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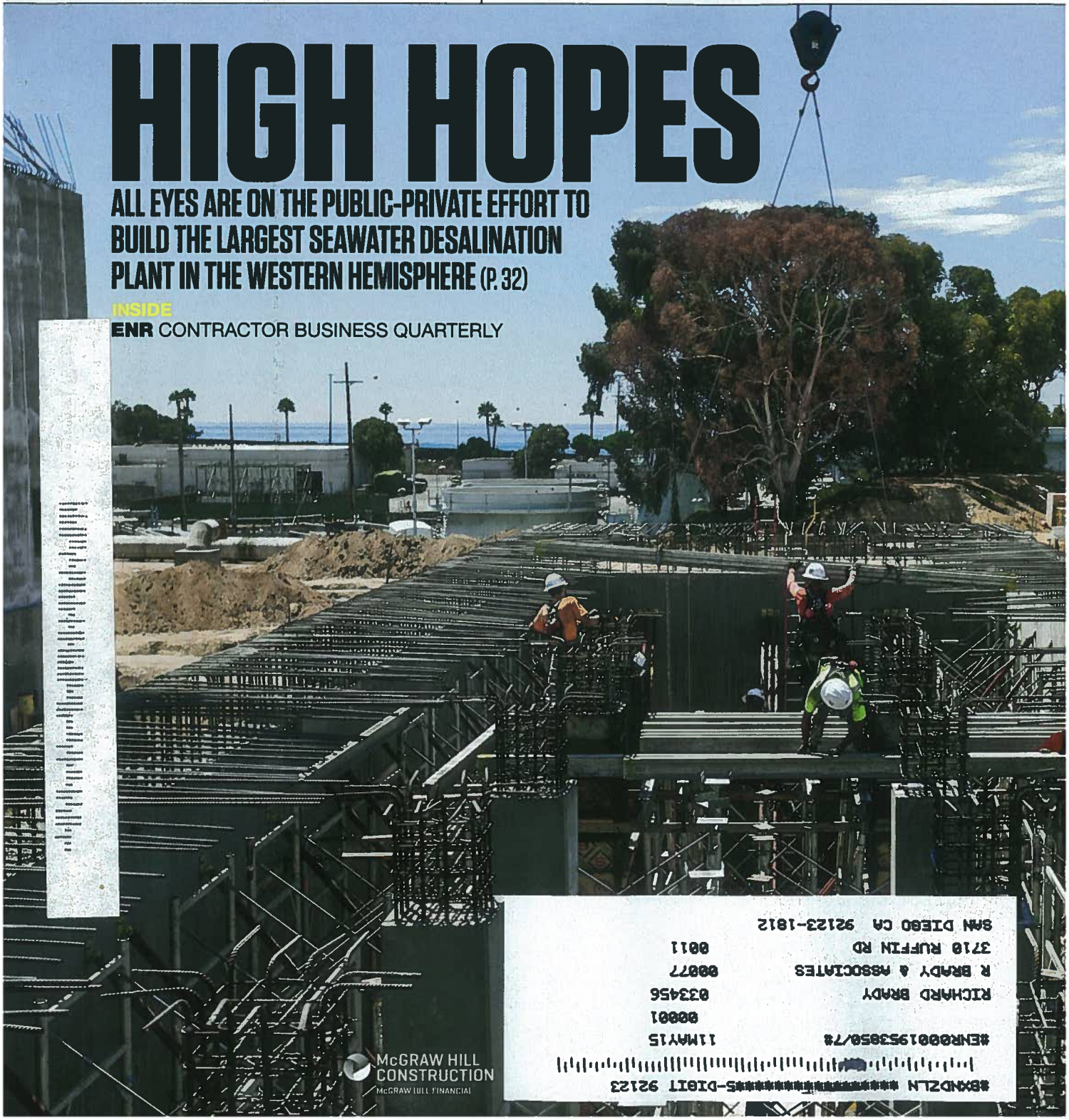
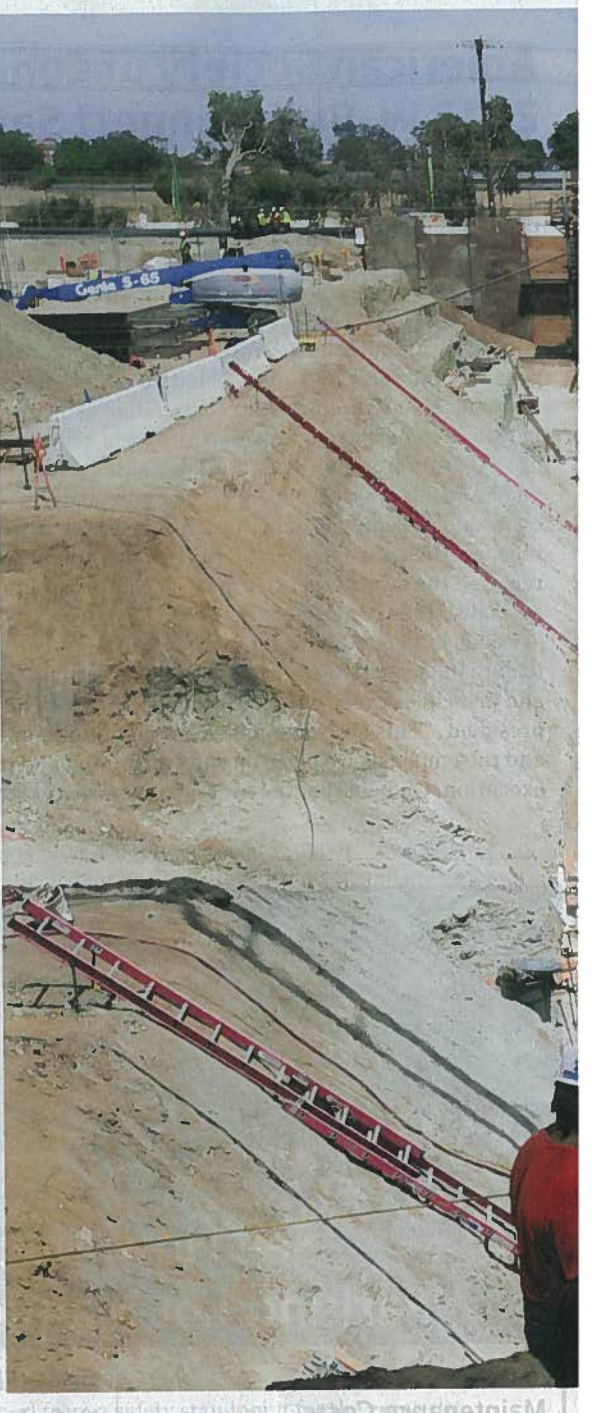




