March 4, 1994

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of: Pacific Gas and Electric Company (Diablo Canyon Nuclear Power Plant, Units 1 and 2)	)))))))	Docket Nos. 50-275-OLA 50-323-OLA (Construction Period Recovery)

AFFIDAVIT

I, Michael J. Angus, being duly sworn, hereby state as follows:

1. I am employed by Pacific Gas and Electric Company as Manager, Nuclear Engineering Services. In this position, I am responsible for overall management of PG&E's engineering support and design engineering activities relating to the Diablo Canyon Nuclear Power Plant.

2. My business address and phone number are:

   333 Market Street, Room A1411
   San Francisco, CA 94105

   (415) 972-5497

3. I had overall managerial responsibility for developing and reviewing the information which forms the basis of the attached PG&E Letter No. DCL-94-037, "Auxiliary Saltwater System Operability," dated February 15, 1994, which has been submitted to the U.S. Nuclear Regulatory Commission on Docket Nos. 50-275 and 50-323. A copy of this letter also was mailed to the San Luis Obispo Mothers for Peace as an addressee on the distribution list for all submittals on these dockets.

4. The information contained in PG&E Letter No. DCL-94-037 responds to the January 12, 1994, NRC inspection report (IR 93-36) referenced in the February 25, 1994, SAN LUIS OBISPO MOTHERS FOR PEACE'S MOTION TO REOPEN THE RECORD REGARDING PACIFIC GAS AND ELECTRIC COMPANY'S APPLICATION FOR A LICENSE AMENDMENT TO EXTEND THE TERM OF THE OPERATING LICENSE FOR THE DIABLO CANYON NUCLEAR POWER PLANT.

5. PG&E Letter No. DCL-94-037 demonstrates that PG&E's maintenance program for the Auxiliary Salt Water (ASW) system at Diablo Canyon is comprehensive and effective, and assures that the ASW system is operable and capable of meeting its design basis requirements. In addition, the preliminary safety evaluation in PG&E Letter No. DCL-94-037 concludes that any past potential inoperability of the Component Cooling Water (CCW) heat exchangers referenced in the NRC inspection report did not adversely affect the public health and safety. Furthermore, any deficiencies which may have resulted in the potential inoperability of the CCW heat exchangers in particular or the ASW system overall have been addressed and corrective actions identified by PG&E.

6. The information contained in this affidavit is true and correct to the best of my knowledge and belief.

ADRIANE D. TOLEFREE
COMM. # 979198
Notary Public — California
SAN FRANCISCO COUNTY
My Comm. Expires DEC 22, 1996

MICHAEL J. ANGUS

Sworn and subscribed to before me this 4th day of March, 1994

Notary Public

Dec. 22, 1996
My commission expires:

ATTACHMENT 2

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Gregory M. Rueger
Senior Vice President and
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February 15, 1994

PG&E Letter No. DCL-94-037

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

Re: Docket No. 50-275, OL-DPR-80
Docket No. 50-323, OL-DPR-82
Diablo Canyon Units 1 and 2
Auxiliary Saltwater System Operability

Gentlemen:

NRC Inspection Report Nos. 50-275/93-36 and 50-323/93-36, dated January 12, 1994, identified a number of NRC unresolved items and concerns related to the operability of the auxiliary saltwater (ASW) system.

PG&E's comprehensive evaluation of current ASW system operability concludes that the ASW system is operable and capable of meeting its design basis requirements. This is based on the following actions PG&E has taken since issuance of NRC Generic Letter (GL) 89-13 in 1989: (1) The ASW system is continuously chlorinated, which effectively controls biofouling; (2) The component cooling water (CCW) heat exchangers are taken out-of-service and cleaned prior to the differential pressure (dp) reaching 140 inches, a level which PG&E's engineering analysis and empirical experience indicates is acceptable to assure the design basis capability of the ASW system; (3) PG&E has implemented a comprehensive maintenance, inspection and monitoring program in compliance with GL 89-13; and (4) PG&E's reanalysis of the results of baseline performance tests of CCW heat exchangers performed in 1991 shows that all four heat exchangers meet design basis requirements. The 1991 test result for the CCW 1-2 heat exchanger was attributable to its microfouled condition at the time of the test.

In addition to these actions, PG&E recently performed testing of the ASW pump flow through the CCW heat exchangers to provide additional information on current ASW flow rates, pump runout, and dp. This additional information confirms the effectiveness of PG&E's GL 89-13 actions and the current operability of the ASW system.

Although PG&E has concluded that the ASW system has been operable at all times since implementation of its GL 89-13 program during 1R4 and 2R4, PG&E also is conducting an analysis of ASW system operating conditions from startup to the implementation date of GL 89-13 to assess potential past operability issues. PG&E's preliminary review indicates that the ASW system has been operable for all periods prior to PG&E's implementation of GL 89-13, with two possible exceptions. The first may have occurred in 1990 when an unusual period of potential microfouling coincided with the chlorination system being out of service for piping replacement. This coincidence of events created the potential for excessive microfouling of the Unit 1 CCW 1-2 heat exchanger. The second exception may have occurred at certain times in 1986-1988 when ASW flows may have been lower than required to support the dp setpoint used to indicate the need for heat exchanger cleaning. However, in both cases, PG&E's preliminary safety evaluation concluded that the ASW system, together with credible operator action, would have ensured that the public health and safety were not adversely affected. PG&E will provide a supplement to this letter when the final results of its past operability analysis are complete.

The NRC Inspection Report identified concerns regarding the timeliness of PG&E's corrective actions, and the accuracy and completeness of information provided by PG&E regarding ASW system operability. PG&E agrees that, at the time of the NRC inspection, it had not resolved the ASW system operability issues raised by its quality organization earlier in 1993. In retrospect, as discussed in more detail in Enclosure 3, PG&E did not resolve the quality issues as thoroughly or as quickly as PG&E management would expect. However, PG&E engineering personnel had responded to the quality issues. At that time, PG&E engineering judgement was that system operability was assured because of the effectiveness of heat exchanger maintenance programs and the design margin believed to exist for the system. As discussed above, PG&E's subsequent evaluation demonstrates that the dp setpoint is acceptable and that the ASW system has been operable since PG&E's implementation of GL 89-13. Therefore, any untimeliness did not adversely affect the public health or safety.

In regard to the Inspection Report's concerns with the accuracy and completeness of information provided by PG&E in response to GL 89-13, PG&E is committed to the highest levels of accuracy and credibility in the information it provides to the NRC and the public, and takes very seriously any issue raised relating to this commitment. Based on its comprehensive review of relevant documents and information related to this issue, PG&E believes that its statement regarding the results of heat exchanger performance testing was accurate and complete when considering the guidance in the GL, as well as the previous information PG&E had provided the NRC regarding the limitations and inconclusiveness of such testing. However, PG&E agrees that its engineering evaluation of the test results should have been more comprehensive. In regard to the status of its ASW piping inspection program, PG&E believes that its statement was accurate and complete. This is because a temporary piping inspection procedure had, in fact, been established. Piping inspections had taken place, a frequency interval of every fourth refueling outage had been set, and conversion of the temporary procedure to a permanent Surveillance Test Procedure was being formally tracked, consistent with PG&E's practices for new surveillance and maintenance programs.

Although present operation, testing, and maintenance practices provide assurance of ASW system operability, PG&E intends to take the following corrective actions. An Integrated

Problem Response Team (IPRT) review of the ASW, CCW, and containment heat removal systems will be performed to assure that these systems meet their design bases requirements. Additional functional testing of the CCW heat exchangers will be performed to further verify the adequacy of maintenance programs and operational controls. Enhanced ASW flow instrumentation will be provided with local readout. To improve timeliness, PG&E's program for evaluating concerns involving potentially degraded conditions will be strengthened. In addition, engineering personnel will be counseled on the need for thoroughness and a questioning attitude in analyzing design basis issues that represent a potential challenge to system operability.

PG&E's detailed evaluations are provided in the following enclosures:

- Enclosure 1 - Discussion of ASW system design basis and system operability.
- Enclosure 2 - Preliminary evaluation of past operability of the ASW and CCW systems, including safety significance.
- Enclosure 3 - Detailed response with PG&E's corrective actions for the specific concerns, issues, and unresolved items identified in the NRC Inspection Report.

PG&E remains confident that the overall quality of engineering for Diablo Canyon Power Plant (DCPP) remains high and that the concerns identified in the Inspection Report are atypical. PG&E's past evaluations of the CCW heat exchangers were based on reasonable engineering judgements at the time. PG&E's maintenance, testing, and inspection programs for the ASW system are comprehensive and assure continued operability of the system. PG&E believes that the corrective actions taken will assure that the concerns raised in the NRC Inspection Report and PG&E's root cause evaluation will be promptly resolved.

Sincerely,

Gregory M. Rueger

cc: Mary H. Miller
Kenneth E. Perkins
Sheri R. Peterson
Diablo Distribution

Enclosures

6352S/TLG/2237

ENCLOSURE 1

DISCUSSION OF AUXILIARY SALTWATER SYSTEM DESIGN BASIS AND SYSTEM OPERABILITY

SUMMARY

The following is a discussion of the current operability of the ASW system, its design bases, key parameters affecting operability, and PG&E's maintenance, operational, and testing activities that assure continued operability.

The ASW system is designed to remove the heat generated from normal and accident conditions at Diablo Canyon and transfer the heat to the ultimate heat sink. The primary design consideration used to accomplish this function is to maintain the CCW system temperature within its allowable limits, while maintaining containment pressure within its design limits during a loss of coolant accident (LOCA) or a main steam line break (MSLB) inside containment.

