Implementation Plan for Compliance with California Policy on the Use of Coastal and Estuarine Waters for Power Plant Cooling

Cabrillo Power I LLC

Encina Power Station

March 2011

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Executive Summary

The Implementation Plan for Compliance (Implementation Plan) with the Statewide Policy on the Use of Coastal and Estuarine Waters for Power Plant Cooling (Policy) prepared for Cabrillo Power I LLC (Cabrillo) will identify how the Encina Power Station (EPS) will achieve compliance (final compliance date December 31, 2017 [Compliance Date]) in response to the California State Water Resource Control Board (SWRCB) Policy which became effective on October 1, 2010. The Policy offers two alternatives for compliance. Track 1 requires the reduction of the intake flow rate to a level corresponding to a closed-cycle wet cooling system; through screen intake velocity must not exceed 0.5 foot per second (fps); or installation of closed cycle dry cooling systems meets the intent and minimum reduction requirements. If demonstration of compliance with Track 1 is not feasible, the Track 2 alternative requires that impingement mortality and entrainment (IM&E) of marine life for the facility must be reduced to a level comparable to that achievable under Track 1, using operational or structural controls, or both.

Encina Power Station Design

EPS is a fossil fuel steam electric power generating station located in Carlsbad, California that withdraws cooling water from the Pacific Ocean via the adjacent Agua Hedionda Lagoon (AHL). The EPS cooling water system uses ocean water to cool the plant's steam condensers in each of the five steam electric generating units. In full operation, the cooling water flow through the plant is 595,200 gallons per minute (gpm) or 857 million gallons per day (MGD). Seawater enters a single cooling water intake structure (CWIS), supplying all five steam-generating units, passing through metal trash racks with vertical bars that are spaced approximately 3.5 inches (in) apart which prevent large debris from entering the system. At mean sea level the calculated approach velocity is 2.9 fps at maximum flow volume. Vertical traveling water screens consisting of a continuous vertical belt of wire mesh panels (Units 1 through 4 = ⅜ in mesh, Unit 5 = ⅝ in mesh) prevent fish and debris from entering the cooling water system. Both trash racks and screen panels are periodically cleaned to remove debris.

The cooling water discharge is regulated under the National Pollutant Discharge Elimination System (NPDES) Permit No. CA0001350. The temperature of the discharge is regulated under the effluent limits of the NPDES Permit, and shall not average more than 20 degrees Fahrenheit (°F) above that of the incoming water during any 24-hour period, nor exceed the incoming lagoon water temperature by more than 25 °F. Biofouling from microfauna and macrofauna too small to be filtered can decrease plant efficiency and impede water flow through the condensers. To ensure plant efficiency, chlorination is conducted on an as needed basis to prevent microfauna biofouling. Heat treatments of 105 °F have been conducted in the intake tunnels every five to eight weeks to prevent macrofauna biofouling. During heat treatment under NPDES Permit effluent limits, heat added to the cooling water shall not cause the temperature of the combined discharge to the ocean to exceed 120 °F for more than two hours. Additionally, EPS routinely dewaters tunnels to manually clean biofouling from the tunnel walls and floor. Condensers are manually cleaned when they become plugged with biota. EPS has opted to perform more frequent manual cleaning than heat treatments in an effort to reduce IM.

Entrainment and Impingement Studies

Two IM&E studies have been conducted at EPS; the first from 1979-1980 and the second during 2004-2005 (See Attachment 1). The 1979-1980 entrainment and source water study entailed collection of monthly plankton samples offshore and in the Inner Lagoon, every two weeks in the Outer Lagoon and every two weeks in front of intakes during daylight hours. The average composition of source and entrainment collections were similar; anchovies (*Engraulidae* spp.) were the most abundant larval fish in both collections, more goby (*Gobiidae* spp.) larvae were collected in entrainment samples, and more kelp and sand bass (*Serranidae* spp.) larvae were collected in source water samples. The 2004-2005 study entailed collection of 13 total monthly surveys at a single station in front of the intake structure. All water in front of the intakes was assumed to have been entrained considering the narrow lagoon construction and constant current flow. Gobies and blennies (*Hypsoblennius* spp.), small fishes that inhabit the mud bottom, and rock and fouling habitats, respectively, in the lagoon accounted for the majority of the larvae collected from the entrainment samples.

The 1979-1980 impingement studies entailed measurement of daily fish and shellfish abundance and weights over 336 days at 12-hour periods. The highest number of fish impinged included open water schooling fish (e.g., queenfish [*Seriphus politus*]), with the greatest numbers being collected in the tunnels during heat treatments in winter. Most shellfish impinged included the commercially valuable yellow crab (*Cancer anthonyi*) and market squid (*Loligo opalescens*). The 2004-2005 impingement studies measured fish and shellfish abundance, weights and lengths during normal operations from 24-hour samples collected weekly and during six heat treatments at night. About 70 percent of impingement occurred during normal operations. Open water fish, such as queenfish and topsmelt (*Atherinops affinis*), comprised most of the species impinged.

The composition of the fish larvae collected from the two studies was similar and impingement biomass was also comparable. Overall fish abundance has increased between the two studies, likely due to changes in available habitats within AHL.

Recent Permits

On June 14, 1976, the San Diego Regional Water Quality Control Board (SDRWQCB) adopted Order No. 76-22, NPDES Permit No. CA0001350 for EPS. Numerous additional orders have been issued to EPS, the most recent being R9-2006-0043. EPS has submitted the permit renewal application for a new order to replace R9-2006-0043, which expires on October 1, 2011 (See Attachment 2).

Poseidon Resources Corporation (Poseidon) proposed to construct and operate the Carlsbad Desalination Project (CDP) on the site of EPS and use a portion of the EPS cooling water effluent for seawater desalination treatment. Cabrillo is not affiliated with Poseidon, who is the lessee. In 2006 Poseidon applied for and was issued an NPDES Permit (No. CA0109223) to allow discharge up to 254 MGD (57 MGD of wastewater and 197 MGD of dilution water). Under Order No. R9-2006-0065, Poseidon submitted a Flow, Entrainment and Impingement Minimization Plan (Minimization Plan) which was approved on May 13, 2009 (Order No. R9-2009-0038).The Minimization Plan identified "mitigation measures to minimize the impacts to marine organisms when the CDP intake requirements exceed the volume of water being discharged by the EPS."

Compliance Alternatives

Carlsbad Energy Center, LLC filed an Application for Certification (AFC) to develop a natural gas-fired generating facility which would use air cooled condensers, equivalent to dry cooling towers. In turn, EPS Units 1-3 would shut down and cease withdrawing seawater. Upon successful commercial operation of the Carlsbad Energy Center Project (CECP), but no later than December 31, 2017, EPS Units 1-3 will be retired and the seawater withdrawal associated with the once through cooling (OTC) water and service water systems for these units will cease. This will result in the complete elimination of approximately 225 millions of gallons per day (MGD). Through the retirement of Units 1-3 and repowering with dry cooling, Units 1-3 will comply with the requirements of the Policy under Track 1.

As demonstrated in Section 3.1, compliance with Track 1 for EPS Units 4 and 5 is not feasible as defined in the Policy and these units must comply with Track 2 or otherwise shutdown. A detailed analysis demonstrates that site space constraints preclude the retrofit of EPS Units 4 and 5 with cooling towers. At EPS, plume abatement for wet cooling towers is considered necessary due to the site's close proximity to residences, roads (US I-5 and Carlsbad Boulevard), the beach, railroad tracks and agricultural roads. For Unit 4, an array of 14 cells that, depending on the arrangement, would require a total footprint of 550 to 1,010 feet (ft) in length (east-west direction) and 160 to 220 ft in width (north-south direction). A similar amount of space would be required for Unit 5. Even if space were available, permitting of these towers would be extremely difficult due to state and local permitting requirements and likely public opposition as evident by the City of Carlsbad's, Terramar's (community nearby to EPS), and Power of Vision's (local interest group) intervention into the current CECP permitting process. If only cooling tower makeup water is required for Units 4 and 5, additional water will be required to provide the 304 MGD required for CDP.

From review of prior impingement studies, more fish have been found to be impinged with an increased withdrawal rate and with an increase in heat treatments. To help comply with Track 2 impingement requirements for Units 4 and 5, less water withdrawn and less heat treatment will result in reduced impingement. EPS has recently reduced heat treatment frequency in an effort to reduce impingement mortality. Operational controls that can reduce withdrawal rates are also being considered.

To comply with Track 2 entrainment requirements, EPS will use the Equivalent Adult Modeling (EAM) approach to evaluate the effectiveness of screening technologies. The model uses natural mortality rates to account for all life stages of fishes potentially impacted by entrainment and standardizes an equivalent number of adults lost and life stages that would survive in the absence of impacts. Cabrillo will evaluate several control technologies and operational measures to reduce IM&E. Required mesh sizes for entrainment reduction will initially be selected based on a comparison of the larvae lengths from the 2004-2005 entrainment study, and length and head capsule dimensions of the highest recorded numbers of those entrained in California coastal power plants. Larvae entrained at EPS will be compared to proportions of those excluded by different mesh sizes accounting for varying lengths and head capsules for each life stage.

Alternate intake technologies have been considered for EPS and evaluated in previous 316(b) submittals. These technologies included fine and coarse mesh traveling screens, wedge-wire screens, barrier nets and microfiltration barriers. Behavioral devices included an offshore intake with velocity cap. Considering the Policy requirements for reduced IM&E, most options are not feasible or practical for EPS compliance.

A listing of the control technologies and operational measures that appear feasible after a preliminary review and will be further evaluated consists of:

- Fine Mesh Dual Flow Screens in Existing Intake
- New Fine Mesh Screening Structure
- Cylindrical Wedge-Wire Screens With Fine Slot Width
- C-Water AquaSweep™ (See Attachment 3)
- Flow Reductions

In considering options for reduction of IM&E impacts, a balance must be achieved to ensure the quality of AHL is maintained. Cabrillo is the owner of EPS as well as AHL. The ecology of the lagoon benefits directly from the flow resulting from the EPS cooling water intake system. With the current EPS operation, the inlet and the lagoon are periodically dredged to maintain the flow. Without the flow from EPS, sediment accretion would accelerate, potentially resulting in inadequate flow through the inlet and a decrease in water quality that would substantially affect the multiple beneficial uses of the lagoon, such as water recreation in the Inner lagoon and the aquaculture operations in the Outer Lagoon, including the white sea bass (*Atractoscion nobilis*) restoration program at the Hubbs Sea World Research Institute. The benefit to water quality in AHL can be seen from a similar situation in Alamitos Bay when the operation of Alamitos Generating Station (AGS) was reduced due to lower energy demand in recent years. As a result of the reduced flow from AGS, concern was expressed over odor problems and bacteria in the Los Cerritos Wetlands. AGS was contacted with a request to discuss options for maintaining flow in the channel in order to maintain the health of the Los Cerritos Wetlands even during times when cooling water is not needed by the plant.

Immediate/Interim Requirements

Large organism exclusion devices are not required at EPS since intakes are not located offshore and intake trash racks exclude large organisms. To mitigate for interim IM&E impacts, Cabrillo proposes to provide three dollars ($3.00) for every one million gallons withdrawn by each generating unit to the California Coastal Conservancy from October 1, 2015 and continuing up to and until final compliance (December 31, 2017).

Cabrillo is also interested in discussing potential credit towards the interim mitigation payments for the periodic maintenance dredging conducted by EPS for maintaining tidal flow to AHL. A precedent for this credit is the permit conditions for the restoration of the San Dieguito wetlands being funded by Southern California Edison for the impacts of the San Onofre Nuclear Generating Station (SONGS) that provides for up to 35 acres of enhancement credit for the, continuous maintenance of tidal flows through the system by dredging the channel out to the ocean.

Monitoring Plan

No additional monitoring is proposed at EPS until studies are required to prove installed technologies are providing necessary reductions under the new Policy. Until then, data from the 2004-2005 study remains as the appropriate baseline IM&E data, as the data for that study were collected using the same standard sampling techniques used for studies at other coastal power plants in recent years including the use of 335 micron mesh net for the entrainment sampling as specified in Section 4.B. (1) on Track 2 Monitoring Provisions in the Policy. The quality of the data collected during the 2004–2005 study is reflected in the fact that it has been used for recent California permits for the Poseidon CDP at EPS which have been reviewed and approved by several state and federal resource agencies. With the exception of species abundance, impinged and entrained species composition should not be expected to change unless habitats change drastically near AHL. Cabrillo will propose an appropriate monitoring plan once a technology has been pilot tested and determined adequate for meeting the IM&E criteria contained in the Policy.

Compliance Schedule

Below is the proposed schedule for EPS to comply with the Policy:

- April 1, 2011: Submit Implementation Plan to outline Track 1 and/or Track 2 compliance with IM&E.
- October 1, 2011: Verify Policy requirement that no greater than 9 in spacing between bars for the intake structure is in compliance with the large organism exclusion devices. This requirement has been satisfied as the distance between the trash rack bars in front of the intake structure are 3.5 in.
- October 31, 2011: Potential SWRCB approval of the Implementation Plan.
- December 31, 2011: Develop engineering and biological assessment of proposed technologies and develop pilot testing program.

- July 2012: Install approved pilot technology to assess IM&E reduction.
- July 2012 - April 2014: Perform quantitative study to evaluate IM&E reductions by pilot technology.
- October 2015: Initiate full scale installation and deployment of approved technology.
- October 2015 - May 2017: Implement an approved quantitative study to demonstrate compliance with IM&E objectives in the Policy from full scale deployment of technology.
- October 1, 2015 - December 31, 2017: Apply Interim Mitigation fee of $3.00/million gallons based on actual flow to the California Coastal Conservancy. The fee will be paid on an annual basis. Interim mitigation fee will be canceled if demonstration of Policy compliance is achieved prior to or after October 2015, but before the Compliance Date.
- December 31, 2017 (on or before): Demonstrate compliance with Policy.

1. Introduction

1.1 California Statewide Policy on the Use of Coastal and Estuarine Waters for Power Plant Cooling

On May 4, 2010 the California State Water Resources Control Board (SWRCB) adopted a Statewide Policy on the Use of Coastal and Estuarine Waters for Power Plant Cooling (Policy) which became effective on October 1, 2010. The intent of the Policy is:

> *...to ensure that the beneficial uses of the State's coastal and estuarine waters are protected while also ensuring that the electrical power needs essential for the welfare of the citizens of the State are met.*

The Policy allows two compliance alternatives which must be approached serially.

Track 1 requires:

- Reduction of the intake flow rate at each unit, at a minimum, to a level commensurate to a closed-cycle wet cooling system (minimum 93 percent intake flow rate reduction for each unit compared to the unit's design intake flow rate)

- Through screen intake velocity must not exceed 0.5 foot per second (fps)

- Installation of closed cycle dry cooling systems meets the intent and minimum reduction requirements

If it can be demonstrated to the satisfaction of the SWRCB that compliance with Track 1 is not feasible, impingement mortality and entrainment (IM&E) of marine life for the facility must be reduced on a unit-by-unit basis to a level comparable to that achievable under Track 1, using operational or structural controls, or both.

For impingement, Track 2 requires:

- Demonstration that through-screen intake velocities are ≤ 0.5 fps

  or

- Monitored impingement mortality reductions of at least 90 percent of the reduction in impingement mortality required under Track 1 (i.e., at least 84 percent [90 percent of 93 percent])

For entrainment, Track 2 requires:

- If relying solely on reductions in flow, by recording and reporting a minimum of 93 percent reduction in monthly flow as compared to the average actual flow for the corresponding months from 2000 to 2005

  or

- Installation of other control technologies (e.g., including, but not limited to, screens or re-location of intake structures), in whole or in part which would reduce monitored entrainment at least 90 percent of the reduction required under Track 1 (i.e., at least 84 percent [90 percent of 93 percent])

Technology-based improvements that are specifically designed to reduce impingement mortality and/or entrainment and were implemented prior to October 1, 2010 may be counted towards meeting Track 2 requirements.

Immediate and interim requirements and their due dates applicable to the Encina Power Station (EPS) are:

- Implementation Plan: April 1, 2010
- Large mammal exclusion devices that meet 9-inch (in) minimum bar spacing: October 1, 2011
- Interim IM&E Impacts Mitigation: October 1, 2015 through the final compliance

The Policy requires final compliance for EPS by December 31, 2017.

The purpose of this Implementation Plan for Compliance (Implementation Plan) with the Policy is to identify how EPS will achieve compliance through the evaluation of alternative operational or structural controls, or both, potential general designs, construction or operational measures that will be undertaken to implement the alternative, and propose a realistic schedule for implementing these measures that is as short as possible. The Implementation Plan will also discuss the proposed repowering of Units 1-3 (permit anticipated in 2011) and to eliminate reliance upon once through cooling (OTC) at those units. The Implementation Plan shall describe possible time periods when generating power is infeasible and describe measures taken to coordinate this activity through the appropriate electrical system balancing authority's maintenance scheduling process. The Implementation Plan will also describe the proposed IM&E monitoring program.

