Final Draft

316(b) Proposal for Information Collection for AES's Huntington Beach L.L.C. Generating Station

Submitted In Compliance with
316(b) Phase II Regulatory Requirements

July 2005

Prepared by:

Dave Bailey, Associate Director
EPRIsolutions
dbailey@eprisolutions.com

TABLE OF CONTENTS

ATTACHMENTS

A: Restoration Measures
B: Description of HBGS Historical Studies, Physical and Biological Information
C: Proposed Method for Evaluation of Environmental Benefits

List of Acronyms

Board	California Regional Water Quality Control Board, Santa Ana Region
BTA	Best Technology Available
CDS	Comprehensive Demonstration Study
CEC	California Energy Commission
CWIS	Cooling Water Intake Structure
E	Entrainment
EPA	Environmental Protection Agency
HBGS	Huntington Beach Generating Station
IM	Impingement Mortality
NPDES	National Pollutant Discharge Elimination System
PIC	Proposal for Information Collection
QA/QC	Quality Assurance/Quality Control
TIOP	Technology Installation and Operation Plan

List of Figures

EXECUTIVE SUMMARY

This Proposal for Information Collection (PIC) is submitted in compliance with the final 316(b) Phase II Rule (the Rule) for existing electric generating stations published in the Federal Register on July 9, 2004. The PIC provides the Californial Regional Water Control Board, Santa Ana Region (the Board) with AES's plans for:

- providing necessary biological information,
- evaluating alternative fish protection technologies,
- evaluating the Rule's compliance alternatives, and
- providing information on consultations with fish and wildlife agencies.

.

Due to its withdrawal of cooling water from the Pacific Ocean and having a capacity utilization that exceeds 15%, Huntington Beach Generating Station (HBGS) will be required to meet both the impingement mortality (IM) and entrainment (E) reduction standards of 80% to 95% and 60% to 90%, respectively. As a result of conducting recent impingement and entrainment monitoring studies at HBGS associated with repowering of Units 3 and 4, AES plans to rely on those studies for developing the estimates for the IM&E Baseline Characterization.

AES plans to evaluate the full range of compliance options offered by the Rule. The Rule allows use of a credit toward compliance under the calculation baseline for design or operational measures that provide the benefit of fish protection. Previous site specific studies have documented that the use of the submerged offshore intake and velocity cap have reduced impingement to a level that will meet the Rules impingement mortality reduction standard. AES's preferred means to meet the Rule's entrainment performance standard for the HGBS is use of restoration measures. Due to some uncertainty regarding availability of this option for compliance, use of technologies and site specific standards will also be evaluated as discussed in Section 3 of this PIC. The primary technologies that will be evaluated include use of cylindrical narrow slot wedgewire screens and fine mesh travelling screens. This PIC also provides an updated schedule consistent with the Board's approval of the previously proposed schedule submitted in November of 2004.

1 INTRODUCTION

EPA signed into regulation new requirements for existing electric power generating facilities for compliance with Section 316(b) of the Clean Water Act on July 9, 2004. These regulations became effective on September 7, 2004 and are based on numeric performance standards[1]. The Rule at 125.94(a)(1-5) provides facilities with five compliance alternatives as follows:

1. A facility can demonstrate it has or will reduce cooling water flow commensurate with wet closed-cycle cooling to be in compliance with all applicable performance standards. A facility can also demonstrate it has or will reduce the maximum design through-screen velocity to less than 0.5 ft/s in which case it is deemed in compliance with the impingement mortality (IM) performance standard (the entrainment standard, applicable still applies).
2. A facility can demonstrate that it already has a combination of technologies, operational measures, and restoration measures in place to meet the applicable performance standards.
3. A facility can propose to install a combination of new technologies, operational measures, and restoration measures to meet applicable performance standards.
4. A facility can propose to install, operate and maintain an approved design and construction technology.
5. A facility can request a site-specific determination of best technology available (BTA) by demonstrating that the cost of installing technologies, operational measures, and restoration measures are either significantly greater the cost for the facility listed in Appendix A of the rule or significantly greater than the benefits of complying with the applicable performance standards.

All facilities that use compliance alternatives 2, 3 and 4 are required to demonstrate a minimum reduction in impingement mortality of 80% (125.94(b)(1)). Facilities with a capacity factor that is greater than 15% that are located on oceans, estuaries, or the Great Lakes, or on rivers and have a design intake flow that exceeds more than 5% of the mean annual flow, must also reduce entrainment by a minimum of 60% (125.94(b)(2)).

The Rule further requires that facilities using compliance alternatives 2, 3, and 5 prepare a Comprehensive Demonstration Study (CDS) as described at 125.95(b) of the Rule based on each of the seven components of the CDS (as appropriate) for the compliance alternative or alternatives selected. Facilities using compliance alternative 1 are not required to submit a CDS and those using compliance alternative 4 are only required to

[1] Performance standards are found at Federal Register, Vol. 69, 7/9/04, 125.94(b)

submit the Technology Installation and Operation Plan (TIOP) and Verification Monitoring Plan. All facilities that use compliance alternatives 2, 3 and 5 are required to prepare and submit a "Proposal for Information Collection" (PIC), the first component of the CDS. The Rule at 125.95(b)(1) requires that the PIC include:

1. *A description of the proposed and/or implemented technologies, operational measures, and restoration measures to be evaluated.*
2. *A list and description of any historical studies characterizing impingement mortality and entrainment (IM&E), and /or the physical and biological conditions in the vicinity of the cooling water intake structures and their relevance to this proposed Study. If you propose to use existing data, you must demonstrate that the data are representative of current conditions and were collected using appropriate quality assurance/quality control procedures.*
3. *A summary of any past or ongoing consultations with relevant Federal, State, and Tribal fish and wildlife agencies and a copy of written comments received as a result of each consultation.*
4. *A sampling plan for any new studies you plan to conduct in order to ensure that you have sufficient data to develop a scientifically valid estimate of IM&E at your site. The sampling plan must document all methods and quality assurance/quality control procedures for sampling and data analysis. The sampling and data analysis methods you propose must be appropriate for a quantitative survey and include consideration of the methods used in other studies performed in the source waterbody. The sampling plan must include a description of the study area (including the area of influence of the CWIS), and provide a taxonomic identification of the sampled or evaluated biological assemblages (including all life stages of fish and shellfish).*

The preamble to the Rule on Federal Register Page 41635 states that the PIC should provide other information, where available, to the NPDES permitting authority regarding plans for preparing the CDS such as how the facility plans to conduct a Benefits Valuation Study or gather additional data to support development of a Restoration Plan.

An important feature of the Rule is use of the calculation baseline. The calculation baseline is defined in the rule as follows:

Calculation baseline means an estimate of impingement mortality and entrainment that would occur at your site assuming that: the cooling water system has been designed as a once-through system; the opening of the cooling water intake structure is located at, and the face of the standard 3/8-inch mesh traveling screen is oriented parallel to, the shoreline near the surface of the source waterbody; and the baseline practices, procedures, and structural configuration are those that your facility would maintain in the absence of any structural or operational controls, including flow or velocity reductions, implemented in whole or in part for the purposes of reducing impingement mortality and entrainment. You may also choose to use the current level of impingement *mortality and entrainment as the calculation baseline. The calculation baseline may be estimated using: historical impingement mortality and entrainment data from our facility or another facility with comparable design, operational, and environmental conditions; current biological data collected in the waterbody in the vicinity of your cooling water intake structure; or current impingement mortality and entrainment data collected at your facility. You may request that the calculation baseline be modified to be based on a location of the opening of the cooling water intake structure at a depth other than at or near the surface if you can demonstrate to the Director that the other depth would correspond to a higher baseline level of impingement mortality and/or entrainment.*

This definition allows existing facilities with a variety of study options to take credit for facility features that deviate from the calculation baseline and provide the benefit of fish protection. Facilities can also simply develop the baseline by documenting their existing levels of IM&E.

2 DESCRIPTION OF HUNTINGTON BEACH GENERATING STATION

Location and Physical Description of Cooling Water Intake Structure and Cooling System.

HBGS is located on the shore of the Pacific Ocean in Huntington Beach, California (Figure 1). The station consists of 5 Units, however, Unit 5 is a combustion turbine and does not use once through cooling water. Units 1 and 2 are each rated at 215 MWe while Units 3 and 4 are each rated at 225 MWe for a total of 880 MWe that rely on once through cooling water. The capacity for these Units over the past five years is 33.7% for Unit 1 and 30.6% for Unit 2. Due to repowering of Units 3 and 4 completed in 2003, five years of capacity information are not available for these repowered Units. However, in 2004 capacity utilization for Unit 3 was 19% and Unit 4 was 17%.

In December 2000, AES Huntington Beach L.L.C filed an Application for Certification for the Huntington Beach Generating Station Retool Project. The project consisted of repowering and operating Units 3 & 4 which were retired from service in 1995. The Retool Project was approved in May 2001. The Units 3&4 steam turbine generators were rebuilt with new natural gas burners and emissions control technologies. Unit 3 came on-line in summer 2002, and Unit 4 in summer 2003.

HBGS has an offshore intake located approximately 1,500 ft offshore and is fitted with a velocity cap (Figure 2). The velocity cap is submerged to a depth of approximately 17.5 ft below mean sea level and is approximately 5 ft above the intake riser. The velocity cap is 33 ft by 28 ft, and provides the benefit of fish protection by changing the direction of cooling water flow from vertical to horizontal. The horizontal velocity at the opening of the velocity cap is 2.8 fps. The velocity cap and pipes are made of concrete and also fitted with mammal barriers to prevent marine mammals, large fish and sea turtles from entering the offshore intake pipe. After entering the velocity cap, the water flows down 21 ft into a 14 ft diameter intake pipe that conveys water to the onshore intake structure.

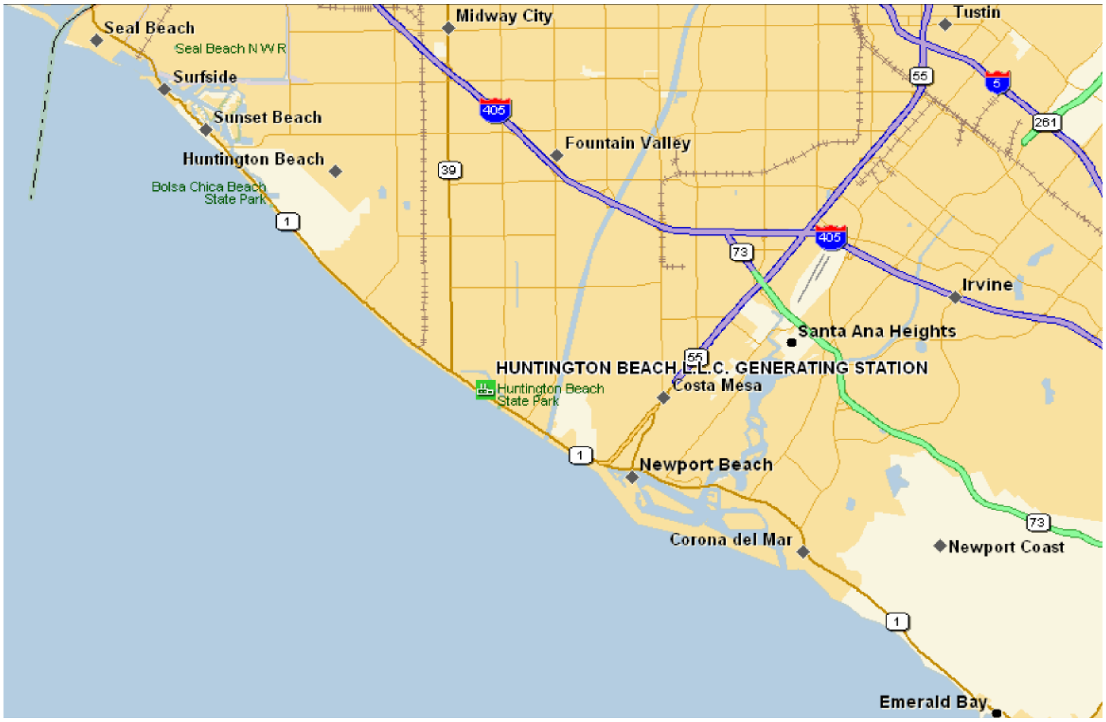

Figure 1 - Vicinity Map of Huntington Beach Generating Station

Once the water reaches the onshore intake it is redirected three ways by guiding vanes to three wider screen bays. These three screen bays then merge into two trash rack bays. The trash racks are made of vertical steel bars spaced 3 inches apart to prevent large debris or objects from reaching and damaging the traveling screens. After passing through the trash racks the intake channel expands slightly and splits into four 11 ft wide channels, each containing a stationary screen and traveling water screens. The approach velocities to the four traveling screens vary slightly and are 0.80, 0.96, 1.04 and 0.98 fps for Units 1, 2, 3, and 4 respectively. The screens are equipped with a high pressure spray wash that washes any debris and impinged organisms into a screenwash trough where the washwater and material removed from the screens is discharged into a trash basket that removes solid objects. The traveling screens are normally operated twice per shift for a period of approximately 20 minutes.

After passing through the traveling screens, cooling water enters a box culvert 14 ft wide and 11 ft high. The culvert is 236 ft long with a slight grade leading to the circulating water pumps. Due to the increased size in the channel, velocity decreases slightly. There are eight cooling water pumps, two for each of Units 1 – 4. The six pumps used by Units 1 -3 are each rated at 98 cfs, with the two pumps for Unit 4 rated at 103.2 cfs. The combined cooling water flow for all 4 once-through cooling Units is 794.5 cfs. After passing through the condensers, cooling water is discharged through a 14 ft diameter concrete pipe that runs parallel to the intake pipe. The discharge point is approximately 1200 ft offshore, 300 ft south of the intake at a depth of 21.3 ft. The discharged waters are directed vertically toward the sea surface by a riser that is similar in design to that at the intake structure.

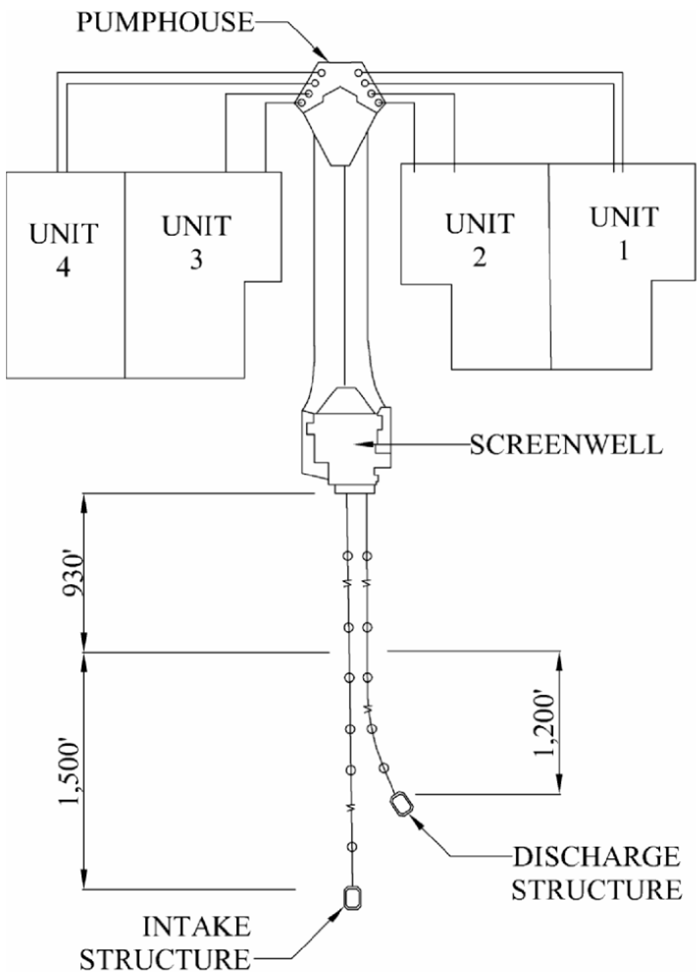

Figure 2 - Huntington Beach Cooling Water Intake System

As is the case with many other California facilities, HBGS uses a combination of sodium hypochlorite and heat treatment to control biofouling. The sodium hypochlorite is used to control microfouling organisms in the condenser tubes that adversely affect heat transfer efficiency. Biofouling in the forebay, cooling water conduits, and on the traveling screens is controlled by heat treatment. In this procedure, some of the heated water that has passed through the condensers is recirculated to the intake forebay for an approximately one hour period sufficient to control mussels, barnacles and other attached organisms that might clog or impede normal operation of the cooling system.

Applicable Performance Standards

Because HBGS withdraws water from an ocean, it is subject to both the impingement mortality and entrainment reduction performance standards. If its capacity factor based on five years of operating data is 15% or less, it would only be subject to the impingement performance standard. However, because HBGS capacity utilization exceeds 15%, it is subject to both the impingement mortality and entrainment reduction performance standards.

Conformance with the Calculation Baseline

The HBGS CWIS does not conform to the Rule's calculation baseline. Significant deviations include:

- The intake is located offshore rather than at the shoreline,
- The intake is submerged rather than at or near the surface, and
- The intake design includes a velocity cap.

The Rule allows facilities to take credit for deviations from the calculation baseline if it can be demonstrated that these deviations provide the benefit of fish protection to impingeable sized organisms. Plans to take credit are discussed in the next section.

3 COMPLIANCE ALTERNATIVES TO BE EVALUATED

AES intends to evaluate the full range of compliance alternatives and options available in the final Rule for potential use in the Comprehensive Demonstration Study (CDS). However, AES also has certain preferences for compliance because some options are considered to be more feasible, cost-effective and environmentally beneficial than others. This section of the PIC provides a description of specific alternatives and options that will be evaluated for compliance. It also indicates AES's preferred compliance alternatives and options based on currently available information, as well as some of the issues currently identified with these alternatives and options.

3.1 Taking Credit for Existing Use of Fish Protection Technologies and Operational Measures Under the Rule's Calculation Baseline

The Rule specifically entitles facilities to take credit for deviations from the calculation baseline, defined in Section 1 above, that provide the benefit of fish protection. As discussed in Section 2, HBGS has a number of CWIS design and operational deviations specifically used to provide fish protection. These systems include:

- Submerged intake
- Use of a velocity cap

Impingement Mortality Reduction Credits

Site specific studies were conducted to evaluate velocity cap effectiveness in 1979 and 1980. A total of 11 surveys were conducted during this period at four generating stations including Huntington Beach. While results of velocity cap effectiveness varied among stations, a high level of fish protection performance was reported for HBGS with average effectiveness between the two years exceeding the minimum 80% impingement reduction performance standard. These studies will be carefully reviewed for use in estimating potential credit toward the IM reduction performance standard.

Entrainment Reduction Credit

In addition, the offshore submerged location of the intake, another deviation from the Rule's calculation baseline, may have the benefit of reducing entrainment relative to a surface, shoreline location. The opportunity for an entrainment reduction credit for this deviation from the calculation baseline will also be considered.

In addition, consistent with the Rule, AES also plans to develop the entrainment baseline using its existing entrainment data. The Rule at §125.95(b)(3)(ii) states in reference to the IM&E Characterization Study data, "these may include historical data that are representative of the current operation of your facility and the biological conditions at the site". As noted in Section 2, HBGS's capacity factor over the past 5 years has been 33.7% for Unit 1 and 30.6% for Unit 2. As discussed, capacity utilization for Units 3 and 4 which completed repowering in 2003 were 19% and 17% respectively in 2004. EPA in the Rules preamble on page 41617[2] points out that some commenters on the Rule "suggested that the calculation baseline should reflect unrestricted operation at full design capacity year-round to avoid continually changing the baseline". However, EPA chose not to base the calculation baseline on this approach stating "EPA chose not to incorporate capacity into the calculation baseline, as the definition is not dependent upon intake flow volumes. EPA has chosen to adopt the "as built" approach: as stated in §125.93, a facility may choose to use the current level of impingement mortality and entrainment as the calculation baseline. For facilities with lower capacity utilization such as HBGS, estimating entrainment based on actual flow is also consistent with the Rule's baseline calculation reference to "the baseline practices and procedures". It is therefore appropriate for HBGS to calculate the level of IM&E by determining impingement and entrainment as a function of cooling water pump operation rather than design flow. The baseline characterization based on actual cooling water pump operation will remain the baseline unless operations change. In the event cooling water pump operation increases, that would constitute a change in facility operations and require additional compliance measures. The 316(b) Rule contemplates review of 316(b) compliance during each permit cycle[3]. This ensures that if operations such as increased cooling water pump operation occur, the permit can be modified to ensure that the performance standards will continue to be achieved.