CARLSBAD, UNSALTED

New seawater desalination plant has potential to build on growing momentum for desal in U.S.

By Pam Hunter and Neal Sandler

SEAWATER LINE Pieces of a 72-in.-dia fiberglass-reinforced pipe for pumping in raw seawater are put in place, then prepped for testing at the Carlsbad project.

Many hopes are riding on the new $1-billion, 54-million-gallon-a-day seawater desalination plant and pipeline in Carlsbad, Calif. If successful, the project, made possible through one of the first public-private partnerships of its kind in the U.S., could serve as a model for other projects around the country.

If the project falters, however, the growing momentum for similar U.S. seawater desalination projects could face a reversal, industry observers say.

"It is being watched closely right now," says Peter MacLaggan, senior vice president of Poseidon Water, the Boston company that is partnering with the San Diego Water Authority to fund and build the project. "If we were to stub our toe and come out of the shoe with a plant that is not performing well, it's going to be a major setback" for desalination projects in the U.S., he says. Nevertheless, "We're very confident that this project will be a model when it's completed."

Seawater desalination has been long accepted as a way to increase freshwater supplies in arid nations, such as Australia, Israel and the U.A.E., and in countries with limited sources of drinking water, such as Singapore. Worldwide, there are some 14,754 desalination plants in operation, producing about 17.2 billion gallons a day, according to IDE Technologies Ltd., a leading designer of desalination plants.

But in the U.S., the use of desalination has been limited by higher costs and concerns over excessive energy consumption. Population growth and drought associated with climate change may alter that, however, as municipalities grapple with the need for more sources of clean drinking water.

"The U.S. has been blessed compared to many

COVER STORY
WATER SUPPLY

other parts of the world in that [it has] had a lot of other [freshwater] supplies that were less expensive to provide to the public," says Rudy Truby, the International Desalination Association's comptroller. "What's happening now is, as population has grown, many of the high-growth places in California, Texas and Florida, where there isn't an excess of surface water or well water ... are having to turn to the sea."

Jujung Chang, director of water technologies at Los Angeles-based AECOM and formerly at Omaha, Neb.-based HDR, adds that, as the cost of reverse-osmosis membranes has declined with continuing technology advancements, interest in desalination and other reverse-osmosis processes has increased in the U.S. Most of that price drop, due to technology advancements, already has reached its lowest point, "even though [overall] costs are [still] reducing as we speak," he says.

