



California Regional Water Quality Control Board

San Diego Region



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SAN DIEGO REGIONAL WATER QUALITY CONTROL BOARD

DATE: March 27, 2009

SUBJECT: **STAFF REPORT: REVIEW OF POSEIDON'S FLOW ENTRAINMENT AND IMPINGEMENT MINIMIZATION PLAN DATED MARCH 9, 2009 WITH SUPPLEMENTAL MATERIALS; ORDER NO. R9-2006-0065, NPDES NO. CA0109223, WASTE DISCHARGE REQUIREMENTS FOR THE POSEIDON RESOURCES CORPORATION, CARLSBAD DESALINATION PROJECT, DISCHARGE TO THE PACIFIC OCEAN VIA THE ENCINA POWER STATION DISCHARGE CHANNEL**

This memorandum is a summary of the San Diego Regional Water Quality Control Board (Regional Board) technical staff's conclusions based on their analysis of the March 9, 2009 Flow, Entrainment and Impingement Minimization Plan as supplemented¹ (March 9, 2009 Minimization Plan) for Poseidon Resources Corporation's (Poseidon, or Discharger) Carlsbad Desalination Project (CDP). While Poseidon has predicted that most of the time, the Encina Power Station (EPS) will discharge sufficient volumes of water to meet CDP's intake needs of 304 million gallons per day (MGD), Regional Board Order No. R9-2006-0065 (NPDES No. CA0109223) (Order No. R9-2006-0065) requires that the CDP comply with California Water Code (CWC) section 13142.5(b) during times when EPS is either temporarily shut down or is operating but not at a level that will result in sufficient discharge volumes to meet CDP's projected intake needs of 304 MGD. For clarity, staff refers to these operating conditions as co-location operation for CDP benefit.

Although in some instances the March 9, 2009 Minimization Plan refers to stand-alone operations in evaluating compliance with CWC section 13142.5(b), staff's evaluation is focused on minimization efforts applicable only to co-location operation for CDP benefit,

¹ Poseidon submitted a revised statement of Chris Nordby on March 18, 2009, and statements from Howard Chang, PhD, and Scott Jenkins, PhD, on March 20, 2009. This staff report will be revised or supplemented to address additional expected revisions from Poseidon.

consistent with the description of Poseidon's proposed CDP operation in their Report of Waste Discharge for Order No. R9-2006-0065. As reflected in Tentative Order No. R9-2009-0038 (Tentative Order), additional evaluation of CDP's operations for compliance with CWC section 13142.5(b) will be necessary if EPS ceases power generation operations² and Poseidon proposes, through a new Report of Waste Discharge, to independently operate EPS's seawater intake and outfall for the benefit of the CDP ("stand-alone operation").

Furthermore, staff's evaluation does not include an assessment of incremental impingement and entrainment effects of the CDP operation under the conditions when EPS is operating and producing sufficient discharge volumes to meet the CDP's intake needs. The Regional Board has already made a determination that these impacts are *de minimis* (see Order No. R9-2006-0065, Pages F-49 to F-50).

This memorandum is intended to assist the Regional Board in making a determination as to whether Poseidon's implementation of the Minimization Plan will result in the "use [of] the best available site, design, technology, and mitigation measures feasible to minimize the intake and mortality of all forms of marine life," as required by California Water Code (CWC) section 13142.5(b) and Order No. R9-2006-0065, under conditions of co-location operation for CDP benefit.

Background

On August 11, 2006, the Regional Board adopted Order R9-2006-0065 (NPDES No. CA0109223) establishing waste discharge requirements for Poseidon Resources Corporation to discharge up to 57 MGD of a combined waste stream comprised of concentrated saline waste seawater and filter backwash wastewater from the CDP into the Pacific Ocean via the EPS cooling water discharge channel. Intake source water from Agua Hedionda Lagoon is to be drawn in through the existing EPS intake structure. The total flow rate of source water needed to operate the CDP at full production is determined to be 304 MGD, in order to produce 50 MGD of potable water. Of this source water, 107 MGD would be used for the production of 50 MGD of potable water (and 57 MGD of wastewater). The remaining 197 MGD of source water not used

² On August 18, 2008, the Regional Board received a Report of Waste Discharge from the Carlsbad Energy Center LLC requesting an NPDES discharge permit for the proposed discharge of brine (associated with Reverse Osmosis) from a new power plant to be constructed near the existing Encina Power Station. The information provided to date (California Energy Commission Preliminary Staff Assessment Carlsbad Energy Center Application For Certification (07-AFC-06), December 2008) indicates that the EPS intends to retire power generating Units 1, 2, and 3 (including the associated pump and screens with the same number) and continue producing electricity through power generating Units 4 & 5 (with similar pump and screen numbers) at an approximate maximum flow rate of 638.5 MGD. Based on this information it is possible, if not likely, that co-located operation, may occur over an extended period of time.

for production is 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).

Section 13142.5(b) of the CWC requires new or expanded coastal industrial facilities using seawater for cooling, heating, or industrial processing, to use the best available site, design, technology, and mitigation measures feasible to minimize the intake and mortality of all forms of marine life. The term "site" refers to the location of the facility along with the associated location of the seawater intake structure(s). Consistent with CWC section 13142.5(b), section VI.C.2.e of Order No. R9-2006-0065 requires Poseidon to submit, within 180 days of adoption a Flow, Entrainment and Impingement Minimization Plan that "shall assess 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." The Order requires an approved Minimization Plan to ensure that the CDP complies with section 13142.5(b) of the Water Code when under conditions of co-location operation for CDP benefit. To approve the Minimization Plan, the Regional Board must determine that the Plan uses the best available site, design, technology, and mitigation to minimize intake and mortality of all forms of marine life under these operating conditions. Under Order No. R9-2006-0065, approval of the Plan is not a condition for commencement of the discharge from the CDP.

