious transfers, shed load, start and load the diesel generators and start the sequenced vital loads.

c. 480 Volt System

The team assessed the adequacy of the 480 Volt system including essential supply and control of pumps, fans and motor operated valves to verify conformance to single failure criterion, equipment sizing, and availability of voltage at equipment terminals. The team determined that the design was adequate except for the following:

> Per DCM No. S-64, "480 Volt System," Revision 2, and other design documents, each of the three vital 480 Volt busses is aligned to a particular vital 4,160 Volt bus. The DCM states that to meet the single failure criterion, the vital loads on any two of the three vital buses are designed to meet the safe shutdown requirements. To verify this, the team reviewed licensee provided marked-up operation valve identification drawings (OVIDs) for ECCS (injection phase and cold leg recirculation); CCW, ASW and the CFCUs indicating

alignments for four conditions: no bus failures, bus F failure, bus G failure, and bus H failure. The criterion was met as long as the ASW system cross-tie was open.

A review by the team of calculation 195A-DC, "Evaluate Adequacy of the Existing Thermal Overload Setting for 460 V Continuous Duty Motors," Rev. 4, determined that the thermal overload heaters (TOL) selected for the CFCU motor protection were slightly oversized. An exception note in this calculation stated that the lower size TOL were not selected as they did not satisfy acceptance criterion 1&2 of the design requirements. The team's evaluation of the lower size heaters indicated that this statement was not correct. The team reviewed calculation 205A-DC, "Evaluation of Reverse Rotation of CFCU on Electrical Protection System," Rev 0, and determined that the selection of the slightly oversized heaters was to provide adequate margin during starting to prevent any undesirable trip when the CFCU fan motors were started with the fans in reverse rotation. The exception note in calculation 195A-DC should provide the correct explanation for selection of the higher size heater than the existing note which was not correct. DCPP initiated AR A0443258 to correct the above exception note in the calculation.

The team also determined from review of calculation 195A-DC in conjunction with DCNs DC1-EE-47513, 45797 and 47195, that the current as built settings for TOL for ASW system motor operated valves 9001A and 9001B and flow control valves FCV-495 and 496 were included in the DCNs and not updated in calculation 195A-DC. AR A0444411 was initiated by DCPP to incorporate the DCN data in a revision to calculation 195A-DC. The team discussed with the licensee their controls for calculations. Procedure CF3.ID4, "Design Calculations," Revision 2, requires that calculations affected by a design change be identified and revised prior to closure of the design change package. The procedure does not however, require that calculations that are made obsolete by a change be automatically archived or made historical. The licensee's position is, that these superseded calculations served their purpose of forming the basis for the previous design and through other controls engineers are made aware of the current calculations. During the course of this inspection, the team had difficulty determining the most current calculations that supported the system design. The licensee's program depends heavily on people to remember the calculational history. This item is identified as example 1 of IFI 50-275/97-202-08, Control of Calculations.

d. Vital 125 Volt DC System

The team reviewed the essential 125VDC system including the batteries and chargers and verified that the system was adequately designed to perform its safety function. The team identified two issues in the DC system concerning the setpoint for the battery charger and the battery float and equalize voltage.

DCM No. S-67, "125V and 250V DC System," Revision 2, was reviewed to assess the adequacy of the essential 125 Volt DC system including the batteries and chargers. The recently replaced 2,320 ampere-hour batteries meet the UFSAR design commitment for a two hour minimum duty cycle to restore AC power to the battery chargers following a LOOP with margin. These capabilities are confirmed by calculations, 235A-DC, "Battery 11 - Sizing, Voltage Drop and Short Circuit Calculations," Revision 1; 236A-DC, "Unit 1 Battery Charger Sizing Calculation for Battery Charger 11, 12, 121, 131 & 132," Revision 1; and by Surveillance Test Procedures STP M-12C11, "Station Battery 11 Service Test," Revision 1A; and STP M-12A11, "Station Battery 11

Performance Test," Revision 1. The accident loads on the battery chargers are about one-half of the 400 amp rating. This provides the other one-half of the amps for the recharging of a discharged battery within twelve hours, as required by the UFSAR.

The vital battery chargers are sized by calculation 236A-DC, and the current revision of this calculation takes credit for a maximum charger capability of 110% of the full load rating (440 amps). Again as per UFSAR Sections 8.3.2.2.1.4, 8.3.2.2.1.2, 8.3.2.2.2.4 and DCM No. S-67 Section 4.3.3.1 for Battery Chargers, the chargers are set at sufficient capacity to carry loads up to 110 percent of its 400 ampere rating and are set to current limit at 110% of rated output current. However, Maintenance Procedure MP E-67.3A, "Routine Preventive Maintenance of Station Batteries," Section 7.19.6 sets the "current limit to 430 (425-435) Amps by adjusting P5 on the Current Control Module." At this present setting of 107.5%, the battery charger has adequate capability to supply the DC loads for analyzed accident scenarios. The current available to recharge a totally discharged battery is slightly reduced and this will lengthen the time required for recharge but will still be less than the twelve hours required by the UFSAR. The 107.5% battery charger setting is not in agreement with calculational assumptions. DCPP initiated AR A0441745 to reconcile the difference between the design bases and actual setting for the battery chargers.

The present battery float voltage setting is 135 Volts plus control tolerances that could allow it to be 135.9 Volts. This is 5 Volts above the TS 4.8.3.1.a.2 minimum requirement of "greater than or equal to 130 Volts on float charge." The Vendor manual from C&D, the battery Vendor, specifies a nominal float Voltage per cell of 2.20 to 2.25 Volts, which is 132 to 135 Volts for the 60 cell vital batteries. The team identified that a higher float voltage can tend to "bake" normally energized DC coils which may shorten the usable life of equipment. However, setting the float at 135 Volts can be beneficial since fewer equalizations would be necessary. DCPP issued AR A0444410 to reevaluate the float Voltage setting.

DCPP selected a nominal equalize Voltage of 138 Volts. For equalizing charge, C&D recommends a range of 2.33 to 2.38 Volts per cell which is 139.8 to 142.8 Volts for 60 cells. The DCM S-67 defines the recommended DC System maximum operating limit of 139.8 Volts. Setting the equalize level at 138 Volts has no serious consequences except to reduce the effectiveness of the equalization. The team identified that DCPP's rationale for operating the battery outside of the battery manufacturer's float and equalization range recommendations was not clear. DCPP initiated AR A0444410 to review the setting for the battery float and equalize voltage.

Review of the licensee's evaluation and resolution of these three items is identified as IFI 50-275/97-202-09, Review of Battery Charger Settings.

e. Vital 120 Volt Instrumentation AC System

The team examined the adequacy of the vital 120 Volt Instrumentation AC system. The equipment in this system was determined to be sized and tested adequately. The team did however, question the possibility of operating the 120 Volt system at a voltage above the nuclear instrumentation qualification. The team's analysis was based on review of DCM No. S-65, "120V AC System," Revision 2, calculation 093-DC, "Load Tabulation for Nuclear Instrument UPSs and Distribution Panels," Revision 7; and Operating Procedure OP J-10:II, "Instrument AC System - Alignment Verification." Specifically OP J-10:11 established an acceptance criteria of 116 to 124

Volts AC for the vital 120 Volt UPS. With the 2% instrument uncertainty the reading could be considered acceptable and be outside the values established in the calculation. There is a potential for out of specification voltage to be applied to the Nuclear Instrumentation with the present verification criteria. DCPP is reviewing this issue under AR A0444409.

f. Cathodic Protection Systems

Due to some recent failures and replacement of buried ASW piping between the Intake Structure and the Turbine Building, the team examined the plant's cathodic protection and grounding. The team reviewed DCM No. T-21, "Grounding," Revision 1; DCM S-68, "Lighting, Heat Tracing, and Cathodic Protection Systems," Revision 3; data from Maintenance Procedure MP E-72.2, "Monthly Cathodic Protection System Monitoring," Revision 3A; and various drawings. The Licensee is in the process of installing additional cathodic protection in the vicinity of the ASW piping and the diesel generator fuel tank. The installed cathodic protection at the Intake Structure appears adequate. Exposed buried grounds near the Unit 1 startup transformers were in good condition.

g. Electrical Protection Systems

The team assessed DCM No. T-18, "Electrical System Protection," Revision 1, and DCM No. T-23, "Miscellaneous Electrical Devices," Revision 2, for the adequacy of the protective devices, coordination and settings. The team examined the 195 series of calculations and especially 195C-DC, "Evaluate adequacy of the Existing Thermal Overload Settings for 460 V Motors for MOVs," Revision 2A. The setting methodology was found to be adequate and questions or concerns raised in the review of the 195 series were discussed and satisfactorily addressed. Other aspects examined were protection schemes, equipment sizing, circuit breaker sizing and settings, trip coordination and short circuit calculations as they relate to the ASW, CS and CFCU systems.

h. Channel Separation and Isolation

The installed channel separation between mutually redundant circuits was examined on a sample basis. Two redundant cable circuits were chosen for review from each of the three systems being assessed: CFCU, ASW and CS. The following drawings were used:

- Setroute Reports (2 pages each) for Cables: F01P02 and H01P02 (Containment Fan Cooler Units 12 and 14), F08H02 and G06H02 (ASW Pumps 11 and 12), G21P02 and H11P02 (CS MOVs 9001A and 9001B)
- Schematic Diagrams: 437600 (CFCU), 437594 (ASW), 437604 (CS)
- Diagram of Connections: 437736, 437738, 437795, 437802, 437807, 437808, 448923, 448922, 448924
- Cable Tray and Conduit Layout Drawings: 57563, 57568, 57597, 57600, 57601, 57606, 57612, 57619, 501452.