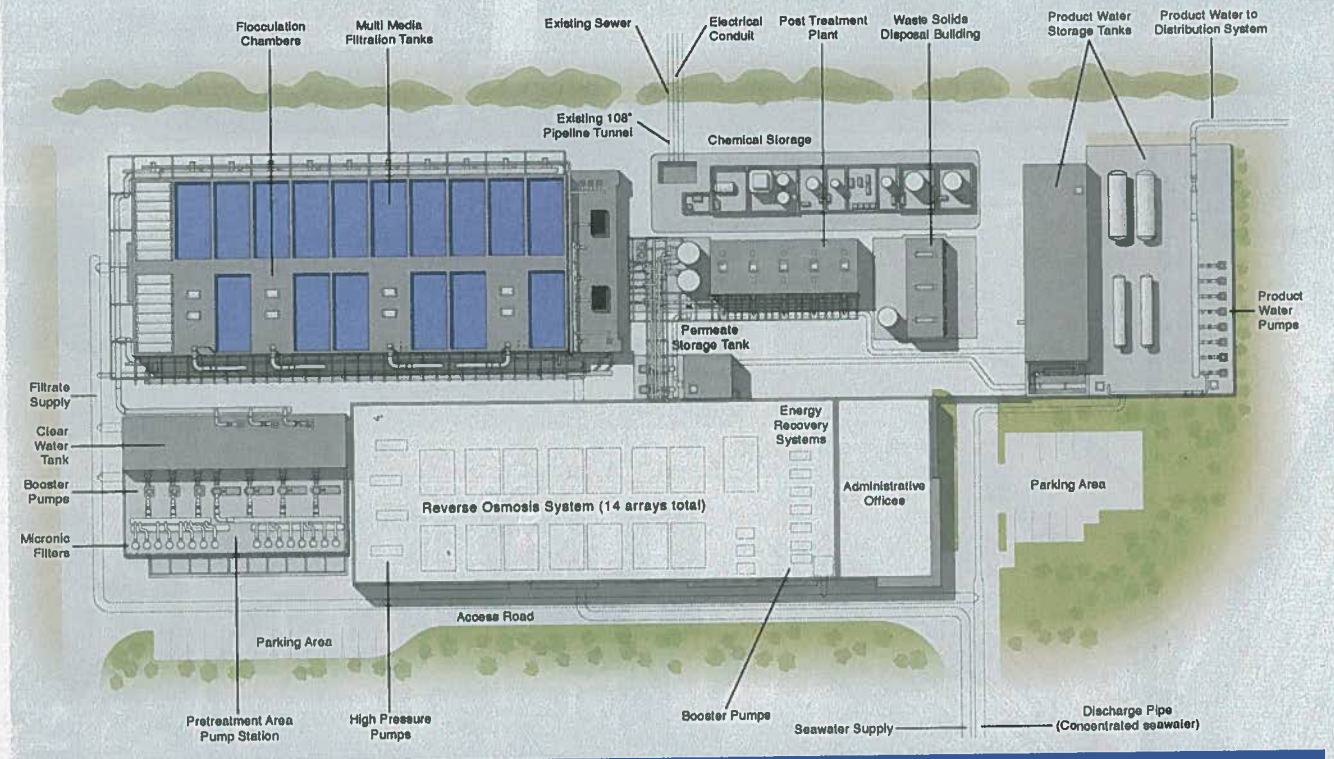
The U.S. market has huge potential for desal, but, until Carlsbad is operating, growth is likely to be modest.

Avshalom Felber, CEO, IDE Technologies, Israel

The Carlsbad plant, when completed by the end of 2015, would be the largest reverse-osmosis seawater desal plant in the Western Hemisphere and the second sizable reverse-osmosis desalination project to be built in the U.S.

The first—a 25-mgd plant built in Apollo Beach, Fla., in 2008—was plagued by difficulties, including years of construction delays, the bankruptcy of several

ANATOMY OF A PLANT *Raw seawater will receive two stages of pretreatment before it goes through a reverse-osmosis system, which will include 13 separate lines and one auxiliary train. Half the water will leave the plant for further treatment and then distribution to San Diego's water system. The other, heavily concentrated brine will be diluted with seawater before it exits the powerplant site through its cooling pond.*



original developers and contractors, and an initial failure to operate as expected. Utility Tampa Bay Water subsequently sued many of the parties involved.

After beginning operations nearly four years behind schedule, the plant now is functioning as planned, providing about 10% of the region's annual water supply, says Tampa Bay Water.