On February 13, 2007, and June 29, 2007, the Discharger submitted draft versions of a Minimization Plan intended to comply with Order R9-2006-0065 under the conditions when EPS is not supplying the 304 MGD needed by the CDP. In order to address outstanding concerns of staff, the Discharger thereafter submitted an updated version of the revised Minimization Plan, dated March 6, 2008. At a public meeting on April 9, 2008, the Regional Board considered the March 6, 2008 Plan and adopted Resolution No. R9-2008-0039 ("Conditional Approval of Revised Flow, Entrainment and Impingement Minimization Plan"). While the Regional Board determined that the revised Minimization Plan did not satisfy all of the requirements in Section VI.C.2.e. of Order No. R9-2006-0065, it conditionally approved the Plan subject to the conditions (1) that within six months, the Discharger submit an amended Minimization Plan that includes a specific proposal for mitigation of the impacts, by impingement and entrainment upon marine organisms resulting from the intake of seawater from Agua Hedionda Lagoon and (2) that the amended Plan address the items outlined in the February 19, 2008 letter to Poseidon and the following additional concerns:

- a) Identification of impacts from impingement and entrainment;
- b) Adequate monitoring data to determine the impacts from impingement and entrainment;
- c) Coordination among participating agencies for the amendment of the Plan as required by Section 13225 of the California Water Code;

- d) Adequacy of mitigation; and
- e) Commitment to fully implement the amendment to the Plan.

In response to Resolution No. R9-2008-0039, on November 18, 2008, Poseidon submitted an amendment to the March 6, 2008, Minimization Plan, titled the Marine Life Mitigation Plan (MLMP). Poseidon intended the MLMP, dated November 14, 2008, to satisfy the conditions in Resolution No. R9-2008-0039. In a letter dated December 2, 2008, the Executive Officer informed the Discharger that the amended Plan did not satisfy the requirements established in Resolution No. R9-2008-0039 since it did not propose a specific mitigation site or specific proposal for mitigation at an identified site, did not fully address the issues raised in the Regional Board's February 19, 2008 letter, and was submitted past the due date of October 6, 2008. On December 9, 2008, the Discharger submitted a response to the December 2, 2008 letter disagreeing and asserting that the amendment to the plan and previous submittals satisfied the Regional Board's conditions set forth in Resolution No. R9-2008-0039.

At its February 11, 2009 meeting, the Regional Board was scheduled to consider whether the MLMP satisfied the conditions established in Resolution No. R9-2008-0039 or whether failure to satisfy the conditions rendered the Resolution inoperative by its own terms. At the commencement of the February 11 item, the Executive Officer, with concurrence by the Discharger, recommended postponing action on the matter and identified a list of outstanding issues concerning the March 6, 2008 Minimization Plan, as supplemented by the MLMP. The Executive Officer identified the outstanding issues as follows: "(1) Placing Regional Water Board and its Executive Officer on equal footing, including funding, with Coastal Commission and its Executive Director, in the MLMP, while minimizing redundancies (e.g., only one Scientific Advisory Panel). Details of dispute resolution process to be worked out; (2) Reducing the number of sites to five, in consultation with the Coastal Commission, with the existing proviso that other sites within the Regional Board boundaries could be added; (3) Poseidon to provide the flow-proportioned calculations for Poseidon's impacts due to impingement, to help support the Board's determination that these impacts are *de minimis*; and (4) Poseidon to provide a consolidated set of all requirements imposed to date by the various agencies."

The Regional Board continued the matter to its April 8, 2009 meeting, directed staff to work with the Discharger to expeditiously address the list of the outstanding issues identified by the Executive Officer, and further directed staff to prepare for Regional Board consideration a resolution or order approving the Flow, Entrainment, and Impingement Minimization Plan required by Order No. R9-2006-0065.

Since the February 11, 2009 meeting, Regional Board staff and the Discharger have met on numerous occasions to address the outstanding issues. By separate submittal on February 26, 2009, the Discharger substantially resolved outstanding issue (4) by

submitting six documents reflecting various agencies' regulatory requirements concerning the CDP.³ On March 9, 2009, the Discharger submitted an extensively revised Minimization Plan, including the November 14, 2008 MLMP, for Regional Board consideration. The March 9, 2009 Minimization Plan substantially resolves outstanding issue (1) by incorporating revisions to effect the placement of Regional Board and Executive Officer on equal footing with Coastal Commission and its Executive Director in the MLMP. It also substantially resolves issue (2) by affirming that among the eleven candidate sites identified in the MLMP, Poseidon will consider the five sites within the Regional Board's boundaries as priority sites for selection.

The most extensive discussions between staff and Poseidon since the February 11, 2009, meeting have revolved around resolution of issue (3) ("Poseidon to provide the flow-proportioned calculations for Poseidon's impacts due to impingement, to help support the Board's determination that these impacts are *de minimis*"). By reviewing calculations, it became apparent that a calculation error that substantially understated the 2004-2005 impingement impacts from EPS's operations and therefore had substantially understated the CDP's projected impacts. Poseidon had described these impacts as *de minimis*, both in earlier versions of the Minimization Plan and in proceedings before the Coastal Commission last year.⁴ As a result of these discussions, the March 9, 2009, Minimization Plan reflects corrected 2004-2005 impingement data and has been significantly revised to present several alternative projections, including flow-proportioned projections, to quantify estimated impingement impacts associated with CDP's operations.

Based upon the corrected impingement calculations, staff believes the projected impingement cannot be appropriately characterized as *de minimis*, and notes that Poseidon no longer proposes that the Board consider these impacts to be *de minimis*.

³ The six documents are: (1) City of Carlsbad Development Agreement, (DA 05-01) (2) City of Carlsbad Redevelopment Permit, (RP 05-12) (3) City of Carlsbad EIR Exhibit B, Mitigation Monitoring and Reporting Program, and (4) City of Carlsbad Precise Development Plan (PDP 00-02); (5) State Lands Commission Lease Amendment (PRC 8727.1), and (6) California Coastal Commission Condition Compliance for CDP No. E-06-013 –Special Condition 8.

