CALIFORNIA OCEAN PROTECTION COUNCIL

January 9, 2008

Mark Krausse, Director
State Agency Relations
Pacific Gas & Electric
1415 L Street, Suite 280
Sacramento, CA 95814

Dear Mr. Krausse, Mark,

Thank you for providing comments on the Ocean Protection Council's (OPC) recent study, *Alternative Cooling System Analysis for California's Coastal Power Plants.* We appreciate your input and welcome all stakeholder participation as the regulatory process moves forward.

Attached is a response from Tetra Tech to the concerns raised in your letter. Also attached is a response to various other comments we received.

Cordially,

Drew Bohan, Executive Policy Officer
Ocean Protection Council

1416 Ninth Street, Suite 1311, Sacramento, CA 95814 Phone: (916) 653-5656 Fax: (916) 653-8102 Email: COPCpublic@resources.ca.g
http://resources.ca.gov/copc

Detailed Responses to PG&E's Comments – prepared by Tetra Tech staff.

Engineering

From an engineering perspective, our concern is that there are very few facilities in the country with salt water cooling towers and no existing nuclear facilities with mechanical draft salt water towers. Additionally, a retrofit of the size and complexity of Diablo Canyon has never been undertaken. Thus, there is absolutely no precedent for assessing the feasibility of such a retrofit.

It is true that significant logistical, regulatory, and safety issues must be addressed before a retrofit as described in the study could be undertaken at DCPP, but these limitations do not include the ability of mechanical draft saltwater cooling towers to perform as intended at a facility of this size. While the scale of a retrofit at DCPP would be unprecedented, this does not necessarily mean such a retrofit is impossible. A 1982 Tera Corp report, *Assessment of Cooling System Alternatives to the Existing Cooling Water System,* prepared with PG&E's participation, found that conversion of DCPP's once-through system to closed-cycle, saltwater mechanical draft cooling towers was technically feasible (Table 1-5, page 1-23).

As described in more detail below, the draft report raises many critical engineering and technical issues, but does not adequately evaluate these issues in reaching its conclusion that cooling towers may be feasible at the site. Given the lack of experience with salt water towers at a nuclear facility, it is all the more important that significant engineering and nuclear safety issues be thoroughly analyzed before making any determination of technical feasibility. NRC regulations require any significant modification such as this to be analyzed to determine its impact on nuclear safety. Prior NRC review and approval of any such modification would likely be required.

Saltwater cooling towers, those that operate with a makeup water source containing dissolved solids at concentrations of 35,000 ppm and higher, have been used successfully used for many years at numerous installations both in the United States and abroad. High salinity mechanical draft cooling towers are currently in operation at Palo Verde Nuclear Generating Station in Arizona, while Hope Creek Nuclear Generating Station in New Jersey uses natural draft towers in a saltwater environment.

Operation in a high salinity environment requires modifications to the tower's design and construction materials to account for the saltwater's effect on thermal performance and the increased operations and maintenance that might result from corrosion and scaling. The OPC study addresses these concerns by properly sizing the cooling towers to provided the desired cooling capacity and by using materials that are more resistant to the negative effects high salinity water, such as fiber-reinforced plastic (FRP), stainless steel fittings, and chloride-resistant concrete. The increased cost associated with these elements is included in the detailed cost estimate provided in Chapter 7C, Appendix B.

The final report will be modified to address your concerns by expanding the discussion of the NRC's oversight role and its importance to the permitting and approval process. These comments are addressed in more detail below.

Environmental Impact

The installation of cooling towers will trigger several significant adverse environmental impacts that are also inadequately assessed in the report. These include impacts to facility and grid stability from salt drift, the treatment necessary for the remaining power plant systems discharge and cooling tower blowdown (over 72 million gallons per day), and the enormous Green House Gas (GHG) implications for both the shutdown period of 12 to 18 months and the 100 MW energy penalty due to decreased plant efficiency.