The team concluded that the divisional or channel separation of the samples was in compliance with the requirements of UFSAR Section 8.3.1.4 and DCM No. T-19, "Electrical Separation and Isolation."

i. Code and Standard Compliances

There were several observations about the documents provided for the inspection that were discussed with the licensee. First, the revision dates of industry standards used for reference, for developmental purposes and for licensing commitments are inconsistently listed in the UFSAR, Technical Specifications, DCMs, calculations and procedures. IEEE standard 450, "IEEE Recommended Practice for Maintenance, Testing, and Replacement of Large Lead Storage Batteries for Generating Stations and Substations," was cited and discussed as an example. The problem extends to many other standards, as well. DCPP generated AR A0444408 to address these deficiencies. Second, the status of calculations was confusing. Specifically, there are situations where limited scope calculations (i.e., smaller calculations) were performed. Data in these smaller calculations may supersede information in a larger calculation. There is no periodic updating of the major calculations to incorporate the collected small revisions. This same condition was also true for other functional reviews discussed elsewhere in this report. Resolution of this item is identified as the second example of IFI 50-275/97-202-08, Control of Calculations.

E1.2.2.3 Conclusion

The team concluded that the aspects inspected of the essential power supply for the ASW, CS and CFCU systems support the conclusion that the supply is adequate. The calculations were generally conservative in approach, used appropriate methodology, produced reasonable results, and were consistent with the licensing documents. The design criteria cover the performance requirements, design requirements, developmental and code references, component descriptions, technical specifications, and limits. The essential 4,160 Volt and 480 Volt systems are adequate to power the pumps, fans and valves in the systems being assessed. When voltage is lost, the source is automatically transferred to a different available offsite supply or to the diesel generators within the prescribed time sequences. A solution for the diesel generator transient response is being pursued. The vital 125 Volt DC and vital 120 Volt Instrumentation AC systems are properly sized and function as required. Concerns about operating setpoints are being evaluated.

E1.2.3 Instrumentation and Control

E1.2.3.1 Scope of Review

The scope of the instrumentation and control design assessment consisted of a review of the ASW system design and associated documents. The review also included an assessment of interfacing portions of the CCW system. Documents that were reviewed included Chapters 6 and 7 of the UFSAR, technical specifications, design criteria memorandum, piping and instrument schematics, electrical schematics, logic diagrams, 11 calculations, the PIMS database, 2 surveillance procedures, 1 operating procedure and 1 modification package. System walkdowns and interviews with plant personnel were also conducted to verify as-built design.

E1.2.3.2 Findings

The system design documents reviewed by the team were consistent with the design bases, except for the items discussed in the following sections.

a. **ESFAS initiation of ASW/CCW**

The team reviewed the setpoint methodology and instrument uncertainty for the engineered safety feature actuation system (ESFAS) actuation of the ASW and CCW systems. The ASW and CCW pumps are automatically initiated on receipt of an SI actuation signal resulting from a high containment pressure signal from the ESFAS. The actuation signal is derived from a 2 out of 3 logic from containment pressure transmitter channels PT-934, PT-935 and PT-936. The team verified that the TS Table 3.3-4 trip setpoint of 3 psig on increasing pressure was within the value provided in Westinghouse Calculation WCAP-11082, "Westinghouse Setpoint Methodology for Protection Systems Diablo Canyon Stations Eagle 21 Version," Revision 2. The team also verified that plant procedures correctly calibrated the instruments.

The team noted that calculation, J-98, "Containment Pressure ESFAS Setpoint," Revision 0, established a channel uncertainty value of 2.37%, which exceeds the uncertainty value of 2.1% provided in the WCAP. This was due to different transmitter manufacturers used in the calculations. WCAP 11082 supports Barton 332 pressure transmitters which have been replaced, whereas J-98 supports the existing Rosemount 1154DP transmitters. The licensee indicated that Calc J-98 is considered temporary until such time when WCAP 11082 is updated to incorporate the Rosemounts. As a result of Calc J-98, the uncertainty of the Rosemounts exceeded those of the Bartons but the calc justified that there is sufficient margin to warrant the use of existing setpoints and TS values. WCAP 11082 is scheduled to be updated after approval of licensing amendment request LAR 96-10 for a 21-month refueling cycle extension. The licensee is committed to ensure correct instrument data is reflected in this update.

Based on the team's review, adequate setpoint margin has been provided in the actuation of the ASW system from the containment high pressure signal.

b. **ASW/CCW RG 1.97 Instrumentation**

There is no specific RG 1.97 I&C requirement for the ASW system. However, the RG requirements apply to the CCW interface system. UFSAR Section 7.5 and Table 7.5-6, DCM T-24, and letter DCL 93-284 provide the design bases for the CCW RG 1.97 instrumentation. Required instrumentation consists of main control room indication for CCW flow to the vital supply headers and CCW heat exchanger outlet temperature.

One CCW flow indicator is provided in the main control room for each vital header (loops FT-65 and FT-68). Outlet temperature indicators (loops TE-6 and TE-7) for CCW Heat Exchangers 1-1 and 1-2 are also provided in the control room. RG 1.97 requires these instrument loops to be designed as Type D, Cat. 2, variables requiring a standby power source. The team reviewed scaling calculations SC-M-14-T6, "Instrument Scaling Calculation CCW Heat Exchanger Outlet Temperature Channels TE-6 & TE-7," Revision 1, and SC-M-14-F68, "Instrument Scaling Calculation CCW Supply Headers A and B Flow Channels FT-68 and FT-65," Revision 0, uncertainty calculation PAM-0-0-001, "Misc. Post-Accident Monitoring Indication Uncertainty," Revision 3; design documents; and as-built condition with respect to indication range, calibration span, accuracy and power supply for these instrumentation. The team verified that both the CCW flow and temperature instrumentation met the licensee's commitment to RG 1.97.

c. ASW/CCW Instrument Loop Accuracy, Scaling and Setpoint Calculations

The team reviewed the setpoint methodology and uncertainty calculations for the following instrument loops to verify that adequate tolerance for instrument error has been incorporated in the design:

1. CCW Heat Exchanger high and low differential pressure
   a. NSP-1-17-15, "CCW Heat Exchanger High DP Alarm," Revision 2
   b. NSP-1-17-15A,"CCW Heat Exchanger Low DP Alarm," Revision 2

2. CCW Heat Exchanger discharge temperature
   a. NSP-1-14-181A, CCW Heat Exchanger High Alarm Setpoint Uncertainty," Revision 0
   b. NSP-1-14-181B, CCW Heat Exchanger Low Alarm Setpoint Uncertainty," Revision 0

3. ASW Discharge Flow and Temperature Indication
   a. C-M-26-1, "ASW Flow Annubar Uncertainty," Revision 0
   b. J-103, "ASW byp. piping PME temp. and Flow channel Indic. Uncertainty," Revision 1

4. ASW Pump vault high level alarm
   a. SC-L-17-22A, "Instrument Scaling Calculation Auxiliary Saltwater Pump Room High Water Level Switches LS-355 and LS-356," Revision 0

5. Ocean Temperature
   a. SC- M-17-T10, "Instrument Scaling Calculation Circulating Water Pump 1-1 Discharge Temperature Channel TE-10," Revision 0

The team's review determined that the above calculations adequately demonstrated instrument capability to perform its intended function. However, an inconsistency was noted between calculations NSP-1-17-15 and NSP-1-17-15A, concerning the use of bias error due to static pressure effects in the loop uncertainty calculation. Since both CCW heat exchanger high and low DP alarm loops PS-45/46A and PS-45/46B derive input signals from a common DP transmitter, the static pressure effect applies to both loops. This error term was assumed as a zero value in NSP-1-17-15. Based on the licensee's evaluation, the effect would be on the conservative side, therefore, there is no safety impact. The licensee acknowledged this error and noted that calculation NSP-1-17-15 would be revised.

d. Ocean Temperature Monitoring

Procedure STP I-1A, "Modes 2 and 3 Shift Checklist," relies on the ocean temperature indication for operator action to manually initiate operation of the redundant CCW heat exchanger. Ocean temperature is indicated by TI-311 and TI-328 on the control room vertical board. These indicators are not RG 1.97 qualified, classified as Class II, not seismically qualified and are not connected to standby power. TI-311 measures temperature downstream of the circulating water pump, so on a loss of power to the pump it would not provide accurate indication of ocean temperature. TI-328 measures temperature in the ocean bay upstream of the ASW intake. Although not mentioned in the procedure, a multi-point temperature recorder (loop TE-68) is available near the hot shutdown panel to indicate ocean temperature through a separate sensor located upstream of the bar racks. This recorder is powered from an emergency bus and will provide an alternate method of indication. This design assures that ocean temperature indication

is available through diverse channels, including accessibility of similar instrumentation in Unit 2. A note on page 9 of procedure STP I-1A instructs the operator to obtain corrected Pacific Ocean temperature from Unit 2 instrumentation if no circulating water pumps are operating. Although not required to be safety related, reliable indication of ocean temperature should be available to the operator if needed.

e. TS and DCM Discrepancies

TS 3/4.3.1 and 3/4.3.2, page B3/4.3-1, 4th par., ESFAS, lists those actions that are initiated by the ESFAS to mitigate the consequences of a steam line break or loss of coolant accident. However, initiation of the ASW as described in UFSAR Sec. 7.1.2.1.2.2 is not referenced. The actual design complies with the UFSAR. This issue does not constitute a safety concern since the licensee's design, drawings, and testing included the initiation of ASW by the ESFAS signal. The licensee concurred with this discrepancy and issued AR A0442762 to initiate corrective action to clarify the TS basis.

