Public Comment
Once Through Cooling
Deadline: 5/20/08 by 12 p.m.

Pacific Gas and Electric Company™

Mark Krausse
Director
State Agency Relations

Pacific Gas and Electric Company
1415 L Street, Suite 280
Sacramento, CA 95814

916-386-5709
Fax: 916-386-5720

May 20, 2008

RECEIVED
MAY 20 2008
SWRCB EXECUTIVE

Chair Tam M. Doduc
State Water Resources Control Board
1001 I Street
Sacramento, CA 95814

Re: Scoping Document on Once Through Cooling

Dear Chair Doduc:

Pacific Gas and Electric Company (PG&E) is committed to moving away from once through cooling (OTC) wherever possible. PG&E has demonstrated that commitment with over $75 million in investments in dry cooling at our two newest power plants, Gateway and Colusa Generating Stations, and our selection of technology for the repowering of our Humboldt Bay plant that will use just over 2% of the water needed for dry cooling. Only our Diablo Canyon nuclear power plant will continue to use OTC technology. PG&E believes that the combination of engineering, permitting, grid reliability and environmental challenges make retrofit to cooling towers infeasible at Diablo Canyon.

Strongly Encourage use of Task Force Expertise in Developing Policy

PG&E is pleased to see the coordination between the State Water Resources Control Board ("the Water Board") and various energy and environmental regulators. This effort is critical to the ultimate success of any OTC policy, and we encourage the Water Board to fully engage these experts in the development of the policy to ensure that the range of issues is effectively addressed. Further, we recommend establishing a panel of engineering experts to assess the feasibility of alternative technologies at various sites, as well as a panel of environmental experts that can assess any potential adverse environmental impacts from the installation of alternative technologies. The regulation of OTC is extremely complex and raises many issues which must be analyzed and balanced in developing a fair and reasonable policy.

Climate Change Goals Must be Considered

In addition to the primary purpose of reducing impingement and entrainment, the staff's Preliminary Draft Policy should generally also reduce GHG emissions to the extent would result in the retirement of mostly older fossil power plants, or their repowering to newer, cleaner technology. The impact will be just the opposite, however, on the two nuclear facilities, Diablo Canyon and the San Onofre Nuclear Generating Station (SONGS). The carbon emissions for one-year of shutdown for retrofit alone at either of these facilities is 10 million metric tones, based upon replacement power being generated by combined cycle gas turbine technology. With total downtime estimates for retrofit at 18 months (and 15

MMT) per plant, total emissions resulting from the Preliminary Draft Policy would be 30 million metric tones—just 5 MMT short of the entire proportional contribution that will be expected of the electric sector in meeting AB 32's 1990 emissions target. The ongoing loss of generation under cooling towers would be approximately 100 MW—for an additional 385,000 metric tones annually.

That is the impact in the unlikely scenario where retrofit is feasible. As neither PG&E nor Southern California Edison believes retrofit is feasible, the actual impact will be 20 MMT per year upon closure of the two facilities—a devastating blow to achieving the environmental imperative of the California Global Warming Solutions Act of 2006.

Options for the Continued Operation of the Nuclear Facilities

Our concerns primarily remain with the preliminary draft policy's lack of compliance flexibility for the nuclear facilities. We have evaluated a myriad of alternative technologies at Diablo Canyon for over twenty years. The only technology that warrants analysis is mechanical draft cooling towers, and as documented in our attached comments, our analysis is that this technology is not feasible. The installation of cooling towers is fraught with enormous engineering and administrative challenges, extremely high cost, and significant adverse environmental impacts of its own. There is no other nuclear plant in the world with salt water mechanical draft cooling towers--and no precedent for a retrofit of the size and complexity that would be required at Diablo Canyon.

The preliminary draft policy does not present any options for a facility such as Diablo Canyon. We recommend that you include a variance provision in the policy that would be similar to the variance provided by USEPA for new plants. Our attached comments provide the outline for such a variance. It would allow OTC or another technology which does not achieve the reductions required under the proposed track I or track II to be found best technology available under certain very specific circumstances. These include situations where the plant is needed to maintain grid reliability or where closure of the facility—even for a limited period for retrofit--would trigger air quality or GHG emissions issues.

Policy Should Incorporate CAISO Grid Study and Court Decisions

PG&E believes there is adequate time to fully address these issues. As the Water Board staff pointed out at the Sacramento workshop on May 13th, development of the policy will be delayed until the latter half of 2008, with adoption of a final policy now moving into 2009. This will coincide, not only with release of the California Independent System Operator's Phase II grid study, but also with the approximate timeline for a decision by the US Supreme Court in the *Riverkeeper II* case. Further, the California Supreme Court granted review of the *Voices of the Wetlands* case and has deferred briefing until the Supreme Court rules in the *Riverkeeper II* decision. Given the significant judicial uncertainty and the staff's reliance on *Riverkeeper II* in developing the preliminary draft policy, waiting for the Supreme Court to rule makes good sense.

In closing, PG&E is committed to providing your staff whatever support is needed in developing a well-considered policy on once through cooling. We look forward to working with the State Water Resources Control Board and other members of the Task Force in development of that policy.

Sincerely,

/s/

Mark Krausse

cc: Ms. Dorothy Rice, Executive Director, State Water Resources Control Board
Mr. Jonathan Bishop, Chief Deputy Director, State Water Resources Control Board
Mr. Dominic Gregorio, State Water Resources Control Board
Ms. Linda Adams, Secretary for Environmental Protection
Ms. Cindy Tuck, Assistant Secretary for Environmental Protection
Ms. Mary Nichols, Chair, California Air Resources Board
Mr. Mike Chrisman, Secretary for Natural Resources
Mr. Michael R. Peevey, President, California Public Utilities Commission
Ms. Jackalyne Pfannenstiel, Chair, California Energy Commission
Mr. Yakout Mansour, President and Chief Executive Officer, California ISO
Mr. Paul Thayer, Executive Officer, California State Lands Commission
Darren Bouton, Deputy Cabinet Secretary, Governor's Office

Pacific Gas and Electric Company's
Comments on the SWRCB's Scoping Document

Water Quality Control Policy on the
Use of Coastal and Estuarine Waters for Power Plant Cooling

I
INTRODUCTION AND EXECUTIVE SUMMARY

A. General Comments

Pacific Gas & Electric Company ("PG&E") supports the protection of California's marine resources through development of a consistent statewide policy implementing Clean Water Act Section 316(b) requirements. Further, we support efforts to transition away from once through cooling (OTC) and are committed to doing so at our new and repowered facilities. We are constructing our new Gateway and Colusa Generating Stations with dry cooled systems, and we are repowering our Humboldt plant with a system that replaces its former once through cooling system. PG&E's only facility that will continue to employ OTC is the Diablo Canyon Power Plant ("DCPP" or "Plant"), a 2,300 MW baseload nuclear facility on the Central Coast.

Our concern, as explained in our September 16, 2006 comments on the State Water Resource Control Board ("SWRCB") Staff's June 2006 Section 316(b) Proposal, is that inflexible regulation of existing power plants could impose billions of dollars of unwarranted retrofit costs, result in premature closures and cause serious statewide electric system reliability problems.[1/] We are pleased that the SWRCB has since involved the California Energy Commission ("CEC"), the California Independent System Operator ("CAISO) and the California Public Utilities Commission ("CPUC") in this process, but we believe that the Staff's revised March 2008 Preliminary Draft Policy will still have unacceptable electric system impacts, especially true in regard to DCPP, which provides about 22% of the power needs of PG&E's customers and will remain critical to California's energy demands for decades to come.

DCPP's impingement mortality and entrainment ("I&E") effects have been exhaustively studied in a thorough investigation conducted under the direct oversight of an agency-appointed Technical Working Group. The study demonstrated that: the Plant impinges only several hundred pounds of fish a year; it has no significant impact on marine mammals or sea turtles; the entrainment of commercially and recreationally important fish larvae is insignificant; and the entrainment of other larvae is modest and has had no clear population-level impact on forage species. On the other hand, retrofitting cooling towers is technologically and administratively problematic, and the Central Coast Regional Water Quality Control Board ("Regional Board" or "RWQCB") has previously found that their cost would be wholly disproportionate to the

---

1/ We incorporate our prior comments by reference, which should already be a part of the administrative record in this proceeding. We refer here to exhibits attached to our earlier comments as "2006 Exhibit __," and have not attached another copy to these comments. Exhibits to these comments are labeled as "Exhibit __."

benefits. The RWQCB has also found that there are no other technologies or operational procedures that could reduce the Plant's I&E effects to the levels that might be achieved by cooling towers.

Despite the foregoing, the Preliminary Draft Policy would impose an even more stringent and inflexible set of cooling water regulations on existing plants such as DCPP than USEPA has imposed on new electric power plants in its Phase I Regulations.[2/] Like the Phase I Regulations for *new* facilities, the Preliminary Draft Policy's Track I for *existing* plants requires cooling towers, and its Track II allows alternative technologies and operational procedures only if they achieve the same level of I&E reduction as cooling towers. Unlike EPA's Phase I Regulations, however, the Preliminary Draft Policy provides no variance from the Track I or II requirements.[3/]

If adopted, the Proposed Rule would require that DCPP be retrofitted with mechanical draft salt water cooling towers (fresh and reclaimed water are not available in sufficient quantity and there are no other alternatives). There are very few salt water cooling towers used in the United States, and to our knowledge, there has been no application of this technology anywhere in the world at a nuclear power plant on the scale that would be required here. Assuming this massive and unprecedented undertaking could even be permitted and constructed and that it would actually work, we estimate that the cost is very likely to be significantly greater than the $1.6 billion estimate in the Tetra Tech 2008 report and would result in at least a 5% increase in electricity rates for PG&E's customers.

We are also concerned by the real possibility that post-construction operation of a salt water cooling tower system could significantly decrease operational efficiencies – quite possibly to unacceptable levels. In short, if the SWRCB mandates the use of salt water cooling towers at DCPP, there is a real possibility that DCPP would be closed rather than risk the failure of a multi-billion dollar investment on an unprecedented retrofit that may create enormous operational problems. The closure of DCPP would place incredible stress on the electric grid and cause a significant economic loss for our customers to shoulder. Further, replacement of the Plant's generating capacity by fossil-fueled plants would increase the state's greenhouse gas emissions by 8-10 million tons/year, and clearly threaten attainment of the state's AB 32 greenhouse gas emission reduction goals.

With such prospects in mind, we urge the SWRCB to be certain of the costs and benefits of the Staff's Preliminary Draft Policy; enormous adverse economic and social implications could flow from its adoption. Although laws governing the SWRCB's decision-making process

---

2/ This is a surprising requirement since it is widely recognized that existing power plants face far greater restrictions than new plants in implementing alternative cooling water designs, and that the cost of retrofitting cooling systems or components into existing plants is far greater than the cost of new construction.

3/ Also unlike EPA's Phase I Regulation and its now withdrawn Phase II Rule for existing power plants, the Proposed Rule also does not exclude plants with a capacity utilization rate of 15% or less from regulation.

require no less,[4/] such analysis has still not been fully conducted, probably because the Staff's Scoping Document implies that federal law preempts such considerations based on the Second Circuit's ruling in *Riverkeeper v. EPA*, 475 F. 3d 83 (2nd Cir. 2007) ("*Riverkeeper II*"). Since the Preliminary Draft Policy was published, however, the U.S. Supreme Court has decided to review the Second Circuit's controversial cost-benefit ruling, which therefore must now be regarded as highly suspect. At a minimum, the SWRCB should make no decision on the Preliminary Draft Policy premised on the belief that federal law preempts the SWRCB from complying with its cost-benefit assessment obligations until the U.S. Supreme Court has ruled.[5/]

B. <u>Areas Requiring Additional Analysis</u>

At present, we believe the following main factors have not been sufficiently analyzed:

1. Cooling Tower Feasibility, Impacts and Cost: At least insofar as DCPP is concerned, Tetra Tech's 2008 report to the Ocean Protection Council does not adequately consider the technical feasibility, possible adverse impacts and actual cost of cooling towers. As indicated above and discussed below, we have grave concerns about the true technological and administrative (permitting) feasibility of such a retrofit. Post-construction operating concerns – such as the increased risks of arcing on the Plant's 500 KV power transmission lines – are extremely worrisome from the perspective of Plant reliability. Better assessment of the ability to permit these projects through the various state and local air regulators, the Coastal Commission and other authorities is also required, including an assessment of the mitigation measures such agencies may require of large cooling tower projects in the coastal zone. We also strongly suggest that the definition of feasibility be reconsidered. The newly proposed definition is not in keeping with CEQA's definition of feasibility. The addition of an expert engineering panel to assess feasibility should be included, as well as a panel to review potential adverse environmental effects from cooling tower installations.

2. Grid Reliability: The ICF Jones & Stokes April 2008 report itself cautions that it makes "optimistic conclusions" based on "limited" modeling, and that further detailed study is "essential in assuring the Board's policy results in no impact to electric system reliability, nor the environment." Among other things, any future study should seriously explore the impact of closing DCPP, which is a far more serious risk than presumed. The SWRCB must fully engage the energy agency members of the task force on the issues of grid reliability now. The appropriate authority for determining the impact of the Preliminary Draft Proposal on grid reliability and resource adequacy is the California Independent System Operator (CAISO).

4/ Cal. Water Code Section 13000 provides that "activities and factors which may affect the quality of the waters of the state shall be regulated to attain the highest water quality which is reasonable, considering all demands being made and to be made on those waters and the total values involved, beneficial and detrimental, economic and social, tangible and intangible."

5/ Presently, the parties expect oral argument to occur in November 2008, and a ruling in early 2009. Note also that the Fifth Circuit is presently considering the 316(b) cost-benefit issue in which the United States continues to contend that the Second Circuit's ruling was incorrect. *ConocoPhillips v. EPA*, Nos. 06-60662 *et al.*

Given the announcement by board staff that it will not be finalizing its policy until late 2008, and that the SWRCB will not be adopting the policy until early 2009, it is incumbent on the SWRCB staff to consider the findings of CAISO's study on the 'Mitigation of Reliance on Old Thermal Generation including Those Using Once-Through Cooling Systems' before adopting that policy. Phase 2 of this study is expected by the end of 2008.

In addition, the ICF Jones & Stokes report opines that investing in cooling towers would be as prudent as the company's recent decision to replace the Plant's steam generators. We disagree entirely. Investing in the replacement of in-kind parts in an existing technology is dramatically different from redesigning and retrofitting a wholly new system as a component of an existing structure, especially using a technology not previously used at a nuclear power plant. Given our significant operational, engineering, and environmental concerns, even if "technically" feasible, we are not inclined to make such an investment as we are uncertain that it would be reasonable to put the existing facility at risk.

3. Benefits of Reducing I&E: Generally speaking, the Preliminary Draft Policy's description of the impact of I&E at individual facilities and statewide is superficial at best. At the May 13th workshop, the expert review panel coordinator indicated that a more detailed review of the data was necessary. A much harder and more objective look at this issue is clearly warranted, especially in relationship to assessing the ecological significance of entrainment losses. It is not sufficient to merely provide the data on absolute number of larvae entrained, as 99% of larvae do not survive to adulthood. In addition to a consistent evaluation of data from each facility, more analysis is needed on the actual impacts on adult populations. As an example, we have included a report on rockfish resources on the central coast which is instructive on the point of long term population stability in the vicinity of DCPP. Exhibit 1.

C. Recommendations

In addition to identifying the continuing need for the Staff to develop a full and objective assessment of the Preliminary Draft Policy, we offer the following further recommendations:

- **Do not decide this issue until the U.S. Supreme Court has decided *Riverkeeper II.*** If federal law does not prohibit cost-benefit analysis under Section 316(b), state law requires it. The Supreme Court's decision is expected in early 2009. Additionally, the California Supreme Court has granted review of the *Voices of the Wetlands* case and deferred briefing until after the *Riverkeeper II* is decided. 74 Cal. Rptr. 3d 453. There is no need to rush to adopt a policy given this significant judicial uncertainty, particularly when the decisions are likely to come down within months of the state board's planned policy adoption.

- **Consider focusing efforts on new and repowered facilities, rather than implementing the policy in terms of classes of facilities based on capacity factors.** Ensure that each facility can be evaluated individually so that site-specific issues in terms of facility technology, environmental impact, permitting and grid stability concerns can be addressed.

- **Include a variance modeled on USEPA's variance for new facilities in the Phase I Regulations.** The variance should allow for less stringent alternative requirements, including continued operations with OTC, on a case-by-case basis, in specific circumstances where cooling towers are technologically or administratively infeasible, present significant environmental impacts, incur costs that are wholly disproportionate to those considered when the rule was adopted, or there would be adverse impacts to electric system reliability, energy rates, or other resources. If the U.S. Supreme Court upholds the validity of cost-benefit analysis in 316(b) decision making, this variance should also include a variance in circumstances where the costs of compliance are wholly disproportionate to the benefits, similar to the cost-benefit variance provision in EPA's Phase II Regulations. We have provided proposed variance language at Part VI.B.2 of these comments.

The organization of the more detailed comments below follows that of the Preliminary Draft Policy's Scoping Document.

II
BIOLOGICAL IMPACTS OF OTC

A. The Scoping Document Wrongly Implies That There Are Extensive Adverse Environmental Impacts As A Result of Impingement and Entrainment at Diablo Canyon

The Scoping Document reports that DCPP's cooling water intake structure takes in water from a 93 square mile area, in which there is "an average estimated proportional mortality of 10.8 percent . . . calculated for [nine] rocky reef taxa [of fishes]." The statement is taken out of context, and wrongly implies that the Plant is killing roughly 11% of rocky reef fishes living in this area. This is incorrect and misleading.

1. Impingement

As correctly noted in the Scoping Document, DCPP has a very low rate of impingement – the only impact that directly affects adult fishes. Indeed, it has been uniformly recognized by the RWQCB and the participants on the Plant's I&E study Technical Working Group that DCPP's direct impact on adult fish is negligible - far below the level of regulatory concern. DCPP impinges roughly the equivalent of the catch of 4 recreational fishing boats per year – roughly 1,600 pounds. The Regional Board found in 2003 that "impingement of adult and juvenile fish on the traveling screens in front of the cooling water intake structure at DCPP amounts to only a few hundred fish per year. This impact is so minor that no alternative technologies are necessary to address impingement at DCPP, and the cost of any impingement reduction technology would be wholly disproportionate to the benefits to be gained." 2006 Exhibit 6, p. 2.

2. Entrainment

The "proportional mortality rates" discussed in the Scoping Document apply only to larval stages during the typically several week period when they are small enough to be entrained. In short, DCPP may entrain about 11% of the rocky reef fish larvae that are too small to avoid capture, which is a number smaller than the total number of *larvae* that are present in this 93 square mile source water area. The 11% estimate is likely conservative for two key reasons. First, the estimates of larval duration used in the modeling were not adjusted for the large variability in the estimated size of the larvae at hatching which has been used in more recent 316(b) entrainment assessments. This increases the ETM estimate of entrainment effects at DCPP. Second, the estimate is for rocky reef fish that live close to the shore. Source waterbody sampling was done offshore and likely underestimates the number of larvae in the rocky reef habitat near the shore. Entrainment sampling was done adjacent to the shoreline intake structure. Thus, the estimated percentage entrained is likely overstated because the total number of larvae subject to entrainment is underestimated.

It is extremely doubtful that the levels of larval proportional mortality estimated from DCPP would translate into any actual effects on adult populations. The marine fishes in the vicinity of DCPP have reproductive strategies for producing large numbers of larvae because of high natural mortality rates that in some species exceed 99%. It is important to realize that fish populations are sustainable if at least two larvae survive to adulthood from each female over the entire period that each female is reproductively active and spawning. Each year a large reserve supply of larvae are produced to account for the fluctuating environment and high natural mortality and the small incremental mortality due to DCPP entrainment would not be expected to have any impacts on these fishes.

There is empirical evidence that even far higher levels of proportional larval mortality than the 11% estimate from DCPP have not had population level effects. Proportional larval mortality in the range of 30 to 50 percent has been estimated at power plants located in semi-closed lagoons and embayments in Southern California. Data from historic and recent studies at some of these locations have shown that even these high levels of entrainment mortality have not necessarily affected the adult populations. In these habitats, the fish with the highest larval entrainment are gobies, which are small and live in borrows on mudflats. The adult densities of gobies in the locations with power plants are similar to or greater than densities in locations without power plants. The high levels of entrainment do not affect these fishes because the goby populations in these habitats are limited by available habitat and not the supply of larvae for recruitment.

The populations of rocky reef fishes with the highest estimates of proportional mortality at DCPP are also limited by available habitat and not larval supply. The much lower levels of larval mortality estimated for DCPP would not be expected to have any impacts on these populations since the proportional mortality estimates are much lower than the levels estimated for semi-closed embayments which are not open to transport of larvae from other areas as would be the case for DCPP.

Further direct evidence of DCPP's limited impacts on marine life was produced by researchers from the California Polytechnic State University in San Luis Obispo. In 2006, they completed a study of rockfish populations on the Central Coast, an area with relative limited human-induced impacts on the ocean. This study concluded that "[i]n general, the south central coast rockfish resources, with the exception of bocaccio[6] (*S. paucispinis*), have not shown strong evidence of a declining trend over the past 25 years." Exhibit 1; 2006 Exhibit 20. This study's data base began in 1980, five years before DCPP commenced operations. If DCPP's entrainment were having a substantial effect, one would have expected to see population-level declines in rockfish. The fact that such declines have not occurred after nearly 23 years of Plant operations indicates that DCPP's impact on these species is not ecologically significant.

B. Other Comments On Specific Scoping Document Biological Statements

Comments on specific biological sections from the Scoping Document are presented below with the text from the Scoping Document referenced by page number and presented in italics.

