

• **Board of Directors**
Water Planning and Resources Committee

December 14, 1999 Board Meeting

10-3

Subject

Update on the Desalination Research and Innovation Partnership (DRIP) for Brackish Water Sources.

Description

The Desalination Research and Innovation Partnership (DRIP) is in the third year of applied research to demonstrate innovative technologies to reduce the cost of desalinating various brackish water sources. Achievement of the DRIP program objectives will allow development of additional local water supplies, help reduce the region's dependence on imported supplies, reduce damages due to corrosion and scaling which result from use of high salinity water, and provide environmental benefits for the Sacramento-San Joaquin Delta. Per board request, staff is providing an update on the DRIP (see [Attachment 1](#)).

Policy

None.

Fiscal Impact

None.

 Jill J. Wicke Acting Manager, Water System Operations	11/19/99 Date
 Ronald R. Jester General Manager	11/22/99 Date

[Attachment 1](#)

Detailed Report

The Desalination Research and Innovation Partnership (DRIP) is in the third year of applied research to demonstrate innovative technologies to reduce the cost of desalinating various brackish water sources. Achievement of the DRIP program objectives will allow development of additional local water supplies, help reduce the region's dependence on imported supplies, reduce damages due to corrosion and scaling which result from use of high salinity water, and provide environmental benefits for the Sacramento-San Joaquin Delta.

As shown in Table 1, DRIP currently consists of thirteen participants, including Orange County Water District (OCWD), San Diego County Water Authority and West Basin Municipal Water District. DRIP has also added three northern California water agencies to give DRIP California-wide representation, and to broaden the appeal of DRIP to entities with a statewide purview. Metropolitan is focusing on Colorado River water, and other DRIP partners are addressing brackish groundwater, municipal wastewater, and agricultural drainage water. Significant progress has been made by the DRIP consortium in the areas of treatment process evaluations, outside funding, and external activities.

Treatment Process Evaluations

The treatment process evaluations are continuing in the areas of pretreatment options, new experimental membranes, carbon aerogel capacitive deionization (CDI), and disinfection alternatives. In addition, project plans are in development to investigate brine minimization and disposal, and scale up of treatment processes. The treatment process evaluations completed to date have yielded very useful results, which are discussed in Attachment A. As indicated in Attachment A, preliminary results from the carbon aerogel CDI process are not promising, and testing of this technology may be discontinued.

Outside Funding

A summary of the outside funding efforts recently undertaken by DRIP is shown in Table 2, and discussed below.

U.S. Bureau of Reclamation

Metropolitan, in partnership with the University of California, Los Angeles (UCLA), was awarded a \$100,000 grant for a proposal entitled "Evaluation of Precipitative Fouling for Colorado River Water Desalination Using Reverse Osmosis." This work will help address membrane fouling issues which have emerged during the ongoing research in the DRIP program. DRIP will also seek to obtain an appropriation or "earmark" for funding in the U.S. Bureau of Reclamation's FY 2001 budget.

U.S. Environmental Protection Agency (USEPA)

\$500,000 has been earmarked in the USEPA FY 2000 budget for the DRIP program. This funding language is contained in the VA HUD Appropriations bill, which was signed by the President in October 1999. These funds will be used to further the DRIP program objectives in the demonstration of innovative desalination technologies.

California Energy Commission (CEC) Public Interest Energy Research (PIER)

In June 1999, the DRIP consortium submitted a proposal to the CEC entitled "Improving Potable Water Quality and Supply Reliability Using Large-Scale Water Treatment Processes" for consideration in their PIER program. In October 1999, the CEC released the budget for the PIER program for FY 1999-2000 which includes an estimated \$1,000,000 for DRIP. The CEC has indicated that funding at a similar level may be available in future years for DRIP if the work continues to show promising results. Contract negotiations for this work are ongoing.

Water Bond

The Safe Drinking Water, Clean Water, Watershed Protection and Flood Control Act of 1999 (Water Bond) was signed by Governor Gray Davis in October 1999. This \$1.97 billion bond measure, if adopted by the voters on the March 2000 ballot, would authorize funding for a variety of safe drinking water, water quality, and water reliability programs. DRIP is currently exploring how Water Bond funds may be obtained to support DRIP.

AB 1605 (Margett)

AB 1605, authored by Assemblyman Bob Margett and sponsored by Metropolitan, would have provided \$1,000,000 for DRIP for continuation of desalination applied research. This bill was passed by both the Assembly and Senate on near unanimous votes, but was vetoed by Governor Gray Davis. The Governor's veto

message emphasized the importance of the proposed work, but indicated that the Water Bond would be a more appropriate potential source of funds for this work.