3.2 Use of Restoration under Compliance Alternative 3

The EPA final Phase II Rule provides that applicants may use restoration measures in addition to, or in lieu of, technology measures to meet performance standards or in establishing best technology available (BTA) on a site-specific basis. The basic philosophy of restoration is mitigation of fish and shellfish losses at a CWIS by either direct supplementation (stocking) of a "species of concern" potentially impacted by the CWIS, or provision, protection and restoration of habitat that "produces" fish and shellfish and thereby replaces those lost due to IM&E. AES views restoration as a

[2] Federal Register, Vol 69, No.131, 7/9/04, pg. 41617, Column 2

[3] The Rule at §125.98(a)(3) states "At each permit renewal, you (referring to NPDES permitting authority) must review the application materials and monitoring data to determine whether new or revised requirements for design and construction technologies, operational measures, or restoration measures should be included in the permit to meet applicable performance standards in §125.94(b) or alternative site-specific requirements established pursuant to §125.94(a)(5).

preferred method for meeting the entrainment reduction performance standard. However, it is also recognized that there is some risk this option may not be available[4].

Attachment A provides a summary of the kinds of restoration measures that will be considered. Project examples are listed for the following reasons: (1) their 316(b) application history by other power companies, (2) known interest in the local area based on an internet review of state programs, and (3) because design and implementation information is readily available. The basic categories of considered projects are as follows:

- Habitat Protection or Creation Program
- Fish Stocking
- Waterbody Restoration
- Removal of Obstruction to Migratory Fish on Tributaries

Other types of projects may be identified in discussions with appropriate state and federal agencies.

AES plans to discuss these ideas and consider other restoration alternatives that may be applicable and will also consider working with other companies with local Phase II facilities to develop joint projects. As part of the requirement for use of restoration, AES plans to fully evaluate available technologies and/or operational measures to demonstrate that existing and supplemental restoration is more feasible, cost-effective or environmentally desirable than use of meeting performance standards through use of technologies and/or operational measures (see below in Section 3.3). The analysis of IM&E data described in Attachment B will be used in determining the amount of restoration necessary to provide a minimum benefit equivalent to at least an 80% IM reduction and 60% E reduction as required by the Rule.

3.3 Use of Fish Protection Technologies and/or Operational Measures under Compliance Alternatives 3 and 4

AES plans to evaluate a variety of technologies and operational measures for compliance. Generally the costs of technologies required for compliance with the entrainment performance standard is significantly more costly than those required for compliance with the impingement reduction performance standard. Since HBGS believes it currently

---

[4] AES is aware that use of restoration is currently the subject of Phase II Rule litigation. The Second Circuit ruled that restoration could not be used for compliance with the 316(b) Phase I Rule. Based on the Phase I litigation decision, EPA added significant text to the Phase II Rule to support its use in Phase II. AES plans to initially limit evaluation of this compliance option in 2005 to discussions with the Board and appropriate State and Federal fish and wildlife agencies to identify potential projects of interest and methods for scaling and verification monitoring related to projects of interest. It is AES's current understanding that the Phase II Rule litigation decision should be rendered by the end of the second quarter of 2006.

meets the IM reduction performance standard (see Section 3.1 above), AES plans to focus on the evaluation of entrainment reduction technologies and operational measures. However, it should be noted that the entrainment reduction technologies and operational measures proposed for evaluation also provide the benefit of impingement mortality reduction as well. A recent review of fish protection technologies and operational measures was conducted as part of the HBGS repowering project[5]. Most of these alternatives were determined to be either not feasible or cost-prohibitive and many focused on technologies to reduce impingement in the forebay area required by the California Energy Commission's Condition of Certification BIO-4. In the event that use of restoration measures is not available for compliance to offset entrainment losses, the following technologies and operational measures are being evaluated:

Narrow-Slot Cylindrical Wedgewire Screens – This was not evaluated as part of the repowering study and is considered to have the potential to reduce both IM&E. A schematic of this technology is shown in Figure 3. This technology is designed to work by using a low through screen velocity relative to the ambient water current velocity. Protection of entrainable organisms is a function of the sweeping velocity of the water current past the screens relative to the through screen velocity. These screens would replace the existing velocity cap. Based on Huntington Beach's maximum cooling water flow of 794.5 cfs, the appropriate number and size of cylindrical wedgewire screen modules would be selected. Wedgewire screen are typically designed to meet the entrainment standard by using 0.5 mm slots; however, HBGS entrainment data will be reviewed to determine if a larger or smaller size would be appropriate. The cost of this technology is a function of slot size, since a smaller slot size requires use of more or larger screens to provide the same volume of cooling water. In addition, the industry standard design for wedgewire screens is a maximum through slot velocity of 0.5 fps which provides compliance with the impingement mortality performance standard.

To verify effectiveness for reducing entrainment, AES will need to evaluate current velocities in the area where the screens would be deployed to confirm there is sufficient sweeping velocity past the screen modules to prevent impingement of entrainable organisms. While these screens have been deployed at a number of freshwater facilities, they have not yet been deployed in marine environments such as the Pacific Ocean. The high biofouling environment in the Pacific may present feasibility issues for this technology. The technology employs use of compressed air released in a manner to cause a blast of air through the screens to control fouling and debris buildup. However, testing in ocean environments will be important to determine if the air blast system is adequate to ensure an uninterrupted supply of cooling water for facilities such as Huntington Beach. This may include conducting pilot studies in this region of the Pacific.

[5] AES Huntingtion Beach L.L.C. Generating Station Entrainment and Impingement Study, Draft Final Report, February 2005, pg 195.

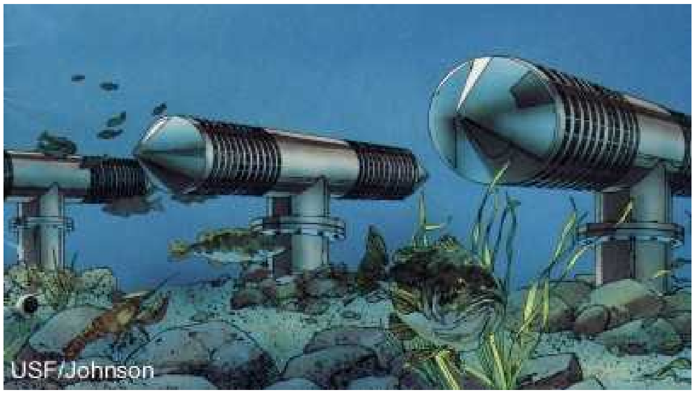

Figure 3 Narrow Slot Wedgewire Screens

Fine-mesh Ristroph Traveling Water Screens - AES also plans to evaluate replacing the existing 3/8 in. traveling water screens for Units 1 - 4 with new 0.5 mm fine-mesh Ristroph screens. This technology, while evaluated for impingement reduction during the repowering study, will be re-evaluated as it is one of the few feasible alternatives with the potential to meet the entrainment performance standard. This fish protection technology is based on first collecting impinged and entrained organisms in a manner to maximize survival and then returning them to the source waterbody. The technology employs a combination of Ristroph fish buckets attached to the bottom of traveling screen panels (Figure 4) and replaces the 3/8 in. stainless steel mesh with a fine mesh fabric (Figure 5). A low pressure screenwash spay system (~10 psi) is installed to wash entrained fish eggs and larvae gently off the screens into the Ristroph buckets. The Ristroph buckets then discharge fish into a fish return system to transport them back to the source waterbody to a location away from the intake to prevent re-entrainment. Fine-mesh screens are typically designed with an approach velocity of 0.5 fps to help maximize survival of fish eggs and larvae. There are several issues that will need to be evaluated relative to this technology. First, the current approach velocity to the traveling screens is about double the typical design velocity for this technology. Due to exceeding the velocity criteria it would be essential to perform laboratory and/or field studies to verify that the survival of entrainable organisms is higher than the existing survival through the condenser system. If impingement survival of entrainable organisms is low at the current velocities, the screenhouse would need to be expanded to accommodate additional screens necessary to reduce the approach velocity. Such an expansion would require each unit to be shutdown for a substantial amount of time and would require considerable site work. Second, due to the onshore location of the existing traveling screens, impinged and entrainable organisms collected will have to be transported a considerable distance to a safe release point. Finally, species and associated life stages tend to vary considerably in terms of their ability to tolerate the collection and handling associated with this option, again emphasizing the need for species and life stage specific testing to verify survival rates. For these reasons, and especially if expansion of the intake and installing more Ristroph screens is required, this option may not be a cost-effective solution.

Figure 4: Ristroph screen buckets attached to bottom of traveling screen panels.

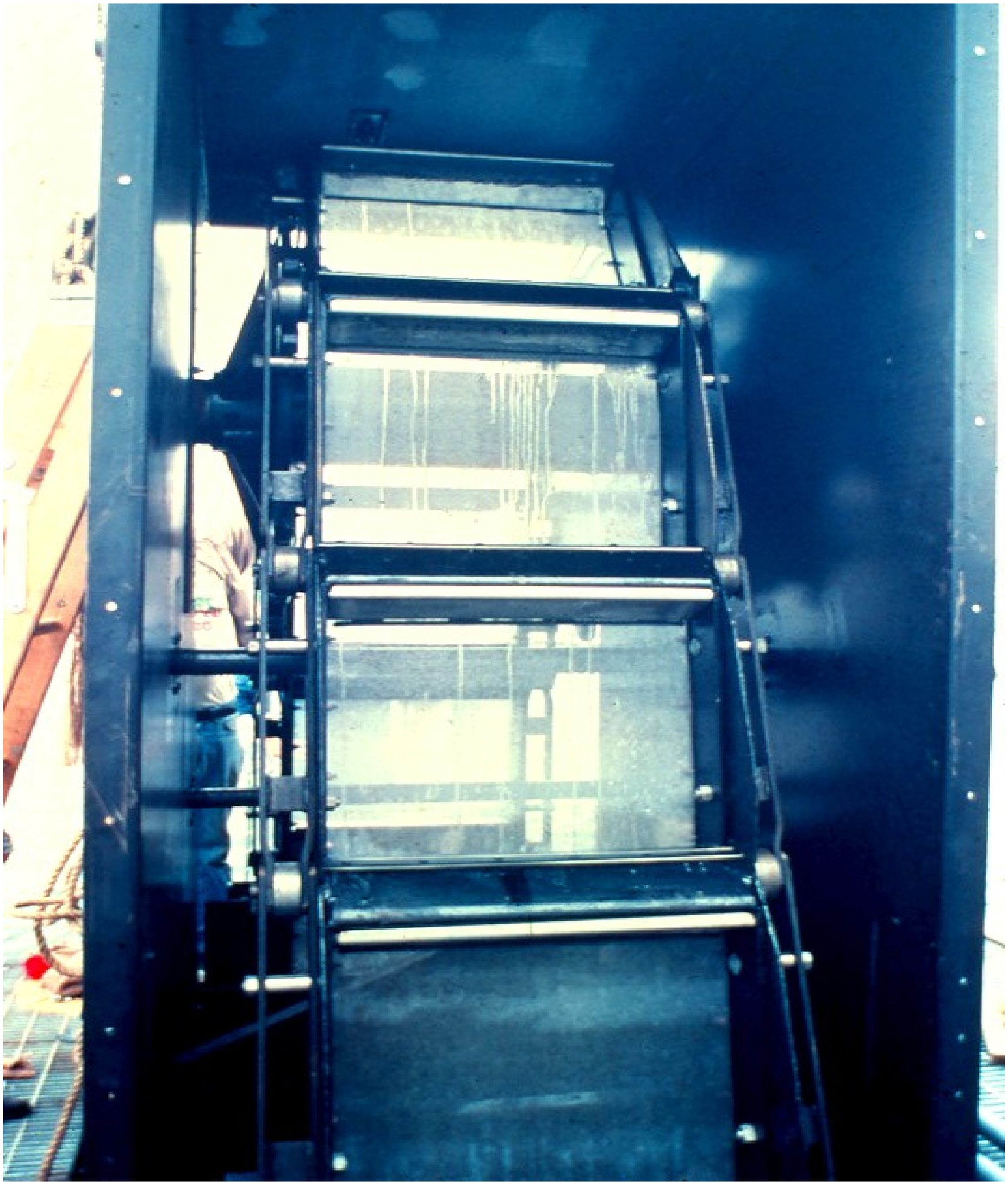

Figure 5: Example of fine mesh screen panels used in a test set up.

- **Use of an Approved Technology under Compliance Alternative 4**. Currently use of wedge wire screens in rivers that meet certain criteria is the only named EPA pre-approved technology. However the Rule provides a process that allows additional technologies to become listed pre-approved technologies. New technologies can be so designated by providing information to demonstrate that if installed in the waterbody type the technology would have little trouble meeting the performance standard for which they are pre-approved.

When results of the proposed IM&E sampling analysis in conformance with the Rule's calculation baseline are available in 2006, if use of restoration measures is not available and AES decides to comply using one or a combination of technology and/or operational measures, it may propose pilot studies in the 2006/2007 time frame to verify performance.

Now that the final 316(b) Rule is in place, a good deal of interest has been generated in developing new fish protection technologies. AES plans to monitor the development and testing of new technologies for potential use. If other technologies more effective in terms of fish protection efficacy and cost-effectiveness become available, AES will inform the Board that the new technology may be added to the PIC for evaluation at HBGS.

3.4 Use of Site Specific Standards under Compliance Alternative 5

AES plans to evaluate potential use of both the cost-cost and cost-benefit tests under compliance alternative 5. Use of these cost tests are provided to allow Phase II facilities to avoid costs that would be considered significantly greater than either the costs estimated by EPA for those facilities or the economic value of the site specific environmental benefits that would be achieved. Should the evaluation of the current impingement reduction technologies and operational measures determine that the IM&E performance standard is not met or use of restoration for offsetting entrainment losses is not available these tests will be used in conjunction with the evaluation of technologies and operational measures discussed in Section 3.3 of the PIC.

Evaluation of Cost-Cost Test - EPA, in developing the national cost of implementing the Rule, considered the cost for each Phase II facility to comply. If the actual cost estimated for a facility to meet the performance standard, based on a site specific analysis, is determined to be significantly greater than the cost estimated by EPA for the facility to comply, the facility can apply for a site specific demonstration under the cost-cost test using compliance alternative 5. The site specific standard would be that achieved by the use of the best performing technology (i.e. achieve the highest level of protection) or operational measure that would pass the cost-cost test. HBGS is identified as facility number AUT0612 in Appendix B of the Rule and the estimated annualized cost for HBGS was estimated to be $1,027,365. However, EPA used a design flow that was only 52% of the actual design flow. Therefore, the adjusted annualized cost estimate is $2,227,964. These costs are based on installation of passive fine-mesh screens to the existing off shore intake with a mesh width of 0.76 mm.

Evaluation of Cost-Benefit Test - The economic value of the environmental benefit of meeting the performance standards will also be evaluated. This evaluation will include the cost of any additional impingement mortality reduction technologies needed to make up any shortfall after taking credit for the offshore submerged intake and velocity cap. It will also include evaluation of the costs of meeting the entrainment performance standard (again after any taking credits as a result of baseline deviations that can be demonstrated to provide the benefit of fish protection) and the resulting benefit of meeting the entrainment standard. This analysis would include consideration of impact information already conducted by AES and the California Energy Commission (CEC) as part of the HBGS repowering project. The approach for this analysis is further discussed in Attachment C of the PIC.

4 BIOLOGICAL STUDIES

The Rule requires that a summary of historical IM studies and/or physical and biological studies conducted in the vicinity of the CWIS be provided as well as study plans for any new IM studies to be conducted. The previous operators of the HBGS (Southern California Edison Company) conducted one year of entrainment sampling at nearby facilities from August 1979 through July 1980. As part of a repowering project, another year of entrainment sampling was conducted from September 2003 to August 2004. Impingement sampling has been conducted and reported annually since 1979. This includes weekly sampling from late July 2003 through July 2004 as part of the repowering study. In addition, site specific velocity cap effectiveness studies were conducted in 1979 and 1980. The full summary of these studies along with a discussion of physical and biological studies in the vicinity of HBGS is presented in Attachment B.

Because of the recent IM&E sampling conducted in conjunction with the repowering of Units 3 and 4, no new IM&E studies are being proposed. Rather, existing data will be used for the purpose of preparing the IM&E Baseline Characterization Study component of the Comprehensive Demonstration Study (CDS). Due to the recent detailed impingement and entrainment sampling in 2003 and 2004, this will be representative of current biological conditions. Attachment B provides documentation that the data were collected using appropriate QA/QC methods.

5 SUMMARY OF PAST OR ONGOING CONSULTATION WITH AGENCIES

The Rule requires that "a summary of any past or ongoing consultations with appropriate Federal, State, and Tribal fish and wildlife agencies that are relevant to the CDS and a copy of written comments received as a result of such consultations" be provided.

In December 2000, AES Huntington Beach L.L.C filed an Application for Certification for the Huntington Beach Generating Station Retool Project. The project consisted of repowering and operating Units 3 & 4 which were retired from service in 1995. California Energy Commission staff was concerned about potential effects due to entrainment and impingement of aquatic organisms and required a yearlong entrainment and impingement study. Both the California Department of Fish and Game and National Marine Fisheries Service expressed support for staff's recommendation of an updated entrainment and impingement study (CEC 2001). Both agencies, as well as the U.S. Fish and Wildlife Service, were part of the technical working group that oversaw the study design and were allowed to comment on draft reports. The entrainment and impingement study was performed in 2003 and 2004, and the final report was published in April 2005[6]

[6] AES Huntington Beach L.L.C. Generating Station Entrainment and Impingement Study, Final Report, April 2005.

6 SCHEDULE FOR INFORMATION COLLECTION

The Rule allows facilities with NPDES permits that expire within four years of the date of publication of the Rule in the Federal Register (July 9, 2004) up to three years and six months to submit the CDS (125.95(2)(ii)). AES submitted a letter dated November 2, 2004 requesting approval of a schedule to prepare and submit the PIC, conduct necessary studies, prepare information and submit the CDS. That schedule was approved in a letter from the Board dated December 23, 2004. The letter noted that final approval of the schedule was contingent upon submittal of the PIC and status reports.

As noted in the Board's letter and in this PIC, it may be possible to accelerate the schedule for HBGS since AES plans to rely on recent and historical IM&E studies for preparing the IM&E Baseline Characterization Study. AES plans to reanalyze these data in a manner consistent with the Rule. A study is also being completed to evaluate entrainment survival at HBGS as part of a project being considered by another company. This study may be relevant to the HBGS IM&E Characterization Study. It is also possible that acquisition of additional data and/or information may be necessary to prepare the CDS IM&E Baseline Characterization Study report. Between now and September 30, 2005 AES and our 316(b) consultants will be focusing on completion of PICs for its other Phase II affected facilities while the Board reviews and provides any comments on this PIC.

Assuming that the Board provides comments within the 60 day period suggested in the Rule, AES will make any necessary changes to modify the PIC within 30 days and provide a revised PIC to the Board by October 30, 2005. At this point, PIC information gathering will be initiated. The first major task will be to complete the IM&E Characterization Study analysis. Completing this analysis is critical in order for AES to make a final decision on compliance alternatives. It is anticipated this analysis will require approximately 4 months to complete (February 28, 2006). Upon PIC approval, AES will also initiate work and discussions with appropriate State and Federal Agencies to identify potential restoration projects of interest for use under compliance alternatives 3 and/or 5. As noted, a Court will issue a decision on the on-going Phase II litigation, so any impact of that decision on the currently available compliance alternatives and compliance options can be considered in making AES's final compliance decision. Based on completion of analysis of the biological data, discussions to identify restoration projects and availability of the restoration option for compliance, AES should be in a position to make a final compliance decision shortly after the Phase II Rule litigation decision which is expected during the second quarter of 2006. At this point, the schedule will be determined by the compliance alternative and option selected. If the compliance alternative requires use of technologies, the need for laboratory or site specific pilot studies are likely to be necessary. Such studies would be initiated in the summer of 2006 and take up to one year to complete.