Several key parameters directly or indirectly affect CCW heat exchanger heat transfer capability. These parameters and the current maintenance, operational, and testing practices that are used to control them, include:

Parameters

- Macrofouling
- Microfouling and scaling
- ASW flow and ocean temperature

Monitoring and Testing

- ASW flow and ocean temperature
- Differential pressure
- Inspections and sampling during tube cleaning

Maintenance

- Continuous chlorination
- Tube cleaning/scraping/waterjet cleaning

As discussed below, these parameters have been evaluated and are considered to be sufficiently controlled by the current operational, maintenance, and testing practices at DCPP to assure that the design basis heat removal capacity of the CCW system is maintained. Therefore, based on PG&E's evaluations, the ASW system is operable and capable of performing its safety function.

ASW SYSTEM DESIGN HEAT TRANSFER CAPACITY

The operability of the ASW system is a function of its heat transfer capacity. The ASW system provides cooling from the ultimate heat sink, the Pacific Ocean, to the CCW system. The CCW system removes waste heat from primary plant equipment during normal plant operation, plant cooldown, and following an accident. The ASW system has been designed to remove sufficient heat from the CCW system to maintain the temperature of the CCW system within its design limits under normal, transient, and accident conditions.

The ASW system has two pumps capable of pumping seawater to the tube side of either of the two CCW heat exchangers. In addition, either heat exchanger can be supplied by an ASW pump from the other unit via a cross-tie. The CCW pumps route component cooling water to the shell side of the two CCW heat exchangers. The heat transferred to the CCW system is then transferred to the ASW system through the two CCW heat exchangers.

Following a LOCA or an MSLB inside containment, the CCW system is required to provide cooling water to the containment fan cooling units (CFCUs) for containment heat removal, and to the various engineered safeguards features (ESF) pump coolers. During the recirculation phase of a LOCA, the CCW system also cools the residual heat removal (RHR) heat exchangers. The current design limits on CCW are that the CCW water temperatures must remain at or below 120°F for continuous operation, but may exceed 120°F, up to a maximum of 132°F, for no longer than 20 minutes.

Since January 1989, the Emergency Operating Procedures (EOPs) have included instructions for the control room operators to place the second CCW heat exchanger in service in the event that one of the two trains of ASW pumps is not operating. Since December 1991, the EOPs have included instructions, upon entry into recirculation, to reduce the number of operating CFCUs to a maximum of three, and to secure the second RHR pump if two ASW pumps and two CCW heat exchangers are not operating. These actions assure that the CCW system will operate within its design limits [See Licensee Event Report (LER) 1-84-040 (March 24, 1989); LER 1-91-018 (June 29, 1992); Final Safety Analysis Report (FSAR) Update, page 9.2-5; and NRC Safety Evaluation Report, Supplement 16, pages 9-5 to 9-7 (August 1983)].

During normal plant operation, the CCW system is designed to remove heat from the CFCUs, ESF pump coolers, and various nonessential heat loads. Only one heat exchanger is normally in service during normal plant operation. In addition, the system is designed to meet single failure criteria. Therefore, the design of each CCW heat exchanger is to remove 100 percent of the design heat load from the CCW system under both normal and accident conditions.

The temperature of the CCW system is primarily a function of heat input to the system by the CFCUs (and RHR heat exchangers during recirculation), and heat removal by the ASW system. The analysis in Westinghouse WCAP-12526, Rev. 1, "Auxiliary Salt Water and Component Cooling Water Flow and Temperature Study for Diablo Canyon Units 1 and 2," provides curves establishing the acceptable combinations of ASW flow and ocean temperature such that the CCW system heat removal requirements are met, assuming that the full surface area of the CCW heat exchanger is available and that the CCW heat exchanger is operated at its design fouling factor of 0.001. The fouling factor establishes a margin that accounts for the degree to which fouling will affect heat transfer, and the fouling factor used in the design is an industry standard.

ORIGINAL DESIGN BASIS AND SUBSEQUENT REVISION IN 1983

The CCW heat exchangers were purchased in December 1969 from the Yuba Heat Transfer Corporation. The heat exchangers were designed for a heat load of 258×10^6 BTU/hr. Subsequent to the original heat exchanger specifications, Section 9.2.7 of the FSAR was issued showing that the peak heat rejection rate required was actually only 252×10^6 BTU/hr.

This maximum heat load of 252×10^6 BTU/hr, which prior to 1983 served as the basis for the design of the ASW system, assumed three CFCUs in operation (based upon single failure of an electrical bus). Another accident scenario was investigated in early 1983, based upon a different single failure. This new scenario assumed a design basis LOCA (doubled-ended cold leg RCS pump suction piping guillotine break) coincident with a single active failure of an ASW pump. In this event, all five CFCUs and all three CCW pumps are assumed to start. This scenario results in a higher rate of heat removal from the containment atmosphere by the CCW system. The heat input into the ASW system during this scenario is 325×10^6 BTU/hr. The CCW heat exchangers have sufficient heat removal capability to maintain the CCW supply temperature at or below the maximum allowable temperature for cooling of safeguards equipment.

The limiting CCW temperature transient has been analyzed by Westinghouse. This analysis (WCAP-12526, Rev. 1) determined, for various scenarios, the required ASW flow rate as a function of ocean water temperature to maintain the CCW temperature within its design basis limit. The results of this analysis were summarized in acceptance curves for various ASW flows and ocean temperatures. This information was incorporated into the monthly Surveillance Test Procedure (STP) M-26, "ASW System Flow Monitoring," acceptance criteria, and includes corrections to the indicated ASW flow (measured at the ASW annubars) for the test conditions. Conservatisms are applied to the STP M-26 measured flows to account for possible system alignments and ocean conditions, to assure minimum accident flow requirements are met.

NRC INSPECTION REPORT ISSUES

NRC Inspection Report Nos. 50-275/93-36 and 50-323/93-36 identified a significant unresolved item relating to the basis for the operability of the ASW system with regard to operational limits on macrofouling and microfouling. The following is PG&E's evaluation of each of these operability issues:

BACKGROUND

Macrofouling

Macrofouling is the blockage of flow through the heat exchanger tubes due to mussels and barnacles in the seawater environment, or due to any potential foreign materials. Blocked heat exchanger tubes reduce the heat transfer capability of the heat exchanger since the effective surface area is reduced. The percent of tube blockage that is acceptable before the heat transfer capability of the heat exchanger is inadequate varies according to the ocean temperature, the ASW flow, the degree of concurrent microfouling, and the type of blockage that occurs (e.g., a fully blocked tube has no heat transfer contribution, but a partially blocked tube with decreased flow around the blockage will continue to provide some heat transfer capability). For the purpose of evaluating both heat transfer and dp, macrofouling is conservatively assumed to block the tube completely, such that its contribution to heat transfer is completely negated. This is accounted for in the heat exchanger modeling by a reduction in the effective tube surface area of the heat exchanger equal to the total surface area of the blocked tubes. However, under actual conditions, macrofouling is unlikely to cause complete tube blockage.

Microfouling and Scaling

Microfouling, as referred to in this document, includes both organic and inorganic materials that adhere to the walls of the CCW heat exchanger tubes and, by their presence, degrade heat transfer at the tube surface. Organic components include bacteria, algae, fungi, and the extracellular byproducts of these organisms (e.g., polysaccharides and slime). Inorganic components include silt, scale, and other deposited minerals. The presence of an established organic layer can encourage the adhesion of inorganic materials from the seawater to the tube surface.

Scaling is related to the operation of the cathodic protection system. Calcium carbonate can be expected to plate out on the inside surface of the tube near the ends of the tubes. This is the result of the reaction of the saltwater with the cathodic protection system. The cathodic protection is designed to protect a limited area and the further the distance from the cathodic protection source, the weaker the electric potential. Therefore, the rate of deposition will be lower the further into the tube from the ends. Based on experience, the deposits due to this phenomenon occur in the last 12 to 18 inches of the tubes and for a few inches beyond the end of the tube inlet inserts.

The actual heat transfer area of the CCW heat exchanger affected by calcium carbonate deposits is approximately 2 percent of the total area. Based on observations, calcium carbonate deposits occur over a few inches on all the inlet ends of the tubes just beyond the plastic tube inserts. Deposition occurring on the outlet end of the lower section of tubes is thicker than on the inlet; this is believed to occur because the inserts on the inlet insulate the tubes from the electrochemical reaction. Since the calcium carbonate deposition is a thin layer and the affected surface area is small, the overall impact on the heat transfer capacity is small. An evaluation has estimated the reduction in the overall heat transfer capability of the heat exchanger to be less than 1.0 percent.

Calcium carbonate deposits, along with other inorganics, can also result in buildup that could result in flow blockage through the tubes, thereby impacting thermal performance. To prevent this from occurring, PG&E has implemented a routine mechanical tube scraping each refueling outage. This interval has been shown to be effective in maintaining the buildup of deposits to less than the inside diameter of the plastic inserts on the inlet of the tubes. Therefore, macrofouling and large debris will become lodged in the inlet end of the tubes and not further down along the tube length due to inorganic depositing. However, regardless of where the flow blockage occurs along the tube length, it will be detected as a contribution to the dp measurement across the heat exchanger.