External Activities

A number of significant external activities supporting the DRIP program have recently been conducted. The DRIP consortium is continuing work on a \$2.9 million grant administered by the California Energy Commission (CEC) under their PIER program. One project task is to conduct three one-day technology transfer workshops to disseminate applied research results. The Electric Power Research Institute (EPRI) and the American Water Works Association Research Foundation (AWWARF), both DRIP partners, have lead responsibility for these workshops. The first technology transfer workshop will be held on December 9, 1999, in Ontario, California. Metropolitan's member agencies and subagencies have been invited to attend the workshop. The workshop will feature presentations on the work completed to date by Metropolitan, OCWD, and EPRI. At the request of the CEC, Metropolitan, along with OCWD and EPRI, participated in the CEC-sponsored Energy Innovations '99 Conference in San Diego. Metropolitan gave a brief presentation on our PIER applied research and participated in a panel discussion entitled "Water: Issue of the New Millennium."

Future Plans

Near-term future plans for DRIP include the following:

- Treatment process evaluations will continue, particularly in the area of process scale-up for membrane elements and the pulsed ultraviolet (UV) light system.
- A Memorandum of Understanding between the DRIP partners will be pursued to formalize and solidify the partnership.
- DRIP will continue to grow strategically, bringing in partners which can provide new research platforms, different brackish source waters for investigation, or geographic diversity to the DRIP program.

DRIP will continue to cultivate existing funding sources, and seek new funding sources to maximize the amount of funding for DRIP coming from outside sources.

Attachments

TABLE 1**DESALINATION RESEARCH AND INNOVATION PARTNERSHIP**

PARTICIPANTS TO DATE (December, 1999)

- * Metropolitan Water District of Southern California
 - * Orange County Water District
 - * San Diego County Water Authority
 - * West Basin Municipal Water District
 - * Southern California Edison
 - * Electric Power Research Institute
 - * American Water Works Association Research Foundation
 - * University of California, Riverside
 - * California Department of Water Resources
 - * Lawrence Livermore National Laboratory
 - * Alameda County Water District
 - * Sonoma County Water Agency
 - * Santa Clara Valley Water District
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ATTACHMENT A

DETAILED DISCUSSION OF CURRENT TREATMENT PROCESS EVALUATIONS

The treatment process evaluations are continuing in the areas of pretreatment options, new experimental membranes, carbon aerogel capacitive deionization, and disinfection alternatives. In addition, project plans are in development to investigate brine minimization and disposal, and scale up of treatment processes. A detailed status of each of these project areas is discussed below.

Pretreatment Options

All desalination technologies require pretreatment for solids removal. DRIP is evaluating three pretreatment options: conventional treatment; conventional treatment with ozone and biofiltration; and microfiltration. The results of the first two pretreatment options will be compared to microfiltration to evaluate relative performance. Successful pretreatment using conventional treatment or conventional treatment with ozone and biofiltration would be a significant breakthrough because use of existing facilities for pretreatment would result in major cost savings when compared to the capital cost of constructing new microfiltration facilities for pretreatment.

A conventional treatment plant operating with ozone and biologically active filters was found to produce a non-fouling effluent for use with reverse osmosis (RO), and may provide a suitable water for stable long-term RO operation. Conventionally treated Weymouth Filtration Plant effluent (without ozone and biofiltration) rapidly fouled a downstream RO unit. Investigation of the nature of the foulant, and of any subsequent remedial actions, is ongoing.

Orange County Water District (OCWD) is currently investigating microfiltration and ultrafiltration of municipal wastewater as pretreatment for RO to determine which system offers the best operational performance. This work supports the goals of the Groundwater Replenishment System managed by OCWD.

San Diego County Water Authority, in conjunction with the City of San Diego Metropolitan Wastewater Department, plans to conduct tests on microfiltration and ultrafiltration as pretreatment for RO using reclaimed wastewater. This work will be funded using Proposition 204 funds received from the Department of Water Resources.

New Experimental Membranes

DRIP is working with manufacturers to evaluate new ultra-low-pressure membranes, and membranes for specific applications, such as chlorine tolerant membranes. Ultra-low-pressure RO membranes were found to markedly reduce the total dissolved solids (TDS) of blended Colorado River and State project waters while achieving good water recovery. The ultra-low-pressure membranes have been successfully operated at a pressure that is significantly lower than the previous generation RO membranes, which is important because it results in lower energy requirements and lower operating cost. Additional work is being conducted to reduce the operating pressure while increasing water recovery and still maintaining excellent salt removal.

The University of California, Riverside will be conducting experiments for the desalination of agricultural drainage water under this task area.