Preparation of the CDS will depend on the final compliance alternative(s) selected as follows:

- Use of Technologies or Operational Measures - It is anticipated that it will require approximately 6 months to review and complete a draft and final CDS based on the technology and compliance assessment information (i.e. Design and Construction Technology Plan and Technology Installation and Operation Plan).
- Use of Restoration - If AES's preferred approach of using restoration measures is available, work will be initiated to prepare a restoration plan. It is anticipated that preparation of this plan and providing the information necessary to address the requirements necessary for this plan will also require 6 months. It is therefore likely that a final CDS based on restoration can be submitted on or before the end of 2006.
- Use of Site Specific Standards - Should use of compliance alternative 5 be a component of the CDS it will be necessary to prepare a Comprehensive Cost Evaluation Study and if the Cost-Benefit test is used a Benefit Valuation Study. In addition, if a technology or operational measure is used as part of compliance alternative 5 the technology and compliance assessment information documents will also be required. Thus the full allowable schedule will be necessary. However, assuming an entrainment reduction technology or operational measure is not identified that would pass the site specific standards, the final CDS would be submitted by the end of 2006.

The Rule recognizes that the CDS studies are an iterative process[7] and allows facilities to modify the PIC based on new information. AES may request Board approval of an amendment to this PIC, based on new information relative to technologies and operational measures, use of restoration measures, Phase II Rule litigation, or subsequent Agency guidance. Such information may require modification of the currently proposed schedule.

[7] See Rule preamble first column pg 41235 of Federal Register/Vol. 69, No. 131/Fri 7/9/04.

Attachments on Following Pages

A RESTORATION MEASURES

Restoration Categories to be Evaluated for 316(b) Compliance at AES's Huntington Beach Generating Station

The final Phase II Rule provides that applicants may use restoration measures in addition to, or in lieu of, technology measures to meet performance standards or in establishing best technology available (BTA) on a site-specific basis. Specifically, EPA's final Phase II Rule states the following requirement relative to the use of the restoration approach:

> *Facilities that propose to use restoration measures must demonstrate to the permitting authority that they evaluated the use of design and construction technologies and operational measures and determined that the use of restoration measures is appropriate because meeting the applicable performance standards or requirements through the use of other technologies is less feasible, less cost-effective, or [emphasis added] less environmentally desirable than meeting the standards in whole or in part through the use of restoration measures.*

Types of Restoration Applicable to §316(b)

The Rule does not specify the types of restoration measures that can be used. This lack of specification provides flexibility in developing/proposing a restoration approach. Restoration measures that have been used at other power stations to meet §316(b) requirements include:

- Wetland restoration (e.g., Public Service Electric & Gas (PSEG) Delaware Bay wetland restoration program for the Salem Generating Station)(Weinstein et al. 2001).
- Fish stocking (e.g., Mirant Mid-Atlantic fish hatchery at the Chalk Point Station, Bailey et al. 2000); Exelon's (formally Commonwealth Edison) walleye hatchery at Quad Cities Station on upper Mississippi River (LaJeone and Monzingo 2000); and the California Department of Fish and Game's Ocean Resources Enhancement and Hatchery Program (CDFG OREHP) white seabass (*Atractoscion nobilis*) hatchery, co-funded by Southern California Edison
- Provision of fish passage (e.g., fish ladders or dam removal) at non-hydropower projects (e.g., PSEG fish ladders in Delaware Bay tributaries for the Salem Generating Station).

- Contribution to, or maintenance of, a restoration fund for impacts associated with the re-powering of the Moss Landing Station on Elkhorn Slough near Monterrey Bay, California – see http://www.duke-energy.com/businesses/plants/own/us/western/morrobay/reports/
- Water quality improvements (e.g., riparian area protection or implementation of non-point source best management practices) that minimize sediment/pollutant runoff thereby resulting in fishery habitat improvements (ex. Morro Bay sediment runoff control), and practices that increase dissolved oxygen content in waterbodies thereby increasing available habitat for fish spawning and survival. While this approach is plausible, there are no known existing examples of such a 316(a) or 316(b) restoration project.

Potential Restoration Measures for AES California Facilities

AES may wish to consider the following example restoration projects[8] to attain the impingement mortality (and, if applicable, entrainment) reduction performance standard or as part of a site-specific standard developed by the permit director. These projects are listed because of their known interest to fish and wildlife agencies in California and because design and implementation information is readily available:

- Fish stocking – While forage species (e.g., gobies, anchovies, sardines) are the most common species impacted at California power plants, stocking of these species to compensate for the losses would not likely be of interest to any of the federal and state fish and wildlife agencies. The objective of a supplementation program would be to identify a 'species of concern', the stocking of which would compensate ('comparable to, or substantially similar to') for the production foregone as measured by a gamefish's consumption (e.g., X northern anchovy are equivalent in energy or food consumption to Y white sea bass or other recreational or commercial fish of concern). This is the approach used by Potomac Electric Power Company for estimating annual hatchery production of striped bass to compensate for bay anchovy (a forage species) losses at their Chalk Point Generating Station on the Patuxent River in Maryland.

  Fish stocking involves the direct supplementation (stocking) of a fish species of concern to aid restoration efforts for that species. Restoration stocking (as opposed to recreational gamefish stocking) is generally pursued where the species of interest has been completely extirpated or where associated habitat restoration is unlikely to contribute to stock restoration. For example, the Georgia Department of Natural Resources (GDNR), following six years of study, recently initiated a long-term effort to restore lake sturgeon to the Coosa River system in Georgia/Alabama. This species is listed as threatened throughout the U.S. and has disappeared completely from much

[8] Projects listed are examples – opportunities for creative restoration projects are unlimited and depend upon corporate interests and negotiations with state and federal resource agencies.

of its original range, including the Coosa River. Through a collaborative effort between several state and federal agencies, GDNR released 1,100 fingerlings to the Coosa River in December 2002 as the first step towards returning lake sturgeon to a healthy, self-sustained population in the river (see: http://georgiawildlife.dnr.state.ga.us/content/displaycontent.asp?txtDocument=305). A similar program may be of interest in California, particularly for the southern steelhead (sea-run rainbow trout, *Oncorhynchus mykiss*) which is a federal and state listed endangered and threatened species along the California coast (see: http://ecos.fws.gov/tess_public/TESSWebpageUsaLists?state=CA). CDFG and RWQCB (and USFWS/NMFS) may support AES's participation in a program to restore rare, threatened, and endangered fish to native habitat. Mirant Mid-Atlantic Inc. currently raises and stocks Atlantic sturgeon at its Chalk Point Hatchery Facility on the Patuxent River for the State of Maryland, Department of Environmental Protection. American shad restoration to the Susquehanna River basin in Maryland/Pennsylvania has been accomplished in part via stocking of juvenile shad and via provision of fish passage (St. Pierre 2003; Hendricks 1995). Restoration stocking (e.g., for southern steelhead) could also be combined with provision of fish passage (i.e., dam removal or fish ladders). This form of restoration is discussed further below.

Fish stocking program support could be via hatchery operation developed on or off plant property (e.g., SCE co-funds the operation of the CDFG OREHP fish hatchery in Carlsbad, CA for culturing and stocking white sea bass – see http://www.sce.com/sc3/006_about_sce/006b_generation/006b1_songs/006b1c_env_prot/006b1c3_songs_miti/default.htm). Such a hatchery would be operated and maintained under state and federal oversight. Alternatively, AES could possibly negotiate a direct annual contribution of funds to a state and federal hatchery supplementation program or a private foundation. For example, the Hubbs/Sea World Research Institute operates the CDFG OREHP fish hatchery for SONGS mitigation. While hatchery or stock supplementation programs can be controversial due to concerns over protection of natural genetic integrity, California resource agencies, based on their approval and development of SCE's SONGS Mitigation Project, supported stocking as compensation for fish losses. CDFG and NMFS also have a long-term fish hatchery program to support maintenance and restoration of anadromous salmonids in California coastal rivers (CDFG/NMFS 2001). California resource agencies' experience with hatchery supplementation may mean that they could be receptive to a hatchery program established by AES as compensation for impingement and entrainment losses at AES power plants in southern California. For example, when operating at design capacity, the SCE co-funded hatchery is expected to exceed compensation for the total SONGS fish losses estimated by an expert panel created by the California Coastal Commission.

For approximate cost references, SCE provided $4.7 million in funding for the white sea bass hatchery which began operation in late 1996. Similarly, the Potomac Electric Power Company (PEPCO) established an aquaculture facility at their Chalk

Point Station at a capital cost (1990 dollars) of $1 million. Annual O&M has been approximately $175,000 to $250,000 depending on the species and number of organisms raised and stocked in Maryland waters.

- Habitat Protection Program Participation – The importance of wetlands, in-stream habitat, and riparian areas as aquatic habitat for fish and invertebrates, and as habitat for wildlife is reviewed in EPRI (2003). Wetland restoration or habitat restoration in general, is becoming increasingly popular across the U.S. and there is a growing case history of habitat restoration as a 316(b) mitigation approach (EPRI 2003). In California, over 90% of its historic wetlands and 95% of historic streamside trees, shrubs, and ground vegetation has been lost from urbanization, agricultural conversion, logging, and flood control (USFWS 2001). Habitat restoration, therefore, should be of major interest to federal and state resource agencies, and non-governmental organizations (NGOs) in California. The following identifies federal, state, and private restoration programs that provide information which AES may find of value for establishing their own restoration program or offer opportunities to collaborate on potential restoration projects.

  Example programs include:

  - *SCE's SONGS Mitigation* (see: http://www.sce.com/sc3/006_about_sce/006b_generation/006b1_songs/006b1c_env_prot/006b1c3_songs_miti/default.htm): the proximity of SONGS and its ongoing restoration program is a key starting point relative to any restoration project initiated by AES for impacts at its southern California generating stations. The California resource agencies and local non-governmental organizations will likely rely heavily on lessons learned during the negotiation and development of the SONGS Program. The San Onofre Nuclear Generating Station Marine Mitigation Program is a multi-faceted environmental enhancement program intended to mitigate unavoidable impacts to the marine environment resulting from operation of the SONGS Units 2&3 cooling water systems. The program includes:
    1. restoring 150 acres of degraded wetlands at San Dieguito Lagoon to mitigate impacts to marine fish populations caused by estimated mortality to fish eggs and larvae;
    2. improving the in-plant fish protection systems to increase survival of adult fish which enter the cooling water systems;
    3. constructing an artificial kelp reef to mitigate impacts to the San Onofre Kelp Bed;
    4. co-funding a marine fish hatchery program intended as supplementary mitigation for kelp impacts; and
    5. funding for Coastal Commission staff oversight and monitoring of these mitigation projects.

SCE is managing the overall mitigation program. Through its Conservation Financing Corporation (CFC) subsidiary, the two largest elements of the mitigation program, the wetlands restoration project at San Dieguito Lagoon and the artificial reef at San Clemente, are being addressed by an equity alliance with CH2MHILL, an environmental management services consulting firm. CFC finances and oversees implementation of these two mitigation projects.

SCE is the plant operator and majority owner of SONGS. SONGS is jointly owned by SCE, San Diego Gas and Electric, and the cities of Anaheim and Riverside, which are funding the mitigation work.

SONGS' owners want to keep interested parties informed about this program, which will significantly enhance the region's marine resources. Through meetings, discussions, newsletters, a Web site, and the public hearing process, SCE expects to inform and involve the largest possible number of interested parties in the development and implementation of the mitigation/enhancement plans. Detailed technical progress on implementing and monitoring the SONGS mitigation effort can be found in the Proceedings from the Second Annual Public Workshop for the SONGS Mitigation Project (Reed et al. 2002).

- *Duke Energy's Morro Bay Modernization Project Habitat Enhancement Program* (see: http://www.duke-energy.com/businesses/plants/own/us/western/morrobay/reports/) – as part of the station modernization, Duke Energy has volunteered to fund a program that would reduce sedimentation and the other major factors undermining the Bay's productivity. The concerns for Morro Bay and the target of Duke's proposal are the issues identified by the Morro Bay National Estuary Program's (MBNEP) Comprehensive Conservation Management Plan (CCMP). Those issues include sedimentation, loss of habitat, and nutrient pollution. Duke's proposal is their preferred alternative to the CEC Staff recommendations for dry cooling. The Regional Water Quality Control Board (RWQCB) staff agrees with Duke's proposal and believes that habitat enhancement would yield greater long-term benefits for the Bay. Duke Energy's proposal would fund habitat enhancement projects authorized by the RWQCB and managed through professional groups like the MBNEP, which have plans and programs to reduce sedimentation and other factors undermining the Bay's productivity. The special value of habitat enhancement is that it not only addresses marine biology, but also protects and enhances habitat for birds and other animals and sustains important recreational resources for the community. Documents describing the program in detail can be downloaded from the noted website. Because of recent economic conditions across the U.S., Duke has canceled plans for modernizing the Morro Bay Power Station and, as a result, their habitat enhancement project has not been implemented.

- *PSEG's Delaware Bay Estuary Enhancement Program* This is the largest restoration program in the U.S. implemented as compensation for impingement and entrainment losses at a power station. Established in 1995, this program was negotiated with New Jersey Department of Environmental Protection (NJDEP) as a mitigative action for fish losses at the Salem Nuclear Generating Station in lieu of implementing a closed-cycle cooling system. Principally focused on the restoration of approximately 10,000 acres of former salt hay farms to natural estuarine salt marsh in the lower Delaware Estuary, the program also includes provision of fish passage in combination with some limited fish stocking to support restoration of anadromous (American shad and river herring) fish stocks. Details of the program can be found in Weinstein et al. (2001). In a following section, the method used by PSEG to scale (i.e., convert fish loss to acres of equivalent wetland habitat) the size of the requisite restoration project is demonstrated. PSEG incurred costs to date for the ongoing restoration project, including capital, O&M, and monitoring exceed $100 million or $9,350/acre (EPRI 2003).

- *Santa Monica Bay Restoration Commission (see:* http://www.santamonicabay.org/site/aboutus/layout/index.jsp) - In recognition of the need to restore and protect the Santa Monica Bay and its resources, the State of California and the U.S. Environmental Protection Agency established the Santa Monica Bay Restoration Project (SMBRP) as a National Estuary Program in December of 1988. The Project was formed to develop a plan that would ensure the long-term health of the 266 square mile Bay and its 400 square mile watershed, located in the second most populous region in the United States. That plan, known as the Santa Monica Bay Restoration Plan, won State and Federal approval in 1995. Since then, the SMBRP's primary mission has been to facilitate and oversee the implementation of the Plan.

  On January 1st, 2003, the Santa Monica Bay Restoration Project formally became an independent state organization and is now known as the Santa Monica Bay Restoration Commission (SMBRC). The Santa Monica Bay Restoration Commission continues the mission of the Bay Restoration Project and the collaborative approach of the National Estuary Program but with a greater ability to accelerate the pace and effectiveness of Bay restoration efforts. Restoration activities are based on a comprehensive plan of action for Bay protection and management, known as the Bay Restoration Plan, that was approved by Governor Pete Wilson in December of 1994 and by USEPA Administrator Carol Browner in 1995. The Plan identifies almost 250 actions, including 74 priority actions, that address critical problems such as storm water and urban runoff pollution, habitat loss and degradation, and public health risks associated with seafood consumption and swimming near storm drain outlets. The Plan outlines specific programs to address the environmental problems facing the Bay and identifies implementers, timelines, and funding needs.

Implementation of the Plan is the focus of current efforts. Securing and leveraging funding to put solutions into action, building public-private partnerships, promoting cutting-edge research and technology, facilitating a stakeholder-driven consensus process, and raising public awareness in order to restore and preserve the Bay's many beneficial uses are key objectives of the SMBRC.

- *National Oceanic and Atmospheric Administration (NOAA) Community-based Restoration Program (CRP)(see: http://www.nmfs.noaa.gov/habitat/restoration/*:) This program applies a grass-roots approach to restoration by actively engaging communities in on-the-ground restoration of fishery habitats around the nation. The CRP emphasizes partnerships and collaborative strategies built around restoring NOAA trust resources and improving the environmental quality of local communities. The program is: (1) providing seed money and technical expertise to help communities restore degraded fishery habitats, (2) developing partnerships to accomplish sound coastal restoration projects, and (3) leveraging resources through national, regional, and local partnerships. This program is one of the services of the NOAA Restoration Center. This Center's mission is to enhance living marine resources to benefit the nation's fisheries by restoring their habitat. Working with others, the Center achieves its mission by (1) restoring degraded habitats, (2) advancing the science of coastal habitat restoration, (3) transferring restoration technology to the private sector, the public, and other government agencies, and (4) fostering habitat stewardship and a conservation ethic. Recently, under the community-based program, NOAA awarded $250,000 to the Gulf of Mexico Foundation for habitat restoration in the five states bordering the Gulf of Mexico. EPA, under their Gulf of Mexico Program (see following) similarly awarded $90,000 to the Foundation. These awards launched a major new effort to reclaim essential fish habitats of the Gulf of Mexico by implementing field efforts to restore and improve marine and coastal habitats that have been degraded or lost.

- *U.S. Fish & Wildlife Service Partnership for Fish & Wildlife* (see: http://partners.fws.gov/index.htm) - This program is supported by funds from federal and state agencies, private landowners, and non-governmental organizations (e.g., Ducks Unlimited, CDFG, The Nature Conservancy). The program is a voluntary partnership program with a goal to restore wetlands and other vital habitats on private land with 70% of the current funding coming from private sources. The remaining funds, along with restoration design and technical assistance is provided by USFWS. State resource agencies, such as CDFG, work with the FWS to help establish priorities and identify focus areas. The restoration of degraded wetlands, native grasslands, streams, riparian areas, and other habitat to conditions as close as possible to natural is emphasized. The Partnership for Fish and Wildlife Program is important for restoration of critical habitats in

California (USFWS 2001). AES financial support to the program and potential in-kind service could potentially be negotiated as compensation for impingement mortality and entrainment at their power plants in southern California.

- *Coastal America's Corporate Wetland's Restoration Partnership (CWRP)*(see: http://www.coastalamerica.gov/text/cwrpoperating.html) - is a program designed to foster collaboration between the federal government, state agencies, and private corporations. Private corporations that participate in this national program will donate funds for either site-specific wetland or other aquatic habitat restoration projects or provide matching funds to a national or regional effort in support of aquatic ecosystem restoration activities. Projects that will receive funds from the CWRP will all be approved Coastal America projects while federal agencies will assist in their proper execution. The Coastal America Partnership will coordinate among all of its Regional Implementation Teams to identify the appropriate private foundation or state trust fund that will receive funds from the CWRP. This organization will not likely accept support in response to regulatory requirements. However, the organization is a source of wetland restoration information and unique partnerships may be arranged.

- Dam removal or fishway construction – an integral component to USFWS and NMFS anadromous fish restoration program is the provision of fish passage at existing artificial river obstructions. Passage can be obtained via direct dam removal or via the provision of fish passage. At the federal level, the key program is the National Fish Passage Program (see: http://fisheries.fws.gov/fwsma/fishpassage/). In 1999, the U.S. Fish and Wildlife Service initiated the National Fish Passage Program. The Program uses a voluntary, non-regulatory approach to remove and bypass barriers. The Program addresses the problem of fish barriers on a national level, working with local communities and partner agencies to restore natural flows and fish migration. The Program is administered by National and Regional Coordinators, and delivered by Fish and Wildlife Management Assistance Offices with their 300 biologists located across the Nation. Appropriations for the Program support the Coordinators, in-the-water fish passage projects, and the Fish Passage Decision Support System (subsequently described). The Program's goal is: to restore native fish and other aquatic species to self-sustaining levels by reconnecting habitat that has been fragmented by barriers, where such re-connection would not result in a net negative ecological effect such as providing increased habitat to exotic species. **Fish Passage Decision Support System** (see https://ecos.fws.gov/fpdss/index.do) is a database of barriers preventing fish movement that is complemented by analytical tools (GIS software) for mapping and prioritizing fish passage projects (calculating stream mileage made available by providing fish passage at the barrier). Barrier information includes location, type, size, owner, passage capabilities, associated fish species, and local habitat information.