TS 3/4.5.5, page 3/4 5-11, RWST Surveillance Requirements, describes verifying the RWST temperature to establish operability during low outside ambient temperature conditions. However, TS bases 3/4.5.5, page B3/4 5-7, only mentions RWST volume and boron concentration as a requirement for operability. As indicated in the UFSAR and surveillance procedure STP R-20, temperature is verified along with boron concentration when performing surveillance of the RWST. This issue does not constitute a safety concern and the licensee will track this issue for correction as part of a planned effort to standardize the DCPP TS. This item is identified as the second example of URI 50-275/97-202-05, Discrepancy in Design Documentation.

E1.2.3.3 Conclusions

The instrumentation and control design for the ASW/CCW system was considered adequate. The above findings do not constitute any operability concerns. Weaknesses were observed in maintaining consistency between the UFSAR, Technical Specification, Design Criteria Manual and associated design documents. The licensee's resolution of issues raised by the team are being addressed through their corrective action system.

E1.2.4 System Interface

E1.2.4.1 CCW Heat Exchanger

To verify the heat load required to be removed by the ASW system and be transferred to the UHS, the team reviewed portions of DCM S-14, "Component Cooling Water System," Revision 04; CCW calculations M-305, 910, 938; and Westinghouse analysis WCAP-14282 and PGE 96-503 associated with the CCW system. The issues related to determining the heat load for the CCW system and the team's evaluation is addressed in Section E1.2.2.2.2.

E1.2.5 System Walkdown

E1.2.5.1 Scope

The team inspected the installed mechanical, electrical, and instrumentation and control equipment for the ASW system to evaluate their consistency with drawings, design specifications, and regulatory requirements. During the walkdown the team interviewed plant system engineers, and operations and maintenance personnel. The team walkdown covered the Intake Structure, CCW heat exchanger room in the Turbine building, control room, auxiliary shutdown panel, cable spreading room, switchgear rooms, battery rooms and electrical distribution panels.

E1.2.5.2 Findings

a. Intake Structure and CCW Heat Exchanger Room

During walkdowns of the Intake Structure and Turbine Building and questioning of licensee personnel, the team verified adequate equipment installation design related to train separation, seismic interaction, internally generated and externally generated missiles, and protection of Intake Structure and snorkels against tornado and winds. Additionally, the team verified that, (1) the location of snorkels and ducts maintained adequate cooling for ASW pump motors during high tide and floods, (2) clogging and silting of the pump bay had been evaluated and considered in the design, and (3) flooding had been adequately considered in ASW pump vault design. The team verified that flooding had also been addressed in the CCW heat exchanger room design and effects of high energy line breaks in the vicinity were considered.

b. CCW Pumps

The CCW pump area walkdown indicated some unidentified debris accumulated in the 1-3 pump inboard seal housing enclosure. The material did not appear to interfere with current pump operation. The licensee initiated actions for Maintenance to clean up the materials in the seal housing during the next shutdown of the pump.

c. ASW Pump Discharge Pressure Indication

During the walkdown of the ASW pump vault, the team noted the Unit 1 ASW pump discharge pressure at 30 psig, as indicated by PI-452. The corresponding reading on the Unit 2 pump was at 50 psig, as indicated by PI-452 (Unit 2). The team questioned the large deviation in the readings, considering that Units 1 and 2 are similar in design. The system engineer concluded that Unit 1 was reading lower than normal (48 psig), which could be associated with the instrumentation since all other pump parameters were within specification. As a resolution, AR A0441411 was issued to initiate investigation and subsequent corrective action.

d. Instrument Tubing Slope.

During a walkdown of the ASW pump area, the team noted that instrument tubing for ASW pump discharge pressure instruments PI-452/454 were not sloped per DCM T-38, "Criteria for Design of Instrument Tubing and Supports," Revision 1. In response, the licensee stated that this condition had been previously identified and evaluated with corresponding justification included

under Engineering Report DVR 5W, dated 3/17/91 and Quality Evaluation QE Q0009595, dated 9/8/92. Based on the team's review of the reports, this issue has been properly addressed.

e. ASW Pump Header Pressure Switches Below Flood Level

The team made the following observations regarding the ASW pump header pressure switches PS-185A and PS-186A:

1. Both instruments were mounted approximately 5' above the corresponding pump vault floor. This elevation was below flood level and the pressure switches could be submerged, resulting in a fault in the pump control circuit that could cause the redundant pump not to start. These instruments are non safety related but they are connected to the safety related class 1E pump control circuit such that flooding of a pump vault concurrent with a ground fault in the battery system could render the redundant pump inoperable. Acceptability of this condition was not addressed in DCM S-17B, "Design Criteria Memorandum, Auxiliary Saltwater System ," Revision 4.

2. Train A pressure switch PS-185A is located in ASW pump room B, and likewise for train B pressure switch PS-186A in pump room A.

The licensee acknowledged these observations and initiated the following corrective actions:

1. Issued AR A0441809 to document the condition and evaluate operability of the ASW system. A Prompt Operability Assessment (POA), included in the AR, provided the following justification as to why the condition did not affect system operability:

   - A detailed walkdown was performed and verified that the pressure switches are seismically mounted (Ref. Calc. IS-45, Revision 6). Failure mode during a seismic event will not short the contacts to ground but will cause starting of the redundant pump, which is conservative. An open pressure switch will not prevent the ASW from performing its safety function since a separate SI start path is provided.

   - Existing control room procedures are in place to identify and mitigate potential DC bus grounds in a timely manner such that any significant DC ground is not considered concurrent with a moderate energy line break in a pump vault. Due to the heat storage capacity and mass of water in the CCW, temperature would increase slowly such as to allow enough time for operator action to restore ASW flow.

   - Existing manual start switches with separate fuses at the switchgear can be used to restore ASW flow.

2. Issued AR A0442005, initiating a design change to install isolation fuses in the pressure switch circuits to address the 1E to non-1E auto-start interlock with the ASW pumps. This method is considered acceptable at DCPP and will not require revising DCM S-17B or upgrading the instruments to safety related classification. Implementation of the design change, scheduled during the next refueling outage for both Units 1 and 2, will close both ARs A0441809 and A0442005.

Based on the licensee's operability review and tracking of correction actions, the team found the licensee's actions acceptable.

E1.2.6 Updated Safety Analysis Report

The licensee had initiated a Licensing Bases and Design Bases Program (LBADB) in early 1997 to review and update the UFSAR. Action Request (AR) forms were prepared for the identified questions or concerns in the UFSAR related to the ASW system. Some of the AR forms were provided to the team for information. The team identified the following additional discrepancies:

- Section 9.2.2.1 states "Based on design basis accident heat load, one of the following four conditions must be satisfied as a minimum to maintain the ASW system design basis." Instead of "ASW" the statement should have read "CCW." AR A0441163 has been written to track the preparation of an UFSAR update change request.

- Various updates to the UFSAR will be necessary with revision of WCAP-14282. These are tracked by DCPP under AR A0439116

E1.3 Containment Spray (CS) System Design Review

E1.3.1 Mechanical

E1.3.1.1 Scope of Review

In evaluating the mechanical design of the CS system, the Inspection Team evaluated the capability of the system to provide containment spray during the injection phase of post-accident ECCS operation and the capability of the RHR system to provide spray during the recirculation phase of ECCS operation. The team reviewed design criteria memorandum S-12, Revisions 3 and 4 for the CS system, UFSAR sections 6.2 and 15.4, drawings, calculations, and normal and emergency operating and surveillance testing procedures. The team also performed system walkdowns and discussed the system design and installation with licensee engineering and operating personnel.

E1.3.1.2 Findings

a. Containment Spray during Post-LOCA Recirculation with One RHR Pump

The team reviewed the RHR system capability to support containment spray during post-LOCA with only one RHR pump (single failure) in operation. The team determined, based on a newly generated licensee calculation, that the RHR system may have the capability to provide containment spray during post-LOCA recirculation if core cooling is throttled. Extensive discussion on this issue follows.

The current UFSAR Section 3.1.8.16 specifies that the Containment Heat Removal System, designed to comply with the July 1967, GDC 52, consists of the Containment Spray (CS) and Containment Fan Cooler (CFC) Systems. UFSAR section 6.2.2.2.2.1 specifies that during the recirculation phase of the accident "recirculation spray suction is provided by the RHR pumps, which draw suction from the containment sump." Technical Specification 3.6.2.1 specifies that

the CS system shall be operable with each spray system capable of taking suction from the RWST and of transferring the spray function to the Residual Heat Removal (RHR) system taking suction from the containment sump.

