P O S E I D O N   R E S O U R C E S

JR 2/13/07

February 12, 2007

VIA CURRIER

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SAN DIEGO REGIONAL WATER QUALITY CONTROL BOARD

Mr. John Robertus
Executive Officer
San Diego Regional Water Quality Control Board
9174 Sky Park Court, Suite 100
San Diego, CA 92123

RE: TRANSMITTAL FLOW, ENTRAINMENT, AND IMPINGEMENT MINIMIZATION PLAN FOR THE CARLSBAD SEAWATER DESALINATION PROJECT

Dear Mr. Robertus:

Poseidon Resources Corporation (Poseidon) respectfully submits to the San Diego Regional Water Quality Control Board (Regional Board) the enclosed Flow, Entrainment, and Impingement Minimization Plan (Minimization Plan) for the Carlsbad Desalination Project in Carlsbad, CA. We are requesting that the Regional Water Quality Control Board initiate review, modification (if necessary), and approval of Minimization Plan as provided in Section VI.2.e of Order No. R9-2006-0065.

Section VI.2.e of Order No. R9-2006-0065 provides that:

> *e. Flow, Entrainment and Impingement Minimization Plan*
>
> *The Discharger shall submit a Flow, Entrainment and Impingement Minimization Plan within 180 days of adoption of the Order. The plan 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 plan is subject to the approval of the Regional Water Board and is modified as directed by the Regional Water Board.*

The attached draft Flow, Entrainment and Impingement Minimization Plan (Minimization Plan) was developed in fulfillment of the above-stated requirements. The Minimization Plan contains site-specific activities, procedures, practices and mitigation measures to minimize impacts to marine organisms when the Carlsbad Desalination Plant intake requirements exceed the volume of water being discharged by the Encina Power Station.

02-1429.03

We look forward to working with the Regional Board on the review, modification (if necessary), and approval of the Minimization Plan for the Carlsbad Desalination Project.

Sincerely,

Peter M. MacLaggan
Senior Vice President

Enclosure

cc Dr. Charles Chang, with enclosure
Mr. Michael McCann, with enclosure
Mr. Robert Morris, with enclosure
Dr. Michael Welch, with enclosure

CARLSBAD SEAWATER DESALINATION PROJECT

SAN DIEGO REGIONAL WATER QUALITY CONTROL BOARD

REGION 9, SAN DIEGO REGION

ORDER NO. R-9-2006-0065

NPDES NO. CA0109223

FLOW, ENTRAINMENT AND IMPINGEMENT MINIMIZATION PLAN

Draft

February 12, 2007

EXECUTIVE SUMMARY

The Carlsbad seawater desalination project (CDP) is proposed to be located adjacent to the Encina Power Station (EPS) and when constructed, will use the power plant cooling water discharge as source water for production of 50 MGD of fresh drinking water and for dilution of the concentrate from the desalination process. Under normal operational conditions the EPS provides adequate volume of source and dilution water for the operation of the desalination plant, and the incremental impingement and entrainment effects and discharge impacts of the desalination plant are insignificant.

The purpose of this Flow, Entrainment and Impingement Minimization Plan (Minimization Plan) is to assess the feasibility of site-specific plans, procedures, and practices to be implemented by the Discharger (Poseidon Resources Corporation) 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.

FLOW, IMPINGMENT AND ENTRAINMENT MINIMIZATION

Based on the comprehensive analysis of a number of flow minimization, impingement and entrainment reduction alternatives, the Minimization Plan has identified the following key procedures and activities to minimize environmental impact on marine life in the vicinity of the plant intake and discharge during temporary or permanent shutdown or reduction of power plant cooling flow:

1. Limit the operation of existing power plant intake pumps and screens to one of the Operational Conditions shown in Table ES-1. Preference would be given to operational scenarios resulting in lowest intake flow that can be achieved with the pumps available at the time.

2. Whenever possible, reduce the total flow collected trough the existing power plant intake to 184.32 MGD (Operational Condition 5) by running only one of any of the six pumps of power plant generation Unit 1, 2 or 3 and one pump of power plant generation Unit 5 (22.2 % of the maximum power plant intake flow of 794.9 MGD). Acute toxicity testing and hydrodynamic modeling of the desalination plant discharge at this scenario indicates that operation of the desalination plant would meet all CDP permit requirements except the total dissolved solids limitations for combined CDP and EPS effluent.

3. Operation of the desalination plant under the condition of maximum reduction of impingement and entrainment (Operational Condition 5) could occur only if the RWQCB were to (1) increase the daily average discharge salinity limit in the current desalination plant NPDES permit from 40 ppt to 46 ppt and (2) increase the maximum daily discharge salinity permit limit from 44 ppt to at least 50 ppt.

The current average and maximum daily limits of 40 ppt and 44 ppt would allow desalination plant operations only under Operational Conditions 1, 2 and 3.

4. Impingement and entrainment associated with Operational Condition 5 are over 30 % lower than these of any of the Operational Conditions 1, 2 or 3, and therefore, the environmental benefits of this mode of operation are substantial while the environmental impact associated with the elevated salinity of the discharge is minimal.

5. In the event of an extended shutdown of EPS power generation units, Poseidon will complete periodic dredging of the Aqua Hedionda Lagoon in order to keep the lagoon entrance open and thereby to maintain the biological productivity and environmental health of the lagoon and to mitigate beach erosion along the City of Carlsbad beach shore in the vicinity of the power plant intake structure.

TABLE ES-1
ALTERNATIVE OPERATIONAL CONDITIONS OF EXISITNG INTAKE FACILITIES FOR REDUCED IMPINGMENT AND ENTRAINMENT DURING POWER PLANT SHUTDOWNS

Condition	Total Intake Flow (MGD)	Power Plant Intake Pumps in Operation	Impingement Reduction (%)(1)	Entrainment Reduction (%)(1)	Discharge Salinity Conc. (ppt)	Minimum Pelagic Dilution @ ZID(2)
1	328.33	One Pump of Any of Units 1, 2 or 3 & One Pump of Unit 4 & One Pump of Unit 5	61.7	58.7	39.5	> 28.2:1
2	322.58	One Pump of Any of Units 1, 2 or 3 & Two Pumps of Unit 4	62.2	59.4	39.6	> 28.2:1
3	316.81	Any Combination of Five out of Six Pumps of Units 1, 2 or 3 & One Pump of Unit 4	60.0	60.2	39.8	> 28.2:1
4	218.88	Two Pumps of Any of Units 1, 2 or 3 & One Pump of Unit 5	72.4	72.5	43.4	21.1:1
5(3)	184.33	One Pump of Any of Units 1, 2 or 3 & One Pump of Unit 5	79.7	76.8	46 ppt	17.7:1

Notes: (1) Estimated for Maximum Power Plant Intake Flow = 794.9 MGD.

(2) Estimated for Historical Average Conditions.
(3) Operational Condition 5 is feasible only if the Regional Board were to (1) increase the daily average discharge salinity limit in the current desalination plant NPDES permit from 40 ppt to 46 ppt and (2) increase the maximum daily discharge salinity permit limit from 44 ppt to at least 50 ppt.

The implementation of the proposed operational plan would reduce reducing impingement of marine organisms by 60 to 80 % and reduce entrainment by 59 to 77 % as compared to a baseline condition of power plant operation with all existing pumps and screens in service (total intake flow of 794.9 MGD). Operation of the power plant intake facilities at the recommended Operational Condition 5 would result in a 43% flow reduction from current minimum NPDES permit requirement of 304 MGD and a similar reduction in impingement and entrainment losses attributable to the CDP when the EPS is not operating.

CHAPTER 1

INTRODUCTION

1.1 PURPOSE

On August 16, 2006 the San Diego Regional Water Quality Control Board (RWQCB) adopted Order NO. R9-2006-0065 for Poseidon Resources Corporation's Carlsbad Desalination Project discharge to the Pacific Ocean via the Encina Power Station discharge channel. Section VI.2.e. of the adopted order provides that:

> *e. Flow, Entrainment and Impingement Minimization Plan*
>
> *The Discharger shall submit a Flow, Entrainment and Impingement Minimization Plan within 180 days of adoption of the Order. The plan 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 plan is subject to the approval of the Regional Water Board and is modified as directed by the Regional Water Board.*

This Flow, Entrainment and Impingement Minimization Plan (Minimization Plan) is developed in fulfillment of the above-stated requirements and contains site-specific activities, procedures, practices and mitigation measures which are planned to be implemented to minimize impacts to marine organisms when the Carlsbad Desalination Plant (CDP) intake requirements exceed the volume of water being discharged by the EPS.

1.2 DESCRIPTION OF EXISITNG POWER PLANT INTAKE FACILITIES

The EPS is a once-trough cooling power plant which uses seawater to remove waste heat from the power generation process. Cooling water is withdrawn from the Pacific Ocean via the Aqua Hedionda Lagoon. The cooling water intake structure complex is located approximately 2,200 feet from the ocean inlet of the lagoon. Variations in the water surface level due to tide are from low -5.07 feet to a high +4.83 feet from the mean sea level (MSL). The intake structure is located in the lagoon approximately 525 feet in front of the generating units.