⁴ The March 9, 2009 Minimization Plan presents impingement losses from CDPs projected operation at levels higher than were presented to the California Coastal Commission (CCC). It appears that the CCC did not have the benefit of accurate information regarding the EPS (or CDP projected) impingement impacts prior to determining those impacts were *de minimis*. For the EPS impact, the CCC finding is based on an average of about 55 fish (~12 lbs) per day, with 80% of this impact due to EPS heat treatments. For the CDP projected impact under stand-alone operation, the CCC appears to have considered an average of about 11 fish per day (i.e., 55 fish, less 80% since CDP would not be conducting heat treatments) and less than 2.5 lbs (~1 kg) fish biomass per day (i.e., 12 lbs, less 80%). Actual EPS impingement values based on the 2004-05 study are an average of 374 fish per day weighing a total of about 7.1 kg (15.7 lbs) per day, and the actual proportion of the total fish impingement attributable to heat treatment is about 50%. The CDP projected impact, as presented in Section 5.2.2 is an average of 232 fish (4.7 kg).

Poseidon presents expert opinion that the mitigation it will implement to compensate for the effects of *entrainment* (as required by the Coastal Commission through approval of the November 14, 2008 MLMP, now incorporated in Poseidon's Minimization Plan) will also adequately compensate for impingement impacts, and thus serve as best feasible mitigation under CWC section 13142.5(b) for purposes of minimizing intake and mortality caused by impingement. As submitted on March 9, 2009 and supplemented by a revised expert opinion on March 18, 2009, Poseidon offered a bare conclusion that the mitigation for entrainment to be accomplished through the MLMP would also fully compensate for the effects of impingement. For this reason, the Regional Board engaged an expert to assist the Regional Board in evaluating the reasonableness of the various approaches to projecting the impacts from impingement presented by Poseidon and to evaluate the adequacy of the proposed mitigation for these impacts. Poseidon agreed to staff's request to have Dr. Raimondi assist the Board for this purpose and is compensating Dr. Raimondi for his efforts.

The impingement data, methods of projecting impingement associated with CDP's operations, and evaluation of the mitigation necessary to adequately compensate for intake and mortality caused by impingement, as well as through entrainment, are discussed in detail both in the March 9, 2009 Plan and in this staff report, below.

With the Board's outstanding issues as identified on February 11, 2009 addressed, staff is able to substantively evaluate the adequacy of the March 9, 2009 Minimization Plan, as supplemented to March 25, 2009, and whether its implementation will result in the compliance with CWC section 13142.5(b) and Order No. R9-2006-0065. Staff's analysis and recommendations are set forth below. Staff's analysis and recommendations may be modified or supplemented as staff evaluate newly submitted information.

Evaluation of Project Compliance with CWC 13142.5(b)

A. Best Available Site

The March 9, 2009 Minimization Plan evaluated three possible sites, within the City of Carlsbad, that could potentially serve as alternative sites for the CDP. All three sites involve the use of coastal waters as the source water for the project. These were: (1) other locations within the EPS property; (2) a site within the Encina Water Pollution Control Facility (EWPCF) property; and (3) a site adjacent to Maerke Reservoir, located 10.6 miles from the proposed project site. Sites were evaluated based on proximity to seawater intake, outfall, and key distribution points, infrastructure needs and production capacity, capital and operating costs, planning and zoning, environmental impacts of construction and operation, and preservation of Agua Hedionda Lagoon⁵.

⁵ Poseidon addresses alternative intake structures, related to site, in Chapter 4 of the Minimization Plan.

Poseidon determined that all three alternatives were found to be infeasible for the following reasons⁶:

- (1) *Other locations within the EPS property*: Alternative sites within the EPS property were infeasible because the power plant owner has reserved the remaining portion of the site to accommodate future power plant modifications, upgrades or construction of new power plant facilities.
- (2) *Encina Water Pollution Control Facility (EWPCF)*: This site could only accommodate a desalination plant with a 10 MGD production capacity, due to the outfall constraints. Use of this site would also require the construction of an intake pipeline to convey source water from the power plant cooling canal; and
- (3) *Maerke Reservoir*: The public rights-of-way between the reservoir and the Pacific Ocean do not have sufficient space to accommodate an intake pipeline and concentrate line. Use of this site would also require the pumping of over 100 MGD of seawater to an elevation of 531 feet (compared to 70 feet at the proposed site) for processing. This area has also been zoned as "Open Space".

The Minimization Plan concluded the proposed location for the CDP at the EPS (as proposed in NPDES Permit No. R9-2006-0065) is the best available site for the Project because there are no feasible and less environmentally damaging alternative locations. The Project EIR⁷, certified by the City of Carlsbad on June 13, 2006, only evaluated alternative 2 above, and concluded the alternative site (site 2 above) would not be as effective as the proposed location in satisfying the objectives of the project. The EIR did not evaluate other locations within the EPS since other locations within the EPS were determined to be substantially the same as the proposed site.

Based on available information for the 3 sites evaluated within the City of Carlsbad, staff concurs that the location within the property leased by the EPS, using the existing EPS intake structure to obtain source water, is the best site for the proposed CDP. The Report of Waste Discharge submitted by Poseidon identified the EPS site as the final project site. The Regional Board evaluated the application on the basis of this location when it adopted Order No. R9-2006-0065, NPDES No. CA0109223 on August 16, 2006, and thus, has already determined by implication that the site is the best available for purposes of CWC section 13142.5(b).

B. Best Available Design

A key feature of the proposed design is the direct connection of the desalination plant intake and discharge facilities to the intake channel and discharge canal of the power

⁶ March 9, 2009 Minimization Plan, Chapter 2, Section 2.2

⁷ December 2005 EIR, Section 6.2

generation plant. This approach allows the CDP to use the power plant cooling water as both source water for the seawater desalination plant and as a blending water to reduce the salinity of the desalination plant concentrate prior to the discharge to the ocean. Under the State Lands Commission conditions of co-location with the EPS⁸, however, Poseidon has little control over the intake structure.