1. Page 12. *"Impacts associated with OTC include impingement, entrainment, and thermal effects. The biological impacts of OTC may not be adequately known since modern quantitative studies are difficult and costly."*

This statement ignores the recent studies on I&E at many of the power plants in California. The results from these studies have provided up-to-date estimates of I&E. Most of the studies have also incorporated extensive source water sampling for fish larvae that might be subject to entrainment. This approach has helped provide a context for entrainment estimates, which historically were difficult to obtain. The results in most cases indicate a low potential for any adverse environmental impacts to fish populations due to OTC. In most cases, entrainment represents a small incremental mortality to nearshore fishes that would not affect the populations. The results from these completed studies provide an unprecedented opportunity to evaluate the effects of OTC and the results from these studies are not being used in developing the policy presented in the Scoping Document.

2. Page 12. *"OTC power plants are generally the largest volume dischargers in the state, ranging from 78 to 2670 MGD. The largest volumes are associated with the active nuclear generating stations, Diablo Canyon and San Onofre, with design flows of 2,670 and 2,587 MGD respectively . . . Discharge volumes roughly correspond to intake volumes. By comparison, the largest wastewater treatment plant with an ocean discharge is the Hyperion wastewater plant (City of Los Angeles), which has a permitted flow of 420 MGD; most ocean dischargers of treated sewage are well below 50 MGD, including the City of San Francisco's Oceanside plant discharge (43 MGD)."*

This comparison between cooling water and wastewater discharge ignores all of the logic used as the basis for past regulation of OTC. Cooling water has been regulated differently because it is recognized that heat is not the same as other pollutants. Water that passes through power plants is returned to the source water with the heat rapidly dissipating to the atmosphere. The characteristics of the source water a few hundred meters from a power plant thermal

---

6 Boccaccio have been over-fished. 2006 Exhibit 12 p. B2-2 (Table B2-1).

discharge is likely to be indistinguishable from background characteristics. The area affected by a thermal discharge still retains value as habitat. Wastewater effluent and other types of discharges contain pollutants that do not break down rapidly in the environment. This can result in degraded water quality that may persist for long periods of time. There are numerous examples of bioaccumulation of these types of pollutants through the food chain. None of these problems result from OTC discharges.

3. Page 12. *"The effluent limits for marine and estuarine wastewater discharges under National Pollutant Discharge Elimination System (NPDES) permits (including power plant discharges) are designed to prevent acute and chronic toxicity to marine aquatic life, thereby protecting fish and other marine life from mortality. When spills and industrial discharges do result in fish kills, in violation of the California Water Code and the Fish and Game Code, enforcement actions are typically taken. Ironically, with all of the limitations and prohibitions placed on discharges, impingement and entrainment have essentially constituted a permitted fish kill for power plant intake systems."*

Section 316(a) and 316(b) of the Federal Clean Water Act and State Porter-Cologne Water Quality Act recognize the potential for some effects due to OTC. The arguments that OTC amounts to unregulated fish kills could be applied to almost any human activity in the ocean. The beneficial uses of the State waters for recreational uses are protected as are industrial uses with the recognition that both will result in some effects. The goal of the regulations is to minimize large-scale and specific types of impacts that could adversely affect biological populations, not eliminate all effects. When large-scale impacts, such as fish kills, do occur as a result of recreational or industrial uses (including OTC) they are rectified under the appropriate codes and regulations.

4. Page 12. *"There has been an historical emphasis on commercially or recreationally important species, primarily fish. The reality is, however, that a power plant cooling system does not discriminate and instead causes mortality to all aquatic life in the water column. Protection of the entire ecological community is essential for promoting a healthy ecosystem."*

Previous studies have focused on commercially and recreationally important fishes based on input from resource agencies. This focus is sound because these species are at greater risk to the effects of impingement and entrainment because they also experience fishing mortality as adults sometimes before they are able to reproduce.

Contrary to the statement in the Scoping Document, OTC does not "…cause mortality to all aquatic life..." To be conservative, recent entrainment assessments in California have assumed 100% mortality of entrained larval fishes, but this was never meant to be applied to all organisms. One of the reasons the 100% mortality value is used for fish larvae is that few survival studies on larval fishes have been done in California, but the expectation would be that there would be a range of survival among species that would vary depending on the design of the cooling water intake structure (CWIS), and the species and life-stage entrained. Larval fishes have a greater likelihood of mortality due to entrainment and passage through a cooling water system since they are soft-bodied and more fragile than other lower trophic level planktonic organisms (e.g., diatoms and crustaceans) that have shells and hard body parts. This was one of the reasons that the USEPA Rule focused on addressing impacts to fish and shellfish rather than lower tropic levels such as phytoplankton and zooplankton.

Some of the other reasons why there is a low potential for impacts to phytoplankton and zooplankton and why the USEPA recognized the low vulnerability of phytoplankton and zooplankton in its 1977 draft 316(b) guidance[7/] include the following:

- The extremely short generation times—on the order of a few hours to a few days for phytoplankton and a few days to a few weeks for zooplankton;
- Both phytoplankton and zooplankton have the capability to reproduce continually depending on environmental conditions; and
- The most abundant phytoplankton and zooplankton species along the California coast have populations that span the entire Pacific, or in some cases all of the world's oceans. For example, *Acartia tonsa*, one of the common copepod species found in the nearshore areas of California has a distribution that includes the Atlantic and Pacific coasts of North and South America and the Indian Ocean.

5. Page 13. *"Protection of the entire ecological community is essential for promoting a healthy ecosystem."*

It is unclear whether this statement applies to all organisms or all species. Any resource manager would agree that it is not necessary to protect every single individual to ensure a healthy ecosystem. The original USEPA guidelines for assessing the effects from OTC included criteria for evaluating adverse impacts that insured that were not affecting the functioning of the ecosystem.[8] One of the criteria was "Whether the impact would endanger (jeopardize) the protection and propagation of a balanced population of shellfish and fish in and on the body of water from which the cooling water is withdrawn (long term impact)."

Since the suspension of the EPA 316(b) Phase II Rule, the 1977 EPA 316(b) Guidelines have again been used in assessing the potential for adverse environmental impacts for many of the power plants throughout the state. These criteria were also used in assessing the data from DCPP 316(b) study conducted from 1996–1999.[9/] No adverse environmental impacts were found at any of the power plants assessed using the EPA criteria.

6. Page 14. *Table 8*

It also appears that Table 8 is somewhat misleading. These figures appear to be estimates of the maximum amount of larval entrainment that may occur if plants operated at their full

---

7/ United States Environmental Protection Agency (USEPA). 1977 Draft Guidance for Evaluating the Adverse Impact of Cooling Water Intake Structures on the Aquatic Environment: Section 316(b) P.L. 92-500.

8 *Ibid.*

9/ Tenera Environmental Services. 2000. Diablo Canyon Power Plant 316(b) Demonstration Report. Prepared for Pacific Gas & Electric Co., San Francisco, CA.

capacity 100% of the time. Some of these studies are quite outdated. The information in this table should be standardized and updated as appropriate.

For all of the foregoing reasons, the biological assessment performed to date grossly overstates the likely actual impacts of OTC power plants in California, and does not provide a sound basis for the adoption of an informed policy.

III
LEGAL CONSIDERATIONS

A. The SWRCB Must Analyze the Costs and Benefits of the Preliminary Draft Policy

Clean Water Act Section 316(b) requires that CWIS's reflect the "best technology available for minimizing adverse environmental impact." This requirement is implemented through the federal National Pollution Discharge and Elimination System (NPDES) permit program. States with delegated NPDES permitting authority may implement their programs in lieu of USEPA's, and Section 510 of the Clean Water Act authorizes states to impose more stringent standards. California has received delegated authority from USEPA to implement the NPDES program, which is incorporated into State law by Water Code Section 13377. The SWRCB Staff are now proposing to impose on existing facilities even more stringent standards than USEPA has imposed on new facilities under its Phase I Rule, notwithstanding the fact that new facilities have far greater flexibility in selecting designs and locations than existing facilities, and notwithstanding the fact that the cost of new construction is far less than that of retrofitting existing plants.[10/]

The California Environmental Quality Act (CEQA), Public Resources Code (PRC) Section 21000 *et seq.*, applies to the promulgation of statewide policies by the SWRCB, and requires that a policy not be adopted unless it is "feasible," meaning "capable of being accomplished in a successful manner within a reasonable period of time, taking into account economic, environmental, social and technological factors." PRC Section 21061.2. In this regard, "an agency may consider specific economic, environmental, legal, social and technological factors," and "has an obligation to balance a variety of public objectives, including economic, environmental and social factors. . ." 14 CCR Section 15021 (b) and (d). The Preliminary Draft Policy does not use this definition of feasibility and we believe that it should.

10/ In addition to incorporating the federal 316(b) program into State law, the Porter Cologne Water Quality Control Act requires that each "new or expanded powerplant or other industrial installation using seawater for cooling, heating, or industrial processing [use] the best available site, design, technology, and mitigation measures feasible . . . to minimize the intake and mortality of all forms of marine life." Water Code Section 13142.5(b). By its terms, this section does not apply to *existing* power plants.

CEQA's broad objective of balanced social, economic and environmental decision-making is also reflected in the Legislature's specific mandates to the SWRCB regarding State water policy. California Water Code Section 100 provides that: "because of the conditions prevailing in this State, the general welfare requires that the water resources of the State be put to beneficial use[11/] to the fullest extent of which they are capable." Water Code Section 13000 further provides that:

> Activities and factors which may affect the quality of the waters of the state shall be regulated to attain the highest water quality which is reasonable, considering all demands being made and to be made on those waters and the total values involved, beneficial and detrimental, economic and social, tangible and intangible.

In the present context, the beneficial industrial use of ocean water for cooling existing electric power plants - which in turn provide an essential service (electricity) for human health, welfare and the economy - must be reasonably balanced against other competing human and ecological beneficial uses of marine waters, such as commercial and recreational fishing, fish spawning and migration, and maintenance of marine habitat and Areas of Special Biological Significance. The best balance of competing uses does not necessarily mean a perfect balance, and Water Code Section 13241 expressly provides that "it may be possible for the quality of water to be changed to some degree without *unreasonably* affecting beneficial uses." (Emphasis added.)

Thus, the fundamental legal question posed by the Preliminary Draft Policy is whether – based on evaluation of *all* relevant social, legal, economic and environmental factors – it would unreasonably interfere with the continued use of ocean water for the purpose of generating electricity at existing power plants. We believe that the adoption of the Preliminary Draft Policy would unreasonably interfere with the use of ocean water at DCPP since the resulting adverse social, economic and environmental harms would greatly exceed any benefits derived from its implementation.

The Preliminary Draft Policy's Scoping Document implies that cost-benefit analysis cannot be conducted under state law because the Second Circuit Court of Appeals greatly restricted the consideration of costs and benefits under Section 316(b) in *Riverkeeper II.* Since the Preliminary Draft Policy was adopted, however, the US Supreme Court has accepted *certiorari* of that decision, for the sole purpose of reviewing this controversial cost-benefit ruling which the USEPA has consistently opposed as wrong - in the promulgation of the Phase II Rule itself, during proceedings before the Second Circuit and the Supreme Court in the *Riverkeeper II* case, and in the appeal of the Phase III Rule now pending in the Fifth Circuit in *ConocoPhillips v. EPA*, Nos. 60662 *et al.* In light of the foregoing, and particularly in light of the Supreme Court's pending review, the cost-benefit ruling in *Riverkeeper II* must be regarded as highly

---

11/ The beneficial uses of marine waters include "industrial supply water; water contact and non-contact recreation, including aesthetic enjoyment; navigation; commercial and sport fishing; mariculture; preservation and enhancement of Areas of Special Biological Significance (ASBS); rare and endangered species; marine habitat; fish migration; fish spawning and shellfish harvesting." California Ocean Plan (2005), Section I.A.

suspect, and cannot be used as a justification for a failure to engage in the type of rigorous cost-benefit analysis required under state law.[12/]

B. The SWRCB Should Wait for *Riverkeeper II* and *Voices of the Wetlands* to be Decided.

Now that the U.S. Supreme Court has granted review of the *Riverkeeper II* decision and will rule on whether cost benefit analysis may be used to set the best technology available standard under Section 316(b) of the Clean Water Act, it makes sense for the SWRCB to consider that decision in developing its policy. Much of the substantiation for the Preliminary Draft Policy appears to be based on the holdings in *Riverkeeper II.*

Additionally, in March 2008, the California Supreme Court granted review of the *Voices of the Wetlands* decision and deferred briefing until the U.S. Supreme Court issues a decision in Riverkeeper II. 74 Cal.Rptr 3d 453. Given the legal uncertainty presented by these two grants of review, it makes sense for the SWRCB to await these crucial decisions before adopting a policy. It is our understanding that a policy will not be ready for Board review until early 2009 in any case – and the U.S. Supreme Court decision is expected in early 2009.

C. The SWRCB Should Further Consider the Role of Restoration

The Second Circuit rejected the use of restoration measures as a 316(b) compliance alternative for both new and existing facilities in *Riverkeeper I and II* respectively. Certiorari of *Riverkeeper I* was not sought, and the U.S. Supreme Court decided not to hear any appeal of the Second Circuit's restoration ruling for existing facilities under the Phase II Rule. On the other hand, the First Circuit in *Seacoast Anti-pollution League v. Costle*, 597 F. Cir. 2d 306 (1st Cir. 1979) upheld the use of restoration in a NPDES permit, and EPA and many states have accepted restoration measures as an appropriate compliance measure for 30 years. As noted above, the California Water Code discusses the use of restoration as a cooling water intake structure compliance alternative in Section 13142.5(b) in relationship to new and repowered plants and the California Supreme Court may provide additional guidance in this regard in their decision on the appeal of *Voices of the Wetlands*. Further consideration should be given to the role of restoration under California law, particularly for facilities that are critical to grid stability, but lack technology options.

D. The Scoping Document Wrongly Describes Diablo Canyon's Permitting Status

Table 10 of the Scoping Document wrongly indicates that there is a "pending lawsuit" in relation to DCPP's NPDES permit. This is not accurate. DCPP's existing NPDES permit was administratively extended in 1995 by a timely application. In 2000, the Regional Board Staff contended that the Plant's thermal discharge violated narrative performance standards in the permit. The matter went to a hearing, which the Board suspended without ruling. A settlement agreement was negotiated and signed by the parties in 2003 and required the renewal of the permit to be effective. Further permit proceedings were conducted on the NPDES permit

---

12/ CA Const. art. III, sec. 3.5.

renewal in July 2003, and a further scientific opinion was sought by the Board on additional restoration options. The scientists submitted two separate reports to the Regional Board in 2004 and 2005 and PG&E submitted comments in response. The administrative enforcement action remains suspended, and the permit proceedings are still pending. There is no NPDES permit lawsuit. Additionally, PG&E continues to work closely with the Regional Board. We have provided on-going information to keep our application current, updated our stormwater program under the state's industrial stormwater permit, and initiated efforts to update our thermal and entrainment/impingement studies.

IV
ALTERNATIVES TO OTC

A. Concerns With Tetra Tech's Cooling Tower Feasibility Study

There have been numerous efforts to analyze the feasibility and cost of mechanical draft saltwater cooling towers at DCPP, including two studies by Tetra Tech and studies on behalf of PG&E. See 2006 Exhibits 2, 3, 5, 15. Tetra Tech's most recent report, prepared on behalf of the Ocean Protection Council, found that mechanical draft cooling towers are "technically and logistically feasible" at the site based on "this study's design criteria." Tetra Tech, California's Coastal Power Plants: Alternative Cooling System Analysis, p. C-1. However, the report also noted that the installation would require the relocation of several major facilities – possibly beyond the current industrial zone – and that "considerations outside of this study's scope may limit the practicality or overall feasibility of a wet cooling tower retrofit at Diablo Canyon."

We have serious concerns with Tetra Tech's assessment and provided detailed comments on the draft report. Exhibit 2. Additionally, we have provided further comments on Tetra Tech's comments and the final report. Exhibits 3, 4. In summary, we believe that the report cannot be used to determine whether cooling towers are feasible because the analysis is not nearly detailed enough to make such a determination. Key issues are the major modifications required to the condensers and other existing system components, operational and safety concerns triggered by the salt drift, down time of at least 18 months, and offshore diffuser required for the remaining minimum 70 million gallon per day cooling tower discharge. Additionally, the 100,000 square foot warehouse and all employee parking would need to be relocated and the availability of industrially zoned land for this purpose is not at all clear. Even if the technical and engineering challenges can be overcome, permits and authorizations needed have not been adequately addressed, including air permits, State Lands Commission approval, Coastal Commission approvals, and NRC approvals. As an example, the SLO Air District issued a letter indicating that the permitting of salt water towers at Morro Bay was unlikely based on a conflict of BACT requirements and the lack of available offsets. 2006 Exhibit 7.

The compelling fact remains that there is no nuclear plant with mechanical draft salt water towers and very few fossil fuel plants with such towers. Since there is no precedent for existing or retrofitted salt water mechanical draft cooling towers at a nuclear facility, the analysis of feasibility must be much more detailed than that provided by Tetra Tech. It is important to note that in developing its 2008 report, Tetra Tech did not visit the site or talk to any facility personnel.

Further, references by other stakeholders to studies indicating that cooling towers are feasible at other nuclear plants (e.g. Indian Point) are incorrect. These studies are of the same level of analysis as the Tetra Tech report and thus, are not sufficient to determine feasibility. No recent decision has been made at any nuclear facility to install cooling towers. The Palisades plant in Michigan remains the one plant that has retrofitted to cooling towers – and it is not directly comparable to DCPP. Palisades is a 790 MW unit located on a relatively flat parcel adjacent to freshwater Lake Michigan. It was retrofitted very early in its operation, when capacity utilization was very low.

B. <u>There Are No Compliance Alternatives For DCPP Other Than Cooling Towers</u>

In addition to the Tetra Tech 2008 report, Tetra Tech (2002), on behalf of the Regional Board, and PG&E have also analyzed a wide array of other potential cooling water intake structure technologies for DCPP. None has been identified which appears to be feasible or capable of achieving the I&E reduction required under the Preliminary Draft Policy.

1. <u>Alternatives Evaluated</u>

a. <u>Dry Cooling:</u> According to the RWQCB's consultant, Tetra Tech, a conceptual dry cooling system for DCPP would require eight (8) units, each occupying an area of 316 feet long x 197 feet wide x 119 feet high, and each containing forty (40) 150 horse power fans. Tetra Tech concluded that dry cooling is not even remotely feasible at DCPP because, among other things, ducts can be no longer than 200 feet, and this is physically impossible at the site. 2006 Exhibit 3, pp. 11–12.

b. <u>Natural Draft Cooling Towers:</u> According to the RWQCB's consultant, a conceptual natural draft cooling system for DCPP would consist of ten (10) 450 foot high, 208 foot diameter concrete cooling towers whose capital costs alone were estimated at $1.58 billion (i.e., does not include future O&M, revenue losses during construction tie-in of the system, etc.). 2006 Exhibit 3, p. 19. Furthermore, natural draft cooling towers are not efficient in cool, damp climates such as those along California's central coast, the complex would have significant adverse visual impacts, and probably could not be constructed because of space constraints and seismic concerns.

c. <u>Fine Mesh Screens:</u> The RWQCB's consultant concluded that fine mesh traveling screens might reduce entrainment by 80% (which may not meet the Preliminary Draft Proposal's entrainment reduction standard), and that such a system would cost $650 million. Pilot studies would be required to determine if the system were feasible. 2006 Exhibit 3. pp.7-10. EPA's consultant, Science Application International Corporation, had previously concluded that "the use of fine-mesh mounted on traveling screens has not been demonstrated as an effective technology for reducing mortality of entrainment losses." 2006 Exhibit 4, p. 3-4. PG&E's consultant concluded that fine mesh screens were unproven and likely would not work in an open ocean environment because of biofouling, that the costs of such a system at DCPP would likely be $770 million, and that the net environmental benefit of screens was doubtful because they would reduce entrainment by increasing impingement. 2006 Exhibit 5, p. 1. Thus, fine mesh screens are not feasible, and in any event would not comply with the Preliminary Draft Proposal's entrainment or impingement standards.

d. Variable Speed Pumps: Given DCPP's role as a baseload facility, variable speed pumps would not provide any significant reduction in flow.

e. Aquatic Filter Barriers/Barrier Nets: Neither of these technologies is proven in open ocean environments and both have been rejected by Tetra Tech. Tetra Tech (2008) at page C.32. An aquatic filter barrier was estimated at 1.5 miles in length.

f. Wedgewire Screens: These types of screens have never been used in an open ocean environment. To be successfully implemented, these screens generally need a consistent current of 0.5 fps. In addition to concerns about debris clogging, the currents off the coast of DCPP do not provide the needed velocity or consistency for the wedgewire screens to have any chance of successful application.

2. The RWQCB Staff Previously Determined that there Is No Feasible Alternatives for the Plant: The RWQCB staff made explicit findings with respect to each of the foregoing technologies and a number of others in July 2003, which are fully presented in 2006 Exhibit 6. The RWQCB staff found that the rate of *impingement* at DCPP was already so low that further reductions were unnecessary. The staff summarized their overall findings regarding *entrainment* reduction alternatives as follows:

> The technologies that may reduce entrainment at DCPP are either experimental (screens and filters) or only conceptually available at this site (saltwater cooling towers). Therefore the Board cannot conclude that these systems are available at DCPP under the meaning of Section 316(b) of the Clean Water Act . . . There are no demonstrated applications of these technologies at facilities similar to DCPP, and there are many significant problems associated with their potential use at DCPP.

2006 Exhibit 6, pp. 2-3. The staff also found that the costs of cooling towers and fine mesh screens were wholly disproportionate to the benefits, which staff then estimated to be in the $10 million range. 2006 Exhibit 6, p. 3.

V
COMMENTS ON ISSUES AND ALTERNATIVES FOR STATE'S 316(B) POLICY

The Scoping Document requests comments on a number of specific questions and issues. PG&E's responses are as follows.

A. Should The SWRCB Adopt A Statewide Policy?

PG&E believes that there should be a consistent approach to permitting decisions throughout the state, and in particular that different results should not be reached by the various Regional Boards given similar facts. Application of a common set of standards in a consistent manner should be required, and we agree generally with the suggestion elsewhere that the Regional Boards should be assisted by SWRCB-formed Expert Panel(s) to address specific subject matter areas, with members who have the requisite expertise.