The mouth of the intake structure is 49 feed wide. Booms are situated in the lagoon across the front of the intake structure to screen floating debris. Water passes first trough metal coarse screens (trash racks with vertical bars spaced 3-1/2 inches apart) to screen large debris and marine species. The intake forebay tapers into two 12-foot wide intake tunnels. From these tunnels the cooling water one or more of four 6-foot wide conveyance tunnels. Cooling water for conveyance tunnels 1 and 2 passes though two vertical traveling screens to prevent fish, grass, kelp, and debris from entering intakes for power plant generation Units 1, 2 and 3. Conveyance tunnels 3 and 4 carry cooling water to intakes for power plant generation Units 4 and 5, respectively. Vertical traveling screens are located at the intakes of pumps for unit 4 and unit 5. Figure 1-1 provides a general schematic of the power plant intake system configuration.

Each pump intake consists of two circulating water pump cells and one or two service pump cells. During normal operation, one circulating pump serves each half of the condenser, i.e., when one unit is online, both pumps are in operation.

A total of 7 (seven) vertical screens are installed to remove marine life and debris that has passed through the trash racks. The screens are conventional through-flow, vertically rotating, single entry-single exit, band-type metal screens which are mounted in the screen wells of the intake channel. Each screen consists of series of baskets or screen panels attached to a chain drive. The screening surface is made of 3/8-inch stainless steel mesh panels, with the exception of the Unit 5 screens, which have 5/8-inch square openings.

The screens rotate automatically when the buildup of debris on the screening surface causes the water level behind the screen to drop below that of the water in front of the screen and a predetermined water level differential is reached. The screens can also be pre-set to rotate automatically at a present interval of time. The screens rotational speed is 3 feet per minute, making one complete revolution in approximately 20 minutes. A screen wash system using seawater from the intake tunnel washes debris from the traveling screen into a debris trough. Accumulated debris are discharged periodically back to the ocean via the power plant discharge lagoon. Table 1-1 summarizes the capacity of the individual power plant intake pumps.

TABLE 1-1

SUMMARY OF EPS POWER GENERATING CAPACITY AND FLOWS

Unit #	Date on Line*	Capacity (MW)	Number of Cooling Water Pumps	Cooling Water Flow (gpm)**	Service Pump Water Flow (gpm)**	Total (MGD)
1	1954	107	2	48,000	3,000	73
2	1956	104	2	48,000	3,000	73
3	1958	110	2	48,000	6,000	78
4	1973	287	2	200,000	13,000	307
5	1978	315	2	208,000	18,200	326
Gas turbine	1968	16	0	0	0	0
			Total:	**552,000**	**43,200**	**857**

* Encina Power Station NPDES Permit No. CA0001350, Order No. 2000-03, SDRWCB.
** Encina Power Station Supplemental 316(b) Report (EA Engineering, Science, and Technology 1997).

It is important to note, that the power plant intake pumping station consists of cooling water intake pumps which convey water through the condensers of the electricity generation units of the power plant and have a total capacity of 794.9 MGD (552,000 gpm) and of service water pumps for the auxiliary systems of the power plant, which total capacity is 62.1 MGD (43,200 gpm). During temporary shutdown of the power plant generation units, only the cooling water pumps are taken out of service. The service water pumps remain in operation at all times in order to maintain the functionality of the power plant. If the desalination plant is shut down permanently, than the service water pumps will not be operational and will not contribute to the impingement and entrainment of the power plant intake pump station. Therefore, this impingement and entrainment reduction analysis associated with the stand-alone operation of the desalination plant encompasses only the cooling water pumps and excludes the service pumps.

The volume of cooling water passing through the power plant intake power station at any given time is dependent upon the number of cooling water pumps (CWPs) and service water pumps that are in operation. With all of the pumps in operation, the maximum permitted power plant discharge volume is 857 MGD or about 595,000 gallons per minute (gpm) (Year 2006 NPDES Permit No. CA0001350). This discharge encompasses both the cooling water pumps (794.9 MGD) and the service water pumps (61.2 MGD).

As electrical demand varies, the number of generating units in operation and the number of cooling water pumps needed to supply those units will also vary. Over the previous four years (2002 to 2005), the EPS has reported combined discharge flows ranging from 99.8 MGD to 794.9 MGD with a daily average of 600.4 MGD. Over the 20.5 year period of January 1980 to mid 2000 the average discharge flow was 550 MGD and ranged from 200–808 MGD.

1.3 DESALINATION PLANT INTAKE AND DISCHARGE FACILITIES

The seawater desalination plant intake and discharge facilities would be co-located with the Encina Power Station. A key feature of the co-location concept is the direct connection of the membrane desalination plant intake and discharge facilities to the discharge canal of the power generation plant. This approach allows using 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. Figure 1-2 illustrates the co-location configuration of the CDP and EPS intake and discharge facilities.

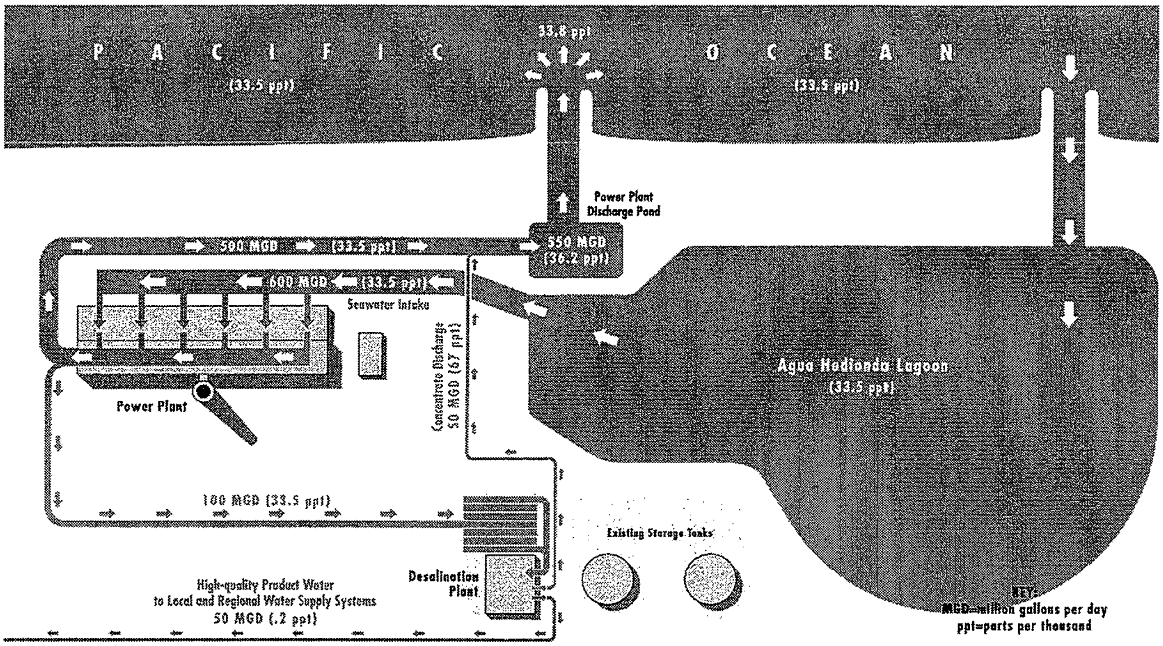

Figure 1-2 – Collocation of Carlsbad Desalination Plant and Encina Power Station

As shown on Figure 1-2, under typical operational conditions approximately 600 MGD of seawater enters the power plant intake facilities and after screening is pumped through the plant's condensers to cool them and thereby to remove the waste heat created during the electricity generation process. The Carlsbad desalination plant intake structure is connected to the end of this discharge canal and under normal operational conditions would divert 106 to 130 MGD of the 600 MGD of cooling water for production of fresh water.

Approximately 50 MGD of the diverted cooling seawater would be desalinated via reverse osmosis and conveyed for potable use. The remaining 50 MGD would have salinity approximately two times higher than that of the ocean water (67 ppt vs. 33.5 ppt). This seawater concentrate would be returned to the power plant discharge canal downstream of the point of intake for blending with the cooling water prior to conveyance to the Pacific Ocean. Under average conditions, the blend of 500 MGD of cooling water and 50 MGD of concentrate would have discharge salinity of 36.2 ppt, which is within the 10 % natural fluctuation of the ocean water salinity (36.9 ppt) in the vicinity of the existing power plant discharge.

The desalination plant intake pump station would be connected to the south end of the existing power plant discharge canal. This pump station would be equipped with vertical turbine pumps which would convey the source seawater from the power plant discharge canal to the desalination plant pretreatment system. At least one seawater desalination plant intake pump would be equipped with variable frequency drive, which would be operated to minimize intake flow and optimize plant performance and operations under varying water and power demands.

1.4 DESALINATION PLANT OPERATIONS DURING PERIODS OF CURTAILED POWER GENERATION

Under the conditions of temporary or permanent power plant shutdown, the desalination plant would run the power plant intake pumps to collect water for two purposes – (1) source water for production of 50 MGD of drinking water and (2) dilution water for the 50 MGD of concentrate generated during the desalination process to levels determined in the desalination plant NPDES permit.

Under the intake and discharge limitations incorporated in the desalination plant NPDES permit, the desalination plant is permitted to collect between 100 MGD and 129 MGD of seawater in order to produce 48 to 54 MGD (average of 50 MGD) of drinking water. The dilution water needed to reduce 50 MGD of desalination plant concentrate with salinity of 67 ppt to the average daily NPDES permit discharge salinity limitation of 40 ppt is 207.7 MGD. During stand-along desalination plant operations, this dilution water would need to be collected using the power plant intake pumps along with the water needed for water production.