As stated above, Poseidon must implement its Plan at the CDP to minimize impacts and mortality to marine life during conditions of co-located operation for the benefit of the CDP. This includes the conditions of (1) temporary shutdown and (2) when EPS is generating power but would not otherwise produce adequate discharge volumes to meet CDP's intake needs. Poseidon proposes to incorporate features in the desalination plant design to reduce impingement, entrainment and flow collection under the first condition, when EPS is temporarily shut down. Design features that will be implemented during temporary shutdowns include operation of a modified (EPS) pump configuration to reduce both inlet (bar racks) and fine screen velocity, and ambient temperature processing⁹. Poseidon has not provided a definition of "temporary shutdown", with specified time frame conditions. Therefore it remains unclear whether Poseidon will implement these features during any period of temporary shut down, regardless of length, or whether the temporary period must exceed some specified number of days before Poseidon can or will do so. Staff believes the Plan should clarify whether these features will be implemented under all temporary shut down, regardless of duration, or whether constraints to implementation will apply.

Additionally, The March 9, 2009 Minimization Plan states that at 304 MGD, the velocity of the seawater entering the inlet channel would be at or below 0.5 feet per second (fps), resulting in impingement losses at the inlet screens (bar racks) being reduced to an insignificant level. It should be noted, however, most intake and mortality from impingement do not occur at the bar rack but rather on the rotating screens. Reduced velocity at the bar rack will not necessarily minimize impingement losses on the rotating screens.

Poseidon does not quantify the reduction in intake or mortality that it anticipates achieving through implementation of these features. However, Poseidon proposes to minimize for all of the projected entrainment and impingement impacts associated with its operations through mitigation. In other words, Poseidon does not purport to "take credit" for any reductions achieved through implementation of design features.

C. Best Available Technology

The March 9, 2009 Minimization Plan contains the results of Poseidon's feasibility assessment of the best available intake, screening, and treatment technology to minimize intake and mortality of marine organisms from entrainment and impingement.

⁸ CA State Lands Commission Amendment of Lease PRC 8727.1

⁹ March 3, 2009 Minimization Plan, Chapter 3, Sections 3.5-3.7

In the Minimization Plan, Poseidon identifies technology alternatives as well as constraints associated with each alternative. When co-located with the EPS, any technology modifications to the existing EPS intake channel must be compatible with both CDP and EPS operations. In addition, the amendment of the EPS intake and outfall lease to authorize use of these facilities by the CDP (by the State Lands Commission) recognized that entrainment and impingement minimization measures cannot interfere with, or interrupt ongoing power plant operations¹⁰.

Poseidon analyzed and investigated a number of alternative seawater intake, screening and treatment technologies prior to selecting the desalination plant intake, screening and seawater treatment technologies planned for the CDP.

1) Poseidon analyzed the following intake alternatives:

- Subsurface intake (vertical and horizontal beach wells, slant wells, and infiltration galleries);
- New open ocean intake;
- Modifications to the existing power plant intake system; and
- Installation of variable frequency drives (VFDs) on existing power plant seawater intake pumps.

2) Poseidon compared screening technologies to identify the best available technology feasible including:

- Fish net, acoustic and air bubble barriers upstream of the existing intake inlet mouth;
- New screening technologies to replace the existing inlet screens (bar racks) and fine vertical traveling screens;

Poseidon concluded that implementation of the alternatives associated with the modification of the existing power plant intake and screening technology were infeasible alternatives because they would interfere with, or interrupt, power plant scheduled operations.¹¹ Poseidon also concluded that taking into account economic, environmental and technological factors, the power plant intake screening alternatives are not capable of being accomplished in a successful manner within a reasonable period of time.¹²

¹⁰ CA State Lands Commission Amendment of Lease PRC 8727.1, Finding No. 12

¹¹ CA State Lands Commission Amendment of Lease PRC 8727.1, Finding No. 12.

¹² March 9, 2009 Minimization Plan, p. 4-27.

Regional Board staff acknowledge that under the conditions of co-location operation for CDP's benefit, Poseidon likely has limited control over the technology of the EPS intake.¹³

It is important to note that the March 6, 2008 version of the Plan included a combination of intake, screening and treatment technologies that were found to be feasible impingement, entrainment and flow reduction technology measures for the site specific conditions of the CDP. These technologies included:

- Installation of VFDs on Desalination Plant Intake Pumps – to reduce the total intake flow for the desalination facility to no more than the needed at any given time, thereby minimizing the entrainment of impinged organisms;
- Installation of micro-screens – to minimize entrainment and impingement impacts to marine organisms by screening the fish larvae and plankton from the seawater;
- Installation of low-impact pretreatment technology – low pressure, chemical free membrane pretreatment filtration technology; and
- Return to the ocean of marine organisms captured by the screens and filters.¹⁴

In the March 9, 2009 Plan, Poseidon proposes to install VFDs on the desalination plant intake pumps (not the EPS intake structure), but no longer proposes as feasible technology alternatives the installation of micro-screens, installation of low impact pretreatment technology, and return to the ocean of marine organisms captured by the screens and filters.¹⁵

When Order No. R9-2006-0065 was adopted, Poseidon was considering granular media filtration and membrane filtration as the two options for pretreatment technologies. Limitations on flow rate in Order No. R9-2006-0065 were based on these two allowable pretreatment technologies. The March 9, 2009 Minimization Plan no longer contains the discussion of installation of low impact pretreatment technology, therefore it can only be assumed that granular media filtration continues to be the intended pretreatment technology. Poseidon's March 9, 2009 Minimization Plan does not explain why these previously feasible features are no longer considered feasible. It is unclear what type of screening, if any, will be installed prior to pretreatment, or if pretreatment will be applied.

¹³ Staff has not attempted to independently verify, nor has the EPS operator indicated which of the alternatives EPS would consider to interfere with, or interrupt EPS operations.

¹⁴ March 6, 2008 Minimization Plan, pp. 4-25-4-30.

¹⁵ See March 9, 2009 Minimization Plan, p.4-24-4-27.

As with the design features Poseidon will implement, Poseidon does not quantify the reduction in intake and mortality it expects to achieve through the installation of VFDs on the desalination plant intake pumps. However, Poseidon proposes to minimize for all of the projected entrainment and impingement impacts associated with its operations through mitigation. In other words, Poseidon does not purport to "take credit" for any reductions achieved through installation of the VFDs.