However, the state should not adopt any policy until the U.S. Supreme Court has reached its decision in *Riverkeeper II*. The larger issue is not the prompt enactment of a state policy different from past 316(b) implementation practices, or more stringent than the now withdrawn Phase II Regulations, but rather adoption of a reasonable and well thought out policy that adequately addresses grid stability issues and effectively assesses facilities on a site-specific basis.

B. How Should New And Existing Plants Be Defined?

PG&E agreed that using EPA's definitions of new and existing facilities from the Phase I and II Regulations is appropriate.

C. What Constitutes BTA For Existing Power Plants?

This is a question that cannot be answered until after the U.S. Supreme Court determines whether cost-benefit analysis can be employed in setting the standard. If the Court decides that cost-benefit considerations may be used – and therefore that federal law does not preempt state cost-benefit analysis, then state law requires that the SWRCB apply them. The Scoping Document's statements in this section that are based on the Second Circuit's *Riverkeeper II* decision are now highly suspect in light of the U.S. Supreme Court's decision to review that ruling, and the SWRCB should not, and we believe lawfully cannot, make a decision based on such statements until the U.S. Supreme Court has ruled.

In assessing the feasibility of implementing technologies at DCPP, the SWRCB should not rely upon the Tetra Tech report's analysis of the "feasibility" of implementing salt water cooling towers at the Plant. Tetra Tech's analysis of the technical feasibility of implementing such a system is not sufficient, the permitting hurdles that such a project would face (beyond Section 316(b) considerations) are daunting at best and perhaps insurmountable, and the analysis fails to objectively assess the operational impacts of a salt water system on future Plant reliability.

In all events BTA must be defined as a technology that is known to be technologically feasible at a given site, that is known to be capable of being permitted by all agencies involved, and that, if the Second Circuit's *Riverkeeper II* decision is reversed, has costs that are proportional to the benefits. Whatever BTA is, there should also be a variance possible from its application on a site-by-site basis. EPA allows this even for new facilities, recognizing that there can be special circumstances.

D. Makeup Water For Closed Cycle Wet Cooling.

If closed cycle wet cooling is a feasible alternative at a site, we agree that it would be appropriate to consider the feasibility of using recycled waste water for the power plant's cooling system.

E. Nuclear And Conventional Facilities

The proposal to provide DCPP additional time to meet Track I or II requirements as a compromise solution for the additional complexities involved in modifying nuclear power plants is probably unnecessary, at least from PG&E's perspective. As discussed above, there is no Track II alternative for DCPP, and it is extremely doubtful that an enormous complex of mechanical draft salt water cooling towers would ever be installed at the Plant. We do not disagree, however, with the principle that there are enormous complexities and additional regulatory considerations and proceedings applicable to nuclear facilities that, as a general matter, can require more time to accomplish than would be the case for conventional power plants.

In keeping with USEPA's Phase II Regulations, the Preliminary Draft Policy contains a nuclear safety exemption – providing that nuclear plants do not need to install alternative technologies that conflict with a nuclear safety requirement. We believe that this provision essentially establishes a variance for nuclear facilities, recognizing that there are certain situations where the installation of cooling towers is not possible. We suggest that the provision's implementation be included within the variance we propose in section VI.B.2. The long-term operation of DCPP is contingent on a flexible compliance approach that allows for a variance from Track I or Track II requirements under certain limited circumstances – in addition to conflicts with nuclear safety.

F. Establishment Of A Compliance Schedule

It is unquestionably the case that there must be a plan for compliance implementation, especially if cooling towers or some other high capital cost technology is chosen. Clearly the CAISO, CPUC and CEC must play an important and perhaps controlling role, in phasing the implementation of any policy that requires significant plant downtime in a system that is already resource constrained. As the Jones & Stokes Grid Reliability Study readily acknowledges, considerably more planning would be required than has occurred to date in order to assure that the Preliminary Draft Policy really could be implemented in a manner that does not jeopardize the system, and that effort should be completed before any decision is made. It is not clear that the "class" approach outlined in the Preliminary Draft Policy is the best approach for establishing a schedule. Our recommendation is that the schedule be developed with significant input and guidance from the Task Force.

G. Monitoring Provisions To Assess Track II Reductions In I/E

Since there is no Track II alternative that can be implemented at DCPP, we leave comment on this issue to others who may be affected by it.

H. Interim Requirements

DCPP does not have an issue with the impingement of large marine organisms and therefore offers no comment on this issue.

With regard to the reduction of cooling water flows to 10% of the average daily flow during periods when energy is not being produced, this requirement would not be practical for the nuclear facilities. During start-up from a unit refueling outage, or during forced outages, at least one circulating water pump (CWP) for an individual unit must be run for extended periods to establish or maintain condenser vacuum. This routinely requires a period of more than 2 days prior to initiating power generation. Following a refueling outage, a single circulator will be run as long as 1 week prior to generating electricity (parallel of the generator to the electrical grid and power ascension) to establish condenser vacuum, and stabilize the secondary side of the power plant. During forced outages which may last longer than 2 days, a main seawater circulator is run for essentially the same purpose. During these periods however, only one CWP is generally run on the affected unit, effectively a 50% reduction in circulating water flow. It should be noted that running CWPs is costly to the facility in terms of auxiliary power consumption. Plant operations already limit running seawater circulators for a unit to those periods necessary to support plant start-up or power operations.

I. Restoration As An Interim Measure

Past experience indicates that identifying, designing and permitting restoration measures are complex processes that take years to accomplish. From a practical perspective, this may be something that could not be performed in most cases before feasible technologies could be permitted and installed.

We think that the use of Habitat Production Foregone ("HPF") to scale restoration efforts is particularly inappropriate for the following reasons:

1. <u>The Habitat Production Foregone Analysis Has Methodological Flaws that Preclude Its Use for Reliably Estimating the Size of Restoration Projects:</u> Based on our experiences with the past application of HPF at DCPP, it is apparent that the HPF suffers from a number of methodological flaws which preclude its use as a reliable estimator of the size of mitigation projects necessary to compensate for I&E losses. Among other things, the HPF methodology: (1) fails to provide a necessary linkage between I&E effects, ecological services and human services; (2) fails to consider discounting, and thus would overestimate the size of the restoration project (e.g., I&E effects terminate when a plant shuts down or installs alternative technologies, but the benefits of restoration may continue in perpetuity); (3) does not account for uncertainty in its analysis; and (4) fails to consider biological compensation, especially in relationship to larval losses, and is again overly conservative for that reason as well. In sum, the HPF is an over-

simplified system that at best produces overly conservative ballpark estimates. These concerns are discussed in greater detail in 2006 Exhibit 11, p. 2, 21-24.

2. <u>HPF Cannot Be Used to Place a Value on I&E Losses:</u> We had the HPF analysis for DCPP reviewed by three sets of resource economists – Triangle Economic Research and Professors Kolstad and Deacon, two UCSB resource economists. All three concluded that the HPF approach violates fundamental economic principles by endeavoring to use habitat replacement costs as a proxy for the value of the lost resources. 2006 Exhibits 11, 13, and 14. "Value" is not based on the costs of producing a good or service, but instead is based on people's willingness to pay for it. As TER observed, for example, the HPF approach would conclude that the "value" of lost larval resources would rise or fall with variations in any component of the costs of constructing artificial reefs. 2006 Exhibit 11, pp. 11-12. The larvae would be more valuable if the cost of gas went up, for example, and less valuable if the costs of artificial reef materials went down. This does not make sense.

USEPA recognized in the Phase II Rule that costs cannot be used as a proxy for value, notwithstanding its serious effort to use habitat replacement costs as a means of valuing I&E reductions. 69 Fed. Reg. 41,624-25. USEPA's Economic Guidelines for Preparing Economic Analyses also flatly reject habitat replacement cost analyses as a proxy for value:

> Alternative approaches that estimate the total value of ecosystems based on the cost of the entire ecosystem or its embodied energy . . . have received considerable attention as of late. However, the results of these studies should not be incorporated into benefit assessments. The methods adopted in these studies are not well-grounded in economic theory, nor are they typically applicable to policy analysis.

EPA 2000 Guidelines p. 98. Comparing TER's peer-reviewed benefit valuation of $1 million with the range of HPF estimates developed by the independent scientists - $6 million to $26 million – highlights the inaccuracy of cost-based valuations, which according to the resource economists can only serve as an absolute upper bound to the real value of benefits, but can never themselves be a defensible estimate of value. 2006 Exhibit 13, pp. 1-2.

For the foregoing reasons, significant additional analysis is required to fully assess and design any interim restoration measures that may be used as a fundamental component of California's Section 316(b) policy.

VI
COMMENTS ON PRELIMINARY DRAFT POLICY (APPENDIX A) AND PROPOSED ALTERNATIVE POLICY RECOMMENDATION

This section of our comments summarizes and supplements the principal concerns discussed above, and contains a proposed variance provision that we believe must be added to the Preliminary Draft Policy.

A. Overview Of Basic Problems With The Preliminary Draft Policy

From our perspective, it makes little sense to impose on existing facilities a set of regulations that is more stringent and inflexible than the state's 316(b) regulations for new facilities. The Preliminary Draft Policy does not address new facilities, but the earlier 2006 proposal indicated that new plants would utilize EPA's Phase I regulations. Existing facilities have fewer compliance options than new facilities, and the cost of retrofitting cooling systems is always more expensive than new construction. The existing California coastal power plants were in large measure located where they are under pre-existing state policies that encouraged the use of salt water over fresh water for cooling purposes. The SWRCB's Powerplant Cooling Policy, adopted in 1975, specifies that inland waters should be used for powerplant cooling only when other alternatives are environmentally undesirable or economically unsound. Powerplant Cooling Policy, Resolution No. 75-58. A policy for existing facilities must acknowledge that site specific review is critical and that flexibility based on site specific considerations including impacts on grid stability is necessary.

We are particularly concerned by the devastating impact that the Preliminary Draft Policy's inflexibility would have on DCPP and SONGS, two of the state's largest capital assets and two invaluable contributors to the goal of reducing GHG emissions to 1990 levels by 2020. Loss of these plants would mean an additional 20 million tons of CO_2 emissions per year – a very significant percentage of the estimated 35 million tons that is the entire electric sector's percentage of the overall required reduction. There is no Track II option for DCPP, and salt water cooling towers are of doubtful feasibility from both a technical and administrative perspective, would cost several billion dollars, significantly increase rates, and may seriously compromise the Plant's efficiency and reliability. We want to be very clear. At this point in time, we do not believe that the installation of cooling towers would be reasonable given the enormous engineering challenges, operational uncertainty and adverse environmental impacts associated with installation; we do not believe cooling towers would result in significant improvements to the marine environment along the Central Coast; we do not think that they should be required at a Plant like DCPP; and we remain very uncertain that they would be installed if they are mandated.

B. Recommended Approach For The Preliminary Draft Policy

1. Focus on new and repowered facilities

We recommend that the policy focus on eliminating once through cooling at new and repowered facilities. These are facilities that are either under development or undergoing significant technology modifications. These situations provide much more efficient opportunities to move away from once through cooling. Phasing should be focused on these plants, with input from the Task Force. Plants that have no plans to repower and plan to retire by a certain date should not be mandated to make significant capital investments that could lead to premature retirement which threatens the grid. The Task Force can play a key role in helping to establish the most effective phasing scenario that assesses the availability of technology and each facility's role in ensuring grid stability.

2. Variance Proposal

We also recommend that the Preliminary Draft Policy for existing facilities include a variance that allows for a reasonable result in circumstances where alternative technologies are simply not workable or warranted. USEPA recognized that even the development of new facilities may require latitude in circumstances unanticipated by the regulations, and provided a variance for such occasions as part of the Phase I Regulations. 40 CFR Section 125.85. In fact, we base our proposed language on the provisions of EPA's new facility variance, modifying it in parts only to provide greater clarity and specificity for application in California. We propose the following variance:

(a) Any interested person may request that alternative requirements less stringent than those specified in Track I or II be imposed in the permit. Alternative requirements found to be best technology available may include authorization for continued use of a once through cooling water intake structure at an existing power plant.

(1) Less stringent requirements shall be granted where one or more of the following criteria are demonstrated:

(A) *Technological Infeasibility:* Compliance with Track I or II is technologically infeasible, as determined by the State Expert Review Panel Engineering Committee. Track I requirements are technologically infeasible if a closed cycle cooling water system cannot be constructed at a site because of space limitations, seismic, geological or other engineering concerns, or cannot be operated at a site so as to achieve a minimum 90% annual reduction in cooling water intake flows as compared to once through cooling because of water temperatures, atmospheric conditions, environmental issues or other confounding factors.

(B) *Administrative Infeasibility:* Compliance with Track I or II requirements is administratively infeasible because a governmental agency with jurisdiction over any aspect of the compliance alternative will not issue a required permit, authorization or other approval.

(C) *Wholly Disproportionate Cost:* The cost of complying with Track I or II would be wholly disproportionate to the cost considered by the State Board in adopting the State's 316(b) Policy.

(D). *Adverse Impacts on Electric System Reliability:* Compliance with Track I or II or closure of a facility because of the technological and administrative infeasibility of complying with Track I or II would, in the opinion of the California Independent System Operator, jeopardize the stability of a regional grid or the state-wide electric system.

[(E). Cost Wholly Disproportionate to Benefits: Should the US Supreme Court reverse the 2nd Circuit Court of Appeal's cost-benefit ruling in the Riverkeeper II case, incorporate here the cost-benefit variance contained in 40 CFR

Section 125.94(a)(5)(ii), except that the words "wholly disproportionate to" shall be substituted for "significantly greater than" wherever appearing.]

(2). Less stringent requirements may be granted where one or more of the following criteria are demonstrated:

(A). *Adverse Impacts on Air Resources:* Compliance with Track I or II would result in significant adverse impacts to air resources, including adverse impacts upon the state's ability to meet its greenhouse gas emissions limits under the California Global Warming Solutions Act of 2006, Calif. Resources Code Section 38500 *et. seq.*

(B). *Adverse Impacts on Water Resources:* Compliance with Track I or II would result in significant adverse impacts on local water resources other than impacts on impingement mortality and entrainment.

(C). *Cumulative Effects:* If any of the conditions specified in (a)(1)(A) – (E) above and/or (a)(2)(A) –(B) above are present in lesser degree and such conditions - either individually or cumulatively - warrant the continued operation that facility pursuant to less stringent standards.

(b) Any alternative requirements imposed pursuant to this section shall be no less stringent than justified by the wholly disproportionate cost or the significant adverse impacts on local air quality, water resources other than impingement mortality and entrainment, or significant adverse impacts on electric system reliability.

(c) The burden is on the person requesting the alternative requirement to demonstrate that alternative requirements should be authorized.

3. Restoration

When, in a very limited number of cases, under the proposed variance either OTC or a technology which does not achieve the full reductions required under Track I or II is deemed to be the best technology available, staff should consider the use of restoration. This would be as an "additional" requirement, not necessarily as a 316(b) compliance requirement. Much additional analysis would be required to design a restoration component, but we believe that such an approach should be discussed with stakeholders.

C. <u>CEQA Review</u>

As indicated by staff, the Scoping Document's outline of the environmental review needs to be significantly expanded in order to comply with functional equivalency requirements. Among other things, the analysis should:

1. <u>Thorough Assessment of I&E Impacts:</u> Include an objective assessment of the ecological impacts of I&E. The impact assessment needs to be consistent, and cannot stop just

by identifying the number of larvae entrained. This should be translated into ecologically significant losses, if any. Nobody, for example, would prohibit air conditioning in the state of California on the finding that commercial and residential air conditioning units entrain five hundred billion fern and mushroom spores annually.

2. Utilities and Service Systems (including Grid Reliability): As the ICF Jones & Stokes report acknowledges, much more needs to be done in this regard. Additionally, their estimated cost range of $100 million to $11 billion is clearly not specific enough for the Board to understand the true magnitude of its decision. We encourage the SWRCB staff to fully engage the energy agencies in a thorough review of the Jones & Stokes report. Further, the Board must consider the findings of Phase 2 of the CAISO's study, Mitigation of Reliance on Old Thermal Generation Including Those Using Once-Through Cooling Systems. This report is due out by the end of 2008.

3. Air Quality: The assessment currently focuses on timing and process for obtaining a permit. The analysis needs to more fully address whether in fact such permits could be obtained. As an example, in March 2004, the San Luis Obispo Air Pollution Control District advised the Central Coast RWQCB that it was unlikely that Duke Energy would be able to install salt water cooling towers at its Morro Power Plant because of Best Available Control Technology requirements and offset issues. 2006 Exhibit 7.

Additionally, the full impacts on greenhouse gas emissions, including the significant energy penalty from the installation of cooling towers, needs to be assessed. Replacement of DCPP's 2300 MW with fossil plants would increase CO_2 emissions by 8-10 million tons/year and will seriously impair the State's ability to achieve the greenhouse gas reduction target mandated by AB 32 (California Warming Solutions Act of 2006, Health and Safety Code Section 38500 et. seq.)

4. Water Quality: The water quality analysis needs to more fully examine what would be required to permit a cooling tower discharge. Our technical assessment is that DCPP would need to install an offshore diffuser system for the high salinity cooling tower discharge – and this creates a whole other set of permitting requirements. It is not simply a matter of an amended NPDES permit. These kinds of issues and impacts must be thoroughly analyzed.

5. Economic Analysis: Further assessment is needed to understand the costs to customers, as well as the differentials in cost to achieve various levels of reduction. There may be technologies for some facilities that can achieve a 50% reduction and cost only 5% of what cooling towers would cost.

VII
COMMENTS ON POLICY DEVELOPMENT PROCESS

A. Comment Period

During the May 13th workshop, it was announced that work on the draft policy would not begin until late summer. However, when an additional extension was requested for comment submittal, it was rejected. We are unsure why staff requires stakeholder comments on May 20th if work on the policy will not begin for several months. This is an enormously complex issue and providing ample comment time for stakeholder input is essential in developing a workable, successful policy. Additionally, while a further extension of time was not allowed, documents have not been readily available for review. As an example, comments by the expert review panel were not distributed until the afternoon of May 19th - less than one day before the comment submission deadline of noon on May 20th and the Grid Reliability study performed by ICF Jones & Stokes was not made available until May 1st.

B. <u>Working Group/Task Force</u>

We firmly believe that it is essential that the Task Force comprised of energy-related agencies provide meaningful input into the development of the policy, not just on implementation. The Task Force must be made up of Board and Commission members. It is critical that policy decisions are evaluated at the highest levels of the various energy agencies and commissions. While it was mentioned at the May 13th workshop that a working group had its first meeting on May 12th, the direction and focus of the group remain unclear. The meeting was pulled together with little notice, making participation difficult. It is our understanding that the development of the ICF Jones & Stokes report may not have effectively used the resources at these various agencies and that it is not at all clear that these groups, such as the CAISO, support or agree with the analysis or conclusions in the report. A footnote to the working group list in the report indicates that "participation does not necessarily imply endorsement by working group members of this study or its conclusions."

Additionally, staff should consider establishing expert panels on issues beyond marine biology. As mentioned at the workshop, consideration should be given to establishing an expert panel to review the adverse environmental impacts associated with the installation of cooling towers. Another panel, one with an engineering focus, should be established to review the Tetra Tech feasibility report and further review the feasibility of alternative technologies. Tetra Tech responded to comments, but did not effectively address all comments. These panels would support and further the work for the Task Force, which is specifically addressing grid reliability issues.

Exhibit 1

ROCKFISH RESOURCES OF THE SOUTH CENTRAL CALIFORNIA COAST: ANALYSIS OF THE RESOURCE FROM PARTYBOAT DATA, 1980–2005

JOHN STEPHENS
California Polytechnic State University
San Luis Obispo and Vantuna Research Group
2550 Nightshade Place
Arroyo Grande, California 93420
Stephens2@earthlink.net

DEAN WENDT
California Polytechnic State University,
San Luis Obispo
2550 Nightshade Place
Arroyo Grande, California 93420

DEBRA WILSON-VANDENBERG
California Department of Fish and Game
20 Lower Ragsdale Drive
Monterey, California 93940

JAY CARROLL
Tenera Environmental, Inc.
141 Suburban Road, Suite A2
San Luis Obispo, California 93401

ROYDEN NAKAMURA
Biological Sciences
California Polytechnic State University
San Luis Obispo, California 93407

ERIN NAKADA
Biological Sciences
California Polytechnic State University
San Luis Obispo, California 93407

STEVEN RIENECKE
Biological Sciences
California Polytechnic State University
San Luis Obispo, California 93407

JONO WILSON
Biological Sciences
California Polytechnic State University
San Luis Obispo, California 93407

ABSTRACT

Rockfishes (*Sebastes* spp.) have historically comprised a large proportion of catches in the nearshore recreational fishery in California, but declining populations of some species have led to increasingly restrictive management of the resource. This report summarizes new and existing data on rockfishes of the south central coast of California. In 2003, the California State Polytechnic University, San Luis Obispo placed observers on commercial passenger fishing vessels (partyboats) from the region. By the end of 2005, we had observed catches from 258 trips (8,839 fisher hours). We appended these data to partyboat catch statistics collected by the California Department of Fish and Game from 1988 to 1998 and calculated annual catch per unit effort (CPUE) and mean sizes by species and year. The CPUE data by species fluctuate annually but rarely show consistent trends. The overall CPUE for 2004 and 2005 ranks in the top five of the twenty sampled years. Mean sizes have been consistent by species, generally just above the size of 50% maturity. Comparing these sizes to historical data shows decreases in some species but not in others. A review of NOAA/NMFS triennial trawl data for the Point Conception area in the southern part of the study region suggests that the deeper shelf and slope species, with a few exceptions, show little evidence of long-term declines. In general, the south central coast rockfish resources, with the exception of bocaccio (*S. paucispinis*), have not shown strong evidence of a declining trend over the past 25 years.