Historically, microfouling has not been a problem at DCPP because of the cold average ocean temperatures along the central coast of California. However, seasonal ocean variations called upwelling and warm ocean temperatures can affect biological growth and increase microfouling. During the spring and early summer, the prevailing northwest winds at DCPP provide the driving force that moves the warmer surface ocean layers in an offshore direction. Cold water then wells up from deeper layers to replace the displaced surface water. This water is typically rich in nutrients conducive to microbiological growth, but the water is usually at such a low temperature (45°F to 55°F) that little or no biological microfouling occurs. However, if the coastal winds decrease, the ambient seawater temperature can rise to a point where the combination of nutrients and warmer temperatures (above approximately 58°F daily average ocean temperature) can allow microfouling to proliferate if accompanied by a lack of adequate biofouling controls. A historical review of the environmental and ASW operating conditions at DCPP indicates that there has been one short period when a combination of these factors created a potential for excessive microfouling. This period was July-August 1990, when the batch chlorination system was out-of-service while cast iron piping in the system was being replaced, and the ambient seawater temperature exceeded 58°F following an ocean upwelling period.

Heat Exchanger Differential Pressure

Continuous monitoring of the dp across the heat exchanger is an important diagnostic tool used to assess the heat exchanger condition during operation. Differential pressure is monitored by taking daily readings, as well as by a dp alarm in the control room. Differential pressure provides an indication of the heat exchanger condition that is qualitatively linked to each heat exchanger's heat transfer capability. Although the measured dp across the heat exchanger does not provide an all-inclusive indicator of heat exchanger performance, it does give a general indication of the combined effect of macrofouling and heavy scaling. Therefore, the dp measurement, with microfouling under control, is one indicator of overall heat exchanger functionality. Maintenance, surveillance testing, and inspections during cleanings are also other indicators.

EVALUATION OF CURRENT OPERATIONAL LIMITS ON MACROFOULING AND MICROFOULING

Continuous Chlorination

As the Inspection Report notes, PG&E has implemented a continuous chlorination program that is very effective and has significantly reduced the frequency of heat exchanger outages for cleaning. Prior to implementing continuous chlorination in 1992, various methods had been used at DCPP to control both micro- and macrofouling. Batch chlorination was in use at DCPP from late 1984 to mid-1991, although a few periods existed during this timeframe when equipment problems or system enhancement modifications precluded the use of chlorination. Both methods of chlorination can control the growth of macrofouling as well as microfouling, although continuous chlorination is a superior method. The control of macrofouling requires higher chlorine concentrations than the control of microfouling; however, DCPP continuously maintains sufficient chlorine in the ASW system to control both types of biofouling in the piping and the heat exchangers.

Since full implementation in 1992, the continuous chlorination system has operated effectively. However, to assure equipment availability for chlorination, Equipment Control Guideline (ECG) 17.2, "ASW Continuous Chlorination System," has been approved to provide administrative controls on the ASW chlorination system. This ECG specifies the length of time that the continuous chlorination system may be out-of-service without compensatory actions to control biofouling. In addition, the ECG includes a periodic surveillance requirement to verify that adequate chlorination is being performed.

Heat Exchanger Tube Cleaning, Scraping and Waterjet Cleaning

In accordance with Maintenance Procedure MP M-56.16, "Heat Exchanger Tube Cleaning," the heat exchanger tubes are mechanically scraped during each refueling outage (nominally every 18 months). Cleaning of the tubes with a waterjet has been performed periodically in the past during macrofouling cleaning (whenever the dp reaches its administrative limit), as discussed below.

Maintenance History and Observed Results

Without adequate controls during the proper oceanic conditions, microfouling of the tube side of the CCW heat exchanger can be a significant contributor to the reduction in heat exchanger performance. The average amount of microfouling found at the time of cleaning has been as high as 7.9 g (dry weight) in the tubes sampled. This was a peak result during an unusual period of high susceptibility to microfouling during which chlorination had been out of service for several months. Following the initiation of continuous chlorination, a more representative figure has been less than 1.0 g (dry weight) per tube. In addition, microscopic analysis of the material removed from the tubes after initiation of continuous chlorination indicates little organic material present (i.e., mostly sediment rather than biofouling). This indicates that the rate of biofouling and its subsequent impact on heat exchanger performance is being effectively controlled by the continuous chlorination program and the regular tube scraping during each outage. When controlled in this manner, microfouling and scaling will not have a significant impact on the heat transfer capability of the heat exchangers.

Historically, the frequency of heat exchanger cleaning prior to the initiation of continuous chlorination had been every four to six weeks. The current cleaning interval with continuous chlorination in service is approximately every six to eight months. The longer cleaning intervals are indicative of the lower rate of macrofouling due to the effectiveness of continuous chlorination.

EVALUATION OF GL 89-13 BASELINE HEAT EXCHANGER TEST RESULTS

The performance of the four CCW heat exchangers (the ratio of predicted heat exchanged under accident conditions versus design nameplate heat exchanged) was as follows. These results include the effects of as-tested macrofouling and microfouling including calcification and scaling.

COMPONENT	HEAT EXCHANGE RATIO
CCW 1-1 HX	1.080
CCW 1-2 HX	0.987
CCW 2-1 HX	1.112
CCW 2-2 HX	1.109

The results of the GL 89-13 testing on the CCW 1-2 heat exchanger indicated a heat transfer capability of 98.7 percent of the design value (97.5 percent after accounting for 1.2 percent uncertainty). A review of the 1990-1991 operating and cleaning history indicates that no chlorination was applied to any of the four CCW heat exchangers during the summer 1990 ocean upwelling and warming period, due to work being performed in the intake structure. However, the CCW 1-1, 2-1, and 2-2 heat exchangers had been cleaned of macrofouling and waterjetted more frequently than the CCW 1-2 heat exchanger during this time period. As a result, these CCW heat exchangers did not develop a microfouling layer equivalent to that of the CCW 1-2 heat exchanger. The CCW 1-2 heat exchanger was not waterjetted or scraped between the 1990 period of high potential microfouling until after the GL 89-13 test in February 1991. This is consistent with the high level of microfouling found in the 1-2 CCW heat exchanger at the time of the test. The CCW 2-1 and 2-2 heat exchangers were cleaned and batch chlorinated with a frequency typical of normal practices.

The average dry weight of the microfouling samples collected from the 1-2 CCW heat exchanger in February 1991 was 7.9 g. In contrast, the dry weight of samples collected from the 2-2 CCW heat exchanger in June 1991 and the 2-1 CCW heat exchanger in August 1991 (prior to their performance testing in September 1991) averaged 0.3 and 0.4 g, respectively.

PG&E believes that if the 1-2 CCW heat exchanger had been cleaned and waterjetted as frequently as the other CCW heat exchangers prior to the test, it would have performed similarly to the Unit 2 heat exchangers. However, in order to confirm this, additional testing will be performed on the heat exchangers during the upcoming Unit 1 and Unit 2 refueling outages.

In addition, PG&E requested HOLTEC, International to analyze the GL 89-13 test data for the CCW 1-2 heat exchanger. The HOLTEC model was specifically developed for GL 89-13 evaluation and has been widely used by the nuclear power industry. It has been validated using an approved software quality assurance program and has been used in audit responses; therefore, it is considered a good validation of the HTC-STX program. The preliminary results of the HOLTEC model reanalysis of the GL 89-13 test data predicted the CCW 1-2 heat exchanger performance at nameplate condition would be 101 percent with a 95 percent confidence level. At the ASW design basis specified in WCAP-12526, Rev. 1 condition, the preliminary result would be 100.3 percent with a 95 percent confidence level. For comparison, the HTC-STX results at the Yuba nameplate condition were 98.7 +/- 1.2 percent and at the ASW design basis specified in WCAP-12526, Revision 1 condition, 98.0 +/- 1.2 percent. A January 1994 resolution of the uncertainty analysis resulted in lowering the overall uncertainty from 1.5 to 1.2 percent for the CCW 1-2 heat exchanger. This reanalysis confirmed the validity of the HTC-STX computer program.

EVALUATION OF EFFECTS OF ASW FLOW AND OCEAN TEMPERATURE ON ASW SYSTEM OPERABILITY

Two important key parameters, related to heat transfer capability, are the amount of ASW flow through the heat exchanger and the temperature of the ASW.

ASW Flow: ASW flow is affected by the number of pumps in operation, actual pump performance, tide level, and the cleanliness of the piping system, traveling screens, and the CCW heat exchanger.

ASW Temperature: Ocean temperature varies daily and seasonally. While the daily average ASW Fahrenheit temperature typically runs in the 50s, the average will occasionally rise into the low 60s.

ASW design basis heat removal capability is a function of ASW flow, heat transfer area, and temperature (with a fouling factor to account for the fouling mechanisms described above). The ASW temperature and flow requirements interrelate to provide an equivalent peak heat removal capacity. For example, the heat removal provided by 10,750 gpm at 64°F is equivalent to the heat removal provided by 9,150 gpm at 58°F.

The CCW heat exchangers must be maintained in accordance with good industry practice for heat exchangers in seawater duty to assure that significant fouling or blockage does not occur. Sufficient ASW flow to meet design basis requirements must also be maintained. Assurance of adequate flow is provided by the performance of STPs M-26 and P-7B.

STP M-26 is performed monthly. The acceptance criteria for STP M-26 have been established based on curves in Westinghouse WCAP-12526, Revision 1, which provides the acceptable combinations of ASW flow and ocean temperature.

STP P-7B, "Routine Surveillance Test for ASW Pumps," is performed quarterly in accordance with ASME Section XI to measure ASW pump flow and vibration.