Carbon Aerogel Capacitive Deionization

Carbon aerogel capacitive deionization (CDI) was brought to the attention of DRIP by Lawrence Livermore National Laboratory, which originally developed the technology. Preliminary laboratory and modeling results had indicated that the water recovery and salt rejection for CDI were similar to RO, but with significantly lower energy

consumption. Based on these promising indications, Metropolitan, in conjunction with OCWD, tested CDI using Colorado River water and synthetic waters. In these tests, CDI demonstrated higher than expected energy usage, poor salt rejection and poor water recovery.

These disappointing results indicate that CDI is not ready for further testing by DRIP at this time, and that additional basic research is needed on this technology. Because DRIP is focused on applied research and not basic research, CDI testing will be suspended indefinitely at the end of the calendar year. However, a number of private entities are conducting basic research on CDI to improve performance. Any significant breakthrough in CDI design or performance for the production of potable water may be incorporated into future DRIP work.

Disinfection Alternatives

Pulsed ultraviolet (UV) light is a new and innovative technology being evaluated for disinfection and biofouling control. Metropolitan is investigating pulsed-UV for drinking water applications, while OCWD is conducting similar experiments for municipal wastewater. Applied research investigating ultraviolet technologies is continuing in two separate areas: (1) evaluation of UV disinfection efficiency; and (2) evaluation of UV as a biofouling control mechanism for RO membranes.

Research has shown that, in filtered waters, medium-pressure and pulsed-UV light can provide excellent disinfection of bacteria, viruses, and *Cryptosporidium* at low UV doses. This work is continuing to determine if the similar effects are observed when disinfecting *Giardia*. The evaluation of membrane biofouling control by UV light is ongoing, and results are expected in early 2000.

West Basin Municipal Water District has proposed investigating the use of UV light for destruction of micropollutants such as n-nitrosodimethylamine (NDMA) in municipal wastewater. Experiments will be conducted to determine if UV technology has the potential to mitigate NDMA formation from chlorination by providing an alternative means of disinfection.

Brine Minimization and Disposal

A waste byproduct of desalination is brine, which is highly concentrated salt water. It is critical that brine production be minimized to increase water recovery, and to reduce the volume of brine requiring disposal, which can be problematic. Minimal brine production, and effective brine handling and disposal, are important objectives in developing a cost-effective desalination facility.

The objective of this task is to reduce the volume of brine produced in the RO process by concentrating the brine to a slurry or solid. Brine disposal options will also be evaluated. Testing of innovative brine treatment technologies, such as freeze crystallization, will begin early next year. The California Department of Water Resources, a DRIP partner, is expected to play a critical role in these investigations.

Scale Up of Treatment Processes

A primary objective of DRIP is to demonstrate large capacity water treatment processes which can serve as building blocks for a full scale desalination facility treating over 100 million gallons per day (mgd). This step is crucial to achieve the economies of scale, and cost benefits, which will make large-scale desalination economically viable. Partnering with industry, Metropolitan and OCWD are investigating scale-up issues for membrane processes and disinfection technologies.

A RO prototype system using large-scale (16" diameter) membrane elements has been designed, and will be constructed in the next several months. This system will begin operation at Metropolitan in the first half of 2000 to evaluate scale-up issues associated with these large elements in treating Colorado River water. After testing is complete at Metropolitan, the test unit will be relocated to a member agency for testing on another source water, such as groundwater or municipal wastewater.

In addition, equipment is currently being fabricated for the large-scale (3-mgd) evaluation of pulsed-UV to determine if bench-scale research can be duplicated. Testing is scheduled to begin in early 2000.

TABLE 2**RECENT/PLANNED FUNDING EFFORTS FOR DRIP**

Funding Source	Description	Amount	Status
U.S. Bureau of Reclamation (USBR)	Metropolitan, with UCLA, was awarded a grant to study precipitative fouling under the USBR's Desal R&D program	\$100,000	Grant awarded in October 1999
U.S. Bureau of Reclamation	DRIP will seek appropriation or "earmark" in USBR budget	\$2,000,000	Initiate in early 2000 for FY 2001 budget
U.S. Environmental Protection Agency (USEPA)	Funding for DRIP was "earmarked" in USEPA FY 2000 budget.	\$500,000	Budget signed by President in October 1999
California Energy Commission (CEC)	Funding for DRIP recommended in FY 1999-2000 budget for Public Interest Energy Research Stage 2 (PIER 2)	\$1,000,000 (estimated)	Contract negotiations ongoing
Water Bond	\$1.97 billion Water Bond goes to voters in March 2000. DRIP exploring funding possibilities	Unknown	Initiate negotiations if bond passes in March 2000
AB 1605 (Margett) – Desalination	Desalination bill passed by Assembly and Senate	\$1,000,000	AB 1605 vetoed by Governor Davis