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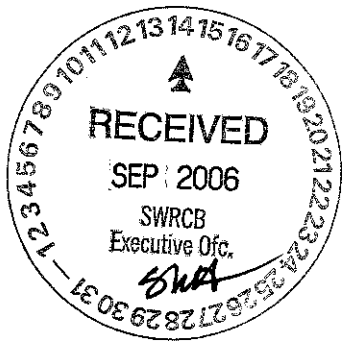
316 (b)
Once Through Cooling
Deadline: 9/15/06 5pm




September 14, 2006

Ms. Song Her
Clerk to the Board
State Water Resources Control Board
1001 I Street
Sacramento, CA 95814

Re: Comment Letter – Proposed Statewide Policy for Once-Through Cooling

EPRI Solutions is pleased to submit the attached comments on the proposed statewide policy for once through cooling (Attachment A). EPRI Solutions is a wholly owned subsidiary of the Electric Power Research Institute (EPRI) headquartered in Palo Alto, California. EPRI has been actively engaged in 316(b) research for a number of decades and played an active role on behalf of the steam electric generation industry in discussions with EPA staff during the entire course of the Phase I and Phase II Rulemakings. Since the Rule went final, EPRI's fish protection research program has focused on assisting the industry with compliance by conducting research on the cost, feasibility and performance of alternative fish protection technologies, use of restoration measures and evaluating the environmental benefits of compliance. Based on this research, EPRI Solutions has been working with individual companies, including most of California's facilities to comply with the final Phase II Rule.

Currently EPRI Solutions, in partnership with Tenera, is engaged in projects with California's 316(b) affected facilities to evaluate the impacts of impingement and entrainment on California's coastal fisheries and the costs of retrofitting facilities with closed-cycle cooling. Reports on each of these projects are expected to be available by the end of this year. The comments in Attachment A are based on both the research conducted to date on these projects, as well as, general EPRI research on fish protection technologies and operational measures.

Should you have questions regarding these comments please feel free to contact me at (571) 643-2320 or by email at dbailey@eprisolutions.com .

Sincerely,

David E. Bailey
Associate Director, Clean Water Act Programs

# Attachment A

## Introduction

The State Water Resources Control Board (SWRCB) issued a "Proposed Statewide Policy on Clean Water Act Section 316(b) Regulations" (Proposal) on July 13, 2006. The Proposal was developed after SWRCB held two stakeholder meetings soliciting public input on the need for California 316(b) regulations. Important deviations of the Proposal from the U.S. Environmental Protection Agency's (EPA) new 316(b) rule (Rule) for existing power plants with once-through cooling water intake volumes of greater than 50 mgd (Phase II facilities) published in the Federal Register in July 2004 that are the subject of these comments include:

- Requiring facilities to meet the Rule's maximum performance standards for reduction of impingement mortality and entrainment rather than the performance standard range provided for in the Rule.
- Only allowing the use of restoration measures for achieving the maximum 90% entrainment reduction after reducing entrainment by a minimum of 60% from the calculated baseline by any combination of operational or structural controls.
- Not allowing facilities to use restoration measures for compliance with the impingement reduction performance standard.
- Basing the "calculation baseline" on actual average flow and including reference stations as part of the calculation baseline.
- Not allowing facilities to use the Rule's Compliance Alternative 5 by demonstrating that the cost of meeting the performance standard would be significantly greater than the benefit or costs considered by EPA.
- Requiring that facilities use "habitat production foregone" method to determine appropriate restoration for compliance.
- Requiring facilities to conduct studies to evaluate cumulative impacts.
- Requiring detailed monitoring studies including:
  - Quantification of all species and life stages
  - Quantification of impacts to zooplankton in addition to fish and shellfish
  - Requiring use of specific performance assessment models (FH, AEL and ETM)

EPRI Solutions and Tenera Environmental are providing comments on the Proposal based on our experience and participation in the federal Phase II rulemaking and direct involvement in 316(b) studies for California's coastal Phase II affected facilities. EPRI played a leadership role in providing expert scientific input to EPA on its final 316(b) Phase I and Phase II Rules. During the rulemaking EPRI held technical workshops in conjunction with EPA, providing technical

information relative to fish protection issues and past research and conducted technology evaluation research funded by EPA. Since the final Phase II Rule was issued on July 9, 2004, EPRI has continued to engage in 316(b) research to assist the industry in compliance. This research includes:

- testing and evaluating alternative fish protection technologies and operational measures;
- conducting scientifically sound impingement mortality and entrainment characterization studies;
- developing technically sound methods for analyzing and modeling impingement and entrainment data under the Rule's various compliance options;
- developing approaches for use restoration and scaling restoration projects for compliance;
- providing technical resources to assist companies in conducting economic evaluations under the Rule's cost-benefit test.

EPRI has been assisted by Tenera Environmental in evaluations of the design, conduct and analysis of impingement and entrainment characterization studies. Tenera Environmental has been involved in most of the studies on the effects of power plant cooling water intake systems (CWIS) conducted in California over the past ten years for 316b Phase II compliance or under licensing requirements for the California Energy Commission. Tenera's scientists have worked with scientists and staff from industry, regulatory agencies, and academia on developing the study designs and analytical tools used for evaluating the effects of once-through cooling in California. Industry, regulators and academia have recognized this expertise; and as a result, Tenera scientists have been invited to participate in symposia and workshops on assessing the effects of once-through cooling and were the principal authors of a report (in review) to the California Energy Commission on assessing the effects of power plant entrainment. Most recently, Tenera Environmental participated in a State Board sponsored training session on 316(b) for regional water board staff and other state agency personnel.

Since the Federal 316(b) Regulation for Phase II facilities (Rule) was issued on July 9, 2004, California's facilities have been actively engaged in completing studies necessary to prepare Comprehensive Demonstration Studies (CDS) that are required to be submitted on January 9, 2008. The Rule requires the CDS to specify what compliance alternatives and options have been selected for compliance. With the exception of a few facilities that possessed results from appropriately current impingement and/or entrainment studies all of California's once through cooling (OTC) steam electric generating facilities have implemented new impingement and/or entrainment studies to meet applicable performance standards.

Table 1 provides an updated list of the once through cooling (OTC) facilities identified in the Proposal. As noted in the table, 2 of the 21 facilities have already been retired and retirement has been announced for South Bay. This leaves sixteen (16) fossil and two (2) nuclear power plants that employ OTC technology.

**Table 1 – California's Power Plants Employing Once Through Cooling Technology Listed in SWRCB Staff's 316(b) Proposed Policy**

| California - Once Through Cooling Power Plants Listed in CEC June 2005 Staff Report | Owner and/or Operator | Facility Flow (MGD) | Comments |
|---|---|---|---|
| **Non-Nuclear Facilities** | | | |
| Alamitos | AES | 1181 | |
| Contra Costa | Mirant | 440 | |
| El Segundo | NRG | 606 | Offshore Intake |
| Encina | NRG | 857 | |
| Harbor | LADWP | 108 | |
| Haynes | LADWP | 967 | |
| Humbolt Bay | PGE | 78 | |
| Hunters Point | PGE | 0 | Retired |
| Huntington Beach | AES | 514 | Offshore Intake |
| Long Beach | AES | 0 | Retired |
| Mandalay | Reliant | 254 | |
| Morro Bay | L.S. Power | 668 | |
| Moss Landing | L.S. Power | 1224 | |
| Ormond Beach | Reliant | 685 | Offshore Intake |
| Pittsburg | Mirant | 506 | |
| Potrero | Mirant | 226 | |
| Redondo Beach | AES | 891 | Offshore Intake |
| Scattergood | LADWP | 495 | Offshore Intake |
| South Bay | L.S. Power | 601 | Planned Retirement |
| **Subtotal Fossil** | | **10,301** | |
| | | | |
| **Nuclear Facilities** | | | |
| Diablo Canyon | PGE | 2,500 | |
| SONGS | SCE | 2,335 | Offshore Intake |
| **Subtotal Nuclear** | | 4,835 | |
| | | | |
| **Total Facilities** | | **15,136.00** | |

Many of the facilities shown in Table 1 have already taken steps to protect fish from impingement and/or entrainment. These specific measures are described in the list of facilities shown in Table 2. Both Contra Costa and Pittsburg have implemented substantial flow reductions through a combination of unit retirements, use of closed-cycle cooling and installation of variable speed drive pumps (Proposals for Information Collection, 2006). All of the facilities with offshore intakes that include El Segundo, Huntington Beach, Ormand Beach, Redondo Beach, Scattergood and San Onofre Nuclear Generating Station (SONGS) employ velocity caps on the intake pipes that have been demonstrated to reduce impingement of fish by 90 percent or more (Thomas, G.L., 1980,). Additionally SONGS employs use of an effective fish return system (Love, 1989). Huntington Beach and Redondo Beach have used fish rescue and return

procedures to reduce impingement mortality (MBC, 2006). Wetland restoration is being used or planned by the California Energy Commission (CEC), California Coastal Commission (CCC) and Regional Water Quality Boards to mitigate entrainment and impingement losses at SONGS and four other OTC generating facilities that have recently re-powered or have completed the re-powering licensing process (Huntington Beach, El Segundo, Morro Bay and Moss Landing). Details of these projects are readily available as part of the publicly available CEC licensing record for these facilities.