The STP M-26 flow measurements have historically varied more than the STP P-7B flow measurements, even though both flow measurements are taken at the same ASW annubars. Recent flow measurements taken with Controlotron instruments and dye dilution tests show that the annubars appear to indicate less than the actual flow rate.

EVALUATION OF CURRENT OPERATIONAL LIMITS ON DIFFERENTIAL PRESSURE

The NRC Inspection Report identified Unresolved Item 50-275/93-36-03 relating to the technical basis for the high alarm setpoint established by PG&E for differential pressure (dp) across the heat exchangers. In particular, the Inspection Report stated that the alarm setpoint was set at 140 inches WG. Pursuant to an Operations Department standing order, cleaning of the heat exchangers is initiated when the differential pressure is about 130 inches WG. Based on the inspector's observations, a concern was expressed that the 140 inch WG setpoint was inconsistent with the amount of macrofouling experienced by the heat exchangers at a lower differential pressure, and therefore the potential existed that at levels below 140 inches WG a heat exchanger might be excessively fouled and outside its design basis. This observation was based upon the understanding by the inspector that the heat exchanger contained a total of 2 percent margin beyond design.

The following is an evaluation of the NRC concerns regarding the technical basis for the current differential pressure alarm setpoint:

Differential pressure is a diagnostic tool and cannot, by itself, quantitatively be used to determine operability (see PG&E letter DCL-88-215, dated September 13, 1988). This is based on a consideration of the uncertainties associated with any established dp limit. These uncertainties include: measurement errors in ASW flow, variation and uncertainty in heat exchanger clean dp levels, uncertainty and drift associated with dp instrumentation, and modeling uncertainties of actual pressure and flow losses that are associated with the heat exchanger design and macrofouling.

However, a dp setpoint can be used as a threshold indicator. When the established threshold is reached, the heat exchanger waterbox and tube conditions should be inspected to assure that actual conditions in the heat exchanger are consistent with those assumed.

PG&E has established thresholds (limits) for the CCW heat exchangers. The limits have been established based on empirical evidence collected by PG&E biologists and engineers as to the actual amount of macrofouling observed in the heat exchanger channel head, and on the tube sheet, when the heat exchangers were removed from service for cleaning over the past nine years of operation. In addition, PG&E has developed a model of hydraulic pressure loss for the CCW heat exchangers which can be used to determine the reasonableness of the empirical evidence cited above. These sources of information are discussed below.

The dp setpoint at DCPP has changed over the years as new information has become available. Early in plant operation the setpoint was at 110 inches WG, a level which immediately caused operational problems. Inspection of heat exchangers in alarm at 110 inches WG indicated that the heat exchangers had little to no macrofouling at this level. PG&E moved the setpoint over the next several years in an attempt to find the optimal balance between cleaning the heat exchanger frequently enough to assure adequate heat transfer, and not cleaning the heat exchanger so often as to increase the overall risk to plant safety of having the heat exchanger out of service. PG&E established a two-tiered limit of a 130 inch WG cleaning criterion, coupled with a 140 inch setpoint at which the heat exchanger is declared inoperable and removed from service, based on the observed low level of fouling during heat exchanger cleanings at these limits of dp.

To further substantiate the empirical evidence and engineering judgment that established the two-tiered limit, PG&E developed a conservative model to estimate differential pressure losses across the CCW heat exchangers. A brief discussion of the concepts used in the PG&E differential pressure model follows.

The PG&E model assumes that dp consists of two components: hydraulic losses across the heat exchanger and differences in static head between the inlet and outlet waterboxes.

The hydraulic losses across the heat exchanger are composed of losses due to turbulence effects at the inlet/outlet of the tubes and waterboxes, and losses through the tubes themselves (including a slight increase in dp due to the tube inserts installed at the tube inlets). This component of measured differential pressure is a direct function of the velocity of the water passing through the heat exchanger and its tubes and thus is a function of the ASW flowrate. However, the velocity of water through the tubes is not only a function of the total ASW flowrate, but also the number of tubes available for flow. Thus, as tubes become plugged (e.g., due to blockage as a result of macrofouling), the hydraulic loss component for the dp increases.

The other component considered in the PG&E model is the difference in static head between the inlet and outlet waterboxes. As a result of testing performed in 1989, it was established that the inlet waterbox level was full. This same testing was interpreted as indicating a void in the outlet waterbox of approximately 30 inches WG. The difference in waterbox level would be reflected in an increase in measured dp. Recent testing using ultrasonic measuring techniques has shown that the level in the outlet waterbox is being maintained at 5 ± 2 inches of the top during operation with one pump aligned to one heat exchanger. The previously measured 30 inches is now attributed to a combination of both the water elevation differences and velocity losses in the outlet waterbox. Thus, the static head differential between the inlet and outlet waterboxes is assumed to be 5 inches instead of the previously assumed 30 inches. This reduces the contribution to measured dp due to waterbox voids.

CCW heat exchanger performance is a function of several variables: ASW flowrate, ASW temperature, and fouling. CCW heat exchanger performance increases with increasing ASW flow and decreasing ASW temperature. Heat transfer across the tubes is a function of the thermal resistance of the tube walls as well as the buildup of insulating materials on the tube surface (e.g., microfouling and scale). The available heat transfer area is a function of the number of tubes through which cooling water can flow. This is affected by macrofouling that may block flow through some of the tubes. As indicated above, this accumulation of macrofouling is reflected by an increase in dp measured across the heat exchanger. Preliminary analysis has shown that the negative impact on heat transfer of partially blocked tubes is smaller in magnitude than the negative impact of fully blocked tubes at equivalent dp levels.

PG&E then conservatively determined the extent to which available CCW heat exchanger margin was reduced as effective area of the heat exchanger was lost due to assumed macrofouling. PG&E used the margin available between design heat transfer capacity and the heat transfer capacity determined during the GL 89-13 testing using the Unit 2 data as a baseline. These test results demonstrated that the heat transfer capability for a clean heat exchanger was 109 percent (including uncertainty) of its design capacity. As discussed above, these Unit 2 data are the most representative of baseline CCW heat exchanger capacity. PG&E modeled increasing numbers of fully blocked tubes until the calculated reduction in heat exchanger performance was equivalent to its design capacity. These calculations showed that at nominal flow conditions, approximately 20 percent (246 if the tubes) could be fully blocked and the heat exchanger would still be able to reject the design heat loads. Combinations of higher ASW flow rates and/or lower ASW temperatures could allow even more tubes to be blocked. This process was repeated for a variety of ASW flow and ocean water temperature combinations since both factors independently influence available heat exchanger capacity. Once PG&E established the number of fully blocked tubes equivalent to a maximum allowable fouled condition, PG&E calculated a predicted associated increase in pressure drop. This predicted increase in pressure drop must be added to the baseline pressure drop of a "clean" (no tubes plugged) heat exchanger. Using this methodology, maximum allowable dp limits were predicted. The methodology utilized by PG&E has been reviewed in detail by an industry heat exchanger expert and found to be a reasonable modeling approach.

This methodology was then used to generate a family of curves for various combinations of ASW flow and ocean water temperature that would assure the CCW heat exchanger capability to remove the design basis heat load. Recent pump flow testing data have shown the calculated allowable dp is approximately 135 inches WG at 64° F for the most limiting pump and heat exchanger combination. Relaxing the conservatism in the model to allow some partially blocked tubes, thereby making the model more realistic, is expected to increase this maximum allowable dp above 140 inches WG. The remaining three heat exchangers in similar service showed allowable operating differential pressures in excess of 140 inches WG. These values correspond well to the dp limits currently in place at DCPP and reconfirm the adequacy of the current two-tiered dp control strategy. These calculations were conservatively based on 64° F ocean water temperatures. Even without accounting for partially blocked tubes, calculated allowable dps would be greater than 140 inches WG for all heat exchangers at ocean temperatures of 62°F and lower, which DCPP generally has experienced during its operating history. This model contains limitations such that it should be applied to heat exchangers where the "clean" baseline operating conditions are firmly established. Since this model has only recently been developed, benchmark data have not been taken.

Notwithstanding, PG&E has taken the results from this model into consideration for the development of future ASW operating criteria. These criteria will be used to assess the condition of the CCW heat exchangers. Specifically, PG&E will maintain the following operating limits for the CCW heat exchangers:

- Consistent with PG&E's engineering judgement and evaluation of past empirical data and as generally confirmed by the analysis presented above, the high differential pressure alarm setpoint will be maintained at 140 inches WG.

- Based on the confirming information provided by conservative modeling, PG&E will maintain the cleaning criteria at 130 inches WG.

- To demonstrate heat exchanger cleanliness, regardless of dp, each heat exchanger will be inspected at a frequency of six months, and will be cleaned as required.

PG&E will maintain the described limits and inspection for the current operating cycles. Since PG&E will be performing functional tests of the CCW heat exchangers during the next refueling outages, PG&E will reassess, as appropriate, these limits based on the outcome of these tests.

In summary, these criteria, combined with the ongoing chlorination and maintenance programs, assure that the system will be capable of performing its design basis function.

ADDITIONAL OPERATIONAL AND MAINTENANCE PROGRAMS

With the combination of monitoring dp, surveillance testing, and additional operational and maintenance activities, the ASW system operability is assured. These additional activities, summarized in Table 1 below, include periodic preventive maintenance and inspections of the traveling screens, pump bays, expansion joints and piping coatings in the ASW flow path, monitoring and cleaning of the CCW heat exchangers as described above, and other STPs for the check valves and power actuated valves in the system.