To oversee the building of the plant, Poseidon Resources, the parent company of Poseidon Water, was part of the original team led by contractor Stone & Webster, which filed for bankruptcy in 2000 and later was bought by The Shaw Group. Then, Covanta Tampa Construction, a now-bankrupt unit of Covanta Energy, was hired to execute the project but soon ran into performance problems.

A 'Perfect Storm'

But both the San Diego Water Authority and MacLaggan say the Carlsbad project will have a different outcome.

MacLaggan blames many of Tampa Bay Water's troubles on a "perfect storm" encountered by Covanta Construction, "all unrelated to the desal project, but [which] took [a] toll on its performance."

Nevertheless, the water authority is going all in on the project. In a water purchase agreement reached after years of haggling, Poseidon agreed to bear all construction risks and all operational risks for the first 10 years.

TOTAL PROJECT COSTS
(in 2012 dollars)

- $537 MIL. Total desalination plant
- $159 MIL. Total conveyance pipeline
- $227 MIL. Financing costs
- $80 MIL. Water-authority improvements and oversight
- $1.003 BIL. Total capital costs

SOURCE: POSEIDON WATER

Sandy Kerl, San Diego Water Authority deputy general manager, says, "Poseidon has 100% of responsibility for constructing the facility and making sure it operates. The water authority does not pay a dime unless water is delivered and delivered at the standard that we have set out in the water purchase agreement."

In exchange, the water authority will pay a slightly higher price for the water it purchases from Poseidon, paying between $1,849 and $2,064 per acre-foot in 2012 dollars, depending on how much is purchased annually. The water authority will purchase between 48,000 and 56,000 acre-ft of water from Poseidon each year.

Although that price is higher than the current cost to import water from the Metropolitan Water District in Los Angeles, the water authority made the calculation that, over time, the costs of a stable, drought-proof local water source would be cheaper than importation. The desalination plant will provide the agency with about 7% to 10% of its water supply in 2020 and about a third of all locally produced water in San Diego County. The water authority has the option to purchase the plant for $1 after 10 years.

Another negotiation point was to ensure the right team was working on the project, says Bob Yamada, water-authority resources manager. He notes, "One lesson learned from the Tampa experience was, we wanted to be engaged and have a say-so in the contrac-

tor selection." Yamada terms as top-notch the selected joint-venture team of Omaha-based Kiewit and Walnut, Calif.-based J.F. Shea as contractor and the San Diego arm of Israel-based IDE Technologies as designer of the reverse-osmosis (RO) system.

IDE has built about 400 desalination plants globally and will operate and maintain the Carlsbad plant for 30 years. In Israel, the company just brought on line a 150-million-cu-meter-per-year plant that is the largest of its kind in the world. "In Tampa, they selected a contractor doing its first [desalination] plant that ran into difficulties that [the contractor] could not easily deal with, and IDE won't have those kinds of problems," the desalination association's Truby observes.

Plant Design

The desalination plant, co-located with the Encina gas-fired power station, will draw seawater flowing into a 66-acre portion of the Agua Hediodna Lagoon that the powerplant uses for cooling. An intake structure will divert 104 mgd of the 304 mgd of cooling water from the powerplant's discharge channel.

About 50 mgd of the diverted seawater will go through anthracite and micro-screen pretreatment, which will extract salt using RO-membrane separation, with 8-in. membranes. The plant will store that 50 mgd of water in an on-site reservoir before pumping it to the water authority's drinking-water system for further treatment and distribution.

Another 54-mgd stream emerging from the RO system will be a brine with twice the salinity of the ocean. It then will be diluted in the powerplant discharge channel for blending with the remaining cooling water before ocean discharge.

The desalination project will require the water authority to spend about $80 million in related construction, Yamada notes. Those jobs include relining a 5-mile-long section of a pipeline to accommodate higher pressures from the plant and modifying the Twin Oaks Valley water treatment plant to blend desalinated water with existing supplies.

PROJECT RISK ALLOCATION

	POSEIDON	WATER AUTHORITY
CONSTRUCTION RISK That facility is not completed on time, on cost and according to design standards.	●	
PERMITTING RISK That current permit and environmental mitigation requirements increase.	●	
CHANGE IN LAW RISK That future unanticipated laws or regulations increase operating costs.	●	●
TECHNOLOGY RISK That the plant technology does not perform as expected.	●	
OUTPUT RISK That the plant produces less than the projected volume of water.	●	
OPERATING MARGIN RISK That the price of water is not adequate to generate enough revenue to pay expenditures or may increase more than expected.	● (Budget cap)	● (Subject to CPI)
PIPELINE OPERATING RISK That the pipeline connecting the plant to the regional aqueduct system and appurtenant facilities transport acceptable water to water-authority wholesale customers.		●
ELECTRICITY That the cost of electricity is accounted for in the water price.	● (Consumption)	● (Price)

SOURCE: POSEIDON WATER

INNOVATIONS IDE's new 150-mcm desal plant near Tel Aviv uses larger membranes than are typically used and no chemicals during pretreatment.