**Table 2 – Currently Planned or Implemented Technologies, Operational Measures or Restoration Measures at California Coastal Generating Stations**

| California - Once Through Cooling Power Plants | Comments |
|---|---|
| Contra Costa | Flow reductions for fish protection have already been implemented sufficient to comply with the federal Rule for entrainment. These reductions have been achieved through a combination of actions that include Unit retirements, installation of variable speed drive pumps, flow caps and use of closed-cycle cooling. |
| El Segundo | Use of submerged offshore intake with a velocity cap for impingement. |
| Huntington Beach | Use of submerged offshore intake with a velocity cap for impingement. Use of restoration measures to offset entrainment for Units 3 and 4. |
| Morro Bay | Detailed plan of restoration measures including benefits and cost evaluations to offset entrainment losses adopted by Central Coast RWQCB for re-powering project |
| Moss Landing | Use of restoration measures to offset entrainment losses fully and successfully implemented through Elkhorn Slough Foundation. |
| Ormond Beach | Use of submerged offshore intake with a velocity cap for impingement. |
| Pittsburg | Flow reductions for fish protection have already been implemented sufficient to comply with the federal Rule for entrainment. These reductions have been achieved through a combination of actions that include Unit retirements, installation of variable speed drive pumps, flow caps and use of closed-cycle cooling. |
| Redondo Beach | Use of submerged offshore intake with a velocity cap for impingement. |
| Scattergood | Use of submerged offshore intake with a velocity cap. |
| SONGS | Use of restoration measures for entrainment, use of submerged offshore intake with a velocity cap to reduce impingement and fish return system for fish avoiding velocity cap protection. Aquaculture and stocking of white seabass to offset intake effects. |

## Comments

Comments on the Proposal are organized as follows:

A. Proposed Performance Standards and Alternative Fish Protection Technologies and Operational Measures

B. Importance of Considering Proposal Benefits

C. Calculation Baseline

D. Restoration (note: should be allowed for IM, and should allow other than APF method)

E. Monitoring Requirements

F. Threatened and Endangered Species.

G. Other Comments

H. Summary of Key Points

I. Literature Cited

### A. Proposed Performance Standards and Alternative Fish Protection Technologies and Operational Measures

Fish protection technologies and operational measures is an area where EPRI has done and continues to do extensive research. EPRI provided numerous documents, comments and testimony during the rulemaking for 316(b) on fish protection technology research and this area of research continues to make up the largest component of the 2006 and planned 2007 316(b) related research program. Comments on the Proposal's performance standards and implications for available fish protection technologies and operational measures are as follows.

Technology Performance - General

While the Rule proposes performance standards as ranges (i.e. 60%-90% for entrainment and 80%-95% for impingement), the Proposal requires adherence to specific technologies or numeric standards. The only flexibility in compliance allows facilities to demonstrate that if only a 60% reduction can be achieved with technologies, restoration measures can be used to reach the required 90% reduction. However, it is important to note that the demonstration is based on showing that alternatives such as closed-cycle cooling or flow reductions are not feasible. EPA explains the basis for using a performance standard range in the Rule on page 41598 in the preamble to the Rule. The range is based on the observed performance variability of alternative fish protection technologies. There are a finite set of available technologies to reduce impingement and an even more limited set of alternatives to reduce entrainment. Many

technologies would be immediately excluded by the proposed policy and others will be infeasible for use in California as discussed in the comments below.

Entrainment Technology

Since entrainment reduction technologies generally address impingement as well as entrainment, and since entrainment is viewed as the more significant issue in California, these alternatives are considered first. There are basically six alternatives for entrainment reduction that are considered in the Rule potentially applicable to California's coastal generating facilities. Each of these is briefly discussed.

- Aquatic Filter Barrier (AFB)

  This technology has only been deployed at one facility, the Lovett Generating Station on the Hudson River, in the U.S. in a full-scale installation and has yet to be demonstrated to meet the Rule's performance standard. The first year the system was deployed at the it developed a large tear during the test. In the second year water was observed flowing over the top of the AFB in the summer and no results have been made available for a full spawning season to fully evaluate performance. Based on the problems with this technology in a river it is not considered to be feasible in open ocean environments and is precluded from use at nearly all, if not all, inshore facilities due to the size of the AFB that would be required and the fact that it would present an obstruction to navigation.

- Use of Collection and Handling Systems

  These systems would effectively be eliminated from consideration under the Policy. The reason being is that it is highly unlikely that some fragile commonly entrained species (i.e. northern anchovies, sardines, croakers, etc.) would have survival rates that would meet the performance standards even at 60%. PG&E conducted studies in 1981 (LMS, 1981) to evaluate survival rates of entrainable sized fishes using various mesh sizes and materials as well as variable intake velocities. While the results determined immediate survival rates of up to 80% for hardy species such as California grunion, results for this species were 47% survival when handling after immediate impingement survival was considered. Results were much lower for northern anchovy, a fragile species. In this case immediate survival off the screens was determined to be 40% with no survival when handling was considered. While there may be some improvement in performance based on current improvements in this technology it is highly unlikely that fragile species will achieve survival rates of the minimum 60% required, let alone the 90% reduction required by the high end of the range. In addition, for many facilities such as Alamitos, Haynes, Huntington Beach, El Segundo, and Scattergood long transport distances (over a mile for some of these facilities) would be required to return impinged or entrained organisms to a location in coastal waters where they would not be subject to reimpingement or re-entrainment.

- Narrow Slot Wedgewire Screens

  Narrow Slot wedgewire screens would automatically meet the proposed impingement

standard since they are designed to have a velocity that would not exceed 0.5 fps. EPRI However, there are feasibility issues with this technology. The first is marine biofouling. These systems have not been employed at any existing power plants located in marine environments on either the east or west coast. The size and distance of the OTC intake tunnels exceed the capacity of the air blast system currently designed to control fouling and debris on the surface of the screen modules. Design changes will be necessary to address fouling both inside the intake tunnels and at the surface of the modules. Secondly, for many facilities such as Alamitos and Haynes the distance required for deployment (i.e. over a mile) will preclude use of this alternative. Thirdly, for other facilities, such as the Harbor Generating Station (HGS) due to its location in a closed harbor area, the technology may have difficulty meeting the performance standard. This is due to the lack of tidal currents to carry entrainable organisms past the screen modules. Studies in a tidal estuarine environment on the east coast screen slot widths of 1, 2, and 3 mm. Study results determined that no fish 5 mm or less in size were excluded. However, more than 80% of the larger ichthyoplankton were excluded (Weisberg, 1987). Currently a number of California's coastal facilities are evaluating the cost and effectiveness of this technology. The results of these evaluations will be available in the latter part of 2007.

- Flow Reductions

  Flow reductions achieved either through limiting operation of existing cooling water pumps or installation of variable speed drive pumps are a means of meeting the proposed performance standard. However, this option has the significant disadvantage of reducing the maximum power generation at a facility. Nearly all of California's fossil generating units have capacity factors less than 50%. Capacity utilization of these units has been reduced to periods when electric power generation demand warrants generation. Use of this option has the potential to significantly reduce available generation in California during peak power demand and could have significant impacts to supply necessary power to the grid when most needed .

