

PROJECT PROFILE SERIES #40

Genwest Silverhawk Power Plant in Nevada to Install Brine Concentrator System



The Facility

The 570-Megawatt Silverhawk Power Station is a natural gas-fired combined cycle electric generating station located in Clark County 20 miles north of Las Vegas, Nevada. In order to meet the permitting requirements and conserve water, the facility uses a dry cooling arrangement.

The project was constructed by Lockwood Greene acting as EPC under the project management of Pinnacle West Energy, an Arizona Public Service enterprise. The generating station started its operation in 2004.

The Problem

In accordance with the State of Nevada and Clark County's strict environmental compliance requirements, this facility is permitted as a Zero Liquid Discharge (ZLD) unit. Though the facility is based on dry cooling arrangement, liquid waste is generated from the demineralizer system and other day-to-day plant operations. The generating station needed to treat 60 gpm wastewater on a continuous basis from the power generating operation plus 10 gpm from the back-up holding pond for a total design wastewater feed capacity of 70 gpm.

The Solution

An Aquatech supplied mechanical vapor compressor driven falling film seeded slurry Brine Concentrator (BC). The Brine Concentrator is used to concentrate the generated wastewater and reduce its volume. The reduced its volume is sent to the onsite solar evaporation ponds.

The site uses two onsite back-up holding ponds to receive the Brine Concentrator underflow and up to a total of 14 days of Brine Concentrator feed water volume as a contingency for non scheduled or extended scheduled BC shutdown.

High Purity distillate from the BCS is blended with Demineralizer RO permeate and further polished to generate De-ionized water for boiler feed. A portion of the permeate and distillate blend is also used as make-up to the evaporative cooler.

High TDS and saturation in low solubility scaling salts such as calcium sulfate (CaSO_4) and Silica (SiO_2) limit the percentage of wastewater that can be recovered in a conventional evaporator system. The Aquatech designed BC utilizes seeded slurry evaporation technology to overcome the limitation imposed on conventional evaporators by the saturation limits of low solubility scaling compounds. The seeded slurry process establishes and maintains slurry of CaSO_4 seed crystals in the evaporator re-circulating brine solution. With careful thermal and mechanical design, the CaSO_4 and SiO_2 co-precipitate preferentially on re-circulating seed crystals and much more slowly on the tube surface.

The evaporator at Silverhawk is uniquely designed and does not use external addition of chemicals to maintain the seed population inside the brine concentrator. The seeding arrangement is provided for initial start up or restarts after prolonged shut downs of the unit.

The brine concentrator is capable of concentrating the wastewater to near saturation in the sodium salts without scaling the heat transfer tubes.

The ultimate concentration achievable by the Brine Concentrator is limited by:

- System economics based on boiling point elevation of the brine
- Relative concentrations of sulfate and chloride so that the double salt, $\text{CaSO}_4\text{ANa}_2\text{SO}_4$ (glauberite) does not form
- Solubility of the sodium salts.

The maximum TDS used in the design of the Brine Concentrator is 8.2% based on the design chemistry.

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Feed Flow Rate, gpm 70

Feed Water Chemistry (ppm as ion)

Calcium.....409

Magnesium 171

Potassium49

Sodium 475

Barium 0.1

Iron 2.3

Copper 0.1

Strontium..... 13.5

Arsenic 1.5

Zinc 0.1

Bicarbonate361 ppm as CaCO₃

Chloride634

Fluoride5.2

Sulfate1,563

Nitrates11.5

Organic PO₄0.6

Inorganic PO₄1.4

Free Chlorine.....0.1

Oil & Grease.....10.0

Silica.....73

Feed Total Dissolved Solids **3,754**

Blowdown Total Dissolved Solids **123,000**

Distillate Quality **< 5.0 ppm TDS**

pH **7.6 to 8.0**