Treatment of the final discharge and/or tower blowdown is not automatically required of all facilities that convert to wet cooling towers. The need to provide some measure of treatment is largely dependent upon the makeup water's initial quality. Water withdrawn from the open ocean with no nearby pollutant sources, such as DCPP, is less likely to contain pollutant concentrations that would be of concern upon concentration in a cooling tower. Total dissolved solids will be discharged at concentrations 50 percent higher than intake water, but the Ocean Plan does not currently have TDS effluent limitations that might be triggered by this change.

Discharges from other power plant systems ("inplant wastes") are subject to their own effluent limitations under the Ocean Plan or Effluent Limitation Guidelines (ELGs). Inplant wastes must meet these limitations prior to discharge into the cooling water flow. The SWRCB is currently investigating this issue in greater detail by reviewing site-specific data for each facility. This additional analysis will be used in support of the Board's final policy decision.

The OPC and SWRCB have jointly funded a separate study that evaluates the impacts to grid reliability and broader economic concerns associated with the future of coastal power plants. In addition, the SWRCB and the Air Resources Board are currently examining secondary environmental impacts that can occur upon conversion to wet cooling systems, including increased airborne pollutant emissions, greenhouse gas emissions and changes to wastewater effluent quality, and the potential regulatory implications of each.

The report notes the potential for adverse environmental impacts related to salt drift, but recognizes that the configuration of DCPP, the potential siting area for wet cooling towers and the relative locations of sensitive equipment minimizes these concern. The NRC's *Generic Environmental Impact Statement for License Renewal of Nuclear Plants* (NUREG-1437) found that drift from the Palisade Nuclear mechanical draft cooling towers generally settled out of the air within 800 feet of the tower, with 70 percent settled out within 300 feet.

Cost Issues

Further, the draft report significantly understates the cost of a retrofit as the shutdown costs are calculated using a merchant-based model which is inappropriate for PG&E, and capital costs are likely underestimated due to inadequate evaluation of many identified technical issues.

We are currently working with the CEC and CPUC to calculate the appropriate cost reference to use when calculating shutdown and penalty costs. Where possible, the final report will reflect merchant or utility cost models and recalculate cost estimates accordingly.

Because of the scale and complexity of a retrofit project at a nuclear facility the report increases the indirect costs to 30 percent of all direct costs, and increases the contingency estimate to 30 percent of the sum of direct and indirect costs. This estimate is based on estimator expertise and best professional judgment and is appropriate for the level of detail.

It is important to note that the report's regulatory section does not fully address or acknowledge some key players in the retrofit permitting process. It does not include any discussion of the role of NRC requirements and licensing processes or the role of the Cal-ISO in ensuring a stable, reliable electric supply for the state. It should also be noted that the State Lands Commission's April 2006 resolution was overturned by the Office of Administrative Law.

Grid stability is a key issue within the larger discussion of the SWRCB policy. Grid reliability issues are the focus of the other study currently underway which is being conducted in close coordination with the ISO, PUC, and Energy Commission.

The final report will contain an expanded regulatory discussion that includes the NRC's oversight role.

The reference to the 2006 SLC resolution will be removed to reflect the OAL's decision.

COMMENTS ON CHAPTER 7C — DIABLO CANYON POWER PLANT

Comments on Section 2.0 — Background

In order to ensure a better understanding of the existing situation at Diablo Canyon, it is necessary to provide a number of corrections and clarifications.

- **The plant does not use heat treatment and has not done so since 1989.**
- **The plant's NPDES permit is in administrative extension. The permit referenced in the report was proposed by Board staff in 2003, but never adopted by the Board.**
- **The industrially zoned site is 585 acres, not 750 acres.**
- **The NRC licenses run through 2024 and 2025 respectively for Units 1 and 2.**
- **The plant's intake system was designed to minimize impingement.**

The above references have been modified to more accurately reflect current operations at DCPP. Tetra Tech is unaware of any reference describing the intake system's design as specifically designed to minimize impingement. An intake cove may result in lower impingement rates than a baseline configuration as described in the Phase II rule, but such assertions must be supported by appropriate evidence. Any studies or data that can be provided by the discharger will be referenced in the final report.