- Closed-Cycle Cooling

  Use of wet or dry closed-cycle cooling by definition results in compliance with the federal Rule and would also achieve compliance under the Proposal. However, this is by far the most costly technology option as a result of very high capital and O&M costs. EPRI Solutions is currently in the process of developing cost estimates to retrofit California's facilities affected by the Proposal. These costs can be significantly higher than the cost of installation of closed-cycle cooling systems at new facilities depending on the layout of the facility and water piping distances. This option also has the disadvantage of loss of some generation capability as a result of the energy requirements to operate the cooling towers and loss of efficiency as a result of reduced condenser cooling efficiency. These systems also have their own environmental disadvantages that include impacts to air (i.e. from replacement power at other facilities to offset lost generation), water quality from blow down in wet systems, salt drift, foam and noise. EPA did base the Phase I Rule for new sources on use of closed-cycle cooling. However, while EPA evaluated requiring closed-cycle cooling retrofits under three of the options

considered for existing facility Rule (pgs. 41605 – 41607) it decided not to base the Rule on this option due to high cost, lack of cost-effectiveness and impacts to National energy supply.

Impingement Technology Performance

Generally for impingement, since protection is focused on larger organisms, more options are available and the cost of technologies is generally lower. However, the options provided in the Proposal will present significant issues for most of California's OTC facilities. The following categories of technologies are either not available in California or will not meet the 95% impingement mortality reduction criteria.

- Behavioral Devices

  Due to the size and swimming ability of most impinged fishes they are able to detect and respond to lights and sounds. EPRI is currently in the process of conducting tests on these devices in fresh water on the east coast. It has previously been determined that while some species of fish respond to such devices others do not. Testing of various behavioral devices was performed by Southern California Edison relative to the San Onofre Nuclear Generating Station (SONGS). Results of the light study tests were published in the peer reviewed literature ((Jahn and Herbinson, 2000). In this study light was being evaluated for the purpose of improving the effectiveness of the overall SONGS impingement fish protection system. In this study some level of response for some species but not at 80% -95% reduction levels in the federal Rule or the proposal's 95% impingement reduction level. Laboratory studies were also conducted on use of acoustic signals at the Redondo Marine Laboratory and made available to the California Coastal Commission for review (Sonalysts, Inc., 1995). These studies focused on a number of offshore species that included northern anchovy, sardines, white croaker, kelp bass and walleye surfperch. These studies did elicit a response from all five species tested with low frequency sound and responses were achieved at the 95% level for croaker, walleye surfperch and kelp bass based on their circular swimming pattern in the test device. It is thought that many offshore species may have developed the acoustic response mechanism in response to use of sound by predatory marine mammals that use sound to find prey. While results are promising there are no data for in shore species. Issues have also been raised relative to this technology on potential impacts to marine mammals.

- Diversion Systems

  Such systems take advantage of waterbody flow to guide fish to a location away from the intake or to an area where fish can be collected and transported to a safe area. Rivers are generally the ideal waterbody type for this option due to the continuous unidirectional water current. However, due to slack tides and variable current patterns along the coastline such options are not generally feasible for California's coastal facilities, especially at the 95% performance range.

- Fish Collection and Handling Systems

While many such systems are currently in operation around the U.S. there are none in operation in California. The effectiveness of these systems for entrainable life stages varies with species. While these systems may be very effective for some species, due to the presence of fragile species both in shore and off shore it would not be expected to meet the 95% standard set in the Proposal. In addition, as discussed for the fine mesh version of this technology, for many facilities the long distances required to transport fish to a location where they will not be subject to re-impingement will result in additional mortality and feasibility issues.

Velocity Reductions

Proposal alternatives for impingement include reducing impingement mortality by 95%, installing closed cycle cooling or reducing the maximum through screen design flow to not exceed 0.5 fps. There are a limited number of options to meet the 0.5 fps criterion for California's coastal facilities as follows:

a. Expand the Intake Structure to Add More Travelling Screens

b. Install a Barrier Net

c. Install Wide Slot Wedge-wire screens

d. Reduce Flow

While these options may be feasible for a small number of facilities, for others this level of reduction could only be achieved at costs in the millions of dollars.

Zooplankton Entrainment Control

The Proposal appears to consider zooplankton entrainment as part of the entrainment community to be protected. It is important to recognize that none of the alternative fish protection technologies that EPA considered in the Rule are designed to protect zooplankton. Many species of zooplankton are less than a millimeter in size. Thus the only alternative for compliance even to reach the minimum 60% reduction for zooplankton entrainment will be use of flow reduction measures. Specifically facilities will be limited to reducing annual average flows by 60% to 90% or retro-fitting with wet or dry closed-cycle cooling. It is also important to consider that unlike larval fish, zooplankton are encased in chiton exoskeletons (and silicon shells) which provide significant protection from entrainment mortality. A further discussion of zooplankton reduction benefits is provided below.

Summary of Available Technologies Under the Proposal

Under the Proposal, facilities would be left with either significant flow reductions and associated reduction in generation available to meet peak energy demand or use of closed-cycle cooling retrofits. The costs of retrofits, based on currently available estimates for the Diablo Canyon Power Plant (DCPP) and SONGS will be over a billion dollars each for these facilities alone. Based on recent peak energy demand in California, the Proposal would pose electric power generation supply issues for the State.

## B. Importance of Considering Proposal Benefits

One of the most significant deviations in the Proposal from the Rule is that any consideration of the environmental benefits of meeting applicable performance standards is not allowed. The proposal neither discusses nor demonstrates the benefits of the deviations from the Rule. For entrainment, the proposal allows facilities to meet a minimum 60% reduction in entrainment through use of technologies and/or operational measures. However, to be allowed to use a 60% reduction there is a requirement to "demonstrate to the Regional Water Board that no combination of operational and structural controls can feasibly achieve the 90% reduction in entrainment". As discussed previously there are currently only two confirmed options that will achieve a 60% or 90% reduction. These are flow reductions and use of closed-cycle cooling retrofits. The Rule was specifically designed to ensure that no significant disruption of energy supply would result or that facilities would be required to install closed-cycle cooling unless the cost of retrofitting was not significantly greater than the benefit. It was the Cost-Benefit Test that specifically ensured these consequences would not be an outcome. The Proposal appears to consider flow reductions of 90% and retrofits generally feasible. Thus, unless a facility cannot retrofit due to space or a public safety issues, such as proximity to an airport, the 90% standard appears to apply.

In light of the potential California energy supply issues or potential costs of billions of dollars to comply with the Proposal, it is important that the environmental benefits to California's coastal fisheries and ecosystems be considered. EPA explicitly determined in the NODA that the costs of implementing the Rule would be substantially greater than the benefits to Pacific coast fisheries.

Impact Sources to Fishery Populations

Moreover, the benefits of compliance with the Proposal can be shown to be quite small compared to the benefits of reducing other types of impacts on marine and coastal ecosystems. A recent report prepared by the Pew Oceans Commission, a blue-ribbon panel chaired by former Congressman and White House Chief of Staff Leon Panetta, summarized scientific information and policy options for dealing with nine major threats to marine resources (Pew Oceans Commission, 2003). Among the most important of these threats are overfishing, nutrient enrichment, and introductions of non-native species.

Overfishing has had severe, and in some cases irreversible impacts on marine ecosystems throughout the world (Dayton et al., 2003). For example, the world-wide abundance of large, predatory marine fish has been reduced by approximately 90% since 1970 (Myers and Worm, 2003). These reductions in predator abundance have led to indirect effects on the structure and function of marine food webs throughout the world. Additional impacts on marine resources caused by fishing include bycatch (discarding of unwanted fish caught in trawls and seines) and habitat destruction due the physical impacts of the fishing gear on reefs and other bottom substrates (Dayton, 1998).

Nutrient enrichment has caused or contributed to major changes to fish communities in many waterbodies. Nutrient enrichment causes oxygen depletion and fish kills. Nutrient enrichment also contributes to blooms of toxic algae that kill large numbers of fish and, in some cases,

contaminate fish and shellfish so that they are toxic to humans (Anderson et al., 2002). The Pew Commission documented 44 U.S. estuarine and coastal areas that suffer from excessive nutrient enrichment (Boesch et al., 2003). Although the majority of these areas are along the Atlantic and Gulf of Mexico coasts, the commission included four California estuaries on its list: Tomales Bay, San Francisco Bay, Elkhorn Slough, and Newport Bay.