1.2 USEPA 316(b) Regulatory History

The Federal Water Pollution Control Act was initially passed in 1972 (33 U.S.C. §1251 et seq.). This legislation, *inter alia*, addressed the issue of the environmental effects of the use of surface water for cooling, including fish losses involved with the cooling water system. The legislation resulted in regulations under §316(b) (40 CFR 125).

In the mid-1970s, the United States Environmental Protection Agency (USEPA) published 316(b) regulations and guidance which were declared invalid on procedural grounds in 1976 (Appalachian Power Company v. Train, 566 F.2d 451 [4^{th} Cir. 1977]) and formally withdrawn by USEPA in 1979. Section 316(b) decisions were made based on a case-by-case best professional judgment (BPJ) of the permit writer.

In 1993, Riverkeeper, Inc. and a coalition of environmental organizations sued USEPA in order to require the promulgation of new cooling water intake regulations (Riverkeeper, Inc., *et al.* v. Whitman, U.S.D.C) resulting in a consent decree (1995 and revised in 2000). USEPA promulgated rules in 2001 (Phase I – new electric generating facilities, 40 CFR 125, Subpart I), 2004 (Phase II – large existing electric generating facilities, 40 CFR 125, Subpart J) and 2006 (Phase III – existing electric generating facilities, all other industrial facilities, 40 CFR 125, Subpart N [SIC listed] and new offshore and coastal oil and gas extraction facilities [specifically excluded in the Phase I Rules]).

The Phase II regulations were challenged and on January 25, 2007 the United States Second Circuit Court of Appeals decision remanded back to USEPA the following sections of the regulations:

- Best Technology Available determination
- Cost-cost variance
- Technology Implementation and Operational Plan
- Performance standards (60 to 90 percent for entrainment and 80 to 95 percent for impingement)
- Restoration
- Cost-benefit variance

Subsequently the USEPA withdrew the remaining portions of the rule (72 Fed. Reg. 130, pp. 37107 to 37109, July 9, 2007).

This decision was appealed and the United States Supreme Court (Court) granted certiorari on April 14, 2008. The Court only considered whether USEPA could undertake a cost-benefit analysis regarding Phase II facilities. The Court decided in favor of allowing USEPA to consider cost-benefit analysis in setting standards for cooling water intake structures (CWIS).

On November 22, 2010, USEPA signed a settlement agreement regarding rulemaking dates for USEPA to set technology standards for existing facilities. The proposed Phase II rule was released for public comment on March 28, 2011 with the intent to finalize by July 27, 2012.

2. Encina Power Station Description

2.1 Location

EPS is located in the City of Carlsbad, California, adjacent to the Agua Hedionda Lagoon (AHL) on the Pacific Ocean, approximately 30 miles north of the City of San Diego.

2.2 Source Water Body Description

AHL is a coastal lagoon system consisting of three interconnected segments situated at the seaward end of the Agua Hedionda Creek drainage. It is located within the city limits of Carlsbad, California. It is one of several lagoons that are located along the coast of southern California. The coastal region of AHL is part of the Southern California Bight (SCB) whose nearshore is punctuated by headlands and submarine canyons. The SCB extends from Point Conception south to Cabo Colonet in Baja California about 120 miles south of the United States-Mexico border. Historically, AHL was a natural, seasonal estuary characterized by frequent closings of the lagoon mouth, especially during summer months. Wet and dry time periods play an important role in opening and closing southern California coastal lagoons (Elwany et al. 1999). Under normal conditions, floods control the opening of these lagoons. After large floods, lagoons stay open from one to three years. In the absence of floods, the lagoons will remain closed unless their inlets are excavated. According to Bradshaw et al. (1976), AHL was first dredged from 1952 to 1954 in order to increase the lagoon volume to provide a cooling water source for EPS, thereby establishing a permanent opening and tidal connection with the nearshore coastal waters. In 1954, two rip-rap lined channels were completed that provided permanent connection with the ocean: a northernmost entrance channel over 300 feet (ft) long with a depth of 5 ft below mean lower low water (MLLW), and a southern channel used to discharge water from EPS.

The present lagoon system consists of three segments: the Outer, Middle and Inner Lagoons (Figure 2-1). The Outer Lagoon is connected to the Pacific Ocean through an inlet channel formed by two jetties. The jetties are located west of the Coast Highway Bridge and have lengths of about 350 ft and 368 ft, north and south respectively. The distance between the centerline of the two jetties is about 243 ft. The lengths of the north and south discharge channel jetties are about 327 ft and 376 ft, respectively. The absolute distance that the jetties extend from the shoreline varies somewhat with the changing location of the shoreline due to seasonal erosion and accretion of sand.

The Outer Lagoon basin is periodically maintenance dredged in compliance with the San Diego Regional Water Quality Control Board (SDRWQCB) General Waste Discharge Requirements for Maintenance Dredge/Fill Projects conducted in Navigable Waters within the San Diego Region, Order No. 96-32. The dredging process removes accumulated sand and sediment which would impede the OTC flow to EPS.

Additional detail concerning the Source Waterbody can be found in the *Clean Water Act Section 316(b) Impingement Mortality and Entrainment Characterization Study* dated January 2008 submitted by Cabrillo Power I LLC (Cabrillo; Tenera Environmental [Tenera] 2008).

2.3 Station Description

EPS is a fossil-fueled steam electric power generating station that began operation in 1954. It has been owned and operated by Cabrillo since May 22, 1999 and was previously owned by San Diego Gas and Electric Company (SDG&E). Figure 2-2 depicts the location of the facility and the cooling water intake and discharge points relative to the shoreline. Cooling water is withdrawn from the Pacific Ocean via AHL and circulated through the EPS Cooling Water System to condense steam used in power production. The combined cooling and service water design flow is 857 million gallons per day (MGD) at full operating capacity. After passing through the plant, the heated seawater is discharged to the ocean through a shoreline conveyance channel.

EPS consists of five steam turbine generating units and a small gas turbine unit. The steam turbine units are fueled by natural gas. Net generating capacity of the individual steam turbine units ranges from 104 megawatts (MW) to 330 MW (Table 2-1). The gas turbine has a net generating capacity of 16 MW which does not use OTC. Units 1-3 began operating in 1954, 1956 and 1958, respectively, the gas turbine was added in 1968, and Units 4 and 5 went on line in 1973 and 1978, respectively.

Table 2-1. Encina Power Station generation capacity and cooling water flow volume

Unit	Net Generating Capacity (MWe)	Circulating Water Flow (gpm [MGD])	Service Water Flow (gpm [MGD])	Daily Flow (gpm [MGD][1])

1	107	48,000 [69]	3,000 [4]	51,000 [73]
2	104	48,000 [69]	3,000 [4]	51,000 [73]
3	110	48,000 [69]	6,000 [9]	54,000 [78]
4	300	200,000 [288]	13,000 [19]	213,000 [307]
5	330	208,000 [300]	18,200 [26]	226,200 [326]
Gas Turbine[2]	16	---	---	---
Total	***939***	***552,000 [795]***	***53,200 [77]***	***595,200 [857]***

1 = Capacity; 2 = Operation; MWe = megawatt electrical; gpm = gallons per minute; MGD = million gallons per day

2.4 Cooling Water System Design

Cooling water for each of the five steam electric generating units is supplied by two circulating water pumps (CWPs) that range in capacity from 24,000 to 104,000 gallons per minute (gpm) (35 to 150 MGD) depending on the units in operation and the associated cooling requirements (Table 2-1). This water is primarily used to cool the plant's steam condensers, where steam is condensed back to water as part of the power production cycle. Each unit is also equipped with a number of smaller saltwater service pumps (SWSPs) that supply water for a variety of purposes (i.e., cooling of small capacity heat exchangers, lubrication of rotating equipment, etc.). With all units in full operation, the cooling water flow through the plant is 595,200 gpm, or 857 MGD, based on the manufacturer ratings for the CWPs and SWSPs (Table 2-1).

2.4.1 Cooling Water Intake Structure

Cooling water for all five steam electric generating units is supplied through a common intake structure located at the southern end of the Outer Lagoon of AHL, approximately 3,000 ft from the opening of the lagoon to the ocean (Figure 2-1). Seawater entering the cooling water system passes through metal trash racks on the intake structure, with vertical bars that are spaced about 3.5 in apart. The bars prevent large debris that could potentially clog or damage plant equipment from entering the system. The trash racks are cleaned periodically to remove debris. Water velocity approaching the trash racks varies with the number of pumps that are in operation and water depth (tide level).

Approach velocity is measured annually as required by the EPS National Pollutant Discharge Elimination System (NPDES) Permit (No. CA0001350). Most recently, the approach velocity was measured on December 20, 2010. Average approach velocity at this time was 1.0 fps. Tidal level was 6.4 ft above MLLW at the time the measurements were made and two of the ten CWPs were in operation. The trash racks were cleaned less than 60 minutes prior to velocity measurement. Using the measured velocity and adjusting the flow volume to simulate maximum flow (all CWPs and SWSPs in operation) yields a calculated maximum approach velocity of 2.2 fps at the same tide height. Adjusting the tide height to mean sea level (MSL) provides a calculated approach velocity of 2.9 fps at maximum flow volume.

2.4.2 Cooling Water Screens

Behind the trash racks, the intake tapers into two 12 ft wide tunnels that further split into four 6 ft wide inlet tunnels (Figure 2-4). Inlet tunnels 1 and 2 provide cooling water for Units 1-3, while inlet tunnels 3 and 4 supply cooling water for Units 4 and 5, respectively. Vertical traveling water screens are positioned immediately upstream of the CWPs and SWSPs to prevent fish and debris from entering the cooling water system (CWS) and potentially clogging the condensers. There are two traveling water screens for Units 1-3, two traveling water screens for Unit 4, and three traveling water screens for Unit 5.

Each traveling water screen consists of a continuous vertical belt of wire mesh panels through which the cooling water flows (Figure 2-5). The mesh size of the screens for Units 1 through 4 is ⅜ in while mesh size for the Unit 5 screens is $^5/_8$ in. Debris larger than the mesh is removed from the cooling water flow and held on the screen panels until the traveling water screen is washed. The screens can be operated manually or activated automatically when a specified pressure differential is detected across the screens due to the accumulation of debris. When the specified pressure is detected, the traveling water screens rotate upward and the material on the screen is lifted out of the cooling water flow. A screen wash system (70 to 100 pounds per square inch [psi]), located at the head of the traveling water screen, washes the debris from each screen panel into a trough which discharges through Discharge Point 001.

2.4.3 Cooling Water Discharge

After passing through the traveling water screens, the cooling water flows through the condensers of the individual units. At the condensers, heat is transferred from the steam exiting the plant's turbines (passing over the outside of the condenser tubes) to the seawater (passing through the inside of the condenser tubes), condensing the steam back to water. Units 1-3 have dual-pass condensers (U-shaped tubes that pass through the condenser twice) made up of numerous aluminum-brass condenser tubes, each with an inside diameter (ID) of about ⅞ in. Units 4 and 5 have single-pass condensers with 1 in ID tubes made of copper-nickel alloy.

The cooling water exiting the condensers flows into a common discharge conduit that empties into an open discharge pond located to the west of the intake structure (Figure 2-4). Water flows from the discharge pond through a culvert under Carlsbad Boulevard and a discharge canal that leads across the beach and into the ocean. The temperature of the cooling water discharged from EPS is regulated under the NPDES Permit effluent limits. The permit places effluent limits on certain chemical constituents and thermal characteristics of the plant's discharge. The terms of the permit specify that the temperature of the combined discharge shall not average more than 20 degrees Fahrenheit (°F) above that of the incoming water during any 24-hour period, and the combined discharge shall not, at any time, exceed 25 °F above that of the incoming lagoon water. A special provision to these discharge limitations is made to accommodate the higher discharge temperatures that occur during heat treatment of the cooling water intake conduits (Section 2.4.4 – *Biofouling Control*). The NPDES Permit specifies that during heat treatment, heat added to the cooling water shall not cause the temperature of the combined discharge to the ocean to exceed 120 °F for more than two hours.

2.4.4 Biofouling Control

Cooling water entering EPS contains a myriad of planktonic organisms that are too small to be filtered from the water flow by either the trash racks or the traveling water screens. Some of these organisms can cause plant operational problems. These organisms can be divided into two major groups: microfouling organisms, such as bacteria, fungi and algae, and larger macrofouling organisms including barnacles, mussels (and other bivalves) and other organisms.

The primary problem caused by the microfouling organisms is the formation of an insulating slime layer in the condenser tubes decreasing plant efficiency. EPS uses periodic injections of sodium hypochlorite (chlorine bleach) to control slime in the condenser tubes. The sodium hypochlorite solution is manufactured on site using intake cooling water. The sodium hypochlorite solution is injected, on an as needed basis, into the cooling water conduit immediately upstream of the CWP and SWSP suctions for each unit. Chlorination is conducted each day on a timed cycle for about five minutes per hour per operating unit. This method of chlorination results in minimal residual chlorine in the cooling water being discharged to the ocean.

Larger macrofouling organisms usually enter the CWS as larvae. Included within this group are a number of encrusting species, including barnacles and mussels that can attach themselves to the walls of the cooling water conduits and grow. If left unchecked, this biofouling layer can impede water flow within the system and interfere with the operation of pumps, valves and other plant apparatus. In addition, the force of the cooling water flow on their shells can detach the biofouling layer from the walls and carry them downstream to the condenser. Mussel and barnacle shells that are between the intake screens and the condensers and exceed the ⅞ to 1 in diameter of the condenser tubes can become lodged at the inlet ends of the tubes thereby blocking water flow through the tubes. As the number of clogged tubes increases, condenser performance decreases and, as a result, condenser operating temperatures and the temperatures of the discharged cooling water also increases. If the influx of tube-clogging debris continues, the condenser must be removed from service and cleaned.

Chlorination used at the concentration and duration applied by EPS to control microfouling organisms is ineffective in the control of macrofouling organisms. Macrofouling organisms tend to be much more tolerant of chlorine than microfouling organisms. Mussels also have the ability to tightly close their shells if they detect harmful substances in the water and can remain closed for hours or days. Chlorination at higher doses and/or applied continuously can effectively eliminate macrofouling organisms but presents serious regulatory and environmental problems if the chlorine is not subsequently removed or deactivated prior to its discharge into the ocean.

As an alternative to chemical treatment, EPS uses heat treatments to control macrofouling. A targeted heat treatment is performed by restricting the inlet cooling water flow and recirculating the condenser discharge water through the conveyance tunnels and condensers until the inlet water temperature increases to the targeted treatment temperature. Recirculation of the cooling water is accomplished through a cross-over tunnel located approximately 120 ft from the discharge, adjacent to the intake channel. The temperature is raised to 105 °F in the intake tunnels and then maintained for approximately two hours. This proved to be adequate in killing the encrusting macrofouling organisms.

Each time the cooling water passes through the condensers it picks up additional heat rejected from the steam cycle. Because the cooling water continues to circulate and the generating units continue to operate, the temperature in the discharge channel is limited by permit limits to a maximum of 120 °F and cannot be maintained for more than two hours. To maintain the targeted treatment temperature at 105 °F during the heat treatment, and to prevent the continued build-up of heat in the system, additional lagoon water is blended into the recirculating flow as a corresponding volume of heated water is discharged to the Pacific Ocean. The targeted heat treatment duration is two hours while maintaining a treatment temperature of at least 105 °F in the intake conduits. This excludes the time required to reach the target temperature and the time required to return to a normal operating configuration. The total time required for the heat treatment procedure, including temperature buildup and cool-down, is approximately seven to nine hours. Because the input of cooling water is reduced during heat treatment due to recirculation, the plant's discharge flow rate is likewise reduced to approximately 7 to 45 percent of the maximum volume discharged during normal operation.

Following the targeted heat treatment some shells of the dead encrusting organisms begin to detach from the walls of the conduits and are carried downstream. Most mussels lose their attachment over a period of days following treatment, but barnacle shells can take weeks or months to deteriorate and break away from the conduit walls. Shells smaller than the condenser tube diameter pass through the system and are discharged into the ocean. Larger shells might be retained and removed by the traveling screens or, as in the case of fouling that occurs between the traveling water screens and the condensers, shells may end up in the condensers where they are subsequently removed by cleaning. To reduce the need for condenser cleaning, heat treatments were optimally performed every five to eight weeks. This short growth period prevents most macrofouling organisms from attaining a size that would allow them to plug the condensers.

Additionally, EPS routinely dewaters the tunnels to manually clean biofouling from the tunnel walls and floor. Condensers are manually cleaned when they become plugged with biota. EPS has opted to perform more frequent manual cleaning than heat treatments in an effort to reduce the quantity of IM&E.

2.5 Encina Power Station Impingement and Entrainment Study (2005-2006)

2.5.1 Background

Cooling water for EPS is withdrawn from the Pacific Ocean via AHL (Figure 2-1). The aquatic environment surrounding EPS consists of AHL and its seasonal tributaries, and the open coastal waters of the Pacific Ocean.