CDFG and NMFS are actively involved in efforts to restore anadromous salmonids in California's coastal rivers. In the area of the AES facilities, restoration of the southern steelhead is of particular concern. While restoration efforts to date have been largely based on hatchery supplementation, RWQCB or other state and federal resource agencies may be receptive to the development of efforts to restore access to historical spawning habitat via dam removal (e.g., see Pejchar and Warner 2001) and or fish laddering at river barriers. As mitigation for impingement mortality and entrainment impacts at AES's California power plants, AES could negotiate removal of one or more dams or provide fish passage where dam removal is not an option. Alaska Steeppass fish ladders offer an effective and moderate cost approach for fishway provision. PSEG of New Jersey has successfully installed such fishways in tributaries to the lower Delaware Bay to restore access to historical spawning habitat for American shad, alewife, and blueback herring. Dam removal, if pursued, would focus on abandoned, non-hydropower projects, such as old low-head mill dams or flow control structures (river levees). The Rindge Dam on Malibu Creek (see: http://www.irn.org/revival/decom/alerts/rindgealert.html), for example, is under strong consideration for removal. Consensus is building among local NGOs and federal and state resource agencies that this aging and silted-in dam should be removed to speed southern steelhead recovery efforts. Steelhead once spawned as far as 3 miles upstream of the dam. Removal of this structure would re-open the habitat to potential spawning by this endangered species. The major impediment to removal is a lack of funding. The California State Department of Parks and Recreation is acting as the clearinghouse for securing the state's share of the funding. Federal efforts are being led by the U.S. Army Corps of Engineers. Fish passage programs could be combined with stocking to restore specific anadromous species of concern such as the southern steelhead. As previously noted, such an approach was successful for restoring American shad to the Susquehanna River in Pennsylvania and Maryland.

- Alternative restoration measures – the above measures have been identified as the most likely restoration approaches that would be receptive to RWQCB and other federal and state resource agencies. Other potential approaches include nonpoint source pollutant runoff abatement programs and contaminated sediments restoration. While these types of efforts focus on water quality improvements, the long-term benefit is improved fish and shellfish habitat. Such efforts would have to demonstrate a clear linkage between the two as compensation for impingement mortality and entrainment losses at AES's southern California power stations. The California Coastal Commission is implementing a statewide Nonpoint Source (NPS) Program (see: http://www.coastal.ca.gov/nps/npsndx.html). Elements of the plan include management measures for reducing runoff pollution from agriculture, silviculture, urban areas, marinas and recreational boating, and via hydromodification (includes modification of stream and river channels, dams and water impoundments, and streambank/shoreline erosion). CCC, therefore, is a source of information for developing a potential nonpoint source runoff abatement program or implementing best management practices (BMPs) to meet the goals of the State's plan in the Los Angeles urban and suburban areas. RWQCB may welcome direct support by AES toward implementing some of the BMPs as compensation for the impingement (and entrainment losses) at AES power plants.

References

Bailey, D. E., J. J. Loos, E. S. Perry, R. J. Wood. 2000. A retrospective evaluation of 316(b) mitigation options using a decision analysis framework. Pages S25-S36 *in* D. A. Dixon, D. E. Bailey, C. Jordan, J. Wisniewski, J. R. Wright, Jr., and K. D. Zammit (Editors). Power Plants & Aquatic Resources: Issues and Assessment. *Environmental Science & Policy* 3(Supplement 1).

CDFG/NMFS (California Department of Fish and Game and National Marine Fisheries Service). 2001. Final report on anadromous salmonid fish hatcheries in California. Joint Hatchery Review Committee, Sacramento, CA. December 3, 2001 (report can be downloaded from: http://www.dfg.ca.gov/lands/fish1.html).

Deysher, L. E., et al. 2002. Design considerations for an artificial reef to grow giant kelp (*Macrocystis pyrifera*) in Southern California. *ICES Journal of Marine Science* 59: S201-S207

Duke Energy Morro Bay LLC. 2002. Morro Bay Power Plant Modernization Project. Habitat Enhancement Program. Morro Bay, California. Report can be downloaded at: http://www.duke-energy.com/businesses/plants/own/us/western/morrobay/reports/

EPRI. 2003. Enhancement Strategies for Mitigating Potential Operational Impacts of Cooling Water Intake Structures: Final Technical Report. Report 1007454. June 2003. Palo Alto, CA.

EPRI. 2002b. Guidelines for Selection of 316(b) Assessment Method or Model. Report 1005176, May 2002. Palo Alto, CA.

Fox, D. A., J. E. Hightower, and F. M. Parauka. 2002. Estuarine and nearshore marine habitat use by Gulf sturgeon from the Choctawhatchee River System, Florida. Pages 111-126 *in* W. Van Winkle, P. Anders, D. Secor, and D. Dixon, editors. Biology, Management, and Protection of North American Sturgeon. American Fisheries Society Symposium 28, Bethesda, MD.

Goodyear, C. P. 1978. Entrainment impact estimates using the equivalent adult approach. Report No. FWS/OBS-78/65. U.S. Fish and Wildlife Service, Washington, D.C.

Hendricks, M. L. 1995. The contribution of hatchery fish to the restoration of American shad in the Susquehanna River. Pages 329-336 *in* H. L. Schramm, Jr. and R. G. Piper, editors. Uses and effects of cultured fishes in aquatic ecosystems. American Fisheries Society Symposium 15, Bethesda, Maryland, USA

Jensen, A. L., R. H. Reider, and W. P. Kovalak. 1988. Estimation of production foregone. *North American Journal of Fisheries Management* 8: 191-198.

Kneib, R. T. 2003. Bioenergetic and landscape considerations for scaling expectations of nekton production from intertidal marshes. Marine Ecology Progress Series 264: 279-296.

LaJeone, L. J., and R. G. Monzingo. 2000. 316(b) and Quad Cities Station, Commonwealth Edison Company. Pages S313-S322 *in* D. A. Dixon, D. E. Bailey, C. Jordan, J. Wisniewski, J. R. Wright, Jr., and K. D. Zammit (Editors). Power Plants & Aquatic Resources: Issues and Assessment. *Environmental Science & Policy* 3(Supplement 1).

McCay, D. P. F., and J. J. Rowe. 2003. Habitat restoration as a mitigation for lost production at multiple trophic levels. Marine Ecology Progress Series 264: 233-247.

Peterson, C. H., and R. N. Lipcius. 2003. Conceptual progress towards predicting quantitative ecosystem benefits of ecological restorations. Marine Ecology Progress Series 264: 297-307.

Mettee, M. F., and P. E. O'Neil. 2003. Status of Alabama shad and skipjack herring in Gulf of Mexico drainages. Pages 157-170 *in* K. E. Limburg and J. R. Waldman (Editors). Biodiversity, status, and conservation of the world's shads. American Fisheries Society Symposium 35, Bethesda, Maryland, USA.

NOAA. 1997. Scaling compensatory restoration actions. U. S. Department of Commerce, National Oceanic and Atmospheric Administration – Damage Assessment and Restoration Program, Silver Spring, Maryland. See also: http://www.nmfs.noaa.gov/habitat/restoration/projects_programs/darp/index.html

Pejchar, L., and K. Warner. 2001. A river might run through it again: criteria for consideration of dam removal and interim lessons from California. Environmental Management 28(5): 561-575.

Peterson, C. H., R. T. Kneib, and C-A. Manen. 2003. Scaling restoration actions in the marine environment to meet quantitative targets of enhanced ecosystem services. Marine Ecology Progress Series 264: 173-175.

Peterson, C. H., J. H. Grabowski, and S. P. Powers. 2003. Estimated enhancement of fish production resulting from restoring oyster reef habitat: quantitative valuation. Marine Ecology Progress Series 264: 249-264.

Powers, S. P., J. H. Grabowski, C. H. Peterson, and W. J. Lindberg. 2003. Estimating enhancement of fish production by offshore artificial reefs: uncertainty exhibited by divergent scenarios. Marine Ecology Progress Series 264: 265-277.

Rago, P. J. 1984. Production foregone: an alternative method for assessing the consequences of fish entrainment and impingement losses at power plants and water intakes. *Ecological Modelling* 24: 79-111.

Reed, D., S. Schroeter, and M. Page. 2002. Proceedings from the second annual public workshop for the SONGS Mitigation Project. San Clemente, CA, February 27, 2002. Submitted to the California Coastal Commission by the Marine Science Institute, University of California, Santa Barbara. April 3, 2002.

St. Pierre, R. A. 2003. A case history: American shad restoration on the Susquenhanna River. Pages 315-322 *in* K. E. Limburg and J. R. Waldman (Editors). Biodiversity, status, and conservation of the world's shads. American Fisheries Society Symposium 35, Bethesda, Maryland, USA.

Strange, E., H. Galbraith, S. Bickel, D. Mills, D. Belton, and J. Lipton. 2002. Determining ecological equivalence in service-to-service scaling of salt marsh restoration. Environmental Management 29(2): 290-300

U.S. Fish & Wildlife Service (USFWS). 2001. Partners for Fish and Wildlife: California. Partners for Fish and Wildlife Program, Sacramento, CA.

Weinstein, M. P., et al. 2001. Restoration principles emerging from one of the world's largest tidal marsh restoration projects. *Wetlands Ecology and Management* 9: 387-407

B DESCRIPTION OF HBGS HISTORICAL STUDIES, PHYSICAL AND BIOLOGICAL INFORMATION

See following pages.

Attachment B
Description of HBGS Historical Studies and Physical/Biological Conditions

The following sections summarize the physical and biological environment near the HBGS, and summarize relevant historical studies that were performed for the HBGS. Also included is a brief summary of the analytical approach for the use of data from the 2003-2004 Entrainment and Impingement Study (MBC and Tenera 2005) in the 316(b) compliance process.

PHYSICAL CONDITIONS

The physical and biological characteristics of the subtidal environment off Huntington Beach have been studied extensively by the Huntington Beach Generating Station (HBGS) operators (Southern California Edison Company [SCE] and AES Huntington Beach L.L.C.) and by the Orange County Sanitation District (OCSD), which discharges primary- and secondary-treated wastewater from a diffuser outfall about 7 km (4 nmi) offshore the generating station in about 60 m of water. Studies performed for the generating station have examined the physical and biological characteristics of the nearshore zone (depths to about 10 m), while studies performed by OCSD have been focused in deeper waters around the wastewater outfall.

Coastal waters in the vicinity of the HBGS intake structure are saline (33 to 34 practical salinity units), though brackish or fresh water may be present near the surface following rainfall (MBC 2005). Weekly temperature profiles off the HBGS from September 2003 through August 2004 indicated coolest temperatures in winter (December through February) and warmest temperatures in summer (June through August) (MBC 2005). During summer, a thermocline is common near the intake, with warmer surface waters overlying cooler bottom waters. The thermocline breaks down in fall, and in winter, waters are not stratified. The thermocline begins formation again in late spring or early summer. From June 1999 to June 2000, currents directly offshore the HBGS moved downcoast and onshore, with a net excursion of 499 km onshore and 659 km downcoast (MBC 2005). Other researchers have reported similar patterns in the area. In 2001, currents were primarily downcoast with maximum velocities near the surface on the outer shelf, and current velocities tended to decrease as a function of proximity to shore (Noble and Xu 2003).

The coastline of Huntington Beach runs, in general, from west-northwest to east-southeast. The continental shelf offshore the generating station is gently sloping; the 30-m isobath is nearly 7 km from shore. Subtidal sediments are predominantly sand, with lesser amounts of silt and clay (OCSD 2000, MBC 2005). Off Huntington Beach, grain size generally decreases with depth. The nearest stand of giant kelp (*Macrocystis pyrifera*) is located inside the Newport Harbor entrance jetty.

The HBGS is located just across Pacific Coast Highway (inland) from the Huntington State Beach, and the intake and discharge structures for the generating station are just offshore the state beach. The state beach is a little over two miles in length, extending north from the Santa Ana River mouth past the generating station to Beach Boulevard. At Beach Boulevard, the state beach borders the Huntington City Beach. Over 11 million people visit the beaches of Huntington Beach annually.

HISTORICAL IMPINGEMENT AND ENTRAINMENT STUDIES

The following section identifies and summarizes previous entrainment and impingement studies conducted at the HBGS. Results from the recent (2003-2004) Entrainment and Impingement Study are proposed for use in determination of the Calculation Baseline. Other studies are summarized simply for context and determination of inter-annual variation.

1978–1980 Huntington Beach Generating Station 316(b) Demonstration

In the 1970s, SCE owned and operated eight coastal generating stations between Oxnard and San Onofre, California. Before conducting intensive 316(b) field studies, SCE studied the physical and biological characteristics of the different generating station intakes (Schlotterbeck et al. 1979). From this analysis, the “representative site concept” was derived. Five groups of intakes with similar characteristics were identified. One intake from each of these groups was used as a representative of all intakes in that group for determination of entrainment of fish larvae. However, impingement sampling of juvenile and adult fishes was conducted at each cooling water intake system. Impacts of cooling water system entrainment and impingement on fishery resources was determined by comparison of losses to available fishery stocks, which were estimated from collections of ichthyoplankton in the Southern California Bight and long-term adult fish monitoring at the generating stations. Results of entrainment studies conducted at the Ormond Beach Generating Station and San Onofre Nuclear Generating Station were used to assess fish losses at the HBGS (with adjustments made for differences in flow volumes between the plants). Target species subjected to analysis were selected in consultation with the California Regional Water Quality Control Board and the California Department of Fish and Game.

Entrainment samples were collected monthly at Ormond Beach and San Onofre from August 1979 through July 1980 (SCE 1983). Samples were collected by pump from the intake structures during six cycles (two day, two night, and two crepuscular cycles) each 24-hr survey period, and filtered through 333-μm mesh plankton nets. Northern anchovy, white croaker, and queenfish comprised 78% of the entrained larvae at Huntington Beach Generating Station estimated using the data from the other facilities (**Table 1**).

Table 1. Daily entrainment estimates at the HBGS from August 1979 through July 1980.

Target Species		Daily Entrainment	Percent
northern anchovy	*Engraulis mordax*	1,106,000	42.9
white croaker	*Genyonemus lineatus*	687,000	26.6
queenfish	*Seriphus politus*	229,000	8.9
spotfin croaker	*Roncador stearnsii*	9,000	0.4
kelp bass	*Paralabrax clathratus*	5,000	0.2
barred sand bass	*Paralabrax nebulifer*	2,000	0.1
Pacific butterfish	*Peprilus simillimus*	2,000	0.1
black croaker	*Cheilotrema saturnum*	1,000	<0.1
sargo	*Anisotremus davidsonii*	<1,000	<0.1
yellowfin croaker	*Umbrina roncador*	<1,000	<0.1
bocaccio	*Sebastes paucispinis*	0	0
Other Species			
Unidentified larvae	Pisces, unid.	111,000	4.3
Other larvae		106,000	4.2
Unid. yolk sac larvae	Pisces, unid.	90,000	3.5
bay goby	*Lepidogobius lepidus*	89,000	3.4
cheekspot goby	*Ilypnus gilberti*	77,000	3.0
combtooth blennies	*Hypsoblennius* spp.	35,000	1.3
California corbina	*Menticirrhus undulatus*	18,000	0.7
Unid. kelp blenny	*Gibbonsia* sp.	14,000	0.5
Total		2,581,000	100.0

Impingement samples were collected at Huntington Beach from October 1978 through September 1980 (SCE 1983). Both 24-hr normal operations and heat treatment surveys were performed. During normal operation surveys, traveling screens and collection baskets were initially cleared, and impinged organisms were allowed to collect for a 24-hr period. Estimated annual normal operations totals were calculated by multiplying the mean daily impingement loss by the number of operational days during the period. The study period was stratified by month for purposes of analysis. Heat treatment fish loss, representing the actual count and weight of organisms, was added to the estimated normal operation fish loss to determine the total fish loss on an annual basis.

Queenfish and white croaker were the dominant species in the impingement study, comprising 64% and 11%, respectively, of total impingement abundance. Daily impingement estimates are presented in **Table 2**, and were calculated by adding the annual normal operations estimate and heat treatment totals, and dividing by 365.

Table 2. Daily impingement estimates at the HBGS from October 1978 through September 1980.

Target Species		Daily Impingement	Percent
queenfish	*Seriphus politus*	1,712.7	64.4
white croaker	*Genyonemus lineatus*	299.1	11.3
walleye surfperch	*Hyperprosopon argenteum*	200.4	7.5
northern anchovy	*Engraulis mordax*	181.7	6.8
Pacific butterfish	*Peprilus simillimus*	87.5	3.3
white seaperch	*Phanerodon furcatus*	78.6	3.0
shiner perch	*Cymatogaster aggregata*	22.3	0.8
black perch	*Embiotoca jacksoni*	3.1	0.1
barred sand bass	*Paralabrax nebulifer*	1.8	0.1
kelp bass	*Paralabrax clathratus*	1.2	<0.1
black croaker	*Cheilotrema saturnum*	0.8	<0.1
sargo	*Anisotremus davidsonii*	0.3	<0.1
bocaccio	*Sebastes paucispinis*	<0.1	<0.1
yellowfin croaker	*Umbrina roncador*	0.1	<0.1
spotfin croaker	*Roncador stearnsii*	0	0
Total		2,589.6	100.0

Impact analyses were based on the approach of MacCall et al. (1983), and calculated the magnitude of loss for all life stages. The probability of mortality due to entrainment and impingement by the cooling water intake system at Huntington Beach Generating Station was calculated through the first five years of each target species' life cycle. The source water population was considered to reside in the Southern California Bight between shore and the 75-m isobath (SCE 1982). Probability of mortality values could only be calculated for six of the target species due to low abundance of other species. At the HBGS, probability of mortality ranged from 0.14% (kelp bass) to 6.6% (queenfish). Impacts to most fish populations from the operation of the cooling water system at the HBGS were determined to be insignificant, indicating observed losses would have no effect on the dynamics of nearshore fish populations. Queenfish losses were regarded as significant; however, "biological evidence indicated that no adverse effect on the nearshore population was expected." Regardless, SCE examined nine alternative cooling water intake technologies and/or devices potentially applicable at Huntington Beach (LMS 1982). It was determined that the velocity-capped cooling water intake in place at the time represented the best technology available. The results of this study have been used to determine 316(b) compliance at the HBGS since the 1980s.

1979-1980 Velocity Cap Effectiveness Study

The effectiveness of the velocity cap of the HBGS cooling water intake structure was studied in July 1979 and July 1980 (Thomas et al. 1980). The study examined entrapment (the entry of fishes into the cooling water intake system) during periods of normal flow (with the velocity cap) and reverse flow (without the velocity cap). Researchers also examined differences between entrapment rates during daytime and nighttime. Results are summarized in **Table 3**.

Table 3. Entrapment Densities at the HBGS during the 1979 and 1980 Velocity Cap Studies (Thomas et al. 1980).

Year	Velocity Cap?	Species (time)	Entrapment Density	Effectiveness
1980	No	All (daytime)	47.2 kg/hr	
1980	Yes	All (daytime)	0.65 kg/hr	99%
1980	No	All (nighttime)	52.99 kg/hr	
1980	Yes	All (nighttime)	6.78 kg/hr	87%
			Average:	**93%**
1979	No	All (day/night 18-hr)	20.45 kg/hr	
1979	Yes	All (day/night 18-hr)	1.97 kg/hr	90%
1979	No	All (nighttime)	32.93 kg/hr	
1979	Yes	All (nighttime)	15.53 kg/hr	53%
			Average:	**72%**

During both study periods, entrapment rates were substantially lower when the velocity cap was in use. Entrapment was also higher at nighttime than during daytime. On average, the velocity cap resulted in an 82% reduction in entrapment at the HBGS.

1979-2004 NPDES Fish and Macroinvertebrate Impingement Monitoring

Composition, abundance, and biomass of juvenile and adult fish and macroinvertebrates impinged at the Huntington Beach Generating Station have been monitored for many years (and continue to the present). Fish impingement sampling was conducted during representative periods of normal operation and during all heat treatment procedures to obtain an estimate of total impingement for the year. A normal operation survey is defined as a sample of all fish and macroinvertebrates entrained by water flow into the generating station intake and subsequently impinged and removed by traveling screens during a 24-hr period. The number of operational days per year is usually less than 365 because of plant downtime for maintenance and seasonal fluctuations in power demand, which may lead to decreased cooling water flow. Normal operation abundance and biomass for a given study year were estimated by extrapolating the monitored abundance and biomass based on the percentage of the annual cooling water flow into the generating station during sampling days.