PHOTO COURTESY OF IDE TECHNOLOGIES, LTD.

A Known Quantity

The RO system will be using proven technologies in place at its existing plants even though the firm has introduced significant innovations, notes IDE CEO Avshalom Felber.

"Tampa has led to a big trauma, and the consultants and clients were very cautious about the project design," Felber says. The Carlsbad team visited IDE's operating plants in Ashkelon and Hadera, both in Israel, and one in Cyprus. Instead of using 8-in. membranes, the newest plant at Sorek, near Tel Aviv, is using 16-in. membranes, Felber says, which increases water output and reduces energy use. The plant began operation this summer and uses no chemicals in the pretreatment stage, he says.

Felber says the firm's R&D efforts have reduced energy consumption by over 15% "through unique design and technology we've developed."

The Carlsbad plant will incorporate green elements to achieve carbon-neutral status. One feature is a device from Energy Recovery Inc., San Leandro, Calif., that recycles pressurized water energy from the RO trains. Poseidon claims the device will reduce the desalination-process energy footprint by 45%. The plant itself also will have rooftop solar panels to produce about 1 MW of energy, displacing load that normally would be bought off the grid. Providing a local source of drinking water, instead of importing it, will provide additional energy savings, MacLaggan says.

IN THE TRENCH Crews are using open trenching to build a 10-mile, 54-in.-dia pipeline to connect the desal plant to the San Diego water system's aqueduct.

Legal Challenges

Although the authority touts the project's overwhelming public support, some local environmental groups have raised concerns over its location and design. "Trying to use ocean desalination as your first choice for resolving scarcity concerns takes all the investment money that could be spent on more economical and environmentally sound alternatives," says Joe Geever, water-resources manager with Surfrider Foundation, which filed 14 lawsuits during the permitting process. All were dismissed or rejected, the last by a federal appeals court in November 2012.

Geever says the group's argument was undermined because Poseidon obtained temporary, rather than long-term, permits for the plant's life expectancy. He adds that, by 2017, the Encina powerplant will no longer be able to use seawater for cooling under new California regulations.

Poseidon says it and the water authority have accounted for that eventuality in the water purchase agreement. The developer will upgrade the existing seawater intake and assume responsibility for dredging the lagoon. The authority's financial obligation is capped at $20 million for capital costs and $2.5 million for operating costs in 2010 dollars.

Even so, the state is weighing an amendment to its Water Pollution Control Act that would relate specifically to desal plants. The state's water control board says it will rely on recommendations of experts that have been studying the environmental effects of desalination to develop more compatible plant designs. Claims Geever, "In those expert-panel reports and recommendations, if you look at what they are recommending and what Poseidon is planning, they're not consistent."

"The water authority does not pay a dime unless water is delivered and delivered at the standard that we have set out in the water purchase agreement."

Sandy Kerl, deputy general manager, San Diego Water Authority

The Carlsbad plant construction, which began in December, is now about 9% complete, with nearly all early demolition and site remediation work finished, says Tony Joyce, Kiewit-Shea project manager. The joint venture also is building a 10-mile, 54-in.-dia conveyance pipeline to connect to the existing aqueduct pipeline system.

Workers now are installing supporting infrastructure and rows of pretreatment cells and, using mostly open trenches, pipeline portions.

Other desal projects are in the works. Poseidon is obtaining permits for a 50-mgd plant in Huntington Beach, Calif., and the water authority is considering expanding to 150 mgd a 50-mgd facility at the Camp Pendleton Marine Corps base, says Yamada. The agency now is evaluating costs and feasibility.

Carlsbad participants and desalination advocates see the project as a workable solution. "We see our biggest potential in the next few years in China, India, Australia and Chile," says Felber, "The global financial crisis has led to a decline in projects in recent years, but this is starting to change."

Felber says the U.S. market has huge potential, including Texas and even Florida, but growth is likely to be modest, at least until Carlsbad is operating.

The global desalination association's Truby agrees, saying, "Poseidon has assembled a very good, experienced team that has a track record, and that's going to be a very big factor in making this plant a success." ■