2.5.2 Impingement and Entrainment Studies at Encina Power Station

Previous 316(b) IM&E studies were done at EPS in 1979-1980 (SDG&E 1980). Because IM&E had not been studied for 25 years and pursuant to the Section 316(b) Phase II regulations (40CFR 125 Subpart J), a study plan for new IM&E studies was developed and submitted to the SDRWQCB in September 2004. The sampling plan was approved by the SDRWQCB and IM&E sampling was conducted from June 2004-June 2005. A copy of the report for this study

(Tenera 2008), including a summary of the 1979-1980 monitoring program, is contained in the attached CD (Attachment 1). This section provides a summary of the results of the 1979-1980 and the 2004-2005 IM&E studies. The two studies are compared in Section 2.5.3.

2.5.2.1 Entrainment and Source Water Study

2.5.2.1.1 1979-1980 Entrainment and Source Water Study

A one-year entrainment and source water characterization study was conducted beginning in 1979 as part of the 316(b) demonstration studies at EPS. Plankton samples were collected monthly at five offshore stations using 0.020 and 0.013 in mesh nets attached to a 2 ft diameter bongo net system. Collections were also made monthly in the Middle and Inner Lagoon segments and every two weeks in the Outer Lagoon segment using 1.6 ft diameter nets (0.020 and 0.013 in mesh size). Entrainment samples were collected every two weeks using a plankton pumping system in front of the intakes. Although most samples were collected during daylight hours, some samples were occasionally taken in the evening or early morning hours.

Anchovies (*Engraulidae* spp.; primarily deep body and northern) were the most abundant larval fishes in both source water and entrainment samples, followed by croakers (*Sciaenidae* spp.) and sanddabs (*Citharichthys* spp.) (Table 2-2). There were more goby (*Gobiidae* spp.) larvae in the entrainment samples whereas kelp and sand bass (*Serranidae* spp.) larvae were substantially more abundant in the combined source water samples from AHL and offshore. Overall the average composition between the entrainment and source water data sets were very similar for the ten most abundant taxa. Only English sole (*Parophrys vetulus*) larvae were among the top ten entrainment taxa not represented in the top ten source water taxa.

Table 2-2. Average annual densities during 1979-1980 of the ten most abundant larval fish taxa in source water and entrainment collections (0.013 in mesh nets)

Common Name	Taxon	Source Water Concentration (mean per 264,000 gal)	Entrainment Concentration (mean per 264,000 gal)
Anchovies	*Engraulidae*	9,527.6	8,552.2
Croakers	*Sciaenidae*	3,417.0	4,005.9
Sanddabs	*Citharichthys*	732.7	827.2

Table 2-2. Average annual densities during 1979-1980 of the ten most abundant larval fish taxa in source water and entrainment collections (0.013 in mesh nets)

Common Name	Taxon	Source Water Concentration (mean per 264,000 gal)	Entrainment Concentration (mean per 264,000 gal)
	spp.		
Gobies	*Gobiidae*	292.8	429.8
Silversides	*Atherinopsidae*	83.5	109.0
Wrasses	*Labridae*	64.5	40.2
Combtooth blennies	*Hypsoblennius* spp.	61.3	57.4
Sea basses	*Serranidae*	51.1	9.1
Rockfishes	*Sebastes* spp.	28.6	25.7
English sole	*Parophrys vetulus*	0	18.6

2.5.2.1.2 2004-2005 Entrainment and Source Water Sampling

Entrainment and source water studies were designed to measure monthly variation in the species composition and abundance of larval fishes, cancer crabs (*Cancer* spp.) and spiny lobsters (*Panulirus interruptus*) entrained by EPS. The source water sampling was done to estimate the source water populations at risk of entrainment.

Entrainment and source water sampling was conducted monthly from June 2004-May 2005, with the exception of two surveys separated by a two-week interval that were done in June 2004. The 13 surveys provided a complete year of seasonal data for 2004-2005. The entire set of entrainment and source water stations (Figure 2-6) was sampled during each of the 13 surveys.

Entrainment samples were collected from a single station (Station E1; Figure 2-6) located in front of the EPS intakes. They were collected using a bongo frame with paired 2.33 ft diameter openings each equipped with 0.013 in mesh plankton nets and codends. The sampling platform was a 24-ft research vessel (*R/V M-REP*) with a side-mounted davit positioned for towing the nets. The start of each tow began approximately 98 ft in front of the intake structure and proceeded in a northwesterly direction against the prevailing intake current, ending approximately 492 ft from the intake structure. Because of the narrow constriction of the lagoon near the intakes there was a constant current flow toward the intake structure when pumps were operational and it was assumed that all of the water sampled at the entrainment station would have been drawn through the EPS CWS. Samples were collected over a 24-hour period divided into four 6-hour cycles. Two replicate tows were conducted at the entrainment station during each cycle. The total time of each tow was approximately two minutes at a speed of approximately 1 knot. A combined volume of approximately 16,000 gallons of water was filtered through both nets. The water volume filtered was measured by calibrated flow meters mounted in the openings of the nets.

Once the nets were retrieved from the water, all of the collected material was rinsed into the end of the net (codend). The contents of both nets were combined into one sample immediately after collection. Samples from the paired nets were not kept separate because they were not statistically independent samples and could not be used as replicates for analysis. The use of a bongo frame design minimizes disturbance from the tow bridle compared to a three-point attachment design and allows each net to collect an unobstructed sample. The combined sample was placed into a labeled jar and preserved in 10 percent formalin. Each sample was given a unique serial number based on the location, date, time and depth of collection, and all information was recorded on a sequentially numbered data sheet. The serial number was used to track the sample through the laboratory processing, data analysis and reporting phases.

Laboratory processing consisted of sorting (removing), identifying and enumerating all larval fishes, megalopal stages of cancer crabs and spiny lobster larvae (puerulus and phyllosome stages) from the samples. Juvenile specimens (not susceptible to entrainment) that were collected incidentally in the plankton sampling were separated in the laboratory from the samples but not included in the entrainment analysis because it was assumed that these larger fish would be able to avoid being drawn into the intake and were larger than the ⅜ in mesh of the traveling screens.

The highest entrainment occurred for larvae of lagoon species (Table 2-3). Gobies and blennies (*Hypsoblennius* spp.), both small bottom-dwelling forms common in southern California lagoons, comprised over 91 percent of the total entrainment, with anchovy larvae the third most abundant taxon at approximately 4 percent. Gobies and blennies primarily inhabit the sheltered waters inside AHL.

Table 2-3. Average concentrations during June 2004-May 2005 of the most abundant larval fishes and target shellfishes in entrainment samples collected in Agua Hedionda Lagoon (Station E1)

Common Name	Taxon	Average Concentration (mean per 264,000 gal)	Total Count	Percentage of Total	Cumulative Percentage
Gobies	*Gobiidae* (CIQ complex)	2,222.93	12,763	61.95	61.95
Blennies	*Hypsoblennius* spp.	1,107.67	5,838	28.34	90.29
Anchovies	*Engraulidae*	134.29	819	3.98	94.27
Garibaldi	*Hypsypops rubicundus*	40.99	188	0.91	95.90
Blind goby	*Typhlogobius califomiensis*	24.65	148	0.72	96.51
Clinid kelpfishes	*Gibbonsia* spp.	22.45	125	0.61	96.90
Labrisomid kelpfishes	*Labrisomidae*	17.65	81	0.39	97.30
Pipefishes	*Syngnathidae*	16.06	83	0.40	97.72
Yellowfin goby	*Acanthogobius flavimanus*	14.41	87	0.42	98.00
Unidentified larval fishes	Larvae, unidentified fish fragment	9.65	56	0.27	100.00
All other species			413	2.0	---
Total			**20,601**	---	---
Cancer crabs	*Cancer* spp. (megalops)	0.17	1	---	---

2.5.2.2 Impingement

EPS has one intake structure that withdraws water from AHL. Seawater entering the CWS passes through metal trash racks (bar racks) on the intake structure. Behind the trash racks, the intake tapers into two and then four tunnels, which provide cooling water for five steam-generating units (Units 1 through 5). The seawater then goes through vertical traveling screens. Units 1 through 4 each have two traveling screens with a mesh size of ⅜ in, and Unit 5 has three screens with a mesh size of ⅝ in.

All material that passed through the bar racks but was larger than the traveling screen mesh was impinged and was subsequently rinsed from the screens when the screens were rotated for cleaning. A high-pressure wash system (70 to 100 psi) located at the head of the screens was used to wash the material into a sluiceway that emptied into metal collection baskets, where the material accumulated until disposal. The traveling screens were operated either manually or automatically when a specified pressure differential was detected across the screens due to the accumulation of debris.

2.5.2.2.1 1979-1980 Impingement Study

Impingement of fishes and shellfishes on the traveling screens and bar rack system of EPS were monitored daily during normal operations for 336 consecutive days in 1979. The main method was to obtain abundance and weights from samples accumulated over two 12-hour periods (daylight and night) each day for all three screening systems at EPS. The six highest-ranking fishes by numbers impinged were queenfish (*Seriphus politus*), deepbody anchovy (*Anchoa compressa*), topsmelt (*Atherinops affinis*), California grunion (*Leuresthes tenuis*), northern anchovy (*Engraulis mordax*) and shiner surfperch (*Cymatogaster aggregata*) (Table 2-4) – all open water schooling fishes. These six species represented 82 percent of all fishes impinged. Over 90 percent of the fishes collected consisted of nine species: deepbody anchovy, topsmelt, northern anchovy, shiner surfperch, California grunion, walleye surfperch (*Hyperprosopon argenteum*), queenfish, round stingray (*Urolophus halleri*) and giant kelpfish (*Heterostichus rostratus*). The greatest number of fishes residing in the tunnels during heat treatments occurred during winter surveys. Shellfishes that ranked high in the total numbers impinged included yellow crab (*Cancer anthonyi*) with 2,540 individuals, swimming crab (*Portunus xantusii*) with 884 individuals, lined shore crab (*Pachygrapsus crassipes*) with 866 individuals, and market squid (*Loligo opalescens*) with 522 individuals. The yellow crab and market squid both have commercial fishery value whereas the other two species are small and are not fished commercially. California spiny lobster, the most valuable invertebrate in the local commercial fishery, was rare in the samples with only two individuals impinged during the entire year-long study period.

Table 2-4. Number and weight (grams) of the 'critical fish species' collected during normal operations and seven heat treatment surveys at EPS, February 1979-January 1980 (from SDG&E 1980)

Common Name	Scientific Name	Normal Operations		Heat Treatments	
		No. Impinged	Weight Impinged (grams)	No. Impinged	Weight Impinged (grams)
Queenfish	*Seriphus politus*	18,681	91,314	3,485	96,320
Deepbody anchovy	*Anchoa compressa*	13,299	64,323	23,142	182,179

Table 2-4. Number and weight (grams) of the 'critical fish species' collected during normal operations and seven heat treatment surveys at EPS, February 1979-January 1980 (from SDG&E 1980)

Common Name	Scientific Name	Normal Operations		Heat Treatments	
		No. Impinged	Weight Impinged (grams)	No. Impinged	Weight Impinged (grams)
Topsmelt	*Atherinops affinis*	10,915	112,340	21,788	166,058
California grunion	*Leuresthes tenuis*	8,583	33,770	9,671	81,708
Northern anchovy	*Engraulis mordax*	7,434	14,573	19,567	93,981
Shiner surfperch	*Cymatogaster aggregate*	6,545	53,258	12,326	272,549
Walleye surfperch	*Hyperprosopon argenteum*	1,877	50,405	8,305	522,797
Slough anchovy	*Anchoa delicatissima*	1,758	4,106	464	1,405
White surfperch	*Phanerodon furcatus*	1,751	16,991	604	8,609
Round stingray	*Urolophus halleri*	1,626	185,896	1,685	404,237
California halibut	*Paralichthys califomicus*	1,215	57,128	329	52,995
Giant kepfish	*Heterostichus rostratus*	1,046	14,912	1,421	36,212
Salema	*Xenistius califomiensis*	538	2,244	161	1,389
Barred sand bass	*Paralabrax nebulifer*	189	15,309	518	26,724
California corbina	*Menticirrhus undulates*	117	9,263	29	4,634
Barred surfperch	*Amphistichus argenteus*	83	1,853	166	15,946
Striped mullet	*Mugil cephalus*	73	44,730	10	5,593
Spotted sand bass	*Paralabrax maculatofasciatus*	73	10,857	616	87,360
Kelp bass	*Paralabrax clathratus*	34	502	568	38,505
White sea bass	*Cynoscion nobilis*	25	226	13	833
Pacific	*Citharichthys*	---	---	---	---

Table 2-4. Number and weight (grams) of the 'critical fish species' collected during normal operations and seven heat treatment surveys at EPS, February 1979-January 1980 (from SDG&E 1980)

Common Name	Scientific Name	Normal Operations		Heat Treatments	
		No. Impinged	Weight Impinged (grams)	No. Impinged	Weight Impinged (grams)
sanddab	*sordidus*				
California sheephead	*Semicossyphus pulchra*	---	---	---	---
Hornyhead turbot	*Pleuronichthys verticalis*	---	---	---	---
Total Above Fishes		***75,862***	***784,000***	***104,868***	***2,103,034***
Total Other Fishes		*3,800*	*611,200*	*3,610*	*322,517*
Total Invertebrates		*6,281*	*153,200*	*1,682*	*49,884**

*only includes weights of counted invertebrates

2.5.2.2.2 2004-2005 Impingement Study

Impingement sampling at EPS was conducted during a 24-hour period one day each week from June 24, 2004-June 15, 2005. Each sampling period was divided into six approximately 4-hour cycles. Before each weekly sampling effort, all of the traveling screens were rotated and rinsed clean of any impinged material. Nets (¼ in mesh size) were placed into each metal basket during impingement sampling for ease of retrieving the impinged material.

During each cycle, the traveling screens remained stationary for a period of approximately 3.5 hours. Traveling screens for Units 1 through 4 were rotated and rinsed for 35 minutes and screens for Unit 5 were rotated and rinsed for 30 minutes (approximate time for one complete revolution of the screens). This rinse period allowed the entire traveling screen to be rinsed of all material that had been impinged since the last screen wash cycle. In a few instances during impingement collections, the screen wash system started automatically due to a high differential pressure prior to the end of the cycle. The material that was rinsed from the screens during the automatic screen washes was combined with the material collected at the end of that cycle. All debris and organisms rinsed from each set of traveling screens were kept separate.

All fishes and selected shellfishes collected at the end of each 4-hour cycle were removed from the debris and then identified and counted. Individual weights and lengths of bony fishes, sharks and rays were recorded (standard length [SL] for the bony fishes, total length [TL] for the sharks and disc width [DW] for the rays).

Carapace width was measured for crabs, total length was measured for shrimps and mantle length was measured for cephalopod mollusks. Weight was also recorded for these shellfishes. Other macroinvertebrates, including hydroids, anemones, sea jellies, barnacles, worms, brittlestars, bryozoans, tunicates, gastropods and bivalves, were not enumerated or weighed but were only recorded as "present" when found in the impinged material.

Impingement sampling was also conducted during heat treatment operations. Procedures for heat treatment involved clearing and rinsing the traveling screens prior to the start of the heat treatment procedure. At the end of the heat treatment procedure, normal pump operation was resumed and the traveling screens were rinsed until no more fishes were collected on the screens and fishes were found in the collected debris. Processing of the samples followed the same procedures used for normal impingement sampling. Six heat treatments were performed during the one-year study and sampling occurred during all.

The highest impingement rates were for open-water fish species and lowest impingement rates were for bottom-dwelling species. A total of 101 species of fishes, sharks and rays was impinged. The numerically most abundant fishes collected during normal operations impingement sampling included topsmelt, shiner surfperch, deepbody anchovy, queenfish, salema (*Xenistius californiensis*) and slough anchovy (*Anchoa delicatissima*) (Table 2-5). These six species comprised about 70 percent of all the fishes impinged during normal operations. Round stingray, bat ray (*Myliobatis californica*) and California butterfly ray (*Gymnura marmorata*) were not abundant compared to other impinged species, comprising approximately 1 percent of the individuals collected, but they accounted for nearly 30 percent of the biomass due to their large individual size. Impingement rates for most species were generally higher during nighttime. The top five species by weight were California butterfly ray, topsmelt, shiner surfperch, round stingray and white sea bass (*Atractoscion nobilis*).