Methods

During normal operation surveys, the traveling screens were rotated for an approximate 10-minute rotation, and the impingement collection basket was cleared of accumulated debris. If this was not possible, a tarp was laid across the debris to separate it from the subsequent collection. Approximately 24 hr later, the screens were rotated again, and all material that accumulated from that screen wash, and any other washes that occurred in the prior 24 hr, was considered part of that normal operation sample. All fish and macroinvertebrates were separated from incidental debris, identified, and counted. Up to 200 individuals of each fish species were measured and examined for external parasites, anatomical anomalies, and other abnormalities. Aggregate weights were taken for each fish and macroinvertebrate species. Annual impingement totals (abundance and biomass) were determined by extrapolating the results from surveys to an annual total based on cooling water flow. Flow during each ~24-hr survey, as well as annual flow, was provided by plant personnel.

Heat treatments are operational procedures designed to eliminate mussels, barnacles, and other fouling organisms growing in the cooling water conduit system. During a heat treatment, heated effluent water from the discharge is redirected to the intake conduit via cross-connecting tunnels until the water temperature rises to approximately 40.5°C (105°F) in the screenwell area. This temperature is maintained for at least one hour, during which time all biofouling organisms, as well as fish and invertebrates living within the cooling water system, succumb to the heated water. During heat treatment surveys, all material impinged onto traveling screens was removed from the forebay. Fish and macroinvertebrates were separated from incidental debris, identified, and counted. Up to 200 individuals of each species were measured, examined for external parasites, anatomical anomalies, and other abnormalities. Aggregate weights were taken by species. Data were collected for each heat treatment survey and combined with the estimated normal operation data to determine estimated total impingement loss for the year. The database for heat treatment and normal operation surveys extends back to 1979 for fish, but only to 1994 for macroinvertebrates. The number of normal operation and heat treatment surveys conducted each year are presented in **Table 4.**

QA/QC Measures

Field Sampling. Impingement sampling was done in conformance with specifications set forth by the Santa Ana Regional Water Quality Control Board (SARWQCB) in the NPDES permits. Specimens in poor physical condition or uncertain identity were crosschecked against taxonomic voucher collections maintained by MBC, as well as available taxonomic literature. Occasionally, outside experts were consulted to assist in the identification of species whose identification was difficult. Scales used to measure biomass (spring and electronic) were calibrated every three months.

Data Entry/Reporting. The following measures were employed to ensure accuracy of all data entered into computer databases and spreadsheets:

- Upon return from the field, all field data sheets were checked by the Project Manager for completeness and any obvious errors;
- Data were entered into pre-formatted spreadsheets;
- After data were entered, copies of the spreadsheets were checked against the field data sheets;
- Data were submitted annually to the SARWQCB, U.S. EPA Region IX, and the California Department of Fish and Game.

Results

Between 1979 and 2004, annual fish impingement (extrapolated normal operations plus heat treatments) averaged 208,396 fish weighing 5,611 kg (**Table 4**; MBC 2005). Highest impingement was recorded in 1981 (905,003 fish) and 1982 (835,295 fish), the years with the highest flow rates (458 mgd and 476 mgd, respectively). Impingement from October 2003 through September 2004 was 41,492 fish weighing 984 kg. Fish abundance in 2004 was dominated by queenfish (31,112 fish), white croaker (3,175 fish), and shiner perch (2,972 fish). Fish biomass in 2004 was dominated by queenfish (459 kg), Pacific electric ray (*Torpedo californica*; 137 kg), and white croaker (65 kg). The fish impingement rate (with respect to cooling water flow) decreased substantially after 1986 (**Figure 1**).

Table 4. Fish impingement results by year at the HBGS, 1979-2004.

	Total Fish Impingement			Heat Treatments			Estimated Normal Operations			
Year*	Fish Species	No.	Wt. (kg)	Surveys	No.	Wt. (kg)	Surveys	No.	Wt. (kg)	Mean Daily Flow (mgd)
1979	83	649,179	20,980	9	334,920	14,539	55	314,259	6,442	417.9
1980	88	676,803	20,919	10	549,804	18,019	91	126,999	2,901	392.9
1981	76	905,003	18,347	11	582,022	13,261	54	322,981	5,086	458.3
1982	75	835,295	16,721	7	464,675	10,080	38	370,620	6,641	476.2
1983	81	435,336	13,690	7	354,234	10,933	50	81,102	2,757	390.4
1984	71	477,063	11,488	7	381,936	7,964	50	95,127	3,524	338.3
1985	74	487,639	12,672	7	354,449	8,082	43	133,190	4,590	304.6
1986	69	314,011	8,692	7	218,012	5,842	42	95,999	2,850	216.5
1987	64	71,386	2,462	5	56,458	1,990	39	14,928	472	201.4
1988	61	96,045	3,332	7	84,408	2,737	58	11,637	595	163.4
1989	57	70,126	3,017	6	62,608	2,522	47	7,518	495	169.9
1990	44	38,549	1,833	6	33,014	1,087	61	5,535	746	152.6
1991	50	3,679	296	4	3,133	115	44	546	181	134.6
1992	52	10,397	396	5	9,140	177	47	1,257	219	145.3
1993	47	19,476	410	4	18,848	297	69	628	113	140.3
1994	50	12,797	843	9	12,353	144	30	444	699	146.3
1995	55	89,342	2,927	7	82,890	1,832	12	6,452	1,095	151.7
1996	42	37,536	705	7	37,046	662	12	490	43	144.7
1997	54	29,588	639	7	28,921	598	12	667	41	146.5
1998	45	25,920	674	6	22,753	471	10	3,167	203	159.9
1999	9	417	31	0	0	0	12	417	31	144.1
2000	21	4,574	711	1**	1,606	73	11	2,968	638	163.8
2001	34	11,964	616	1	4,685	313	12	7,279	304	179.7
2002	59	23,348	998	7	22,722	870	12	626	129	275.9
2003	59	51,320	1,512	8	48,804	1,404	20	2,516	109	286.0
2004	57	41,492	984	6	29,442	710	44	12,050	274	357.0
Avg.	**57**	**208,396**	**5,611**		**146,111**	**4,028**		**62,285**	**1,584**	**240.7**

* Sample year was Jan.-Dec. from 1979 through 1991, Jan.-Sep. in 1992, and Oct.-Sep. from 1993 on.
** Anoxic conditions due to no flow, not a heat treatment.
mgd = million gallons per day.

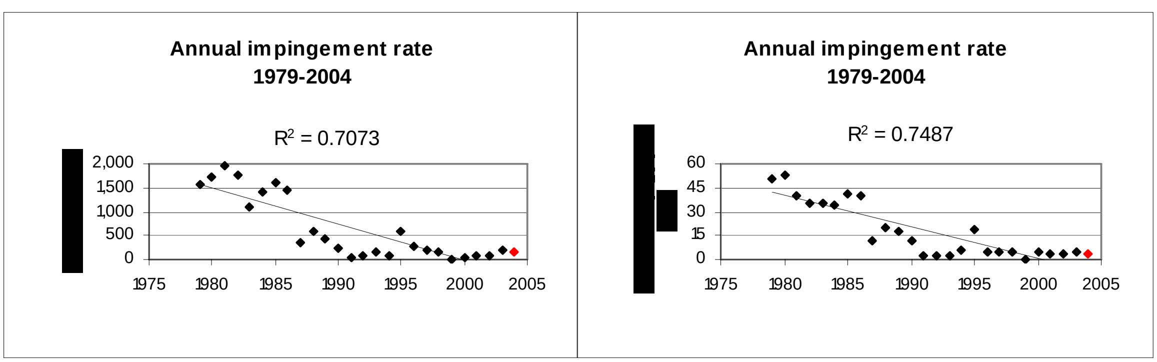

Figure 1. Fish impingement rates (catch per unit effort) from 1979 to 2004 at the HBGS. Catch per unit effort is expressed as annual individuals (left) and biomass (right) per 1,000,000 gallons per day of daily average cooling water flow. 2004 data points are derived from the 2003-2004 Entrainment and Impingement Study (MBC 2005).

Annual macroinvertebrate impingement (extrapolated normal operations plus heat treatments) averaged 22,319 individuals weighing 147 kg between 1994 and 2004 (MBC 2005). Highest impingement abundance was recorded in 2004 (83,060 macroinvertebrates), while highest impingement biomass occurred in 1999 (508 kg). Macroinvertebrate abundance in 2004 was dominated by the nudibranch *Dendronotus frondosus* (62,547 individuals), tuberculate pear crab (*Pyromaia tuberculata*; 7,110 individuals), and yellow rock crab (*Cancer anthonyi*; 6,013 individuals). Macroinvertebrate biomass in 2004 was dominated by yellow rock crab (31 kg), two-spotted octopus (*Octopus bimaculatus/bimaculoides*; 28 kg), and *Dendronotus frondosus* (17 kg). The long-term dataset for impinged macroinvertebrates is not as complete as that for fishes; annual macroinvertebrate impingement totals are available only from 1994 to present. During that time period, the impingement rate has increased slightly with respect to abundance, but biomass has remained stable (**Figure 2**).

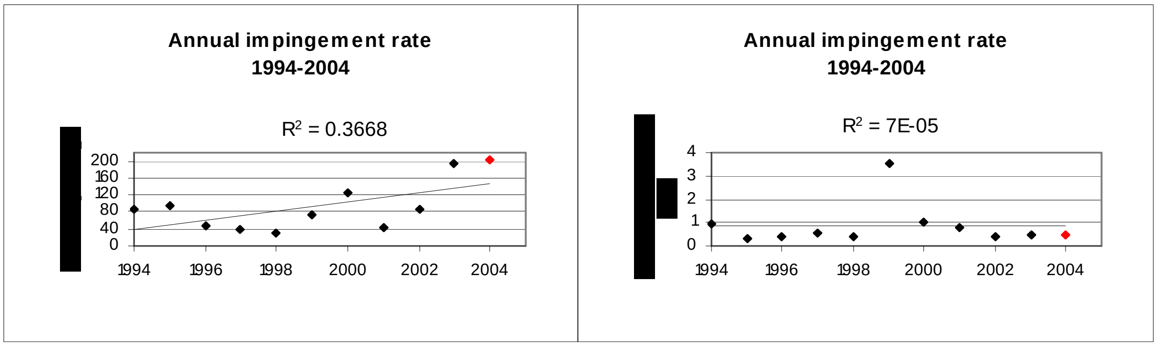

Figure 2. Macroinvertebrate impingement rates (catch per unit effort) from 1979 to 2004 at the HBGS. Catch per unit effort is expressed as individuals (left) and biomass (right) per 1,000,000 gallons per day of daily average cooling water flow. 2004 data points are derived from the 2003-2004 Entrainment and Impingement Study (MBC 2005).

2003-2004 Entrainment and Impingement Study

In December 2000, AES Huntington Beach L.L.C. submitted its Application for Certification to the California Energy Commission (CEC) for the AES Huntington Beach L.L.C. generating station Retool Project. The Project consisted of restoring and operating Units 3 and 4, which were retired from service in 1995. In March 2001, the CEC issued its Staff Assessment of the project, which recommended, “a license be issued for a restricted time period consistent with AES’s electrical generating contract with the Department of Water Resources or until September 30, 2006”. As part of this conditional license, AES was required to perform a yearlong entrainment and impingement study. Study methods were designed by a technical working group comprised of representatives of AES Huntington Beach, the Santa Ana Regional Water Quality Control Board, the California Energy Commission, State and Federal Resource Agencies, and consultants. Field sampling began in July 2003 upon completion of the repowering project (MBC and Tenera 2005).

Methods

To determine composition and abundance of ichthyoplankton entrained by the generating station, sampling in the immediate proximity of the cooling water intake was conducted twice monthly in September and October 2003, weekly from November 2003 through July 2004, and twice during August 2004. During each sampling event, two replicate tows at the entrainment station were collected four times per 24-hr period—once every six hours. Sampling cycles were initiated at approximately 1200 hr, 1800 hr, 2400 hr, and 0600 hr. The second and fourth cycles were initiated to correspond with sunset and sunrise, respectively.

Sampling was conducted offshore (within 100 m) of the submerged intake structure (**Figure 3**) using an oblique tow that sampled the water column from approximately 13 cm off the bottom and then back to the surface. Two replicate tows were taken with a minimum target sample volume of 30 to 40 m^3 for each net on the bongo frame. The net was redeployed if the target volume was not collected during the initial tow.

The wheeled bongo frame was fitted with 60-cm diameter net rings with plankton nets constructed of 333-µm Nitex® nylon mesh, similar to the nets used by the California Cooperative Oceanic Fisheries Investigations (CalCOFI). Each net was fitted with a Dacron sleeve and a cod-end container to retain the organisms. Each net was equipped with a calibrated General Oceanics® flowmeter, allowing the calculation of the amount of water filtered. At the end of each tow, nets were retrieved and the contents of the net gently rinsed into the cod-end with seawater. Contents were washed down from the outside of the net to avoid the introduction of plankton from the wash-down water. Samples were then carefully transferred to prelabeled jars with preprinted internal labels. Samples from one of the two nets were preserved in 4 percent buffered formalin-seawater, while contents of the other net were preserved in 70 to 80 percent ethanol. Larvae preserved in ethanol can be made available for genetic and/or otolith analysis, if required. Genetic analyses have been performed in recent studies in attempts to validate the identity of certain species.

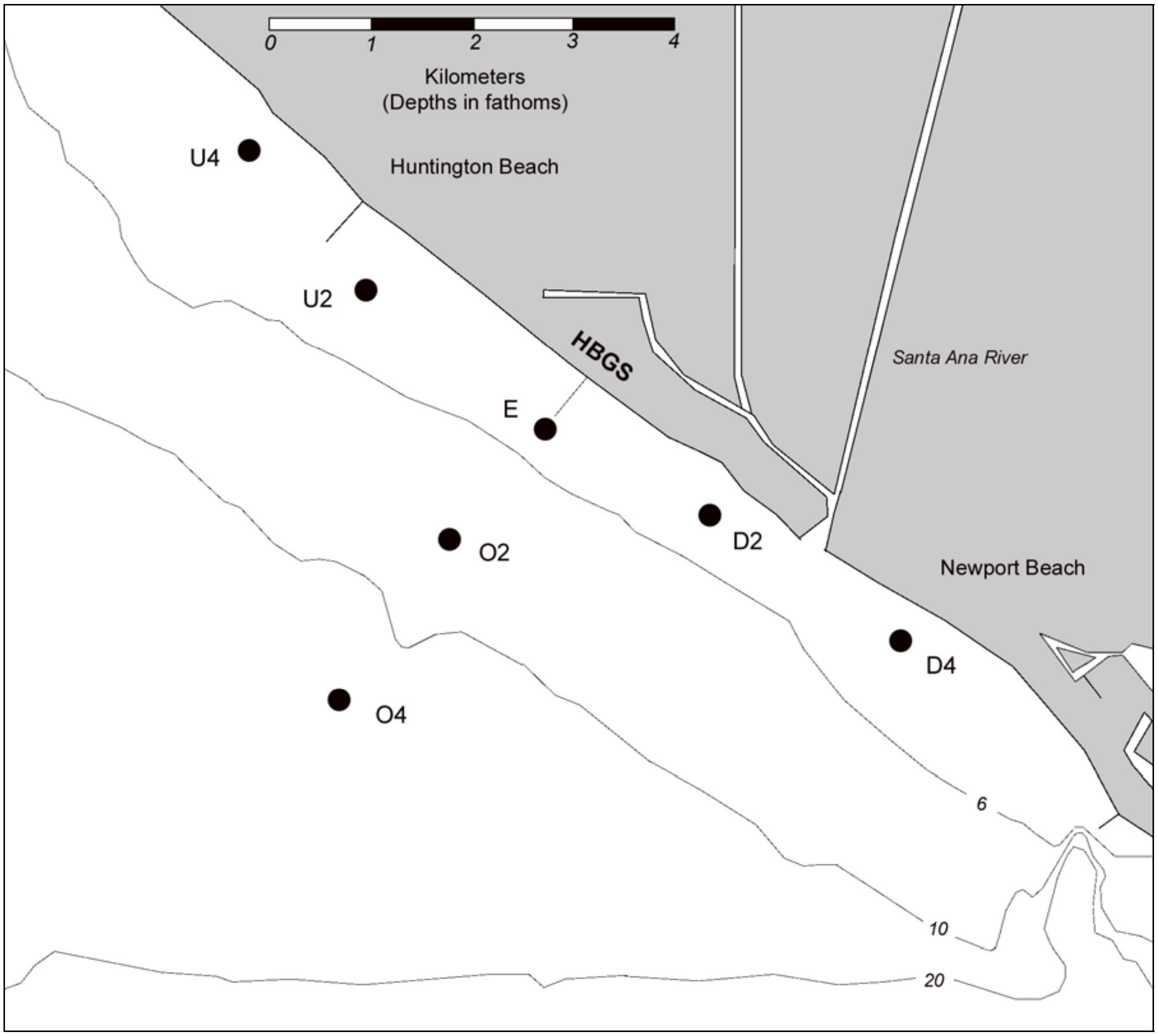

Figure 3. Location of entrainment (E) and source water sampling stations (U4, U2, D2, D4, O2, and O4), where U, D, and O designate stations upcoast, downcoast and offshore of the intake, respectively. Also shown are the 6-fathom (11-m), 10-fathom (18-m), and 20-fathom (36-m) isobaths.

MBC sampled fishes and macroinvertebrates impinged on traveling screens during normal operation of the HBGS on a weekly basis beginning in late-July 2003 and continuing through July 2004. Once per week, fish impingement samples were collected for one approximately 24-hr period in coordination with generating station operations personnel. Twenty-four hours prior to each survey, the screens were run and the accumulation dumpster emptied. The following day, traveling screens were operated for approximately 10 minutes, enough time to complete one rotation and sufficient to bring up any impinged organisms from the forebay for identification. Accumulated fishes, invertebrates, algae, and debris from the 24-hr sample were sorted, and fishes and macroinvertebrates were identified to species (whenever possible), enumerated and batch-weighed. Standard length of up to 200 individual fishes of each species was measured, and sex of up to 50 individuals of selected species was determined by external morphology or inspection of gonads. Algae and shell debris were identified and batch-weighed by species. Station operation data (number of circulator pumps operating, intake temperature, and discharge temperature) and general weather conditions were recorded during sampling.

Circulating water flow through the plant during the 24-hr sample period was determined by consulting with plant personnel. Results from each weekly 24-hr impingement sample were extrapolated to a weekly impingement total using cooling water flow for the 7-day period (Saturday through Friday). The normal operation impingement total was the sum of the weekly extrapolations based on the cooling water flow of the HBGS. A total of six heat treatment procedures was performed during the impingement study. All fish and macroinvertebrates impinged during the heat treatment procedures were identified, quantified, and weighed. Sample processing techniques were the same as those for normal operation surveys. The annual impingement estimate was the sum of the heat treatment results and the extrapolated normal operation results.

Entrainment

A total of 6,950 fish larvae in 57 different taxonomic groups was collected during the 45 entrainment surveys completed during the September 2003 through August 2004 period (**Table 5**), including 227 unidentified or damaged specimens. Ten taxa comprised 90% of the total larvae collected: unidentified gobies (mainly of the genera *Clevlandia, Ilypnus*, and *Quietula* [CIQ complex]), spotfin croaker, unidentified anchovies (>95% northern anchovy), queenfish, white croaker, salema, unidentified croakers (newly hatched larvae of several species), combtooth blennies, black croaker, and diamond turbot (*Pleuronichthys guttulatus*). Of the five target invertebrate taxa included in the study (*Cancer* crab megalops, market squid [*Loligo opalescens*] hatchlings, mole crab [sand crab; *Emerita analoga*], California spiny lobster [*Panulirus interruptus*], and ridgeback rock shrimp [*Sicyonia ingentis]*) only mole crab and *Cancer* crabs were found in the entrainment samples (**Table 6**). Mole crab zoeae comprised almost 99% of the entrained target invertebrates. Almost all of the mole crab larvae collected were in the earliest stages of their larval development (Zoea Stage I); only two megalopal stage larvae were collected from entrainment samples and none were collected from source water samples.

