ENERGY RECOVERY SYSTEM FOR THE CARLSBAD SEAWATER DESALINATION PLANT: POSEIDON WATER

Carlsbad, California

Carlsbad Desalination Facility (left) and reverse osmosis membranes at Carlsbad Desalination Facility (right)

PROJECT DESCRIPTION

The Carlsbad Seawater Desalination Plant is the largest saltwater desalination plant in the Western Hemisphere, providing 50 million gallons of desalinated seawater per day. The desalination energy recovery project at the plant—part of the plant's High-Energy Efficiency Design—uses state-of-the-art pressure exchanger technology (provided by Energy Recovery, Inc.) that allows for recovering and reusing a significant portion of the energy from the reverse osmosis process. In addition to the state-of-the-art pressure exchanger technology, the High-Energy Efficiency Design also incorporates premium efficiency motors and variable frequency drivers (VFDs) on desalination plant pumps that have motors of 500 horsepower or more. The total desalination plant power use under the High-Energy Efficiency Design is 28.1MW, which corresponds to unit power use of 13.488 kWh/kgal (4,397 kWh/AF). This can be compared to a "baseline design" that uses standard energy recovery equipment (e.g. Pelton wheels) and has a higher power use of 31.3 MW, which corresponds to 15.02 kWh/kgal (4,397 kWh/AF).

Extensive pilot testing demonstrated that using the new pressure exchangers would yield 1.98 MW of power savings, and the incorporation of high-efficiency motors and VFDs on large pumps would result in 1.26 MW of power savings. The total estimated savings of 3.2 MW for the High-Energy Efficiency Design corresponds to a total annual electricity use reduction of 28,244 mWh/yr and a carbon footprint reduction of 10,001 tons of CO2/yr.

FINANCES

Specific cost for the energy recovery system project is unavailable to be shared. For reference on performance and savings, the installation of the state-of-the-art pressure exchanger-based energy recovery system allows recovery and reuse of just under 35% of the energy associated with the reverse osmosis process, with a 45% gross energy recovery, which overall reduced the plant's operating cost—and therefore water rates—by approximately 20%.

MAKING THE PROJECT HAPPEN

The primary motivating factor in incorporating the energy recovery system was to ensure the high-energy efficiency of the Carlsbad Desalination Plant. To demonstrate the potential savings, a pilot-scale seawater desalination plant utilizing the pressure exchanger technology was tested both at the U.S. Navy's Seawater Desalination Testing Facility and at Poseidon's Carlsbad seawater desalination demonstration plant.

More detailed information on the High-Energy Efficiency Design and its total energy use can be found at the following project report: click here for report

WUCA
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ENERGY RECOVERY SYSTEM PROJECT

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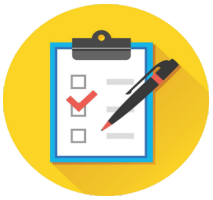
IMPLEMENTATION

The energy recovery system was incorporated into the design of the plant as it was being constructed. Poseidon worked closely with the California Coastal Commission and other regulatory agencies to pilot and ultimately implement measures to incorporate the pressure exchange-based energy recovery system into the Carlsbad Desalination Plant's High-Energy Efficiency Design.

CHALLENGES

At the time of the plant's design phase, there were no other full-scale seawater desalination plants in the United States that were using the pressure exchanger energy recovery technology. To demonstrate the potential energy savings, it was necessary to implement a pilot-scale seawater desalination plant utilizing the pressure exchanger technology at both the U.S. Navy's Seawater Desalination Testing Facility and Poseidon's Carlsbad seawater desalination demonstration plant.



ADVICE AND LESSONS LEARNED

Despite the pressure exchanger technology not being previously used in any other full-scale seawater desalination plants in the United States, the ability to work with regulatory agencies and the supplier of the pressure exchangers, Energy Recovery Inc., proved very useful for demonstrating the ability of the newer technology to produce energy savings. This collaborative testing phase ultimately resulted in the technologies being incorporated into the final plant design. This process demonstrated the importance of continuing to work with researchers and companies to develop new technologies in hopes of continuing to improve the energy efficiency of seawater desalination.

LEARN MORE

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