Table 2-5. Number and weight of fishes, sharks and rays impinged during normal operation and heat treatment surveys at EPS from June 2004-June 2005

Common Name	Scientific Name	Normal Operations		Heat Treatments	
		Sample Count	Sample Weight (grams)	Sample Count	Sample Weight (grams)
Topsmelt	*Atherinops affinis*	5,242	42,299	15,696	67,497
Shiner surfperch	*Cymatogaster aggregata*	2,827	28,374	18,361	196,568
Deepbody	*Anchoa*	2,079	11,606	23,356	254,266

Table 2-5. Number and weight of fishes, sharks and rays impinged during normal operation and heat treatment surveys at EPS from June 2004-June 2005

Common Name	Scientific Name	Normal Operations		Heat Treatments	
		Sample Count	Sample Weight (grams)	Sample Count	Sample Weight (grams)
anchovy	*compressa*				
Queenfish	*Seriphus politus*	1,304	7,499	929	21,390
Salema	*Xenistius californiensis*	1,061	2,390	1,577	6,154
Slough anchovy	*Anchoa delicatissima*	1,056	3,144	7	10
Silverside	Atherinopsidae	999	4,454	2,105	8,661
Walleye surfperch	*Hyperprosopon argenteum*	605	23,962	2,547	125,434
Northern anchovy	*Engraulis mordax*	537	786	92	374
California grunion	*Leuresthes tenuis*	489	2,280	7,067	40,849
Giant kelpfish	*Heterostichus rostratus*	344	2,612	908	9,088
Spotted sand bass	*Paralabrax maculatofasciatus*	303	4,604	1,536	107,563
Pacific sardine	*Sardinops sagax*	268	1,480	6,578	26,266
Spotfin croaker	*Roncador stearnsii*	182	8,354	106	17,160
Barred sand bass	*Paralabrax nebulifer*	151	1,541	1,993	32,759
California butterfly ray	*Gymnura marmorata*	146	60,629	70	36,821
White surfperch	*Phanerodon furcatus*	144	4,686	53	823
California needlefish	*Strongylura exilis*	135	6,025	158	11,899
Kelp bass	*Paralabrax clathratus*	111	680	976	13,279
Specklefin midshipman	*Porichthys myriaster*	103	28,189	218	66,860
Unidentified chub	unidentified chub	96	877	7	44
California	*Paralichthys*	95	1,729	21	4,769

Table 2-5. Number and weight of fishes, sharks and rays impinged during normal operation and heat treatment surveys at EPS from June 2004-June 2005

Common Name	Scientific Name	Normal Operations		Heat Treatments	
		Sample Count	Sample Weight (grams)	Sample Count	Sample Weight (grams)
halibut	*californicus*				
Sargo	*Anisotremus davidsoni*	94	1,662	963	68,528
All other fishes, sharks and rays		1,037	101,810	9,667	917,838
	Total	***19,408***	***351,672***	***94,991***	***2,034,900***

2.5.3 Comparison of 1979-1980 and 2004-2005 EPS Entrainment and Impingement Data

2.5.3.1 Entrainment

The most abundant fish larvae collected during the 1979-1980 and 2004-2005 entrainment studies were similar; however, the abundance of these taxa changed between studies. Gobies, blennies and anchovies were among the top ten species during both studies. Compared to the IM&E study at EPS conducted by SDG&E in 1979-1980, goby larvae were approximately five times more abundant in the recent entrainment samples while combtooth blenny (*Hypsoblennius* spp.) larvae were nearly twenty times more abundant in the recent entrainment samples (Tables 2-2 and 2-3). Anchovy and croaker larvae were significantly more abundant in the earlier study (Tables 2-2 and 2-3).

Although large variation in the abundances of fish larvae is expected among years, one explanation for the differences between the two studies are the changes in available habitats in AHL that have occurred over the past 25 years. For example, shallow mudflats in AHL, the habitat for gobies, have expanded due to watershed erosion and sedimentation has resulted in an overall reduction in total habitat in AHL due to infilling of the Middle and Inner Lagoons and development of sandbars at the western edge of the Inner Lagoon (MEC Analytical Systems [MEC] 1995). The habitat for blennies has also increased due to the addition of floats and barges for aquaculture operations that provide large surface area for fouling communities that are utilized by blennies for habitat – these structures did not exist during the 1979-1980 studies. The higher abundances of anchovy and croaker larvae in the 1979-1980 study are likely due to the cooler water climatic regime in the SCB that favored increased populations of these taxa.

2.5.3.2 Impingement

Results from the 1979-1980 and 2004-2005 impingement studies also show similar species composition including topsmelt, shiner surfperch, deepbody anchovy, queenfish and slough anchovy. One noticeable difference, however, was much higher numbers of salema in 2004-2005. Annual impingement fish biomass (normal operations and heat treatments) was similar in both studies – approximately 9,263 pounds (lbs) in 2004-2005 compared to approximately 8,421 lbs in 1979-1980.

Although the average losses measured during heat treatments were also similar between the two studies (Table 2-6), the results from normal operation impingement suggest that the total abundances of fishes in AHL that are subject to impingement have increased over the 25 years since the first study was done. Data on shellfishes were not compared because of the differences in sampling protocols for shellfishes between the two studies.

Table 2-6. Average daily abundances of fishes collected during normal operation (unadjusted for EPS flow) and heat treatment impingement surveys during the 1979-1980 and 2004-2005 surveys

Study Period	Average Daily Fish Abundance Normal Operations		Average Fish Abundance Heat Treatments	
	Numbers	Biomass (lbs)	Numbers	Biomass (lbs)
1979-1980	237	9.0	15,497	763.9
2004-2005	373	15.0	15,832	747.8

2.6 Poseidon Desalination Permit

Poseidon proposes to construct and operate the CDP on the site of EPS. Cabrillo is not affiliated with Poseidon who is the lessee. Poseidon originally applied for a NPDES Permit to discharge up to 64.5 MGD of wastewater. CDP will use a portion of the EPS cooling water effluent for seawater desalination treatment. Treatment processes at CDP will consist of pretreatment, reverse osmosis desalination, and disinfection and product water stabilization. CDP is allowed to discharge up to 57 MGD of reverse osmosis brine.

The total flow rate of source water needed to operate CDP at full production is 304 MGD, in order to produce 50 MGD of potable water, and will result in 57 MGD of wastewater with the remaining 197 MGD needed as dilution water to comply with the salinity requirements of the NPDES Permit. This results in a total discharge flow rate of 254 MGD (57 MGD of wastewater and 197 MGD of dilution water). The NPDES Permit (No. CA0109223) was issued on June 14, 2006 with an effective date of October 1, 2006 (California Regional Water Quality Control Board Region 9, San Diego Region; Order No. R9-2006-0065).

As required by Order No. R9-2006-0065, Poseidon submitted a Flow, Entrainment and Impingement Minimization Plan (Minimization Plan) that assesses the feasibility of "site-specific plans, procedures, and practices to be implemented and/or mitigation measures to minimize the impacts to marine organisms when the CDP intake requirements exceed the volume of water being discharged by the EPS." Contingent upon the approval of the Mitigation Plan, CDP can withdraw water through the EPS intake when the operation of EPS does not provide adequate flow (Order No. R9-2006-0065, Section VI.C.2.e.).

The Minimization Plan, dated March 27, 2009, was approved May 13, 2009 (Order No. R9-2009-0038). The Minimization Plan:

- Identifies the best available site feasible to minimize IM&E of marine life
- Identifies the best available design and technology feasible to minimize IM&E
- Estimates potential unavoidable impacts to marine life
- Identifies the best available mitigation feasible to minimize any residual IM&E, and is in addition to those measures addressed through site, design and technology approaches
- Establishes a Biological Performance Standard
- Requires a Productivity Monitoring Plan
- Requires an Impingement Monitoring Program
- Requires notification of the Regional Board Executive Officer when all units at EPS will be non-operational for power generation, without seawater intake, and unavailable to the California Independent System Operator to be called upon to produce power for a consecutive period of 180 days or more.

3. Compliance Alternatives

3.1 Track 1 Compliance

3.1.1 Units 1-3

3.1.1.1 Repowering Application

On September 14, 2007 an Application for Certification (AFC) for the Carlsbad Energy Center Project (CECP) was filed by Carlsbad Energy Center LLC[1] to develop a natural gas-fired generating facility in the City of Carlsbad in San Diego County, California. The proposed CECP will be a fast-start high-efficiency, combined-cycle facility with a capacity of a 558 megawatt electrical (MWe) gross. CECP will utilize air cooled condensers, thereby reducing the volume of seawater withdrawn by the current EPS OTC system. Upon successful commercial operation of the CECP, but no later than December 31, 2017, EPS Units 1-3 will be retired and the seawater withdrawal associated with the OTC water and service water systems for these units will cease. The total intake flow for Units 1-3, approximately 225 MGD, will be eliminated.

The Policy states, "The installation of closed cycle dry cooling systems meets the intent and minimum reduction requirements of this compliance option" (Policy 2.A. (1)). Pg. 4). The use of air cooled condensers is equivalent to dry cooling towers (i.e., both transfer heat through tubes directly to air without the evaporation of water). Through the retirement of Units 1-3 and repowering with dry cooling, Units 1-3 will comply with the requirements of the Policy under Track 1.

A Decision from the California Energy Commission (CEC) of the CECP has not been issued. Under the Policy, EPS must be in compliance no later than December 31, 2017 (Compliance Date). CECP anticipates that the repowering will be approved resulting in the retirement of Units 1-3, the associated shutdown of approximately 225 MGD and the replacement of Units 1-3 with highly efficient, fast start combined cycle generation prior to the Compliance Date. In the event that the repowering of CECP is not completed by the Compliance Date, Cabrillo will retire Units 1-3 and cease withdrawing approximately 225 MGD of seawater. Under the scenario, the intake flow for Units 1-3 will be eliminated, therefore, exceeding the 93 percent flow reduction requirements for Track 1 compliance.

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[1] Carlsbad Energy Center LLC is an indirect wholly owned subsidiary of NRG Energy, Inc.

3.1.2 Units 4 and 5

3.1.2.1 Demonstration that Track 1 is Not Feasible

In order to utilize the Track 2 compliance alternative, an owner or operator of an existing power plant must demonstrate to the SWRCB's satisfaction that compliance with Track 1 is not feasible (Policy 2.A.(2). Pg. 4). Not feasible is defined in the Policy (Section 5) as:

> *...cannot be accomplished because of space constraints or the inability to obtain necessary permits due to public safety considerations, unacceptable environmental impacts, local ordinances, regulations, etc. Cost is not a factor to be considered when determining feasibility under Track 1.*

As demonstrated in the remainder of Section 3.1, compliance with Track 1 for EPS Units 4 and 5 is not feasible as defined in the Policy and EPS will pursue compliance with Track 2.

3.1.2.1.1 Site Space Constraints

The proposed redevelopment of the site includes the installation of new combined-cycle Units 6 and 7 and the installation of a new desalination plant, all located within the current property boundary of EPS. Figure 3-1 shows the locations of these proposed facilities.

The new combined-cycle units will be located east of the railroad tracks in the location of the existing fuel oil tanks number 5, 6 and 7, which will be removed before new unit construction. The installation footprint for the new units will approximately extend from the railroad tracks easterly to the eastern property line and from the northern berm of fuel oil tank number 7 southerly to the northern berm for fuel oil tank number 5.

The new desalination plant will be located south of existing fuel oil tanks number 1 and 2. The existing fuel oil tank number 3 will be removed and the footprint of the new plant will extend from the northern containment berm of fuel oil tank number 3 south approximately 800 ft and from the eastern berm of fuel oil tank number 3 westward approximately 250 ft.

It is also proposed that fuel oil tanks number 1 and 2 will be removed.

Since the prevailing wind direction at the site is predominantly from the west the preferred orientation for any mechanical draft cooling tower arrays would be in the east-west direction.

Available Space within the Property Boundary

Based on the proposed construction and demolition initiatives and since the preferred orientation of the cooling towers is in the east-west direction, the only areas that are available for installation of cooling towers within the current property boundary are the areas where the existing fuel oil tanks number 1 and 2 are located and a narrow piece of land adjacent to the south-east side of Unit 5 and north of the railroad siding.

The largest amount of area available in the space currently occupied by fuel oil tanks number 1 and 2 is approximately 480 ft in the east-west direction and 600 ft in the north-south direction. For the additional area adjacent to the south-east side of Unit 5, the largest amount of area available north of the railroad siding is approximately 570 ft in the east-west direction and 120 ft in the north-south direction.

Cooling Tower Configurations

For rectangular mechanical draft cooling towers there are basically two standard configurations that are used. One is a side by side configuration where the individual tower cells are positioned side by side in a one cell wide arrangement resulting in an array that is one cell in width and the total number of cells in length. The other configuration is a back-to-back configuration where two cells are positioned together in a back-to-back arrangement resulting in an array that is two cells in width and one half the total number of cells in length. Where the availability of open space on a site is restricted due to the presence of other structures needed to support the plant's operation, the back-to-back arrangement is typically used.

At EPS, plume abatement for wet cooling towers is considered necessary due to the site's close proximity to residences, roads (US I-5 and Carlsbad Boulevard), the beach railroad tracks and agricultural roads. The addition of plume abatement technology increases the number of cooling tower cells required.

Table 3-1 provides the design criteria used in this evaluation for cooling tower sizing and selection.

Table 3-1. Cooling tower design parameters

Parameter	Unit 4	Unit 5
Unit Rating	287 MW	315 MW
Cooling Water Flow	200,000 gpm	208,000 gpm

Table 3-1. Cooling tower design parameters

Parameter	Unit 4	Unit 5
Steam Flow	1.511 x 10^6 lb/hr	1.658 x 10^6 lb/hr
Heat Duty	1.435 x 10^9 BTU/hr	1.575 x 10^9 BTU/hr
Cooling Water Temp. Rise	14.4 °F	15.2 °F
Design Wet Bulb Tem (1% incident)	68.8 °F	68.8 °F
Cooling Tower Approach	10 °F	10 °F
Cooling Tower Correction Factor	2 °F	2 °F
Cooling Tower Plume Abatement	Yes	Yes
Plume Abatement Design Point	45 °F / 95% RH	45 °F / 95% RH

MW = megawatt; gpm = gallons per minute; lb/hr = pound per hour; BTU/hr = British thermal unit per hour; °F = degrees Fahrenheit; RH = relative humidity

Side by Side Array – Unit 4

For Units 4 and 5 with plume abatement, and circulating water flow rate of 200,000 gpm and 208,000 gpm, respectively, it has been estimated that a total of 14 cooling tower cells would be required in the tower array for each unit. For each unit the estimated tower cell size would be 60 ft long by 65 ft wide. In addition, the plume abated towers would have a height of approximately 60 ft. The most effective configuration for an array is to position the cells side by side as this allows for air intake on both sides of the cell. For an array of 14 cells positioned side by side, this would require a total tower length of 910 ft. In addition, to allow for operating and maintenance access around each side of the tower, an additional 50 ft of space around the tower is recommended. For Unit 4, this would require a total footprint of 1,010 ft in length (east-west direction) and 160 ft in width (north-south direction).

Based on the space constraints discussed above, a side by side tower array for Unit 4 or Unit 5 would not fit within either of the available site locations.

Back to Back Arrays

There are suggested spacing and alignment criteria for cooling tower arrays when they have to be located in proximity to one another. Maintaining proper spacing and orientation ensures that the performance is not negatively impacted by the other towers.

The two possible alignments that would provide the east-west orientation that closely parallels the main wind direction have the two cooling tower arrays aligned in parallel to one another. The first alignment (parallel) has the towers parallel to one another in the east-west direction with the ends of each tower array in alignment with each other. The tower arrays are separated in the north-south direction by a distance equal to the length of one of the tower arrays. The second alignment (staggered) has the towers also in parallel to one another in the east-west direction but with the ends of the tower arrays offset in the east-west direction by one half of a tower array length. The tower arrays are separated in the north-south direction by a distance equal to three quarters of the length of one of the tower arrays.

For the parallel alignment, the footprint required for the Units 4 and 5 tower arrays, including the 50-ft access area around the tower installations, would measure approximately 790 ft in the north-south direction and 550 ft in the east-west direction. With an available area of 600 ft in the north-south direction and 480 ft in the east west direction, this tower array alignment would not be able to fit in the space available.

For the staggered alignment, the footprint required for the Units 4 and 5 tower arrays, including the 50-ft access area around the tower installations, would measure approximately 678 ft in the north-south direction and 775 ft in the east west direction. With an available area of 600 ft in the north-south direction and 480 ft in the east west direction, this tower array alignment also would not be able to fit in the space available.

Based on the discussion above, it is clear that the siting of mechanical draft cooling towers with plume abatement within the currently available areas on the plant site is not feasible.

Dry Cooling System for Units 4 and 5

An alternate methodology to the use of wet mechanical cooling towers is the use of an air cooled condenser (ACC), or dry system. This type of system directs the exhaust steam from the turbines to a series of finned tube assemblies where fans supply cooling air which causes the steam to condense. The condensate is then collected below the finned tube assemblies and pumped back to the steam generation system.

Since the exhaust steam from the turbines is being routed directly to the finned assemblies, the ACC system has to be located in close proximity to the steam turbine.

Using the steam flows and condensing heat loads identified in Table 3-1, a design (1 percent incident) dry bulb temperature of 79.3 °F, and an allowable condenser pressure of 5 in mercury (Hg), Units 4 and 5 would each require an array of seven A-Frame assemblies, with each A-frame assembly consisting of six fan-cooled modules, to provide the level of steam condensing needed.

For seven A-Frame assemblies, the space requirement, including a 50 ft access area around each assembly, would measure approximately 370 ft by 319 ft. As noted above these arrays should be located as close as possible to the steam turbines. Units 4 and 5 are located at the south end of the generating station. The closest area to Units 4 and 5 would be the area just east of the boiler rooms for these units. This area is currently largely occupied by the 230 kilovolt (kV) and 138 kV substations and is not a viable location.

There is also a narrow strip of land just south of Unit 5 and abutting the southern property line. This area measures approximately 570 ft by 150 ft, which is not sufficient space for either of the ACCs.

