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

ATTACHMENT 10 – EXPLANATION OF MODIFICATION TO ENTRAINMENT MINIMIZATION TECHNOLOGY MEASURES

March 27, 2009

EXPLANATION OF MODIFICATION TO ENTRAINMENT MINIMIZATION TECHNOLOGY MEASURES

The San Diego Regional Water Quality Control Board ("Regional Board") will consider the Flow, Entrainment and Impingement Minimization Plan ("Plan") for the Carlsbad desalination Project ("CDP" or "Project") at its April 8, 2009 meeting. The Plan was required as a Special Provision of the Project's NPDES permit in order to assure compliance with the Porter-Cologne Water Quality Control Act, Water Code Section 13142.5(b), which requires industrial facilities using seawater for processing to use the best available site, design, technology, and mitigation feasible to minimize impacts and mortality to marine life.

This memorandum explains the reasoning for the modification to the entrainment minimization technology measures as reflected in Chapter 4, Technology, of the Plan. Based on updated research and input from the California Coastal Commission and the Commission's Scientific Advisory Panel ("SAP") [1], Poseidon has discovered that the installation of micro screens ahead of seawater pretreatment facilities and the use of a low pressure membrane pretreatment system would not be effective in returning viable organisms to the ocean, and would not result in any minimization or reduction of entrainment. Accordingly, the Plan was modified to remove these technology measures from the Plan.

I. POSEIDON ELIMINATED TECHNOLOGY MEASURES FOLLOWING FINDING BY THE COASTAL COMMISSION THAT SUCH MEASURES WOULD BE INEFFECTIVE IN REDUCING ENTRAINMENT AND IMPINGEMENT IMPACTS

In the April 2008 version of the Plan previously submitted to the Regional Board, Poseidon proposed the installation of micro screens and the use of a low pressure membrane pretreatment system to increase the potential to capture marine organisms and to successfully return them to the ocean.[2] Based upon the use of these proposed technology measures, Poseidon initially considered the mortality rate of the entrained marine organisms to be less than 100%.

Subsequent to that proposal, however, Poseidon, with the assistance of the Coastal Commission and the SAP, discovered that these technology measures would not be effective in returning viable organisms to the ocean, and would not result in any minimization or reduction of entrainment. The SAP observed that the protocols used in the Project's entrainment studies

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[1] **SAP** is a team of independent scientists that provides guidance and oversight to the Commission on ecological issues associated with the San Dieguito Restoration Project. That Project is being implemented by Southern California Edison pursuant to requirements of coastal development permits issued by the Commission and is meant to mitigate for marine resources losses caused by the San Onofre Nuclear Generating Station (SONGS). The Marine Review Committee **SAP currently** consists of ***Dr. Richard Ambrose***, Professor and Director of Environmental Science & Engineering Program, Department of Environmental Health Sciences, University of California Los Angeles; ***Dr. John Dixon***, Senior Ecologist, California Coastal Commission; ***Dr. Mark Page***, Marine Science Institute, University of California at Santa Barbara; ***Dr. Pete Raimondi***, Professor and Chair of Ecology and Evolutionary Biology, University of California at Santa Cruz; ***Dr. Dan Reed***, Marine Science Institute, University of California at Santa Barbara; ***Dr. Steve Schroeter***, Marine Science Institute, University of California at Santa Barbara; and, ***Dr. Russ Schmitt***, Director of Coastal Research Center, University of California at Santa Barbara.

[2] Set forth in Exhibit A is the description of these technology measures which was removed from the Plan.

included an assumption of 100% mortality based on guidance from the U.S. EPA and reflecting the practice of California's State and Regional Water Boards, the California Energy Commission, and the Coastal Commission in conducting and evaluating these studies.[3] The Commission applied this assumption to the Project after consideration of the micro screen and pretreatment system technology measures proposed in the April 2008 version of the Plan. The basis for the Commission's decision not to grant any mitigation credit for these technology measures was the lack of peer-reviewed scientific studies that support using a lower mortality rate for different types of desalination systems that cause entrainment.[4]