As indicated in Table 2 of Attachment F – Fact Sheet of the desalination plant NPDES permit, the discharge from the desalination plant consists of concentrate of 50 MGD to 54 MGD and pretreatment filter backwash flow of 4.0 MGD to 10.5 MGD. While the salinity of the concentrate is two times higher than the salinity of the source seawater (i.e., 67 ppt), the salinity of the backwash water is the same as that of the ambient seawater (i.e, 33.5 ppt). Since the filter backwash water is retuned to the ocean as well, this seawater can also be used as dilution water for the concentrate. Therefore, the volume of the backwash water can be subtracted from the additional volume of dilution seawater that needs to be collected from the ocean during power plant shutdowns in order to bring the level of salinity of the total discharge down to the current NPDES permit salinity limit of 40 ppt.

For example, as indicated previously, the dilution water needed to reduce 50 MGD of concentrate of salinity of 67 ppt down to 40 ppt, is 207.7 MGD. If the pretreatment system uses and discharges 4.0 MGD (average discharge for granular media pretreatment system), than the total flow that needs to be collected from the ocean under stand-along desalination plant operations is: 100 MGD (for desalination) + 4 MGD (for filter backwash) + 207.7 MGD (for dilution of 50 MGD of 67 ppt concentrate down to 40 ppt) – 4 MGD (to account for the fact that the backwash waster also serves as dilution water) = 307.7 MGD. Because the backwash flow is always counted as both intake source water for treatment and as discharge water available for dilution, the total volume of intake water of 307.7 MGD that needs to be collected by the power plant intake pumps to produce 50 MGD of drinking water is only dependent on the target salinity of the discharge concentrate.

As indicated in Table 2 of Attachment F – Fact Sheet (page F-5) of the current NPDES permit, the maximum daily flow of the plant may reach 54 MGD. For this condition, the dilution water needed to reduce 54 MGD of concentrate of salinity of 67 ppt down to 40 ppt is 224.3 MGD. Because the intake source water in this case will be 108 MGD (two times 54 MGD) than the total intake flow needed to accommodate this worst-case scenario is 108 MGD + 224.3 MGD = 332.3 MGD.

CHAPTER 2

ASSESMENT OF POTENTIAL FLOW MINIMIZATION MEASURES

2.1 INTRODUCTION

As indicated in Chapter 1, the total intake flow needed for the normal operation of the 50 MGD Carlsbad seawater desalination plant is 307.7 MGD. Approximately 104 MGD to 129 MGD of this flow would be required for water production and the reminder will be needed for safe disposal of the desalination plant concentrate.

The minimum flow needed for production of 50 MGD of drinking water is determined by the desalination technology proposed to be used for the Carlsbad project. The seawater membrane reverse osmosis desalination process requires the intake of a minimum of two gallons of seawater to produce one gallon of fresh water. Therefore, a minimum 100 MGD of pretreated seawater is needed to produce 50 MGD of drinking water for this project. This volume cannot be reduced further due to the process performance limitations of the reverse osmosis system. Therefore, the highest potential for overall intake flow reduction is associated with the reduction of the seawater volume needed for the dilution of the concentrate.

2.2 FACTORS DETERMINING THE MINIMUM INTAKE FLOW

As indicated in Section 2.1, the total intake flow to the seawater desalination plant could potentially be reduced by the decrease of the intake of raw seawater needed for dilution of the desalination plant concentrate. This minimum volume of water required for dilution is driven by two key limiting factors:

- The minimum volume needed to protect marine life. This volume is determined by the amount of water needed to dilute the 50 MGD of concentrate below level that could be acutely toxic for the marine organisms inhabiting the discharge area.

- The minimum volume needed to provide adequate mixing of the concentrate with the ambient seawater in the zone of initial dilution (ZID) of the discharge.

2.3 MINIMUM INTAKE FLOW NEEDED TO PROTECT MARINE LIFE

The existing desalination plant NPDES permit contains a California Ocean Plan-based performance goal for acute toxicity of the facility discharge of TUa = 0.765 (see Table 10, page 12, of NPDES Permit). In addition the permit has a daily average and average hourly total dissolved solids (salinity) limitations of 40 mg/L and 44 mg/L, respectively (see Table 9, page 12 of NPDES Permit).

The permit salinity limits were established based on a conservative analysis of the desalination plant discharge completed during the environmental impact report preparation phase of the project. In order to more accurately determine the salinity threshold at which the desalination plant concentrate can be discharged safely, Section VI.2.c.1 of the adopted NPDES Permit order requires the discharger to conduct a study using CDP pilot plant effluent to assess short-term exposure of test species to salinity concentrations that range from 36 to 60 parts per thousand (ppt). The goal of the salinity and acute toxicity special study is to assess compliance with the acute toxicity performance goal and to identify the maximum amount of salinity that can be discharged without causing acute toxicity. Recognizing that future EPS flows may be decreased, an additional goal is to identify the minimum seawater intake flows required to allow the CDP discharge to comply with salinity and acute toxicity requirements.

In conformance with the NPDES permit requirements, Poseidon Resources completed the required "Salinity and Acute Toxicity Study". Attachment 1 of this report contains the study plan for the short-term toxicity threshold evaluation. Attachment 2 includes the results from the Acute Salinity Study.

Acute toxicity testing was performed in accordance with the Study Plan provided in Attachment 1 and in with the procedures established by the USEPA guidance manual, *Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms*, 5th Edition, October 2002 (EPA-821-R-02-012). The bioassay was completed using Topsmelt test organisms.

The No Observed Effect Concentration (NOEC) of the test occurred at 42 ppt of concentrate salinity. The Lowest Observed Effect Concentration (LOEC) was found to be 44 ppt. The lethal concentration for 50 % of the population (LC50) was 58.57 ppt. In addition, the No Observed Effect Time (NOET) for 60 ppt concentration was 2 hours, while the Lowest Observed Effect Time (LOET) for the 60 ppt concentration was 4 hours. The results of the Salinity and Acute Toxicity Study are summarized in Table 2-1.

TABLE 2-1

SALINITY AND ACUTE TOXICITY OF DESALINATION PLANT CONCENTRATE

Concentrate Salinity (ppt)	Test Species Survival (% of total)	Acute Toxicity of Concentrate TUa[1,2]	Average and Maximum Total Desalination Plant Intake Flow Needed (MGD)
33.5 (Control)	100	0.00	NA
36	95	0.41	720 – 777.6
38	90	0.59	422 - 456
40	**95**	**0.41**	**307.7 – 332.3**
42	97.5	0.23	247.1 – 266.8
44	85	0.69	209.5 – 226.3
46	**87.5**	**0.65**	**184 – 198.7**
48	80	0.77	165.5 – 178.8
50	55	0.97	151.5 – 163.6
52	62.5	0.93	140.5 – 151.8
54	45	1.02	131.7 – 142.2
56	55	0.97	124.4 – 134.4
58	65	0.91	118.4 – 127.8
60	37.5	1.06	113.2 – 122.3

Notes: (1) TUa calculated as: log (100 - % survival)/1.7
(2) Desalination NPDES Permit TUa Performance Goal = 0.765

Analysis of the toxicity testing data presented in Table 2-1 indicates the following:

- The NPDES permit daily average salinity limitation of 40 ppt is conservative. The NPDES permit TUa Performance Goal of 0.765 is not exceeded until salinity reaches 48 ppt and is safely met at salinity of 46 ppt or less.

- Current NPDES permit average hourly salinity limitation of 44 ppt is also very conservative. The test data indicates that no mortality effect was observed for a period of 2 hours at discharge salinity of 60 ppt.

- Concentrate of salinity of 46 ppt and acute toxicity level TUa of 0.65 complies with a reasonable margin of safety with the NPDES acute toxicity TUa performance goal of 0.765. Therefore, this concentrate salinity level could be considered as an acceptable benchmark which could be used to determine the minimum intake flow needed to protect aquatic life.

- If the average daily concentrate salinity limit is increased from 40 ppt to 46 ppt, the maximum amount of intake flow needed for stand-alone desalination plant operations can be reduced from 332.3 MGD to 198.7 MGD (40 % intake flow reduction).

2.4 MINIMUM INTAKE FLOW TO MAINTAIN ADEQUATE MIXING

As indicated previously, another key criterion to determine the minimum intake flow needed for environmentally safe plant operations is the rate of hydrodynamic mixing and dilution of the discharge with the ambient seawater in the ZID. The current NPDES permit has a specific requirement related to the minimum initial dilution of the discharge in the ZID of 15.5:1.

In order to determine discharge plume dissipation and mixing at increased concentrate discharge salinities/smaller dilution flows, the stand-alone desalination plant operations were modeled at several discharge flow rates corresponding to end-of-discharge canal salinity concentrations of 40.1 to 50.3 ppt. The flow scenarios were modeled for particular combinations of power plant intake pumps that could produce feed water flows that would yield closest to the target concentrate salinity levels in Table 2-1. The modeled scenarios are presented in Table 2-2. The results of the hydrodynamic modeling are summarized in Attachment 3 ("Near Shore Saline Effects due to Reduced Flow Rate Scenarios during Stand-Along Operations of the Carlsbad Desalination Project at Encina Generating Station", Scott Jenkins & Joseph Wasyl, 12 January 2007).