TABLE 1
MAINTENANCE AND TESTING ACTIVITIES

Equipment/Parameters	Procedure/ Work Order	Frequency
Traveling Screen		
Corrosion/Damage	PM 41722	18 months
Pump Bays		
Corrosion/Debris	PM 52070	18 months
Pumps/Disch. Check Valves		
Flow/Vibration	STP P-7B	Quarterly
Expansion Joints		
Cracks/leaks	PM 40010	Annually
Power Actuated Valves		
Stroke Time	STP V-3F	Quarterly
Piping		
Flow	STP M-26	Monthly
Temperature	STP I-1A	12 hours
Coating/Biofouling (Inspection)	STP M-235	6 years
Biofouling (Chlorination)	ECG 17.2	—
Heat Exchangers		
Flow	STP M-26	Monthly
Differential Pressure	PK01-01	Continuous
Biofouling/Calcification	PM 53586	As needed
Biofouling (Chlorination)	ECG 17.2	—
Coating/Corrosion	PM 51872	18 months
Tube Cleaning/Scraping/Waterjet	MP M-56.16	18 months

EVALUATION OF PUMP RUNOUT

The NRC Inspection Report identified a concern regarding potential ASW pump runout under certain conditions. The concern had previously been identified in PG&E surveillance report SQA-93-0031.

"Runout" describes a condition of pumping higher flow rates than the pump's design performance curve. Specifically, runout concerns are associated with operating the ASW pump at high flow conditions such that cavitation, pump motor tripping, and/or pump overheating may occur. PG&E has reviewed its calculations, ASW pump testing results, and data from the pump manufacturer, and concluded that acceptable net positive suction head (NPSH) is available for the runout flow conditions, and that the associated brake horsepower (BHP) and temperatures will not jeopardize pump motor operation.

At ocean water temperatures of 64°F or greater, a second heat exchanger is placed in service to assure that sufficient heat transfer capability is available for design basis accident heat loads. It is for this configuration of one ASW pump supplying cooling water to two CCW heat exchangers that ASW pump runout is predicted.

The ASW pump runout concern was based on calculated flows using the highest measured flow reading of the STP M-26 test results. Given the test data and correcting it for the limiting conditions (i.e., high and low tides, minimum flow resistance through the heat exchanger, and fully open CCW heat exchanger valves) with one pump supplying two heat exchangers, the predicted flows were 16,100 gpm and 15,100 gpm for high and low tides, respectively. This was determined by engineering personnel to not represent a challenge to the operability of the ASW system. A review of actual pump performance records determined that the predicted high flows could not be achieved with the existing equipment and system design configuration. Testing was also performed in 1989 for various configurations of the ASW system (TP TB-8903), which provided additional data to support the judgement that the postulated runout conditions were not probable. A flow of 13,540 gpm and a brake horsepower of 439 HP were measured for one pump supplying two CCW heat exchangers.

The design calculation for the ASW system estimated flows of 15,100 gpm and 14,500 gpm for high and low tide conditions, respectively, when aligned with one pump supplying two heat exchangers. The design calculation addressing ASW pump NPSH requirements concluded that the NPSH available at a high tide exceeded the required NPSH by several feet; the NPSH available at low tide was below the required NPSH by approximately two feet. The low tide condition was determined to be acceptable, although minor cavitation may occur, based on the fact that the difference between the required and available NPSH is small and the operating condition would be of a short duration (until tide level increased within a few hours). Damage due to cavitation occurs over a long period of continual operation (months to years) in a condition of insufficient NPSH available.

Design evaluation of the maximum brake horsepower for the ASW pumps estimated the BHPs to be approximately 450 HP, over the range of operating design flows. This design value was also supported by information provided by the pump manufacturer, who stated that at a flow of approximately 13,000 gpm, the horsepower curve peaks at 450 HP and remains flat out to 15,000 gpm and beyond. However, it was anticipated that ASW pump operation may result in brake horsepowers that exceed the design maximum of 450 HP. As a result, further evaluation by the motor manufacturer concluded that the ASW pump motors are capable of operating at 465 HP without exceeding their design limits.

To confirm PG&E's conclusions regarding runout, plant test TP TB-9409, "ASW System, Test of Alternate Configurations," was conducted on February 4-8, 1994. The ASW pump and test data were evaluated and confirmed that cavitation and motor overheating/tripping are not a concern. The flow results correlated well with design calculations. Test flows were adjusted to design basis low tide conditions (-4.1 ft mean sea level) and, only the configuration of one pump supplying two CCW heat exchangers, where cavitation is predicted. The cavitation is judged to be minor and acceptable for operation because of the minimal difference between available and required NPSH, and the short duration of the extreme low tidal condition. The tests confirmed that the ASW pump motors may operate at brake horsepowers in excess of 450 HP with a maximum of less than 465 HP for the design operating conditions. The test results also confirmed that the motor bearing and stator temperatures would remain within their design basis limits.

PG&E consulted the ASW pump manufacturer and an independent pump expert on the impact of operating the ASW pumps in a condition where the NPSH available was less than the required amount. It was their judgement that the pump will continue operating; however, there may be a slight drop in performance at the point where the required NPSH for the flow was not available. This operating condition would result in cavitation, and eventual impeller and pump damage if operated continually over a long period of time (months to years). The impact of the cavitation at the postulated condition was determined to be of very low consequence since low NPSH margin occurs only at low tide conditions in the one pump, two heat exchanger configuration. It was also determined that the impact of operating at higher flows with cavitation would not result in a significant, if any, increase in BHP requirements since the pump performance would begin to drop off. Engineering calculations will be revised to incorporate the results from test TP TB-9409.

In summary, PG&E has evaluated the potential for ASW pump runout and concluded that it will not affect the capability of the system to perform its design function. This conclusion is based on actual testing, pump and motor manufacturers' information, and engineering calculations.

CONCLUSION REGARDING CURRENT ASW SYSTEM OPERABILITY

The CCW heat exchangers are capable of meeting their design basis requirements when maintained in a clean condition and operated within design basis parameters.

PG&E's current maintenance, operational, and testing programs for the heat exchangers assure that they will continue to be maintained sufficiently clean of macrofouling and microfouling to allow them to perform their design basis function. Based on the above evaluation, the ASW system is operable and will continue to perform its intended safety function.

ENCLOSURE 2

PRELIMINARY SAFETY EVALUATION OF PAST OPERABILITY OF ASW AND CCW SYSTEMS

Introduction

As described in Enclosure 1, key parameters affecting the performance of the ASW and CCW systems include: macrofouling and microfouling, ASW flow, and ocean temperature. An extensive review of historical maintenance, testing, operational, and biological factors was performed to identify time periods with a high potential for macrofouling and microfouling. During this review of past operation, specific periods of time have been identified during which one or more of these key parameters may have been outside current acceptance criteria. These time periods, and the safety significance of the associated fouling, are discussed below.

Biological Fouling Conditions

The potential for significant microfouling of CCW heat exchanger tubes occurs when certain conditions are met. These conditions include:

- An upwelling of cold, nutrient-rich water from deep ocean layers, which occurs as a result of strong northwesterly winds that characteristically blow during the spring.
- A period of high ocean temperatures, which, following an upwelling period, allows the microorganisms to "bloom." Experience indicates that ocean temperatures of approximately 58°F or greater must be reached over a several week period for the "bloom" to occur.
- The chlorination system is out-of-service for a considerable period prior to and during the "bloom." Without chlorination during the "bloom" period, microfouling could form on the tubes of the heat exchanger. If chlorination is restarted after the "bloom" has occurred, further microfouling is stopped. However, residual material placed by the microorganisms remains in the tubes as a coating and continues to impact heat exchanger performance. Once deposited, waterjetting or scraping of the tubes is needed to remove the residual material.

Bounding Microfouling Condition

PG&E's evaluation of maintenance and operational practices over Diablo Canyon's operating history indicates that the bounding conditions for potentially significant microfouling only occurred during July and August of 1990. Prior to this period, upwelling of nutrients had occurred and was followed by a period of ocean warming. As a result, a microfouling "bloom" occurred. PG&E's analysis indicates that microfouling reached significant levels in July 1990 as ocean temperature exceeded 58°F. In addition, the chlorination system was out-of-service during this period while PG&E was replacing cast iron piping in the system. When batch chlorination was restored on August 21, 1990, further microfouling ceased. However, the residual material from the microorganisms remained in the CCW heat exchanger tubes until waterjetting or tube scraping was performed. PG&E's review indicates that there were no other time periods when the lack of chlorination and maintenance was coupled with favorable environmental conditions for microfouling.

Of the four CCW heat exchangers, the 1-2 heat exchanger was the most susceptible to microfouling based on its chlorination, maintenance, and operating history. The remaining three heat exchangers received waterjet cleanings between the period of high microfouling potential and the performance of the GL 89-13 performance testing. In addition, two of the other three heat exchangers were operated less frequently during the period of high microfouling potential.

The CCW 1-2 heat exchanger was not waterjetted or scraped during the period from August 1990 until after the performance of the GL 89-13 performance test in February 1991. PG&E believes that the heat transfer microfouling characteristics of the CCW 1-2 heat exchanger during its associated GL 89-13 testing represent the bounding microfouling case.

PG&E evaluated the highest macrofouling that may have existed coincident with high microfouling. During August 1990, the CCW 1-2 heat exchanger was taken out of service for cleaning with a recorded dp of 130 inches. It was not again taken out of service until the test in February 1991, at which time the recorded dp was 110 inches. Thus, the August 1990 dp of 130 inches represented the highest macrofouling reached during this bounding microfouling period. The level of macrofouling associated with a dp of 130 inches, coupled with an assumed level of microfouling found during the testing of the CCW 1-2 heat exchanger, represents the most limiting fouling of a CCW heat exchanger.