Introductions of non-native species have had catastrophic impacts on many waterbodies. Introduced species have been shown to alter interspecies interactions, to induce changes in nutrient cycling and energy flow, and produce unpredictable effects on food webs (Ruiz and Carlton, 2003). San Francisco Bay alone supports more than 175 introduced species of marine invertebrates, fish, algae, and higher plants (Carlton , 2003).

Although there have been significant changes in fish populations along the California coast mostly due to overfishing, other factors including changes in water quality and warmer ocean temperature regimes have been associated with changes in these populations starting in 1976 (Holbrook et al. 1997). Shifts in fish populations have been well-documented from southern California where large increases in human population have undoubtedly contributed to the changes (Horn and Stephens, 2006). Although there is no evidence that power plant OTC has caused or even contributed to these changes, especially since most of the power plants in southern California have been operating since the 1950s (a large number of units were added at many facilities in the '60's), the confluence of factors that could potentially affect fish populations make it difficult to separate the potential effects of OTC from other factors (Englert and Boreman, 1988).

The many factors that can affect fish populations in California are exemplified by the population declines in striped bass and other species in the Sacramento and San Joaquin estuary. Impacts to the estuary's fish populations are occurring from many potential sources, including water exports, pesticides and herbicides, invasive species, and over-harvest and poaching of recreational and sport harvested species (CalFed, 2000). To mitigate for OTC effects from the Pittsburg and Contra Costa power plants, the estimated number of striped bass entrained and impinged by the plants were reared in culture and returned to the estuary. This did not result in any effects on striped bass populations, which continued to decline. If the cooling water withdrawal of these two power plants had in fact played a role in the decline of the estuary's striped bass populations, (or analogously any entrained species population), the replacement of the striped bass that were entrained and impinged should have resulted in an increase in sport harvest. Intensive monitoring of striped bass populations and other populations have shown continued declines to the present time, reaching critical levels in several populations. These declines have occurred despite a nearly eighty percent reduction in the amount cooling water used by the power plants in recent years.

Once Through Cooling Influence on Fishery Populations

There are few examples in California of long-term data that can be used to look at effects of OTC on fish populations independent of other anthropogenic impacts. The Diablo Canyon Power Plant (DCPP) is located in central California where coastal fish populations are more isolated from wastewater and watershed development impacts present in other areas of the state. The DCPP is also unique in having long-term data on adult fish populations that start in 1976, nine

years before the plant began operating (PG&E, 1988). The DCPP also has a cooling water volume of 2.5 billion gallons per day, the largest in the state, and has a capacity factor greater than 90% since it began operating in 1985. If OTC was causing changes in fish populations they should be detectable from the areas around DCPP. This has not been the case. Long-term monitoring of adult fishes in control areas not affected by the power plant thermal discharge show no changes over time that are coincident with the start of plant operation and could be caused by entrainment of fish larvae (Ehrler et al., 2003). In addition, long-term data from sport fish party boats show no changes in catch per unit effort over the period of plant operation that could be attributable to power plant entrainment.

The DCPP long-term monitoring data and independent fisheries-specific data show no changes that could be attributable to plant operation; however, what does become apparent from a review of the data are the changes bought about due to fishing pressure and fishing regulations. When a trap fishery in shallow nearshore areas started in the area around 1990 there was a decline in targeted species such as cabezon and rockfishes apparent in the monitoring data. There have been increases in the abundances of cabezon at the monitoring stations since controls were placed on the fishery in the late 1990s (Tenera Environmental, 2006). This type of population response and recovery would be unlikely if entrainment of the larvae of these species by the DCPP intake was having a large effect.

Impingement in the Context of OTC Usage

Unlike power plants on the east coast, the number of fish impinged at nearly all of California's power plants is relatively low. This is documented from the results of recent studies and also in statements from Regional Water Quality Control Board staff:

- Morro Bay Power Plant – "The evidence supports the conclusion that impingement impacts of the Project are not significant either in the absolute sense or relative to the existing plants."[1]

- Diablo Canyon Power Plant – "Regarding impingement of adult fish in the intake structure, the number of fish lost per year is so minor (a few hundred fish per year) that intake structure modifications or operational changes are not necessary. These losses are already minimized pursuant to Clean Water Act Section 316(b)."[2]

Nearly all of the plants in northern California have shoreline intakes with conventional bar racks and 3/8" mesh traveling screens. The plants either do not heat treat their intake tunnels or heat treat very infrequently due to their current operating characteristics. A plant on the open ocean like Diablo Canyon has very low impingement due to the low intake velocities and strong swimming ability of the fishes out on the open exposed coast. Total annual impingement of

[1] Central Coast Regional Water Quality Control Board. Draft Waste Discharge Requirements. Order No. R3-2004-0028 NPDES No. CA0050610 For Duke Energy, Morro Bay, Morro Bay Power Plant, Units 1 and 2. December 2, 2004.

[2] Central Coast Regional Water Quality Control Board. Staff testimony for regular meeting of July 10, 2003 Pacific Gas and Electric Company's Diablo Canyon Power Plant renewal of NPDES Permit Prepared on June 6, 2003

fishes is the approximate equivalent of the fishes caught during four party boat trips. Plants in more protected harbors and bays such as Morro Bay and Moss Landing generally have higher impingement. In southern California, plants with offshore intakes are fitted with velocity caps. Studies done at Huntington Beach and Ormond Beach Generating Stations in late 70s and early 80s show that the velocity caps can reduce impingement by upwards of 90%

Not allowing any consideration of environmental benefits is especially burdensome in the absence of any consideration of the environmental benefits of meeting the 95% impingement reduction performance standard in the Proposal. As previously noted, all of the offshore facilities have installed velocity caps for the purpose of fish protectionand previous studies have shown that this technology can achieve a reduction of approximately 80-90%. This is sufficient to comply with the Rule and many of these facilities are in the process of conducting studies to confirm the level of performance at their facilities. However, this technology is not expected to achieve the 95% reduction required by the Proposal. An additional reduction of 75 fish per year would be required for El Segundo and 525 fish per year at Huntington Beach to achieve a 95% reduction. Yet the potential cost to achieve this level of reduction due to the current intake design is likely to be in the range of millions of dollars and tens or hundreds of thousands of dollars per year in O&M costs depending on the option selected to achieve the additional 15% reduction. The effect of the current draft Proposal that does not allow for any consideration of benefit will result in very high costs with very small, or no, benefits for most of these facilities.

Entrainment in the Context of OTC Usage

The South Bay Power Plant (SBPP) and Encina Power Station (EPS) entrainment studies, in addition to relatively recent studies at DCPP, Huntington Beach, Morro Bay and Moss Landing, provide sources of information to evaluate entrainment associated with power plant operation. The results of these studies indicate there is simply no evidence suggesting that impingement or entrainment is damaging fish populations in California's coastal waters. At every one of the facilities with data from previous intake studies, some over three decades ago, not only was there no evidence of any present day damage, the source water communities of entrained fish and invertebrate larvae were remarkably unchanged. Independent scientists consulting to the Central Coast RWQCB made specific finding of this nature in their final review of the Moss Landing 2000-2001 316(b) studies of the Elkhorn Slough, Moss Landing Harbor and Monterey Bay source water in comparing them to their own study findings from 1977, a period of nearly three decades.

Specific examples regarding the lack of entrainment impacts from OTC usage include:

- South Bay Power Plant

  Studies at the South Bay Power Plant showed very little change in annual estimates of goby larvae entrainment between studies in 1979–1980 and studies in 2001 and 2003, even though they are entrained in greater numbers than any other fish. The absence of any long-term changes in larval productivity is supported by abundance data on adult gobies from an independent study that showed increases in the population through the time period from 1994-1999.