In the case of Poseidon's proposed screening and pretreatment technology measures, the Commission found that the entrained organisms will be subject to a number of stressors – including high pressures, significant changes in salinity, possible high temperature differences if the power plant is operating, etc. – and they will then be discharged to a different environment than is found in Agua Hedionda.[5] From this, the Commission concluded that any one or a combination of these stressors could result in mortality of the marine organisms prior to the return to the ocean.[6]

In addition, the long-term survival of marine organisms once they have been returned to the ocean is also uncertain. Researchers have observed that predators will often wait at the area where the marine organisms are returned, having associated it with the regular release of "dazed fish that make for an easy meal."[7] Thus, it is uncertain whether the returned marine organisms survive past the initial release into the ocean or thereafter contribute reproductively to the population.[8]

Therefore, Poseidon determined that these technology measures would not be effective in the minimization or reduction of entrainment, and the decision was made to remove these technology measures from the Plan.

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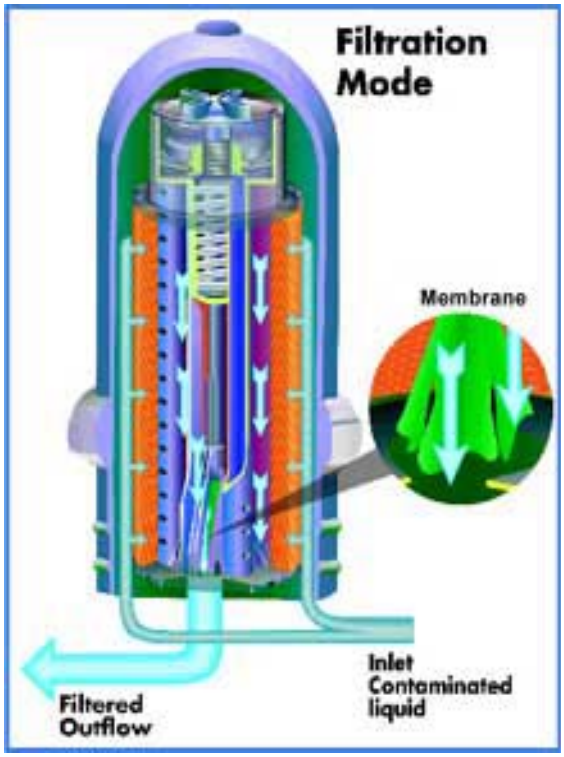
[3] California Coastal Commission. *Recommended Revised Condition Compliance Findings, Marine Life Mitigation Plan for Coastal Development Permit E-06-013, Poseidon Resources Carlsbad Desalination Project*, November 21, 2008, at 13. Available at http://documents.coastal.ca.gov/reports/2008/12/W16a-12-2008.pdf;
[4] *Id.*
[5] *Id.*
[6] *Id.*
[7] Ferry-Graham, Dorin, and Lin, *Understanding Entrainment at Coastal Power Plants: Informing a Program to Study Impacts and Their Reduction*, CEC-500-2007-120 at 36 (March 2008).
[8] *Id.*

EXHIBIT A
ELIMINATED DESCRIPTION OF REMOVED TECHNOLOGY MEASURES

4.4.2 Installation of Micro-screens Ahead of Seawater Pretreatment Facilities

A very fine screen (120 micron/0.12 mm) or also known as micro-screen filtration technology is planned to be installed to filter out most of the marine organisms entrained by the desalination plant intake pumps. The micro-screens are equipped with polypropylene discs, which are diagonally grooved on both sides to a specific micron size. A series of these discs are stacked and compressed on a specially designed spine. The groove on the top of the disks runs opposite to the groove below, creating a filtration element with series of valleys and traps for marine particulates. The stack is enclosed in corrosion and pressure resistant housing. Filtration occurs while water is percolating from the peripheral end to the core of the element (Figure 4-8).