The only other location within the property boundary that has any open space is the area where fuel oil tanks 1 and 2 are located. In addition to this location being a significant distance from Units 4 and 5 (approximately 1,800 ft), the space available in this area is 600 ft by 480 ft. To locate both arrays in this area would require a space measuring approximately 787 ft by 319 ft. This location would not be viable for locating the arrays due to insufficient space as well as the excessive distance from the units.

Based on the space and proximity requirements for an ACC system at the EPS site, it is clear that this type of system is not a viable consideration.

3.1.2.1.2 Carlsbad Desalination Plan

As stated earlier, CDP will obtain process and dilution water from the EPS discharge flow. CDP is authorized to withdraw up to 304 MGD of ocean water through the EPS intake. Regardless of any flow reduction resulting from EPS actions, CDP will continue to withdraw up to 304 MGD. If EPS permanently ceases operations and CDP proposes to independently operate the existing EPS seawater intake and outfall for the benefit of the CDP ("stand-alone operation"), it will be necessary to evaluate whether, under those conditions, CDP complies with the requirements of Water Code section 13142.5(b). EPS Units 4 and 5 withdraw 307 MGD and 326 MGD, respectively. Due to the CDP requirement of 304 MGD, only one of the units can use flow reduction as a means of compliance. If the flow in both units were to be reduced to meet Track

1 compliance, it would be necessary for CDP to operate the EPS intake to obtain its required 304 MGD requirement.

3.1.2.1.3 Proximity to Roads, Domiciles and Agriculture

As stated earlier, wet cooling towers without plume abatement could not be used at EPS for Track 1 compliance due to the close proximity of residences, roads (US I-5 and Carlsbad Boulevard) and agricultural fields that would be potentially impacted by the cooling towers' plume. Therefore, plume abatement was considered necessary in the feasibility review for cooling towers.

3.1.2.1.4 Permitting Constraints

Since EPS is an existing major source of emissions as defined in the San Diego Air Pollution Control District (District) Regulation II, Rule 20.1 *New Source Review – General Provisions*, modifications would be subject to requirements specified in District Regulation II, Rule 20.3. Based on available information, it is believed that obtaining a District Permit-to-Operate (District Regulation II, Rule 10) and subsequent modified Title V Operating Permit under Regulation XIV is feasible. However, significant barriers will likely be encountered that would make it difficult to meet current District Requirements.

The cooling tower installation will likely be required to comply with New Source Review requirements specified in Rule 20.3. These requirements include, but are not limited to, the following:

- The project will be required to meet Best Available Control Technology (BACT) requirements for PM10 emissions under Rule 20.3(d)(1). This is required for any project in the District where the post-project potential-to-emit (PTE) exceeds 10 lbs per day PM10 emissions. This would likely require the installation of high efficiency drift eliminators. It would be the responsibility of the applicant to prepare a "Top-Down" BACT analysis to demonstrate that the chosen drift eliminators represent the most efficient, technically feasible and cost-effective technology that has been demonstrated in practice.

- The applicant would be required to complete an air quality impact analysis (AQIA) for PM10 emissions as specified in Rule 20.3(d)(2). The purpose of the AQIA would be to demonstrate that the project would not:

    - cause a violation of a state or national ambient air quality standard anywhere that does not already exceed such standard, nor

- cause additional violations of a national ambient air quality standard anywhere the standard is already being exceeded, nor

- cause additional violations of a state ambient air quality standard anywhere the standard is already being exceeded, nor

- prevent or interfere with the attainment or maintenance of any state or national ambient air quality standard.

The AQIA trigger thresholds for PM10 as specified in Rule 20.3, Table 20.3-1 are 100 lbs per day (lb/day) or 15 tons per year (ton/year). The estimated PM10 emissions from cooling tower drift would be 600 lb/day (28.1 ton/year) and 624 lb/day (30.4 ton/year) for Units 4 and 5 respectively. These estimated PM10 emission rates assume a 0.0010 percent drift eliminator efficiency and exceed the subject AQIA thresholds.

District project approval would be subject to public review requirements under Rule 20.3(d)(4). This can potentially add significant time to project approval as any comments presented by the public will be required to be addressed by the District/applicant. In addition, a public hearing can be requested which may also extend the project approval process.

Other agency requirements that can add difficulty to the permitting process and potentially delay project approval include:

- The facility Title V Operating Permit would be subject to modification under Regulation XIV. This process would require public review and the final permit would be subject to USEPA review and approval. An updated Compliance Assurance Monitoring (CAM) Plan would likely be required for the drift eliminators in accordance with Federal Clean Air Act requirements (40 CFR Part 64).

- A visible plume analysis would likely be required due to the proximity to the beach, the US I-5 Freeway, railroad tracks and residential areas.

- The facility would likely be required to undergo air toxics new source review under District Regulation XII Rule 1200: *Toxic Air Contaminants – New Source Review* due to potential metals emissions in the cooling tower drift. This would include conducting dispersion modeling and a health risk assessment. This can potentially complicate the permitting process, especially if health-risk criteria cannot be met.

- The project may be subject to California Environmental Quality Act (CEQA) review which would result in a multi-media environmental impact analysis for the entire project, including both construction and operational impacts. This review process can add significant time to the project approval process.

- It should also be noted that there would be an "energy penalty" associated with the installation of wet cooling towers that is predicted to be approximately 2.5 percent. This would result in an approximate 2.5 percent increase in operational emissions from Units 4 and 5 for equivalent power output to current conditions

3.1.2.1.5 Local Ordinances/Regulations

In addition to the District permitting requirements, other local requirements through the City of Carlsbad can add significant challenges to the project permitting process. Examples include local height restriction, aesthetics and noise ordinances.

Local height restriction ordinances include a limit of 45 ft as indicated in the Electric Power Research Institute (EPRI) *Issues Analysis of Retrofitting Once-Through Cooled Plants with Closed-Cycle Cooling – California Coastal Plants* document (EPRI 2007). The addition of a plume abatement tower would result in the cooling towers exceeding this limit. Therefore, a variance may be required to obtain local approval.

Other local requirements are summarized below.

Local Noise Requirements

The noise element to the general plan must consider applicable land use compatibility for the cooling towers. Elements to a proper study include the consideration of noise source, mitigation design and overall visual constraints. Past experiences with the City of Carlsbad regarding these issues indicates that it would be a time consuming and costly effort to satisfy all regulatory requirements for a complete noise study submittal. Site measurements and surveys would be required which, in many cases, places a burden on the applicant to generate and/or acquire the appropriate land use maps necessary to complete a simple noise study, such as topographic features, visual simulations and other site specific details. The city's project managers are thorough in their reviews which typically lead to additional project costs and schedule delays.

The noise ordinance must additionally consider construction and operational noise impacts on all pre-determined sensitive receptors, such as nearby residential communities, avian habitats and local fish species. This portion of the study is data intensive and requires research into all relevant noise code guidelines that govern such actions. A complex noise model is then constructed to simulate all identified construction phases to assess the worst-case impact.

Cooling tower operational noise sources must also be clearly identified and modeled for comparison to daytime and nighttime noise code regulations. This can be problematic for the applicant as nighttime noise limits are generally much quieter and represent the most-restrictive and costly noise mitigation scenario.

Noise Control Design Issues

Cost and aesthetics play a role in the final choice of any mechanical system and mitigation system design. Given the final location of the cooling towers, it may be necessary to accurately assess and create a noise model that accounts for all mechanical equipment associated with the proposed project. In most cases, it is cumbersome for the applicant and consultant to acquire the necessary manufacturer's mechanical equipment specifications necessary to build an accurate noise model. Mitigation may become exotic given the type and location of the noise source which can lead to delays and increased costs in project deliverables. Furthermore, elevated noise sources such as a cooling tower can become quite problematic, especially if they increase the risk of direct noise pathway exposure to adjacent residential communities. This can play a significant role in obtaining local project approval.

Visual Aesthetics

Many communities within the Carlsbad coastal zone are locally governed by visual guidelines. The affluent beachfront community of Carlsbad is no exception. Residents pay a premium in order to enjoy a controlled and visually regulated community environment. The city is well known to be keenly aware of these issues and will likely require the applicant to address all visual components that may infringe upon robust code requirements. It should be considered, however, that normally the benefits of noise reduction far outweigh the aesthetic impacts for residents protected from unwanted sound. Several disadvantages of noise barriers and/or exotic noise mitigation include:

- Aesthetic impacts for motorists and neighbors, particularly if scenic vistas are blocked
- Costly visual simulations to assess impacts from all directions
- Costs of mitigation design, construction and maintenance

3.1.2.2 Ancillary Benefits to Agua Hedionda Lagoon from Maintaining Cooling Flow

One of the benefits of operating the cooling water intake system at EPS in AHL is the enhancement of hydraulic circulation in the lagoon system. Without the power plant, the only exchange in the lagoon would occur from tidal exchange and during storm events when there is freshwater inflow from runoff from the surrounding watershed. The opening between the lagoon and the ocean is also maintained through dredging done by the power plant. The dredging and the operation of the power plant cooling water intake system reduce the residence time of water in the entire lagoon to approximately 2.6 days or five tidal cycles. Even in the Inner Lagoon, the residence time is only 3.2 days or 6.3 tidal cycles. As the following examples show, the maintenance dredging of the opening and the operation of the EPS CWIS greatly enhances water quality in the lagoon.

The water quality improvements in AHL due to operation of the EPS CWIS have not been quantified, but studies done in Alamitos Bay, to the north in Long Beach, California, for the original 316(b) studies for the Alamitos Generating Station (AGS) by Intersea Research Corporation (IRC; 1981), showed that the flows from AGS and the Haynes Generating Station, also located in Alamitos Bay, reduce the residence time of the water in Alamitos Bay to approximately one day. IRC (1981) estimated that the cooling water flows annually supply the bay with 50 tons of additional oxygen relative to the supply provided by natural exchange processes, greatly enhancing the water quality in the bay.

The benefit to water quality in Alamitos Bay due to operation of the power plants was clearly shown when the operation of AGS was reduced due to lower energy demand in recent years. As a result of the reduced flow from AGS, concern was expressed over odor problems and bacteria in the Los Cerritos Wetlands. The Los Cerritos Wetlands are located in the back reaches of Alamitos Bay near the power plant and under normal conditions benefit from continual inflows of water through the channel leading to the power plant which helps circulate water through the wetland system during plant operation. AES Alamitos, the owner/operator of AGS, was contacted with a request to discuss options for maintaining flow in the channel in order to maintain the health of the Los Cerritos Wetlands even during times when cooling water is not needed by the plant. If plants like EPS and AGS were retrofitted with closed-cycle cooling, the health of the associated wetland systems and their associated productivity would be adversely affected.

The benefits of maintaining tidal exchange in AHL and other coastal lagoons through dredging are widely recognized and are usually an integral component of wetland restoration projects. For example, one of the conditions of the coastal development permit adopted by the California Coastal Commission (CCC) for the San Onofre Nuclear Generating Station (SONGS) Units 2 and 3 was to create or substantially restore 150 acres of tidal wetland as mitigation for impacts to the marine environment caused by the construction and operation of SONGS Units 2 and 3. The CCC initially identified eight wetland sites for potential mitigation, before approving the choice in June 1992 of San Dieguito, approximately 15 miles to the south of EPS in Del Mar, California. The

Environmental Impact Report/Environmental Impact Statement (EIR/EIS) prepared for the San Dieguito restoration project included information on the final permit conditions for the project (San Dieguito River Park Joint Powers Authority [SDJPA] and United States Fish and Wildlife Service [USFWS] 2000). The permit conditions in the EIR/EIS stated that Southern California Edison was required to submit a plan that included a total of 150 acres of credit, including the creation and/or substantial restoration of 115 acres of tidal wetland and that up to 35 acres of enhancement credit would be given for permanent, continuous maintenance of tidal flows through the system by dredging the channel out to the ocean. The 35 acres of enhancement credit was based on the determination that 126 acres of existing wetlands at San Dieguito would be enhanced by 28 percent if the tidal flows were maintained continuously.

It is clear from the examples above that the flow resulting from the cooling water intake system assists in maintaining water quality in AHL. With the current EPS operation, the inlet and the lagoon are periodically maintenance dredged to maintain the flow. Without the flow from EPS, sediment accretion would accelerate, potentially resulting in inadequate flow through the inlet and a decrease in water quality that would substantially affect the multiple beneficial uses of the lagoon which includes water recreation in the Inner Lagoon, and the aquaculture operations in the Outer Lagoon, including the white sea bass restoration program at the Hubbs Sea World Research Institute.

3.2 Track 2 (Units 4 and 5)

3.2.1 Compliance Criteria

In order to be able to use the Track 2 compliance alternative, an owner or operator of an existing power plant must first demonstrate, to the SWRCB's satisfaction, that compliance with Track 1 is not feasible. The previous sections describe the basis upon which Cabrillo claims that compliance with Track 1 is not feasible at EPS. Therefore, EPS will comply with the Policy under Track 2.

Under Track 2, an owner or operator of an existing power plant must reduce IM&E of marine life on a unit-by-unit basis to a level comparable to Track 1 using operational or structural controls or both.

3.2.1.1 Impingement Mortality

Impingement mortality compliance under Track 2 can be achieved in one or two ways:

- Demonstrate, through monthly verification, that the through-screen intake velocity does not exceed 0.5 fps

  or

- Demonstrate actual reduction in impingement mortality comparable to that achieved under Track 1

A comparable level, as defined by the Policy, is a level that achieves at least 90 percent of the reduction in impingement mortality required under Track 1. Track 1 requires a minimum 93 percent reduction in intake flow rate for each unit for compliance, compared to the unit's design intake flow rate.

The relationship between impingement and flow rates was studied as a potential indicator of impacts (EPRI 2003). This study concluded that volumetric flow rate is a poor predictor of impingement and that there are a number of factors which may influence impingement rates, including waterbody size and ecological zone of withdrawal. The extensive review of studies in the United States and internationally found that there are generally more fish impinged (or entrained) with increased withdrawal rate; however, there is much variability. For purposes of compliance under Track 2, it will be assumed that less water withdrawn will result in comparably reduced impingement rates. Therefore, we can translate the Track 1 minimum 93 percent reduction in intake flow rate as an equivalent reduction of fish impingement rate. Applying the definition of a comparable level (i.e., achieving a 90 percent reduction required under Track 1), the minimum compliance criteria for impingement mortality reduction is 84 percent (93 percent x 90 percent).

3.2.1.2 Entrainment

Entrainment compliance under Track 2 can be achieved one of two ways:

- Reduce cooling water flow a minimum of 93 percent as compared to the average actual flow for the corresponding months from 2000 to 2005

  or

- Demonstrate an actual reduction of entrainment relying in whole or in part of control technology comparable to that achieved under Track 1

A comparable level, as defined by the Policy, is a level that achieves at least 90 percent of the reduction in impingement mortality required under Track 1. For purposes of compliance, it is assumed we can translate the Track 1 minimum 93 percent reduction in intake flow rate as an equivalent reduction of fish entrainment. Applying the definition of a comparable level (i.e., achieving a 90 percent reduction required under Track 1), the minimum compliance criteria for impingement mortality reduction is 84 percent (93 percent x 90 percent). Compliance must be determined based on ichthyoplankton and on certain invertebrate lifestages, specifically, the crustacean phyllosoma and megalops larvae, and squid paralarvae fractions of meroplankton if screens are employed to reduce entrainment.

EPS will use an Equivalent Adult Modeling (EAM) approach for evaluating the effectiveness of any screening technologies used in complying with Track 2 of the Policy. EAM is a well established approach for evaluating IM&E losses (Horst 1975, Goodyear 1978, Dixon 1999) that was also used extensively by USEPA in analyses for the 316(b) Phase II rulemaking (USEPA 2004, EPA-821-R-02-003). EAM is a useful approach for evaluating IM&E losses because it accounts for the multiple ages and life stages of fishes potentially impacted and standardizes the losses to numbers of equivalent adults at a specific age or life stage. The model recognizes that natural mortality rates vary for different age and life stages and uses these age and life stage specific mortality rates to estimate the number of fishes at a different age that would have been expected to survive in the absence of the power plant losses.

As a direct consequence of the processes of natural mortality, later stage fish larvae have a much higher probability of reaching adulthood than earlier life stages. For example, the number of adult equivalents resulting from an EAM for 1,000, 30-day old larvae will be much greater than the equivalent adults from 1,000, 3-day old larvae. Accounting for the different mortality rates for the age and life stages of larvae is especially important for evaluating the effectiveness of any screening technology because of the need to balance screening efficiency with the potential for survival. While a small mesh size down to 0.02 in will screen out large numbers of small, very young larvae, very few of these larvae will survive to become reproductive adults due to the high natural mortality rates experienced by these earliest life stages. The greatest population benefit from intake screens will result from using screen sizes that minimize the entrainment of older (larger) larvae and juveniles that have a higher likelihood of becoming reproductive adults.

3.2.2 Prior Technologies/Operational Measures for Impingement Mortality and Entrainment Reduction

The operation of the cooling water intake system during the 2004-2005 12-month study period resulted in an annual estimated impingement of 120,354 fish weighing 4,780 lb on the traveling screens during normal operations, and an additional 94,991 fish weighing 4,484 lb that were collected during periodic heat treatment operations used to control the growth of fouling organisms on the tunnel walls. This means that numerically 44 percent and 48 percent by weight of the fish impingement occurred during heat treatment.