Also, the report greatly simplifies the permitting challenges for a cooling tower installation, as a workable installation would likely include not only the monumental task of designing and building the towers, but the potential necessity of undergrounding the 500kV transformers and transmission lines, the relocation of the 98,000 square foot warehouse, displacement of already limited vehicle parking areas, and significant modification of various other plant systems. Approvals would be needed from the NRC, CPUC, the

California Coastal Commission, the Regional Water Quality Control Board, and the San Luis Obispo County Air Pollution Control District.

It is agreed that the permitting and logistical challenges facing a wet cooling system retrofit at DCPP are substantial, but they are not insurmountable. The cumulative effect of these issues may render such a retrofit infeasible, but the study's purpose is to evaluate feasibility limited to technical and logistical constraints with consideration given to regulatory and permitting restrictions. As noted above, the NRC's oversight role will be discussed in the existing regulatory review chapter in the final report, which includes a discussion of the roles of other state and local agencies you mention.

Comments on Section 3.0 — Wet Cooling System Retrofit

Comments on Section 3.2 — Design Basis

Condenser Specifications

Tetra Tech states that some modifications to the condenser (tube sheet and water box reinforcement) may be necessary to handle the increased water pressures that will result from the increased total pump head required to raise water to the elevation of the cooling tower riser. No provisions are included to re-optimize the condenser performance for service with a cooling tower. Tetra Tech states, "If wet cooling towers were installed, DCPP, as a facility with a projected remaining life span of 15 years or more (currently licensed to operate through 2021 and 2025 for Units 1 and 2), would likely pursue an overall strategy that included re-optimizing the condenser to minimize performance losses resulting from a conversion." We believe Tetra Tech is understating the required modification to the condenser to make it suitable for a cooling water operating pressure (nominally 50 PSIG) of twice the present waterbox design pressure and roughly five times the present operating pressure. With no provided basis, Tetra Tech states that modifications are generally limited to reinforcement measures to enable the condenser to withstand the increased pressures. We believe that the required modifications to the condenser, even without thermal optimization, would be major both from a cost standpoint and a construction duration standpoint.

Although the limited time for this review precluded an in-depth investigation of these issues, it is our judgment that such an investigation would conclude that replacement of the present waterboxes, tube sheets and tubes with a modular design and welded tube-to-tube sheet joint would be required. This would be a major undertaking with significant impact on both the cost and downtime.

The final report will be modified to reflect consultation with Alstom Power, a leading provider of surface condensers to the steam electric industry. For Diablo Canyon, Alstom provided a budget estimate based on replacement of the tube bundles with new titanium tubesheets, new titanium tubes, support plates and structural stiffeners that would meet the design specifications of a retrofitted system. This estimate includes installation, although we recognize that site-specific limitations may increase the installation costs.

Tetra Tech believes that these modifications, although more significant than described in the administrative draft, will not increase the cumulative downtime estimate for the facility. Many aspects of a cooling tower retrofit can be constructed concurrently with other activities that require the facility's shutdown.

Plume Abatement

The Tetra Tech report states, "The proximity of DCPP to coastal recreational areas, and the potential visual impact on these resources, may require plume abatement measures. California Energy Commission (CEC) siting guidelines and Coastal Act provisions evaluate the total size and persistence of a visual plume with respect to aesthetic standards for coastal resources; significant visual changes resulting from a persistent plume would likely be subject to additional controls." Yet the report finishes its discussion on the subject by saying, "Plume-abated towers are not included in the design for DCPP. If they are required, limitations on space may become more restrictive than they already are for the conventional cooling towers designed for this study."

We believe it is highly likely that plume abatement measures would be required by the permitting agencies. Thus, plume-abated towers and the associated need for additional required space must be included in the study prior to making any determination of feasibility.