D. Best Available Mitigation

Poseidon proposes to reduce entrainment and impingement through the above-described methods, but also asserts that mitigation, through the creation of wetland habitat, will adequately compensate for any entrainment and impingement of marine organisms that is not avoided by use of best site, design and technology in operation of the CDP under conditions of co-location operation. Thus, Poseidon proposes to rely in large part on mitigation as a form of minimization, as allowed by the terms of CWC section 13142.5(b).

The Minimization Plan quantified impacts from impingement and entrainment in terms of stand-alone operation. Although staff is not evaluating the adequacy of mitigation in terms of impacts incurred from stand-alone conditions, it is appropriate to evaluate the sum of the impacts (i.e. impacts due to intake at 304 MGD) because during co-location operation for the benefit of CDP, the existing NPDES permit essentially allows for incremental impacts up to the same amount as stand-alone operating conditions.

The withdrawal of seawater by the EPS once-through cooling system affects marine life through impingement and entrainment. Impingement impacts occur when fish and invertebrates enter the EPS intake facility, become trapped against the primary or secondary screening devices of the circulating water system, and are killed against the screens as a result of pressure exerted from the flow of water. Entrainment impacts occur when organisms too small to be blocked by the screens are drawn into the circulating water system and killed as a result of pressure changes, temperature changes, turbulence, and mechanical damage as they pass through the plant. Entrainment affects the smaller, early life stages of marine organisms (i.e., eggs, larvae), whereas impingement affects the larger, later life stages (i.e., juveniles and adults).

(1) Quantification of Impacts from Impingement

Chapter 5 of the March 9, 2009 Minimization Plan quantifies the projected impacts on marine life due to impingement for co-located operation, as well as for operation of the CDP when EPS is permanently non-operational.

When the EPS is operating for the benefit of CDP, the CDP could cause a non-*de minimis* incremental increase in impingement. When the EPS is temporarily powered down, Poseidon anticipates that impingement rates at the EPS intake screens will be

lower than those of EPS operations at 304 MGD due to the use of a modified pump configuration that is expected to reduce intake velocities through the screens¹⁶.

The projected CDP impingement impact in terms of the number and biomass of marine organisms is based on the results of an impingement study conducted at EPS from June 24, 2004 to June 15, 2005 (Tenera, January 2008¹⁷). During this study, impingement was surveyed one day per week in order to quantify impingement rates typical of EPS normal operations (52 surveys, each representing 24 hours). In addition, to quantify impingement rates typical of EPS heat treatment operations, impingement was surveyed during each heat treatment conducted that year (6 surveys, each representing one heat treatment event).

The 2004-05 study found that, during EPS normal operations, impinged organisms represented approximately 100 taxa of fish¹⁸ and 40 taxa of invertebrates (e.g., octopus, squid, crabs, lobsters).¹⁹ No State- or Federally-listed threatened or endangered species were impinged.²⁰ The 52 surveys throughout the year showed a range of daily impingement from relatively low to relatively high; for fish, the range per survey was 17 to 5,001 individuals (0.1 kg to 109.5 kg) and, for invertebrates, the range per survey was 1 to 714 individuals (0.03 kg to 4.2 kg).²¹ The 52 surveys showed an average daily impingement of 374 fish (7.1 kgs) and 38 invertebrates (0.3 kg).²²

Under EPS heat treatment operations,²³ the study found that impinged organisms represented approximately 70 taxa of fish²⁴ and 20 taxa of invertebrates.²⁵ No State- or Federally-listed threatened or endangered species were impinged.²⁶ The six heat

¹⁶ If EPS intends to decommission Units 1-3, and leave Units 4 & 5 operational, this could limit the alternatives for operating under a modified pump configuration.

¹⁷ Tenera Environmental. 2008. Cabrillo Power I LLC, Encina Power Station Clean Water Act 316(b) Impingement Mortality and Entrainment Characterization Study: Effects on the Biological Resources of Agua Hedionda Lagoon and the Nearshore Ocean Environment. Prepared for Cabrillo Power I LLC, Carlsbad, CA.

[[http://www.energy.ca.gov/sitingcases/carlsbad/documents/applicant/appendices/5.2D_2008_Impingement_Entrainment_Study_316\(b\).doc.pdf](http://www.energy.ca.gov/sitingcases/carlsbad/documents/applicant/appendices/5.2D_2008_Impingement_Entrainment_Study_316(b).doc.pdf)]

¹⁸ March 9, 2009 Minimization Plan, Attachment 8, Table A. See also Attachment 3 for fish impinged during each survey. See also Tenera 2008, Table 4-2.

¹⁹ March 9, 2009 Minimization Plan, Attachment 8, Table B. See also Attachment 3 for invertebrates impinged during each survey. See also Tenera 2008, Table 4-5.

²⁰ Tenera 2008, Section 5-4, page 5-48.

²¹ March 9, 2009 Minimization Plan, Table 5-1.

²² March 9, 2009 Minimization Plan, Table 5-1.

²³ During a heat treatment, the intake channel is closed off from the lagoon, and heated discharge water is circulated back through the cooling water circulation system for several hours to kill organisms that are growing in the conduits. All fish and invertebrates in the intake channel are killed and, when the pumps return to normal operation, the organisms end up on the rotating screens as impinged organisms.

²⁴ Tenera 2008, Table 4-2.

²⁵ Tenera 2008, Table 4-5.

²⁶ Tenera 2008, Section 5-4, page 5-48.

treatments showed a range of impingement per heat treatment. For fish, the range per heat treatment was 7,127 to 24,037 individuals (192 kg to 537 kg) and, for invertebrates, the range per heat treatment was 72 to 525 individuals (1 kg to 7 kg).²⁷ The six heat treatments resulted in an average impingement of 15,832 fish (339 kg), and 231 invertebrates (3.3 kg).²⁸

The March 9, 2009 Minimization Plan indicates that, had the CDP been in operation in 2008, the EPS discharge would have met approximately 89% of its 304 MGD feed water requirement. An estimate of the 2008 incremental impact in terms of the number and weight of marine organisms associated with the 11% additional CDP need is not provided. The 2008 CDP incremental impact can be estimated in a number of ways. For example, 2004-05 impingement rates could be applied to the number of million gallon pumped by EPS solely for the benefit of the CDP (~12,712 MG), the proportion of the total EPS flow pumped for the benefit of the CDP (~8%), the proportion of the CDP required flow pumped for the benefit of the CDP (~11%), or the number of days on which the EPS pumped for the benefit of the CDP (~33 to 112 days depending on the deficit threshold chosen). In addition, if operation of the CDP in 2008 would have led to the need for more frequent heat treatment of the EPS intake facility, then it would be reasonable to include in the CDP incremental impact a corresponding portion of the impingement impacts due to heat treatments.

