

VTE Geothermal Desalination Pilot/Demonstration Project

Undertaken by Sephton Water Technology
in Cooperation with CalEnergy Operating Company
Funded by the California Department of Water Resources
and the U.S. Bureau of Reclamation

Project Summary, February 2012

Objectives

We are in the process of demonstrating the Vertical Tube Evaporator (VTE) desalination process as a viable and cost effective technology for conversion of saline water to potable water in the Imperial Valley. Geothermal steam will provide the thermal energy source for the process. The Salton Sea will be the primary saline water source. The VTE process can operate with low or atmospheric pressure geothermal steam not needed for electrical power generation. This renewable energy resource is being provided by CalEnergy for use in an existing pilot and upcoming demonstration project. The specific research objectives of the project are:

1. Demonstrate the ability to produce high quality potable water from Salton Sea water.
2. Quantify VTE heat transfer performance with Salton Sea water.
3. Demonstrate operation over time without scaling or reduction in performance.
4. Control corrosive contaminants in the geothermal steam to preserve VTE equipment and identify suitable and economic materials of construction.
5. Demonstrate separation of an array of source water contaminants such as microbial agents, chemicals of environmental concern, and minerals from product water into concentrated brine or precipitated salts.
6. Study the capacity of the local geothermal aquifer to accept brine injection and evaluate the benefits derived by doing this.
7. Demonstrate an environmentally benign brine management plan by producing brine concentrate chemically suitable for injection into the geothermal wells.
8. Formulate and execute an information sharing program.

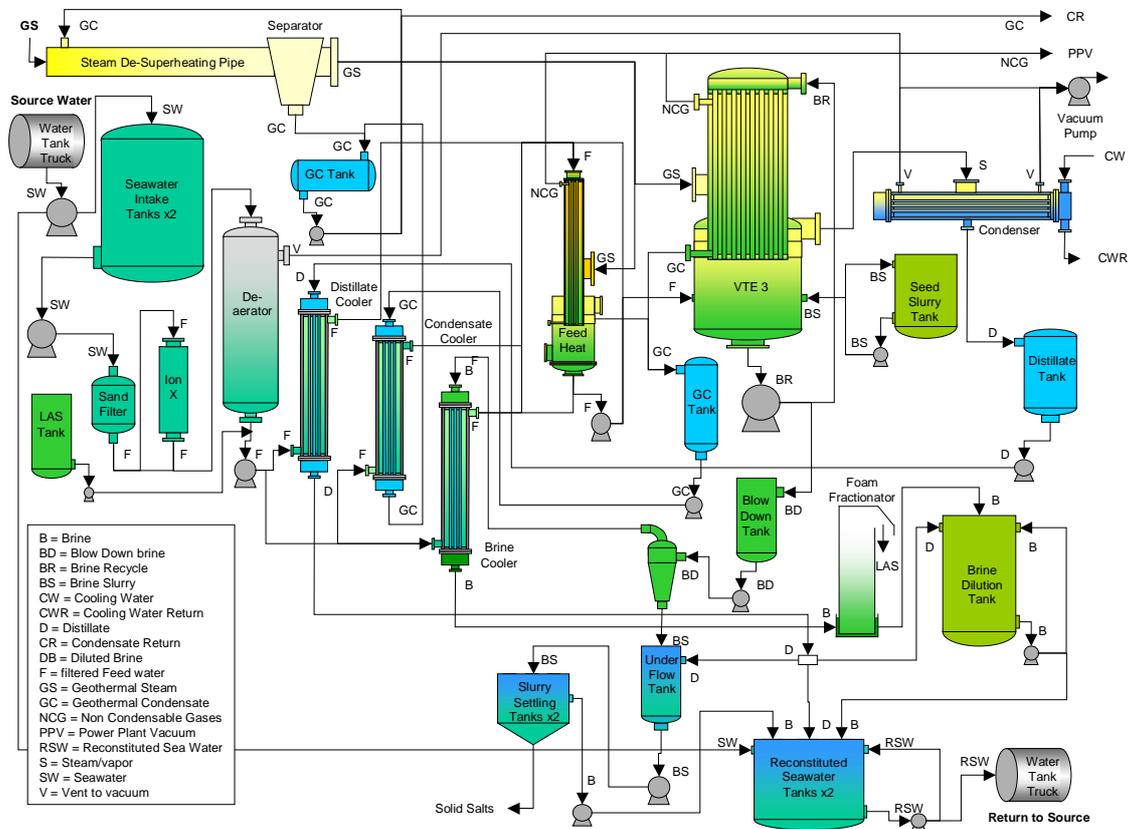
The project is focusing first on desalinating Salton Sea water as the most difficult saline water resource in the region. We also intend tests on less saline water resources, such as brackish ground water or agricultural drain water. The distilled water produced could be used directly for environmental restoration, or for local industries and municipalities by exchanging distilled water produced for agricultural drain water to replenish the source.

Background

The first phase of the project began in November 2004 and was funded by the U.S. Bureau of Reclamation from funds allocated by Congress for research related to Salton Sea restoration. A Vertical Tube Evaporator (VTE) Pilot Plant was assembled next to the CalEnergy Units 1&2 geothermal power plant and tests were run on several thousand gallons of Salton Sea water transported to the site by tank vehicle.

condensate pond and the non-condensable gasses are returned to the geothermal plant vacuum system. Cooling water at up to 100 gpm is drawn from and returned to the geothermal plant. Salton Sea water is brought in by tank truck, transferred to holding tanks, separated into distilled water, solids, and concentrated seawater brine by the VTE process, then recombined, mixed, and tested for return to the Sea.