Plume-abated towers are not included in the design for DCPP because there are no identifiable safety or public hazard impacts that would warrant their use, nor are there any discrete requirements in local use or coastal regulatory programs. Visual impact evaluations under Coastal Act and CEC guidelines are relatively subjective and may be less stringent for a remote, relatively inaccessible location such as DCPP. Furthermore, it is plausible that the appropriate regulatory agencies would accept intermittent visual impacts from a plume in exchange for dramatically reduced intake and thermal impacts.

Facility Configuration and Area Constraints

As indicated in the background, the parcel zoned industrial is only 585 acres, not the 750 cited. It is unclear whether this loss of acreage changes the analysis, particularly given the likely need for more space if plume-abated towers are required. Further, the report contains little or no discussion of the significant earth moving required to grade sufficient space for tower placement. Prior review by Burns Engineering indicated that the proposed tower placement would require excavation of a 1600 x 600 foot section of the adjacent mountain. Additionally, there is no discussion about the feasibility of the required 60-foot deep-pile foundations that would be necessary to ensure a stable foundation.

As noted above, the report does not assume plume-abatement towers would be required at DCPP. Changes describing the industrial zone's area do not affect the overall wet cooling tower design.

The study considered the report prepared by Burns Engineering in response to Tetra Tech's previous analysis and included additional civil works to account for grading, excavation, demolition, and installation of new facilities. This cost, estimated at $209 million, is described in Chapter 7C, Appendix B under "Demolition/Other".

Relocation and Impact of Various Support Structures

Due to the extremely limited space available on the DCPP site, the Tetra Tech study acknowledges that any retrofit project that incorporated a closed-cycle system would require the relocation of significant support structures such as the 98,000 square foot main warehouse and parking lots to other areas that are not available within the portion of the property that is zoned for industrial development. The relocation of the warehouse would have a significant impact on the cost and feasibility of a cooling tower retrofit. It would have significant impacts operating costs, nuclear security, and permitting issues as well as possible nuclear safety issues due to delay in availability of replacement parts. The Tetra Tech study does not address the impact of these issues, stating, "Off-site relocation of parking areas and support services, if feasible, would increase project costs and are beyond the scope of this study."

The study addresses the cost of these changes, including the demolition and reconstruction of the warehouse and parking areas, but does note that relocation may be problematic. The study is not intended to be definitive on this point due, in part, to the level of detail required to make a conclusive determination. Rather, the study accounts for potential obstacles to the degree practicable and notes further consideration will likely be warranted if a similar project moves forward in the future. As noted elsewhere, a wet cooling system retrofit at DCPP is a large and substantially complex undertaking, one that would result in major modifications and reconfigurations of the site. Tetra Tech believes that, while substantially disruptive to the existing site, relocation of these structures would not necessarily be prohibitive to the overall retrofit of the DCPP cooling system.

Comments on Section 3.3 — Conceptual Design

Flooding Threat to Nuclear Safety

The proposed cooling tower project would invalidate an NRC-approved turbine building flood safety analysis and pose an increased threat to nuclear safety. The possibility of a leak in the Circulating Water System poses a threat to safety-related components in the turbine building, especially the safety related emergency diesel generators (EDGs). The present Circulating Water Pumps (CWPs) trip on high-condenser pit levels to minimize the consequences of a flooding event, such as would be caused by loss of a condenser waterbox manway cover.

We agree that NRC involvement will be necessary for a variety of safety and reliability reasons. Issues that must be addressed at a nuclear facility are obviously more complex than a fossil-fueled facility. This complexity, however, does limit the level of detail that can be evaluated within this study's scope and time frame. Accordingly, Tetra Tech based its evaluation on data received for a previous analysis as well as the Tera Corp feasibility assessment and the Burns Engineering Services summary response to the 2002 Tetra Tech report. Potential safety concerns related to possible flooding have not been raised in previous analyses or in correspondence received from DCPP.