- Encina Power Station

  Recent studies at the Encina Power Station (EPS), which draws water from Agua Hedionda Lagoon (AHL), showed that goby larvae were entrained in higher numbers than other fishes and comprised 62% of the total fish larvae entrained[3]. Monthly densities were typically several thousand per 1,000 m3 in the inner and middle portions of the lagoon, over 1,000 per 1,000 m3 in the outer lagoon, and less than 100 per 1,000 m3 in the nearshore zone. Slightly lower concentrations were measured in the earlier 316(b) study done in 1979 (SDGE 1980), with goby concentrations averaging almost 500 per 1,000 m3 in lagoon samples and 30 per 1,000 m3 in nearshore samples. The higher densities in the recent study indicate that the goby population in AHL has not changed considerably over time and not been adversely affected by the operation of EPS. The higher densities are noteworthy since infilling of the middle and inner lagoons and development of sandbars at the western edge of the inner lagoon (MEC 1995) have contributed to a reduction in total habitat area in recent years.

  In contrast, densities of blenny larvae of 1,000 per 1,000 $m^3$ in the outer lagoon during the recent study were much greater than the densities of 67 per 1,000 $m^3$ from the earlier 316(b) study. The increase in larval blennies in AHL over this time period probably reflects the establishment and expansion of aquaculture operations that provide additional habitat for these fishes. The study results for blennies contrasts with the results for gobies that showed only slightly increased densities in the recent study. Whereas the habitat for gobies has declined slightly since the previous study, the habitat for blennies has increased significantly with the placement of artificial habitat in the outer lagoon.

  The dependency on habitat more than larval supply is shown by results from supplemental studies on adult gobies in AHL done during the recent 316b study. Results showed large numbers of new recruits in mudflat areas in spring. By late summer the numbers had decreased indicating density dependent mortality at the settlement stage for gobies. The density dependent mortality is related to the availability of mudflat habitat, which is not affected by power plant entrainment. Overall, densities of adults in AHL were greater than densities of adults measured in nearby Batiquitos Lagoon (Merkel and Associates, 2002) which does not have a power plant intake.

- Diablo Canyon Power Plant

  Long-term monitoring in central California near the Diablo Canyon Power Plant (DCPP), with an OTC volume of 2.5 billion gallons per day, showed declines in some species and increases in others in 10 years of plant operation (PG&E, 1999). Long-term declines may

[3] Tenera Environmental. 2006. EPS Cooling Water System: Entrainment and Impingement of Marine Organisms Effects on the Biological Resources of Agua Hedionda Lagoon and the Nearshore Ocean Environment. (unpublished data).

be attributed to a climatic shift and localized fishing, but there is no evidence that larval entrainment has substantially affected local populations that produce planktonic larvae. The health of the nearshore fish populations around DCPP is supported by recent fishery studies showing that the stocks in central California have not experienced the same declines seen elsewhere in the state (Stephens et al., 2006). Both sets of data show striking trends in response to changes in fishing pressure and fishing regulations, but no apparent response to the presence of the DCPP cooling water intake system – the largest single OTC system in California. If OTC is a large environmental problem why are no effects seen in fish populations due to OTC in the pristine area around DCPP with many fewer human impacts than other areas of the state.

- Moss Landing Power Plant

  A Central Coast Regional Water Quality Control Board Staff Report on the Moss Landing Power Plant NPDES Permit from May 15, 2003, long-term studies on the fish fauna of Moss Landing Harbor and Elkhorn Slough by researchers at the Moss Landing Marine Laboratories showed "…in general, the species composition and overall densities of the dominant fish larvae appear to have remained fairly similar, with some species of fish larvae being considerably more abundant in 1999-2000 than in previous decades. The main categories of fish larvae exhibiting higher densities were gobies, the Pacific herring, Pacific sand lance, staghorn sculpin, white croaker, true smelts, and blennies." Although the Moss Landing Power Plant OTC was proposed as a cause of some of the changes that were observed, "…the intakes for that plant are in Moss Landing Harbor, and there is no evidence *that water from Elkhorn Slough specifically was entrained in sufficient volume to cause these changes in the ichthyofauna."* Changes in the Elkhorn Sough and Moss Landing Harbor ichthyoplankton, as shown from the results of changes in gobies from the Encina Power Station, primarily result from physical changes in habitat over time. "*As the slough's habitats have been modified (e.g. through tidal scour and erosion, especially of the tidal creeks, but also the main channel), the fish assemblages and their use of these habitats also have changed. Thus, the main reason for these changes in the Elkhorn Slough fish assemblages is erosion and the subsequent shifting of sediment…"*

Value of Historical Studies

In addition to the entrainment studies currently in progress, there are historical studies that provide for valuable comparisons with current study results and identify potential changes in fish populations due to power plant entrainment. The report on effects of OTC published by California Energy Commission in June 2005, states that IM&E studies done in the 1970s and early 1980s "…usually concluded that the cooling system had no or minimal adverse impact on the environment, and Water Boards generally accepted these conclusions. Foster (2005) concluded, however, that while the impingement studies generally provided accurate impact estimates, nearly all of the entrainment impacts in these early studies were poorly assessed, most often due to problems with study designs and sampling methods. Conclusions of "no adverse impacts" were generally unjustified." The IM&E study done at SONGS under the direction of the Marine Review Committee in the early 1980s was cited as an exception. Contrary to the statements in this CEC review of power plant studies, there were well-designed IM&E studies done in the 1970s. Two examples are the South Bay Power Plant and Encina Power Station,

which combined entrainment and source water sampling similar to the approaches later used at SONGS and DCPP. In fact, the study at the SBPP was used in a scientific journal article that was the foundational basis for the ETM approach promoted by the CEC Report as "state-of-the-art".

OTC Assessments in Other US States

The State of Maryland has spent millions of dollars through their Department of Natural Resources on the largest power plant research program in the U.S. After many years of studies they have concluded that power plant water withdrawal has had no identifiable impact on Chesapeake Bay fisheries even though the volume of OTC withdrawal from the bay is greater than any other estuarine area in the United States. Other examples from the east coast of definitive studies on OTC with long-term data collected by numerous research groups include:

- Hudson River studies showing that the striped bass spawning population increased by 10X in spite of 6 power plants employing OTC technology to withdrawal more than 5 billion gallons per day (Barnthouse 2000).

- Studies showing that the annual production of juvenile striped bass in the Delaware River grew from nearly zero in the early 1980s to more than 1,000,000 fish per year by 1990 (Kahn et al. 1998). This exponential population growth has been attributed to improvements in water quality, and occurred despite the operation of the Salem Generating Station (more than 1 billion gallons per day) and other OTC power plants withdrawing water from the Delaware.

- The Connecticut Yankee Nuclear Station located on the Connecticut River, a tidal river, was retired from service several years ago. Studies conducted prior to, during and after retirement showed no changes in fish populations that could be attributed to plant operation.

It is important to remember that the numbers of larvae produced by most fishes during their reproductive years as adults can be enormous, but only two of those larvae need to survive to adult to maintain a stable population level. For example, California halibut may release as many as 50 million eggs per year over a period of greater than 20 years, and rockfishes may release up to one million larvae per year for several years to decades depending on the species. Other species such as gobies produce only a few thousand larvae per year over a much shorter lifespan, but even in these fishes, the total lifetime survival required to maintain the population is less than 0.1%. The incremental losses of larvae due to OTC do not have any measurable effect on fish populations because they are adapted to living and reproducing in highly variable environments where the natural rates of mortality are very high and vary from year-to-year. The variation is much larger than the levels of entrainment mortality that operate on small subsets of the total coastal populations of these fishes.

Despite the large numbers of larval fish that are entrained, there is no scientific basis in population dynamics or fisheries management policy and practice to expect adverse effects on the populations. More importantly, there is no evidence from previous 316(b) studies or information presented in the Proposal that OTC has caused or is, at present, causing significant

adverse effects on California coastal fish populations. Though the absolute numbers of larvae entrained seem enormous, these losses comprise very small fractions of the populations at risk to entrainment. From a population sustainability perspective, the mortality imposed on larval populations by entrainment at OTC power plants is negligibly small compared to mortality levels of concern in fishery management. The California Department of Fish & Game has stated (CDFG 2002) in their Nearshore Fisheries Management Plan that an overfished stock is one that has been reduced to 30% of its unfished biomass and that controls would need to be enacted whenever a stock is reduced to 60% of its unfished biomass. The designs of recent entrainment studies are based on similar principles of fishery management and provide estimates of the numbers entrained (harvested) as percent of the total larvae at risk to entrainment (catchable). In these studies, the entrained fractions typically average between 2 and 10 percent of the estimated larval source populations. For many species, the average mortality level is much lower. These source populations represent, for most species, only small fractions of the total annual larval production by the adult spawning population. Because most of the spawned larvae are never susceptible to entrainment, the population-level mortality rates are likely to be much smaller than the mortality rates estimated in typical entrainment studies. Even the 2-10% mortality measured in typical entrainment studies is very small compared to the fishing mortality required to reduce a fish population to 60% or less of its unfished abundance. For many this scientific fact is difficult to comprehend or is philosophically at odds with their ideas of preservation.