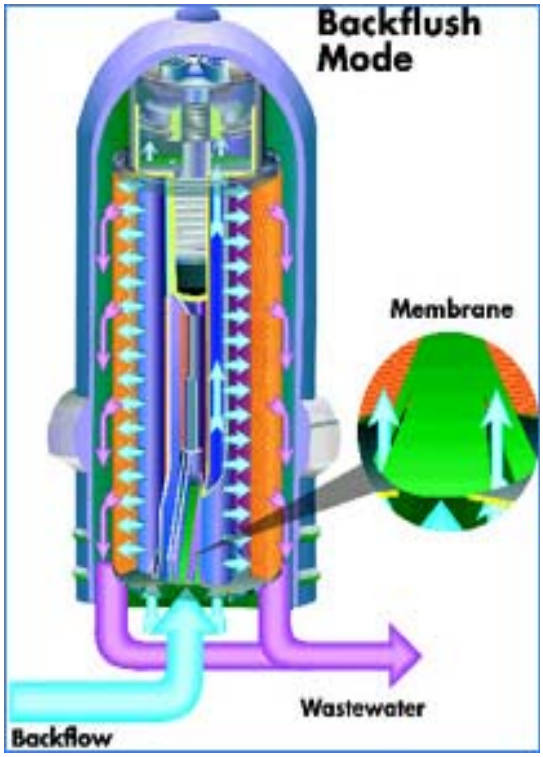


Figure 4-8. Microscreens in filtration and backwash flow modes

Since the intake seawater is already pre-screened by the 3/8 to 5/8- inch power plant intake screens, the seawater directed to the disk filters will contain debris and marine organisms smaller than 3/8-inch (9500 microns) (5/8-inch = 15.8 mm = 15,800 microns). During the filtration mode, seawater debris and marine organisms larger than 15,800 microns but smaller than 120 microns will be retained and accumulated in the cavity between the filter disks and the outer shell of the filters, thereby increasing the head loss through the filters. Once the filter head loss reaches a preset level (typically 5 psi or less) the filters enter backwash mode. All debris and marine organisms retained on the outer side of the filters are then flushed by tangential water jets of filtered seawater flow under 2 to 3 psi of pressure and the flush water is directed to a pipe, which returns the debris and marine organisms retained on the filters back to the ocean.

Because of the small size and relatively low differential pressure, these filters are likely to minimize entrainment and impingement mortality of the marine organisms in the source seawater. Since the disk filtration system is equipped with a wash water/organism return pipe, the impinged marine organisms are returned back to the ocean, thereby increasing their chance of survival. Based on US EPA source (US EPA, 2002, Technical Development Document for the Proposed Section 316 (b) Phase II Existing Facilities Rule, EPA 821-R-02003) fine mesh screens show promise for both impingement and entrainment control and "can reduce entrainment by 80 % or more". According to this source, the use of 0.5 mm (500 µ) screen at the Big Bend Power Plant in Tampa Bay area, "the system efficiency in screening fish eggs (primarily drums and bay anchovy) exceeded 95 % with 80 % latent survival for drum and 93 % efficiency for bay anchovy. For larvae (primarily drums, bay anchovies, blennies, and gobies), screening efficiency was 86 % with 65 % latent survival for drum and 66 % for bay anchovy. (Note that latent survival in control samples was also approximately 60 %). According to the same source, a full-scale test by the Tennessee Valley Authority at the John Sevier Plant showed less than half as many larvae entrained with a 0.5-mm (500 µ) screen than 1.0 mm (1,000 µ) and 2.0 mm (2,000 µ) screens combined. These data are indicative of the fact that most likely using finer screens would result in lower entrainment effect. Since the micro-screens proposed for the Carlsbad project have 120 µ openings which are smaller than the smallest fine screens used elsewhere (i.e., 500 µ), the entrainment reduction capability of these micro-screens is expected to be comparable to the fine screens tested at the full scale installations referenced above.

1.2.1 Use of Low Pressure Membrane Pretreatment System

After the source seawater is screened by the 120-µ micro-screens, this water would be conveyed to a membrane pretreatment system in order to remove practically all remaining suspended solids and particulates. The filtered water will then be pumped to the seawater reverse osmosis system for salt separation.

The pretreatment system planned to be used for the Carlsbad seawater desalination project will consist of submerged ultrafiltration (UF) hollow-fiber membranes bundled in cassettes and operated under slight vacuum – typically in a range of 2.5 to 6 psi (see Figure 4-9). The nominal fiber pore size of the UF membranes is 0.02 µ. Practically all marine organisms that were not removed by the 120-µ micro-screens (mostly algae and other phyto- and zooplankton) would be retained by the UF membranes and would periodically be returned back to the ocean during the backwash cycle of these membranes. Membrane backwash would typically be

completed with air and water once every 20 to 40 minutes. No chemicals are planned to be applied for seawater conditioning prior to filtration.