Replacement of Service Cooling Water Heat Exchangers and Condensate Coolers

Inside the turbine building, the circulating water cools not only the Main Condenser but also the Service Cooling Water (SCW) heat exchangers and the Condensate Cooler for the Main Generator Hydrogen Coolers (to maintain generator gas temperature within limits). If the SCW heat exchangers would no longer be serviced by once-through seawater flow, significant issues arise due to the loss of low temperature inlet cooling water. The draft report does not provide any analysis of either maintaining system operability with existing design requirements or retrofitting this critical plant cooling system to effectively operate with closed-cycle cooling.

The report addresses conversion of the existing main condenser system only. For many of the reasons cited in your letter, the study specifically excluded the SCW and other auxiliary cooling systems from the analysis. Much like the Phase I and Phase II rules, this study addresses operations that directly relate to the production of steam for electricity generation (i.e., condenser cooling system). Accordingly, the study assumes that auxiliary/safety cooling systems will maintain their existing once-through cooling operation.

Constructability of Interconnecting Piping and New Pump House

Connections would have to be made to all the supply and return conduits including those coming from the north end of the Unit1 condenser. A review of detailed site drawings indicates that the excavations and routing required for these large-diameter connections would be an extremely difficult, if not impossible, engineering task . The limited area for this inter-tie in front of the turbine building is extremely congested with both safety-related and non-safety-related systems, piping and conduits.

The selection of the pump house location and supply and return conduits was based on the mechanical draft cooling tower assessment prepared for PG&E (*Assessment of Cooling System Alternatives to the Existing Cooling Water System,* Tera Corp, 1982). This location, in front of the turbine building, was part of that study's conclusion that mechanical draft wet cooling towers were a technically feasible alternative for DCPP. It is unclear what changes have occurred to the site that would render this location unusable. However, the location selected for the pump house will be altered in the final report to address these concerns. The new location, approximately 600-700 feet south of the turbine building, is not expected to appreciable increase the overall retrofit cost estimate.

Comments on Section 3.4 — Environmental Effects

Air Emissions

Tetra Tech states that state-of-the-art drift eliminators are included in the study for each cooling tower cell at DCPP. However, a significant amount of salt would be deposited on the DCPP site by the towers. Tetra Tech does not address the impact of these salt deposits on equipment degradation, maintenance costs, the environment, or the increased occurrence of electrical arcing of the 500kV lines. The NRC would have an interest in the increased potential for tripping the plant due to arcing. Salt deposition could have a significant impact on the degradation and maintenance requirements of nuclear safety related systems. This

issue must be further analyzed to quantify its nuclear safety impact before making any determination of feasibility.

Presumably, equipment at DCPP that is sensitive to salt's corrosive effects is designed for a certain degree of exposure from wind and wave action. The location selected for wet cooling towers and the direction of prevailing winds would result in salt deposition that is higher to the southeast, downwind from the turbine building and away from most sensitive equipment. Wind directions are not uniform, however, especially in a coastal canyon such as at DCPP. Increased maintenance operations may be necessary, such as more frequent washing to prevent arcing or insulator flashover. Such issues would require more analysis, especially for a nuclear facility, but Tetra Tech believes that any necessary operational changes can be accommodated without affecting the overall technical feasibility of the project.

More detailed information is available in the CEC's 2007 report *Cost, Performance, and Environmental Effects of Salt Water Cooling Towers.*

Make-up Water

Tetra Tech's use of one existing Circulating Water Pump for tower make-up is unworkable.

The final report will be modified to address this issue by incorporating new makeup water pumps. The associated cost increase will be reflected in the revised cost estimate.

NPDES Permit Compliance

The remaining discharge of at least 72 million gallons per day is not adequately analyzed. This discharge would be significantly warmer and saltier than the existing power plant discharge and may also contain other contaminants used to keep the cooling system operational. This anticipated minimum tower system discharge cannot be permitted without significant treatment.