Bounding Macrofouling Condition

PG&E's review of macrofouling data identified periods of operation at an elevated dp (greater than 140 inches). The historical data focused attention on a period from August 1986 to March 1988. The apparent bounding case of macrofouling identified in this period occurred on November 8, 1987, when CCW 1-2 heat exchanger was removed from service with a dp of 170 inches in conjunction with an ocean water temperature of 61° F. A review of environmental conditions associated with this period of high dp determined that coincident conditions required for significant microfouling did not exist. PG&E believes that microfouling levels at that time were consistent with the levels observed during the Unit 2 CCW heat exchanger GL 89-13 tests.

PG&E has evaluated this condition of high macrofouling. Based on the available information, PG&E's evaluations have determined that the bounding conditions of high macrofouling were not as limiting as the conditions which existed in August 1990. Thus, the condition of high microfouling with a 130 inch dp is the bounding fouling case.

Safety Significance

PG&E has analyzed the bounding case for high microfouling coincident with a 130 inch dp as described above for safety significance. These analyses were performed using the old Westinghouse Mass and Energy (M&E) release model, which is the licensing basis for DCPP. Additionally, a newer more realistic Westinghouse M&E release model with a methodology licensed for use at other Westinghouse plants was used with best estimate values and other realistic inputs for certain parameters. This model more accurately reflects the physical phenomena that occur. Although not licensed for use at DCPP, this new model can be used to determine the M&E releases expected for the current and past plant configuration.

The impact of bounding case fouling on the containment integrity analyses was performed by Westinghouse using the old (current licensing basis) M&E release model. Westinghouse evaluated the design basis LOCA as well as the limiting MSLB accidents for impacts on containment pressure and temperature. The conclusion of these evaluations is that the containment design basis pressure and temperature would not have been exceeded during a postulated LOCA or MSLB.

The design basis CCW temperature limits allow a transient temperature maximum of 132° F for 20 minutes. The temperature limit for continuous operation is 120° F. PG&E has evaluated the impact of the bounding case fouling on the limiting post-LOCA CCW temperature transients. Using the old (current licensing basis) M&E release model, PG&E and Westinghouse have determined that the peak CCW temperature may have exceeded the design basis CCW temperature during the injection phase following a LOCA.

Westinghouse then performed an analysis of the containment temperature transient following a LOCA using the new, more realistic M&E release model. The results of these analyses were used by PG&E to evaluate the CCW temperature transient that would result from the containment conditions calculated by Westinghouse using the new M&E release modeling methodology. These evaluations concluded that the CCW temperature remains below design limits during the injection phase of the accident, but could have exceeded its design basis temperature limits in recirculation for an extended period if operator action is not taken.

The potential for the CCW system to overheat during the post-LOCA recirculation phase of an accident was previously identified by PG&E in 1991. LER 1-91-018, "Component Cooling Water System Outside Design Basis," reported that the heat load during cold leg recirculation may exceed the CCW system design basis temperature limits. Specific recirculation transient analyses were not performed. At that time it was reported that operator action to keep CCW temperatures within design limits was required if the two ASW pump/two CCW heat exchanger configuration could not be established. The safety significance conclusions regarding the bounding case of fouling are similar to those reported in LER 1-91-018. Guidance to address conditions when both ASW pumps and CCW heat exchangers were not available was incorporated into step 3.d of EOP E-1.3, "Transfer to Cold Leg Recirculation," in response to the LER. The potential for elevated CCW temperatures identified above is due primarily to the heat loads that were imposed on the system during recirculation, and not specifically caused by the identified heat exchanger fouling. Preliminary analysis has indicated that, had this EOP guidance been in place at the time that the bounding conditions existed, the CCW system temperature, using the new M&E release model, would have remained within its design basis.

To bound the conditions in place during the 1990 high macrofouling and microfouling case, as well as the 1987 high macrofouling case, PG&E evaluated the CCW temperature transient assuming likely operator actions prior to revising the EOPs even though more timely operator actions were in place for the 1990 case. Prior to the 1991 revision of EOP E-1.3, EOP E-0, "Reactor Trip or Safety Injection," was revised in 1989 to require placing a second CCW heat exchanger in service when only one ASW pump is available (post-LOCA). PG&E developed a timeline of actions which, while not formally proceduralized, are believed to be representative of those actions that would have occurred prior to the 1989 EOP changes. The timeline would have operators secure two CFCUs 15 minutes after the start of recirculation in response to high CCW temperature alarms and subsequently place the second CCW heat exchanger into service 10 minutes later. This timeline bounds both the 1990 and 1987 cases.

Assuming operator action as described above, the limiting CCW temperature transient was evaluated for the bounding 1990 high micro- and macrofouling case. The peak CCW temperature based on this scenario was approximately 136° F and the cumulative time above 120° F was approximately 50 minutes. The impact of the elevated CCW temperatures on the components of the vital CCW headers was evaluated. Westinghouse analyzed the impact of the CCW temperature profile and has determined that the SI and RHR pumps and the CFCU fan motors would perform their design basis function. The CCW pump manufacturer confirmed that the CCW pumps would perform their design basis function at the elevated CCW temperatures. The post-LOCA sampling system may have been temporarily disabled by the elevated CCW temperatures. However, the ability to assess core damage remained available from alternate proceduralized means. The centrifugal charging pumps (CCP) cannot be shown to continue to be available at these elevated temperatures although the exact point of failure is not known. However, the CCPs are available for the entire injection phase of the accident. Regardless of the CCPs availability for recirculation phase, Westinghouse and analyses have determined that during the recirculation phase, other ECCS pumps are available to perform required ECCS functions.

Based on the foregoing detailed analysis of this event, PG&E concludes the following:

- The fouling identified on the CCW heat exchangers would not have resulted in the containment design pressure or temperature being exceeded.

- The CCW design basis temperature limits would only have been exceeded during post-LOCA recirculation.

- Considering the CCW temperature transient, containment and core cooling functions would not be significantly affected. All vital components served by the CCW system would have continued to perform their design basis function, or redundant equipment would have been available to perform these functions.

Accordingly, this event had no safety significance and the health and safety of the public would not have been affected.

ENCLOSURE 3

PG&E'S RESPONSE TO NRC INSPECTION REPORT NOS. 50-275/93-36 AND 50-323/93-36

NRC Inspection Report Nos. 50-275/93-36 and 50-323/93-36 identified a number of NRC concerns and open, followup, and unresolved items regarding past and future operability of the ASW system and PG&E's implementation of controls to assure continued ASW system operability. PG&E's response to each of these items in the Inspection Report is provided below.

NRC Inspection Report Followup and Unresolved Items

NRC Followup Item 93-36-01 noted that the ASW system flow test acceptance values did not include a simple value for minimum flow, but provided a series of curves dependent on the ocean and CCW temperatures. The inspection noted that PG&E stated the test acceptance values were derived from a Westinghouse study, WCAP-12526, Revision 1, "Auxiliary Salt Water and Component Cooling Water Flow and Temperature Study for Diablo Canyon Units 1 and 2," dated June 1992. The study is one of three different design bases described in PG&E's design criteria memorandum, DCM No. S-17B, Revision 2, "Auxiliary Saltwater System." The inspection noted that PG&E had indicated that the revised design bases had not been reviewed by the NRC technical branches. The inspection records stated that acceptability of PG&E's revised design bases is considered an open item.

PG&E Response

The original design basis for the ASW system was provided by Westinghouse. This design basis required the ASW system to remove a post-LOCA heat load of 252×10^6 Btu/hr. The heat load was based upon maximizing containment pressure by assuming the loss of a vital electrical bus which causes a loss of power to two CFCUs. This scenario yielded conservative containment LOCA pressures.

In 1983, a scenario was determined to be more limiting to the ASW system heat load. This scenario assumed that during a LOCA no vital bus failure occurred, but assumed the active failure of an ASW pump. In this scenario, the maximum post-LOCA heat load is transferred to the five CFCUs and then to the ASW system through the CCW heat exchangers. This maximum heat load is 325×10^6 Btu/hr. Since 1983, this transient has been recognized as the Diablo Canyon design basis for the ASW system as noted in NRC SSER 16. PG&E has not changed this design basis.

The Westinghouse study in WCAP-12526, Revision 1, does not change the ASW heat load design basis. This WCAP provides equivalent heat removal using ASW flow and seawater temperature as variables.

Actions Being Taken

PG&E will review the current ASW basis with the NRC technical staff.

NRC Unresolved Item 93-36-02 noted an apparent failure to provide complete and accurate information to the NRC regarding the ability of the CCW 1-2 heat exchanger to meet the design basis heat load.

PG&E Response

Summary

In regard to the Inspection Report's concerns with the accuracy and completeness of information provided by PG&E in response to GL 89-13, PG&E is committed to the highest levels of accuracy and credibility in the information it provides to the NRC and the public, and takes very seriously any issue raised relating to this commitment. Based on its comprehensive review of all relevant documents and information, PG&E believes that its statement regarding the results of heat exchanger performance testing was accurate and complete when considering the guidance in the GL, as well as the previous information PG&E had provided the NRC regarding the limitations and inconclusiveness of such testing. However, PG&E agrees that its engineering evaluation of the test results should have been more comprehensive.