INTRODUCTION

Elements of the rockfish (*Sebastes* spp.) resource of California have been depleted for many years. Fishery-related problems have been diagnosed by many researchers including Lenarz (1987), Ralston (1998), Gunderson (1998), and Love et al. (1998, 2002). Rockfish are long-lived, slow to mature (iteroparous), and therefore subject to pre-spawning mortality (Leaman 1991). Two factors, overfishing and climate change, are considered primarily responsible for the declining marine fish populations in much of California. Climate change, including El Niño Southern Oscillation (ENSO) events and Pacific Decadal Oscillation (PDO) reversals (Chavez et al. 2003), has been emphasized by many, including Beamish (1995), Brooks et al. (2002), Francis and Hare (1994), and Holbrook et al. (1997). Fishing pressure has also been implicated as a major factor in scientific publications (Mason 1995; Jackson et al. 2001; Myers and Worm 2003) and by the media. Recently, the interrelationship between these two forcing functions on California partyboat catches has been analyzed by Bennett et al. (2004) while Tolimieri and Levin (2005) have looked at their effects on bocaccio (*S. paucispinis*). Possible detrimental effects of warmer climatic conditions on rockfish include reduced adult condition factors or gonadal growth (Ventresca et al. 1995; Harvey 2005), and increased mortality in larvae and young-of-the-year (YOY) (Boehlert et al. 1985; Ross and Larson 2003). Besides density-related decreases in catch per unit effort (CPUE), there has been an indication that relative sizes of species have also declined over the years (Mason 1998) and that the lack of large females in the population could lead to reduced recruitment through loss of fecundity or the loss of highly competent larvae produced by such females (Berkeley et al. 2004).

This paper examines changes in CPUE and mean sizes of the rockfish species taken in the nearshore environment of the south central coast (SCC) of California (fig. 1), an area not specifically examined in previous

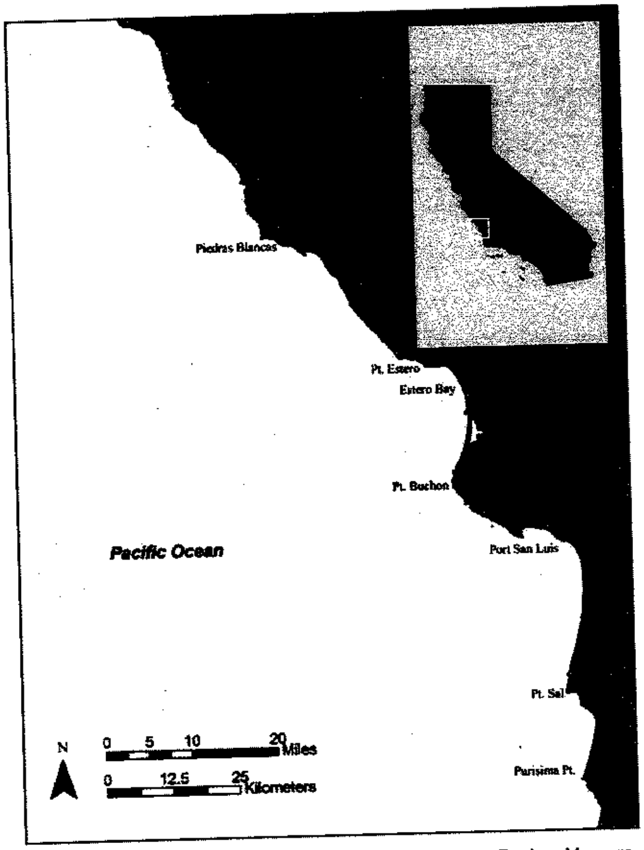


Figure 1. Coastal California and the south Central Coast Region. Map provided by Jim Stramp, Tenera Environmental.

studies and an area that marks the transition between the warm-temperate southern California bight to the south, and the cool-temperate "Oregonian" oceanic province to the north. The latter is the center of distribution for the majority of eastern Pacific rockfish species (Love et al. 2002).

The earliest published data on fishes of the SCC was Heimann and Miller's (1960) comparison of trawlers and partyboat fisheries from 1957 to 1958 while Miller and Gotshall (1965) included the area in their partyboat survey of 1957–61. Miller et al. (1967) reported on blue rockfish while Miller and Geibel (1973) reported on blue rockfish and lingcod. Love et al. (1991) discussed aspects of the biology of nearshore rockfish of the central coast. The present report is based upon the partyboat monitoring program of the California State Polytechnic University, San Luis Obispo (Cal Poly, 2003–05) and makes use of these published records as well as unpublished data for the region for 1988–98, which are partially available in administrative reports through the California Department of Fish and Game (CDFG) (Wilson et al. 1996; Wilson-Vandenberg et al. 1995, 1996; Reilly et al.1998), and unpublished partyboat studies by the Pacific Gas and Electric Company (PG&E) Diablo Canyon (1980–86), in situ young-of-the-year (YOY) recruitment observations (PG&E/Tenera Environmental [1976–2004]), and recruitment module studies (Cal Poly [2004–05]). These data are discussed along with the available results of the NOAA/NMFS Triennial Trawl Surveys (1977–2004) for the Conception region.

METHODS

The Cal Poly partyboat observer program, which began July 2003 and is ongoing, follows the methods developed by the CDFG (Reilly et al. 1998) with some exceptions. In both protocols the observer selects a sample of between six and 15 anglers to observe at the start of the trip. The observer records the number of the sampled anglers fishing at each drop along with the fishing time for that drop, its maximum/minimum depth, and the number of fish caught by species. Localities are recorded for each site. We measured the total length of all fish as they were landed and then recorded their fate, whether they were retained or returned to the ocean. CDFG observers recorded the species as they were landed as well as their fate but measured them from the fishers' bags at the end of the fishing day (kept fish only). They may also measure fish not included in the observer's sample. The CDFG protocol does not allow accurate determination of the relationship of size to depth. The Cal Poly data were limited to rockfishes (*Sebastes* spp.), hexagrammids (greenlings and lingcod), and cabezon (*Scorpaenichthys marmoratus*), though other species were noted. The CDFG recorded all fish. The catch-per-unit-effort (CPUE) statistic is the total number of fish caught by the observed sample divided by the effort. The effort variable (man hours) is developed from actual fishing time in minutes for each drop multiplied by the number of anglers in the observed sample. Data from the field sheets were checked by each observer and entered into a Microsoft Access® database, with subsequent quality control. Comparative data were made available on Microsoft Access® by the CDFG from their 1988–98 partyboat surveys for the same sites. Similar data for 1980–86 were available from PG&E's Diablo Canyon surveys.

Recruitment data (1976–2004) from diver transects at a PG&E control station for Diablo Canyon (Patton Cove), which is outside the influence of the power plant's thermal discharge plume, was supplied by Tenera Environmental.

We imitated SMURF collections of settling larvae (Ammann 2004) in 2004. SMURFs are 1.0 m by 0.35 m mesh plastic cylinders filled with larger mesh plastic grids that act as settlement "traps" for many nearshore fish species. Ours were attached to buoys just below the surface and sampled bi-weekly at three stations, three SMURFs per station.

TABLE 1
2003–05 Observed Catch of Rockfish, Greenlings, and Cabezon.
Numbers of fish caught and numbers retained; mean length (cm) of fish caught and retained; catch per unit effort.

Species/Sebastes	Number Caught	Number Kept	length (st dev.) Caught	Kept	CPUE
2003					
S. atrovirens (kelp)	8	7	31.7 (2.2)	31.6 (2.3)	0.003
S. auriculatus (brown)	1151	1099	34.4 (4.7)	34.7 (4.3)	0.51
S. carnatis (gopher)	2268	1074	26.4 (2.5)	27 (2.2)	1
S. caurinus (copper)	83	76	33 (7.2)	34 (6.7)	0.03
S. chlorostichus (greenspotted)	2	2	20 (2.1)	20 (2.1)	<.001
S. chrysomelas (black & yellow)	33	23	26.8 (1.7)	27.5 (1.4)	0.01
S. constellatus (starry)	50	45	31.3 (4.0)	31.8 (3.5)	0.02
S. dalli (calico)	72	17	15.6 (1.5)	17 (1.8)	0.03
S. entomelas (widow)	0		0		
S. flavidus (yellowtail)	239	75	22.8 (6.7)	29.3 (6.5)	0.11
S. hopkinsi (squarespot)	0		0		
S. melanops (black)	152	140	30.3 (2.6)	30.5 (2.5)	0.07
S. mineatus (vermillion)	859	813	33.8 (7.1)	344.4 (6.9)	0.38
S. mystinus (blue)	3984	2659	27 (5.1)	28.8 (4.1)	1.75
S. nebulosus (china)	36	28	28.8 (2.9)	29.3 (2.3)	0.01
S. paucispinis (bocaccio)	9	0	45.4 (8.1)	0.003	
S. pinniger (canary)	72	0	29.8 (3.4)	0.03	
S. rosaceous (rosy)	183	53	20.7 (3.0)	21.8 (2.8)	0.07
S. rosenblatti (greenblotched)	0	0			
S. ruberrimus (yelloweye)	0	0			
S. rubrivinctus (flag)	0	0			
S. serranoides (olive)	360	224	30.1 (7.6)	33.6 (5.7)	0.16
S. serriceps (treefish)	61	60	29.5 (2.7)	29.5 (2.7)	0.02
Scorpanichthys marmoratus (cabezon)	13	6	40.9 (5.6)	43.9 (4.7)	0.005
H. decagrammos (kelp greenling)	95	26	31.1 (2.9)	32.4 (2.7)	0.04
H. lagocephalus (rock greenling)	2	2	32.5 (2.1)	32.5 (2.1)	<.001
O. elongatus (lingcod)	1025	231	56 (8.8)	66.2 (6.2)	0.45
Total Fish	10,757	6,647			
Overall CPUE					4.70
2004					
S. atrovirens (kelp)	27	26	30.9 (2.1)	31.2 (1.7)	0.008
S. auriculatus (brown)	1029	986	36.7 (4.0)	36.9 (3.8)	0.32
S. carnatis (gopher)	2406	1359	26.4 (2.2)	27 (2.0)	0.75
S. caurinus (copper)	304	282	35.6 (5.8)	36.3 (5.3)	0.1
S. chlorostichus (greenspotted)	0				0
S. chrysomelas (black & yellow)	11	1	31.2 (2.0)	25.5 (0)	0.003
S. constellatus (starry)	219	201	30.8 (3.6)	31.3 (3.3)	0.07
S. dalli (calico)	61	2	15 (1.4)	15.5 (0.7)	0.02
S. entomelas (widow)	2	0	18.5 (2.1)		<.001
S. flavidus (yellowtail)	631	150	22.5 (5.3)	28.9 (4.5)	0.19
S. hopkinsi (squarespot)	3	0	17.3 (4.6)		<.001
S. melanops (black)	31	25	30.9 (2.3)	31.4 (2.1)	0.01
S. mineatus (vermillion)	2017	1927	35.2 (7.2)	35.6 (7.1)	0.63
S. mystinus (blue)	9059	4927	27.6 (4.4)	30.1 (2.9)	2.8
S. nebulosus (china)	58	49	29.6 (3.2)	30 (2.9)	0.02
S. paucispinis (bocaccio)	57	55	52.1 (5.8)	52.7 (4.5)	0.02
S. pinniger (canary)	214	0	29.6 (4.0)		0.07
S. rosaceous (rosy)	424	51	20.5 (2.5)	22.2 (3.7)	0.13
S. rosenblatti (greenblotched)	0				0
S. ruberrimus (yelloweye)	2	0	51.5 (7.8)		<.001
S. rubrivinctus (flag)	15	15	31.2 (2.0)	31.2 (2.0)	0.005
S. serranoides (olive)	499	389	34.7 (7.2)	36.9 (6.1)	0.15
S. serriceps (treefish)	27	25	29.5 (3.3)	29.8 (3.0)	0.008
Scorpanichthys marmoratus (cabezon)	24	18	45.3 (6.7)	47.5 (4.6)	0.007
H. decagrammos (kelp greenling)	98	8	29.9 (2.0)	32.8 (1.6)	0.03
H. lagocephalus (rock greenling)	0				0
O. elongatus (lingcod)	1385	106	55.8 (9.1)	69 (7.6)	0.43
Total Fish	18,603	10,602			
Overall CPUE					5.77

TABLE 1, continued
2003–05 Observed Catch of Rockfish, Greenlings, and Cabezon.
Numbers of fish caught and numbers retained; mean length (cm) of fish caught and retained; catch per unit effort.

Species/Sebastes	Number Caught	Number Kept	length (st dev.) Caught	length (st dev.) Kept	CPUE
2005					
S. atrovirens (kelp)	0				0
S. auriculatus (brown)	504	453	37.5 (3.8)	37.9 (3.6)	0.35
S. carnatis (gopher)	591	343	26.3 (2.3)	26.8 (2.2)	0.41
S. caurinus (copper)	371	347	36.6 (5.6)	37.3 (5.0)	0.26
S. chlorostictus (greenspotted)	0				0
S. chrysomelas (black & yellow)	2	0	29.5 (2.1)		0.001
S. constellatus (starry)	329	279	29.4 (4.2)	30.3 (3.5)	0.23
S. dalli (calico)	43	0	14.7 (1.6)		0.03
S. entomelas (widow)	70	11	21.2 (4.6)	28.3 (5.7)	0.05
S. flavidus (yellowtail)	1092	404	26.1 (5.5)	31.0 (4.2)	0.76
S. hopkinsi (squarespot)	0				0
S. melanops (black)	4	2	31.3 (1.8)	31.3 (2.5)	0.001
S. mineatus (vermillion)	1218	1143	36.7 (7.1)	37.2 (6.9)	0.84
S. mystinus (blue)	2751	1674	28.1 (4.7)	30.8 (3.1)	1.9
S. nebulosus (china)	27	23	29.3 (3.1)	29.6 (3.0)	0.02
S. paucispinnis (bocaccio)	85	84	46.9 (8.0)	47.2 (7.7)	0.06
S. pinniger (canary)	153	1	30.8 (4.7)	33.5	0.11
S. rosaceous (rosy)	436	58	20.6 (2.2)	22.1 (2.7)	0.3
S. rosenblatti (greenblotched)	2	2	34.8 (.4)	34.8 (.4)	0.001
S. ruberrimus (yelloweye)	4	0	50.4 (11.3)		0.003
S. rubrivinctus (flag)	17	16	31.1 (2.5)	30.9 (2.5)	0.01
S. serranoides (olive)	188	176	39.6 (5.7)	40.1 (4.9)	0.13
S. serriceps (treefish)	15	9	27.6 (2.7)	27.9 (3.0)	0.01
Scorpanichthys marmoratus (cabezon)	8	7	53.9 (5.3)	53.9 (5.3)	0.006
H. decagrammos (kelp greenling)	18	2	30.1 (1.6)	32.8 (1.8)	0.012
H. lagocephalus (rock greenling)	0				
O. elongatus (lingcod)	414	130	56 (10.7)	67.5 (6.4)	0.29
Total Fish	8,353	5,166			
Overall CPUE					5.78

Further data for the region were available from the NOAA/NMFS Triennial Trawl publications (1977, 1995, 1998, and 2001) and we received data from 2004 from the NOAA Northwest Fisheries Science Center and the NOAA Alaska Fisheries Science Center's Racebase database (Beth Horness, NOAA/NMFS, pers. comm.).

RESULTS AND DISCUSSION

For 2003, 2004, and 2005 we observed partyboat catches from Patriot Sportfishing and Virg's Sportfishing operating out of Port San Luis and Morro Bay, respectively. A total of 258 trips were observed: 68 in 2003, 126 in 2004, and 62 in 2005. The number of trips was evenly dispersed between the two ports. In 2005, fishing was allowed only at depths of 20 fm (36.6 m) or shallower and the season lasted from 1 July until the middle of December (five+ months). For 2004, the season opened 1 January, closed for the months of March, April, and July, and was open for the remainder of the year (nine months). That year, fishing as deep as 30 fm (54.7 m) was permitted for about one-third of the period, and fishing was restricted to 20 fm the remainder of the time. For 2005, the season opened on 1 May and ended 30 September (five months). Fishing was permitted to 40 fm (80m) or less for the entire season.

The Cal Poly partyboat data (tab. 1) includes the total catch and retention of species of interest for each year with mean size and standard deviation for each category. There were 23 species of rockfishes, three hexagrammids, and one cottid for a total of 27 species of interest taken in our samples for these three years. Of these, 11 rockfishes and the two hexagrammid greenlings represent elements of the 19 species complex included in the California Resources Agency Nearshore Fishery Management Plan. Catch per unit effort is considered to be a reliable measure of fish density in the habitat. The overall partyboat CPUE (fig. 2) has remained relatively constant over the years even though recreational regulations have reduced the overall bag limit, number of hooks per line, and the take, while increasing size limits on some species and excluding others from take altogether. A number of factors could reduce the effects of these changes, including improved fish finding (sonar) and new technology in artificial lures. The recent Cal Poly data do not show evidence of decline and the CPUE (2003–05) ranks in the top five in the 20 years sampled.

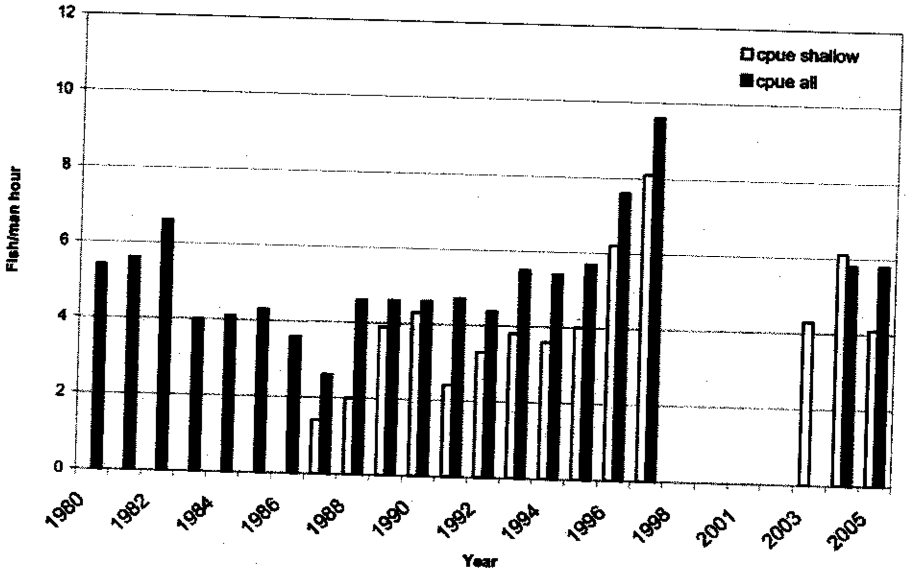


Figure 2. Partyboat CPUE for all species of interest in the South Central Coast, 1980-2005.

Data on species-specific CPUEs are much more informative than generic ones. Because partyboats fish deeper than where the majority of several of our species of interest (grass, black and yellow rockfish, treefish, kelp greenling, and cabezon) are distributed, these species are therefore not sampled well by this methodology and we will not discuss them further. Most of the other species that were taken are available to fishers at shallow depths, but many are more numerous and are larger in size at greater depths. Thirteen species made up more than 1% of the catch in at least one year of sampling. In order of decreasing total abundance they were: blue, gopher, and vermillion rockfish, lingcod, brown, yellowtail, olive, rosy, copper, starry, canary, and black rockfish, and bocaccio. The assemblage rank order did not differ significantly over these three years (pair-wise Kendall's tau, p =.05, uncorrected for multiple testing) even though different depths were fished over different years. During 2005, because fishing was allowed to depths of 40 fm (80 m), we were able to test the effect of this depth range on species distributions. Five of the thirteen rockfish species increased regularly in CPUE with greater depth (canary, copper, olive, rosy, and yellowtail), while two species, brown and gopher rockfish, decreased in density with depth. Changes in CPUE and size are shown (fig. 3) for relevant species. The CPUE of two species, blue and starry rockfish, decreased in depths below 20 fm but decreased or stayed constant in depths greater than 30 fm, while the CPUE of vermillion rockfish and bocaccio increased in the deepest fishable strata of 30–40 fm. Five species increased in size (mean length) in deeper water: blue, canary, copper, olive, and yellowtail rockfish. These data suggest that it is important to consider depth when describing changes in abundance and size of rockfishes through time.