The configuration selected calls for cooling tower blowdown to be discharged from the cooling tower side of the system, i.e., prior to recirculation through the condenser. Thus, while blowdown discharge temperatures may be marginally warmer than once-through flows, the increase in temperature over the receiving water is relatively similar. Notable, DCPP, as an existing discharger under the Thermal Plan, is subject to narrative thermal effluent limitations rather than a numeric limit ("shall comply with limitations necessary to assure protection of the beneficial uses and areas of special biological significance"). The Central Coast Regional Water Board has implemented this provision as a numeric limit based, in part, on the extent of the thermal plume. It is reasonable to assume that a retrofitted facility, with a discharge flow 95 percent less than the previous once-through system and a significantly smaller thermal plume, would be subject to revised thermal effluent limitations that would accommodate the revised thermal discharge profile.

The discharge from a DCPP wet cooling tower would have a salinity level approximately 50 percent higher than the receiving water, which is permissible under the current Ocean Plan. A numeric effluent limitation, if established, would likely be calculated similar to a water quality-based standard, which incorporates a mixing zone that would allow for a certain degree of dilution

in the receiving water. It is unlikely, at least under the current regulatory framework, that DCPP would be required to provide treatment for increased salinity levels.

Likewise, a treatment system for other constituents that are concentrated in the cooling tower (e.g., metals) is less likely due to DCPP's intake location on the open ocean. With no other measurable point sources of pollution in the vicinity, these constituents are less likely to be present in concentrations that would warrant concern. Constituents normally found in detectable quantities in ocean water (e.g., copper, silver, and zinc) are addressed with a background credit in the Ocean Plan.

Thermal Efficiency

Our preliminary calculation using an increase of 18°F for the cooling tower configuration and an ocean water temperature of 55°F to 60°F indicates an increase of 0.85 to 1.0 inches HgA backpressure versus the 0.7 to 0.85 inches HgA calculated by Tetra Tech.

The methodology used to estimate the net increase in turbine backpressure is presented in Chapter 5 and uses the thermal and environmental data summarized in Chapter 7C, sections 3.2.1, 3.2.2 and 3.4.5.

A transcription error in the calculation spreadsheet used an incorrect value for the design condenser flow rate. This has been corrected and will be reflected in the final report including all associated changes. The revised backpressure increases range from 0.8 to 0.95 inches HgA.

Comments on Section 4.0 — Retrofit Cost Analysis

Shutdown Timeframe is Not Accurate

There are two key issues with this analysis. First, an eight-month shutdown is not a reasonable estimate. For a project of this complexity, our professional judgment is at least one year, and more likely 18 months, would be required. We agree with footnote 5 on page C-24, which indicates that Diablo's importance to the grid would require a staggered conversion, but that such a conversion is not possible given the existing configuration of the facility.

The offline estimate is based on estimates developed for other facilities, including Indian Point Nuclear (4 months for each of two units) and Salem Nuclear (7 months). The 1982 Tera report estimated a required shutdown of 4 months at DCPP if a conversion to mechanical draft towers was undertaken. The report uses a shutdown period of 8 months to reflect additional complexities at DCPP (e.g., proximity of units, condensed siting area, and pipe interconnections). This does not include normally-planned refueling outages, which last 40 days on average. Together, the offline estimate for DCPP is 9 months.

Additionally, the cost of replacement power is incorrectly calculated using a merchant generator model. For a utility such as PG&E, replacement power must be purchased to make up for the loss of generation. In this circumstance, there is no netting against cost savings, except for savings in fuel costs. Due to labor agreements and other issues, there are no savings in labor or other expenses when Diablo Canyon is not operating.

We are currently working with the CEC and CPUC to determine the most appropriate rate for use in calculations. Any changes to the estimated costs will be reflected in the final report.

Operations and Maintenance

The draft report includes annual estimates of operations and maintenance in the range of $7 to 10 million. This estimate does not include any additional operations and maintenance funding for the necessary water treatment system (estimated to be $35 million per year), likely increased corrosion of plant equipment, and other required system modifications.

Cost estimates for *possible* water treatment are not included because the extent of treatment, if any, cannot be quantified without a better understanding of water quality-based effluent limitations that would be applicable to a retrofitted facility. There are different methods that may be used to comply with effluent limitations. For example, increased diffusion may allow the facility to achieve the desired effect without the need for chemical treatment systems.