The measured larval densities during each survey were multiplied by a total daily maximum intake flow of 1,919,204 m^3 (507 mgd) that equates to an estimated annual cooling water volume of 702,428,664 m^3. Approximately 350 million fish larvae were calculated to have been entrained during the yearlong study (**Table 5**). The number of individual taxa increased during the study with greatest numbers of taxa occurring in summer 2004, from an average of approximately 8 taxa per survey from September through February to 18 taxa per survey in summer 2004, including a survey in late July when over 30 taxa were collected (**Figure 4**). The greatest overall abundances occurred in late summer 2004 when densities were approximately five times greater than earlier months (**Figure 5**). Although gobies and anchovies were abundant throughout the sampling period, high concentrations of spotfin croaker, salema, and queenfish contributed to peak abundances in August 2004. Low concentrations of larvae were measured during some surveys in early February and early March, although abundances generally increased through spring when many fishes start reproducing.

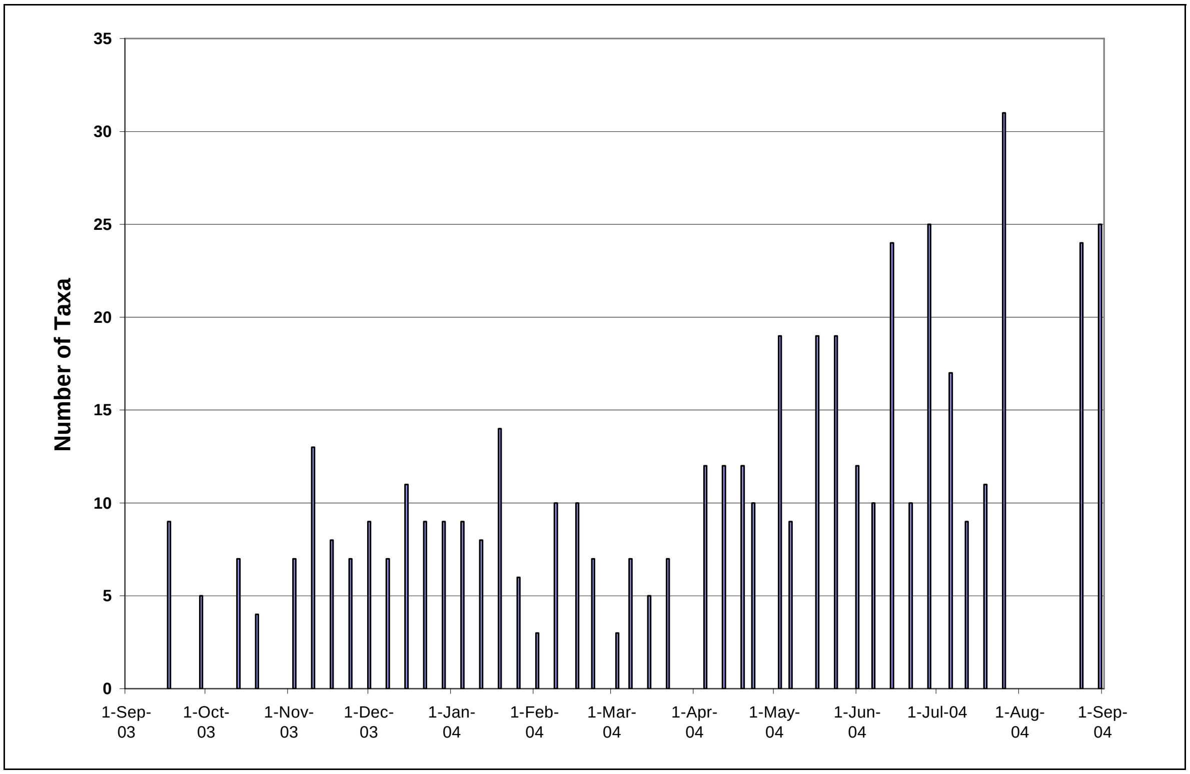

Figure 4. Total number of taxa per survey collected at the HBGS intake structure from September 2003 through August 2004.

Entrainment samples were characterized by large numbers of gobies, blennies, and several other fishes common in bay environments whose larvae were probably exported into the open ocean by tidal currents from estuarine spawning areas upcoast and downcoast of the HBGS. Some commercially and recreationally important taxa such as California halibut, white seabass, and rockfishes comprised a small percentage of the total number of taxa entrained, but others, including northern anchovy and several croaker species, comprised nearly 50% of the total fish larvae collected (**Table 5**).

Table 5. Larval fishes collected during 45 entrainment surveys from September 2003 through August 2004. A flow volume of 702,428,664 m^3 was used to estimate total entrainment for the sampling period.

	Taxon	Common Name	Sample Count	Percent of Total	Cumulative Percent	Mean Density (#/1000m3)	Total Estimated Entrainment	Entrainment Std. Error
1	Gobiidae (CIQ complex)	gobies	2,484	36.95	36.95	151.56	113,166,834	6,568,091
2	*Roncador stearnsi*	spotfin croaker	912	13.57	50.51	53.07	69,701,589	8,636,383
3	Engraulidae	anchovies	1,209	17.98	68.50	74.46	54,349,017	4,355,775
4	*Seriphus politus*	queenfish	306	4.55	73.05	18.17	17,809,864	2,415,487
5	*Genyonemus lineatus*	white croaker	446	6.63	79.68	28.14	17,625,263	1,491,336
6	*Xenistius californiensis*	salema	153	2.28	81.96	7.70	11,696,960	5,186,479
7	Sciaenidae	croaker	244	3.63	85.59	14.73	10,534,802	1,004,033
8	*Hypsoblennius* spp.	blennies	166	2.47	88.06	10.28	7,165,513	580,175
9	*Cheilotrema saturnum*	black croaker	96	1.43	89.48	5.41	7,128,127	1,481,158
10	*Hypsopsetta guttulata*	diamond turbot	87	1.29	90.78	5.28	5,443,118	476,544
11	*Paralichthys californicus*	California halibut	98	1.46	92.24	6.40	5,021,168	447,516
12	Atherinopsidae	silverside	97	1.44	93.68	5.98	3,654,229	577,117
13	*Menticirrhus undulatus*	California corbina	43	0.64	94.32	2.33	2,809,417	807,329
14	*Paralabrax* spp.	sand bass	48	0.71	95.03	2.93	2,793,730	518,724
15	*Citharichthys* spp.	sanddabs	31	0.46	95.49	2.15	1,913,607	314,973
16	*Hypsypops rubicundus*	garibaldi	43	0.64	96.13	2.44	1,622,966	776,711
17	*Oxyjulis californica*	senorita	27	0.40	96.53	1.66	1,190,449	311,376
18	*Sphyraena argentea*	California barracuda	14	0.21	96.74	0.79	1,133,103	258,040
19	Pleuronectidae	flounders	17	0.25	97.00	1.02	982,419	131,877
20	*Umbrina roncador*	yellowfin croaker	24	0.36	97.35	1.63	962,905	266,187
21	*Gillichthys mirabilis*	longjaw mudsucker	20	0.30	97.65	1.29	834,682	155,798
22	*Lepidogobius lepidus*	bay goby	18	0.27	97.92	1.16	683,887	161,835
23	Syngnathidae	pipefishes	17	0.25	98.17	0.91	591,496	353,236
24	*Leptocottus armatus*	Pacific staghorn sculpin	16	0.24	98.41	0.97	584,664	115,109
25	*Pleuronichthys ritteri*	spotted turbot	12	0.18	98.59	0.75	561,958	87,434
26	*Triphoturus mexicanus*	Mexican lampfish	8	0.12	98.71	0.51	536,324	95,606
27	*Acanthogobius flavimanus*	yellowfin goby	15	0.22	98.93	0.88	522,589	176,940
28	*Diaphus theta*	California headlight fish	11	0.16	99.09	0.63	486,274	110,942
29	Myctophidae	lanternfishes	6	0.09	99.18	0.39	423,578	94,314
30	Haemulidae	grunts	5	0.07	99.26	0.28	368,219	121,028
31	*Atractoscion nobilis*	white seabass	5	0.07	99.33	0.29	347,306	114,685
32	*Gibbonsia* spp.	clinid kelpfishes	10	0.15	99.48	0.55	341,921	87,691
33	*Pleuronichthys verticalis*	hornyhead turbot	3	0.04	99.52	0.17	198,470	52,984
34	*Sardinops sagax*	Pacific sardine	4	0.06	99.58	0.25	166,724	117,891
35	*Peprilus simillimus*	Pacific butterfish	2	0.03	99.61	0.14	138,138	56,479
36	*Semicossyphus pulcher*	California sheephead	2	0.03	99.64	0.13	129,222	52,033
37	*Stenobrachius leucopsarus*	northern lampfish	3	0.04	99.69	0.21	111,109	46,395
38	Labrisomidae	labrisomid kelpfishes	3	0.04	99.73	0.18	108,964	58,784
39	*Halichoeres semicinctus*	rock wrasse	1	0.01	99.75	0.06	97,344	45,888
40	Paralichthyidae	lefteye flounders & sanddabs	2	0.03	99.78	0.12	95,195	45,031
41	*Medialuna californiensis*	halfmoon	2	0.03	99.81	0.13	77,804	58,815
42	*Scomber japonicus*	Pacific mackerel	2	0.03	99.84	0.10	61,004	32,608
43	Scorpaenidae	scorpionfishes	1	0.01	99.85	0.09	50,467	38,150
44	*Symphurus atricauda*	California tonguefish	1	0.01	99.87	0.07	42,344	32,009
45	*Strongylura exilis*	California needlefish	1	0.01	99.88	0.07	40,637	30,719
46	*Oxylebius pictus*	painted greenling	1	0.01	99.90	0.07	40,289	30,456
47	*Typhlogobius californiensis*	blind goby	1	0.01	99.91	0.06	36,976	27,951
48	*Merluccius productus*	Pacific hake	1	0.01	99.93	0.06	33,954	25,667
49	*Coryphopterus nicholsi*	blackeye goby	1	0.01	99.94	0.06	33,202	25,099
50	Agonidae	poachers	1	0.01	99.96	0.05	30,817	23,295
51	*Ruscarius creaseri*	rouchcheek sculpin	1	0.01	99.97	0.05	30,813	23,293
52	Pleuronectiformes	flatfishes	1	0.01	99.99	0.05	30,192	22,823
53	Cottidae	sculpins	1	0.01	100.00	0.05	28,990	21,914
			6,723			**406.91**	**344,570,635**	
	larvae, unidentified yolksac	unidentified yolksac larvae	136			9.23	6,100,663	1,148,559
	larval fish fragment	unidentified larval fishes	51			3.08	2,508,742	386,659
	larval/post-larval fish unid.	larval fishes	39			2.37	1,655,508	246,622
	larval fish - damaged	unidentified larval fishes	1			0.06	41,681	29,473
			227			**14.74**	**10,306,594**	

Table 6. Invertebrate larvae (select taxa) collected during 45 entrainment surveys from September 2003 through August 2004. A flow volume of 702,428,664 m^3 was used to estimate total entrainment for the sampling period.

Taxon	Common Name	Sample Count	Percent of Total	Cumulative Percent	Mean Density (#/1000m3)	Total Estimated Entrainment	Entrainment Std. Error
Emerita analoga (zoea)	mole crabs - larva	10,399	98.73	98.73	658.95	465,806,877	91,912,298
Cancer anthonyi (megalops)	yellow crab	77	0.73	99.46	4.68	5,207,996	1,320,180
Cancer gracilis (megalops)	slender crab	31	0.29	99.75	1.97	1,304,771	311,450
Cancer antennarius (megalops)	brown rock crab	18	0.17	99.92	1.15	973,538	202,088
Cancer productus (megalops)	red rock crab	3	0.03	99.95	0.18	164,478	53,672
Emerita analoga (megalops)	mole crabs - larva	2	0.02	99.97	0.17	69,793	54,061
Cancer spp. (megalops)	cancer crabs	2	0.02	99.99	0.11	65,159	34,834
Cancer spp.	cancer crabs	1	0.01	100.00	0.06	35,885	27,126
		10,533			**667**	**473,628,497**	

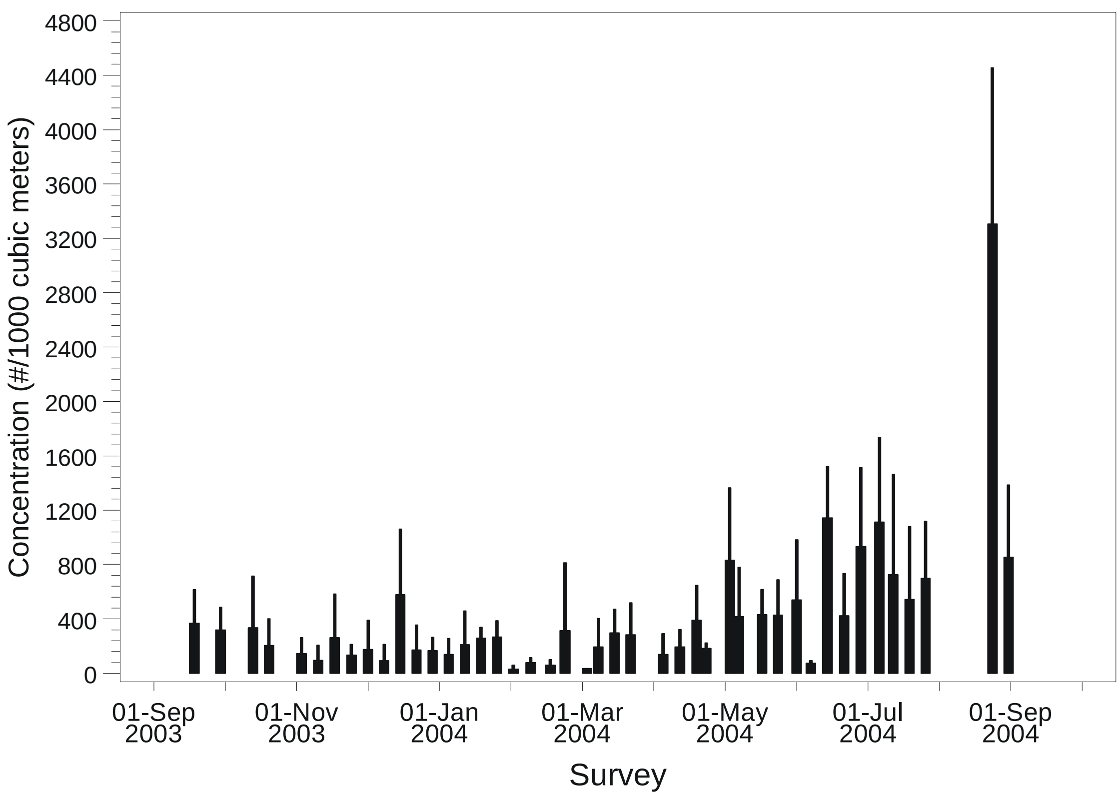

Figure 5. Mean concentrations (#/1000 m^3) and standard error for all larval fishes collected at the HBGS intake from September 2003 through August 2004.

Impacts due to entrainment were assessed using demographic models and the Empirical Transport Model (*ETM*). Of the 10 fish and 5 invertebrate species analyzed, entrainment estimates were converted to adult equivalents for only two fish species due to lack of required life history information. Adult Equivalent Loss (*AEL*) estimates were 147,493 CIQ gobies and 304,125 northern anchovies. Fecundity Hindcasting (*FH*) estimates were made for only three species due to lack of required life history parameters. The estimated number of adult females whose reproductive output was eliminated due to larval entrainment ranged from 6,466 combtooth blennies to 202,538 CIQ gobies. Lastly, the probability of mortality (P_m) for nine fish and one invertebrate species were calculated using the *ETM*. The P_m values were subsequently used to determine the Area of Production Foregone (APF) for target taxa. The APF is the estimated area of larval production that was lost due to the effects of entrainment. Results are presented in **Table 7**.

Table 7. Summary of entrainment modeling estimates for target taxa and estimation of area of production foregone. The shoreline distance (km) used in the alongshore extrapolation of P_m is presented in parentheses next to the shoreline distance estimate.

Taxon	Estimated Annual Entrainment	P_m Alongshore Extrapolation	Shoreline Distance (km) of Production Foregone	Area of Production Foregone (km^2)
CIQ gobies	113,166,834	1.0% (60.9 km)	0.604	3.024
n. anchovy	54,349,017	1.2% (72.0 km)	0.894	4.471
spotfin croaker	69,701,589	0.3% (16.9 km)	0.050	0.248
queenfish	17,809,864	0.6% (84.9 km)	0.531	2.657
white croaker	17,625,263	0.7% (47.8 km)	0.340	1.699
black croaker	7,128,127	0.1% (19.4 km)	0.023	0.115
salema	11,696,960	NA	NA	NA
blennies	7,165,513	0.8% (12.8 km)	0.098	0.492
diamond turbot	5,443,118	0.6% (16.9 km)	0.098	0.488
California halibut	5,021,168	0.3% (30.9 km)	0.077	0.386
rock crab	6,411,171	1.1% (26.5 km)	0.284	1.418

Fish Impingement

In total, an estimated 51,082 fish representing 57 species were impinged during 52 normal operations and six heat treatment surveys (**Table 8**). Surveys were conducted from July 2003 through July 2004. Total impingement biomass was 1,292 kg (2,848 lb). The most abundant fish species were queenfish (70%), white croaker (10%), shiner perch (8%), and northern anchovy (4%). Abundance during six heat treatment impingement surveys accounted for 75% of total impingement abundance.

Normal Operations Results. An estimated 12,694 fish representing 36 species were impinged during 52 weeks of normal operations surveys (**Table 8**). Highest normal operations abundance occurred on 28 January 2004. Aside from this somewhat anomalous impingement total, there were slight seasonal peaks of abundance in Sept.-Oct. 2003 (mainly queenfish and northern anchovy) and in Apr.-May 2004 (primarily queenfish and white croaker). The most abundant species were queenfish (83%), northern anchovy (7%), white croaker (2%), and shiner perch (2%). Abundance during the 52 normal operations surveys accounted for 25% of total impingement abundance. Fish biomass for the survey year totaled 290 kg (639 lb). Biomass was dominated by larger elasmobranchs, such as Pacific electric ray (45%), thornback (*Platyrhinoidis triseriata*; 6%), and bat ray (*Myliobatis californica*; 4%), as well as some of the more abundant fish species, including queenfish (20%) and specklefin midshipman (*Porichthys myriaster*; 4%).

Heat Treatment Results. An estimated 38,388 fish representing 55 species were impinged during six heat treatment surveys (**Table 8**). The most abundant species were queenfish (66%), white croaker (12%), shiner perch (10%), and northern anchovy (4%). Abundance during the six heat treatment impingement surveys accounted for 75% of total impingement abundance. Highest heat treatment abundance was recorded in May 2004 (primarily queenfish and white croaker) and in September 2003 (primarily queenfish and shiner perch).

Table 8. Fish impingement totals from 52 normal operation and 6 heat treatment surveys. (Continued on following page).