TABLE 2-2

HYDRODYNAMIC MODELING OF DESALINATION PLANT DISCHARGE AT REDUCED INTAKE FLOW AND STAND-ALONE OPERATIONS

Scenario	Total Intake Flow (MGD)	Concentrate Salinity Discharge Conc. (ppt)	Intake Pumps in Operation	Minimum Pelagic Dilution @ ZID[(1)]	Maximum Bottom Salinity (ppt) [(1)]	Benthic Area Exposed To Salinity > 36.9 ppt (acres) [(1)]	Flow Reduction from Current Permit Requirement (%)
1	149.8	50.3 ppt	One Pump of Unit 5	9.9:1	42.3	39.4	42.9 %
2	172.8	47.1 ppt	All Pumps Of Units 1 & 2 and One Pump of Unit 3	13.5:1	42.0	30.5	51
3	184.3	46 ppt	One Pump of Unit 5 And One Pump of Unit 1, 2 or 3	17.7:1	41.4	25.6	43
4	218.9	43.4 ppt	One Pump of Unit 5 And Two Pumps of Unit 1, 2 or 3	21.1:1	40.1	16.4	39
5	304.0	40.1 ppt	Two Pumps of Unit 4	28.2:1	38.1	8.3	0 %

(*) Note: (1) Historical Average Condition.

Review of Table 2-2 indicates the following key findings:

- Intake flows of less than 184.3 MGD (concentrate salinity > 46 ppt) will result in mixing ratio lower than the current NPDES Permit requirement of 15.5 to 1.
- At intake flow of 184.3 MGD and historical average discharge conditions the mixing ratio of 17.7 to 1, is compliant with the permit requirement of 15.5 to 1.

As indicated in Table 2-1, the discharge will also be compliant with the permit's toxicity requirements.

- Intake flow of 218.9 MGD (concentrate salinity of 43.4 ppt) will satisfy the current NPDES permit's initial dilution ratio requirement of 15.5:1 for both historic average and extreme conditions and will be compliant with the acute toxicity requirement of the NPDES permit.

- Operating the stand-alone desalination plant at intake flow of 307.7 MGD which corresponds to the current NPDES permit discharge salinity of 40 ppt, has the advantage of over 3 times smaller footprint of the benthic area exposed to elevated salinity as compared to 184.3 MGD/46 ppt scenario. However, this operational scenario would result in 40 % higher intake flow and associated impingement and entrainment impacts.

2.5 OPERATIONAL SCENARIOS OF POWER PLANT INTAKE PUMPS

The toxicity and hydrodynamic analysis of the desalination plant discharge presented in the previous two sections indicates that there are three potentially viable concentrate target intake flows at which the power plant intake pumps could be operated with minimal impact on the marine environment:

- 307.7 MGD (40 ppt of concentrate discharge);
- 218.9 MGD (43.4 ppt of concentrate discharge);
- 184.3 MGD (46 ppt of concentrate discharge).

As indicated previously, the existing power plant intake pumps are constant-speed units that can only deliver discrete flows via the operation of various combinations of individual pump units. Based on consultation with the power plant staff, the following pump operational conditions were identified to deliver the target flows listed above:

Operational Condition 1 (Target Intake Flow 307.7 MGD – 40 ppt)

• One Pump of Unit 2	- 34.56 MGD
• One Pump of Unit 4	- 144.01 MGD
• One Pump of Unit 5	- 149.76 MGD
Total =	- 328.33 MGD

Operational Condition 2 (Target Intake Flow 307.7 MGD – 40 ppt)

• One Pump of Unit 1	- 34.56 MGD
• Both Pumps of Unit 4	- 288.02 MGD
Total =	- 322.58 MGD

Operational Condition 3 (Target Intake Flow 307.7 MGD – 40 ppt)

- Both Pumps of Unit 1 - 69.12 MGD
- One Pump of Unit 2 - 34.56 MGD
- Both Pumps of Unit 3 - 69.12 MGD
- One Pump of Unit 4 - 144.01 MGD

Total = - 316.81 MGD

Operational Condition 4 (Target Intake Flow 218.9 MGD – 43.4 ppt)

- Two Pumps of Unit 1, 2 or 3 - 69.12 MGD
- One Pump of Unit 5 - 149.76 MGD

Total = - 218.88 MGD

Operational Condition 5 (Target Intake Flow 184.3 MGD – 46 ppt)

- One Pump of Unit 1, 2 or 3 - 34.56 MGD
- One Pump of Unit 5 - 149.76 MGD

Total = - 184.32 MGD

The impingement and entrainment associated with these five operational conditions will be assessed in the next sections.

CHAPTER 3

POTENTIAL IMPINGEMENT REDUCTION MEASURES

3.1 METHODOLOGY FOR IMPINGEMENT ASSESSMENT

The impingement effect of any intake structure is caused by its screens and is associated with two parameters: the intake flow and the velocity of this flow through the screens. For the purposes of this analysis, the impingement effect is assumed proportional to the intake flow at velocities above 0.5 fps. If the intake through-screen velocity is below or equal to 0.5 fps, the impingement effect of the intake screens is zero in accordance with the designation of this condition by US EPA (316 (B) Regulations) as a Best Technology Available for elimination of impingement.

3.2 RELATIVE IMPINGMENT POTENTIAL OF EXISITNG INTAKE FACILITIES

The EPS has five power generation units, each of which is serviced by two constant speed seawater intake pumps. Therefore the total number of pump units is 10. The six (6) cooling water intake pumps of power generation Units 1, 2 and 3 convey their entire flow of 207.36 MGD through two common traveling screens with 3/8-inch openings. Unit 4 has two cooling pumps of total capacity of 288.02 MGD, which flow passes through two separate 3/8-inch traveling screens. Unit 5 is cooled by two cooling pumps of total capacity of 299.54 MGD which pass all of their flow through three traveling screens. These three screens have 5/8-inch openings.

Each of the seven (7) power plant intake screens are installed in a separate intake channel. The screens are conventional through-flow vertically rotating, single entry, band type units mounted in the intake channels. Each screen consists of series of baskets (screen panels) attached to a chain drive. Cooling water passes through the wire mesh screening surface and debris in the raw seawater are retained on the screens. The screens rotate automatically when the debris buildup causes a predetermined headloss through the screens. As the screens revolve, the collected debris is lifted from the intake water surface by the upward travel of the screen baskets. The screens travel at velocity of 3 feet per minute making one complete revolution in 20 minutes. A screen wash system washes the debris from the traveling screens into screen well baskets where it is accumulated for disposal. The removed debris is returned back to the ocean periodically. Table 3-1 presents the capacities of the individual pumps and the through-screen velocities at high and low tide conditions. All velocities indicated in this table are determined for a all pumps in operation at their maximum flowrate.

TABLE 3-1

POWER PLANT INTAKE PUMP CAPACITY AND THROUGH-SCREEN VELOCITIES AT MAXIMUM COOLING PUMP FLOW (794.9 MGD)

Power Plant	Pump Capacity (MGD)	Maximum Through-Screen Velocity (fps) @ High Tide (4.83 of MSL)	Maximum Through-Screen Velocity (fps) @ Low Tide (-5.07 of MSL)	Note
Unit 1				
Pump 1 S	34.56	1.2	2.1	All pumps of Units 1, 2 & 3 share two common screens of identical size and capacity
Pump 1 N	34.56			
Total Capacity	**69.12**			
Unit 2				
Pump 2 S	34.56			
Pump 2 N	34.56			
Total Capacity	**69.12**			
Unit 3				
Pump 3 S	34.56			
Pump 3 N	34.56			
Total Capacity	**69.12**			
Unit 4				All flow pumped through two screens
Pump 4 E	144.01	1.8	2.8	
Pump 4 W	144.01			
Total Capacity	**288.02**			
Unit 5				
Pump 5 E	149.76	1.0	1.6	All flow pumped through three screens
Pump 5 W	149.76			
Total Capacity	**299.54**			

Note: MSL – mean sea level.

Because the through-screen velocity of all pump units is higher than 0.5 fps when operated at maximum flow, their relative contribution to the total impingement potential of the intake pump system will be proportional to the pump flow. Therefore, if the total maximum impingement potential of the entire power plant intake pump system is designated as 1, the individual pump units will have the relative maximum impingement potential presented in Table 3-2.

TABLE 3-2

POWER PLANT INTAKE PUMPS - RELATIVE MAXIMUM IMPINGEMENT POTENTIAL

Power Plant	Pump Capacity (MGD)	Relative Maximum Impingement Potential
Unit 1		
Pump 1 S	34.56	0.044
Pump 1 N	34.56	0.044
Total	**69.12**	**0.088**
Unit 2		
Pump 2 S	34.56	0.044
Pump 2 N	34.56	0.044
Total Capacity	**69.12**	**0.088**
Unit 3		
Pump 3 S	34.56	0.044
Pump 3 N	34.56	0.044
Total Capacity	**69.12**	**0.088**
Unit 4		
Pump 4 E	144.01	0.180
Pump 4 W	144.01	0.180
Total Capacity	**288.02**	**0.360**
Unit 5		
Pump 5 E	149.76	0.188
Pump 5 W	149.76	0.188
Total Capacity	**299.54**	**0.376**
TOTAL	**794.9**	**1.0**

Based on the last four years of operation, under typical operational conditions, the power plant runs Units 4 and 5 (a total intake flow of 587.56 MGD) only and occasionally operates additional units as needed (to average 600.4 MGD on an annual average basis). Using the breakdown shown in Table 3-2, the relative reduction of impingement for plant operation at average annual power plant flow of 600.4 MGD is shown on Table 3-3.