The VTE Pilot and Demonstration Plants will only transfer heat energy from the geothermal steam to the saline water being distilled. There will be no direct contact between any geothermal materials and Salton Sea or other saline source water materials. All distilled water and concentrated brine separated from Salton Sea or other water will be returned to the source except for small samples for laboratory testing. All geothermal steam from the power plant will be returned to the geothermal plant as condensate or non-condensable gasses.



VTE Demonstration Plant Schematic, Figure 3.

The VTE Demonstration Plant (Figure 3) will operate similarly to the Pilot Plant, but at a higher capacity. It will use an evaporator rated for 50,000 gallons per day capacity, but the maximum amount of water distilled will be about 21,000 gallons per day using a maximum of 7,500 lbs/hour of low-pressure geothermal steam from the Cal Energy plant. The maximum flow of cooling water will be 400 gpm using the existing 4" tie in pipes to the power plant cooling system.

Seawater will be transported to and from the site by tank truck. A reduction in the level of the Salton Sea leaves insufficient local offshore depth to operate continuous flow fish screens previously approved by environmental agencies. Also, the remaining DWR funds are limited. For these reasons, intake and return pipelines to the Salton Sea that were previously planned will not be constructed at this time.

Applicability to Local Needs

One research objective has been to find methods to control the water chemistry of concentrated Salton Sea brine so that it can be suitable for injection into the geothermal aquifer. This would provide a way to safely remove salts, selenium, and other contaminants from saline wildlife habitat areas at the Salton Sea while converting most of the water treated to beneficial use. It may also help maintain the geothermal aquifer. Substantial progress has recently been made toward this objective.

The VTE technology has previously been tested in collaboration with the California DWR at Los Banos to maintain salinity in a salt gradient solar pond using solar thermal energy from the pond. VTE technology may be well suited to converting Salton Sea water or saline wastewater to supply saturated brine for use in solar energy generating salt gradient solar ponds while recovering most of the water for potable use. This process can be driven by non-commercial geothermal steam or by solar energy collected and stored as heat in the ponds. In addition to producing solar energy, salt gradient solar ponds installed in exposed lakebed as the Salton Sea recedes can eliminate fugitive dust, serve as a large repository for excess sea salts, and supply pure distilled water for wildlife refuge or other beneficial uses. Discussions with the Imperial Irrigation District to pilot test this concept on recently exposed Salton Sea lakebed are underway.

The State of California has identified a Preferred Alternative for Salton Sea restoration, but funding and political support for this alternative is uncertain at this time. VTE technology could be used to help restore the water quality in a saline habitat zone at the Salton Sea such as those anticipated by the State plan or by smaller Federal wildlife plans. VTE technology could also convert large quantities of Salton Sea water, high salinity wastewater, or reject brine from proposed reverse osmosis groundwater treatment plants to distilled water for use by local industry or municipalities, freeing up Colorado River water for agriculture and environmental restoration efforts.

Current Status

At this time (August-February 2012) we intend to complete testing of the VTE Pilot Plant to work out methods to control corrosion of common evaporator tube metals caused by hydrogen sulfide and ammonia in geothermal steam. We next intend to assemble a VTE Demonstration Plant by installing an existing larger Vertical Tube Evaporator, erecting it in a 40ft by 50ft spill containment structure adjacent to the current VTE Pilot Plant and fabricating pipes and auxiliary equipment needed to operate the evaporator and connect it to the VTE Pilot Plant and the CalEnergy plant's low pressure steam pipe, cooling system, condensate pond, and non-condensable gas recovery system. The VTE Plants will be assembled from VTE desalination equipment owned by Sephton Water

Technology and support equipment provided by Reclamation. Pipe, steel and other materials will be purchased locally.

After completion of the tests, the VTE Pilot and Demonstration Plants will be disassembled and all equipment and materials will be removed from the CalEnergy site. Data from the tests will be evaluated to provide recommended methods and estimates of the economic and environmental restoration benefits of the geothermal driven VTE technology. Final reports will be submitted to the U.S. Bureau of Reclamation and the California DWR, which will be available to other agencies or interested parties.

The required Federal, State, and local permits were obtained to construct the existing VTE Pilot Plant in 2004 and 2005. The Imperial County Building Permit from 2005 (#046994) was renewed in 2008 (#051946) for upgrades to the Pilot Plant. All physical work done to date is within the scope of the permits issued in 2004, 2005, and 2008.

For the VTE Demonstration Plant, a CEQA and NEPA process has been completed by Reclamation, the California Regional Water Quality Control Board has issued a determination that an NPDES permit is not required, and the California Department of Fish and Game has been notified of procedures to prevent take of endangered species. An operating permit with the Imperial Air Pollution Control District was secured when using power from portable generators. The plant is now on utility power with no regulated air emissions. In December 2008, encroachment permits were applied for with the Imperial County Department of Public Works and IID, and drawings were submitted to the Imperial County Planning and Building Department for the intake and return pipes to the Salton Sea. We renewed the Imperial County building permit in 2008 for improvements to the VTE Pilot Plant. We will submit drawings and a building permit application for new equipment to be installed for the VTE Demonstration Plant when recent plan modifications and a seismic analysis of the foundation and structure is complete.

A 2005 minor amendment (allowing the VTE Pilot Project) to Imperial County Conditional Use Permit #9014A-94 held by CalEnergy Operating Company was extended in 2010 to the end of this year.

VTE desalination is well suited to take advantage of the geothermal energy resource to benefit Imperial County. In the near future, these benefits could include millions of gallons of high quality water each day, salinity control for wildlife habitat areas, recharge of the geothermal aquifer, support of efforts to reduce negative impacts from reduced inflows to the Salton Sea, and supporting local development of renewable energy.