By design, the RHR system provides the recirculation phase of containment spray by taking suction from the containment sump and discharging into the CS system piping and spray headers downstream of the CS pumps. The RHR system also provides core cooling by injecting flow into the RCS (LHSI) and providing the suction source for the HHSI and SI pumps ("piggy-back").

In December 1991, the licensee discovered (LER 1-91-018) that the heat loads placed on the CCW system by two trains of RHR in the event of an accident with a loss of a single train of ASW would be unacceptable. The CCW system heat loads could be brought to within design limits by operating with only one train of RHR. Since the containment spray function is assumed by the RHR system during recirculation, PG&E believed that one RHR pump could not provide both adequate core cooling flow and containment spray flow simultaneously. No engineering calculation was performed to substantiate this belief, but it was felt to be an obvious conclusion based on pump curves and flow path resistances. Additionally, the licensee did not have a calculational basis for the original assumed ability of the RHR system to provide the containment spray function during the recirculation phase of the accident after a single failure occurred. Based on the new data (LER 1-91-018), PG&E initiated changes to the UFSAR to re-classify the containment spray function during recirculation as non-safety related, revised EOP E-1.3 to prohibit spray during recirculation with only one RHR pump in operation, and eliminate the UFSAR requirement to operate spray for a minimum of 2 hours. Westinghouse was requested to reevaluated the containment analysis to verify that two of the five containment fan coolers could remove the containment heat without the need to spray the containment using the RHR pump aligned to the containment sump. The team's review of the Westinghouse containment reanalysis is discussed in Section E1.2.1.2.c of this report.

Even though the LER only described single failure effects on the RHR system by a loss of ASW and CCW system capacity, this situation could also occur if there was a single active failure of an RHR pump during the injection phase or the loss of a single electrical bus as described in Section E1.2.1.2.d of this report. Additionally, since the licensee change essentially eliminated the containment spray function during the recirculation phase, the inspection team questioned the ability of the CS system to meet the TS requirements.

During the inspection, the licensee performed calculation STA-075 entitled; "Minimum ECCS Flow and Minimum Recirculation Spray Header Flow," dated August 29, 1997, to demonstrate that containment spray and core cooling could both be performed by a single RHR pump during recirculation. This calculation determined that by reducing RHR (LHSI) flow to the core the RHR pump could provide flow to the CS spray header. The decision to reduce ECCS capability in order to provide CS was at the discretion of the technical support center (TSC). Minimum available core cooling flow was calculated to be 1200 gpm with a corresponding available spray flow of 1000 gpm. However, the licensee's analysis did not determine the minimum required spray flow needed during the recirculation phase of operation since the containment analysis no longer depended on spray flow. The minimum required core cooling flow at the beginning of recirculation was determined to be 765 gpm based on a Westinghouse analysis, NSAL 95-001, "Minimum Cold Leg Recirculation Flow - ECCS Analysis" dated January 20, 1995. This Westinghouse analysis specified that a flow to the core equal to 1.2 times the core boil-off caused by decay heat was required.

b. Revision 9 to EOP E-1.3

The team reviewed the safety analysis performed to issue Revision 9 to EOP E-1.3; "Transfer to Cold Leg Injection." The team determined that this safety analysis failed to recognize that by prohibiting containment spray during recirculation if only one RHR pump was available they were also dealing with a newly discovered consequence of the single failure of the RHR pump. The team considered this to be a potential unanalyzed consequence of the malfunction of equipment important to safety.

In December 1991, PG&E determined that they should prohibit the containment spray function during recirculation if only one RHR pump is in operation. To do this, they prepared and issued Revision 9 to EOP E-1.3. As part of the revision process, the Operations Department completed a Safety Evaluation Screen Checklist (NPAP C-19/NPG-4.3) for Revision 9 on December 13, 1991. All screening questions were marked "no" and therefore no 50.59 safety evaluation was performed. Revision 9 of E-1.3 was then issued on December 13, 1991. Westinghouse, at the request of PG&E, subsequently completed a Nuclear Safety Evaluation Check List (SECL-91-458, Revision 1) on January 10, 1992. This Westinghouse evaluation concluded that the revision to E-1.3 did not result in an unreviewed safety question but one of the evaluation questions was marked "yes." Specifically, the question: "A change to procedures as described in the UFSAR?" was marked "yes." This led Westinghouse to perform a complete safety evaluation and recommend a change to UFSAR Table 6.3-5.

In the same time period, PG&E performed Operability Evaluation (OE) 91-15 (entitled; "CCW System Temperature During Post LOCA Reactor Coolant System Cold Leg Recirculation") which was issued on December 23, 1991 (Revision 0). This OE was required by station administrative guidelines to "sponsor" Revision 9 to E-1.3 and included a safety evaluation. This safety evaluation and the one performed by Westinghouse considered the following technical issues involved with the decision not to use containment spray during recirculation with only one RHR pump in operation and concluded that there were no safety concerns:

- There are no increases in the offsite or control room post-LOCA doses since the iodine is completely removed from the containment atmosphere by the CS system during its injection phase. In addition, the containment pressure is still reduced to one half its peak value within 24 hours so there is no increase in containment leak rate and resultant doses.

- The peak containment pressure is reached during the injection phase and long term containment pressure is controlled by the fan coolers and never required the use of containment spray. The fan coolers are capable of bringing the containment pressure to one half its peak value within 24 hours as required by the design basis without the use of containment spray.

- The lack of containment spray during recirculation alters the long term containment temperature/pressure profile. The altered profile has no impact on the environmental qualifications of the equipment inside containment.

Other technical issues not mentioned in the safety evaluations but discussed with the Inspection Team are as follows:

- Containment sump pH is not affected since all the NaOH in the Spray Additive Tank is pumped into the containment by the CS pumps during the containment spray injection phase.

- Long term post-LOCA hydrogen mixing in the containment has always been done by the fan coolers. The containment spray was never necessary for hydrogen mixing during recirculation.

These technical arguments are valid and appear to establish that the lack of containment spray during recirculation is acceptable and has no effect on the ability of the station to mitigate the consequences of a design basis accident.

The problems noted by the Inspection Team in the above safety evaluations involved the following: The Operations Department did no safety evaluation for Revision 9 to EOP E-1.3 before it was issued because their screening was in error. Westinghouse did a safety evaluation for the revision after it was issued and concluded that there was no unreviewed safety question but recommended an UFSAR change. In spite of this Westinghouse recommendation, PG&E did not change UFSAR Table 6.3-5. The Westinghouse safety evaluation and the one associated with OE 91-15 performed by PG&E both failed to recognize that TS 3.6.2.1 required that the RHR system provide the long term containment spray function during the recirculation phase of the accident. Additionally, the newly discovered consequence of the single failure of an RHR pump could also be considered to be an unanalyzed consequence of the malfunction of equipment important to safety. The Inspection Team considered this issue to be a potential unreviewed safety question that should have been brought to the attention of the NRC for review when the LER condition was discovered. This item is identified as URI 50-275/97-202-10, Potential USQ and TS Adherence Associated with Containment Spray During Containment Recirculation.

c. Recent Safety Evaluation on Containment Spray during Recirculation

Because of the concerns expressed by the Inspection Team with regard to the change in the original design basis as to containment spray during post-LOCA recirculation, PG&E prepared a new consolidated safety evaluation. The new safety evaluation was titled; "10 CFR 50.59 Safety Evaluation for Reclassification of Containment Spray During the Recirculation Mode of Safety Injection As a non-safety-Related Function." The purpose of the document is to ."....... consolidate, validate, and update ......" the contents of the three safety evaluations done in 1991/92 as part of the process to issue Revision 9 to EOP E-1.3 (prohibit containment spray with only one RHR pump in operation) and to remove the "2 hour" statement from the UFSAR. The new safety evaluation attempts to address two points; (1) the potential unavailability of containment spray during recirculation, and (2) the use of containment spray during recirculation under TSC direction with only one train of RHR in operation. This safety evaluation therefore does not replace any of the safety evaluations done in 1991/92 but is a new evaluation using PG&E's latest information such as Calculation STA-075. This calculation was done in response to issues raised by the Inspection Team and shows that, in fact, the RHR system can provide limited spray during recirculation with only one pump in operation with restricted flow to the core.

The Team determined that the licensee's response to Question 4 in this new safety evaluation involving the probability of occurrence or consequences of a malfunction of equipment important to safety previously evaluated in the SAR was marked "No." The limitations on the use of containment spray during recirculation with only one RHR pump in operation were never

addressed in any revision of the UFSAR and therefore are a new ramification of the previously evaluated consequences of the single failure of an RHR pump. Additionally, as specified in 10 CFR part 50.59, a change to the facility or procedures specified in the UFSAR can not be made without prior Commission approval if it involves a change in the TS or is a USQ. The NRC is currently evaluating whether the licensee's change involved a USQ and whether a change to the TS should have been requested prior to the change. This item is included as part of URI 50-275/97-202-10, Potential USQ and TS Adherence Associated with Containment Spray During Containment Recirculation.

e. CS Pump Testing and Acceptance Criteria

The team reviewed DCM No. S-12, TS 3/4.6.2.1, Calculation N-085 (entitled "Containment Spray Profile" Revision 0 dated 6/28/93), and Surveillance Test Procedures STP P-CSP-11, 12, 21 and 22. The team verified the adequacy of the regular surveillance test done for the CS pumps and its acceptance criteria to demonstrate pump performance. The team determined that the STP satisfies TS 3/4.6.2.1 requirements and provides assurance of satisfactory pump performance as required by ASME Section XI.