CPUEs and size data measured outside the preferred habitat of a species may not be typical for that species (MacCall 1990), therefore we compare species that occupy similar depth strata and depict CPUE from all depths as well as data from 20 fm or less (figs. 4 and 5). Species that seem to center their distribution around 20 fm (black, blue, brown, china, gopher, and olive rockfish and lingcod) are compared (fig. 4). Here, CPUE is generally higher for the shallow (<21 fm) data which more accurately reflect the preferred habitat. For a number of species (black, brown, china, and olive rockfish) the highest CPUE of the 14-year sampling period occurred in 1990–91, which were "normal" years for oceanographic conditions between the ENSO events of 1983–84 and 1992–93. Black and china rockfish have been in low abundance recently which may reflect a northern displacement of these species from their southern limits in response to the warm PDO (1977–98). Olive rockfish have not been abundant the last three years but apparently were very abundant between 1998 and 2002 (Steve Moore, Patriot Sportfishing, pers. comm.) when sampling did not occur. CPUE for these shallow species appears to decrease during 2005 but this may be the result of decreased fishing in shallow water and expanded fishing outside their depth range. Only 21% of the fishing drops in 2005 were in shallow water. Blue, brown, gopher, and olive rockfish, and lingcod appear to have strong populations. CPUEs for blue rockfish peak coinciding with El Niño events. It has been shown that the conditional factor of blue rockfish declines during El Niños because of reduced food resources (Ventresca et al. 1995). The

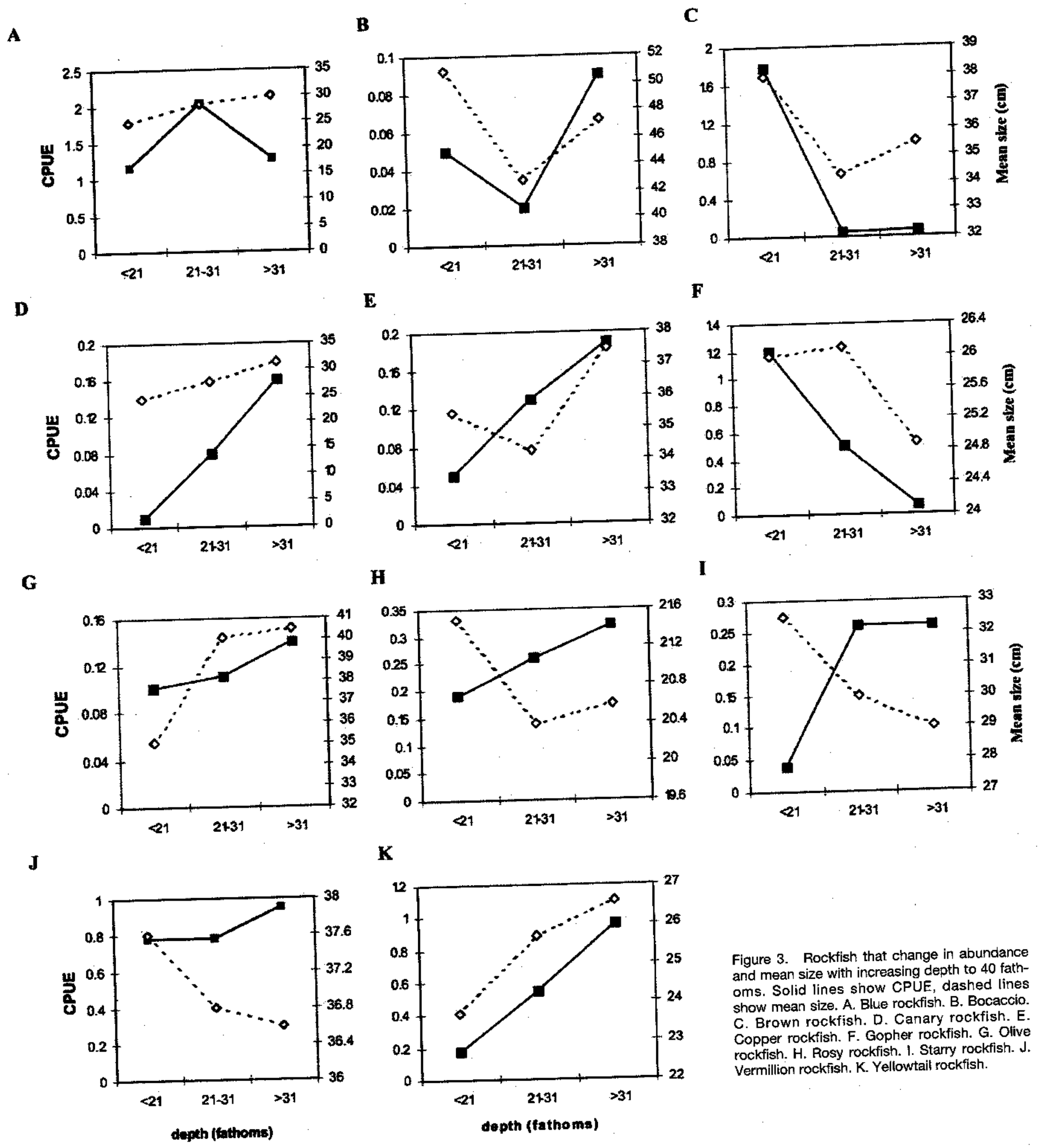


Figure 3. Rockfish that change in abundance and mean size with increasing depth to 40 fathoms. Solid lines show CPUE, dashed lines show mean size. A. Blue rockfish. B. Bocaccio. C. Brown rockfish. D. Canary rockfish. E. Copper rockfish. F. Gopher rockfish. G. Olive rockfish. H. Rosy rockfish. I. Starry rockfish. J. Vermillion rockfish. K. Yellowtail rockfish.

increased catchability observed here may be related.

As cited earlier, seven species (bocaccio and canary, copper, rosy, starry, vermillion, and yellowtail rockfish) though often common in depths less than 20 fm, increase in density in deeper water (fig. 5). The 2005 CPUE for copper and vermillion rockfish is the highest of the time series, while that for rosy and starry rockfish ranks in the top five. Bocaccio have been in decline since at least 1989 (Ralston et al. 1996; MacCall et al. 1998), and are still depleted as evidenced by their low

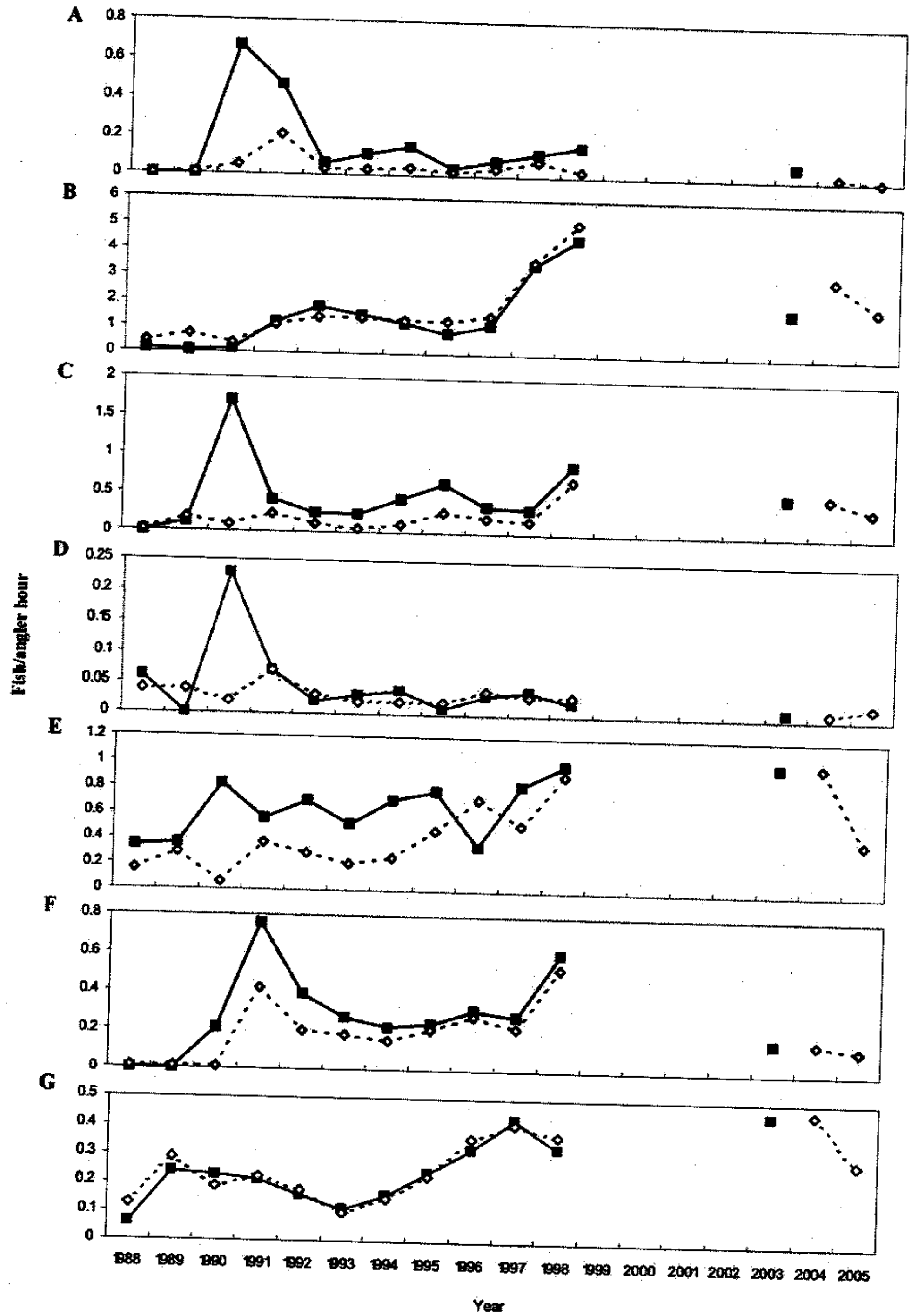


Figure 4. Changes in CPUE by year (partyboat data, SCC) for fish abundant in waters shallower or equal to 20 fathoms. Solid lines show fish caught in 20 fathoms or less, dashed lines show fish caught at all depths. A. Black rockfish. B. Blue rockfish. C. Brown rockfish. D. China rockfish. E. Gopher rockfish. F. Olive rockfish. G. Lingcod.

CPUE. Their density increased slightly in our 40 fm data but it appears that their density has not changed much in the last 12 years since their major collapse (1989–92). Recent work by Tolimieri and Levin (2005) suggests that the balance between reproductive success (recruitment) and population growth in the bocaccio is tenuous at best and that any fishing pressure could push the population towards extinction. The present bag limit for bocaccio is two fish per angler, an increase over the no-take regulation in 2003, but still conservative.

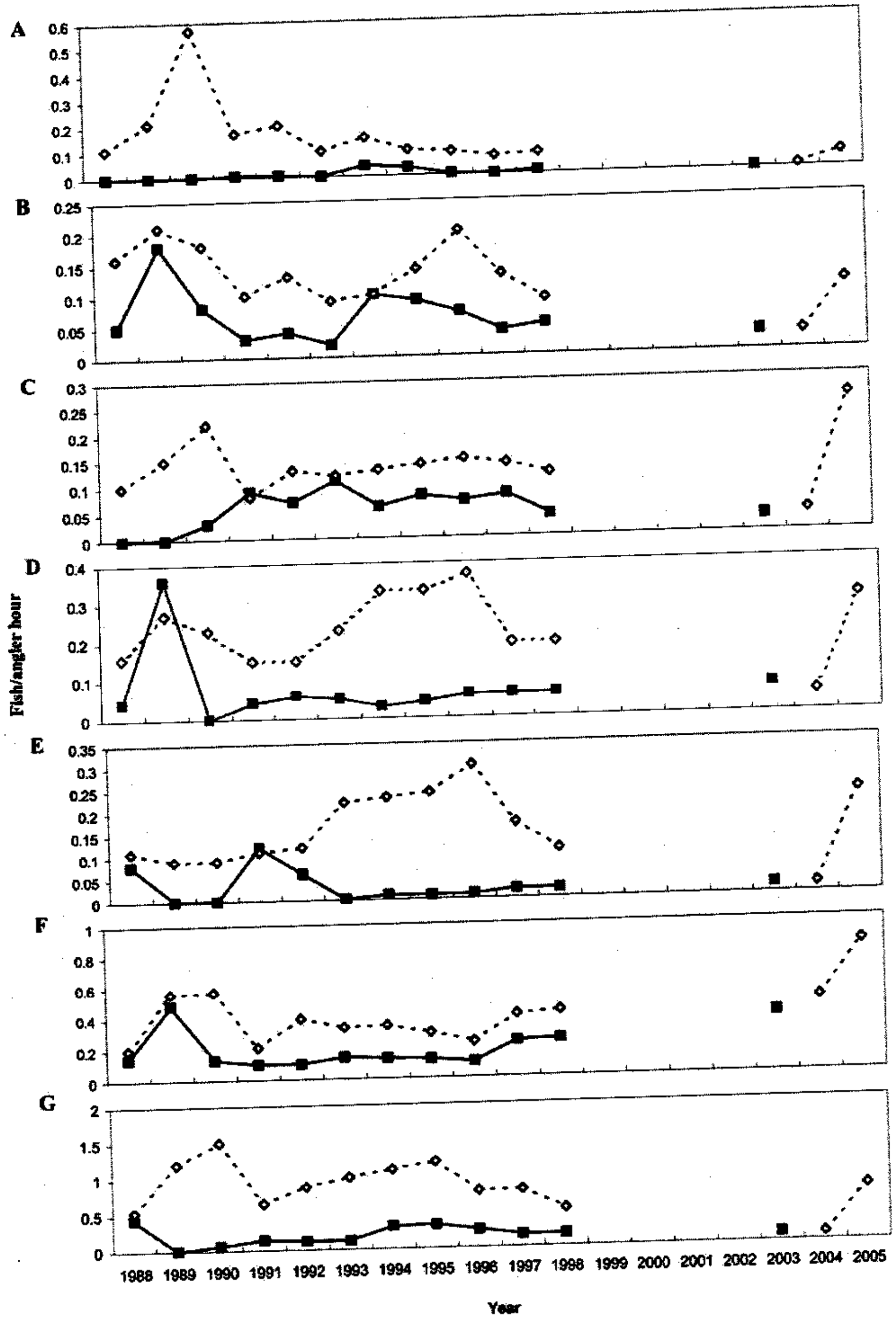


Figure 5. Changes in CPUE by year (partyboat data, SCC) for fish common in shallow water and deeper than 30 fm. Solid lines show fish caught in 20 fm or less, dashed lines show fish caught at all depths. A. Bocaccio. B. Canary rockfish. C. Copper rockfish. D. Rosy rockfish. E. Starry rockfish. F. Vermillion rockfish. G. Yellowtail rockfish.

Densities of most species do not appear to change dramatically or consistently with El Niño years. This may reflect the relatively low fishing intensity in the SCC as well as the relatively cool water habitat. Bennett et al. (2004) discussed the interaction of ocean climate and fishing pressure on rockfish. During El Niño events in the warm, heavily fished southern California bight, CPUE decreased, while in the cool-water low fishing intensity sites north of San Francisco, CPUE increased. A similar interaction could apply here.

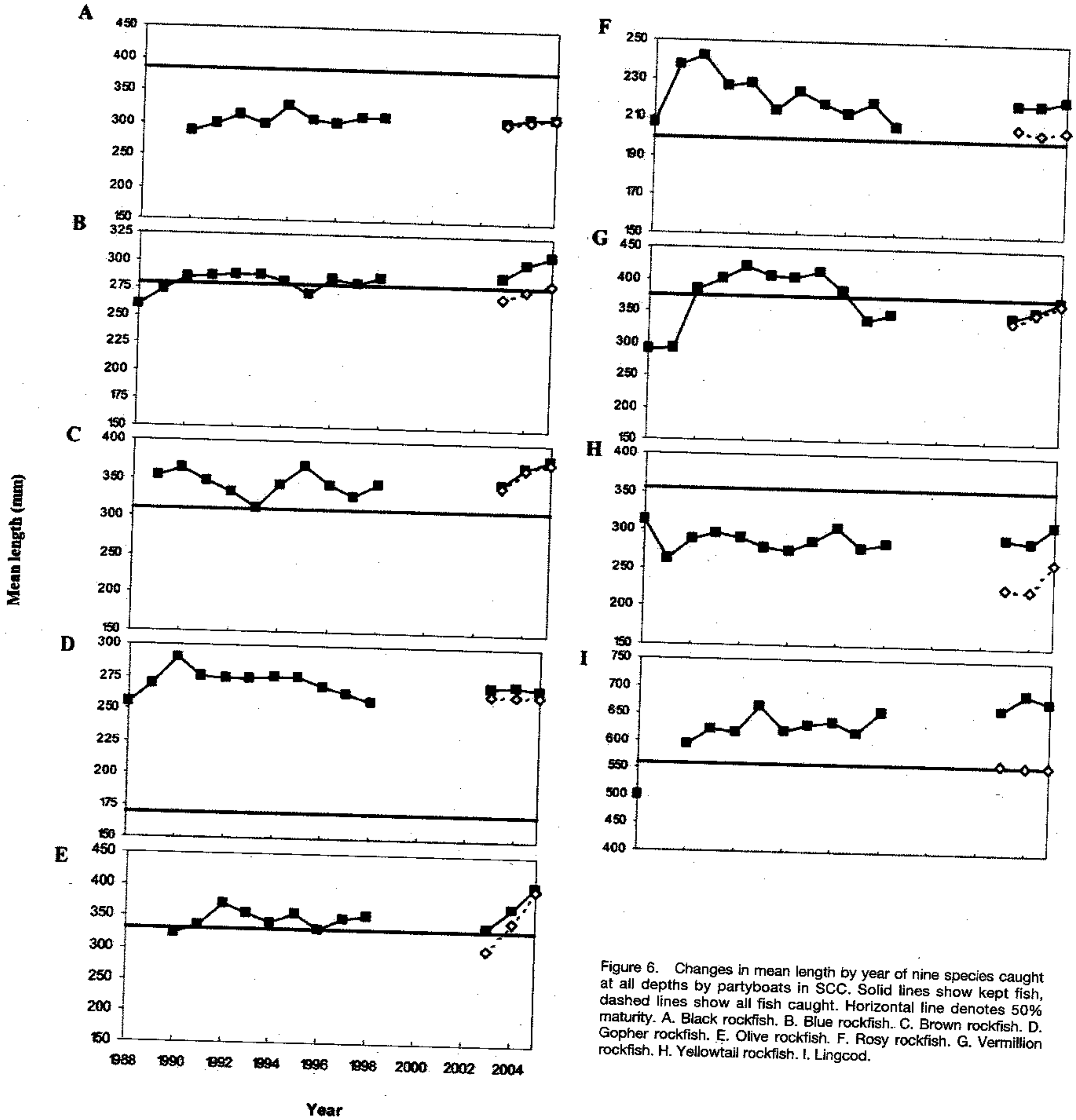


Figure 6. Changes in mean length by year of nine species caught at all depths by partyboats in SCC. Solid lines show kept fish, dashed lines show all fish caught. Horizontal line denotes 50% maturity. A. Black rockfish. B. Blue rockfish. C. Brown rockfish. D. Gopher rockfish. E. Olive rockfish. F. Rosy rockfish. G. Vermillion rockfish. H. Yellowtail rockfish. I. Lingcod.

Reduction of fish size, as well as in CPUE (density), is an important indicator of possible population problems. Reduction in fish size may be due to fishing pressure which reduces the number of large mature individuals in the population (Cushing 1975). Long-lived and slow-growing species are especially vulnerable to this effect. The loss of large females from the population can have an especially strong effect on larval production and survival (Berkeley et al. 2004). Thus, growth and recruitment overfishing can be closely related. The annual change in mean length as a measure of size since 1988 (fig. 6) does not indicate a major trend by species in the SCC. Most species have mean lengths above the 50% maturity size, though yellowtail and black rockfish do not. Yellowtail caught in deeper waters (2005) did exceed this mean length, and the smaller size of the shallow-water

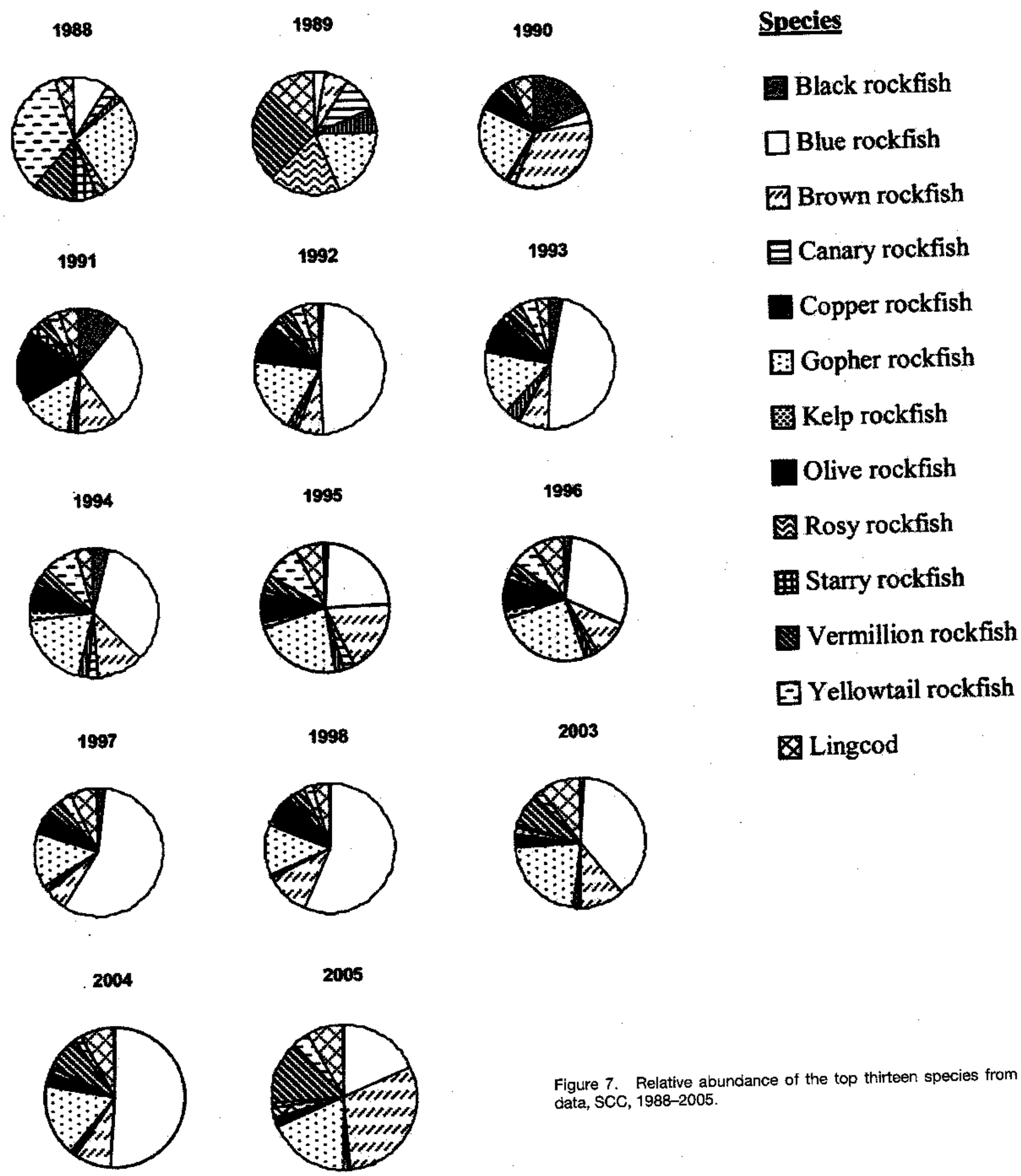


Figure 7. Relative abundance of the top thirteen species from partyboat data, SCC, 1988–2005.

catch may reflect ontogenetic movements in this species. Black rockfish generally have not done well on the SCC since the change to a warm phase of the PDO, and were small for the species even in 1980–86 (Karpov et al. 1995). The SCC is the southern limit of their range.