In the EPS Proposal for Information Collection (PIC), dated April 1, 2006, Cabrillo committed to evaluate potential operational and procedural enhancements to reduce impingement during heat treatment events. EPS has open channels that can be dewatered and in the future, manual cleaning of the channel walls will occur to control biofouling.

3.2.3 Potential Technologies/Operational Measures for Impingement Mortality and Entrainment Compliance

3.2.3.1 Alternative Intake Technology/Operational Measures Screening Assessment (Based on Prior 316(b) Submittals)

A review of potential technologies/operational measures was included in the PIC. That evaluation is summarized below with some revisions based on the latest information available.

3.2.3.1.1 Cylindrical Wedge-Wire Screens – Fine Slot Width

In the PIC, the use of wedge-wire screens located in AHL was eliminated from further consideration due to the lack of ambient cross flow current velocity, which is necessary to sweep organisms and debris away from the screen. Although ambient velocity is an important factor for the successful operation of wedge-wire screens, there is the potential that currents created in the Outer Lagoon by tidal fluctuations may be adequate. For this reason it is now proposed to further evaluate the use of wedge-wire screens, although other factors including, but not limited to biofouling, shallow water depth, deposition of sand and dredging requirements, may present significant challenges to the use of this technology.

3.2.3.1.2 Fish Barrier Net

It was determined that a barrier net with an area of 30,000 square ft (ft^2) would be required for the full station flow. With just Units 4 and 5 in operation, the required net size would be approximately 22,000 ft^2. It was noted in the PIC that the net would be subject to biofouling with no mechanism for self cleaning of the net. It would be necessary for a diving contractor to remove and clean the net and replace it with a second net while the first net was being cleaned. Due to the size of the openings in the net, no entrainment reduction would be achieved. For these reasons it was concluded that the barrier net was not practically feasible for implementation at EPS.

3.2.3.1.3 Aquatic Filter Barrier

This technology, as manufactured by Gunderboom, is an aquatic microfiltration barrier system consisting of a fabric filter that is installed in the waterbody around the entrance to the intake. The fabric filter is supported by floating booms and extends the full water depth. It was determined in the PIC that the aquatic filter barrier was not practically feasible at EPS due to the lack of cross currents which are necessary to carry away impinged organisms and debris. Beyond what was identified in the PIC, the surface area of the fabric filter should be such that the flow rate is approximately 4 gpm per ft^2. To provide entrainment protection for EPS at Units 4 and 5 with a design flow of 439,200 gpm, the fabric filter surface area would have to be approximately 110,000 ft^2. With an average water depth of approximately 10 ft at normal low tide, the fabric filter would have to be approximately 11,000 ft long. A filter barrier of this length within the lagoon is not practical.

3.2.3.1.4 Fine Mesh Dual Flow Screens

In the PIC it was concluded that application of fine mesh dual flow screens at the location of the existing screens is not feasible due to the inability to achieve a 0.5 fps approach velocity at the face of the screens. It was also concluded that the application of fine mesh dual flow screens would require the construction of a new screening structure at the lagoon, but that the use of fine mesh dual flow screens did not present any significant advantage when compared to a new structure with fine mesh through flow screens. For these reasons, further evaluation of fine mesh dual flow screens was not recommended.

After further evaluation and the acceptance of through screen velocities of approximately 2 fps, the replacement of the through flow screens with dual flow fine mesh screens may be feasible. For Unit 4 the screen basket width may have to approach 12 ft, which is wider than typically used for this style screen, but may be feasible. For Unit 5, screens with a basket width of 6 to 8 ft would be necessary. For either unit, structural modifications to the existing screenwells would be necessary. If the required structural modifications are determined to be feasible, other potential operational issues with the conversion to dual flow screens with wider than normal baskets would have to be investigated. The impact of the high velocity and turbulent screen exit conditions on the CWPs would have to be studied and the ability to achieve an acceptable velocity distribution across the face of the wide screen baskets would require further analysis or flow modeling.

With the through screen velocity in excess of 0.5 fps, it would also require the installation of a fish return system. After an initial review, the installation of a fish return system appears feasible. An acceptable discharge location for the system will have to be determined.

For the reasons noted above, the replacement of the existing through flow screens for Units 4 and 5 with fine mesh dual flow screens will be an option for further evaluation.

With regard to the use of fine mesh dual flow screens with a new intake structure, it may be possible to design a structure that could be somewhat smaller than what will be required using through flow screens and potentially reduce the number of screens required. For this reason, fine mesh dual flow screens will remain a possible technology for use with a new screening structure at the lagoon.

3.2.3.1.5 Modular Inclined Screens

This technology was eliminated from further consideration in the PIC since it was not a suitable or proven technology. Modular inclined screens with opening sizes small enough to reduce entrainment of eggs and larvae have not been tested. In addition, this technology has never been tested or installed at a generating station with a seawater intake.

3.2.3.1.6 Angled Screen System – Fine Mesh

This style of screen cannot be installed in the existing intake structure. It would be necessary to construct a new screening structure at the lagoon. As noted in the PIC, a new screening structure for fine mesh angled screens would be at least as large, and significantly more complex, than a new structure for either through flow or dual flow screens. Since the angled screens have fewer installations and have not demonstrated IM&E reductions which are significantly better than either through flow or dual flow fine mesh screens, this style of screen was eliminated from further consideration.

3.2.3.1.7 Behavior Barriers

3.2.3.1.7.1 Offshore Intake with Velocity Cap

The construction of an offshore intake with a velocity cap at EPS would likely achieve compliance for impingement mortality reduction based on the documented results from the El Segundo offshore intake (Weight 1956) and more recent studies at Scattergood Generating Station (MBC Applied

Environmental Sciences [MBC] et al. 2006). While the offshore intake would likely produce some reduction in entrainment due to location, full compliance with entrainment reduction requirements is unlikely. For this reason, the offshore intake was not considered for further evaluation.

3.2.3.1.7.2 Air Bubble Curtain

Little or no testing has been completed to determine the effectiveness of air bubble curtains for the species present in AHL. Due to the lack of data to project any level of IM&E reduction, this technology was not recommended for further consideration.

3.2.3.1.7.3 Strobe Lights

As noted in the PIC, few species similar to those which are present in AHL have been tested for avoidance response to strobe lights. Laboratory testing was also completed for the possible application of strobe lights at SONGS and the results were not conclusive. Furthermore, this technology does not reduce entrainment. Due to the lack of supporting effectiveness data, further consideration of this technology was not recommended.

3.2.3.1.7.4 Sound

This technology was not recommended for further consideration in the PIC since there was no data that clearly demonstrated an avoidance response by those species that are present in AHL, even though many different sound devices have been tested and numerous species have demonstrated an avoidance response. Furthermore, this technology does not reduce entrainment.

3.2.3.2 Selected Alternative Intake Technology/Operational Measures Conceptual Design

A preliminary evaluation of alternative technologies and operational measures was completed to identify the potential options for compliance with the IM&E reduction requirements. Due to the time available from the release of the Policy and the submittal date of this Implementation Plan and the requirement for additional analysis and site specific testing to more accurately determine design parameters and associated effectiveness of technologies, in addition to the need to resolve operational concerns and potential environmental and permitting issues, one specific compliance alternative has not been identified. The intent here is to identify alternatives that are feasible at EPS and have the potential to achieve compliance. Along with the identification of these alternatives, a preliminary plan for future analysis and testing to identify the final compliance option is presented.

3.2.3.2.1 Coarse Mesh Modified Ristroph Screens

The PIC identified two technologies as feasible and recommended for further evaluation. The one option was replacement of the existing traveling intake screens with coarse mesh modified Ristroph style screens. The modified Ristroph screens would have ⅜ in smooth mesh baskets with fish buckets, a dual pressure spray wash system, independent fish and debris troughs, and other features to enhance impingement survival. It would also be required that the screens operate continuously to avoid long periods of impingement prior to removal of the organisms from the screens. This technology would reduce impingement mortality but would not reduce entrainment, since the mesh size would not be reduced from what is used on the existing screens. Under the current Policy it is required that both IM&E be reduced; therefore, this technology does not have the potential to satisfy the full compliance requirements. Since other potential technologies that must be considered for entrainment reduction will also achieve equivalent impingement mortality reductions as coarse mesh modified Ristroph screens, this option for modified Ristroph screens will not be evaluated further since it would be redundant with other options to be considered.

3.2.3.2.2 New Fine Mesh Screening Structure

The second option for compliance with IM&E reduction requirements presented in the PIC was a new fine mesh screening structure. The option as presented in the PIC is for a screening structure where the through screen velocities would be less than 0.5 fps, therefore, meeting the requirement for impingement mortality. Upon further review of this option, the construction of a structure with enough screens to achieve a through screen velocity of 0.5 fps does not appear practically feasible. Due to the shallow water depth at and around the intake (approximately 10 to 12 ft at low tide) and the low percentage of open area for fine mesh screens (25 to 30 percent), it would require over 60 through flow screens with baskets that are 10 ft in width to achieve a through screen velocity of 0.5 fps. If dual flow screens with baskets that are 10 ft wide were used, the number of screens required would be slightly over 30.

A more feasible option would be to use 2 fps or less as the through screen velocity with the use of dual flow screens. This velocity is reasonable for effective operation of the screens, but since it is in excess of 0.5 fps a fish return system will be required to safely return impinged fish to the waterbody. This concept would require approximately eight screens, with the actual number of screens dependent upon the screen mesh requirement.

Verification of the feasibility of this concept and the capability to achieve the necessary reduction in IM&E would require a thorough analysis of the length frequency distribution for the entrained organisms with correlation to the head capsule depth, lab testing to determine the effectiveness of entrainment reduction with different mesh sizes and through mesh velocities, analysis of intake water for size distribution of suspended solids, gathering of bathymetric and geotechnical information at the intake, and flow modeling of any new intake structure.

The mesh size for use with a screening technology would be selected using an analysis of the lengths of fish larvae collected during the June 2004-May 2005 entrainment sampling. The geometric relationship between length and head capsule dimensions (width and depth) has been determined for larvae from California fishes entrained in the highest number at coastal power plants. These relationships would be used to determine the distribution of head capsule dimensions for the larvae entrained at EPS and the proportion of the entrained larvae that would be excluded by different mesh sizes accounting for the variation in length and head capsule for each age. The head capsule is used to set the minimum mesh size since that is the only part of the larvae with hard body parts that are not easily compressible. The relationship between length and age would be determined from published larval growth rates for those fishes. The proportion of the larvae in each age class would then be extrapolated to a common age using EAM, such as the age-one equivalent used in the USEPA analyses. This would be done for estimates of entrainment with and without screens of varying sized mesh to compare their effectiveness at protecting the population. The mesh size that Cabrillo would propose to use would be the size most appropriate to meet the Policy criteria.

The estimated effectiveness of the different mesh sizes using this approach should be conservative since the majority of the larvae would not contact the screen head-first. Also, the larvae used in estimating the screen size have been preserved in formalin and alcohol, which results in shrinkage of the specimens. As a result, the actual larvae contacting the screen will be slightly larger at the same age than the larvae used in estimating mesh size

3.2.3.2.3 Cylindrical Wedge-Wire Screens

Another potential option that will be further evaluated is the use of cylindrical wedge-wire screens with fine slot width openings. The potential exists to install wedge-wire screens in AHL; however, a significant number of concerns regarding the operation and maintenance of wedge-wire screens installed at this site have to be addressed. With the limited depth within the lagoon it is anticipated that the maximum size of the screens would be 48 in diameter. The number of required screens is a function of the selected slot width, but it is anticipated that between 40 and 60 screens would be required for the cooling water flow associated with Units 4 and 5. It would be necessary to optimize the configuration of the array of screens with consideration of local ambient currents, sand deposition tendencies, dredging requirements, interference with recreational boating, proximity to aquaculture, and flow distribution between screens. Other operational and maintenance concerns include biofouling and the possible release of copper from anti-bioufouling materials.

3.2.3.2.4 C-Water AquaSweep™ Technology

The C-Water AquaSweep™ is an intake technology for the reduction of IM&E which is being developed for commercial operation by CH2M Hill. While this technology has not been developed to the point of commercialization, the concept has been proven to have the potential for reduction of IM&E through the use of computational fluid dynamics (CFD) modeling and preliminary physical model testing. The technology would employ the use of a new structure at the current intake structure. The AquaSweep™ grid, through which the intake water flows, would be installed in front of the existing trash racks. The concept would also employ the use of low head, low speed circulators to create a sweeping current approximately parallel to the face of the grid. Effectively, the source water body flow is split into an intake flow and a sweeping flow. The inertial separation which ensues, efficiently and effectively prevents the smallest of aquatic life forms from being pulled into the existing CWIS, and ensures their safe movement through the separator and delivery back to the source water body.

The concept has the potential for use at EPS, but still requires several phases of development prior to becoming commercially available. The developers of this technology anticipate initiating pilot testing of this concept as soon as 2012 and commercialization by 2013. Although this intake technology is still in the development phase and does not have any full scale applications on which to base effectiveness, it is considered a potential technology for application at EPS. For a full description of the C-Water AquaSweep™ technology see Attachment 3.

3.2.3.2.5 Fine Mesh Dual Flow Screens

Replacement of the existing through flow screens with fine mesh dual flow screens presents some challenges due to the requirement for structural modifications to the existing intake tunnels and screenwells, stretching the limits of the dual flow technology regarding maximum basket widths, and achieving acceptable flow velocities and patterns for proper operation of the screens and the CWPs. However, with approximate screen basket widths of 12 ft for Unit 4 and 6 to 8 ft for Unit 5, the use of these screens may be feasible. This option will also require the installation of a fish return system. NRG Energy, Inc. has successfully pilot tested fine mesh dual flow screens at an east coast generating facility and considers fine mesh dual flow screens to be a feasible option worthy of further consideration at EPS.

3.2.3.2.6 Flow Reduction

In addition to the use of intake technologies, operational changes will be investigated to identify possible reductions in flow that can be achieved to supplement the reductions from the selected intake technology if the required compliance reductions are not completely achieved through the technology option. Projected flow reductions will be based on comparisons to the average actual flow from 2000 to 2005.

3.2.3.3 Outage Requirements and Coordination

Each of the potential options will require different outage durations. It is anticipated that the fine mesh screening structure, cylindrical wedge-wire screens, and C-Water AquaSweep™ Technology will require that the Unit 4 and Unit 5 outages occur at the same time. The replacement of the through flow screens with fine mesh dual flow screens will require outages for both units, but not simultaneous outages. The actual outage durations can be better developed after the design of the selected technology is further advanced and construction techniques for minimizing the required outages are investigated. It is estimated that the installation of a new technology at the existing intake could require an outage of 8 to 12 weeks, while the installation of dual flow screens in the existing intake tunnels may require individual unit outages of 2 to 6 weeks, depending upon the extent of the structural modifications required . Upon completion of the selection and pilot testing of the proposed technology, the specific time periods for the unit outages will be identified and coordination with the proper authority will be conducted.

3.2.4 Beneficial Cooling Water Reuse (Carlsbad Desalination Plant)

EPS has agreed to provide 304 MGD of production water to CDP from its cooling water discharge flow. This is considered a beneficial reuse of water. As described earlier, any reduction in flow below 304 MGD for power production will be augmented up to 304 MGD to provide production water for CDP.

4. Immediate and Interim Requirements

4.1 Large Mammal Exclusion Device

EPS does not have an offshore intake structure and is not required to have a large organism exclusion device. As stated previously, EPS has metal trash racks on the intake structure, with vertical bars that are spaced about 3.5 in apart which exclude large organisms. Therefore, EPS currently meets the Policy requirement for large mammal exclusion devices spaced at less than 9 in.

4.2 Mitigation for Interim Impingement and Entrainment Impacts

The State Policy requires existing power plants to "implement measures to mitigate the interim IM&E impacts resulting from the cooling water intake structure(s), commencing October 1, 2015 and continuing up to and until the owner or operator achieves final compliance. The owner or operator must include in the Implementation Plan the specific measures that will be undertaken to comply with this requirement."

The SWRCB has identified the preferred mitigation method as providing funding to the California Coastal Conservancy that will ultimately be used "for mitigation projects directed toward increases in marine life associated with the State's Marine Protected Areas in the geographic region of the facility." The California Coastal Conservancy has identified several restoration projects in the South Coast region that, when implemented, would provide increases in habitat and production of marine life.

Cabrillo proposes to provide funding to the California Coastal Conservancy as interim mitigation from October 1, 2015 and continuing up to and until EPS is in final compliance with the Policy. The amount provided will be based on the actual cooling water intake flow of each unit during each calendar year (January 1 through December 31). Discharge data submitted to SDRWQCB will be used for the volume calculations. Cabrillo proposes as mitigation three dollars ($3.00) for each one million gallons withdrawn by each unit. The calculations will be based on actual flow for the 12 months preceding the October 1, 2015 interim mitigation requirement and on a rolling 12-month period thereafter to the Compliance Date. Funds will be submitted to the California Coastal Conservancy annually.