At the time PG&E letter DCL-91-286, dated November 25, 1991, was submitted, PG&E believed that its statements were accurate and complete. GL 89-13, and Supplement 1, provided guidance regarding the level of detail required in licensee responses (see GL 89-13, Supplement 1, Questions and Answers I.C.1 and III.C.2). PG&E believes that its response was consistent with this guidance particularly when considered in context with information that PG&E had provided the NRC in PG&E letter DCL-90-027, dated January 26, 1990, regarding the limitations and inconclusiveness of the heat exchanger testing.

PG&E consulted an industry heat exchanger expert and further evaluated the CCW 1-2 heat exchanger testing results. PG&E now concludes that testing results did not meet design basis heat transfer requirements when analyzed using the Heat Transfer Consultants Inc., HTC-STX computer program due to the effects of microfouling at the time of the CCW 1-2 heat exchanger test. Based on the analysis presented in Enclosure 1, if the CCW 1-2 heat exchanger had been cleaned of microfouling prior to the conduct of the test, the heat exchanger would have passed. Current chlorination, maintenance, and operating practices assure the cleanliness of all CCW heat exchangers.

Background

NRC GL 89-13, Item 2, recommended that a test program be developed to verify the heat transfer capabilities of safety-related heat exchangers cooled by service water. It also indicated that an alternative acceptable to the NRC is frequent regular maintenance of a heat exchanger in lieu of testing. PG&E's response to GL 89-13 relied predominantly upon the established maintenance program, but heat transfer tests were performed to establish baseline heat exchanger nominal performance.

During the evaluation of the testing results, PG&E used an industry computer program, HTC-STX, to perform the analysis. The computer model predicted that CCW 1-2 heat exchanger was performing at 1.3 percent less than the design (nameplate) heat transfer capability. However, the 1.3 percent difference was judged to be within the range of the heat balance and measurement accuracy. Since all three of the other CCW heat exchangers exceeded their design heat transfer capability and all four CCW heat exchangers were designed similarly, PG&E concluded all four of the heat exchangers would meet their design basis requirements. This conclusion also appeared consistent with the guidance in GL 89-13, which recognized the inherent limitations of baseline testing programs.

Recently, HOLTEC International was contacted to reanalyze the CCW 1-2 heat exchanger test data. HOLTEC is a qualified supplier of engineering services to PG&E, and HOLTEC indicated that their computer code has been validated. The preliminary analysis demonstrated that using the HOLTEC model the CCW 1-2 heat exchanger operated at 101 percent of design nameplate rating at the time of the test with a 95 percent confidence level.

For these reasons, the statement in DCL-91-286 factually reflected PG&E's engineering judgement at the time and was accurate and complete.

In retrospect, PG&E should have been more thorough in its analysis of the test results and should have documented the basis of accepting the CCW 1-2 heat exchanger test results. Consultation with an industry heat exchanger expert, who has worked previously on service water systems, has shown that: (1) the tests PG&E performed were generally well conceived and produced results of higher accuracy than PG&E believed possible at the time; (2) the test model used was more conservative in its results than the HOLTEC computer model used by the industry for similar GL 89-13 tests; and (3) the performance of the CCW 1-2 heat exchanger was due to biological microfouling present at the time of testing.

Actions Being Taken

PG&E is taking the following actions to assure that test results are comprehensively evaluated and regulatory submittals provide sufficient explanatory information.

1. Procedure AD1.ID1, "Format, Content and Style of Procedures," was revised subsequent to the performance of the GL 89-13 heat exchanger testing to require that comprehensive acceptance criteria be documented for special tests. Procedure AD13.ID1, "Conduct of Plant and Equipment Tests," will be further enhanced to require that deviations from acceptance criteria be documented and justified prior to acceptance of the deviation.

2. Design engineering, system engineering and licensing personnel involved with the GL 89-13 testing, analysis, and submittal preparation will be counseled on the thoroughness that must be applied when engineering judgement is used to justify acceptance of test deviations.

3. A case study describing the situation, communications, corrective actions, and management's expectations on the events surrounding the ASW heat exchanger testing will be conducted with appropriate NPG personnel. The Directors of System Engineering, Mechanical Engineering, and Site Quality Assurance will present the case study. PG&E believes that by using the Directors to lead the case study, a clear message of expectations on the high standards of thoroughness, clear communication, and delineation of responsibilities will be fully reemphasized to thu technical staff.

NRC Unresolved Item 93-36-03 noted an apparent failure to establish adequate dp limits to ensure CCW heat exchanger operability.

PG&E Response

Enclosure 1 provides a detailed description of the PG&E analysis which confirms the engineering judgement and empirical observations used by PG&E to establish current CCW heat exchanger dp setpoint limits.

Actions Being Taken

Upon completion of additional heat exchanger performance tests scheduled for 1R6 and 2R6, PG&E will reevaluate the dp setpoint.

Enhanced ASW flow instrumentation will be installed with local readouts.

ECG 17.2 has been approved to provide administrative controls on the ASW chlorination system.

In addition to inspections performed when dp limits are reached, each heat exchanger will be inspected at a frequency of six months and cleaned as required.

NRC Unresolved Item 93-36-04 notes an apparent failure to develop a routine inspection program for the ASW system piping by the end of the fourth refueling outages, as committed to the NRC, and an apparent failure to provide accurate implementation status of the program in a letter to the NRC.

PG&E Response

Summary

PG&E agrees that a permanent procedure was not in place for periodically inspecting the ASW system piping at the time of the NRC inspection. However, a temporary procedure had previously been issued for the initial inspection conducted during 1R4 and 2R4. In addition, an Action Request (AR) was tracking the completion of the final procedure prior to performance of the next inspection scheduled for refueling outages 1R8 and 2R8. The surveillance procedure for piping inspection was issued on January 12, 1994, prior to its scheduled issuance date of June 1, 1994.

Background

GL 89-13 recommended establishment of a routine inspection and maintenance program for the ASW piping and components so that corrosion, erosion, protective coating failure, silting, and biofouling would not degrade the performance of safety-related systems. PG&E letter DCL-90-027, dated January 26, 1990, indicated that procedures would be established by 1R4 and 2R4 for a routine inspection and maintenance program for the ASW system. The letter also indicated that the appropriate interval for the performance of these inspections would be determined based on 1R4 and 2R4 observations.

PG&E conducted ASW system piping inspections during the 1R4 and 2R4 refueling outages. The piping inspections determined that the ASW system pipe lining was in excellent condition and capable of meeting its function as a protective barrier.

PG&E performed the 1R4 and 2R4 ASW piping inspections using temporary procedure TB-9048, "ASW Piping Inspection." The inspection found little macrofouling on the piping. Based on the results of the piping inspections, PG&E determined that the inspection frequency should be every fourth refueling outage. Conversion of the temporary procedure, TB-9048, into an STP with a reinspection frequency of every fourth refueling outage was being tracked by ARs. This is consistent with PG&E's practice for new maintenance and surveillance programs.

Actions Taken

To eliminate the concern regarding issuance of the inspection procedure, STP M-235, "ASW Piping Inspection," was issued on January 12, 1994.

NRC Followup Item 93-36-05 noted that the previous PG&E review of the design basis did not identify several important design basis issues. An evaluation of the need to reperform an assessment of the adequacy of the design basis for the ASW system is a followup item.

PG&E Response

Summary

The evaluation of the capability of the ASW system to meet its design basis is provided in Enclosure 1.

Actions Being Taken

1. Additional CCW heat exchanger performance tests on both units will be performed to verify the adequacy of operational and maintenance practices to assure that the CCW heat exchangers meet design basis requirements. The tests will be conducted during the 1R6 and 2R6 refueling outages and will include dp measurement.

2. An "Integrated Problem Response Team (IPRT) will be conducted on the ASW, CCW and interfacing systems by the end of 1994. This IPRT will thoroughly and critically review these systems. Membership of the IPRT will include operations, quality services, maintenance, Westinghouse, and engineering personnel. Based on the results of the IPRT, DCM S-17B will be revised to provide additional information on ASW system heat removal capacity.

NRC Unresolved Item 93-36-06 notes the apparent failure of PG&E to promptly resolve conditions adverse to quality, in particular the failure of PG&E's engineering organizations to resolve several Site Quality Assurance (SQA) surveillance findings in a timely manner.

PG&E Response

Summary

PG&E agrees that resolution of the SQA surveillance findings was not as thorough or comprehensive as PG&E management would expect. PG&E believes this stems from a failure of the organization to clearly focus on the operability consequences of issues raised in the SQA surveillance. As a result, appropriate priority was not placed on resolving the SQA issues by the responsible technical departments. This was not, however, a case where the surveillance issues were "dropped" by either SQA or the technical organizations. Significant followup activities occurred subsequent to the performance of the SQA surveillance in an attempt to bring issues raised to appropriate resolution. In addition to capturing unresolved issues in ARs, numerous phone calls, electronic-mails, and face-to-face meetings took place between SQA and responsible technical organizations. Twenty-one individual AR entries and eight electronic mails were sent between SQA and the engineering organizations on surveillance issues. The surveillance issues were the subject of discussion at two ASW system team meetings in early December 1993. Numerous undocumented contacts (phone calls, discussions, etc.) occurred between the responsible organizations. The Manager of Nuclear Quality Services met with the SQA Director and lead auditor in early August to discuss the status of responses to the surveillance. At this meeting, the Manager instructed that a schedule be established for resolution of the issues. The SQA staff and line organizations subsequently met in August and agreed to a December 31, 1993, completion schedule to resolve the technical issues. In addition, the Manager of Nuclear Quality Services raised the surveillance findings as an issue at the Nuclear Technical Services Emerging Issues meeting in San Francisco in August and November 1993 and also raised the issue at the DCPP Plant Manager's staff meeting to request that attention be placed on the surveillance response. However, despite the communication occurring on the issue, PG&E management personnel lost focus of the potential operability impact of the issues.