In addition, the arguments presented by State Board, California Energy Commission, and California Coastal Commission staff and members of the environmental stakeholder groups ignore the role of compensation (density dependent predation and recruitment) in maintaining these populations. An important example is the observation on gobies from Agua Hedionda Lagoon. In the case of gobies there appears to be strong density dependent mortality at the stage when the fishes recruit onto the mudflat habitat they will occupy as adults (Brothers, 1975). There is only so much space for goby burrows on the mudflat and all of the juvenile gobies that are unable to find suitable available habitat are probably prey for larger fishes. The adult population of gobies has very little dependence on larval supply, but is very dependent on habitat availability. Similar density dependencies have been shown in other temperate and tropical reef fishes. Estimates of the strength of density-dependence are now frequently used to inform fisheries management decisions. For example, recent stock assessments for cabezon and kelp greenling, prepared for the Pacific Fisheries Management Council, include an explicit model of density-dependent population dynamics (Cope and Punt, 2005; Cope and Punt, 2005). Although the relative effects of density-dependence have been debated (Rose et. al., 2001), there is a strong theoretical basis for its importance.

An equally important statistic from both the past and most recent entrainment studies is that the majority of the larval fish entrained are from species that are not commercially or recreationally important and therefore are not harvested. Since they are not harvested, the low levels of mortality imposed by entrainment are being imposed on populations that are at a level close to the natural carrying capacity of the coastal environment. The mortality due to entrainment would not affect such populations. In fact the loss (or cropping) of early life stages in populations limited by food or space generally leads to faster growth and higher survival of subsequent life stages; another reason why reductions in entrainment losses of larval fish will not be followed by observable increases in source water populations.

The lack of evidence of environmental impacts from OTC explains why industrial cooling water remains a significant and compatible beneficial uses in coastal and bay basin plans. The State's power plant siting policy with preference to power plants that use ocean water rather than freshwater for cooling is as environmentally sound today as it was when it was first created. All of the State's approved water quality basin plans for bays and estuaries explicitly recognize the compatible, beneficial use of the water for industrial cooling The current studies being conducted under the new 316b Rule will undoubtedly provide many other examples that OTC is not resulting in significant impacts to nearshore populations. Unfortunately, the State Board is moving toward implementing a policy without any definitive studies on the effects of OTC. However, California's coastal generating facilities are currently conducting impingement and entrainment studies. Studies conducted at most of these facilities include source waterbody sampling that will allow use of the ETM model. These studies will provide quantitative information on the current level of entrainment for each facility that should provide information to quantify the affects of entrainment on marine fish populations and the level of environmental benefits that would be achieved as a result of a California Policy more stringent than the federal Rule.

Ecological Impacts Associated with OTC

The Proposal indicates that entrainment studies will be performed each permit cycle and include entrainment and source water sampling for ichthyoplankton and zooplankton. Furthermore it prescribes that data be sufficient to provide reasonably accurate estimates of Adult Equivalent Loss (AEL), Fecundity Hindcasting (FH), and be used in the Empirical Transport Model (ETM). While some shellfish larvae have been included in recent and current studies of CWISs in California, zooplankton are not included in the current studies and historically have not been included in entrainment studies. The basis for including zooplankton may be statements made in the California Energy Commission (CEC) June 2005 Report on power plant impacts (Foster 2005). The report and statements made in Dr. Foster's presentations to the State Board indicate that the current sampling, by focusing on fish larvae, is only accounting for a tiny fraction of the total number of organisms being entrained.

While this is true, the report also states "Adults and other stages of small planktonic invertebrates (e.g. copepods) and phytoplankton (e.g. diatoms) are generally not sampled due to their small individual size and the assumption that because their large population sizes and rapid growth and reproduction, ecologically important impacts are unlikely" (Appendix A Entrainment Impacts in Impacts Analysis Section).

Zooplankton and phytoplankton have not been included in entrainment studies for good reason. As stated in Dr. Foster's report the potential for impacts to these organisms is limited. This has been supported by studies at many east coast facilities on impacts to primary (phytoplankton) and secondary (zooplankton) producers as a result of entrainment. For example, field and laboratory studies of entrainment impacts on phytoplankton and zooplankton were conducted at the Roseton, Indian Point, and Bowline Point plants on the Hudson River during the 1970s (Central Hudson et al., 1977). Thermal tolerance studies showed that mortality of most species was less than 10%, except at high discharge temperatures. These temperatures would be expected to occur only occasionally, and only during the summer months. Field studies conducted at all three plants demonstrated no differences in microbial respiration, primary

production, or zooplankton density between near-field and far-field sampling stations.

Studies of OTC entrainment effects on phytoplankton and zooplankton were conducted at Chalk Point Station on the Patuxent River Estuary on the Chesapeake Bay. These findings were summarized in an impact assessment report prepared by the Maryland Department of Natural Resources Power Plant Siting Program (PPRP 1985). In terms of phytoplankton the report significance of findings and conclusions were that effects where limited to the discharge canal and did not extend outside of the allowable thermal mixing zone and that populations recover rapidly (i.e. in hours) from entrainment effects. In terms of zooplankton most of the mortality was associated with chlorine (i.e. during the period when zooplankton studies were conducted Chalk Point continuously chlorinated during the summer). The report states "Without chlorination, through-plant losses averaged 20-30%, but frequently were zero, particularly during colder seasons.

Studies comparing near-field and far-field sampling at the San Onofre Nuclear Generating Station also showed no differences in abundances attributable to power plant operation. In fact, abundances were higher at the near-field stations closest to the power plant.

To reiterate, there is little chance of impacts to phytoplankton and zooplankton for the following reasons:

- 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 off DCPP during 1974-1975 sampling is distributed along the Atlantic and Pacific coasts of North and South America and the Indian Ocean.

- EPA recognized the low vulnerability of phytoplankton and zooplankton in its 1977 draft 316(b) guidance (EPA 1977), which stated that, because of their short life span and population regeneration capacity, these organisms should be less vulnerable to adverse impacts than macroinvertebrates and fish. Larval fishes which make up a minute fraction of the organisms in seawater are studied for effects of entrainment for the following reasons:They have much shorter spawning seasons relative to phytoplankton and zooplankton. In many species, spawning occurs only once during the year.

- Unlike phytoplankton and zooplankton that may be distributed over large oceanic areas, most fishes are restricted to the narrow shelf along the coast and in some cases have specific habitat requirements that further restrict their distribution.

- Unlike many phytoplankton and zooplankton species, there is a greater likelihood of mortality due to entrainment in larval fishes.

In contrast to the perception that entrainment studies focus on larval fishes because they are easier to study, they are actually the focus of study because they are much more vulnerable to the effects of entrainment and there is a greater risk that losses could affect the adult populations in some conditions. It has also been suggested that the process of OTC removes or degrades fish habitat but this argument ignores the following facts:

- There is no physical disturbance to the habitat.
- The cooling water is returned within minutes to the Pacific Ocean.
- The returned cooling water still contains all entrained organisms that continue to be available for consumption by filter feeding fishes, invertebrates, and larval fishes, which are all primary consumers of phytoplankton and zooplankton.
- The capacity of the habitat to produce aquatic life is not reduced.
- Sampling conducted to examine impacts on planktonic organisms in the nearfield of the discharge at SONGS and on the east coast have found these areas to be productive (i.e. similar to far field areas rather than degraded).

Economic Assessments

The Scoping Document discusses EPA's estimates of costs and benefits of the Rule for California. EPA's cost estimate for California's facilities to comply with the Rule is $31.7 million. EPA estimated the economic benefit to California's commercial and recreational fisheries would be approximately $3 million per year. The scoping document points out that "EPA was not able to monetize benefits for about 98% of all species being protected by the Phase II Rule". Therefore the use benefits calculated by USEPA only represent consideration of 2% of species and USEPA specifically recommended using caution in interpreting this information. While monetary estimates are not available for the non-consumptive marine life resources being protected by reductions in IM&E it is obvious that the use benefits dramatically underestimate the overall ecological benefits of the Phase II Rule." A number of comments are offered relative to Scoping Document's economic assessments.