Cabrillo is also interested in discussing potential credit towards the interim mitigation payments for the maintenance dredging conducted by EPS to maintain tidal flow to AHL. A precedent for this credit is the permit conditions for the restoration of the San Dieguito wetlands being funded by Southern California

Edison for the impacts of SONGS that provides for up to 35 acres of enhancement credit maintenance of tidal flows through the system by dredging the channel out to the ocean.

This approach will allow for consistent implementation of the Policy among all the plants required to conduct interim mitigation. By providing funding on an annual basis it also addresses uncertainties on the volume of cooling water necessary to support operations at EPS. This approach also avoids the uncertainties that are associated with the implementation of any restoration project and the difficulties in determining the appropriate level of funding for projects that might continue to require funding and provide benefits well beyond the date when final compliance is achieved.

5. Proposed Monitoring Plan

5.1 Current Studies Adequately Describe Baseline Impingement Mortality and Entrainment Losses

As described above, the data collected at EPS during the recent 2004-2005 study are appropriate for use in characterizing baseline IM&E at EPS and no additional monitoring is proposed until studies are required to confirm that installed technologies are providing the necessary reductions under the new Policy. The quality of the 2004-2005 study is demonstrated by the use of the results by several California resource agencies in considering permits for the Poseidon CDS, and an even more recent AFC submitted to the CEC for the replacement of Units 1-3 with two new units using closed cycle cooling.

As shown in the comparison of the results from the two 316(b) studies conducted at EPC in 1979-1980 and 2004-2005 described above, the species composition of the fishes impinged and entrained by EPS have not changed considerably. The species composition of fishes impinged and entrained at EPS with an intake inside AHL will be much less variable than plants with intakes on the open coast. For example, the dominant fish larvae in enclosed habitats like AHL (lagoons, harbors and coastal embayments) will always include gobies due to the abundance of shallow mudflat and sandy habitat, and blennies due to habitat associated with rock jetties and fouling communities on docks, pilings and other structures. In fact, gobies and blennies have been two of the dominant fish larvae collected during all of the recent entrainment studies conducted at other power plants located in harbor and coastal embayments in southern California, often comprising 90 percent or more of the total entrainment as they did at EPS. Shifts in the dominant species entrained at EPS would only be expected to occur with major changes in the available habitat in AHL.

Although few changes in species composition would be expected to occur in IM&E at EPS, there will be changes in abundance among years. These fluctuations will not affect the ability to determine if any installed technologies provide the necessary reduction required under Track 2 in the new Policy since these studies will be designed to detect the proportional reductions in IM&E due to the technology, which should be independent of the absolute levels of abundance. This proportional difference would not be expected to vary except with significant changes in species composition or changes in plant operation and is one of the primary arguments for using the Empirical Transport Model in most of the recent entrainment assessments in California (Steinbeck et al. 2007). This assessment model estimates the proportional losses to source populations of larvae due to entrainment and is generally conducted for only a single year since the proportional loss to the population will vary much less than the absolute abundances of those populations among years.

No additional monitoring is proposed at EPS until studies are required to prove installed technologies are providing necessary reductions under the new Policy. Data from the 2004-2005 study remains as the appropriate baseline IM&E data as the data for that study were collected using the same standard sampling techniques used for studies at other coastal power plants in recent years including the use of 335 micron mesh net for the entrainment sampling as specified in Section 4.B.(1) on Track 2 Monitoring Provisions in the Policy. The quality of the data collected during the 2004–2005 study is reflected in the fact that it has been used for recent California permits for the Poseidon CDP at EPS which have been reviewed by several state and federal resource agencies. EPS will submit study plans for demonstrating compliance of any technologies proposed for meeting the required reductions under Track 2 and work with SWRCB and SDRWQCB staff to ensure that the studies provide the data necessary for that determination.

5.2 Post Technology/Operational Modification Monitoring

As described above, a number of technology modifications are being considered for installation/modification at EPS. Monitoring programs to validate the performance of a technological modification against the criteria in the Policy are fundamentally different than those studies performed to characterize IM&E. How these studies are designed and conducted can be very dependent on the modifications to the intake. Cabrillo will propose an appropriate monitoring plan once a technology has been pilot tested and determined adequate for meeting the IM&E criteria contained in the Policy. The proposed monitoring plan will contain annual reporting to allow a review of the necessity for additional monitoring.

6. Proposed Compliance Schedule

Below is the proposed schedule for EPS to comply with the Policy:

- April 1, 2011: Submit Implementation Plan to outline Track 1 and/or Track 2 compliance with IM&E.
- October 1, 2011: Verify Policy requirement that no greater than 9 in spacing between bars for the intake structure is in compliance with the large organism exclusion devices. This requirement has been satisfied as the distance between the trash rack bars in front of the intake structure are 3.5 in.
- October 31, 2011: Potential SWRCB approval of the Implementation Plan.
- December 31, 2011: Develop engineering and biological assessment of proposed technologies and develop pilot testing program.
- July 2012: Install approved pilot technology to assess IM&E reduction.
- July 2012 - April 2014: Perform quantitative study to evaluate IM&E reductions by pilot technology.
- October 2015: Initiate full scale installation and deployment of approved technology.
- October 2015 - May 2017: Implement an approved quantitative study to demonstrate compliance with IM&E objectives in the Policy from full scale deployment of technology.
- October 1, 2015 - December 31, 2017: Apply Interim Mitigation fee of $3.00/million gallons based on actual flow to the California Coastal Conservancy. The fee will be paid on an annual basis. Interim mitigation fee will be canceled if demonstration of Policy compliance is achieved prior to or after October 2015, but before the Compliance Date.
- December 31, 2017 (on or before): Demonstrate compliance with Policy.

7. References

Bradshaw, J., B. Browning, K. Smith, J. Speth, and E. Fullerton. 1976. The Natural Resources of Agua Hedionda Lagoon. Coastal Wetlands Series #16. Prepared for U.S. Fish and Wildlife Service, June 1976. 110 pp. + 9 appendices.

Dixon, D.A. 1999. Catalog of assessment methods for evaluating the effects of power plant operations on aquatic communities. Report number TR-112013. Electric Power Research Institute, Palo Alto, CA.

Electric Power Research Institute (EPRI). 2003. Impacts of Volumetric Flow Rate of Water Intakes on Fish Populations and Communities. EPRI Report No. 1005178. Electric Power Research Institute, Palo Alto, CA.

EPRI. 2007. Issues analysis of retrofitting once-through cooled plants with closed-cycle cooling – California coastal plants. Final Report, October 2007. TR-052907.

Elwany, M. H. S., A-L. Lindquist, R. Flick, W. O'Reilly, J. Reitzel, and W. Boyd, 1999. Study of Sediment Transport Conditions in the Vicinity of Agua Hedionda Lagoon, Volume 1: Technical Report. SIO Reference No. 00-07, Scripps Institution of Oceanography, Center for Coastal Studies, La Jolla, CA, 8 January 1999. 10 chapters + 3 appendices.

Goodyear, C. P. 1978. Entrainment impact estimates using the equivalent adult approach. United States Fish and Wildlife Service, FWS/OBS–78/65, Ann Arbor, MI.

Horst, T. J. 1975. The assessment of impact due to entrainment of ichthyoplankton. Pp. 107118 In S. B. Saila, ed., Fisheries and Energy Production: A symposium. Lexington Books, D.C. Heath and Company, Lexington, MA.

Intersea Research Corporation (IRC). 1981. Haynes Generating Station Cooling Water Intake Study: 316(b) Demonstration Program. Prepared for the Los Angeles Dept. Water and Power, Los Angeles, CA. Nov. 1981.

Maulbetsch Consulting. 2007. Issues Analysis of Retrofitting Once-Through Cooled Plants with Closed-Cycle Cooling: California Coastal Plants. EPRI Report no. TR-052907. Palo Alto, CA.

MBC Applied Environmental Sciences (MBC), Tenera Environmental, Inc., and URS Corp. 2007. Scattergood Generating Station Clean Water Act Section

316(b) Velocity Cap Effectiveness Study. Prepared for Los Angeles Dept. of Water and Power.

MBC and Tenera. 2008. Alamitos Generating Station Clean Water Act Section 316(b) impingement mortality and entrainment characterization study. Prepared for AES Alamitos L.L.C., Long Beach, CA.

MEC Analytical Systems (MEC). 1995. 1994 and 1995 field survey report of the ecological resources of Agua Hedionda Lagoon. Submitted to San Diego Gas and Electric Company. 47 pp. + Appendices.

San Diego Gas and Electric (SDG&E). 1980. Encina Power Plant cooling water intake system demonstration. Prepared for California Regional Water Quality Control Board, San Diego Region.

San Dieguito River Park Joint Powers Authority (SDJPA) and U.S. Department of the Interior, Fish and Wildlife Service (USFWS). 2000. Environmental Impact Report/Environmental Impact Statement (EIR/EIS) for the San Dieguito Wetland Restoration Project Volume II. Document SCH# 98061010, September 2000.

Steinbeck, J. R., J. Hedgepeth, P. Raimondi, G. Cailliet, and D. L. Mayer. 2007. Assessing power plant cooling water intake system entrainment impacts. Report to California Energy Commission. CEC-700-2007-010. 105 pp plus appendices.

Tenera Environmental. 2008. Clean Water Act Section 316(b) Impingement Mortality and Entrainment Characterization Study. Prepared for Cabrillo Power I LLC Encina Power Station, January 2008.

Weight, R.H. 1958. Ocean Cooling Water System for 800 MW Power Station. Journal of the Power Division, Proceedings of the American Society of Civil Engineers. 84(6)(1958):1888-1 to 1888-222.

United States Environmental Protection Agency (USEPA). 2004. Phase II— Large existing electric generating plants, Final Rule - Regional Analysis Document for the Final Section 316(b) Phase II Existing Facilities Rule. EPA-821-R-02-003; February 12, 2004.

Figure 2-1. Location of Encina Power Station Cooling Water Intake Structure in Relation to Agua Hedionda Lagoon Source Water