E1.3.1.3 Conclusions

The Inspection Team concluded that the CS system was designed and tested to provide the design basis flows during the injection phase of post-accident recovery. The team also concluded that the RHR system, even with only one pump in operation, could provide the necessary core cooling flow and some quantity of containment spray during the recirculation phase. The licensee considers the ability to provide containment spray during recirculation to be technically unnecessary.

The Team considers the licensing methodology employed by the licensee to re-classify the containment spray function during recirculation as non-safety related and to prohibit spray during recirculation with only one RHR pump in operation to be a potential USQ requiring further NRC review. Additionally, essentially abandoning a TS required function should have occurred only after changing the plant TSs.

E1.3.2 Electrical

The electrical discussion in Section E1.2.2 of this report covers the electrical design review of the CS system.

E1.3.3 Instrumentation and Control

E1.3.3.1 Scope of Review

The scope of the instrumentation and control design assessment consisted of a review of the CS system design and associated documents. Interfacing portions of the RHR system were also reviewed. Documents that were reviewed included Chapters 6 and 7 of the UFSAR, technical specifications, design criteria memorandum, piping and instrument schematics, electrical schematics, logic diagrams, 15 calculations, PIMS database, 2 surveillance procedures and 1 operating procedure. System walkdowns and interviews with plant personnel were also conducted to verify as-built design.

E1.3.3.2 Findings

The system design documents reviewed by the team adequately supported the design bases, except for the items discussed in the following paragraphs:

a. ESFAS Initiation of CS System

The team reviewed the setpoint methodology and instrument uncertainty calculations for the ESFAS actuation of the CS system. A high-high containment pressure (P)signal from the ESFAS concurrent with a Safety Injection (S) signal automatically initiates operation of the CS pumps. The team verified that plant procedures properly calibrated the instruments to the TS trip setpoint values.

The team did however, note a discrepancy in DCM S-12, Section 4.3.1.g, which provided a description of the initiating signal for the CS system. The DCM section described only the "P" signal for automatic actuation of the CS system. According to UFSAR Chapter 7 and Logic Diagram 4014233, a coincident "P" and "S" signal is required to initiate automatic actuation, which is consistent with the design documents. This discrepancy has no safety impact. The issue involves an inconsistency between the design criteria document and the UFSAR. The licensee concurred and noted that AR A0438244 resolution will correct the DCM. This item is identified as the third example of URI 50-275/97-202-05, Discrepancy in Design Documentation.

b. CS System RG 1.97 Instrumentation

UFSAR Section 7.5, UFSAR Table 7.5-6, DCM T-24, "Diablo Canyon Power Plant Instrumentation and Controls," Revision 2, and letter DCL 93-284 provide the design bases for the CS system RG 1.97 instrumentation. Required instrumentation consists of CS pump flow and RWST level indication in the main control room.

One containment spray flow indicator is provided on Main Control Room Panel PAM1 for each CS pump (FI-931and FI-932). RG 1.97 requires CS pump flow instrumentation to be designed as a Type D, Cat. 2, variable requiring a class 1E power source. Three redundant RWST level indicators (LI-920, 921 and 922) are provided in the main control room. RG 1.97 lists RWST level instrumentation as Type D, Cat. 2. However, DCPP upgraded them to a Type A, Cat.1 variable requiring redundancy and full Class 1E qualification. The team reviewed scaling calculations SC-I-9-L920, "Instrument Scaling Calculation Refueling Water Storage Tank 1-1 Level Channel LT-920," Revision 1; SC-I-9-L921, "Instrument Scaling Calculation Refueling Water Storage Tank 1-1 Level Channel LT-921," Revision 1; SC-I-9-L922, "Instrument Scaling Calculation Refueling Water Storage Tank 1-1 Level Channel LT-922," Revision 1; "Scaling Calculation RWST 1-1 Level Channel LT-920/921/922," Revision 1; uncertainty calculation PAM-0-09-920, "Normal Operation and Post Seismic RWST Level Indication Uncertainty," Revision 4; EQ Reports IH-24 and IH-32; and design documents and as-built condition with respect to indication range, calibration span, accuracy, qualification and power supply for this instrumentation. During a walkdown of the control room, the team identified a discrepancy between RG 1.97 and DCM T-24 in regard to "PAMS" labeling of instruments on Panel PAM1. Labeling was consistent with RG commitments, however, AR A0443473 was issued to correct the DCM.

The results of the review verified that both the CS pump flow and RWST level instrumentation met RG 1.97 commitments.

c. RWST Level Instrumentation

TS Section 3/5.5 requires a minimum contained volume of 400,000 gallons with a 2300 to 2500 PPM boron concentration in the RWST for the post-LOCA injection function. Three redundant level instrument loops (LT-920, LT-921 and LT-922) provide input for indication, trip the RHR pumps on Low RWST level and a low-low level alarm to signal depletion of the RWST. Boron concentration is verified through manual sampling and chemical analysis (Ref. Procedure STP R-20, "Boric Acid Inventory," Revision 17). Setpoint bases for the RWST is provided under Westinghouse PLS document, "Precautions, Limitations and Set Points for Nuclear Steam Supply Systems," Revision 9, Document DC 663229-47-10. The PLS provided setpoints and tolerances in gallons of level for the following; HI level alarm, LOW level alarm and RHR pump trip with an alarm, and LO-LO level alarm.

RWST volume scaling calculation TV-9-2, "Scaling calculation for RWST," Revision 3, and transmitter scaling calculations SC-I-9-920 through SC-I-9-922 translated the above Westinghouse PLS values to % level. In addition, the team also reviewed uncertainty calculation PAM-0-09-920," Normal Operation and Post Seismic RWST Level Indication Uncertainty," Revision 4, and J-54,"Nominal Setpoint Calculation for Selected PLS Setpoints," Revision 10, the PIMS database, and the instrument calibration data sheets. The team determined that the RWST level transmitters were properly spanned, compensated, and calibrated to account for boron concentration and differences in elevations. Additionally, the team verified that adequate margin has been provided in the determination of setpoints and indication accuracy of the RWST level instruments.

d. Spray Additive Tank (SAT) System Instrumentation

The SAT system instrumentation was assessed to verify its capability to measure the amount of sodium hydroxide solution that is added to the containment spray. Level instrumentation loop LT-931 measures SAT volume by monitoring hydrostatic pressure, which is not linear with the tank volume (consists of a horizontal cylinder with spherical ends). A correlation between indicated level and contained volume was established by TV-12-1, "Scaling Calculation for Spray Additive Tank 0-1," Rev.0. TS Section 3/4.6.2 requires a SAT contained volume of between 2025 and 4000 gallons of solution containing between 30 and 32% NaOH by weight, to ensure the proper pH value for recirculated solution in the containment. A low SAT level equal to or less than 60% +/-1%, as established by the Westinghouse PLS document, is alarmed in the main control room. Per calculation J-54, calibration of this instrument loop results in an alarm setpoint that corresponds to 2570-2707 gallons contained volume in the SAT. The DCPP design does not provide a LO-LO SAT level alarm to alert the control room when the tank contents have been exhausted.

UFSAR Section 6.2.3.5.3, Spray Additive Tank Instrumentation, states that two alarms are provided to announce that the SAT solution has been exhausted. Based on a verification of control room annunciator layout drawing 500808 and the as-installed condition, only one alarm exists which is on window group PK01. Also, contrary to the UFSAR description, this alarm is to announce that the TS level of 60% in the SAT has been reached, instead of being exhausted. This discrepancy also affects Instrument Schematic 102033 Sh. 18 and DCM S-12, par. 4.3.9.1.

The licensee concurred with this discrepancy and issued AR A0442941 to revise the UFSAR, Instrument Schematic and DCM S-12. The licensee does not consider that a tank LO-LO alarm is necessary for CS pump protection since emptying of the SAT and injection of gasses into the system will not have an adverse effect. Therefore, the existing design which consists of one alarm, provides sufficient information to evaluate the condition of the SAT in accordance with system design and the TS. The licensee plans to document their technical review of this issue in their safety evaluation that will be performed to revise the UFSAR. This item is identified as the fourth example of URI 50-275/97-202-05.

There is no installed instrumentation to measure chemical concentration in the SAT. Concentration is verified through chemical analysis under procedure C-1, "Spray Additive System Chemical Inventory."