Research is in progress that will help reduce uncertainties and expand the list of species in the EPA assessment. One of the technical issues relative to use of EPA's method for quantification of environmental benefits is lack of information on natural mortality rates for many of the species commonly entrained in California. There is currently data collection in progress under a CEC funded project that will significantly expand the number of dominant species that can be evaluated. These include several species of croaker which is dominant in impingement and entrainment sampling at many facilities in southern California.

A second concern raised regarding EPA's valuation approach in California is that it does not value ecosystem impacts. As discussed in the Ecological Benefits section comments above, effects to phyto- and zoo-plankton have not been quantified and available information from SONGS and east coast studies does not support that they are significant from an economic standpoint and at best are a subject of study.

The Scoping Document expresses concern for not including economic estimates for the majority of species entrained (i.e. only 2% of species included in the estimate). However, this should not be interpreted to suggest that the estimate should be 50 times higher. Reasons for this include:

- For most of the species the number of organisms entrained was extremely small and in many cases amounted to collection of one, two or a few larvae. Due to high natural larval mortality rates (i.e. 98% to 99.5%) such losses are insignificant both from an economic and ecological standpoint as discussed in the entrainment section comments.
- With the exception of croakers, EPA included estimates for the species which make up the vast majority of entrainment both in terms of numbers and biomass.
- EPA's method for estimating benefits used a combination of conservative assumptions. For example, EPA's estimate assumes that all of the forage species such as gobies and blennies after consideration of natural mortality rates that were entrained would have been eaten by commercial or recreational species. This is almost certainly not the case. Gobies are closely associated with in shore coastal wetland habitat and are the single most commonly entrained species. Goby larvae caught in tidal currents and carried offshore and entrained at facilities along the coast are not likely to be transported back into coastal wetlands in any significant numbers to mature and reproduce. However, EPA's estimate, after consideration of natural mortality losses assumes all these larvae would have returned to wetland habitat and become adults.

Gobies are the single most commonly entrained species. Gobies are closely associated with in shore coastal wetland habitat. Gobies caught in coastal currents and carried offshore and entrained at facilities along the coast are not likely to be transported back into coastal wetlands in any significant numbers to mature and reproduce. However, EPA's estimate, after consideration of natural mortality losses assumes all these larvae would have returned to wetland habitat and become adults.

Lastly, the entrainment data on which EPA based its estimates were collected in the late 1970's and most of the fossil generating units had significantly higher capacity utilization and entrainment rates during this period than is currently the case. The entrainment data being collected in 2006 will allow a much more accurate estimate of benefits.

The implication of these comments is that it is not clear that EPA has significantly underestimated the economic benefit of meeting the performance standards. Data is being collected now that will provide a basis for improving the current estimate including data that will allow important species such as croaker and better data for the gobies. It is certainly clear that EPA's estimate of the cost to comply would be a dramatic underestimate under the proposed policy. The high costs to comply under the proposal (i.e. billions of dollars) combined with lack of any quantitative support for significant economic environmental benefits does indicate that use of the Cost-Benefit test or similar consideration of benefits be incorporated into the Proposal.

**C. Calculation Baseline**

There are two important issues raised by the Proposal relative to the Calculation Baseline.

Use of Actual Average Flow

As discussed in previous sections nearly all of California's fossil generation is used for peaking and capacity utilization for these facilities is well below 50%. By requiring facilities to use average annual flow and associated lower economic benefits, these facilities would face the choice of either further flow reductions and impacts to available generation during periods of peak demand or high capital and O&M costs to retrofit. Failure to consider benefits makes use of average annual flows particularly burdensome.

Use of Reference Stations

The use of reference stations under the calculation baseline is unclear. The Rule included use of the Calculation Baseline solely as a means to provide facilities that had already installed fish protection measures or used mitigation to offset impingement or entrainment losses under previous State 316(b) regulatory programs a means to be given credit for those measures. How reference stations would be used to provide such a credit is not clear in the Proposal nor was this explained at the July 31, 2006 Stakeholders Workshop. More explanation is needed on how reference stations would be used under the proposal.

**D. Restoration**

There are a number of ways that use of restoration deviates from the Rule that warrant comment.

Restoration Not Allowed for Impingement

The proposal did not explain the rational for not allowing use of restoration for impingement. The reason provided at the Workshop was due to the wider number of technology options available for compliance compared to entrainment. However, from a practical standpoint, as explained in Section A of the comments the actual number of options for coastal facilities is limited or will be very costly for a relatively small benefit. Based on the relatively small level of impingement at many facilities, restoration measures may be more environmentally beneficial than technologies for many facilities.

Use of Area Production Foregone (APF) for Restoration Scaling

The Proposal mandates that APF be used for determining the size of restoration projects. APF is not applicable to all species or habitats. For example if a facility chose to use direct replacement methods such as fish stocking, the level of replacement needed can be directly determined based just on losses. Moreover, it is important to remember that "Area" does not produce fish – habitat produces fish. APF is only applicable for species associated with specific habitats and where larval production is dependent on the availability of that habitat. If habitat is not limiting then APF will have no relationship with production and the species will not benefit from habitat restoration. Pelagic zone, reefs, mud flats, rocky Intertidal, subtidal habitats all support different species, with different production rates. If APF is used in scaling restoration then the area of the specific habitat for the species being estimated needs to be mapped. The applicability of the method for a given species and the numbers used in the APF calculations need to be carefully considered.

The Proposal, by its focus on impingement and entrainment effects, might not only redirect attention away from addressing California's issues in protecting California's marine and coastal ecosystems, but might also create constraints on the use of restoration and forestall the creation, restoration and preservation of much needed habitat to sustain and rebuild these ecosystems. The wide scale and broad use of restoration by all of the State and Federal resource agencies is clear evidence of its scientific value. It would be a mistake to regard restoration a second-class category of compliance to be used only to close the shortfall of intake technologies. In the absence of any clear scientific evidence of harm to our marine populations and coastal ecosystem caused by seawater intakes, one conclusion is that there are no impacts and another is that the effects are so slight or diffuse we have not observed them. In either case, investments that restore and preserve watersheds and habitat for our state's marine and coastal ecosystems are environmentally superior to investments in intake technologies that require impacts to be occurring in order to be beneficial and, only last for the life of the power plant. Many ecological benefits arise from restored and preserved marine habitats that go far beyond offsetting the entrainment effects of seawater intakes. Phytoplankton and crustacean zooplankton, which have been shown to pass essentially unharmed thorough power plant cooling water systems, are produced in vast quantities marine and coastal habitats. Given the lack of any scientific evidence of seawater intake impacts, it is likely that investment in intake technologies to reduce entrainment would not have the desired beneficial population effect. A number of California's leading marine scientists have recently restated these doubts about <u>any</u> benefit arising from the Proposal at the State Water Board's August workshop. No one at the workshop spoke against the use of restoration as a compliance alternative.

## E. Monitoring Requirements

The Proposal's requirement for impingement sampling is generally consistent with the Rule. However, there are certain aspects of the proposal for entrainment that would be expected to result in extremely high monitoring costs and/or provide little value in terms of compliance decision-making.

<u>Zooplankton Sampling</u>

It is not clear why zooplankton monitoring is being required unless it is the SWRCB's intention to require facilities to significantly reduce actual cooling water flows and/or require retrofits since these are the only options available to reduce entrainment of zooplankton by 60% to 90%. As discussed based on currently available information, these organisms due to high natural reproduction and higher tolerance have not been found to be significantly affected by entrainment based on nearfield studies. In addition the cost of such studies is expected to significantly exceed the cost of larval fish studies.

<u>Level of Sampling for Proposal Options</u>

The Proposal calls for conducting entrainment sampling once per permit cycle. It is suggested that need for additional sampling be based on the nature of the compliance option selected. For example, if a facility were to install closed-cycle cooling or reduce flow commensurate with closed-cycle cooling no additional sampling would be required. It is not clear why such studies

would be necessary using that example. Similarly, why should additional sampling be required if a facility were to install narrow slot wedgewire screens and demonstrated that it reduced entrainment by 90%? It is suggested that the need for additional monitoring each permit cycle once verification monitoring was completed should be determined based on the nature of the compliance alternative or option used.