		Normal Operation Totals		Heat Treatment Totals		Impingement Totals		Percent of Total	
Species	**Common Name**	No.	Wt. (kg)	No.	Wt. (kg)	No.	Wt. (kg)	No.	Wt.
Seriphus politus	queenfish	10,468	58.015	25,379	590.141	35,847	648.156	70.2	50.2
Genyonemus lineatus	white croaker	274	3.374	4,629	92.047	4,903	95.421	9.6	7.4
Cymatogaster aggregata	shiner perch	215	2.014	3,830	49.813	4,045	51.827	7.9	4.0
Engraulis mordax	northern anchovy	824	5.513	1,369	9.343	2,193	14.856	4.3	1.2
Phanerodon furcatus	white seaperch	80	0.485	789	18.588	869	19.073	1.7	1.5
Peprilus simillimus	Pacific butterfish	131	2.096	470	13.826	601	15.922	1.2	1.2
Hyperprosopon argenteum	walleye surfperch	30	0.498	446	15.255	476	15.753	0.9	1.2
Atherinopsis californiensis	jacksmelt	23	2.370	309	27.298	332	29.668	0.7	2.3
Atherinops affinis	topsmelt	-	-	231	3.664	231	3.664	0.5	0.3
Leuresthes tenuis	California grunion	49	0.211	91	0.498	140	0.709	0.3	0.1
Paralabrax clathratus	kelp bass	-	-	138	46.965	138	46.965	0.3	3.6
Scorpaena guttata	California scorpionfish	35	5.528	75	21.066	110	26.594	0.2	2.1
Sardinops sagax	Pacific sardine	69	3.322	38	3.994	107	7.316	0.2	0.6
Urobatis halleri	round stingray	52	17.322	48	22.331	100	39.653	0.2	3.1
Porichthys myriaster	specklefin midshipman	99	10.249	1	0.006	100	10.255	0.2	0.8
Embiotoca jacksoni	black perch	12	1.873	54	5.288	66	7.161	0.1	0.6
Cheilotrema saturnum	black croaker	21	0.330	44	6.682	65	7.012	0.1	0.5
Paralabrax nebulifer	barred sand bass	7	0.364	55	9.301	62	9.665	0.1	0.7
Atractoscion nobilis	white seabass	11	0.135	49	4.793	60	4.928	0.1	0.4
Roncador stearnsii	spotfin croaker	-	-	49	1.766	49	1.766	0.1	0.1
Chromis punctipinnis	blacksmith	7	0.015	39	2.241	46	2.256	0.1	0.2
Xenistius californiensis	salema	11	0.101	35	0.345	46	0.446	0.1	<0.1
Pleuronichthys ritteri	spotted turbot	35	2.438	4	0.007	39	2.445	0.1	0.2
Menticirrhus undulatus	California corbina	-	-	33	3.104	33	3.104	0.1	0.2
Torpedo californica	Pacific electric ray	31	129.444	-	-	31	129.444	0.1	10.0
Heterostichus rostratus	giant kelpfish	21	1.045	9	0.708	30	1.753	0.1	0.1
Synodus lucioceps	California lizardfish	29	1.130	-	-	29	1.130	0.1	0.1
Pleuronichthys verticalis	hornyhead turbot	27	0.277	1	0.144	28	0.421	0.1	<0.1
Myliobatis californica	bat ray	19	10.659	5	7.267	24	17.926	<0.1	1.4
Citharichthys stigmaeus	speckled sanddab	14	0.043	9	0.054	23	0.097	<0.1	<0.1
Paralichthys californicus	California halibut	15	4.068	6	5.868	21	9.936	<0.1	0.8
Anchoa compressa	deepbody anchovy	6	0.032	14	0.144	20	0.176	<0.1	<0.1
Leptocottus armatus	Pacific staghorn sculpin	17	0.870	3	0.103	20	0.973	<0.1	0.1
Platyrhinoidis triseriata	thornback	18	15.812	2	1.242	20	17.054	<0.1	1.3
Girella nigricans	opaleye	7	4.274	12	8.378	19	12.652	<0.1	1.0
Rhacochilus vacca	pile perch	-	-	19	4.729	19	4.729	<0.1	0.4
Anisotremus davidsonii	sargo	-	-	17	1.434	17	1.434	<0.1	0.1
Rhacochilus toxotes	rubberlip seaperch	-	-	17	0.745	17	0.745	<0.1	0.1
Scomber japonicus	chub mackerel	-	-	17	0.336	17	0.336	<0.1	<0.1
Medialuna californiensis	halfmoon	-	-	13	3.545	13	3.545	<0.1	0.3
Porichthys notatus	plainfin midshipman	9	3.267	1	0.003	10	3.270	<0.1	0.3
Trachurus symmetricus	jack mackerel	7	0.030	2	0.253	9	0.283	<0.1	<0.1
Ophidion scrippsae	basketweave cusk-eel	7	0.378	1	0.011	8	0.389	<0.1	<0.1
Pleuronichthys guttulatus	diamond turbot	6	0.849	2	0.358	8	1.207	<0.1	0.1
Ophichthus zophochir	yellow snake eel	6	1.332	1	0.200	7	1.532	<0.1	0.1
Chilara taylori	spotted cusk eel	-	-	7	0.128	7	0.128	<0.1	<0.1
Umbrina roncador	yellowfin croaker	-	-	6	1.934	6	1.934	<0.1	0.1

Continued on next page.

Table 8. (Continued).

Species	Common Name	Normal Operation Totals No.	Normal Operation Totals Wt. (kg)	Heat Treatment Totals No.	Heat Treatment Totals Wt. (kg)	Impingement Totals No.	Impingement Totals Wt. (kg)	Percent of Total No.	Percent of Total Wt.
Halichoeres semicinctus	rock wrasse	-	-	4	1.391	4	1.391	<0.1	0.1
Hypsoblennius gilberti	rockpool blenny	-	-	3	0.016	3	0.016	<0.1	<0.1
Rhinobatos productus	shovelnose guitarfish	-	-	2	11.174	2	11.174	<0.1	0.9
Sebastes auriculatus	brown rockfish	-	-	2	1.184	2	1.184	<0.1	0.1
Triakis semifasciata	leopard shark	-	-	2	0.812	2	0.812	<0.1	0.1
Syngnathus californiensis	kelp pipefish	-	-	2	0.007	2	0.007	<0.1	<0.1
Paralabrax maculatofasciatus	spotted sand bass	-	-	1	0.900	1	0.900	<0.1	0.1
Semicossyphus pulcher	California sheephead	-	-	1	0.359	1	0.359	<0.1	<0.1
Odontopyxis trispinosa	pygmy poacher	-	-	1	0.005	1	0.005	<0.1	<0.1
Sebastes miniatus	vermillion rockfish	-	-	1	0.002	1	0.002	<0.1	<0.1
	Totals:	12,694	289.763	38,388	1,001.80	51,082	1,291.559	100.0	100.0
	No. of Species:	36		55		57			

Fish biomass during the six heat treatment surveys totaled 1,001.8 kg (2,209 lb). Biomass was dominated by the most abundant species, such as queenfish (59%), white croaker (9%), and shiner perch (5%), and larger fish such as kelp bass (*Paralabrax clathratus*; 5%) and jacksmelt (*Atherinopsis californiensis*; 3%).

Macroinvertebrate Impingement

In total, an estimated 70,638 invertebrates representing 37 species were impinged during the study year (**Table 9**). Total biomass was 168 kg (369 lb). The most abundant macroinvertebrate species were the nudibranch *Dendronotus frondosus* (88%), yellow rock crab (*Cancer anthonyi*; 4%), graceful rock crab (*Cancer gracilis*; 2%), and Pacific rock crab (*Cancer antennarius*; 2%). Abundance during six heat treatment impingement surveys accounted for less than 2% of total impingement abundance.

Normal Operations Results. An estimated 69,432 macroinvertebrates representing 31 species were impinged during 52 normal operations surveys (**Table 9**). Impingement was highest in late-March 2004 (primarily *Dendronotus*) and early-December 2003 (mainly *Dendronotus*). The most abundant species were the nudibranch *Dendronotus frondosus* (90%), yellow rock crab (4%), and graceful rock crab (2%). Abundance during 52 normal operations surveys accounted for more than 98% of total impingement abundance. Macroinvertebrate biomass during all 52 normal operations surveys totaled 150 kg (332 lb). Biomass was dominated by two-spotted octopus (15%), shell debris of the Pacific littleneck (*Protothaca staminea*; 15%), yellow rock crab (14%), purple-striped jelly (*Chrysaora colorata*; 14%) and the nudibranch *Dendronotus frondosus* (10%). No whole Pacific littleneck were impinged; instead, bits of shell debris were collected in 11 of 41 surveys, and in larger amounts (> five kilograms per week) during two of those nine surveys in July and September 2003. It is likely that individuals colonized the surfaces of the CWIS along with barnacles, mussels, and turf.

Table 9. Macroinvertebrate impingement totals from 52 normal operation and 6 heat treatment surveys.

Species	Common Name	Normal Operation Totals No.	Normal Operation Totals Wt. (kg)	Heat Treatment Totals No.	Heat Treatment Totals Wt. (kg)	Impingement Totals No.	Impingement Totals Wt. (kg)	Percent of Total No.	Percent of Total Wt.
Dendronotus frondosus	nudibranch	62,150	14.963	-	-	62,150	14.963	88.0	8.9
Cancer anthonyi	yellow rock crab	2,706	21.754	151	1.342	2,857	23.096	4.0	13.8
Cancer gracilis	graceful rock crab	1,484	2.905	11	0.079	1,495	2.984	2.1	1.8
Cancer antennarius	Pacific rock crab	958	8.588	68	1.179	1,026	9.767	1.5	5.8
Pyromaia tuberculata	tuberculate pear crab	597	0.955	386	0.382	983	1.337	1.4	0.8
Cancer productus	red rock crab	417	6.101	25	0.165	442	6.266	0.6	3.7
Crangon nigromaculata	blackspotted bay shrimp	336	0.511	2	0.004	338	0.515	0.5	0.3
Polyorchis penicillatus	jellyfish	326	4.207	-	-	326	4.207	0.5	2.5
Pachygrapsus crassipes	striped shore crab	27	0.088	149	0.401	176	0.489	0.2	0.3
Hermissenda crassicornis	nudibranch	50	0.031	111	0.114	161	0.145	0.2	0.1
Lysmata californica	red rock shrimp	20	0.026	140	0.194	160	0.220	0.2	0.1
Portunus xantusii	Xantus swimming crab	47	0.292	16	0.055	63	0.347	0.1	0.2
Octopus bimaculatus/bimaculoides	two-spotted octopus	27	22.919	34	2.474	61	25.393	0.1	15.2
Heptacarpus palpator	intertidal coastal shrimp	27	0.068	31	0.018	58	0.086	0.1	0.1
Chrysaora colorata	purple-striped jelly	53	21.674	-	-	53	21.674	0.1	12.9
Pisaster sp.	sea star (decomposed)	48	9.872	-	-	48	9.872	0.1	5.9
Ophiothrix spiculata	spiny brittlestar	26	0.082	14	0.007	40	0.089	0.1	0.1
Pugettia producta	shield-backed kelp crab	26	0.114	11	0.199	37	0.313	0.1	0.2
Panulirus interruptus	California spiny lobster	12	10.998	20	8.637	32	19.635	<0.1	11.7
Salpidae	salp, unid.	18	0.108	-	-	18	0.108	<0.1	0.1
Cerebratulus californiensis	ribbon worm	17	0.186	-	-	17	0.186	<0.1	0.1
Navanax inermis	California aglaja	-	-	15	0.038	15	0.038	<0.1	<0.1
Dendronotus subramosus	stubby dendronotus	-	-	14	0.028	14	0.028	<0.1	<0.1
Neotrypaea californiensis	bay ghost shrimp	13	0.060	-	-	13	0.060	<0.1	<0.1
Urechis caupo	innkeeper worm	6	0.577	2	0.025	8	0.602	<0.1	0.4
Flabellina iodinea	Spanish shawl	7	0.007	-	-	7	0.007	<0.1	<0.1
Loligo opalescens	market squid	7	0.442	-	-	7	0.442	<0.1	0.3
Parastichopus parvimensis	warty sea cucumber	7	0.459	-	-	7	0.459	<0.1	0.3
Loxorhynchus crispatus	masking crab	7	0.212	-	-	7	0.212	<0.1	0.1
Hemigrapsus oregonensis	yellow shore crab	6	0.006	-	-	6	0.006	<0.1	<0.1
Penaeus californiensis	yellowleg shrimp	5	0.185	-	-	5	0.185	<0.1	0.1
Pisaster ochraceous	ochre starfish	-	-	3	1.103	3	1.103	<0.1	0.7
Loxorhynchus grandis	sheep crab	-	-	1	0.657	1	0.657	<0.1	0.4
Pachycheles pubescens	pubescent porcelain crab	-	-	1	0.001	1	0.001	<0.1	<0.1
Pachycheles rudis	thick-clawed porcelain crab	-	-	1	0.001	1	0.001	<0.1	<0.1
Protothaca staminea	Pacific littleneck (debris)	-	22.012	-	-	-	22.012	<0.1	13.1
Petricola californiensis	California petricolid (debris)	-	0.058	-	-	-	0.058	<0.1	<0.1
	Totals:	69,432	150.462	1,206	17.103	70,638	167.565	100.0	100.0
	No. of Species:	31		22		37			

Heat Treatment Results. An estimated 1,206 macroinvertebrates representing 22 species were impinged during six heat treatment surveys (**Table 9**). The most abundant species were the tuberculate pear crab (32%), yellow rock crab (13%), striped shore crab (*Pachygrapsus crassipes*; 12%), and red rock shrimp (*Lysmata californica*; 12%). Abundance during the heat treatment impingement surveys accounted for only 2% of total impingement abundance. Heat treatment abundance was highest in late-May 2004, and that sample was comprised primarily of small crustaceans, including tuberculate pear crab, red rock shrimp, yellow rock crab, and striped shore crab.

Calculation Baseline

Entrainment and impingement data collected from the 2003-2004 Entrainment and Impingement Study (MBC and Tenera 2005) are proposed for use in determination of the Calculation Baseline as required by the Phase II Regulations (§125.95(b)(1)(ii)). The regulations stipulate the data must be representative of current conditions, and that proper quality assurance and quality control (QA/QC) measures were applied during data collection and analysis. Since the data were collected recently, the sampled densities are representative of current conditions. The Calculation Baseline for entrainment will be determined using densities of larval fishes and target invertebrates during 2003-2004, and scaled appropriately using cooling water flow volume from 2000-2004. Similarly, the calculation baseline for impingement will be determined using data from 2003-2004. As allowed in the §316(b) regulations, adjustments to the impingement data may be applied to account for fish protection afforded from the velocity cap and offshore location. Additionally, *AEL* estimates and Area of Production Foregone estimates may potentially be used in Cost-Benefit analyses. These estimates might also be scaled appropriately depending on the cooling water flow volume used in the Calculation Baseline. A discussion of the QA/QC measures applied during the 2003-2004 entrainment and impingement study is provided in the following section.

QA/QC Measures

This section describes the QA/QC measures applied to data collection and analysis efforts during the yearlong AES HBGS Entrainment and Impingement Study. The study design was required to follow those of recent entrainment and impingement studies (e.g. Diablo Canyon, Moss Landing, and Morro Bay). A technical working group (TWG) was formed to provide comment and guidance on study design, implementation, and analysis. The TWG was comprised of representatives from: AES Huntington Beach L.L.C., the California Energy Commission, the California Coastal Commission, the California Department of Fish and Game, National Marine Fisheries Service, the Santa Ana Regional Water Quality Control Board, the U.S. Fish and Wildlife Service, and consultants to AES Huntington Beach and the California Energy Commission. Members of the TWG were allowed to provide comments on three drafts of the study plan, a three-month data report (December 2003), a six-month report (April 2004), a nine-month report (September 2004), and a draft final report (February 2005).

Field Sampling. The following measures were employed to ensure proper sample collection, preservation, and processing in the field:

- Flowmeters were regularly calibrated to ensure accurate sample volume calculations;
- Nets and cod-ends were regularly inspected for damage and wear;
- Stations were located using a Global Positioning System that provided accuracy to within one meter;
- Tows where the difference in sample volumes between the two bongo nets were >20% were redone;
- Samples were transferred to prelabeled containers with preprinted internal labels.

Laboratory Processing. Once the samples were returned to the laboratory, the following measures were employed to ensure proper sample sorting and identifications:

Samples were first sorted at MBC for larval fishes. Subsequently, the samples were transferred to Tenera to sort the samples for target invertebrates. This second round of processing also ensured any missed larval fishes were sorted from the samples. The first ten samples sorted by an individual were resorted by a designated quality control (QC) sorter. A sorter was allowed to miss one target organism when the total number of target organisms in the sample was less than 20. For samples with 20 or greater target organisms the sorter was required to maintain a sorting accuracy of 90 percent. After a sorter processed ten consecutive samples with greater than 90 percent accuracy, the sorter had one of their next ten samples randomly selected for a quality control check. If the sorter failed to achieve an accuracy level of 90 percent their next ten samples were resorted by the QC sorter until they met the required level of accuracy. If the sorter maintained the required level of accuracy one of their next ten samples was resorted by QC personnel.

A similar QC program was conducted for the taxonomists identifying the samples. The first ten samples of fish or invertebrates identified by an individual taxonomist were completely re-identified by a designated QC taxonomist. A total of at least 50 individual fish larvae from at least five taxa must have been present in these first ten samples; if not, additional samples were reidentified until this criterion was met. Taxonomists were required to maintain a 95 percent identification accuracy level in these first ten samples. After the taxonomist identified ten consecutive samples with greater than 95 percent accuracy, they had one of their next ten samples checked by a QC taxonomist. If the taxonomist maintained an accuracy level of 95 percent then they continued to have one of each ten samples checked by a QC taxonomist. If they fell below this level then ten consecutive samples they identified were checked for accuracy. Samples were re-identified until ten consecutive samples meet the 95 percent criterion.

Identifications were crosschecked against taxonomic voucher collections maintained by MBC and Tenera Environmental. A maximum of 200 representative fish larvae from each of the target taxa were measured using a dissecting microscope and image analysis system. Larvae were measured to the nearest 0.5 mm.

Data Entry. The following measures were employed to ensure accuracy of all data entered into computer databases and spreadsheets:

- Upon return from the field, all field data sheets were checked by the Project Manager for completeness and any obvious errors;
- Data were entered into pre-formatted spreadsheets;
- After data were entered, copies of the spreadsheets were checked against the field data sheets;
- The same protocol was followed for entry of larval fish/invertebrate data.

2004-2005 Entrainment Survival Study

A study to determine the potential effects of the Huntington Beach Desalination Facility feedwater intake system was initiated in spring 2004 (Tenera 2004). The proposed facility would withdraw approximately 100 mgd from the HBGS cooling water system. After the seawater passes through the HBGS's condensers, 100 mgd would be withdrawn to produce 50 mgd of high-quality potable water. The remaining 50 mgd would be concentrated seawater, which would re-enter the HBGS cooling water discharge downstream from the Desalination Facility's intake point, and blend with up to 407 mgd of HBGS's cooling water flow for dilution prior to discharge in to the Pacific Ocean.

Beginning in spring 2004, plankton samples were collected biweekly by pumping discharge cooling water from the cooling water system through 4-in. diameter piping, a calibrated flowmeter, and a recessed-impeller pump. During the first three surveys, sample water was pumped into a tank with a 335-μm mesh plankton net. All material was subsequently rinsed into sample containers and preserved. In all subsequent surveys, the sample water was diverted into a tank with a net or into a larval table that was designed to allow the collection of larvae in a low-flow system to minimize potential damage from abrasion. The water was pumped into the table for approximately 15-min. and then diverted into the tank for the next 30-min. period. During the 30-min. period, the water in the larval table was drained and all material was removed from the table and sorted to remove larvae prior to preservation. All live larvae were placed into numbered collection chambers in an aquarium to track their condition for a period of up to two hours after collection. All samples from the tank and larval table were returned to the laboratory where the organisms were identified to the lowest taxonomic level practicable. The total number of larvae collected was used to determine composition and abundance of taxa present in the samples. The information from the study is being used in a CEQA process as part of the local permitting process for the plant.

Literature Cited:

Lawler, Matusky and Skeller Engineers (LMS). 1982. Intake technology review. Final report to Southern California Edison Company. Research and Development Series 82-RD-102. Sep. 1982. 250 p.

MacCall, A.D., K.R. Parker, R. Leithiser, and B. Jesse. 1983. Power plant impact assessment: A simple fishery production model approach. Fishery Bulletin U.S. 81(3):613-619.

MBC Applied Environmental Sciences. 2005. National Pollutant Discharge Elimination System, 2004 receiving water monitoring report, AES Huntington Beach L.L.C. Generating Station, Orange County, California. 2004 Survey. Prepared for AES Huntington Beach L.L.C. 59 p. plus appendices.

MBC Applied Environmental Sciences and Tenera Environmental. 2005. AES Huntington Beach L.L.C. Generating Station Entrainment and Impingement Study: Final Report. Prepared for AES Huntington Beach L.L.C. and the California Energy Commission. Feb. 2005. 224 p. plus appendices.