Dr. Peter Raimondi, of University of California, Santa Cruz, has agreed to assist the Board with regard to the estimation of impingement impacts that may be associated with operation of the CDP. Poseidon agreed to this request and is compensating Dr. Raimondi for his efforts. Dr. Raimondi has been asked to provide an opinion on whether the approaches to estimating impingement effects presented in the March 9, 2009 Minimization Plan (e.g., Chapter 5, Attachment 5) provide reasonable estimates of projected impingement for CDP's operations under co-location conditions. Dr. Raimondi's opinion is expected to be available by March 31, 2009. Once staff has received this opinion, the impingement section of this staff report may be updated.

The March 9, 2009 Minimization Plan provides a projection for the CDP impingement impact when the CDP is operating independently (Section 5.2.2). Although the Regional Board is not considering independent operation of the CDP at this time, the impingement projection for independent operation is discussed below because two topics warrant additional comment: (a) two days of unusually high impingement, which have bearing on the CDP projection for independent (and co-located) operation, and (b) heat treatment impacts, which will not apply to the CDP projection for independent operation.

²⁷ March 9, 2009 Minimization Plan, Attachment 3 (staff calculations from survey data).

²⁸ Tenera 2008, Table 5-2.

The CDP impingement projection for independent operation can be derived from the results of the EPS 2004-05 impingement study using a number of approaches. Poseidon provides a comparison of three general approaches, each with two specific options (Attachment 5 of the March 9, 2009 Minimization Plan). The six approaches differ mainly with respect to (1) whether the CDP projection is flow-proportioned, i.e., whether the EPS impingement results for each survey are prorated ("discounted") to the CDP flow volume of 304 MGD, and (2) whether the CDP projection includes, excludes, prorates, or weights the results from two days of unusually high impingement. In Section 5.2.2 of the March 9, 2009 Minimization Plan, Poseidon uses one approach to derive a projected CDP stand-alone impingement of 232 fish (4.7 kg) and 22 invertebrates (0.2 kg) per day. Poseidon will be submitting revisions relating to the CDP projected impingement impact. Once staff has reviewed the revised materials, the impingement section of the staff report may be updated.

During the 2004-05 impingement study, two of the 52 surveys had relatively high impingement, especially in terms of fish biomass (weight). On January 12, 2005, fish weighing 109.5 kg were impinged (5,001 individuals) and on February 23, 2005, fish weighing 29.5 kg were impinged (1,274 individuals). Poseidon concludes that the January 12, 2005 and February 23, 2005 surveys are outliers due to their greater biomass and higher numbers compared with the means of the other 50 surveys (per Attachment 5, Section III.1).

It is important to thoroughly explore and try to understand the cause of the relatively high impingement on these two days (and of high impingement in general) because, if the cause is understood, then it might be possible to address the cause and prevent/avoid similar high impingement mortality in the future.

Poseidon suggests that the high biomass impinged on January 12 and February 23, 2005 is somehow related to the heavy rains that preceded the two surveys. They suggest that freshwater fish may have died in the lagoon due to rain-associated urban runoff, or died as a result of being flushed into more saline waters, after which they drifted, dead, onto the intake screens (Attachment 5, Section III.2). Poseidon's experts underscore the scale and nature of the heavy rainfall (statements from Dr. Jenkins and Dr. Chang, received March 20, 2009).

Staff is concerned that heavy rainfall may not be the underlying cause of the high impingement on January 12 and February 23, 2005 (or at least not the only cause) as it does not explain certain aspects of the 2004-05 data. First, if heavy impingement is associated with heavy rainfall, then one might expect the heavy rainfall in October 2004 to have led to a spike in impingement comparable to the ones seen on January 12 and February 23, 2005²⁹. However, the October surveys show no such spike. Second, the surveys that had the third, fourth and fifth greatest amount of impinged fish biomass are

²⁹ e.g., March 20, 2009 statement by Dr. Jenkins, Figure 2 indicates peak runoff event in October 2004.

not associated with rainfall (i.e., July 14, 2004, August 11, 2004, and April 13, 2005). Third, the mechanism by which heavy rainfall might translate to high impingement is unclear; the suggested flushing of freshwater fish into the lagoon and onto the intake screens can account for a portion of the impinged biomass on January 12 and February 23, but most of the impinged fish (and fish biomass) were marine species.

A plausible alternative explanation is that the biomass impinged on January 12 and February 23, 2005 is related, in part or entirely, to EPS intake operations and not to heavy rainfall. The 2004-05 daily flow data³⁰ indicates that the January 12 survey may have been associated with a unique operational circumstance, i.e., the survey was preceded by four days for which intake pump records are not available, the only such week during the year.³¹ Furthermore, the January 12 survey is associated with the lowest minus-tide series of the year.³² Velocities through the intake screens are greatest during low tides due to the reduced screen area through which the flow volume must pass. Velocity through the screens during the minus tide on the afternoon of the January 12 survey may have been unusually high and have exceeded the ability of even the largest fish to swim away. [Many fish are drawn into and concentrated within the intake channel, as shown by the relatively high number (and biomass) of fish impinged during heat treatments. On January 12, 2005, there likely would have been many fish in the intake channel at risk of impingement because there had been no heat treatment for almost 12 weeks; the usual interval is about 8 weeks.]