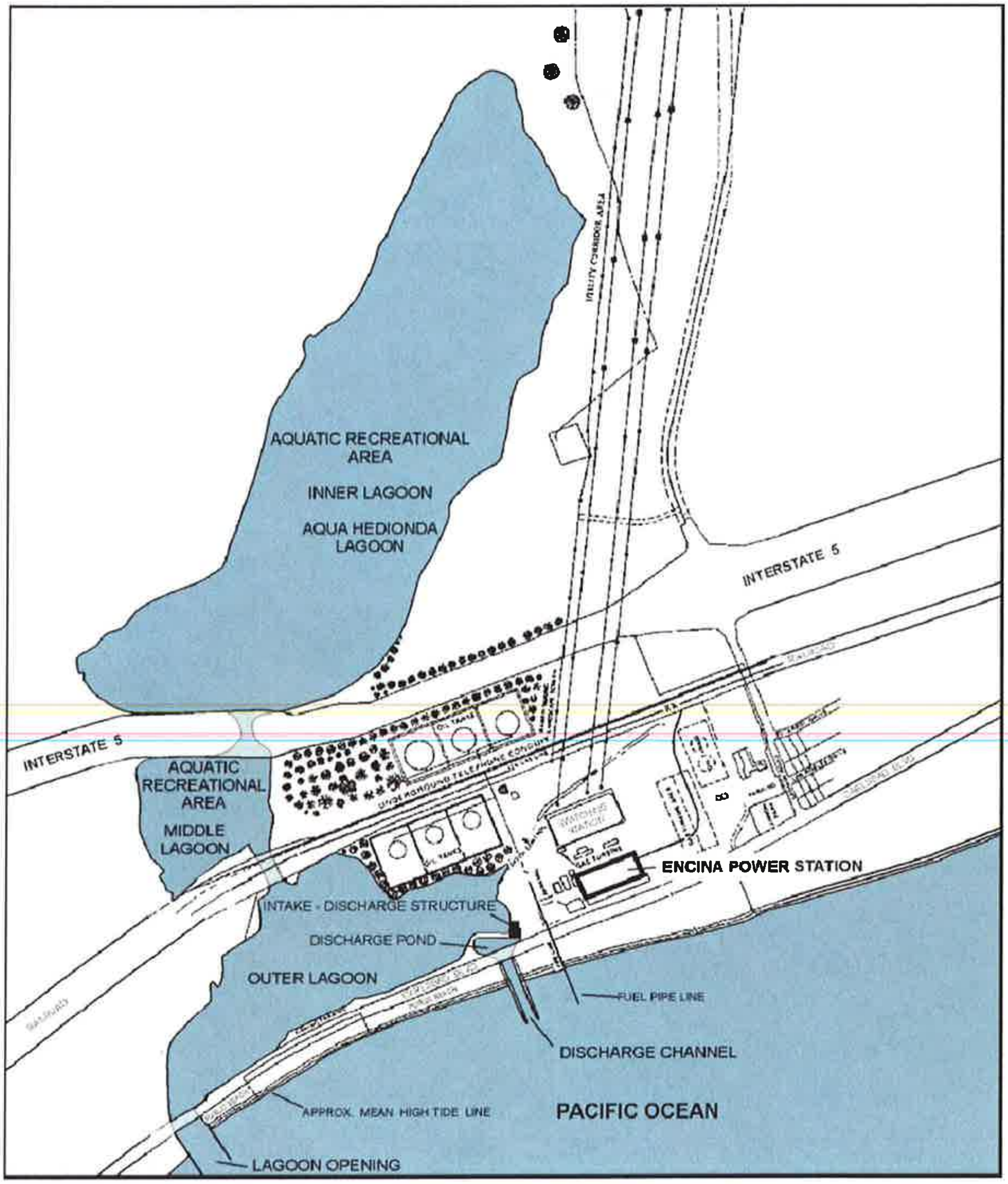


Figure 2-2. Encina Power Station Location Map

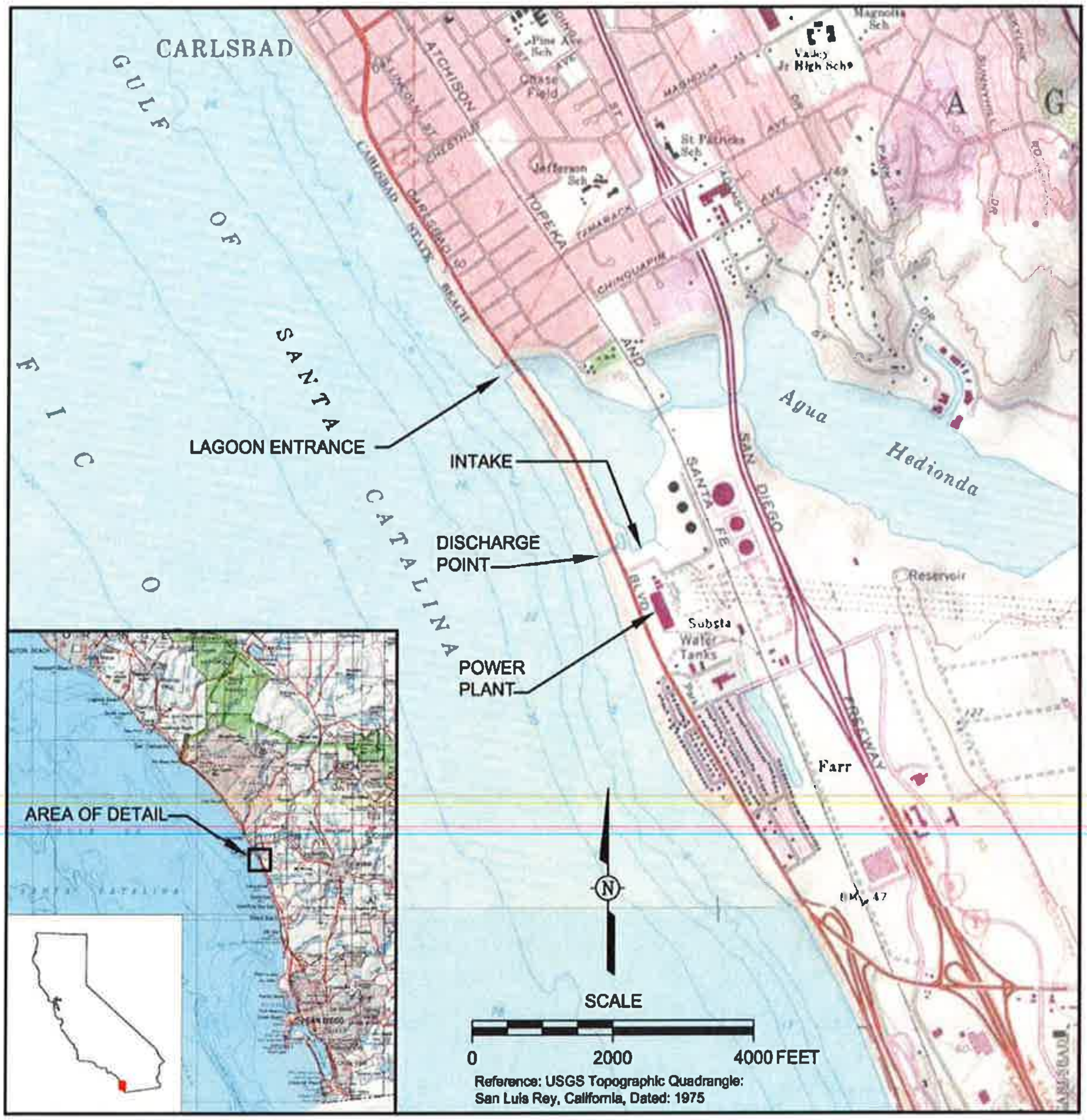


Figure 2-3. Longitudinal Cross-Section of Encina Power Station Intake Structure

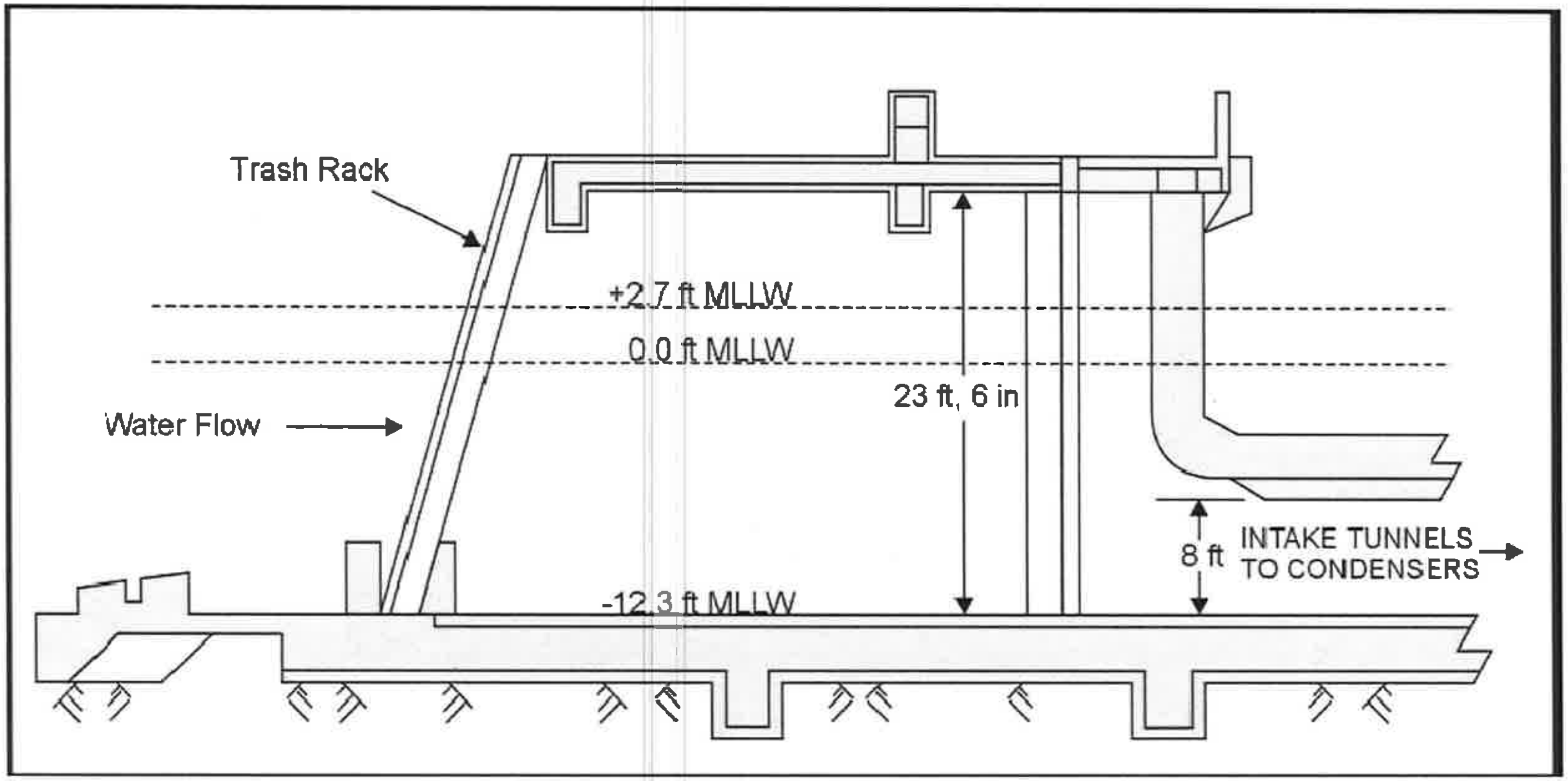
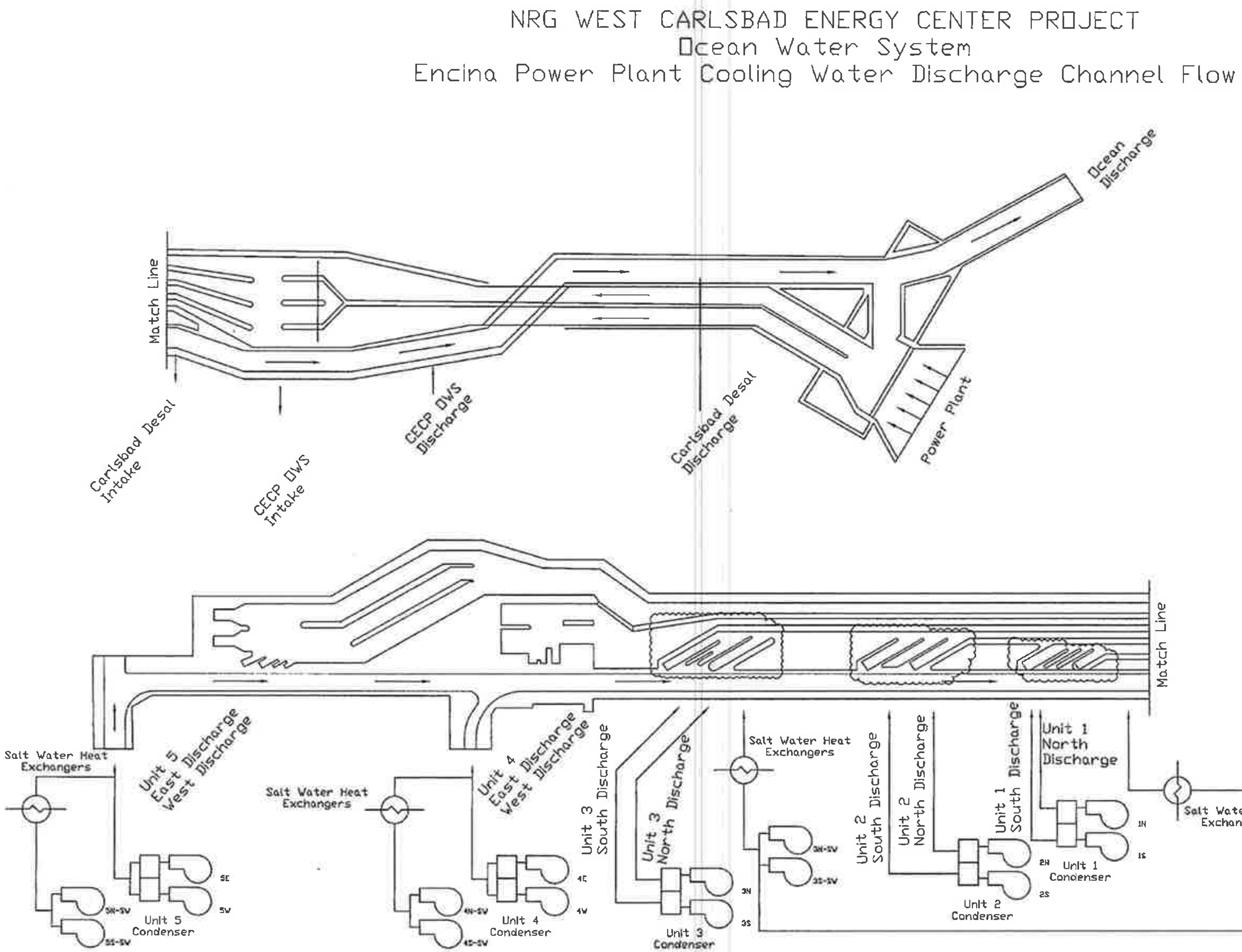


Figure 2-4. Schematic of Encina Power Station Cooling Water Intake Structure



Circulating (Condenser) Water Pumps

	Pump Capacity mgd
Unit 1N	34.56
Unit 1S	34.56
Unit 2N	34.56
Unit 2S	34.56
Unit 3N	34.56
Unit 3S	34.56
Unit 4E	144
Unit 4W	144
Unit 5E	149.76
Unit 5W	149.76
Total Flow	794.88

Salt Water Service Water Cooling Pumps

Unit 1-SW	4.32
Unit 2-SW	4.32
Unit 3N-SW	4.32
Unit 3S-SW	4.32
Unit 4N-SW	9.36
Unit 4S-SW	9.36
Unit 5N-SW	13.10
Unit 5S-SW	13.10
Total SW Flow	62.20
Total Flow	857.08

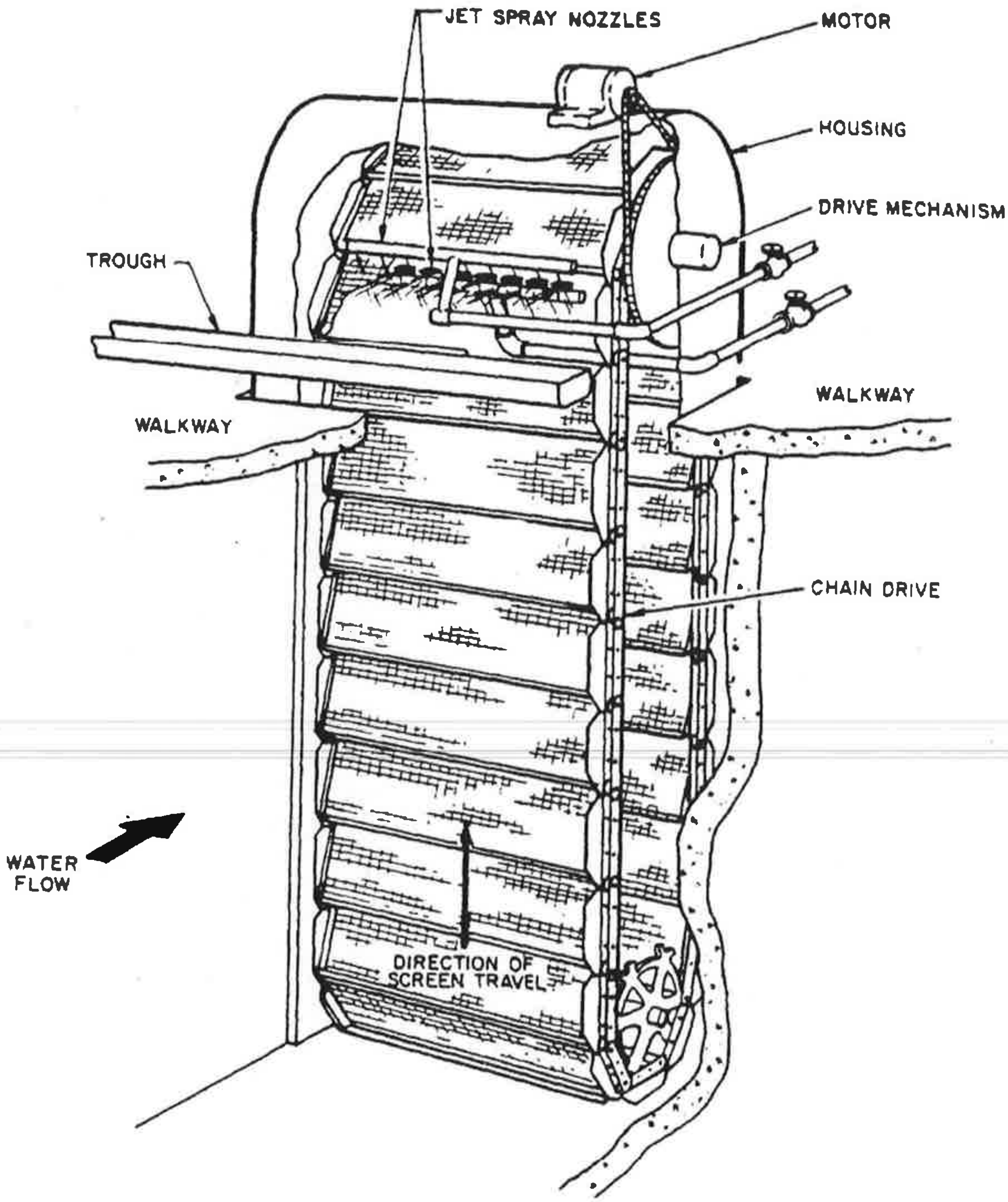
References

Note:
Location of Carlsbad Desal and CECPOWS intake and discharge points are shown for informational purposes only

NRG

1009715-M-SK-003 Rev E
28 October 2009
Drawn by A. Schaf

Figure 2-5. Diagram of Traveling Water Screen Similar to Those in Use at the Encina Power Station (illustration from EPRI)



1. Total flow including circulating water and saltwater service pumps
2. Gas turbine units do not utilize once-through cooling water sources

Figure 2-6. Location of Encina Power Station Entrainment (E1) and Source Water (L1-L4; N1-N5) Plankton Stations

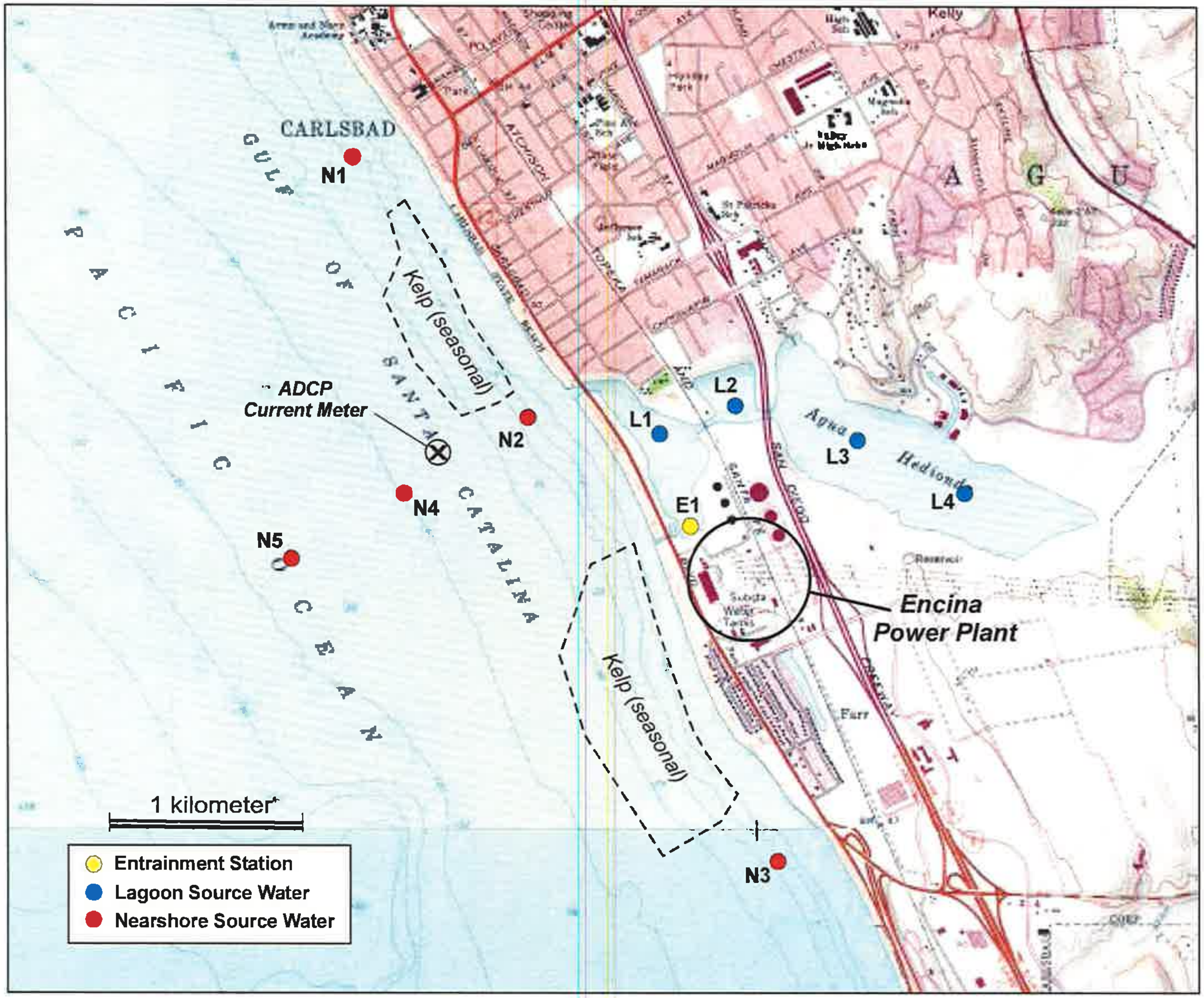


Figure 3-1. Carlsbad Energy Center Project – Plot Plan