Noble, M. and J. Xu (eds.). 2004. Huntington Beach Shoreline Contamination Investigation, Phase III, Final Report. Coastal circulation and transport patterns: The likelihood of OCSD's plume impacting Huntington Beach shoreline. U.S. Geol. Sur. Open-File Report 2004-1019 Ver. 1.0. http://pubs.usgs.gov/of/2004/1019.

Orange County Sanitation District (OSCD). 2000. Marine monitoring 2000 annual report. CD-ROM.

Schlotterbeck, R.E., L.E. Larson, P. Dorn, R.C. Miracle, R.G. Kanter, R.R. Ware, D.B. Cadien, and D.W. Connally. 1979. Physical and biological categorization process for selection of Southern California Edison Company representative 316(b) study sites. Southern California Edison Company Research and Development Series: 79-RD-68. 46 p.

Southern California Edison Company (SCE). 1982. 316(b) Demonstration Technical Appendix: Impact assessment model and Bight-wide plankton investigations. Southern California Edison Company Research and Development Series: 82-RD-93. 30 p. plus appendices.

Southern California Edison Company. 1983. Huntington Beach Generating Station 316(b) Demonstration. Prepared for California Regional Water Quality Control Board, Los Angeles Region. Sep. 1982. 36 p. plus appendices.

Tenera Environmental. 2004. Huntington Beach Desalination Facility Intake Effects Assessment. Final Draft. Prepared for Poseidon Resources Corp. 26 Oct. 2004.

Thomas, G.L., R.E. Thorne, W.C. Acker, T.B. Stables, and A.S. Kolok. 1980. The effectiveness of a velocity cap and decreased flow in reducing fish entrapment. Final Report to Southern California Edison Company. Univ. Wash. Coll. Fisheries, Fisheries Res. Inst. FRI-UW-8027. 31 Dec. 1980. 22 p. plus appendices.

C PROPOSED METHOD FOR EVALUATION OF ENVIRONMENTAL BENEFITS

See following pages.

Proposal for Information Collection (PIC): Deriving Economic Benefits of Reduced Impingement and Entrainment at AES's Huntington Beach L.L.C. Generating Station

Background

For use of the Cost-Benefit test under the site-specific standards, AES is required to have a Benefits Valuation Study prepared. The final 316(b) Phase II Final Rule (herein after referred to as the Rule) requires use of a comprehensive methodology to value fully the impacts of impingement and entrainment mortality at the Huntington Beach L.L.C. Generating Station. Other requirements for use of the test include:

- A description of the methodology(ies) used to value commercial, recreational, and ecological benefits (including non-use benefits, if applicable);
- Documentation of the basis for any assumptions and quantitative estimates. If the valuation includes use of an entrainment survival rate other than zero, a determination of entrainment survival at the facility based on a study approved by the NPDES permitting authority must be submitted;
- An analysis of the effects of significant sources of uncertainty on the results of the study;
- If requested by the NPDES permitting authority, a peer review of the items you submit in the Benefits Valuation Study. You must choose the peer reviewers in consultation with the Director who may consult with EPA and Federal, State, and Tribal fish and wildlife management agencies with responsibility for fish and wildlife potentially affected by your cooling water intake structure. Peer reviewers must have appropriate qualifications depending upon the materials to be reviewed.
- A narrative description of any non-monetized benefits that would be realized at your site if you were to meet the applicable performance standards and a qualitative assessment of their magnitude and significance.

All benefits, whether expressed qualitatively or quantitatively, should be addressed in the Benefits Valuation Study and considered by the NPDES permitting authority and in determining whether compliance costs significantly exceed benefits.

The benefits assessment begins with an impingement and entrainment (IM&E) mortality study that quantifies both the baseline mortality as well as the expected change from rule compliance. Based on the information generated by the IM&E mortality studies, the benefits assessment includes a qualitative and/or quantitative description of the benefits that would be produced by compliance with the applicable performance standards at the facility site. To the extent feasible, dollar estimates of all significant benefits categories would be made using well-established and generally accepted valuation methodologies.

In order to have the appropriate information if the benefit/cost option is chosen, we propose a strategy for the collection and analysis of economic information. The strategy is based on information obtained and presented in "AES Huntington Beach L.L.C.

Generating Station Entrainment and Impingement Study" (MBC and TENERA, 2005). It should be noted that one particular benefit category, benefits accruing to individuals even if they have no plans ever to use resources associated with Huntington Beach L.L.C. generating station (non-use benefits), are to be estimated only

> "In cases where the impingement or entrainment study identifies **substantial harm** to a threatened or endangered species, to the sustainability of populations of important species of fish, shellfish or wildlife, or to the maintenance of community structure and function in a facility's water body or watershed ." (Final Rule, Federal Register page 41648).

"Substantial harm" is a stringent requirement to necessitate estimation of non-use values and thus non-use values usually would not be included in the final analysis. However, because the Final Rule does raise the potential for estimation of non-use values, we do provide some contingency for their estimation.

Description of Methodologies to Determine Benefits

The 316(b) rule defines a performance standard that the EPA has established for all existing power plant facilities to meet. The Huntington Beach L.L.C. generating station is located on the Pacific Ocean and therefore, it is subject to the impingement mortality (IM) performance standard (requiring a reduction in IM of 80% to 95%) and the entrainment (E) reduction performance standard (requiring a reduction in E of 60% to 90%). However, the Final Rule states that facilities do not have to meet the IM and E performance standard if it can be shown that the costs of achieving the performance standard are significantly greater than the benefits. Therefore we are providing a plan to collect information in case it is necessary to determine whether the benefits of the identified technology are significantly less than costs.

Impingement studies have been conducted at Huntington Beach L.L.C. from July 2003 to July 2004 and entrainment studies have been conducted at Huntington Beach L.L.C. from September 2003 through August 2004. Based on these studies, the potentially representative commercial and recreational species (RS) with impingement and entrainment mortality are likely white croaker, spotfin croaker, rock crab, California halibut, anchovy, and queenfish. If additional impingement and entrainment studies are done and these species continue to the RS, then there may be both commercial and recreational fisheries that benefit from reduced mortalities. It is also possible that non-use values will need to be addressed.

The EPA examined a technology (closed-cycle cooling) to achieve a national standard for entrainment and impingement mortality. In determining benefits at a national level, EPA used certain economic concepts of benefits associated with using the assets that cooling water adversely effects and methodologies to estimate the benefits (U.S. EPA, 2004a; U.S. EPA 2004b; U.S. EPA 2004c). In order to make the benefits comparable to costs, they presented benefits in a monetary unit, dollars. Their benefit estimates reflected the willingness to pay of individuals to go from the current environmental status to one associated with an identified technology. All of the methods proposed in this PIC were also used in EPA's national analysis.

More specifically, this benefit analysis will seek to provide a unit value per fish caught ($/fish) for recreational and commercial species affected by the new technology. With this information, total recreational and commercial benefits can be determined by multiplying the unit value times the expected increase in recreational and commercial catch arising from the identified technology. In addition, some information will be provided with respect to non-use values.

Recreational Angling

For the recreational anglers, there are two potential ways to proceed:

1.) Benefit Transfer- the application of benefit estimates provided in other studies to the Huntington Beach L.L.C. situation;
2.) Primary research- collection and/or assemblage of data on recreational fishing on the Southern California area and using the data to derive an estimate of the value per fish for the important species.

While the two approaches initially will be discussed independently, there is a sound reason to consider them in concert with one another. That is, the benefit transfer information provides a reality check for any values derived in the primary research. Any primary research effort should contain a thorough literature review, a component that would have information very similar in nature to the benefits transfer analysis. Also, the benefit transfer approach may provide a fallback position if the primary research is unsuccessful in providing benefit estimates. After both have been discussed independently, a strategy that integrates them will be offered.

A Benefit Transfer Approach

The use of benefit transfers requires finding a previous economic study (or studies) that considers a comparable situation to fishing near Huntington Beach L.L.C. and contains dollar values per unit fish caught or a value function for dollar values per unit fish caught. Particularly important would be having species similar to the effected species and a fishing population similar to the Huntington Beach L.L.C. situation. Although there are numerous other aspects of the fishing situation that might be important, these two are the most critical.

In order to identify an appropriate study or studies, it would be essential to visit the site to examine first-hand the type of recreational fishing that is occurring. At the same time, contact with key people in the area will be made to determine if any relevant studies or data do exist (see references for some articles). We would consider it essential that the following sources be contacted or examined:

1. State or Federal Hearings on previous Huntington Beach L.L.C. station's license renewal.
2. State or Federal Hearings on previous power plant facilities in the general southern California area.
3. Authors of EPA "in-house" studies associated with the Final Rule. In particular, EPA's RUM analysis of the California region (U. S. EPA. 2004d) should be considered.
4. Personnel from California Fish and Game.
5. Key Informants at universities or other research facilities
    a. University of California, San Diego
    Dr. Richard Carson (Department of Economics) is an expert in contingent valuation and non-use valuation.
    b. University of California, Berkeley
    Dr. Michael Hanneman (Department of Agricultural and Resource Economics) is an expert in economic valuation and has studied sportfishing in southern California
    c. University of California, Los Angeles
    Dr. Trudy Cameron is an expert in econometrics and has studied sportfishing in California.
    d. Southwest Fisheries Science Center, National Marine Fisheries Service
    Drs. Dale Squires, Cynthia Thompson and Sam Herrick are experts in fisheries economics and management.
    e. Local Consulting firms. Jones and Stokes Inc. (particularly Thomas Wegge) of Sacramento completed numerous sportfishing studies in California.
6. Existing bibliography sources available by internet
    a. National Marine Fisheries Service, Southeast Fisheries Center
    b. Sportfishing Values Database
    c. Environmental Valuation Reference Inventory (EVRI): Canadian based.
    d. Beneficial Use Values Database (BUVD)
    e. Regulatory Economic Analysis Inventory, (REAI) maintained by the U.S. EPA
    f. ENVALUE, an environmental value database maintained in Australia.
7. *Investigation and Valuation of Fish Kills* (American Fisheries Society, 1992) Excerpt: "Chapter 4 ("Monetary and Economic Valuation of Fish Kills") dates back to the Pollution Committee's *Monetary Values of Fish* booklets of 1970 and 1975, which dealt with southern U.S. species. In 1978, the AFS North Central Division's Monetary Values of Fish Committee published *Reimbursement Values for Fish*, addressing species in 12 northern states and 2 Canadian provinces. To integrate these and other regional values, a special AFS Monetary Values of Freshwater Fish Committee collected values from 135 federal, state, provincial, and private agencies and hatcheries. These data were published in 1982 as Part I of AFS Special Publication 13. For the present book, the Socioeconomics Section has repeated the earlier survey to update replacement costs for killed fish and summarized procedures for estimating the broader economic losses resulting from a fish kill."

These potential sources will be used to obtain "off-the-shelf" values that could possibly be relevant to the effected species at the Huntington Beach L.L.C. station. In addition, some of these contacts may be useful as researchers, data sources, and/or witnesses for any hearings that evolve. They may also be useful as peer reviewers or as sources to identify peer reviewers.

Primary Research

There are several other methodologies that could be used to estimate economic values for the species considered, but they will require some level of primary research.

Data and programs could be obtained from the U.S. EPA and examined to see if the results reported in USEPA (2004d) are defensible. If they are not, a new RUM model could be estimated with the data. The major changes introduced in the research would be to consider:

1.) correcting (if necessary) problems associated with the original analysis;
2.) the RS species rather than in a grouping[1];
3.) the Huntington Beach, Redondo Beach and Alimitos sites would be delineated rather that using aggregate sites used in the USEPA study (Southern California counties were used as sites).

The analysis would also update the angling activity and possible generalized the RUM model in ways that current research is including.

Strategy to Obtain Recreational Unit Values per Fish Caught

The initial portion of the study would be to complete a benefits transfer analysis and determine whether or not the values obtained were reasonable for the purposes of the decisions to be made. That is, if the mitigation strategy returned recreational benefits of that were approximately equal to the costs, it may be unwise and inefficient to move onto primary research because in all likelihood the estimate of costs would not be "significantly larger" than the benefits. If however, the benefit transfer method suggested that the benefits were to be small relative to costs, it may or may not be useful to do one of the primary research plans suggested in the previous section. The quality of existing studies would also be a determinant.

Discussions with key informants in the benefit transfer work would determine the availability and reliability of data from the previous studies of recreational fishing. In addition, some notion of the potential improvement in estimates from using new data and a new model would be obtained.

With this information and a better understanding on the costs of doing the primary research studies, decisions regarding what combination of benefit transfer and primary

[1] For example, California halibut is considered in the category "flatfish" in previous studies. If there were sufficient anglers targeting California halibut, then a category California halibut could be designated.

research would be most advantageous. The primary research would in all likelihood provide better estimates of value but may be more costly. Given the present information, it is likely that the analysis performed by the U.S. EPA in 2004 could be used. Additional effort would be devoted to determining whether the aggregation of sites and species could cause the estimated values to be biased.

Commercial Fishing

The first determination would be whether commercial fishing is affected by reduced mortality to effected species. California Fish and Game and the National Marine Fisheries Service would be consulted regarding species that the impingement and entrainment studies identified. Both producers and consumers could gain from increases in commercial catch, but the assessment would likely only estimate the gains to direct producers, i.e. commercial fishermen. This is based on the expectation that relatively small changes in commercial landings result from reduced IM&E mortalities. This is the approach that EPA took in the 2004 study.

The approach that EPA uses for assessing commercial benefits to producers bases the unit value on the ex-vessel price (sometimes referred to as dockside price) of the species under consideration. The logic of the approach begins with an assumption that harvest increases do not induce effort (inputs used in harvesting) to increase following reductions of entrained and/or impinged organisms. If this were entirely true, then the ex-vessel price times the increase in quantity harvested would represent producers surplus. However, EPA appreciates that this would not likely be true and that effort and costs would undoubtedly increase in the long run in response to increased commercial profits (i.e. producer surplus). In the absence of property rights to the harvest, one would expect the producer surplus to be eliminated. Recognizing this and allowing for uncertainty in effort response, the EPA proposes using a range of 0-40% of the ex-vessel price times the increase in harvest as a measure of the increase in producers' surplus.

In the unlikely event that the change in landings would be relatively large and cause a change in commercial fisheries prices, we would need to collect information on commercial harvests and prices. There is not a good way to use benefit transfer methods for the consumers' surplus although EPA is exploring one proposed by Bishop and Holt (2003). This approach at present does not look that promising. At present, it does not appear that the change in commercial landings will be sufficiently large to cause prices changes.

However, if additional information suggests price changes, existing data from California Fish and Game and the National Marine Fisheries Service could be sufficient to estimate an inverse, general equilibrium demand curve (see Just, et al. for a description) for the species in question. With these estimates, the benefits to consumers could be calculated.

Non-use Valuation

Based on current knowledge, it does not appear necessary to estimate non-use values. That is, the criteria EPA proposed in the final ruling for their estimation does not appear to be met.

But, in the unlikely event that non-use values will have to be estimated, we would look to using a benefit transfer approach or doing primary research for Huntington Beach L.L.C. Based on the draft impingement and entrainment studies, we do not believe that the magnitude of the non-use values would justify undertaking a primary research study for non-use values associated with the Huntington Beach station.

Thus, if non-use values were needed, we would suggest using a benefit transfer method in all likelihood. There have not been any studies of non-use values associated with power plant activities *per se.* People have had to rely on studies associated with other types of activities. For example, EPA used a benefit transfers approach in their Proposal for the 316(b) regulations and in the NODA. EPA (Tudor et al., 2003) reviewed numerous studies of use and nonuse values that were associated with surface water improvements (their Appendix A). Of those shown, only three address both changes in fish populations and non-use values associated with them (Huang, et al. 1997; Whitehead and Groothuis, 1992; Olsen, et al. 1991).

We propose considering these three studies in addition to doing a review of the recent literature. The recent literature may be important because EPA has placed some emphasis on this ecological valuation recently. For example, there is a meeting entitled “Improving the Valuation of Ecological Benefits, a STAR Progress Review Workshop” that was held in Washington in October, 2004. The papers presented at that workshop are now available on the internet. One of them is directly related to California.

The results of this activity would likely be the development of a relationship (specifically a ratio) between use values and non-use values. For years, EPA used the 50% rule, a practice that implied that nonuse values were 50% of use values. Our approach, just like some of their 316(b) efforts (Tudor 2003), would be to refine this ratio for situations more akin to the changes associated with power plant operations.

References

Bishop, R. and M. Holt. 2003. “Estimating Post-Harvest Benefits from Increases in Commerciql Fish Catches with Implication for Remediation of Impingement and Entrainment Losses at Power Plants”. Unpublished Xerox. U. of Wisconsin-Madison. 10 pp.

MBC Applied Environmental Sciences and Tenera Environmental. “AES Huntington Beach L.L.C.Generating Station Entrainment and Impingement Study”, Draft Final Report, California Energy Commission, Sacramento, CA. 426 pp.

Hanemann, W. M., T. Wegge, and I. Strand. 1989. Development and Application of a Predictive Model to Analyze the Economic Effects of Species Availability. National Marine Fisheries Service, Southwest Region, Terminal Island CA. Admin. Rpt. SWR 89-02. June.

Huang, J. T. Haab, and J. Whitehead. 1997. “Willingness to Pay for Quality Improvements: Should Revealed and Stated Preference Data Be Combined?”, *Journal of Environmental Economics and Management* 34: 240-255.

Just, R.E., D.L. Hueth, and A. Schmitz. 2004. “*The Welfare Economics of Public Policy:A Practical Approach to Project and Policy Evaluation* .” Edward Elgar, Cheltenham UK. 688 pp.

Kling, C. and C. Thomson. 1996. The Implications of Model Specification for Welfare Estimation in Nested Logit Models. *Am. J. Agr. Econ*. 78 (February):103-114.

McConnell, K.E., Q. Weninger and I. Strand. "Joint Estimation of Contingent Valuation and Truncated Recreation Demands," Chapter in Valuing the Environment Using Recreation Demand Models (Eds. Kling and Herriges).Edward Elgar Publishers, Cheltenham, UK. 199-216. 1999.

Olsen, D., J. Richards, and R. Scott. 1991. “Existence and Sport Values for Doubling the Size of Columbia River Basin Salmon and Steelhead Runs”, *Rivers* 2(1): 44-51

Thomson, C. and S. Crooke 1991. Results of the Southern California Economic Sportfishing Survey. NOAA Technical Memorandum, NMFS, Southwest Fisheries Center, August.

Tudor, L., R. Wardwell, E.Besedin, and R. Johnston. 2003. Comparison of Non-use and Use Values from Surface Water Valuation Studies. Memo to the 316 (b) Record. Office of Water, USEPA. Washington, D.C.

U. S. EPA. 2004a. “§316(b) Phase II Final Rule, Regional Studies, Part A: Evaluation Methods, Chapter A9: Benefit Categories and Valuation”. http://www.epa.gov/waterscience/316b/econbenefits/final.htm.

U. S. EPA. 2004b. “§316(b) Phase II Final Rule, Regional Studies, Part A: Evaluation Methods, Chapter A10: Methods for Estimating Commercial Fishing Benefits”, http://www.epa.gov/waterscience/316b/econbenefits/final.htm.

U. S. EPA. 2004c. “§316(b) Phase II Final Rule, Regional Studies, Part A: Evaluation Methods, Chapter A11:Estimating Benefits with a Random Utility Model”. http://www.epa.gov/waterscience/316b/econbenefits/final.htm.

U. S. EPA. 2004d. “§316(b) Phase II Final Rule, Regional Studies, Part B: California Region, Chapter D4: RUM Analysis” http://www.epa.gov/waterscience/316b/econbenefits/final.htm.

U. S. EPA. 2004e. "§316(b) Phase II Final Rule, Regional Studies, Part B: California Region, Chapter B3: Commercial Fishing Analysis" http://www.epa.gov/waterscience/316b/econbenefits/final.htm.

Whitehead, J. and P. Groothuis. 1992. "Economic Benefits of Improved Water Quality: A Case Study of North Carolina's Tar-Pamlico River", River 3(3): 170-178.