The 2004-05 flow data indicate that the February 23, 2005 survey also may have been associated with a unique operational circumstance, i.e., the survey was preceded by six days of reduced daily flows (306 – 407 MGD), the only such week during the year. The volume on the sample day, 307 MGD, appears to be typical of Unit 4 (per Section 3.5.3, p. 3-7). Velocities through the Unit 4 screens are the highest of all five units.³³ If Unit 4 was in operation on February 23, then, despite the low flow volume, the through-screen velocities may have been relatively high, especially during that afternoon's minus tide.

³⁰ 2004-05 calculated intake flow submitted March 5, 2009.

³¹ The 2004-05 intake flow data (submitted March 5, 2009) indicate that, in the week prior to the January 12, 2005 survey, there are four days recorded as zero intake (1/7/05 through 1/10/05), and two days of low intake flow (1/6/05 and 1/11/05). EPS monitoring reports show discharges of between 580 MGD to 660 MGD on those days so presumably there was intake. On March 25, 2009, staff requested clarification and was informed that days assigned values of 0 MGD intake are days for which flow data from the plant were not available.

³² January 7 through January 12 had minus tides of -1.1, -1.6, -2.0, -2.1, -1.9, and -1.6, respectively, all in feet relative to Mean Lower Low Water according to 2005 NOAA Tide Predictions for La Jolla (Scripps Pier). Based on the predicted tides, the -2.1 ft tide on January 10, 2005 is the lowest of the year. Of all 52 surveys, it appears to staff that the January 12, 2005 survey had the second lowest tide (-1.6 ft); the February 9, 2005 survey had the lowest (-1.7 ft). [Staff acknowledges that actual tidal heights may differ slightly from the predicted heights.]

³³ E.g., February 12, 2007, Minimization Plan, Table 3-1; also Tenera 2008, Table 2-2.

Staff has not seen an analysis of the 2004-05 EPS impingement data in terms of through-screen velocities. Such an analysis might provide insight into the high impingement on those days, as it would take into account velocity changes due to tidal height, units in operation, screens in use, and degree of screen occlusion.³⁴ An examination of other information relevant to lagoon conditions (e.g., salinities in the three lagoon basins, any evidence of fish kills unrelated to EPS) and EPS plant operations (e.g., intake flow volumes, time since heat treatments, field notes taken on survey days) might also shed light on the conditions that led to high impingement on those two days.

The March 9, 2009 Minimization Plan indicates that heat treatments will be eliminated when the CDP is operating independently (e.g., Section 5-1). For fish, the six heat treatments conducted during the 2004-05 sampled year accounted for almost 50% of the total mortality (44% of fish individuals and 47% of fish weight). For invertebrates, the numbers were lower; the six heat treatments accounted for about 15% of the total mortality (10% of individuals and 14% of biomass). Staff concurs that the elimination of heat treatments would result in a substantial reduction in mortality due to impingement, i.e., approximately 50% reduction. It should be noted, however, that additional evaluation of the CDP's operations will be necessary if/when Poseidon proposes to operate independently. In particular, the proposed alternative to heat treatments, i.e., the use of scrubber balls, will need to be evaluated in terms of potential impacts to marine organisms.

(2) Quantification of Impacts from Entrainment

Chapter 5 of the Minimization Plan also quantifies the impacts on marine life due to entrainment for operation of the CDP when the EPS is temporarily or permanently non-operational.

Poseidon calculated the entrainment mortality of the most commonly entrained larval fish living in Agua Hedionada Lagoon by applying the Empirical Transport Model (ETM), and using entrainment data collected from June 1, 2004 to May 31, 2005. The estimate was computed using the total flow for stand-alone operation (i.e. 304 MGD; 104 MGD for desalination and 200 MGD for dilution), and the analysis assumes no changes would be made to minimize impacts from site, design, and technology. Chapter 5.3.3 of the Minimization Plan provides justification for the source water volumes applied to the ETM.

The ETM results in the Minimization Plan indicate that the proportional mortality (Pm) for the three most common entrained species of fish in Agua Hedionada Lagoon is 0.122

³⁴ When screens become occluded (blocked) by impinged organisms or debris, velocities increase through remaining clear areas.

(i.e. on average, 12.2% of the three most common fish species in the source water would be entrained).

The Pm, multiplied by the area of the source water body (i.e. 302 acres) can be translated to Acres of Production Foregone (APF); which in turn can be used to determine appropriate compensatory mitigation (in terms of acres of like-wetland creation).

The California Coastal Commission (CCC), in consultation with Dr. Peter Raimondi, evaluated the data provided by Poseidon, and determined it appropriate to apply a standardized margin of error to the results. Additionally, because Poseidon's analysis did not include APF for the area of nearshore ocean waters that would be affected, the CCC also imposed additional mitigation requirements for nearshore impacts and allowed for the conversion of nearshore mitigation to wetland mitigation, on the basis that wetland habitat would be ten times more productive than nearshore habitat.

The following table³⁵ is an excerpt summarizing CCC's evaluation of APF for entrainment impacts at various confidence intervals.

Habitat Type	APF (acres) at three levels of confidence			Conversion ratio	Resulting APF (in acres) at three levels of confidence		
	50%	80%	95%		50%	80%	95%
Estuarine	37	49	61	1:1	37	49	61
Nearshore	55	64	72	10:1	5.5	6.4	7.2
Total Mitigation					42.5	55.4	68.2

The CCC evaluated the information contained in the table above and concluded that 55.4 acres of wetland mitigation, to be implemented in two phases (an initial 37 acres, followed by an additional 18.4 acres), would adequately compensate for entrainment impacts for operation of the CDP at 304 MGD.

Assuming no new entrainment data has been generated since evaluation by the CCC in November, it is appropriate for the Regional Board to rely on the CCC's findings with regards to the adequacy of mitigation for entrainment impacts.

(3) Proposed Mitigation for Combined Impacts

Chapter 6 of the March 9, 2009 Minimization Plan describes the mitigation measures associated with the CDP and incorporates the Marine Life Mitigation Plan (MLMP) as

³⁵ Table 2, adjusted APF totals, from the November 21, 2008 revised CCC condition compliance findings for Special Condition No. 8

an attachment. By incorporating the MLMP into the Minimization Plan, and requiring its implementation as a permit condition, the MLMP would be enforceable by the Regional Board. The MLMP is a plan for mitigation and monitoring of impacts due to entrainment from the CDP. It was developed by Poseidon in consultation with multiple resource agencies including the Regional Board, and has been approved by the CCC. The MLMP was written for stand-alone operation, and proposes phased implementation of up to 55.4 acres of wetland mitigation within the Southern California Bight. Phase I requires the creation of 37 acres, and Phase II requires an additional 18.4 acres.