TABLE 3-3

POWER PLANT COOLING WATER INTAKE PUMPS - IMPINGEMENT POTENTIAL AT AVERAGE ANNUAL FLOW OF 600.4 MGD

Power Plant	Pumped Flow (MGD)	Relative Impingement Potential @ Average Flow
Unit 1		
Pump 1 S	0.0	0.0
Pump 1 N	0.0	0.0
Total	**0.0**	**0.0**
Unit 2		
Pump 2 S	0.0	0.0
Pump 2 N	0.0	0.0
Total Capacity	**0.0**	**0.0**
Unit 3		
Pump 3 S	0.0	0.0
Pump 3 N	0.0	0.0
Total Capacity	**0.0**	**0.0**
Unit 4		
Pump 4 E	144.01	0.180
Pump 4 W	144.01	0.180
Total Capacity	**288.02**	**0.360**
Unit 5		
Pump 5 E	149.76	0.188
Pump 5 W	149.76	0.188
Total Capacity	**299.54**	**0.376**
TOTAL	**794.9**	**0.736**

3.3 IMPINGEMENT REDUCTION AT ALTERNATIVE INTAKE OPERATIONAL CONDITIONS

As indicated in Chapter 2, five alternative operational conditions of the existing power plant intake pumps were identified as viable to reduce flow intake, impingement and entrainment and at the same time protect the marine environment in the area of the desalination plant discharge. These operational conditions vary by the total volume of seawater intake flow and the number and location of the power plant pumps proposed to be used to get to the specific total intake flow:

- Operational Condition 1 - Total Intake Flow of 328.33 MGD
- Operational Condition 2 - Total Intake Flow of 322.58 MGD
- Operational Condition 3 - Total Intake Flow 316.81 MGD
- Operational Condition 4 - Total Intake Flow of 218.9 MGD
- Operational Condition 5 – Total Intake Flow of 184.32 MGD

The relative impingement potential of each of these conditions is presented below. The estimate of actual through screen-velocity of each operational condition is provided in Attachment 4.

Impingement Potential of Operational Condition 1 – Intake Flow of 328.33 MGD
The proposed number, capacity and location of the intake pumps planned to be used to achieve Operational Condition 1 are listed in Table 3-4.

TABLE 3-4
IMPINGEMENT POTENTIAL OF OPERATIONAL CONDITION 1

Power Plant	Pump Capacity (MGD)	Relative Maximum Impingement Potential
Unit 1		
Pump 1 S	0.00	0.000
Pump 1 N	0.00	0.000
Total	**0.00**	**0.000**
Unit 2		
Pump 2 S	0.00	0.000
Pump 2 N	34.56	0.044 * 0.33 = 0.015
Total Capacity	**34.56**	**0.015**
Unit 3		
Pump 3 S	0.00	0.000
Pump 3 N	0.00	0.000
Total Capacity	**0.00**	**0.000**
Unit 4		
Pump 4 E	0.00	0.000
Pump 4 W	144.01	0.180
Total Capacity	**144.01**	**0.180**
Unit 5		
Pump 5 E	0.00	0.000
Pump 5 W	149.76	0.188
Total Capacity	**149.76**	**0.188**
TOTAL	**328.33**	**0.383**

Operational Condition 1 would result in impingement reduction by shutting down one pump of Unit 1 and all pumps of Units 2 and 3, while maintaining all of the common screening facilities servicing these pumps in operation. This operation will allow to reduce the velocity through the screens below 0.5 fps during periods when the actual tide elevation is between -0.687 ft and +4.83 ft above the mean sea level (see Attachment 4). Based on statistical analysis of the tide elevations, this condition is expected to occur 67 % of the time (see Attachment 4). Therefore, the impingement potential of the operating pump of Unit 1 is reduced to 33 % of maximum. This operational condition would result in 61.7 % reduction of impingement as compared to power plant operation at maximum flow of 794.92 MGD and 48 % of impingement reduction as compared to the power plant operation at daily average flow of 600.4 MGD (see Tables 3-3 and 3-4).

Impingement Potential of Operational Condition 2 – Intake Flow of 322.58 MGD
This operational condition is similar to Condition 1, with the exception that both pumps of Unit 5 are shutdown and both pumps of Unit 4 are in operation. This condition was introduced in order to provide operational flexibility in case Unit 5 pumps are out of service for routine or emergency maintenance or repair.

TABLE 3-5
IMPINGEMENT POTENTIAL AT OPERATIONAL CONDITION 2

Power Plant	Pump Capacity (MGD)	Relative Maximum Impingement Potential
Unit 1		
Pump 1 S	0.00	0.000
Pump 1 N	34.56	0.044 * 0.33 = 0.015
Total	**34.56**	**0.018**
Unit 2		
Pump 2 S	0.00	0.000
Pump 2 N	0.00	0.000
Total Capacity	**0.00**	**0.000**
Unit 3		
Pump 3 S	0.00	0.000
Pump 3 N	0.00	0.000
Total Capacity	**0.00**	**0.000**
Unit 4		
Pump 4 E	144.01	0.180
Pump 4 W	144.01	0.180
Total Capacity	**288.02**	**0.360**
Unit 5		
Pump 5 E	0.00	0.000
Pump 5 W	0.00	0.000
Total Capacity	**0.00**	**0.000**
TOTAL	**322.58**	**0.375**

This operational condition would result in 62.2 % reduction of impingement as compared to power plant operation at maximum flow of 794.92 MGD and 49.0 % of impingement reduction as compared to the power plant operation at daily average flow of 600.4 MGD.

Impingement Potential of Operational Condition 3 – Intake Flow of 316.81 MGD
Impingement reduction under Operational Condition 3 would be achieved mainly by shutting down the largest power plant intake water pumps (the cooling pumps for Unit 5). Since this scenario includes the operation of five out of six pumps of Units 1, 2 and 3, the through-screen velocity through their common screens is relatively high and therefore, no additional impingement reduction credit is assigned to this scenario under high tides.

TABLE 3-6
IMPINGEMENT POTENTIAL OF OPERATIONAL CONDITION 3

Power Plant	Pumped Flow (MGD)	Relative Impingement Potential @ Average Flow
Unit 1		
Pump 1 S	34.56	0.044
Pump 1 N	34.56	0.044
Total	**69.12**	**0.088**
Unit 2		
Pump 2 S	0.00	0.000
Pump 2 N	34.56	0.044
Total Capacity	**34.56**	**0.044**
Unit 3		
Pump 3 S	34.56	0.044
Pump 3 N	34.56	0.044
Total Capacity	**69.12**	**0.088**
Unit 4		
Pump 4 E	0.00	0.00
Pump 4 W	144.01	0.180
Total Capacity	**144.01**	**0.180**
Unit 5		
Pump 5 E	0.00	0.00
Pump 5 W	0.00	0.00
Total Capacity	**0.00**	**0.00**
TOTAL	**316.81**	**0.40**

This operational condition would result in 60.0 % reduction of impingement as compared to power plant operation at maximum flow of 794.92 MGD and 45.6 % of impingement reduction as compared to the power plant operation at daily average flow of 600.4 MGD.

Impingement Potential of Operational Condition 4 – Intake Flow of 218.88 MGD
Under this operational condition impingement is reduced by operating only two cooling water pumps of the total of six pumps for Units 1, 2 or 3 and of only one pump of Unit 5. The impingement potential of this scenario is shown in Table 3-7. Review of this table indicates that intake pump operation under this scenario would result in 72.4 % reduction of impingement as compared to power plant operation at maximum flow of 794.92 MGD and 62.5 % of impingement reduction as compared to the power plant operation at daily average flow of 600.4 MGD.

TABLE 3-7
IMPINGEMENT POTENTIAL OF OPERATIONAL CONDITION 4

Power Plant	**Pump Capacity (MGD)**	**Relative Maximum Impingement Potential**
Unit 1		
Pump 1 S	0.00	0.000
Pump 1 N	0.00	0.000
Total	**0.00**	**0.000**
Unit 2		
Pump 2 S	34.56	0.044
Pump 2 N	34.56	0.044
Total Capacity	**69.12**	**0.088**
Unit 3		
Pump 3 S	0.00	0.000
Pump 3 N	0.00	0.000
Total Capacity	**0.00**	**0.000**
Unit 4		
Pump 4 E	0.00	0.000
Pump 4 W	0.00	0.000
Total Capacity	**0.00**	**0.000**
Unit 5		
Pump 5 E	0.00	0.000
Pump 5 W	149.76	0.188
Total Capacity	**149.76**	**0.188**
TOTAL	**218.88**	**0.276**

Impingement Potential of Operational Condition 5 – Intake Flow of 184.33 MGD
This operational condition includes running only one of the six pumps of the Units 1, 2 and 3 and of one pump of Unit 5. The impingement potential of this scenario is shown in Table 3-8. This operational condition yields the highest impingement reduction potential – 79.7 % as compared to power plant operation at maximum flow of 794.92 MGD and 72.4 % of impingement reduction as compared to the power plant operation at daily average flow of 600.4 MGD.