In addition to tank level, spray additive flow indication (loop FT-930) is also provided in the main control room to monitor operation of the SAT. Level instrument calibration and setpoint data were determined under calculations TV-12-1, LT-12-2, "Spray Additive Tank 1-1 Level Channel 931Calibration," Rev. 1, and LT-12-5, "Spray Additive Tank Level Channel LIC-932 Calibration," Rev. 2. Channel uncertainty is determined by calculation J-54, "Nominal Setpoint Calculation for Selected PLS Setpoints," Rev.10. SAT flow calibration was determined under SC-M-12-F930, "Instrument Scaling Calculation Spray Additive Tank 1-1 to Eductors Channel FT-930," Rev.0. Based on a review of these calculations, the PIMS database and a verification of the instrument installation, the team found the SAT instrumentation to be adequate.

The team noted the following calculational discrepancy during review of the SAT instrumentation:

> Scaling Calculation SC-L-12-1, "Instrument Scaling Calculation Spray Additive Tank 1-1 to Eductors Flow Channel FT-930" appears to be redundant with Scaling Calculation SC-M-12-F930. Both calculations have the same title and similar results but no references or superseding notes are indicated in either calc. Based on discussions with the licensee and as noted in another calculation (N-070), SC-M-12-F930 should replace SC-L-12-1. The licensee indicated that SC-L-12-1 will be deleted.

E1.3.3.3 Conclusions

The instrumentation and control design for the CS system was considered adequate. The above findings do not constitute any operability concern as all setpoints that were reviewed have adequate margin and the technical specification limits are not exceeded. Discrepancies in the Post Accident Monitoring instrumentation were limited to documentation errors that do not affect the capability of the system. Weaknesses were observed in the UFSAR and calculations, specifically, in keeping these documents current and consistent with the as-built design.

E1.3.4 System Walkdown

E1.3.4.1 Scope

The team inspected the installed mechanical, electrical, and instrumentation and control equipment for the CS system to evaluate their consistency with drawings, design specifications, and regulatory requirements. During the walkdown the team interviewed plant system engineers,

and operations and maintenance personnel. The team's walkdowns covered the CS system pump rooms, control room, auxiliary shutdown panel, cable spreading room, switchgear rooms, battery rooms and electrical distribution panels.

E1.3.4.2 Findings

a. CS Pumps

The team noted boron accumulation in the pump seal leakage collection housings for the CS pumps. The outboard seal for pump 1-2 was recently replaced and there was a small amount of boron in the housing from the repair activity in addition to residue from expected minor shaft leakage during required surveillance runs. However, Pump's 1-1 outboard seal had more significant accumulation than typically expected. The licensee responded that pump 1-1 seal leakage was above the DCPP acceptable rate, and a seal replacement work order was in place to schedule the activity during the week of September 8, 1997. The seal collection housing material is stainless steel and minor accumulation of boron is acceptable. Some leakage and accumulation is expected when each pump is run for maintenance or surveillance. The seal was replaced during the inspection period. However, the new seal installation was incorrect and the pump area was sprayed with borated water. AR A0443429 documented the problem and facilitated rework. Subsequent testing verified acceptable seal performance. The AR's corrective actions included the need for a licensee review of the seal replacement maintenance work package to assure that future replacements will be acceptable without rework.

b. RWST Level Local Indication

During the plant walkdown of Area J, elevation 100', the team noticed the local RWST level indicator, LI-964, reading at 98% level. The RWST instrumentation is designed to provide a high level alarm at 96% level. During a subsequent walkdown of the control room, no indication of a high level alarm condition was noted although local indicator LI-964 had exceeded the setpoint. The licensee acknowledged that there had been a similar condition in Unit 2, where a high alarm appeared inconsistent with indicated level due to instrument calibration tolerances overlapping as a result of operations requirement to maintain RWST level higher than normal. This condition had been addressed in AR A04279229, dated April 1997. This observation had no safety significance since there are redundant RG 1.97 RWST level indicators FI-920, FI-921, FI-922 in the control room.

c. SAT Level Indication

The team noted that the SAT nitrogen pressure gage PI-972 range was "-30 to +30" but had no units of measure. This gage is monitored daily on operator rounds to ensure a nitrogen blanket pressure on the SAT of 5 psig. The licensee responded that this gage, calibrated 30" vacuum to 30psig, was originally furnished with no units on the indicator scale by Westinghouse, although Vendor drawing DC 663230-119-8 PG. 9 shows a range of "30"-0-30#." It appears that plant operations is cognizant of this condition and considers the existing indicator acceptable.

d. Instrument Tubing

During a walkdown of the CS pump and SAT area, the team noted that the CS pump instrumentation tubing was not sloped properly or not provided with vent or drain valves.

Specifically, those instruments in question were pressure instruments PI-933A, PI-933B, PI-933C and PI-933D. Industry standards and DCPP's requirements are defined in DCM T-38, which provide design guidelines for instrument line slopes, vents and drains. In response, the licensee stated that this condition had been previously identified under AR A0265124 on a generic basis. Due to its generic impact, Engineering Report DVR 5W, dated 3/17/91 and Quality Evaluation QE Q0009595, dated 9/8/92, were initiated to perform detailed walkdowns to document and justify existing instrument tubing installations that deviated from DCM T-38. These reports evaluated as-built installations which included deviations such as zero or negative tubing slopes, missing vents and drain valves, missing clips, and supports exceeding the required span. Based on a review of the reports, the team concluded that the issue was properly addressed.

e. RHR Heat Exchanger Flow Instrumentation

RHR heat exchanger CCW flow instrument loops F-85 and FI-88 provide signals for flow indication and high/low flow alarms. The team noted that the high and low taps for these instrument loops are located on a pipe elbow in a vital CCW supply line. Since installation of taps on pipe elbows is not common practice, the team reviewed applicable calculations J-048, "Flow Element Pipe Elbow Type for FIs-85 and 88," Revision 2 and NSP-1-14-84, "RHR Heat Exchanger High CCW Flow Alarm Setpoint Uncertainty," Revision 0, to verify suitability of this type of configuration. Based on the team's review, the design is considered adequate for the intended function and accuracy of the instrument loops.

E1.3.5 Updated Safety Analysis Report

As a result of a review of the UFSAR, the team noted the following discrepancies:

- UFSAR Section 6.2.3.4.1, page 6.2-45, Component Testing, mentions provisions for testing SAT tank high pressure and low level alarms. The tank high pressure alarm does not exist in the I&C design.
- UFSAR Section 6.2.2.2.1, page 6.2-22, Containment Spray, describes the initiating signal for the CS system. The UFSAR description does not mention the role of the "S" signal in the CS actuation. As described in Chapter 7 of the UFSAR, DCM S-12, and various design documents, CS is actuated upon a coincident "S" and "P" signal.
- UFSAR Section 6.2.2.5, page 6.2-31, CS Instrumentation, describes the requirement for measuring containment spray nozzle flow. This section needs to be clarified since the existing instrument configuration can only measure nozzle flow when spraying from the CS pump but not from the RHR system.

These discrepancies have no safety impact. The issues involve inconsistencies in the UFSAR and various I&C design documents. ARs A0441540 and A0442684 were issued to initiate UFSAR and other design document corrections.

E1.4 Containment Fan Cooler System Design Review

E1.4.1 Mechanical

E1.4.1.1 Scope of Review

The team performed a design review inspection of the Containment Fan Cooler (CFC) system in support of the verification of DCPP's capability for heat removal to reduce containment pressures and temperatures following a LOCA or MSLB. For the mechanical design review of the CFC system safety functions following a design bases accident, and requirements for the system to support normal plant operations, the team evaluated DCPP's licensing and design basis documentation. The team reviewed UFSAR sections 6.2, 9.2.2, and 15.5.17 related to the CFC and CCW systems; Technical Specifications sections 3 and 4; DCM S-23A, Revision 4, Containment HVAC System; Portions of DCM S-14, Revision 2, CCW System as related to the CFC system; drawings; related calculations for both CFC and CCW systems; and operating, maintenance and surveillance procedures for verification of design in the functional performance of the components. The team additionally performed a review of the design change package for removal of the moisture separators and HEPA filters from the containment fan cooler unit (CFCU). The design change for the CCW surge tank over-pressurization to eliminate potential flashing in the CFCUs was also reviewed. The team participated in plant and equipment walkdowns, limited to system components supporting the CFCUs (no containment entries were made for this inspection).

E1.4.1.2 Findings

a. Verify CFCS Performance for Containment Pressure and Heat Removal

The team verified the capability of the CFCS to reduce the pressure and remove the heat generated in the containment due to a MSLB/LOCA and maintain containment integrity. The team determined that 2 CFCUs running at low speed with a minimum CCW flow of 1600 gpm through each cooler coil was adequate to maintain the containment integrity during MSLB/LOCA injection phase.

The limitation of the CFCS is that for long term post-LOCA cooling the coolers are able to transfer more heat than the CCW system can subsequently transfer to the UHS with only one CCW heat exchanger in operation and one ASW pump supplying cooling water at an ocean temperature of 64°F. Consequently, the number of fan coolers operating may have to be reduced to limit the total heat transferred during these specific postulated scenarios.