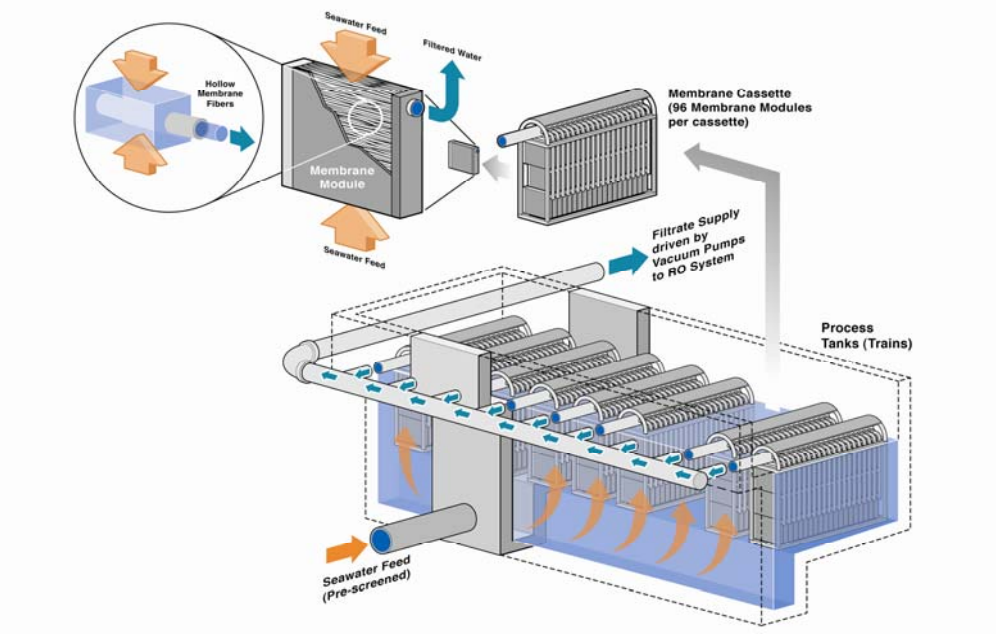


Figure 4-9 – Ultrafiltration Pretreatment System

Evaluation of the same UF pretreatment technology at the Carlsbad seawater desalination pilot plant indicates that the UF system retains all plankton and has potential to be effective entrainment reduction measure. Initial microscopic analysis of the phytoplankton in the UF system backwash completed by M-REP Consulting shows that over 70 % of algal cells maintain their integrity after passing through the micro-screens and the ultrafiltration process (see Figure 4-10).[9]

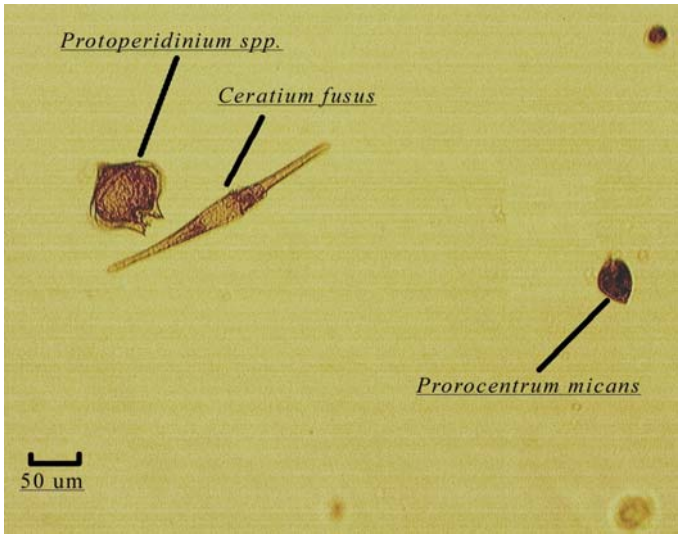


Figure 4-10 – Algae Removed by the UF Pretreatment System

[9] M-Rep Consulting, Update on the preliminary results of the Carlsbad Pilot Algal Study, February 27, 2008.