TABLE 3-8

IMPINGEMENT POTENTIAL OF OPERATIONAL CONDITION 5

Power Plant	Pump Capacity (MGD)	Relative Maximum Impingement Potential
Unit 1		
Pump 1 S	0.00	0.000
Pump 1 N	0.00	0.000
Total	**0.00**	**0.000**
Unit 2		
Pump 2 S	0.00	0.000
Pump 2 N	34.56	0.044 * 0.33 = 0.015
Total Capacity	**34.56**	**0.015**
Unit 3		
Pump 3 S	0.00	0.000
Pump 3 N	0.00	0.000
Total Capacity	**0.00**	**0.000**
Unit 4		
Pump 4 E	0.00	0.000
Pump 4 W	0.00	0.000
Total Capacity	**0.00**	**0.000**
Unit 5		
Pump 5 E	0.00	0.000
Pump 5 W	149.76	0.188
Total Capacity	**149.76**	**0.188**
TOTAL	**184.32**	**0.203**

Comparison of Impingement Reduction of Alternative Operational Conditions

Table 3-9 summarizes the impingement reduction potential of the five operational conditions as compared to the maximum power plant intake flow of 794.92 MGD and the average power plant intake flow of 600.4 MGD. Review of the data presented in this table indicates that intake flow reduction from the current average level of 600.4 MGD to 184.33 MGD will result in a significant reduction of impingement (72.4 %) of marine organisms by the intake while maintaining environmentally safe level of salinity in the desalination plant discharge of 46 ppt. In order to implement this operational condition however, the current NPDES permit's average daily discharge salinity limit would need to be increased from 40 ppt to 46 ppt and the daily maximum discharge salinity limit would need to be raised from 44 ppt to 50 ppt or more.

Under the current NPDES average daily and daily maximum salinity limits (40 ppt and 44 ppt, respectively) and stand-alone operations of the desalination plant, the intake flow of the EPS cooling pumps can be reduced to not less than 316.81 MGD and the intake pumps can be operated under Operational Conditions 1, 2 or 3, only. Operation at these conditions will yield significantly less impingement reduction than that that can be achieved under Operational Condition 1 (49 % vs. 72.4 %).

TABLE 3-9

COMAPRISON OF IMPINGEMENT REDUCTION AT ALTERANTIVE OPERATIONAL CONDITIONS OF POWER PLANT INTAKE FLOWS

Operational Condition	Total Intake Flow (MGD)	Intake Pumps in Operation	Impingement Reduction Compared to That at Maximum Pump Flow of 794.92 MGD (%)	Impingement Reduction Compared to That at Average Pump Flow of 600.4 MGD (%)
1	328.33	One Pump of Any of Units 1, 2 or 3 & One Pump of Unit 4 & One Pump of Unit 5	61.7	48.0
2	322.58	One Pump of Any of Units 1, 2 or 3 & Two Pumps of Unit 4	62.2	49.0
3	316.81	Any Combination of Five out of Six Pumps of Units 1, 2 or 3 & One Pump of Unit 4	60.0	45.6
4	218.88	Two Pumps of Any of Units 1, 2 or 3 & One Pump of Unit 5	72.4	62.5
5	184.33	One Pump of Any of Units 1, 2 or 3 & One Pump of Unit 5	79.7	72.4

The impingement assessment of the desalination plant intake provided above represents a worst-case scenario reflective of long-term power plant shutdown – i.e. shutdown over 365 days per year and 24 hrs per day.

Based on the year 2006 track record of operational conditions, the power plant has been shut down for only 10 days. If the desalination plant was in operation in 2006, this would have corresponded to impingement increment due to the desalination plant operations of only 0.76 %, if during the time of power plant shutdown the intake is operated at 184.44 MGD to provide source water for the stand-alone operation of the desalination plant (10 days/365 days x (1-0.724) x 100 % = 0.76 %). If the power plant is shutdown for one month (30 days), the increment over the current baseline impingement potential of the power plant would be only 2.3 %.

It should be pointed out that if the power plant is shutdown for one month or more, the adverse effects on the Aqua Hedionda lagoon due to lack of circulation and the associated suppression of the bio-productivity of the lagoon are likely to be significantly higher than the 2.3 % of the incremental impingement associated with the desalination plant operations, assuming minimum intake flow of 184.33 (Operational Condition 5). Therefore, the overall effect of desalination plant stand-alone operations on the lagoon ecosystem health and productivity would be positive.

Assessment of Impingement Effect of Alternative Operational Conditions Based on Existing Studies

The abundance and biomass of fishes and invertebrates impinged on the EPGS traveling screens were documented in an extensive study as part of the 316(b) Cooling Water Intake Demonstration (SDG&E, 1980). Biological sampling was done over a period of 336 consecutive days by collecting quantitative 12-hour accumulation samples during each day and night period, using nets placed in the collector baskets of all three traveling screen systems. Combined pump flows during the 48-week study ranged from 26.5% to 100% of maximum pumping capacity (794.9 MGD) with an overall average of 80.3% (638.6 MGD).

The total amount of impinged organisms for the individual sampling events of 1980 study is presented in Table 3-10. In order to assess the potential impingement effects of projected desalination plant flows during times of shutdown of EPS, the abundances and biomass of impinged organisms recorded in this 1980 study were scaled to the flow rates of the five alternative Operational Conditions described earlier in this section. The assessment of daily biomass of impinged species for the alternative Operational Conditions is presented in Table 3-11.

Review of Table 3-11 indicates that under worst-case operational condition (Condition 3 of total intake flow of 328.33 MGD), the daily total number of impinged fish is projected to be 131 individuals per day and the total weight of this fish would be 2.8 lbs/day. Operational Condition 5 (intake flow of 184.33 MGD) will cause lowest daily impingement rate of 74 individuals per day with average weight of 1.56 lbs/day.

A more detailed examination of the species composition identified during the 1980 SDG&E Study shows that queenfish, deepbody anchovy, and topsmelt comprised over half of the fishes by number, and that round stingray, Pacific electric ray, topsmelt, and queenfish comprised much of the biomass. Large invertebrates, in comparison, comprised approximately 7% of all organisms counted and less than 10% of the total biomass.

Significance of Impingement Losses

The biomass loss assessment provided above, demonstrates that the additional flows needed to provide seawater for the desalination plant during shutdowns of EPS would have little effect on the overall annual impingement losses caused by the power plant.

TABLE 3-10

1980 SDG&E STUDY TEST DATA FOR TOTAL DAILY (24-HOUR) ABUNDANCE AND BIOMASS OF IMPINGED FISHES

			All Stations	
Time Period (1979)	Week	Total Number	Total Weight (kg)	Total Flow (mgd)
Feb 04-10	1	455	5.00	759.8
Feb 11-17	2	291	2.50	794.9
Feb 18-24	3	1,374	11.99	765.6
Feb 25-March 03	4	366	4.91	765.6
March 04-10	5	47	1.17	531.9
March 11-17	6	48	1.23	531.9
March 18-24	7	43	4.69	531.9
March 25-31	8	31	2.26	531.9
April 01-07	9	276	9.75	531.9
April 08-14	10	24	1.23	496.8
April 15-21	11	20	1.52	496.8
April 22-28	12	58	2.05	438.3
April 29-May 05	13	25	3.07	467.6
May 06-12	14	97	0.52	210.4
May 13-19	15	33	0.22	210.4
May 20-26	16	67	0.82	239.6
May 27-June 02	17	52	0.48	210.4
June 03-09	18	118	1.33	526.0
June 10-16	19	194	1.97	561.1
June 17-23	20	491	6.02	496.8
June 24-30	21	516	3.31	438.3
July 01-07	22	368	1.33	438.3
July 08-14	23	611	2.42	467.6
July 15-21	24	166	1.45	765.6
July 22-28	25	305	1.57	759.8
July 29-Aug 04	26	362	4.64	794.9
Aug 05-11	27	107	0.89	794.9
Aug 12-18	28	192	1.56	759.8
Aug 19-25	29	591	2.48	736.4
Aug 26-Sep 01	30	261	1.84	736.4
Sep 02-08	31	343	1.56	794.9
Sep 09-15	32	103	0.45	707.2
Sep 16-22	33	90	1.01	765.6
Sep 23-29	34	189	1.76	765.6
Sep 30-Oct 06	35	194	1.78	765.6
Oct 07-13	36	130	3.17	794.9
Oct 14-20	37	156	0.87	794.9
Oct 21-27	38	370	2.14	794.9
Oct 28-Nov 03	39	417	1.98	794.9
Nov 04-10	40	247	2.13	794.9
Nov 11-17	41	307	1.84	794.9
Nov 18-24	42	793	3.16	794.9
Nov 25-Dec 01	43	584	1.09	759.8
Dec 02-08	44	229	2.65	794.9
Dec 09-15	45	97	1.56	794.9
Dec 16-22	46	196	2.18	794.9
Dec 23-29	47	146	1.52	561.1
Dec 30-Jan 04 (1980)	48	48	2.84	794.9
	Average	**255**	**2.46**	**638.6**

TABLE 3-10

ASSESMENT OF DAILY (24-HR) ABOUNDANCE AND BIOMASS OF IMPINGED FISHES FOR ALTERANTIVE OPERATIONAL CONDITIONS BASED ON 1980 STG&E STUDY DATA

Operational Condition	Total Intake Flow (MGD)	Intake Pumps in Operation	Total Daily Number of Impinged Fish	Total Daily Weight of Impinged Fish (kg/lbs)
1	328.33	One Pump of Any of Units 1, 2 or 3 & One Pump of Unit 4 & One Pump of Unit 5	131	1.27/ 2.8
2	322.58	One Pump of Any of Units 1, 2 or 3 & Two Pumps of Unit 4	129	1.24/ 2.73
3	316.81	Any Combination of Five out of Six Pumps of Units 1, 2 or 3 & One Pump of Unit 4	126	1.22/ 2.69
4	218.88	Two Pumps of Any of Units 1, 2 or 3 & One Pump of Unit 5	87	0.84/ 1.85
5	184.33	One Pump of Any of Units 1, 2 or 3 & One Pump of Unit 5	74	0.71/ 1.56

3.4 ADOPTON OF POWER PLANT IMPINGEMENT REDUCTION MEASURES

The current EPS NPDES Permit (Order No. R9-2006-0043, NPDES CA0001350) requires the EPS owner to, by January 9, 2008, submit to the Regional Water Board a Comprehensive Demonstration Study to characterize impingement and entrainment, and identify specific measures for their reduction. Since the desalination plant will not be operational before the end of 2008, the technologies, operation measures and/or mitigation measures implemented by the power plant and in place at the time the desalination plant begins operations would be evaluated and would be adopted, if feasible.