The CDFG collected size data (1988–98) from fish retained by the partyboat fishery, and the depths from which they were taken were uncertain. Our data (2003–05) include both caught and kept fish as well as depth of capture. We have used kept fish size to make our data comparable to previous studies, but the use of size from only kept fish biases (increases) the fish size estimate of the fished population because fishers sometimes released smaller fish. The difference between mean sizes of all captured fish and the size of those retained are presented in Table 1. Certain species (e.g., brown, gopher, and vermillion rockfish) are rarely discarded regardless of size, and the kept/catch ratio is close to unity.

The lingcod data demonstrate the effect of minimum size regulations on the kept/catch ratio. Rockfish regulations rarely specify minimum size limits because survival of released fish is estimated to be very low due to swim bladder distension. Lingcod, however, lack swim bladders and show little effect from being brought to the surface so that releasing smaller fish is a viable option. In 2003, the minimum size was 60 cm total length and only about 25% of landed fish were kept. In 2004, the minimum size was raised to 76 cm and only 10% were retained, while in 2005, the minimum size was reduced to 60 cm and more than 30% were kept. Certainly, in this case, the number of fish retained is not a reflection of the fish size in the population.

The relationship of size to depth of capture for 2005, the year when regulations allowed fishing to depths of 40 fm (fig. 3), suggests that changing the allowable depth of the fishery can lead to increases in size. The mean lengths for fish from 2005 were higher for species that inhabit deeper strata. The closure of partyboat fishing in 2003 to waters deeper than 20 fm would not account for size differences observed in 2005. It is therefore not possible to accurately relate historical size differences to today's catch without depth data from each source.

Karpov et al. (1995) discussed decreases in rockfish size comparing Miller and Gotshall's partyboat survey data of 1957–61 to the Marine Recreational Fishery Statistics Survey (National Marine Fisheries Service) data from the 1980s. Mason (1998) described a decremental trend in rockfish size from partyboat catches, 1959–94, in the Monterey region. She used logbook data to estimate total catch and catch per angler day, and CDFG sampling surveys to estimate species composition and lengths. Neither estimates are without question but her general description of trends seems reasonable. She used data with depth limits for species groups, and her ten most abundant species included bocaccio, chilipepper, greenspotted and greenstriped rockfish from the deep group, canary, widow, and yellowtail rockfish from the mixed-depth group, and blue and olive rockfish from our shallow group. We can compare our length data for 2005 to Mason's last data point (1994) for blue, yellowtail, olive, rosy, and canary rockfish and bocaccio, and with the exception of the canary rockfish, our mean lengths (tab. 1) are equal to or higher than hers. It is probable that there is a latitudinal trend in size for rockfishes (but see Laidig et al. 2003) and that growth patterns as well as fishing intensity are not the same between sites. The PG&E Diablo Canyon partyboat sampling data from 1980 to 1986 (Gibbs and Sommerville 1987) include size-frequency histograms for seven species. If we compare their 1982 data to ours from 2005, four species (gopher, blue, canary, and copper rockfish) have higher mean lengths in 1982 while three species (olive and yellowtail rockfish and bocaccio) were smaller. Blue rockfish data from the early 1960s (Miller et al. 1967) for Avila samples have means that fluctuate between 33.6 cm (1960) and 28.0 cm (1964). The years 1959, 1960, and 1963 had higher means than 2005 while the means for 1962 and 1964 were lower. There is considerable annual fluctuation in catch size of rockfishes that must be related to site specific and historical factors such as recruitment success and fishing intensity. Continual fishing pressure is certain to decrease the abundance of older, larger reproductive individuals in populations of slow-growing fish like rockfish.

An additional effect of fishing pressure might be a change in the dominance of one or more species within the assemblage. Using only the shallow data (20 fm or less) to eliminate depth effects, we created pie charts for 13 species that rank in the top 10 for any single sampled year for the 14 years of sampling (fig. 7). After 1992, blue, brown, and gopher rockfish make up about 75% of the catch. Yellowtail and gopher rockfish were important in 1988; vermillion, gopher, and rosy rockfish in 1989; and black, brown, and gopher rockfish in 1990. The dominance of brown rockfish in 2005 results from the fact that the majority of the shallow fishing that year occurred at Point Purisima which is an exceptional habitat for browns.

We tested the rank order of abundance of species in the shallow water assemblage (1979–2004) using Kendall's tau statistic (p = .05, uncorrected for multiple testing) between all possible pairs of years. Over 80% of the 190 comparisons were significantly correlated (tab. 2). There was a slow, modest transformation of the assemblage over the 20 sampling years. For example, the 1979 rank order was significantly correlated to most years prior to 1992, and not to later years. The 1980 rank order was generally correlated until 1996 but not thereafter. Some years (1985, 1990, and 1991) did not significantly correlate to a number of years and these instances are not easily interpreted.

Information on recruitment to the fishery can be obtained from annual changes in size frequency (Mason 1998). Recently, vermillion rockfish have had strong recruitment to the habitat (Dan Pondella, Vantuna Research Group, pers. comm.) and to the fishery of the SCC, and have shown an increasing CPUE since 1996 with decreasing mean length. Since 1998, the mean size has stabilized or increased reflecting growth in the recruitment class. The best record of shallow water recruitment to the nearshore habitat in the SCC region is available from PG&E's unpublished diver transect studies of rockfish at Patton Cove near Diablo Canyon (fig. 8). Pulses of rockfish recruitment have occurred since the study began in 1976 though pelagic species (bocaccio, and olive, yellowtail, and blue rockfish) have not recruited strongly since the mid 1980s. The last five years have shown very limited successful recruitment at the study site. In 2004,

TABLE 2
Composition of total catch by partyboats, 1979–2004

A. Rank order of abundance of the total catch of rockfish and lingcod based upon surveys by PG&E (1979–86), CDFG (1988–98), and Cal Poly (2003, 2004)
B. Year to year comparison, Kendall's nonparametric correlation (tau, uncorrected for multiple testing); n.s. correlation below traditional confidence level, p =.05

A

species	1979	1980	1981	1982	1983	1985	1986	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	2003	2004
yellowtail	3	3	2	2	2	1	1	1	1	1	2	2	2	2	2	2	2	2	7	6
blue	1	1	1	1	1	2	2	2	2	4	1	1	1	1	1	1	1	1	1	1
vermillion	11	12	9	9	7	7	9	3	3	2	6	3	3	3	5	8	5	6	5	3
rosy	5	4	3	3	4	3	5	4	6	6	11	9	4	4	4	4	8	8	8	7
gopher	14	10.5	8	6	3	10	3	5	5	13	4	5	6	6	3	3	3	2	2	2
widow	7	6	11.5	12	12	9	7.5	6	13	5	9	4	9	5	10	13	7	13	16.5	16
canary	4	5	5	7	9	4	4	7	7	9	13	10	12	13	12	9	12	11	11	11
lingcod	8	9	16	14	15	14	11	8	4	8	6	8	10	9	8	5	4	7	4	8
starry	10	7	4	4	6	5	6	9	12	10	12	13	5	7	7	6	10	10	12	10
bocaccio	2	2	10	11	17	8	10	10	8	3	10	7	11	10	13	12	14	12	14	13
copper	9	10.5	6	8	8	6	7.5	11	10	7	14	11	8	11	11	11	11	9	10	9
china	15	14	15	13	10	16	15	12	15	15	15	16	17	16	15	14	17	15	13	12
greenspot	6	13	11.5	10	11	11	12	13	14	12	17	14	14	15	14	16	16	16	15	16
olive	12	8	7	5	5	15	14	14	16	16.5	3	6	7	8	9	7	6	4	6	7
brown	16	17	16	15.5	14	13	13	15	9	16.5	5	12	13	12	6	10	9	3	3	5
chilipepper	13	16	17	17	16	17	16	16	11	17	16	17	15	17	17	17	15	17	16.5	16
black	17	15	18	15.5	13	12	17	17	17	14	7	15	16	14	15	15	13	14	9	14

B

	1980	1981	1982	1983	1985	1986	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	2003	2004
1979	0.73	0.52	0.44	ns	0.51	0.51	0.49	0.35	0.54	ns	0.38	ns	ns	ns	ns	ns	ns	ns	ns
1980		0.65	0.64	0.39	0.60	0.58	0.52	ns	0.56	ns	0.51	0.45	0.52	0.38	0.47	ns	ns	ns	ns
1981			0.90	0.65	0.71	0.71	0.58	0.39	0.42	ns	0.41	0.65	0.52	0.53	0.61	0.37	0.44	ns	0.38
1982				0.75	0.64	0.67	0.54	ns	0.37	ns	0.47	0.67	0.57	0.57	0.66	0.42	0.47	ns	0.43
1983					0.49	0.52	0.49	ns	ns	0.36	0.41	0.59	0.51	0.60	0.63	0.49	0.54	0.41	0.55
1985						0.75	0.59	0.46	0.63	ns	0.43	0.54	0.50	0.47	0.47	ns	ns	ns	ns
1986							0.73	0.58	0.47	ns	0.51	0.61	0.55	0.61	0.60	0.44	0.41	ns	0.38
1988								0.66	0.64	0.38	0.63	0.66	0.71	0.59	0.59	0.53	0.44	ns	0.40
1989									0.49	0.36	0.56	0.53	0.48	0.57	0.57	0.51	0.54	0.39	0.51
1990										ns	0.60	0.51	0.55	0.36	ns	ns	ns	ns	ns
1991											0.63	0.45	0.55	0.58	0.57	0.72	0.70	0.61	0.58
1992												0.68	0.78	0.60	0.54	0.69	0.60	0.41	0.49
1993													0.84	0.72	0.66	0.66	0.60	0.38	0.54
1994														0.74	0.65	0.71	0.61	0.39	0.55
1995															0.79	0.76	0.76	0.57	0.73
1996																0.71	0.76	0.57	0.70
1997																	0.73	0.60	0.64
1998																		0.76	0.85
2003																			0.81

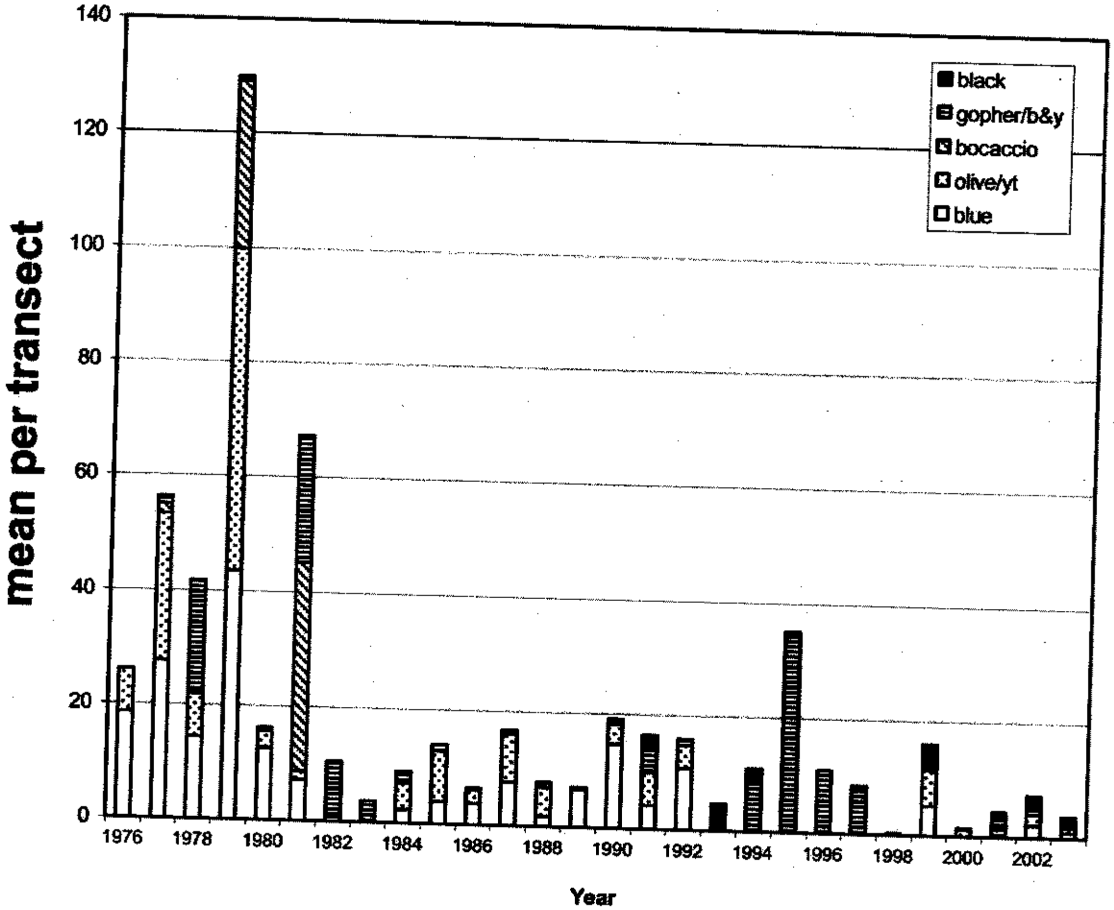


Figure 8. Recruitment of young-of-the-year/juvenile rockfish at Patton Cove, 1976–2003.

this site became a portion of the Cooperative Research and Assessment of Nearshore Ecosystems sampling system (CDFG) for the SCC and several additional sampling sites were added. It will be interesting to compare these more diverse data to those from the Patton Cove site alone.

In 2004–05, we initiated a study of larval settlement using SMURF settlement modules which have been employed for some years at contiguous sites in the Santa Barbara area (J. Caselle, UCSB, pers. comm.) and in the Santa Cruz area (M. Carr, UCSC, pers. comm.). Recruitment success depends not only on larval supply but within-site predation (Hobson et al. 2001; Adams and Howard 1996), and with SMURFs we examine the settlement of recently transformed larvae and reduce the effects of subsequent predation. The two-year pattern of settlement (fig. 9) shows a similar pattern for cabezon and the complex of copper, gopher, and black and yellow rockfish. The black, yellowtail, and olive rockfish complex failed to recruit in 2005. A similar pattern occurred in the Santa Cruz area (M. Carr, UCSC, pers. comm.), though not in the southern California bight. In this case, the lack of recruits reflects absence of larvae rather than post-settlement predation.

The NOAA/NMFS triennial trawl data are available and provide estimates of CPUE, biomass, and abundances in the SCC (tab. 3). The original survey in 1977 (Gunderson and Sample 1980) sampled deeper strata (depths below 91 m) than those between 1995 and the present, which sampled below 55 m. The NOAA/NMFS surveys did not calculate population estimates and CPUE was measured as kg/km trawled, while later publications used kg/ha. The area sampled later can be about 30% smaller than the former estimate (trawl width is estimated to be between 12 m and 14 m). Further, there was a hiatus of 18 years between 1977 and 1995 when no data were collected as far south as the SCC. However, the existing data can still be used as an indicator of change for shelf and slope species in the SCC. The triennial trawl surveys sample depths between 55 m and 500 m (30–275 fm). At the shallower depths they overlap partyboat strata. Depths from 50–150 fm have been closed since 2003 to all bottom fishing including commercial and recreational. The triennial trawl data since 1980 have

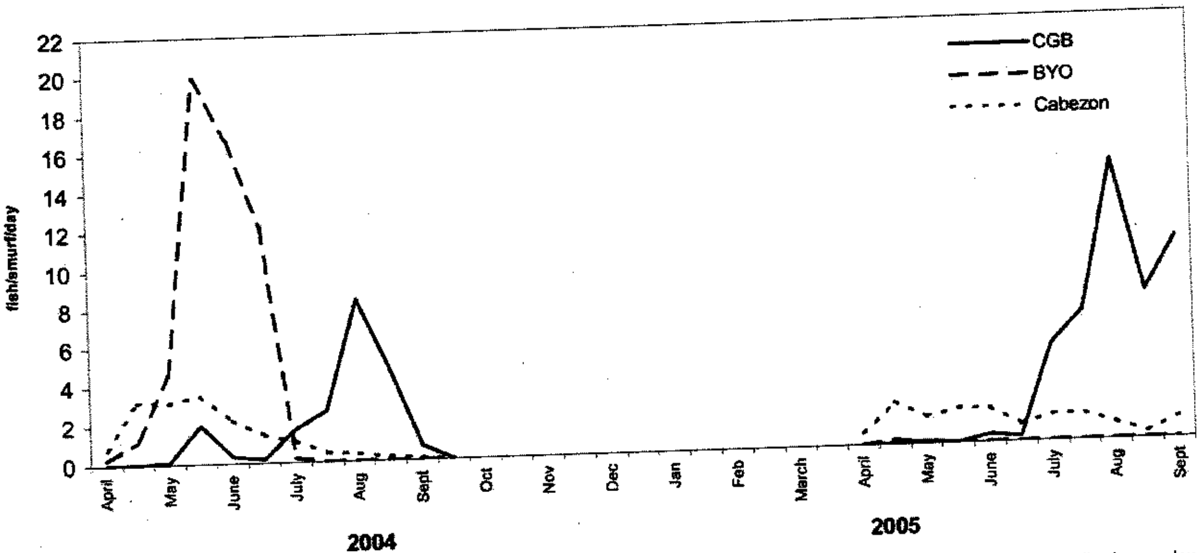


Figure 9. Larval settlement to SMURFs on the SCC, 2004–2005. Solid line represents CGB (copper, gopher, black & yellow) complex, dashed line shows BYO (black, yellowtail, and olive) complex and dotted line, cabezon.

TABLE 3
NOAA/NMFS Triennial Bottom Trawl Survey Data, Conception Region

	A. CPUE Estimated (kg/ha) (data for 2004 not available)				B. Biomass Estimates (tons)					C. Abundance estimates (# fish/1000) (data for 1977 not available)			
species	1977	1995	1998	2001	1977	1995	1998	2001	2004	1995	1998	2001	2004
aurora rockfish		1.82	1.59	1.93					610				2455
bank rockfish		0.1	0.003						17				39
blackgill rockfish		0.4	0.67	1.05					208				339
bocaccio	2.3	0.15	0.02		830	58	11	52	214	189	24	87	239
canary rockfish	0.1	0.41	0.01			T	2	8	T	2	2	5	2
chilipepper	0.6	4.45	2.2	30.36	200	1467	702	13568	2201	5440	2903	96454	11487
copper rockfish			0.001										
cowcod			0.003										
darkblotched rockfish	0.1		0.003			3	1	3	52	6	3	18	196
greenblotched rockfish			0.003										
greenspotted rockfish			0.003										
greenstriped rockfish			0.06			3	3	1	9	49	48	25	30
halfbanded rockfish		0.81	0.28	0.23		0	0	0	332	0	0	0	7160
redbanded rockfish			0.003										
rosethorn rockfish			0.003										
sharpchin rockfish			0.003			T	T	2	T	1	5	20	1
shortbelly rockfish	1.7	3.13	17.36	3.73	610	1643	8510	4104	1286	22927	180842	40560	53199
shortraker rockfish				0.06									
splitnose rockfish	11.2	17.99	14.6	6.16	3610	8521	4781	2663	15861	59487	39242	21752	156082
stripetail rockfish	6.2	10.1	6.24	4.42	2170	4080	1788	1685	2190	43047	21351	15363	46828
widow rockfish	0.3					10	T	10	16	56	1	67	13
yellowtail rockfish						29	0	17	0	186	0	20	0
shortspine thornyhead	0.3	0.88	0.25	1.23	80	249	90	407	442	1079	508	1501	1261
longspine thornyhead		0.47	0.76	0.78					96				418
Total Biomass					7500	16063	15888	22520	22924				

been published in NOAA Technical Memoranda (1995 [Wilkens et al. 1998]; 1998 [Shaw et al. 2000]; and 2001 [Weinberg et al. 2002]). The 2004 data were collected but are not yet published; however, we have been given access to some of the unpublished SCC data. The SCC is represented by the Conception site which extends from 34°30'N to 36°00'N. This is not the same Conception site used by Ware and Thomson (2005). Their Conception extends from 36°N to the Mexican border, crossing major faunal lines, changed environmental conditions, and decreasing estimates of productivity. The estimated rockfish total biomass (tons) for the Conception region (1995–2004) is 17,318, 17,092, 22;810, and 23,726 by year. The 2001 estimate in the report (12,898) is obviously an error and we recalculated this figure as a total of reported data. These biomass totals are small compared to the estimates for most other regions. The Conception region, however, is the smallest of the regions. If we standardize by unit area, the standardized biomass of Conception ranks first or second by year among the five U.S. sites.

The CPUE estimates for selected species in the Conception region (tab. 3A) includes limited data on 23 species (1977, 1995, 1998, and 2001 [2004 not as yet available]). Estimated total biomass (tab. 3B) has increased since 1977, even if only species reported in 1977 are included. Similarly, the estimated species abundance (tab. 3C) has increased, though not in a linear fashion. Extremely large catches of one species have large effects on these data: shortbelly rockfish in 1998, chilipepper in 2001, and splitnose rockfish in 2004. The coefficients of variation are large for these data though the trends, or lack of trends, shown may be valid. There has been no significant change in rank order of important species based on yearly CPUE or estimated abundance between 1995 and 2004 (Kendall's tau, $p = .05$, uncorrected for multiple testing). The 1977 data were not significantly correlated to the other years, but the species list was probably incomplete. These data suggest that the rockfish assemblage in the triennial trawl depth range has been stable at least since 1995. We have not as yet been granted permission to sample these depths experimentally with partyboats, although the data could potentially corroborate such trends.

In conclusion, it does not appear that the major decline in rockfish abundance or biomass which has been observed for some species in the northeast Pacific since the late 1970s can be documented for fish from the south central coast of California, with the exception of bocaccio. Existing trends may be masked by sampling error as well as by technological improvements in the sportfishing boats' ability to locate and capture fish. Nevertheless, this site is the southernmost area of the cool temperate zone (Oregonian) and is isolated from large human population centers (Monterey and San Francisco to the north, and Santa Barbara, Los Angeles, and San Diego to the south). This combination of nutrient-rich upwelling, cool temperatures, and lower levels of exploitation, coupled with vigorous fishery regulations (CDFG, PFMC), is likely responsible for the persistence of this rockfish assemblage.