**F. Threatened and Endangered Species**

There are existing Federal and State laws and regulations in place to protect threatened and endangered species. A new State 316(b) Policy is not needed for this purpose. Marine mammals entrapped by offshore intakes are generally captured and released back to the environment. As discussed these power plants are working through existing regulations to address the rare occasions when marine mammals do not survive. Both Mirant's Contra Costa and Pittsburg Generating Stations have been known to entrain protected species such as Chinook salmon and Delta smelt. Mirant is working through existing federal and state laws and regulations to address potential impacts to these species. In response to concerns over these species Mirant has already implemented significant flow reduction measures as discussed in Table 2.

**G. Other States as 316(b) models for California**

The Proposal discusses and provides an attachment on New York's 316(b) policy. It is currently not clear why the New York was selected and whether other state approaches were also considered as appropriate models for California. New York's 316(b) policy does not, in fact, support the stringent and inflexible requirements contained in the Proposal.

<u>New York</u>

New York policy is driven, to a large extent, by a need to protect aquatic resources of the Hudson River estuary. New York's Environmental Conservation Law was amended in 1987 to establish a Hudson River Estuary Management Program intended to preserve, protect, restore, and enhance the Hudson River estuary (ECL §11-0306). In enacting the amendment creating this program, the New York State Legislature noted that the Hudson River estuary is of statewide and national importance as a habitat for marine, anadromous, catadromous, riverine, and freshwater fish species and that it is the only major estuary on the east coast to still retain strong populations of its historical spawning stocks. Currently, six power plants with once-through cooling operate on the Hudson River estuary. These plants have a total generating capacity of 5.5 thousand MW and a peak cooling water flow of 5.7 billion gallons per day (Limburg et al. 2006). At full flow, the combined daily withdrawals of all of these plants represent approximately 60% of the daily average freshwater flow of the Hudson measured at Green Island Dam (McDowell 1986). According to the Final Environmental Impact Statement (FEIS) prepared by NYSDEC pursuant to SPDES permit applications for the Roseton 1&2, Bowline 1&2, and Indian Point 2&3 generating stations (NYSDEC 2003), these three plants together entrain more than 2 billion fish eggs, larvae, and juveniles annually.

New York's approach to reducing impingement and entrainment for new facilities has been consistent with the EPA Phase I Rule especially on the Hudson River. However, the New York policy has been much less stringent on existing facilities. For these facilities, New York allows

the impingement and entrainment baselines to be calculated using design flows rather than actual flows. Compliance credit is given for any reductions in flow, regardless of whether or not the reduction was intended to reduce entrainment and impingement. In addition, the compliance target at some plants has been set at 80% or lower. In addition, some facilities have been allowed to claim credit for survival of entrained organisms. This approach allows older plants and plants with low capacity factors to use operational modifications and technologies such as variable-speed pumps to achieve compliance. More stringent requirements are placed on existing base-load plants. For example, the draft permit for the Indian Point Nuclear Station requires closed-cycle cooling. This flexible approach allows New York to maintain a stable supply of electric power while reducing entrainment over the long term.

Maryland

The majority of Maryland's generating stations are located on the Chesapeake Bay, the Nation's largest estuary. There is concern over the state of the Bay. The EPA is provided with special funds to address Chesapeake Bay issues. In the Rule (pg 31586, col. 3) EPA says that half of the National estimated annual equivalent age 1 losses (3.4 billion) occur in the Mid-Atlantic where EPA estimates 1.7 billion age 1 equivalents lost. The Maryland Power Plant Research Program (PPRP - provides a function similar to CEC in Maryland) has funded millions of dollars in independent research to evaluate effects of OTC, in addition to studies conducted by the generating facilities. The PPRP 1999 Cumulative Environmental Impact Report (PPRP, 1999) on generation environmental and economic issues states:

- In regard to impingement/entrainment and thermal discharges "Results of these studies show that while operation of individual power plants impact various ecosystem elements in various ways, those impacts, taken together, have had no identifiable substantive cumulative impact on Maryland's aquatic resources to date." and

- "Although large entrainment losses of some types of aquatic organisms have been measured frequently, no consistent depletions in numbers of organisms have been found, or the loss is being mitigated."

**H. Summary of Key Points:**

Based on this review of the Proposal and our current knowledge of the Rule and California's coastal facilities the following summary of key points are offered:

1. The federal 316(b) Phase II rule was finalized after:

   - issuing questionnaires to all affected facilities

   - performing extensive information on the part of EPA and its technical consultants

   - careful review of available technologies and operational measures

   - consideration of both costs and benefits.

The Federal Rule was developed following an extensive process including detailed review of

existing information Currently information is not available to support many of the assumptions being used as a basis for the Proposal . The assumptions include availability of fish protection technologies to reduce entrainment by a minimum of 60% and impingement by a minimum of 95%, significance of impacts to primary and secondary producers (i.e. phytoplankton and zooplankton), a quantitative assessment of the benefits of meeting the proposed performance standards, the extent and magnitude of any cumulative impacts, and the cost of compliance and impacts to California's energy supply.

2. There are a number of proposed deviations from the Federal Rule that are especially problematic to the affected facilities and include:

- No Consideration of Benefits – This is especially significant since the Proposal would leave most California facilities with the option of either retrofitting with closed-cycle cooling or curtailing generation as a result of flow reductions. Due to the high cost of retrofits and limited flow use (i.e. limited benefits) of many of these facility's impacts to California energy consumers and Companies should be carefully evaluated.

- Restrictions on Use of Restoration – The use of restoration for mitigating impingement and entrainment effects can be successfully applied; not allowing use for impingement and limiting its use for entrainment minimizes a sound economic and scientifically sound option. The document appears to assume that due to the wider range of impingement mortality reduction options, facilities should be able to achieve the 95% reduction standard. However, the reality is that due to use of offshore intakes, or intake locations in shallow or navigable waters, options are limited and would be extremely expensive. This is especially important considering the relatively small numbers of fish being impinged and flow use of most facilities.

- Requiring Use of a Minimum of a 60% Reduction in Entrainment Through Use of Technologies and/or Operational Measures – As discussed in these comments due to the location of most California facilities in high fouling environments, use of offshore intakes or intakes in navigation channels or harbors and the distance of facilities from the ocean, few facilities will be able to comply unless they install closed-cycle cooling or significantly reduce OTC flow resulting in an extremely high compliance cost or significantly reduce power generation.

- Requiring use of a 95% Reduction for Impingement – The Policy use of a 95% reduction in impingement mortality should be reconsidered. Many technologies that EPA believed were capable of achieving the performance standard range would not achieve the upper end of that range. In addition, some of those that could meet the range such as wedgewire screens are not feasible at most facilities due to location on navigation channels and distance from the ocean.

- Requiring Zooplankton Studies – The proposal to require zooplankton monitoring would have little value. Available information indicates there would be little environmental benefit. In addition there is currently inadequate time to conduct such studies and comply with the Federal Rule. Further, other than flow reductions such as installation of closed-cycle cooling, there are no technologies or operational measures to reduce zooplankton entrainment and available information indicates the high cost of such studies

is not warranted.

3. California's facilities are currently in the process of collecting necessary information in the form of impingement and entrainment studies and technology evaluations. The results of this information should be considered in any new Policy. The results of studies associated with the Proposal for Information Collection should provide significant information on the current level of impacts to California's fisheries as well as currently available technologies to reduce those impacts.

4. In addition, in the near future the results of the Phase II Rule litigation are expected to be available. Any Policy deviations from the Federal Rule should take into consideration the final litigation decision in order to be consistent with that decision.

5. Due to the Rule's compliance timeline, it is not clear how facilities would have time to comply both with the Federal Rule and the Proposal.

6. Due to the complexity of the Rule the SWRCB may find it beneficial to hold additional stakeholder meetings that focus on topical issues. These might include workshops on feasibility, effectiveness and cost of available technologies and operational measures, use of restoration and appropriate scaling metrics and quantification of economic benefits.

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