CHAPTER 4

POTENTIAL ENTRAINMENT REDUCTION MEASURES

4.1 METHODOLOGY FOR ENTRAINMENT ASSESSMENT

Under the alternative Operational Conditions 1 through 5 defined in Section 2, when EPS is offline and the desalination plant is the only facility using the existing intake structure, the desalination plant may collect between 184.33 MGD (Operational Condition 5) and 328.33 MGD (Operational Condition 1) of seawater in order to produce 50 MGD of drinking water. For the purpose of this analysis, the marine organisms entrained under any of the stand-alone operational conditions are assigned 100 % mortality. The entrainment of marine organisms attributed to the alternative operational conditions of the power plant intake pumps during stand-alone desalination plant operations is determined as a function of the total volume of seawater colleted by the EPS cooling water pumps.

During the review phase of the Final EIR for the Carlsbad project, Tenera Environmental has prepared an assessment of the proportional mortality (PM) of marine organisms that could be caused by the stand-alone operation of the desalination plant at intake flow of 306 MGD. Proportional mortality is defined as the percent of the total amount of marine organisms that inhabit the area of the lagoon and the ocean in the vicinity of the lagoon entrance, which area could be influenced by the power plant intake operations. This PE assessment for an intake volume of 306 MGD is provided as Attachment 5 and is summarized in Table 4-1. This table is extended to include estimates of the entrainment assigned to the EPS cooling water pumps when these pumps are operated at maximum capacity of 794.9 MGD and daily average power plant flow of 600.4 MGD.

The available proportional mortality data presented in Table 4.1 were used to determine the entrainment associated with power plant intake facility operation under Operational Conditions 1 through 5 when the desalination plant is in a stand-alone mode.

TABLE 4-1
AVERAGE DAILY PROPORTIONAL MORTALITY (PM) ASSOCIATED WITH ENTRAINMENT AT INTAKE FLOWS OF 306 MGD, 600.4 MGD & 794.9 MGD

Fish Group	PM @ 306 MGD (%)(1)	PM @ 600.4 MGD (%)	PM @ 794.9 MGD (%)
CIQ Gobies	34.1	66.9	88.6
Combtooth Blennies	16.5	32.4	42.9
Northern Anchovy	1.7	3.3	4.4

Note: (1) Source - Tenera Environmental, 2006 (see Attachment 5);
(2) Calculated Proportionally to Cooling Water Pump Intake Flow.

4.2 ENTRAINMENT REDUCTION AT ALTERNATIVE INTAKE OPERATIONAL CONDITIONS

Estimates of entrainment-related proportional mortality (PM) associated with power plant's intake cooling seawater pumps at Operational Conditions 1 through 5, along with the maximum entrainment potential of each operational condition are presented in Table 4-2.

TABLE 4-2
COMAPRISON OF ENTRAINMENT REDUCTION AT ALTERANTIVE OPERATIONAL CONDITIONS OF POWER PLANT INTAKE PUMPS

Operational Condition	Total Intake Flow (MGD)	Entrainment-related Proportional Mortality (%)		Entrainment Reduction Compared to That at Maximum Pump Flow of 794.92 MGD (%)	Entrainment Reduction Compared to That at Average Pump Flow of 600.4 MGD (%)
1	328.33	CIQ Gobies	36.5	58.7	45.3
		Combtooth Blennies	17.6	58.7	45.3
		Northern Anchovy	1.8	58.7	45.3
2	322.58	CIQ Gobies	35.9	59.4	46.3
		Combtooth Blennies	17.4	59.4	46.3
		Northern Anchovy	1.8	59.4	46.3
3	316.81	CIQ Gobies	35.3	60.2	47.2
		Combtooth Blennies	17.1	60.2	47.2
		Northern Anchovy	1.8	60.2	47.2
4	218.88	CIQ Gobies	24.4	72.5	63.5
		Combtooth Blennies	11.8	72.5	63.5
		Northern Anchovy	1.2	72.5	63.5
5	184.33	CIQ Gobies	20.5	76.8	69.3
		Combtooth Blennies	9.9	76.8	69.3
		Northern Anchovy	1.0	76.8	69.3

Significance of Entrainment Losses

The loss of larval fish entrained by the Carlsbad Desalination Plant (CDP), whether the EPS is operating or not, represents a small fraction of marine organisms from the abundant and ubiquitous near shore source water populations. Using standard fisheries models for adult fishes, the loss of larvae (99 percent of which are lost to natural mortality) due to the desalination facility entrainment at any of the five operational conditions would have no effect on the species' ability to sustain their populations, including the gobies at maximum PM under Operational Condition 1% of 36.5%.

Comparison of entrainment potential of the alternative operational conditions indicate that Condition 5 (intake flow of 184.52 MGD) will yield lowest entrainment PM losses (1% to 20.5 % depending on the species). The entrainment potential of this scenario is 43.8 % lower than that of Scenario 1 (intake flow of 328.33 MGD) because of the lower total volume of seawater used by the desalination plant under this operational condition.

Species with the highest mortality (i.e. the CIQ Gobies) are not substantially impacted because of their widespread distribution and high reproductive potential due to spawning several times a year, and are able to sustain conditional larval stage mortality rates of up to 60% without a decline in adult population level (see Attachment 5). This absence of potential population level effects is especially true for the species' early larval stages. The sheer numbers of larvae that are produced overwhelm population effects of both natural mortality and high levels of conditional mortality.

The most frequently entrained species are very abundant in the area of the EPS intake, the Agua Hedionda Lagoon, and the Southern California Bight, and therefore, the actual ecological effects due to any additional entrainment from the desalination plant at any of the Operational Conditions 1 through 5 are insignificant. Species of direct recreational and commercial value constitute a very small fraction (less than 1 percent) of the entrained organisms. Therefore, the operation of the desalination facility would not cause a significant ecological impact.

California Department of Fish and Game in its Nearshore Fishery Management Plan provides for sustainable populations with harvests of up to 60 percent of unfished adult stocks. The incremental entrainment ("harvest") effect of larval fishes from the desalination facilities operation under any of the Operational Scenarios 1 through 5 scenario at total seawater intake flow of 184.52 MGD (Scenario 5) to 328.33 MGD (Scenario 1) is approximately 1 to 36.5 percent (depending on the species); losses that would have no significant effect on the source water populations to sustain themselves.

The magnitude of the entrainment losses for all operational conditions is estimated for these conditions occurring continuously (i.e., 24 hrs per day, 365 days per year). Taking into consideration that the power plant is not expected to discontinue operations any time soon, the actual entrainment effects will be even smaller. Additionally, entrainment mortality losses are not harvests in the common sense, because the larval fish are not removed from the ocean, but are returned to supply the ocean's food webs – the natural fate of at least 99 percent of larvae whether entrained or not. Generally, less than one percent of all fish larvae become reproductive adults.

4.3 ADOPTION OF POWER PLANT ENTRAINMENT REDUCTION MEASURES

As noted above, Order No. R9-2006-0043 (NPDES CA0001350) requires the EPS owner to, by January 9, 2008, submit to the Regional Water Board a Comprehensive Demonstration Study to characterize impingement and entrainment, and identify specific measures for their reduction. Since the desalination plant will not be operational before the end of 2008, the technologies, operation measures and/or mitigation measures implemented by the power plant and in place at the time the desalination plant begins operations would be evaluated and would be adopted, if feasible.

CHAPTER 5

INTAKE IMPINGEMENT AND ENRTAINMENT MINIMIZATION PLAN

5.1 RECOMMENDED POWER PLANT INTAKE SYSTEM OPERATIONS

Based on the review and evaluation of alternative modes of operation of the power plant intake facilities and the desalination plant discharge impact on the marine environment, the following plan for operation is recommended during periods of temporary shutdown of EPS electricity generation facilities:

1. Limit the operation of existing power plant intake pumps and screens to one of the Operational Conditions shown in Table 5-1. Preference would be given to operational scenarios resulting in lowest intake flow that can be achieved with the pumps available at the time this mode of operation has to be practiced.