ACKNOWLEDGEMENTS

We thank the following for supporting this study: The Marine Interest Group of San Luis Obispo, Patriot Sport Fishing (Steve Moore), Virg's Sport Fishing (Darby Neil), Central Coast Fisheries and Conservation Coalition, Steelhead Recovery Coalition, Port San Luis Harbor Commission, Port San Luis Commercial Fisheries Organization, and CCMI-Resources Legacy Fund Foundation.

LITERATURE CITED

Adams, P. B. and D. F. Howard. 1996. Natural mortality of blue rockfish, *Sebastes mystinus*, during their first year in nearshore benthic habitats. U.S. Fish. Bull. 94:156–162.

Ammann, A. J. 2004. SMURFs: standard monitoring units for the recruitment of temperate reef fishes. J. Exp. Mar. Biol. Ecol. 299(2):135–154.

Beamish, R. J. (ed). 1995. Climate Change and Northern Fish Populations. Canadian Special Publication of Fisheries and Aquatic Sciences 121. 739 pp.

Bennett, W. A., K. Roinestad, L. Rogers-Bennett, L. Kaufman, D. Wilson-Vandenberg, and B. Heneman. 2004. Inverse regional responses to climate change and fishing intensity by the rockfish (*Sebastes* spp.) fishery in California. Can. J. Fish. Aquat. Sci. 61:2499–2510.

Berkeley, S. A., M. A. Hixon, R. J. Larson, and M. S. Love. 2004. Fisheries sustainability via protection of age structure and spatial distribution of fish populations. Fisheries 29(8):23–32.

Boehlert, G. W., D. M. Gadomski, and B. C. Mundy. 1985. Vertical distribution of ichthyoplankton off the Oregon coast in spring and summer months. U.S. Fish. Bull. 83:611–621.

Brooks, A. J., R. S. Schmitt, and S. J. Holbrook. 2002. Declines in regional fish populations: have species responded similarly to environmental change? Mar. Freshwater Res. 53:189–198.

Chavez, F. P., J. Ryan, S. E. Lluch-Cota, and M. Niquen. 2003. From anchovies to sardines and back: multidecadal change in the Pacific Ocean. Science 299: 217–221.

Cushing, D. L. 1975. Marine Ecology and Fisheries. Cambridge University Press. 278 pp.

Francis, R. C. and S. R. Hare. 1994. Decadal scale regime shifts in the large marine ecosystem of the northeastern Pacific: a case for historical science. Fish. Oceanogr. 3:279–291.

Gibbs, S. E. and D. C. Sommerville. 1987. Diablo Canyon sportfish monitoring program, progress report for 1986. *In* Environmental Investigations at Diablo Canyon, 1986. Vol. 1, Marine Ecological Studies. D. W. Behrens and C. O. White, eds. San Ramon, CA.

Gunderson, D. R. 1998. A call for a change in managing our rockfish resources. *In* Marine Harvest Refugia for West Coast Rockfish: A workshop. M. Yoklavich, ed. U.S. Dep. Commer., NOAA Tech. Mem., NOAA-TM-NMFS-SWFSC-255, pp. 156.

Gunderson, D. R. and T. M. Sample. 1980. Distribution and abundance of rockfish off Washington, Oregon, and California during 1977. Mar. Fish. Rev. 42:2–16.

Harvey, C. H. 2005. Effects of El Niño events on energy demand and egg production of rockfish (Scorpaenidae: *Sebastes*): a bioenergetic approach. U.S. Fish. Bull. 103:71–83.

Heimann, R. F. G. and D. J. Miller. 1960. The Morro Bay otter trawl and partyboat fisheries, August 1957 to September 1958. Calif. Fish and Game 46:35–58.

Hobson, E. S., J. R. Chess, and D. F. Howard. 2001. Interannual variation in predation on first-year *Sebastes* spp. by three northern California predators. U.S. Fish. Bull. 99:292–302.

Holbrook, S. J., R. J. Schmitt, and J. S. Stephens, Jr. 1997. Changes in an assemblage of temperate reef fishes associated with a climate shift. Ecolog. Appl. 7(4):1299–1310.

Jackson, J. B. C., M. X. Kirby, W. H. Berger, K. A. Bjorndal, L. W. Botsford, B. J. Bourque, R. H. Bradbury, R. Cooke, J. Erlandson, J. A. Estes, T. R. Hughs, S. Kidwell, C. B. Lange, H. S. Lenihan, J. M. Pandolfi, C. H. Peterson, R. S. Steneck, M. J. Tegner, and R. R. Warner. 2001. Historical overfishing and the recent collapse of coastal ecosystems. Science 293:629–637.

Karpov, K. A., D. P. Albin, and W. H. Van Buskirk. 1995. The marine recreational fishery in northern and central California: a historical comparison (1958–86), status of stocks (1980–86), and effects of changes in the California current. California Department of Fish and Game, Fish. Bull. 176. 192 pp.

Laidig, T. E., D. E. Pearson, and L. L. Sinclair. 2003. Age and growth of blue rockfish (*Sebastes mystinus*) from Northern and Central California. U.S. Fish. Bull. 101:800–808.

Leaman, B. M. 1991. Reproductive styles and life history variables relative to exploitation and management of *Sebastes* stocks. Envir. Biol. Fishes 30: 253–271.

Lenarz, W. H. 1987. A history of California rockfish fisheries. *In* Proceedings of the International Rockfish Symposium. Fairbanks, AK. Alaska Sea Grant Rep. 87-2, pp 35–41.

Love, M. S., R. N. Lea, R. D. MacAllister, and D. A. Ventresca. 1991. Biological aspects of nearshore rockfishes of the genus *Sebastes* from central California. Cal. Dept. Fish and Game, Fish. Bull. 177:1–109.

Love, M. S., J. E. Caselle, and K. Herbinson. 1998. Declines in nearshore rockfish recruitment and populations in the southern California bight as measured by impingement rates in coastal electric power generating stations. U.S. Fish. Bull. 96:492–501.

Love, M. S., M. Yoklavich, and L. Thorstienson. 2002. The rockfishes of the northeast Pacific. University of California Press, Berkeley. 405 pp.

MacCall, A. D. 1990. Dynamic geography of marine fish populations. Seattle, Washington: Washington Sea Grant / University of Washington Press, 153 pp.

MacCall, A. D. 1998. Declining rockfish lengths in the Monterey Bay, California, recreational fishery, 1959–94. Fish. Rev. 60(3):15–28.

Mason, J. E. 1995. Species trends in sport fisheries, Monterey Bay, California, 1959–1986. Mar. Fish. Rev. 57:1–16.

Mason, J. E. 1998. Declining Rockfish Lengths in Monterey Bay, California, Recreational Fishery, 1959–94. Mar. Fish. Rev. 60:15–28.

Miller, D. J. and J. J. Geibel. 1973. Summary of blue rockfish and lingcod life histories; a reef ecology study; and giant kelp, *Macrocystis pyrifera*, experiments in Monterey Bay, California. Cal. Fish and Game, Fish. Bull. 158. 130 pp.

Miller, D. J. and D. W. Gotshall. 1965. Ocean sportfish catch and effort from Oregon to Point Arguello, California, July 1, 1957–June 30, 1961. Cal. Fish and Game, Fish. Bull. 130. 135 pp.

Miller, D. J., M. W. Odemar, and D. W. Gotshall. 1967. Life history and catch analysis of the blue rockfish (*Sebastes mystinus*) off central California, 1961–1965. Cal. Fish and Game. Mar. Res. Operations Ref 67-14. 130 pp.

Myers, R. A. and B. Worm. 2003. Rapid worldwide depletion of predatory fish communities. Nature 423:280–283.

Ralston, S. 1998. The status of federally managed rockfish on the west coast. *In* Marine Harvest Refugia for West Coast Rockfish: A workshop. M. Yoklavich, ed. U.S. Dep. Commer., NOAA Tech. Mem., NOAA-TM-NMFS-SWFSC-255, 6–16.

Ralston, S., J. N. Lanelli, R. A. Miller, D. E. Pearson, D. Thomas, and M. E. Wilkins. 1996. Status of the bocaccio in the Conception/Monterey/Eureka INPFC areas in 1996 and recommendations for management in 1997. Appendix to Status of the Pacific coast groundfish fishery through 1996 and recommended acceptable biological catches for 1997. Pacific Fishery Management Council, Portland, Oregon.

Reilly, P. N., D. Wilson-Vandenberg, C. E. Wilson, and K. Mayer. 1998. Onboard sampling of the rockfish and lingcod commercial passenger fishing vessel industry in northern and central California, January through December 1995. Marine Region, Admin. Rep. 98-1. 110 pp.

Ross, J. R. M. and R. J. Larson. 2003. Influence of water column stratification on the depth distributions of pelagic juvenile rockfishes off central California. Calif. Coop. Oceanic Fish. Invest. Rep. 44:65–75.

Shaw, F. R., M. E. Wilkins, K. L. Weinberg, M. Zimmerman, and P. R. Lauth. 2000. The 1998 Pacific west coast bottom trawl survey of groundfish resources: estimates of distribution, abundance, and length and age composition. U.S. Dep. Commer., NOAA Tech. Mem., NOAA-TM-NMFS-AKFSC-114. 137 pp.

Tolimieri, N. and P. S. Levin. 2005. The roles of fishing and climate in the population dynamics of bocaccio rockfish. Ecol. Appl. 15(2):458–468.

Ventresca, D. A., R. H. Parrish, J. L. Houk, M. Gingras, S. D. Short, and N. C. Crane. 1995. El Niño effects on the somatic and reproductive condition of blue rockfish, *Sebastes mystinus*. Calif. Coop. Oceanic Fish. Invest. Rep. 36:167–173.

Ware, D. M. and R. E. Thomson 2005. Bottom-up ecosystem trophic dynamics determine fish production in the Northeast Pacific. Science 308:1280–1284.

Weinberg, K. L., M. E. Wilkins, F. R. Shaw, and M. Zimmermann. 2002. The 2001 Pacific west coast bottom trawl survey of groundfish resources: estimates of distribution, abundance, and length and age composition. U.S. Dep. Comm., NOAA Tech. Mem., NOAA-TM-NMFS-AKFSC-128. 141 pp.

Wilkins, M. E., M. Zimmermann, and K. L. Weinberg. 1998. The 1995 Pacific west coast bottom trawl survey of groundfish resources: estimates of distribution, abundance, and length and age composition. U.S. Dep. Comm., NOAA Tech. Mem., NOAA-TM-NMFS-AKFSC-89. 138 pp.

Wilson, C. E., L. A. Halko, D. Wilson-Vandenberg, and P. N. Reilly. 1996. Onboard sampling of the rockfish and lingcod commercial passenger fishing vessel industry in northern and central California, 1992. Marine Resources Div., Admin. Rep. 96-2. 103 pp.

Wilson-Vandenberg, D., P. N. Reilly, and L. Halko. 1995. Onboard sampling of the rockfish and lingcod commercial passenger fishing vessel industry in northern and central California, January through December 1993. Marine Resources Div., Admin. Rep. 95-2. 122 pp.

Wilson-Vandenberg, D., P. N. Reilly, and C. E. Wilson. 1996. Onboard sampling of the rockfish and lingcod commercial passenger fishing vessel industry in northern and central California, January through December 1994. Mar. Res. Div. Admin. Rep. 96-6. 96 pp.

Exhibit 2

PG&E Comments on

California Coastal Power Plants Cost and Engineering Analysis of Cooling System Retrofits Draft Prepared by Tetra Tech

1. OVERVIEW:

PG&E appreciates the opportunity to provide comments on Tetra Tech's draft report: Cost and Engineering Analysis of Cooling System Retrofits. While PG&E is committed to the use of non-OTC technologies at new facilities, we have two remaining OTC plants: Humboldt and Diablo Canyon. We are in the process of obtaining final approval to repower our Humboldt plant using dry cooling, and thus, our expectation is that Diablo Canyon will be our only OTC facility within the next few years.

Given the limited amount of time and the unavailability of the technical information supporting many of the draft report's conclusions, we are precluded from performing an in-depth analysis of Tetra Tech's work. However, we have identified many issues that warrant considerable additional investigation and research before a definitive determination that a retrofit is technically feasible could be reached.

Our concerns may be summarized in three broad categories: Engineering issues, adverse environmental impacts, and cost issues.

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. 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.

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.

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.

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. While the report acknowledges the difference between a retrofit and repowering, the regulatory section focuses heavily on requirements that drive new facility construction and the repowering of facilities—not a retrofit of an existing facility. It should also be noted that the State Lands Commission's April 2006 resolution was overturned by the Office of Administrative Law.

2. 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.

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.

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.

The present condenser has a history of tube leaks which would be made worse by significantly increasing the water box pressures. These tube leaks have required the plant to shutdown which has the potential to adversely impact plant safety. The present condensers have 2 to 3% of their tubes plugged due to leakage. Increased tube leaks would have an adverse impact on the operation of the condensate polishers and potentially an adverse impact on transient feedwater and main steam chemistry. Secondary side water chemistry is an important aspect of nuclear safety due to potential degradation of steam generators and main turbines (missile generation) and potential plant trips. Plant trips due to chemistry excursions unnecessarily exercise plant safety systems. Transient departures from water and steam chemistry limits would, as a minimum, impact the steam generator and main turbine warranties. None of these issues were addressed in the Tetra Tech report.

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. We agree with Tetra Tech that re-optimization would require extensive demolition and excavation of the existing site to gain access to the existing condensers (on the lower level of the turbine building) and reconfigure the tubes and supply and return lines connecting to the water boxes. The Tetra Tech report states, "Because of the complexity and level of detail required to develop an accurate estimate of a condenser re-optimization for DCPP, no attempt is made to characterize the cost or impact on facility downtime during construction in this study."

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.

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.

Location of the New Pump House

The location of the new Pump House as shown in Figure C-6 blocks access to the Turbine Building crane bay where all large pieces of machinery (turbine rotors, generators, pumps, etc) enter and exit the building. Its proposed location is technically unacceptable.

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."

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.

The following documents discuss our licensing commitments in this area.

FSAR Section 10.4.5.4, "Flooding," describes a flooding analysis performed on circulating water leakage due to an improperly secured condenser waterbox manway cover. The FSAR credits the CWP trip on high condenser pit level for eliminating the need for operator action to protect the safety related EDGs from circulating water system leakage.

Supplement 7 to the Safety Evaluation Report (SSER 7), Section 10.4, "Other Features," states that the only safety-related equipment that would be vulnerable to circulating water system flooding would be the diesel generators. SSER 7 states that an automatic trip system has been installed for the circulating water pumps that eliminates the need for the operator to take rapid corrective action in the event of a large circulating water leak, and that the NRC staff finds it acceptable.

The installation of cooling towers would greatly increase the threat due to flooding and would require further analysis and most likely NRC approval. If the present once-through system developed a leak (such as that due to an improperly secured condenser waterbox manway cover), the water level would build up in the turbine building sump and level switches would trip the CWPs. Because the elevation of the present circulating water conduits are below the elevation of the leak, the flooding into the turbine building would stop after the circulating water pumps stop. However, with the evaluated wet cooling towers, large quantities of piping and the cooling tower basin are located above the elevation of the leak. Therefore, even after the new CWPs were tripped, the water inventory above the elevation of the leak (roughly 10 million gallons) would drain into the turbine building. The volume of water is such that, if contained, it could fill the Unit1 or Unit2 turbine building to a hypothetical depth of over 20 feet and impact a variety of safety-related equipment, including the EDGs.

This issue is not addressed by Tetra Tech, would require significant analyses and could result in a condition the NRC would be unwilling to license.

<u>Replacement of Service Cooling Water Heat Exchangers and Condensate Coolers</u>

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. Some of the issues associated with incorporating the system into a closed-cycle system are discussed below.

The increase of cooling water temperature by 17 to 20°F (as well as the increase in pressure) would necessitate replacement of both the SCW Heat Exchangers and the Condensate Cooler and possibly many of the components cooled by the SCW system.

The SCW system removes heat from various secondary system components via a closed loop cooling cycle and rejects the heat to the Circulating Water System. The closed loop SCW system presently runs with a cold end temperature on the order of 79°F (e.g. 58°F circulating water cools the service cooling water to 79°F). Even after replacing the heat exchanger with a much larger heat exchanger it will not be possible to cool the SCW to 79°F using 78°F circulating water from the cooling towers.

The heat loads cooled by the SCW System include:

- Main feed pumps turbine lube oil coolers
- Condensate booster pumps lube oil coolers
- Generator exciter
- Fuse wheel
- Generator seal oil coolers
- Iso-phase bus coolers
- Main turbine reservoir lube oil coolers
- Post LOCA sampling system room air conditioning and sample panel chiller
- Plant air compressors 05 and 06 (via the SCW booster pumps)
- Reciprocating air compressor jacket coolers and aftercoolers
- Air system air dryers
- TSC air conditioning units
- Personnel access control room air conditioning unit
- Operations ready room air conditioning unit
- Condenser vacuum pump seal water heat exchanger
- Electro-hydraulic control coolers
- Feedwater sample cooler 72
- #2 heater drain pump lube oil coolers and sample cooler
- Secondary process control room isothermal bath water chiller

In addition to the replacement of the SCW heat exchanger, many of the above components cooled by the SCW could require modification or replacement due to the higher SCW cooling water temperature. The Tetra Tech study does not address this major issue.

<u>Constructability of Interconnecting Piping and New Pump House</u>

Tetra Tech provides a very simplistic non-detailed description of the implementation of the new pump house and the interconnection of the new piping to the existing circulating water conduits. Figure C-6 shows Tetra Tech's simplified sketch of the pipe routing between the new pump house and the towers, but fails to address how and where the interconnection to existing supply and return conduits would be accomplished and the magnitude of the safety and non-safety related systems that would be severely impacted and would physically interfere with the design and the proposed construction.

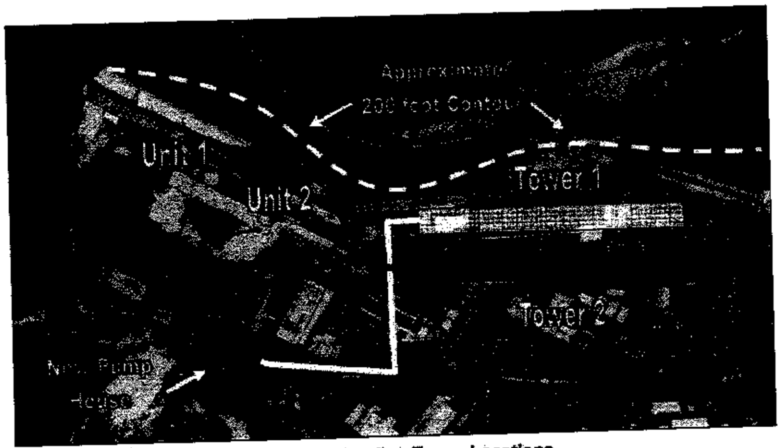
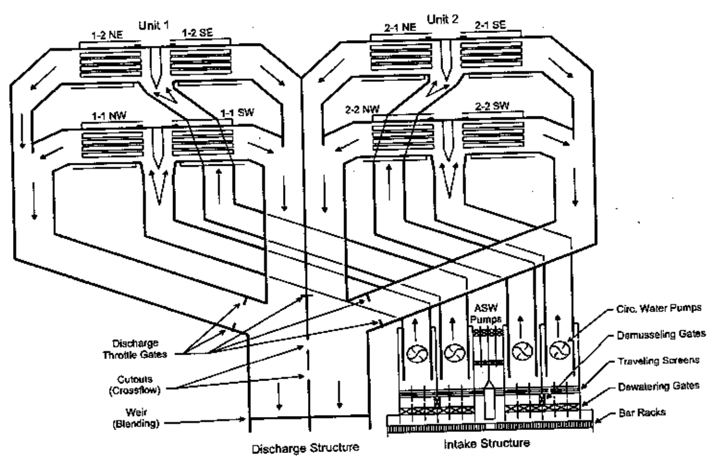


Figure C–6. Cooling Tower Locations

The following schematic shows the existing circulating water conduits to the condenser. 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.

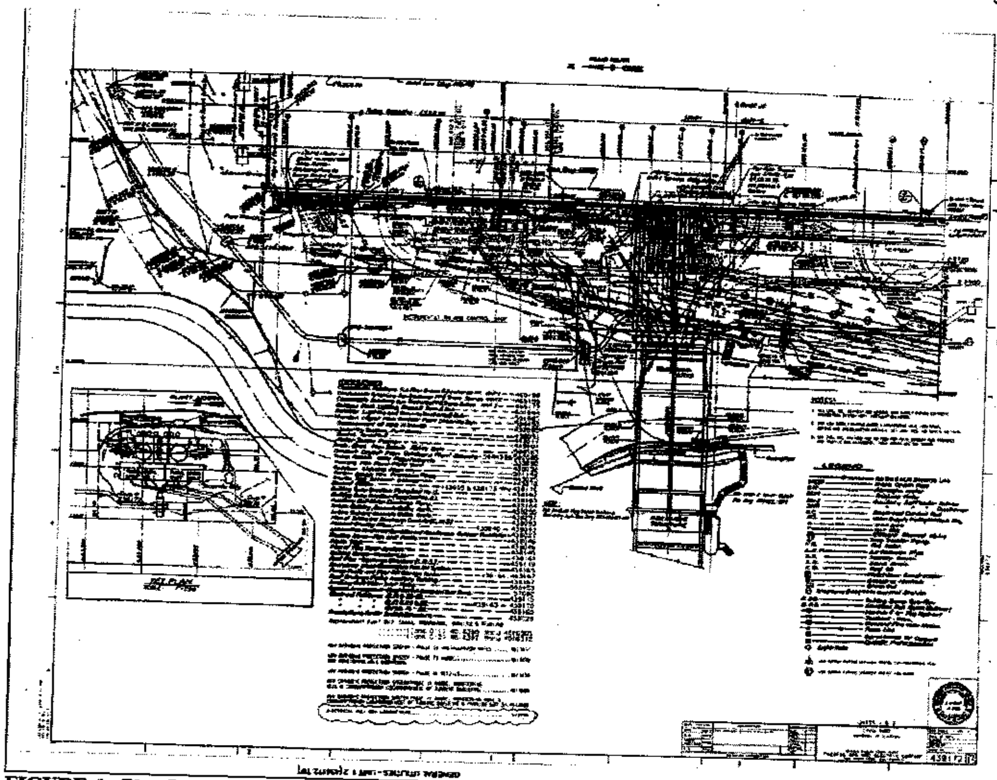


FIGURE 6 - Plan View of Tie-in Underground Construction Conditions in Front of Turbine Building

The Tetra Tech study does not sufficiently address if it is even possible to route the large diameter piping in this area, nor the disruption of the numerous systems that would have to be relocated to accomplish this construction. The safety-related ASW system bisects this area and is required to remain in operation even with both units shut down. The difficulty, time and cost associated with these excavations, tie-ins and system interferences is immense. The development of the details of this aspect of the retrofit would lead to numerous obstacles which were not sufficiently addressed by Tetra Tech.