The team reviewed calculation HVAC 94-01, "Determine air flow rates for 5 CFCU's in low speed running in parallel," Revision 0, to verify the required air flow to the cooling coils for containment pressure and heat removal. This calculation determined that for minimum safeguards, two CFCUs balanced to a maximum flow of 114,000 CFM (57,000 CFM each) at low speed were required. For maximum safeguards to limit the CCW temperature rise within design limits, the air flow to each CFCU should be less than 54,000 CFM for all five CFCUs running in parallel. This calculation was verified by the System Engineering Group by actual measurements of air flow rates. The results confirmed that the flow rates for all five fans were less than 54,000 cfm. The results determined that air flow from each CFCU would be 45,500 CFM if all five CFCU's were running in parallel. The data was collected under AR A0291998, AE-03. Surveillance STP M-93-

A performs air flow measurements each refueling outage and verifies that the actual air flow characteristics are not deteriorating over time.

In reviewing the various CFCU cooling coil calculations, the team identified that only the CCW internal fouling factor was considered in the Westinghouse analysis. Westinghouse in their WCAP analysis did not take any penalty for air-side cooler fouling conditions. The condensate film created during the event was taken as a penalty by Westinghouse. Westinghouse's contention is that any chemical accumulation on the coils will be washed away by the excessive volume of liquid condensing on the air-side of the coolers. Other foreign materials potentially entering the air plenums upstream of the coolers and possibly becoming a physical interference to flow through the coolers (debris fouling) was also not addressed by DCPP in any analysis. The potential for significant debris fouling was determined by the team to be unlikely because of the physical location of the coolers. All of the CFCUs and associated air inlet modules prior to the cooling coils are located on the operating elevation of containment. The equipment is all located outside of the primary missile shield wall. Debris loosened by the accident conditions is remote to this area and very unlikely to be transported to the area of the CFCUs. In reaching this conclusion the team took into consideration a recent event at DCPP where a small RCS leak of 0.02 gpm contributed to long term (about 7 months) flow of RCS products through the CFCU enclosures with no significant chemical accumulation on the cooler surfaces. The boron was washed off, as predicted, by condensation of the steam and was runoff into the drain system for the CFCUs. However, during scheduled maintenance of the CFCU's, it was identified that boron did precipitate and was deposited on the fan surfaces, fan enclosure, and to some extent on the downstream back-draft damper blades, but not on the coil surfaces. In response to the team's concern regarding performance of the fan and back-draft damper with boron accumulation, the licensee provided an evaluation which concluded that the CFCU's would perform their design required functions following an accident. A sensitivity analysis was performed by PG&E Engineering that indicated the CFCUs could allow a 10% decrease in performance due to external fouling and undefined degradation of the system with only a 1.5 psi containment peak pressure post-accident increase. The margin without this system degradation is 4.8 psi. The team reviewed the analysis and found it acceptable.

b. Effect of CFCU Reverse Rotation on Electrical Protection Devices

The team reviewed the effect of reverse rotation of the fans in the CFCU on the mechanical and structural integrity of the fans and duct work and the motor protection circuit. DCPP has experienced problems with the back-draft dampers that causes reverse rotation of the fans to speeds as high as 170 rpm. The problems have been caused by the dampers being stuck in the open position due to linkage assembly problems or one of the blades being partially open when the damper should have been fully closed. The back-draft dampers have essentially been provided to protect the CFCU fan and motors from potential adverse effects of back pressure (7.0 psid) during a LOCA when the lower containment volume where the CFCU ductwork discharges would pressurize more than the upper containment volume from where the CFCUs take intake.

Based on the team's review of Westinghouse's analysis PCE-92-0057, "Summary of Back draft Damper Problem Evaluation," Rev. 0 and DCPP calculation 205A-DC, "Evaluation of Reverse Rotation of CFCU on Electrical Protection System," Rev 0, the team concluded that the failure of the back draft dampers leading to reverse rotation of the fans would not have prevented the CFCUs from performing their safety function for the following reasons:

- The fans used in the DCPP's CFCUs were subjected to higher back pressure in a test performed by Westinghouse which showed that a back pressure of 9.0 psid had no significant effect on the mechanical integrity of the fan.
- The flow area through the damper is relatively small compared to the duct, coils, inlet dampers etc., such that there will be a large pressure drop across the damper and the pressure differential between the inside and outside of the CFCU enclosure will be about 0.7 psid which is less than the rated 3 psid. The back pressure will, therefore, have no effect on the structural integrity of the CFCUs.
- The maximum reverse speed caused due to back draft from which the fans could be started at a reduced voltage of 85% at low speed is 400 rpm. To prevent any undesirable tripping of breaker and thermal overload relay in the motor control circuit when starting motors with fans in reverse rotation, DCPP has replaced the breakers and thermal overload relays with higher magnetic trip rating breakers and slow trip type thermal overload relays. For high speed, the maximum reverse speed from which the fans can be started is 120 rpm.

The licensee has identified some equipment failures in the counterweights and shaft pin designs for the back draft dampers. Maintenance and repairs to the dampers have been performed. The team's review of the mandatory periodic preventive maintenance determined that this has resulted in improved performance of the damper assemblies, thus minimizing/eliminating CFCU fan reverse rotation.

c. Vendor Technical Manual (DC 663079-51-15) Discrepancies

The team reviewed the Vendor Technical Manual (VTM) for the CFCUs to verify existing design with the requirements in the VTM. Some discrepancies were identified. A "Special Instructions" section in the VTM identified the requirement for a water trap to be installed in the drain line from the CFCU combined motor cooler coil housing and environment protection enclosure. The trap would assure that no back leakage could enter the enclosure. This motor enclosure was stated in the VTM as required to protect the motor from the accident environment during and following an event. The EQ documents reviewed indicated the same requirement. Drawings for the motor cooler drain lines did not indicate the water traps as installed. The licensee verified that the traps were not installed and during the inspection, received confirmation from Westinghouse that the traps were not required. AR 0441408 was initiated to revise the VTM.

A typo in the text Sections 1.3.4 and 1.3.5 of the VTM describing the cooling coils tubing wall thickness as 0.035" and 0.35" was identified by the team. AR A0443446 was initiated to correct the number to 0.035" for coil tubing wall thickness descriptions. This AR also requires that the EQ documentation be revised to state that a completely sealed enclosure is not essential for environmental qualification.

E1.4.1.3 <u>Conclusions</u>

The team concluded that the CFCU system is being operated within the design and licensing requirements and can meet the plant accident and normal heat removal requirements in transferring heat to the CCW system.

The attributes reviewed have identified that the CFCU design requirements for containment heat removal are being maintained. Plant modifications to the system have not compromised the system's capability to perform the safety functions required by plant design.

The limitation of the CFCU system is that the coolers are able to transfer more heat than the CCW system can subsequently transfer to the ultimate heat sink in specific accident scenarios. Consequently, the number of fan coolers operating may have to be reduced to limit the total heat rate transferred during these specific postulated scenarios. The Technical Support Center will determine CFCU operating requirements under events when the CCW design limits may be exceeded. Safety does not appear compromised by this option for operation - the only effect is that the time required to reduce containment pressures and temperatures to ambient conditions following an accident will be extended.

E1.4.2 Electrical

The electrical discussion in Section E1.2.2 of this report covers the electrical design review of the CFC system.

E1.4.3 Instrumentation and Control

E1.4.3.1 Scope of Review

The scope of the instrumentation and control design assessment consisted of a review of the CFCU system design and associated documents. Interfacing portions of the CCW system were also reviewed. Documents that were reviewed included Chapters 6 and 7 of the UFSAR, Technical Specifications, design criteria memorandum, piping and instrument schematics, electrical schematics, logic diagrams, 3 calculations, PIMS database, 1 surveillance procedure and 1 operating procedure. System walkdowns and interviews with plant personnel were also conducted to verify as-built design.

E1.4.3.2 Findings

The system design documents reviewed by the team adequately supported the design bases, except for the items discussed in the following paragraphs:

a. CFCU RG 1.97 Instrumentation

UFSAR Section 7.5, Table 7.5-6 DCM T-24, and letter DCL 93-284 provide the design bases for the CFCU RG 1.97 instrumentation. Required instrumentation consists control room indication of containment atmosphere temperature, containment sump water temperature indication, and operating status for each CFCU.

Two redundant containment atmosphere temperature indicators (loops TE-940 and TE-941) are provided on main control room panel PAM1. Two redundant containment sump temperature indicators (loops TE-942 and TE-943) are also located on panel PAM1. RG 1.97 lists these instrument loops as Type D, Cat. 2, variables with standby power source. Based on the team's review of DCM T-24, uncertainty calculation PAM-0-0-001, design documents and as-built condition, both the containment atmosphere and sump water temperature indicators were designed in accordance with RG 1.97. A review of the logic diagrams, schematics and panel layout also confirmed that speed indicating lights, and motor ammeters to monitor CFCU operating status were provided in the design in accordance with the RG.

b. **CFCU/CCW Instrument Loop Accuracy and Scaling Calculations**

The team reviewed the setpoint methodology and uncertainty calculations for the following instrument loops to verify that adequate tolerance for instrument error has been incorporated in the CFCU design:

1. SC-M-14-F70, "Instrument Scaling Calculation Containment Fan Coolers Flow Channels FT-70, FT-71, FT-72, FT-73 and FT-74," Revision 1.

2. PAM-0-14-070, Determination of Indication Uncertainty of CFCU CCW Flow," Revision 1.

The team determined that the above calculations adequately supported the instrument design.

E1.4.3.3 Conclusions

The instrumentation and control design for the CFCU system was considered adequate. There were no findings that would constitute operability concerns or require further followup.