2. Whenever possible, reduce the total flow collected trough the existing power plant intake to 184.32 MGD (Operational Condition 5) by running only one of any of the six pumps of power plant generation Unit 1, 2 or 3 and one pump of power plant generation Unit 5 (22.2 % of the maximum power plant intake flow of 794.9 MGD). Acute toxicity testing and hydrodynamic modeling of the desalination plant discharge at this scenario indicates that operation of the desalination plant will be environmentally safe.

3. Operation of the desalination plant under the condition of maximum reduction of impingement and entrainment (Operational Condition 5) could occur only if the RWQCB were to (1) increase the daily average discharge salinity limit in the current desalination plant NPDES permit from 40 ppt to 46 ppt and (2) increase the maximum daily discharge salinity permit limit from 44 ppt to at least 50 ppt. The current average and maximum daily limits of 40 ppt and 44 ppt would allow plant operation only under Operational Conditions 1, 2 and 3.

4. Impingement and entrainment associated with Operational Condition 5 are over 40 % lower than these of any of the Operational Conditions 1, 2 or 3, and therefore, the environmental benefits of this mode of operation are substantial while the environmental impact associated with the elevated salinity of the discharge is minimal.

TABLE 5-1

ALTERNATIVE OPERATIONAL CONDITIONS OF EXISITNG INTAKE FACILITIES FOR REDUCED IMPINGMENT AND ENTRAINMENT DURING POWER PLANT SHUTDOWNS

Condition	Total Intake Flow (MGD)	Power Plant Intake Pumps in Operation	Power Plant Intake Fine Screens in Operation	Daily Average Discharge Salinity Conc. (ppt)	Maximum Daily Discharge Concentration Salinity Conc. (ppt)
1	328.33	One Pump of Any of Units 1, 2 or 3 & One Pump of Unit 4 & One Pump of Unit 5	All Seven Screens In Operation.	39.5	44
2	322.58	One Pump of Any of Units 1, 2 or 3 & Two Pumps of Unit 4	All Four Screens for Units 1,2, 3 & 4 in Operation & Three Screens for Unit 5 Shutdown	39.6	44
3	316.81	Any Combination of Five out of Six Pumps of Units 1, 2 or 3 & One Pump of Unit 4	All Four Screens for Units 1,2, 3 & 4 in Operation & Three Screens for Unit 5 Shutdown.	39.8	44
4	218.88	Two Pumps of Any of Units 1, 2 or 3 & One Pump of Unit 5	All Five Screens for Units 1,2, 3 & 5 in Operation & Two Screens for Unit 4 Shutdown	43.4	50
5	184.33	One Pump of Any of Units 1, 2 or 3 & One Pump of Unit 5	All Five Screens for Units 1,2, 3 & 5 in Operation & Two Screens for Unit 4 Shutdown	46	50

5.2 INTAKE SYSTEM OPERATIONAL PROCEDURES

The Encina Power Station and the Carlsbad seawater desalination plant will be staffed 24 hours per day and 365 days per year. During temporary shutdowns of the Encina Power Station electricity generation facilities, power plant staff on duty will implement the following standard operational procedures:

1. Power plant staff will notify desalination plant staff regarding the time at which the power plant generation facilities is scheduled to be shutdown. This

notification should be forwarded to the desalination plant staff as soon as possible but no later than two (2) hours before the time of the actual shut down of the power plant electricity generation units so the desalination plant staff has adequate time to prepare for the changed mode of power plant operation.

2. Power plant staff on duty will select mode of power plant intake facility operations from the operational scenarios listed in Table 5-1. Mode of operation that should be considered first is the Operational Condition 5 (i.e., intake facility operation at 184.33 MGD). If this operational condition cannot be implemented because any of the equipment (screens, controls, pumps, etc,) needed to run at this mode of operation is down, than the power plant staff shall proceed with the selection of Operational Condition 4, 3, 2 or 1, in this sequence.

3. Power plant staff will notify the desalination plant staff on duty regarding the selected operational condition at least twenty-four (24) hours before the power plant intake facilities are actually switched to this mode, so the desalination plant is prepared to track closely the desalination plant operations and modify it as needed in order to comply with the regulatory requirements associated with the desalination plant operations. Usually the power plant cooling pumps servicing any of the electricity generation units continue to operate for 24 hours to 48 hours after the generation unit is shut down in order to cool the unit down slowly and prevent unit damage from overheating. Therefore, the power plant staff and desalination plant staff will have ample amount of time (24 to 48 hours) to select the most viable operational condition at the time of the power plant shutdown and to prepare and coordinate the power plant intake facilities (pumps, screens and service equipment) and the desalination plant operations for stand-alone operation of the desalination plant staff during the period of temporary power plant shutdown.

4. Power plant staff on duty will modify the power plant intake pumps system operations in accordance with the specific directions for intake pumps and screens required to be in operation under the selected operational condition. Notify the desalination plant staff at the time of the switch to the selected operational condition.

5. During periods of power plant shutdown, the desalination plant staff will track the desalination plant operation more closely and will monitor the salinity/conductivity of the desalination plant discharge at the discharge pond monitoring point designated in the current NPDES permit. Desalination plant staff will adjust facility operations to maintain compliance with the average daily and daily maximum limits of salinity defined in Table 5-1.

6. Power plant staff shall notify the desalination plant operational staff on duty at least two (2) hours before Encina Power Station restart electricity generation which would allow desalination plant operators to adjust facility operations if needed.

Both power plant and desalination plant staff will work in close cooperation in order to assure facility compliance with all applicable regulatory requirements. Because the operation of the desalination plant intake pumps will be interlocked with that of the power plant pumps, a complete shutdown of all power plant intake pumps will trigger an automatic shutdown of the desalination plant intake pumps. This automatic pump operation interlocking provision would prevent a situation where the desalination plant intake pumps may run during times when all of the power plant pumps are shutdown.

CHAPTER 6

POTENTIAL IMPINGEMENT AND ENTRAINMENT MITIGATION MEASURES

The previous sections of this Plan discuss the optimum operations of the Carlsbad seawater desalination plant and the intake of the existing Encina Power Station's intake facilities that allow minimizing the intake flow, impingement and entrainment while maintaining environmentally safe discharge of the desalination plant's concentrate. Under the recommended minimization plan, the power plant cooling water intake facilities would be operated at total flow of 184.32 MGD, which would result in impingement of reduction of 79.7 % and entrainment reduction of 76.8 % as compared to the power plant's impingement and entrainment at maximum intake flow of 794.92 MGD.

In addition to the impingement and entrainment described in the previous sections, in the case of permanent power plant shutdown or switch to alternative cooling system, Poseidon Resources would commit to continue the periodic dredging of the lagoon in order to facilitate desalination plant operations and to maintain the environmental health of the lagoon and to abate beach erosion in the vicinity of the desalination plant discharge.

6.1 MAINTEANCE OF LAGOON ENVIRONMENTAL HALTH AND ABATEMENT OF BEACH ERROSION

Agua Hedionda Lagoon is connected to the Pacific Ocean by means of a manmade channel that is artificially maintained. Seawater circulation throughout the outer, middle and inner lagoons is sustained both by routine dredging of the manmade entrance to prevent its closure, which would occur naturally, and the Encina Power Station's cooling water withdrawals from the lower lagoon. Without the CDP or EPS need for water, fresh seawater flows into the lagoons would cease, and the entrance to the lagoons would be closed off by the natural long-shore transport of native beach sands. A comprehensive hydrodynamic study of the interaction between the lagoon and the ocean indicates that without the intake of seawater by the power plant cooling pumps, the entrance to the lagoon would be expected to close over time, and to remain closed most of the year (see Attachment 6). This in turn would have a very detrimental effect on the environmental health of the lagoon, on its ecosystem (including on the endangered species currently inhabiting the lagoon) and on its recreational value and beneficial use.

The Lagoon provides a wide range of beneficial uses. Nearly all of these uses are directly or indirectly affected by seawater flow and exchange created by the EPS once-through cooling flows and large circulation pumps. The existing cooling water flows (and/or future needs of the CDP) provide for fresh ocean water that renew the Lagoon's water quality and flush nutrients and other watershed pollution, particularly from the Lagoon's upper reaches. In addition, the inflow of fresh supplies of ocean water induced by the pumping and tides carry waterborne supplies of planktonic organisms that nourish the many organisms and food chains of the Lagoon, including the White Sea Bass restoration program of the Hubbs Sea World Research Institute and the aquaculture operations in the lower Lagoon.

The lost circulation due to tidal flows through the dredged maintained channel and pumping would directly affect the Lagoon's water quality and water related activities, such as fishing, and water contact recreation, such as the very popular water ski, kayaking and swimming activities in the middle and upper lagoons. The name, Agua Hedionda, which means "stinking water" in Spanish, reflects a former condition that would revert due to increasing stagnation resulting from lack of pumping and ocean inflow through its intake channel should EPS cease to function.

To avoid this significant loss of highly productive marine habitat, in the event of extended shutdown of EPS power generation units, Poseidon would maintain circulation of the seawater, continue routine dredging of the entrance to the lagoon to prevent its closure, and deposit the sand dredged from the lagoon on adjacent beaches so as to maintain, restore and enhance habitat for grunion spawning and to maintain, restore and enhance opportunities for public access and recreation along the shoreline and within the coastal zone.