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Technical Memorandum No. 1

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Subject: Intake and Return Water System Objectives and Operations
MMWD Seawater Desalination Pilot Plant Program
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INTRODUCTION

Separate technical memoranda describe the preliminary performance objectives and operations for the different primary components of the MMWD Seawater Desalination Pilot Plant program. The Pilot Plant Program Technical Memoranda (TM) include:

- TM No. 1: Intake and Return Water System Objectives and Operations
- TM No. 2: MF/UF Filtration System Objectives and Operations
- TM No. 3: Conventional Treatment System Objectives and Operations
- TM No. 4: SWRO and BWRO System Objectives and Operations
- TM No. 5: Solids Handling System Objectives and Operations
- TM No. 6: Water Quality Sampling and Analysis Program
- TM No. 7: Post Treatment System Objectives and Operations

This memorandum, TM-1, outlines the preliminary performance objectives and operations plan for the Intake and Return Water Systems for the MMWD Seawater Desalination Pilot Plant Program. Process and Instrumentation Diagram (P&ID) P-2 shows a detailed schematic diagram of the pilot plant Intake System. P&ID P-7 shows the pilot plant Return Water System.

INTAKE SYSTEM OBJECTIVES

The overall objectives for the Intake System include:

- Evaluate, via pilot testing, intake components and design concepts most likely to be required for a full-scale facility.
- Design and operate the intake screen to minimize impingement and entrainment of marine organisms.
- Evaluate periodic shock chlorination for biological control, if necessary.

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- Determine appropriate materials and design/operating parameters for a full-scale intake system.

INTAKE SYSTEM COMPONENTS

The intake system for the MMWD Seawater Desalination Pilot will take water from the North San Francisco Bay at the end of an approximately 2000-foot long pier and deliver it to the pilot plant site at the Marin Rod and Gun Club. The intake system includes:

- Passive Intake Screen with a manual air-burst self cleaning system
- Intake pump and priming pump
- Intake piping
- Seawater Holding Tank

Passive Intake Screen

The California Department of Fish and Game and the National Marine Fisheries Service, Fish Screening Criteria for the San Francisco Bay (tidal area) include:

Approach Velocity: 0.33 fps for self-cleaning screens. Defined as the flow velocity perpendicular to the screen.

Screen Openings: 3/32-inch (2.38 mm) for slotted openings

The intake screen will be designed not to exceed the above criteria for an intake flow of 125 gpm. The intake screen will be made of a copper/nickel alloy to minimize biological fouling and corrosion and a manual air-burst will be operated periodically to clean the screen. A small package compressor and air-receiver for the system are anticipated to be located on the pier adjacent to the intake pump.

At the intake location, the bay floor is approximately 6 feet below the mean low-low water (MLLW) level. The maximum low tide (twice per month) can be 1.9 feet below the MLLW level. The screen is approximately 12-inches in diameter and will be suspended from a jib crane approximately 2 feet above the bay floor and secured with lines to the pier pilings. At mean low-low tide, the intake screen will be submerged by approximately 3 feet of water. At maximum low tide the screen will be submerged by approximately 1 foot of water. Assuming that wind generated waves at this location do not exceed 2-feet from crest to trough, the intake would remain submerged under windy, storm conditions during maximum low tide.

Intake Pump and Piping

The intake pump will be a 316 stainless steel centrifugal pump mounted on the pier. A manual priming pump (plastic materials) will establish the suction prime for the pump. Once the intake pump is primed and operating properly the priming pump will be taken out of service and isolated.

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The intake pump mounted on the pier would have sufficient suction head under worst-case conditions (2-ft wind generated waves and maximum low tide) to draw water from the bay and pump it to the pilot site. (According to our calculations, at the worst-case conditions, we have four feet of suction pressure to overcome potential screen bio-fouling). Mounting the pump on the pier also permits using a vacuum gage on the suction line to monitor the fouling rate of the passive intake screen. The use of a submersible pump was evaluated but not selected due to significantly higher equipment costs, longer delivery time and difficulty in incorporating the passive intake screen on the suction of the pump.

The intake piping is proposed to be 4-inch white schedule 40 PVC piping or 4-inch light-gray HDPE piping. The light color will minimize temperature increase of the water in the section of pipe above the water line.

Seawater Holding Tank

The seawater holding tank provides a surge/supply tank to facilitate pilot operations and serves as a common feed tank to the three pilot plant pretreatment processes. The tank will have a hydraulic detention time of approximately 10 minutes. This volume will permit stopping the intake pump for short periods while maintaining continuous operation of the rest of the pilot plant. If sufficient cleaning is not achieved within ten minutes, the cleaning procedure can be repeated after refilling of the holding tank.

PROPOSED INTAKE SYSTEM OPERATIONS PLAN

The following Intake System operational parameters will be manually monitored and evaluated during the course of the pilot study:

- Intake pump suction pressure (vacuum)
- Intake System flow rate
- Intake screen cleaning frequency
- Intake system biofouling and impact of periodic shock chlorination – measured via changes in suction vacuum and visual observations.