<u>Required Operation of the Auxiliary Saltwater System (ASW)</u>

The safety related ASW system (which cools the spent-fuel-pool system and must be available for emergency heat dissipation) is required to operate even when both units are shut down. The ASW piping is intertwined with the circulating water conduits in the area in front of the turbine building where the cooling tower piping tie-ins are proposed. The safety related ASW power and control conduits also traverse this area. Additionally, a portion of the ASW piping for each unit is integrated with the circulating water conduits. Any retrofit of the ASW system to a closed-cycle cooling configuration would significantly increase heat exchanger inlet water temperatures outside of existing design parameters. This safety system design challenge would likely present an insurmountable feasibility issue if this system was placed on closed-cycle cooling. Tetra Tech did not adequately address issues regarding either maintaining or retrofitting the ASW system which has both nuclear licensing and technical feasibility implications.

<u>Comments on Section 3.4 — Environmental Effects</u>

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.

Make-up Water

Tetra Tech's use of one existing Circulating Water Pump for tower make-up is unworkable. Tetra Tech's conceptual design is that "one circulating water pump rated at 207,000 gpm, which is currently used to provide once through cooling water to the facility, will be retained in a wet cooling system to provide makeup water to both cooling towers."

Tetra Tech further states that, "The capacity of the retained pump exceeds the makeup demand capacity by approximately 130,000 gpm. Any excess capacity will be routed through a bypass conduit and returned to the intake forebay. Instituting a diversion as outlined in Figure C–7 may not be practical for DCPP given the large volume of water that would be recirculated. New makeup water pumps would represent a marginal increase in capital and installation costs compared with the total value of the project."

The present circulating water pumps are rated (design point) at 433,000 gpm @ 96.5 feet Total Differential Head (TDH), not 207,000 gpm as stated by Tetra Tech. At the higher discharge head required to feed the cooling tower system, the pump would be operating at or near its shut-off point, may not be able to supply the required make-up flow and would be in danger of destroying itself. (Pump shut-off head is 160 ft, pump head at 207,000 gpm is 132 feet, cooling tower basin water elevation is roughly 140 to 150 feet, CT riser elevation is roughly 190 feet.) With one unit shut down this technically unacceptable condition would be made worse. Additionally, a design in which two 1100 MW plants are dependant on a single pump (especially one pump operating away from its design point) is technically and commercially unacceptable. Four new make-up water pumps would be required. The new pumps with associated intake structure, power supply, controls, etc., would be a significant increase to the cost and complexity of the total project.

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. Yet the report's analysis suggests that capital costs to provide such treatment would be under $400,000 – clearly an insufficient amount for such a large volume of brine discharge. Another significant issue is that receiving waters offshore of Diablo Canyon have ambient temperature ranges as low as 48-52 degrees Fahrenheit for extended periods of time. The draft report does not analyze the overall plant system discharge temperatures following a retrofit and it is unclear how the facility would meet State Thermal Plan requirements during routine operations. Additionally, the analysis appears to suggest that maintenance costs would be on the order of $0.5 per gallon, which would equate to $35 million dollars a year—but this amount is not included in annual operations and maintenance figures.

Thermal Efficiency

Tetra Tech states that the use of wet cooling towers at DCPP will increase the temperature of the condenser inlet water by 17 to 20° F above the surface water temperature, depending on the ambient wet bulb temperature at the time. Backpressures for the once-through and wet cooling tower configurations were calculated on a monthly basis using ambient climate data. "In general, backpressures associated with the wet cooling tower were elevated by 0.70 to 0.85 inches HgA compared with the current once-through system (Figure C–10 and Figure C–12)." Tetra Tech gave no further basis or details of their calculations.

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.

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.

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.

In addition, the assumed cost of replacement power of roughly $65/MWh is considerably understated. A fairer average cost to purchase power on the surplus market would be the market price referent (MPR) of approximately $96/MWh. The MPR is a CPUC-set benchmark price at or below which approved contracts will be considered *per se* reasonable. At this level, the cost of replacing lost generation would be closer to $960 million, which would be offset by only approximately $66 million in fuel savings. Thus, the costs associated with lost generation due to a conversion shutdown would be closer to $894 million assuming the 8-month period estimated by Tetra Tech. However, estimates by Burns Engineering in reviewing the Central Coast Regional Water Quality Control Board's 2002 study by Tetra Tech and our further research indicates that a shutdown in the range of 12-18 months is more likely, leading to a total cost for replacement power in the range of $1.3 - 2.0 billion.

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.

Pacific Gas and Electric Company

Mark C. Krausse
Director
State Agency Relations

1415 L Street, Suite 280
Sacramento, CA 95814

(916) 386-5709
(916) 386-5720 Fax
mckd@pge.com

November 20, 2007

Secretary Michael Chrisman
California State Resources Agency
1416 Ninth Street, Suite 1311
Sacramento, CA 95814

Dear Secretary Chrisman:

PG&E appreciates the opportunity to provide comments on the draft report prepared by Tetra Tech for the Ocean Protection Council: Cost and Engineering Analysis of Cooling System Retrofit. PG&E is committed to the use of non-once-through cooling (OTC) technologies at new facilities. We will be using dry cooling at our Gateway, Colusa and—pending repowering in the 2010/11 timeframe—Humboldt power plants. After this, our 2300 MW nuclear facility at Diablo Canyon will be our only OTC facility. Attached you will find detailed comments on the report's Diablo Canyon assessment.

In order to develop a sound state policy on once-through cooling, PG&E believes that it is essential to develop the type of information contained in the Tetra Tech draft report. An effective and sustainable policy must both promote a healthy marine environment and ensure a stable electric supply and delivery system. A thorough assessment of the feasibility of retrofitting California's coastal power plants to closed cycle systems requires a site-specific evaluation of each facility. While we applaud the draft report's site-specific approach, it identifies many critical issues without providing any further assessment or analysis. This is a significant weakness if the report is to provide essential information to the State Water Resources Control Board on retrofit feasibility. To be effective, the report must be revised to address the identified issues.

Given the limited timeframe for review, we are only able to provide an overview of the issues that warrant further investigation and research. Our concerns may be summarized in three broad categories: engineering issues, adverse environmental impacts, and costs issues.

Engineering Issues: There is little experience with salt water towers at a nuclear facility and a retrofit of the size and complexity of that required at Diablo Canyon has never been attempted. Given this background, it is essential that significant engineering issues be thoroughly analyzed before making any determination of technical feasibility. The report simply does not do that. The are serious concerns regarding Tetra Tech's evaluation of condenser modifications, facility configuration/location, wastewater treatment, other systems cooled by the existing system, and NRC license requirements. Until these issues are adequately addressed, it is not possible to make any finding of "feasibility" at Diablo Canyon. It does a great disservice to the process to suggest otherwise.

Environmental Impacts: 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 discharge of at least 72 million gallons a day, and the enormous GHG implications for both the 12-18 month shutdown period and the on-going 100 MW energy penalty due to decreased plant efficiency.

Cost Issues: 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 the inadequate evaluation of many identified technical and engineering issues.

We support the development of a once-through cooling policy that ensures California's marine environment is protected and promotes an orderly transition away from once-through cooling while protecting the stability and reliability of California's electric system. It is absolutely critical that the State Water Resources Control Board have access to accurate and thorough information as they develop the state's policy on such an important issue, and we would be happy to provide any additional information on Diablo Canyon that is necessary. We are continuing to assess the feasibility of cooling towers for Diablo Canyon as proposed by the Tetra Tech report. Further more detailed information will be shared with you and SWRCB staff as available.

If you have any questions or would like to discuss these issues further, please call me at your convenience.

Sincerely,

Mark Krausse

cc: Drew Bohan
Christine Blackburn
Dorothy Rice
Jonathan Bishop

Exhibit 3

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.

PG&E Comments on SWRCB Power Plant Cooling Scoping Document
Exhibit 4

Tetra Tech - Cost and Engineering Analysis of Cooling System Retrofits PG&E Response to Tetra Tech's January 2008 Comments

PALO VERDE AND HOPE CREEK ARE SUBSTANTIALLY DIFFERENT FROM THE PROPSOSED RETROFIT AT DIABLO

It is incorrect to classify the Palo Verde Nuclear Station as a "salt water make-up mechanical draft" facility. The cooling water make-up at the facility is more appropriately designated "hard water with salinity" and is not equivalent to ocean saltwater. PG&E agrees that total dissolved solids in the power plant's cooling water supply results in an overall metal-salts concentration similar to seawater, however, the chemical composition of the water is not similar. The salt in seawater is primarily Sodium Chloride (NaCL), where as the dissolved salts in the water supply at Palo Verde is not. Palo Verde make-up water is contaminated with a variety of chemicals primarily Calcium Carbonate ($CaCO_3$) and other non-chloride constituents.

There is a distinct difference in this chemistry. Chloride contamination of the secondary system (turbine steam and condensate closed cycle system) is a significant concern for Pressurized Water Reactor (PWR) facilities. Chlorides result in excessive degradation of secondary system stream generator metals. Even transient elevated chlorides in the secondary system can require shut down of an operating PWR unit. Chloride contaminate excursions have resulted in shutdown of DCPP units previously, and ongoing chemistry management challenges posed by even minor in-leakage exhibited with the existing condensers (at current operating pressures) result in significant ongoing costs to the facility. With elevated sodium chloride concentrations in the proposed mechanical draft closed-cycle system (minimum 1.5X raw seawater), and condenser inlet operating pressures of approximately 45-50 PSI (verse current normal range of 5.5 to 9.5 PSI), chloride contamination of secondary condensate would be more difficult to control, and any leak much more significant to plant operability. At a minimum, it supports the contention that a complete replacement of the existing main steam condensers would be a requirement of a retrofit. It would be imperative that condenser tubes and tube sheet junctions capable of withstanding the higher pressures, as well as an installation that can realistically be operated with continuous leak-tight performance, would be necessary. Extensive upgrade or complete replacement of the existing turbine building main steam condenser to facilitate a closed-cycle retrofit would be required for this reason alone.

The Hope Creek facility is also not an appropriate comparison to the proposed retrofit of DCPP. Make-up water at this location is actually brackish (variable freshwater/seawater mixture) and not equivalent to ocean saltwater. Sodium Chloride concentrations in the Delaware River Estuary location range between 0 and 20,000 ppm dependent on tidal flux and freshwater river flow volume. The plants cooling tower loop routinely operates between 13,000 and 18,000 ppm Sodium Chloride with 1.3x concentration of make-up water contaminates. Both make-up and cooling system salinity at this facility are significantly lower than that achievable for DCPP. More importantly, the plant site is entirely dissimilar to DCPP. Hope Creek is situated on a flat and open location. The site is shared with the Salem Nuclear Facility in a 350 acre industrial security zone. Additional flat open area surrounds the industrialized security zone. The installed cooling tower at Hope Creek is also approximately 300-yards away from the operation unit, a configuration facilitated by the open space. The location has different atmospheric characteristics as well that support natural draft tower operations, and initial plant design also facilitates main condenser operations at significantly lower inlet pressures than that required for proposed closed-cycle functionality at DCPP. Additionally, emissions exhibited from natural draft towers are different than that for mechanical draft towers. Salt and other PM-10 emissions from Hope Creek's natural draft tower total approximately 372 lbs/day on average. This is in comparison to projected salt emissions of 4,800-19,800 lbs/day from a mechanical draft cooling tower installation at DCPP that would, by necessity, be immediately adjacent the operating units and associated 500KV transmission system.

In summary, both Palo Verde and Hope Creek were constructed to operate efficiently with the cooling systems installed as part of initial plant design. This includes condenser systems, associated rated system pressures, pumping equipment and configurations, and anticipated ambient water chemistry and atmospheric conditions. This is not comparable to a retrofit of a facility in a location with restricted open space, and that was initially designed and constructed for operation with the existing once-through-cooling system at current system pressures and performance. It is relevant to emphasis that steam electric power plants are essentially designed and constructed around a specific heat dissipation (heat-sink) system. Using comparisons to the conditions and performance of operating units sited, designed, and constructed with a specific cooling system as supporting evidence for determining the feasibility of retrofitting is fundamentally flawed

THE 1982 TERA REPORT SHOULD NOT BE A BASIS FOR A FINDING OF TECHNICAL FEASIBILITY

The Tetra Tech report inappropriately interpreted the statements and conclusions of the 1982 Tera Corporation report. Technical feasibility as defined in the Tera report was based on two specific criteria that did not include detailed evaluation of actual construction or implementation feasibility. The criteria included whether an alternative would reduce the heat and/or volume of the discharge and provide an additional practical, beneficial purpose. The Tera report specifically indicated that a retrofit would not be considered technically feasible if it required modifications to major plant components or systems such as the turbines, condensers or major plant structures. Subsequent evaluations have found that condenser modifications would be necessary. The Tera report also found that a retrofit of Diablo Canyon would be "beyond the proven state of the art." (Page 1-1).

Furthermore, the 1982 report was only intended to be a preliminary assessment, and did not account for all actual site installations, specifically the size and footprint of the existing underground seawater conduits west of the DCPP turbine building. The report was also published prior to commercial operation and actual operating experience for Unit-1 and Unit-2.

The diagrams provided in the Tera report (simple thin side by side lines denoting the intake conduits) are not representative of the installations in the area west of the turbine building. The main seawater conduits occupy a wide and extensive portion of the area underground. It is impractical that any substantial excavation, structure placement, or preliminary piping tie-ins be accomplished in this area without impacting operations of both units. Therefore, placement of a new pump house in this location presents many difficulties. Furthermore, the ocean bluff immediately adjacent presents further complexity to adequately support and seismically stabilize a structure that would house critical power production operating equipment.

SALT DEPOSITION IS A SERIOUS CONCERN AND RAISES SIGNIFICANT ENVIRONMENTAL AND PERMITTING ISSUES

On-site natural salt spray originates from wind interacting with the ocean 85-feet below the power plant ground level, and occurs on the opposite side of the turbine building from the 500KV transformer systems. Regardless of wind direction, current plant configuration protects the high voltage conductors and insulators from rapid and extensive salt contamination. Periods of excessive drift generated by high winds in combination with discharge outfall disturbance also remains west of the turbine building. Regardless, significant salt contamination and subsequent corrosion of the site administration, training, fabrication and warehousing support structures, and associated equipment, is currently extensive and negatively impacts ongoing site operation and maintenance costs.

The proposed cooling tower complex (as placed in the proposed configuration) would result in the emission of large volumes of salt at approximately the 140-foot elevation immediately adjacent the Unit-2 500KV transformers and transmission system connecting to the main switchyard. Site winds are in fact most frequently toward the Southeast, but winds, including gale force winds, do occur periodically to the North and Northeast. This condition recently occurred for 4-days straight (January 2008) due to gale force winds originating from the Southeast. The amount, elevation, and location of the salt drift from the tower complex would be far more damaging to the overall plant site, and present a new and direct threat to the 500KV systems currently shielded from routine ocean salt drift and deposition.

Simply increasing "washing" as suggested by Tetra Tech would not negate the introduced arcing and insulator flashover threat especially to the Unit-2 500KV system. During an unfavorable wind condition, the salt laden plume from the cooling towers would be driven directly into the high voltage transformer equipment and conductor lines.

Additionally, obtaining permitting for emissions from salt water mechanical draft installation would be extremely difficult and potentially unattainable. The region in which DCPP is located is in non-attainment for PM-10 emissions. Any new significant PM-10 emissions source is required to procure offsets which are not readily available. Additionally, Best Available Control Technology (BACT) is required for any emissions source greater than 25lb/day. Salt emissions from a DCPP retrofit to mechanical draft towers are estimated at 4,800-19,800 lbs/day. There is no reason to anticipate that any retrofit of the DCPP would be exempted from complying with San Luis Obispo County Air Pollution Control District (APCD) requirements. The APCD has previously commented on a similar proposed retrofit of the fossil fueled Morro Bay Power Plant to closed-cycle cooling. Reference the March 4, 2004 APCD letter to the State Regional Water Quality Control Board "Saltwater Cooling Towers Related to Air Quality – Duke Morro Bay Power Plant Modernization Project" 2006 Exhibit 7.

THE REMAINING DISCHARGE PRESENTS SERIOUS ENVIRONMENTAL AND PERMITTING CHALLENGES

Although permitting requirements remain uncertain, the Central Coast RWQCB has stated that any prolonged discharge with salinity more than 10% above ambient would require installation of a diffuser system, at a minimum, to be permitted (regardless of any other chemical contaminates). High salinity blow-down from the proposed cooling tower system is estimated to be approximately 72 mgd at a minimum. Therefore, even if remaining plant ASW/SCW once-through cooling volume of approximately 43 mgd could be used to dilute the tower blow-down, the combined discharge of approximately 115 mgd would remain >10% above ambient salinity, and a diffuser system would be required. This system would have to be placed on the ocean floor, and include piping that would extend out into the open sea significantly beyond the current discharge cove area. This installation itself would present a new and significant construction permitting challenge.

MINIMUM DOWN TIME WILL BE IN THE RANGE OF 12–18 MONTHS

PG&E's consultants believe that down time will be in the range of 12-18 months at a minimum. Tetra Tech does not provide any comparative information to assess whether estimates for plants such as Indian Point or Salem are relevant to a retrofit at Diablo Canyon. Specific site conditions and retrofit parameters are not presented that facilitate evaluation of the complexity of these proposed projects in comparison to that proposed for DCPP. Furthermore, it is known that the plant sites and surrounding areas at both these facilities are significantly more open and level than that at DCPP. Indian Point is located on a 239 acre site in an area of low rolling hills. Salem is located in conjunction with the Hope Creek Facility in a flat 350 acre industrialized security zone surrounded by additional flat open space. Indian Point has an available freshwater resource (Hudson River) and Salem a low salinity brackish water resource (Delaware River Estuary).

For the Salem Facility, Sargent & Lundy Engineering developed a conceptual retrofit assessment that estimates a 66-month overall site project which includes power production outages totaling at least 7-months (in addition to normal refueling outages) for each unit. However, the minimum outage estimates are based on conceptual designs only, and are not adequate for determining actual unit down-time required for successful implementation of a fully scoped retrofit. For the Indian Point Facility, Enercon Services similarly completed a retrofit assessment; however minimum unit outage estimates (in addition to normal refueling outages) were determined to be substantially more than the 4-months cited by Tetra-Tech.

At DCPP, extensive main condenser upgrades or retrofitting could not feasibly be accomplished in parallel with the extensive excavations and subsequent construction required for cooling water conduit modifications and tie-ins. These modifications must be accomplished underground in the only reasonable access pathway to the main condenser locations deep within the turbine building. Therefore, the bulk of these two general efforts would need to be performed in sequence in any realistic retrofit scenario resulting in extension of unit down time for this reason alone substantially above Tetra Tech estimates.

Even with prior site preparation and cooling tower unit construction, due to the certain extensive modifications required for the power plant seawater intake, main condenser upgrades, and the difficulty of tie-ins, PG&E remains certain that both units of DCPP would be inoperable for a minimum of 12-18 months even with favorable construction schedule adherence. Any discussion of retrofit feasibility must include realistic site specific construction time estimates, and not estimates based on generalities provided by industry equipment suppliers and vendors, or those based primarily on conceptual designs only.

THE DIABLO INTAKE IS DESIGNED TO MINIMIZE IMPINGEMENT

The DCPP intake structure was designed using operational experience from PG&E's former Sacramento Delta power plants, and civil engineering guidance that incorporated information from "Studies on Fish Preservation at the Contra Costa Steam Plant of the Pacific Gas and Electric Company" 1953, authored by James Kerr (State of California Department of Fish and Game, Fish Bulletin No. 92). Fish impingement related operational experience, and findings of the Kerr study, were integrated into the PG&E 1960 Civil Engineering Manual for Circulation Water Systems. The manual identifies "Protection of Fish" recommendations for intake design that include engineering low intake structure approach water velocities and lateral escape routes for fish.

These engineering recommendations were used during design of the DCPP intake. Specific impingement reduction consideration incorporated into the DCPP intake structure include a wide and flat (straight) opening that generates a uniform low velocity water flow from the mouth of structure up to the cooling water pump bay closure gates, installation of cut-outs between closure gate forebays, and installation of a passive fish return bay on each end of the structure. Large 5-ft. x 27.9-ft. (139.5 square-foot) cut-outs were placed in concrete forebay partitions to provide a route for water and fish to freely migrate across the structure behind the debris exclusion bar racks, and an additional bar rack bay was constructed at each end of the structure with a 9-ft. wide racked opening. Together, these characteristics provide a lateral escape route designed into the structure. The extra end bays provide a location for fish to move out of the intake flow and migration back out of the intake structure. In combination with placement of the intake in an engineered cove (designed to protect the intake structure from severe ocean swell damage) impingement losses experienced during DCPP operations have been very low demonstrating effectiveness of the implemented design criteria to limit fish impingement