E1.4.4 System Walkdown

CFCU System Instrumentation Walkdown.

The team's walkdown of the control room for the CS system as discussed in Section E1.3.3.4 also included a verification of the as-installed RG 1.97 instrumentation for the CFCU system, which includes containment atmosphere and sump water temperature indicators, motor, ammeters and speed status lights for each CFCU. As part of the CFCU I&C verification, the team also walked down the penetration area to verify the CFCU/CCW coil outlet flow transmitters and local temperature indicators. Instrument ranges, locations, and method of identification and installation design were reviewed against the UFSAR, DCM T-24 and design documents. As a result of the walkdowns, the team concluded that the installed instrumentation is in accordance with the design and RG 1.97.

XI Exit Meeting

After completing the on-site inspection, the team conducted an exit meeting with the licensee on September 11, 1997, that was open to public observation. During the exit meeting, the team leader presented the results of the inspection. A partial list of persons who attended the exit meeting is contained in Appendix B. Proprietary material was reviewed during this inspection but this report contains no proprietary information.

Appendix A

List of Open Items

This report categorizes the inspection findings as unresolved items (URIs) and inspection followup items (IFI) in accordance with Chapter 610 of the NRC Inspection Manual. A URI is a matter about which the Commission requires more information to determine whether the issue in question is acceptable or constitutes a deviation, nonconformance, or violation. The NRC may issue enforcement action resulting from its review of the identified URIs. By contrast, an IFI is a matter that requires further inspection because of a potential problem, because specific licensee or NRC action is pending, or because additional information is needed that was not available at the time of the inspection.

Item Number	Finding Type	Title
50-275/97-201-01	IFI	Review of UHS Calculation for Maximum UHS Temperature at Which the Plant can be Operated Without Exceeding ASW system Design Limits (Section E1.2.1.2.c)
50-275/97-201-02	IFI	Review of Revision to WCAP-14282 and incorporation of revised WCAP-14282 into design bases documentation (Section E1.2.1.2.c.2)
50-275/97-201-03	URI	Determine if Long-Term post-LOCA Operation of ASW System With Both Trains Tied Together Represents a USQ (Section E1.2.1.2.d)
50-275/97-201-04	IFI	ASME Section XI testing of ASW pumps (Section E1.2.1.2.f)
50-275/97-201-05	URI	Discrepancy in Design Documentation (Sections E1.2.1.2.g, E1.2.3.2.e, E1.3.3.2.a, E1.3.3.2.d
50-275/97-201-06	URI	Availability of an Alternate Flowpath for the ASW System Suction (Section E1.2.1.2.h)
50-275/97-201-07	URI	EDG transient analysis computer simulation study (Section E1.2.2.2.a)
50-275/97-201-08	IFI	Control of Calculations (Section E1.2.2.2.c, E1.2.2.2.i)
50-275/97-201-09	IFI	Review of Battery Charger Settings (Section E1.2.2.2.d)

Item Number	Finding Type	Title
50-275/97-201-10	URI	Potential USQ and TS Adherence Associated with Containment Spray During Containment Recirculation (Section E1.3.1.2.b & c)

Appendix B

Exit Meeting Attendees

NAME	ORGANIZATION
D. Allen	NRC, Resident Inspector
S. Bloom	NRC, Project Manager, NRR/DRPE
D. Brosnan	PG&E, Supervisor, Nuclear Safety Assessment and Licensing (NSAL)
R. Berger	PG&E, NSAL, Containment Design Engineer
D. Chamberlain	NRC, Deputy Director, DRS/Region IV
K. Herman	PG&E, DES, Supervisor of Electrical Design
J. Kelly	PG&E, DES, Mechanical Engineer
S. Ketelsen	PG&E, NSAL, Supervisor Nuclear Interface
D. Norkin	NRC, Section Chief, NRR/PSIB
B. Powers	PG&E, Vice President and Plant Manager
G. Rueger	PG&E, Senior Vice President and General Manager
J. Skaggs	PG&E, Operation Department
M. Smith	PG&E, DES, Supervisor Nuclear Design
T. Stetka	NRC, Branch Chief, DRS/Region IV
D. Tateosian	PG&E, Manager Design Engineering Services (DES)
J. Taylor	Westinghouse, PG&E Representative
R. Webb	PG&E, DES, Director of Technical Support
L. Womack	PG&E, Vice President and Manager of Nuclear Tech Services

Appendix C

List of Acronyms

AB	Auxiliary Building
AC	Alternating Current
ANSI	American National Standard Institute
AOV	Air-Operated Valve
AR	Action Request
ASME	American Society of Mechanical Engineers
ASW	Auxiliary Saltwater
AUX S/D	Auxiliary Shutdown
AUX	Auxiliary
AUX S/D PNL.	Auxiliary Shutdown Panel
BTU	British Thermal Unit
CCW	Component Cooling Water
CFCS	Containment Fan Cooler System
CFCU	Containment Fan Cooler Unit
CFM	Cubic Feet per Minute
CFR	Code of Federal Regulations
CS	Containment Spray
CTMT	Containment
CV	Control Valve
DBA	Design Base Accident
DBD	Design Basis Documentation
DC	Direct Current
DCM	Design Criteria Memorandum
DCN	Drawing Change Notice
DCR	Document Change Request
DCPP	Diablo Canyon Power Plant
DP	Differential Pressure
ECCS	Emergency Core Cooling System
EDG	Emergency Diesel Generator
EOP	Emergency Operating Procedure
EQ	Environmental Qualification
ESF	Engineered Safety Features
ESFAS	Engineered Safety Features Actuation System
F	Fahrenheit
FCN	Field Change Notice

FCR	Facility Change Request
FCV	Flow Control Valve
ft., FT	Feet or Foot
FW	Feed Water
gal., GAL	Gallons
gpm., GPM	Gallons Per Minute
HELB	High Energy Line Break
HEPA	High Efficiency Particulate Air
HS	Hand Switch
HVAC	Heating, Ventilating, and Air Conditioning
HZ, Hz	Hertz
I&C	Instruments and Control
IFI	Inspection Follow-up Item
IN	Information Notice
ISI	In Service Inspection
IST	In Service Testing
kVA	Kilovolt-Ampere
LAR	License Amendment Request
LCO	Limiting Condition for Operation
LER	Licensee Event Report
LOCA	Loss-of-Coolant Accident
LOOP	Loss-of-Offsite Power
M/HELB	Moderate/High Energy Line Break
M&TE	Measuring and Test Equipment
MCB	Main Control Board
MCC	Motor Control Center
MF	Main Feedwater
MOV	Motor Operated Valve
MSLB	Main Steam Line Break
MP	Maintenance Procedure
NaOH	Sodium Hydroxide
NC	Normally Closed
NNI	Non-Nuclear Instrumentation
NNS	Non-Nuclear Safety
NO	Normally Open
NPSH	Net Positive Suction Head
NRC	Nuclear Regulatory Commission
NSR	Nuclear Safety Related
NSSS	Nuclear Steam Supply System

OE	Operability Evaluation
P&ID	Piping & Instrumentation Diagram
PAM	Post Accident Monitoring
PEP	Plant Engineering Procedure
PG&E	Pacific Gas & Electric
PI	Pressure Indicator
PIC	Pressure Indicator Controller
PM	Preventive Maintenance
PMT	Post Maintenance Testing
PMWO	Preventive Maintenance Work Order
PORV	Power Operated Relief Valve
PRA	Probabilistic Risk Assessment
psi, PSI	Pounds per Square Inch
psia, PSIA	Pounds per Square Inch Absolute
psid, PSID	Pounds per Square Inch Differential
psig, PSIG	Pounds per Square Inch Gauge
PT	Pressure Transmitter
PVC	Polyvinyl Chloride
QA	Quality Assurance
RB	Reactor Building
RC	Reactor Coolant
RCP	Reactor Coolant Pump
RCS	Reactor Coolant System
RG	Regulatory Guide
RHR	Residual Heat Removal
RPS	Reactor Protection System
RWST	Refueling Water Storage Tank
RV	Reactor Vessel
S&L	Sargent & Lundy
S\D	Shutdown
SA	Safety Actuation
SAT	Spray Additive Tank
SCFM	Standard Cubic Feet per Minute
SE	Safety Evaluation
SEC	Seconds
SECL	Safety Evaluation Check List
SER	Safety Evaluation Report
SFAS	Safety Features Actuation System
SI	Safety Injection

SOV, SV	Solenoid Operated Valve
SPDS	Safety Parameter Display System
SPEC	Specification
SSFI	Safety System Functional Inspection
SSPS	Solid State Protection System
STP	Surveillance Test Procedure
TCV	Temperature Control Valve
TDH	Total Developed Head
TR	Temperature Recorder
TS, Tech. Spec.	Technical Specifications
TSC	Technical Support Center
TT	Temperature Transmitter
UFSAR	Updated Final Safety Analysis Report
UHS	Ultimate Heat Sink
UPS	Uninterruptible Power Supply
URI	Unresolved Item
USQ	Unreviewed Safety Question
V DC, VDC	Volts DC
V AC, VAC	Volts AC
W	Watts
WCAP	Westinghouse Containment Analysis Program