Preliminary Operations Plan

The intake system will be manually controlled and operated on a continuous basis with periodic, manual screen cleaning. Flow will be set at approximately 125 gpm to maintain a constant, full level in the seawater holding tank and provide for a small rate of overflow, which will be directed to the return water tank. During operation, the flow into the tank will vary due to the differences in static head on the intake cause by tidal variations but will maintained at a rate in excess of that required for the pretreatment units. Also as the demand from the pilot plant increases and decreases as required by the operations protocol, the amount of overflow will vary.

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Intake Screen Cleaning

The intake screen will be cleaned periodically by air-burst, based on the increase in the intake pump suction vacuum. It is anticipated that this cleaning will occur once every few days or less frequently.

The cleaning procedure will be to shut off and isolate the intake pump, perform the manual air-burst cleaning for approximately one to two minutes, and then re-start the intake pump. The pump should not lose prime in the short time to perform the air burst. However, if it does, the priming pump will be used to re-prime the intake pump. During this procedure, the pilot plant will operate on the stored water in the seawater holding tank.

If the airburst cleaning does not adequately clean the screen (as measured by the intake suction vacuum), then the screen will be raised, inspected and manually cleaned.

Periodic Shock Chlorination

System bio-fouling will be monitored by visual observation and by RO system performance. Sodium Hypochlorite could be periodically dosed to the intake system to help control bio-fouling in the intake system and the pilot plant. Based on the relative amount of bio-fouling, the hypochlorite could be dosed at a range of 5 to 20 mg/l for a period of 15 to 30 minutes, every 5 to 7 days. As shown on drawing P-2, chlorine can be dosed at two locations: at the discharge side of the intake pump or just upstream of the raw water flowmeter. These two points are separated by approximately one-half mile of piping along the pier.

The chlorine addition will be manual and an operator will be present during the entire operation to ensure no chlorine is introduced into the SWRO units or to the return water. Typically, most of the chlorine dosed during a shock chlorination procedure will be reduced by the biofouling in the system. The SWRO systems cannot be exposed to chlorine and so sodium bisulfite will be added to reduce any remaining chlorine before the SWRO units. The SWRO units will have an ORP instrument to shut down the SWRO unit in case of inadequate neutralization of the chlorine. Also, during chlorination events, sodium bisulfite will be added to the return water tank to ensure no chlorine is returned to the bay. When no chlorine is being added, Operators will take daily samples of return water to confirm a non-detectable total chlorine residual in the discharge to the bay. During shock chlorination, the Operator will take samples every 10 minutes to confirm no chlorine, for a period half hour before and at least 1 hour after shock chlorination.

RETURN WATER SYSTEM OBJECTIVES

The overall objectives for the Return Water System include:

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- Return minor overflows, filtrate/permeate and RO concentrate back to the San Francisco Bay.
- Ensure there is no chlorinated water is discharged to the Bay.

RETURN WATER SYSTEM COMPONENTS

The Return Water system for the MMWD Seawater Desalination Pilot Plant will take filtrates and permeates from the pretreatment and RO systems, RO concentrate and miscellaneous overflows from pilot plant and return the combined flows back to the San Francisco Bay approximately 500-feet out along the Marin Rod and Gun Club pier. Concentrated solids and sludge removed from the source water by the pretreatment systems will be sent to the Central Marin Sanitation Agency Wastewater Treatment Plant as described in TM-5. The Return Water System includes:

- Return Water Tank and Sodium Bisulfite dosing
- Return Water Pump
- Return piping

Return Water Tank

The Return Water Tank will capture the pretreatment filtrates, and RO permeate and concentrate from the pilot plant treatment systems. The tank will also receive overflows from various pilot plant tanks needed for hydraulic balancing of the pilot plant operations. The tank will have a hydraulic detention time of approximately 5 minutes based on a usable volume of 500 gallons.

During chlorine addition, sodium bisulfite will be added to the Return Water tank to make sure that no residual chlorine returns to the bay. See the discussion of shock chlorination above.

Return Water Pump and Piping

The Return Water Pump will be a 316 stainless steel centrifugal pump controlled by level switches in the Return Water Tank. The return piping is proposed to be 4-inch white schedule 40 PVC piping. The schedule 40 PVC pipe is cost effective and appropriate for the system operating pressures. The return water will be returned to the bay at two points approximately 500-feet out on the pier.

PROPOSED RETURN WATER SYSTEM OPERATIONS PLAN

The following Return Water System operational parameters will be monitored and evaluated during the course of the pilot study:

- Return Water Tank High Level - SCADA

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- Return water chlorine residual – daily manual verification of no chlorine under normal operations and increased frequency verification during shock chlorination

The Return Water System operations will be automatic. Flow from the return water pump will be manually set at approximately 125 gpm to match the flows going through the pilot plant. The pump will be controlled to stop at a low level in the Return Water Tank and to start at a high level. The Pilot Plant SCADA system will alarm on Return Water Tank high-high level. The intake pump will stop on high-high Return water tank level to prevent flooding resulting from a failure of or insufficient flow by the return water pump.

TM No. 1 Document Review History:

1. Tom Pankratz first Draft review completed 11/7/04.
2. Todd Reynolds prepared Final Draft (dated 12/3/04).
3. Jim Lozier review Final Draft (dated 12/21/04).
4. Todd Reynolds and Val Frenkel incorporated review comments 12/21/04.
5. Jim Lozier final review (dated 12/22/04)

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File