The delay in recognizing the potential operability implications of the SQA surveillance is in contrast with PG&E's demonstrated ability to thoroughly assess operability issues using procedure OM7.ID8, "Operability Evaluations," when presented with clear operability issues such as hardware failures or 10 CFR Part 21 notifications. In response to the SQA surveillance, PG&E technical organizations continued to conclude that the SQA surveillance issues did not represent current operability concerns. This was based on engineering judgement that existing maintenance and chlorination programs, described in response to GL 89-13, effectively assured current ASW system operability. The PG&E technical organizations, therefore, did not consider it necessary to enter OM7.ID8 to assess operability. The events were exacerbated by a failure to take adequate ownership for resolution of the concerns, particularly at the Director and Senior Engineer levels within NPG. This led to a situation where periodic dialogue was occurring at the technical staff level but issues were not being fully resolved. Management inquiries as to what problems existed and what progress was being made were answered with responses that a technical resolution was proceeding.

As discussed in Enclosure 1, PG&E's subsequent evaluation demonstrated that (1) the dp setpoint is acceptable; (2) the ASW system has been operable since PG&E's implementation of GL 89-13; and (3) any untimeliness, therefore, did not adversely affect the public health or safety.

On December 15, 1993, a Prompt Operability Assessment was issued to document operability of the ASW system. In addition, a Nonconformance Report was issued to further investigate and resolve this concern. OE 93-16 was issued on December 30, 1993, to provide further justification for ASW system operability.

PG&E engineering has subsequently provided comprehensive evaluation of the operability issues raised in the SQA surveillance.

To prevent recurrence of these events, PG&E will establish specific procedural guidance on the maximum time PG&E will allow staff level personnel to evaluate questions involving potentially degraded structures, systems, and components before the issue becomes a quality problem and is elevated to upper management as an operability issue for prioritization and resolution. Appropriate technical staff will be trained and counseled on these management expectations. PG&E engineering management will also use outside experts, as appropriate, to help resolve technical issues that are at impasse and thus assure timely resolution.

Actions Being Taken

PG&E is taking the following corrective actions:

1. PG&E will establish an Interdepartmental Administrative Procedure to resolve issues that raise questions regarding operability. The key elements will be: (1) address any issue of immediate operability concern using procedure OM7.ID8; (2) generate a Quality Evaluation (QE) for issues that are not a clear, immediate operability concern, if the issue remains unresolved for 30 days; (3) establish firm completion dates within the QE; (4) place issues exceeding these completion dates on an "Operability Concerns List;" (5) review the Operability Concerns List at the NPG Officers/Managers weekly meeting; (6) assign specific responsibilities for resolution of Operability Concerns List items at the weekly meeting; and (7) review progress on assigned issues as identified by the Manager of Nuclear Quality Services.

2. A Human Performance Evaluation System (HPES) study will be performed. As part of the case study evaluation of the events of GL 89-13 testing, a

preliminary HPES study has been completed and identified the following items to be included in the case study discussion:

- The need for continuing vigilance in the depth and comprehensiveness of independent technical reviews of engineering evaluations and NRC licensing submittals.

- The need for clear test acceptance criteria for special tests and documentation of results and deviations.

- The need for enhanced supervisory oversight of engineering evaluations that relate to potential operability concerns.

- The need for improved teamwork and communication between departments on issues relating to operability or quality concerns.

- The need for a questioning attitude on design basis issues that potentially affect the operability and margins for safety-related systems, structures, and components by all personnel including design engineers, system engineers, maintenance personnel, and operators.

3. An HPES followup evaluation will be performed to determine the effectiveness of the case study discussion on assuring that management expectations are clearly understood and followed by the technical staff.

4. As was previously indicated in the Inspection Report response, appropriate technical personnel will be counseled on the need for thoroughness, completeness, and objectivity when analyzing questions that could impact operability.

5. Industry experts will be consulted, as appropriate, to provide resolution of technical issues at impasse.

NRC Unresolved Item 93-36-07 noted failure to use a validated computer code to predict design basis heat transfer capacity during heat exchanger capacity testing.

PG&E Response

Summary

PG&E believes that the computer program used for evaluation of the heat exchanger testing results met the guidance provided in GL 89-13.

Background

GL 89-13, Supplement 1, provided the results of workshops held between the NRC and interested parties to clarify the requirements of GL 89-13. The response to question III.A.12 in GL 89-13, Supplement 1, on heat transfer testing indicated that off-the-shelf software that is reviewed for technical adequacy is acceptable to the NRC.

Heat Transfer Consultants Inc.'s "Shell and Tube Heat Exchanger Design and Rating Program" (HTC-STX) was the computer program used to predict the ASW heat exchanger performance at design basis conditions. This program is a design, rating, and evaluation model for shell and tube heat exchangers. In March 1991, the HTC-STX model was benchmarked against the results of Yuba's heat exchanger design. The difference between the heat transfer coefficient given by Yuba and that calculated by the model was 2.6 percent, with the model predicting higher performance. In conversations with Yuba, they indicated that they incorporated a 2 percent margin into their design. Consequently, in 1991 the comparison between the actual Yuba design and PG&E's model was actually 0.6 percent, which is excellent agreement. Based on these comparative results, PG&E's benchmark provided sufficient verification that the model could be used and the results accepted.

In response to this unresolved item, PG&E recently performed two independent calculations to demonstrate that the model is valid. PG&E contacted Heat Transfer Consultants, Inc. to obtain their theoretical formulation of the heat transfer coefficient. An independent calculation was performed to evaluate the test fouling and predicted heat exchanger performance. These results demonstrate the validity of the computer program.

In addition, PG&E requested HOLTEC, International to analyze the GL 89-13 test data for the CCW 1-2 heat exchanger. The HOLTEC model was specifically developed for GL 89-13 evaluation and has been widely used by the nuclear power industry. It has been validated using an approved software quality assurance program and has been used in audit responses; therefore, it is considered a good validation of the HTC-STX program. The preliminary results of the HOLTEC model reanalysis of the GL 89-13 test data predicted the CCW 1-2 heat exchanger performance at nameplate condition would be 101 percent with a 95 percent confidence level. At the ASW design basis specified in WCAP 12526, Rev. 1 condition, the preliminary result would be 100.3 percent with a 95 percent confidence level. For comparison, the HTC-STX results at the Yuba nameplate condition were 98.7 +/- 1.2 percent and at the ASW design basis specified in WCAP-12526, Revision 1 condition, 98.0 +/- 1.2 percent. A January 1994 resolution of the uncertainty analysis resulted in lowering the overall uncertainty from 1.5 to 1.2 percent for the CCW 1-2 heat exchanger. This reanalysis confirmed the validity of the HTC-STX computer program.

NRC Followup Item 93-36-08 noted a concern regarding the effect of calcification (on the inner surface of heat exchanger tubes) on the heat exchanger capacity and the potential effect of undetected tube plugging at the outlet.

PG&E Response

PG&E believes there is very low potential for undetected tube plugging. Tube plugging would be detected by heat exchanger dp. If significant calcification occurs, dp will increase and heat exchanger cleaning would be necessary. If tubesheet cleaning of macrofouling does not effectively reduce dp, PG&E's maintenance organization would use effective mechanical cleaning methods to eliminate calcification and return the heat exchanger to service.

Action Being Taken

PG&E agrees that trending of the dp increase on each CCW heat exchanger would be useful in anticipating calcification and other buildup that may affect dp. Consequently, PG&E will revise STP M-26 to require a formal trending program to monitor this parameter.

ATTACHMENT 3

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

January 25, 1994

Docket Nos. 50-275, 50-323

Mr. Richard A. Clarke
Chairman of the Board
and Chief Executive Officer
Pacific Gas and Electric Company
77 Beale Street
San Francisco, California 94106

Dear Mr. Clarke:

On January 11-13, 1994, NRC senior managers met to evaluate the nuclear safety performance of operating reactors, fuel facilities, and other materials licensees. The NRC conducts this meeting semiannually to determine if the safety performance of the various licensees exhibits sufficient weaknesses to warrant increased NRC attention. In addition, at this meeting, senior managers identify specific plants that have demonstrated a level of safety performance that deserves formal NRC recognition. At the January 1994 Senior Management Meeting, the Diablo Canyon Nuclear Power Plant was identified as having achieved a high level of safety performance, and as a result, met criteria for recognition of its performance. I am pleased to note that Diablo Canyon has again been identified as a good performer.

In identifying such plants, NRC senior managers perform an evaluation of performance in many areas including operational safety, self-assessment, problem resolution, and plant management organization and oversight.

The NRC recognizes that to achieve the level of performance demonstrated by the Diablo Canyon Nuclear Power Plant, there must be management involvement in all phases of plant activities, the staff must be dedicated and knowledgeable and fully supportive of plant activities, and a commitment to safety must exist throughout the organization. We commend you and your staff for achieving this high level of safety performance. Your achievement is a positive example to the industry.

The greatest challenge that you now face is to maintain this level of performance and not to rest on past achievements. Continued management involvement and support, and dedicated efforts from your staff to identify and promptly correct problems are necessary for you to continue to meet this difficult challenge.

James M. Taylor
Executive Director
for Operations

cc: See next page

cc:

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