Staff interprets 13142.5(b) requirements for best available mitigation to require mitigation that would fully compensate for all remaining impacts due to impingement and entrainment mortality that are not minimized through site, design, and/or technology. It would be beneficial to know the specifics of the mitigation (i.e. location, and nature of restoration work proposed) to accurately evaluate whether these efforts fully mitigate for anticipated losses. In lieu of that, the MLMP sets forth some standards for selection (Section 3.1), and objectives for the selected mitigation site(s) (Section 3.2).

The MLMP proposes mitigation at 11 potential sites in southern California; 5 of which are in the San Diego region. These sites are Tijuana Estuary, San Dieguito River Valley, Agua Hedionda Lagoon, San Elijo Lagoon, Buena Vista Lagoon, Huntington Beach Wetland, Anaheim Bay, Santa Ana River, Los Cerritos Wetland, Ballona Wetland, and Ormond Beach. Additional sites may be incorporated if appropriate. The March 9, 2009 Minimization Plan clarifies, as the Board requested on February 11, that sites within the boundaries of the San Diego Region shall be given priority consideration. If appropriate, additional sites may be added to the list, in consultation with the CCC Executive Director, and the Regional Board Executive Officer. Restriction 3.3.c of the MLMP proposes to divide the mitigation between a maximum of two wetland restoration sites, unless there is a compelling argument to do otherwise.

Within nine months of receiving the Coastal Development Permit, Poseidon must submit to the CCC and Regional Board a list of the selected mitigation site or sites and corresponding preliminary restoration plans, for review and agency approval. Six months following the CCC's approval of the selected sites and proposed restoration, pending necessary permits, Poseidon must begin wetland construction. Poseidon must submit similar plans for Phase II implementation, if Phase II implementation is required, within five years of receiving the Coastal Development Permit for Phase I implementation. As stated in the CCC-approved MLMP, "Poseidon may also choose during Phase II to apply for a Coastal Development Permit to reduce or eliminate the required 18.4 acres of mitigation and instead conduct alternative mitigation by implementing new entrainment reduction technology or obtaining mitigation credit for conducting dredging." It is anticipated that if such an alternative were sought, Poseidon

would be required to seek approval by the Regional Board, as well, and those alternatives would be evaluated at that time.

The MLMP also contains monitoring requirements, and criteria for performance standards similar to those required of Southern California Edison's mitigation for SONGS at San Dieguito lagoon. The MLMP provides for the oversight of such monitoring by a scientific advisory panel (SAP), and commits to public availability of monitoring results. The March 9, 2009 Minimization Plan provides for the resources and interaction of the SAP and Regional Board staff.

The performance standards listed in section 5.4 of the MLMP seek to achieve establishment of physical and biological criteria as compared to yet-unspecified wetland reference stations, within a 95% confidence interval. Mitigation will be successful when all performance standards have been met each year for a three-year period. However, there are minimal³⁶ commitments as to how long it is anticipated to achieve such success. Failure to obtain sites and implement mitigation in accordance with the schedule in the MLMP would result in an increased period of time where impacts are occurring and required mitigation has not been established. Under such circumstances, the appropriateness of additional compensatory mitigation for "temporal losses" should be considered.

There is currently no monitoring requirement for the discharger to conduct periodic analyses on the impacts from impingement and entrainment from CDP, once operational, and how they relate to the productivity of the compensatory mitigation (in terms of species, number, and biomass). Such studies would not only validate the impacts estimated to date, but would also allow for the direct comparison of productivity created against productivity lost due to impingement and entrainment from operation of the EPS intake for CDP benefit. This would be useful information for the Board's review of a) renewal of Order No. R9-2006-0065, b) evaluation of the need for implementation of Phase II mitigation, versus alternative treatments proposed, and c) evaluation of Poseidon's Report of Waste Discharge for stand-alone operation if EPS becomes non-operational.

Chapter 6 of the March 9, 2009 Minimization Plan states that the "estimated impingement and entrainment impacts will be fully offset by the mitigation wetlands, not taking into consideration the design and technology measures that will diminish marine life mortality further," and adds, in the March 18, 2009 supplemental statement by C. Nordby that, "In addition to mitigation for entrainment the mitigation project will provide the additional benefit of offsetting CDP's estimated stand-alone impingement. That is, the MLMP accomplishes two objectives: it mitigates fully for all entrainment and mitigates fully for all impingement that may result from CDP's stand-alone operations."

³⁶ 5.4.b.1 of the MLMP does require that, within 4 years of (wetland) construction, the total densities and numbers of species of fish, macroinvertebrates, and birds shall be similar to the reference wetlands.

However, the March 9, 2009 Minimization Plan does not specify the mitigation proposed for impacts due impingement in addition to those already required by the CCC for entrainment. Therefore, staff cannot determine whether the proposed mitigation adequately compensates for impacts from impingement and entrainment.

Dr. Raimondi will also assist the Board in evaluating the adequacy of mitigation in light of the impingement and entrainment assessments in the March 9, 2009 Minimization Plan. He has been asked to provide an opinion on whether the proposed mitigation adequately accounts for the effects of both impingement and entrainment. Dr. Raimondi's evaluation of mitigation adequacy will focus on the co-location conditions and will consider a range of operations, from EPS operating to meet approximately 89% of CDP's intake needs (as in 2008), to more conservative projections of EPS operating to meet 75%, 50%, and 25% of CDP's intake needs. Dr. Raimondi's opinion is expected to be available by March 31, 2009. This section of the staff report may be updated shortly thereafter.

Conclusions

Staff anticipates evaluating additional submittals by Poseidon and Dr. Raimondi and presenting conclusions and recommendations in a supplemental staff report.