CASE NOTE

ABB variable speed drive systems improve solar plants' feed water pump efficiency

Four, 1520 kW ACS1000i medium voltage variable speed drives are being used to control the speed of feed water pumps which is helping to improve energy efficiency at two concentrated solar power (CSP) plants in Spain.

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Aerial view of Valle 1 and Valle 2 solar thermal power plants in San José, Cadiz, Spain.
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Valle 1 and Valle 2 solar power plants
Valle 1 and Valle 2 are adjacent solar plants that generate electricity by means of parabolic trough collectors. They are located in San José del Valle, Cadiz, Spain and are operated by Torresol Energy.

Valle 1 and Valle 2 feature:
- 50 MW rated electrical power per plant
- 160 GWh/year net electrical production per plant
- 510,000 m² of parabolic trough collectors
- 7.5 hours of heat storage capacity per plant

The plants utilize molten salt for thermal energy storage that allows each plant to operate up to 7.5 hours without sunlight.

Using concentrated solar radiation as primary energy enables Valle 1 and Valle 2 to supply electricity to 40,000 households while saving 45,000 tons of CO_2 emissions a year that would otherwise have been generated by conventional power plants.

Parabolic trough technology
Valle 1 and Valle 2 use parabolic trough collectors that concentrate solar radiation into a central collector pipe through which thermal oil is circulated. This arrangement is fitted with a high-precision control system that tracks the sun from east to west. The thermal oil is used to vaporize water which, by means of expansion in a steam turbine, drives an electrical generator that feeds the energy into the grid.

Highlights
Improved pump drive system efficiency
High power plant efficiency
Easy installation
Saving valuable space

Feed water pump
The high-pressure feed water pump is an important part of the thermal storage system. It controls the amount of water fed from the deaerator to the solar preheater. To force the water through the solar preheater, the pump must generate sufficient pressure.

Feed water pumps are characterized by high reliability requirements and fairly high dynamics during plant load changes.

ABB drives for Torresol Energy, Spain

Challenge
Solar thermal power plants use the same power conversion system found in conventional power plants. Such a power plant usually consumes 5 to 10 percent of the electricity it produces. Processes driven by electric motors typically consume 80 percent of this electricity. To improve the heat rate, the efficiency of these processes needs to be maximized.

High-pressure feed water pumps are one of the biggest energy consumers in a power plant. Solar thermal power plants experience high load changes due to the high variations in solar radiation intensity. By adjusting the pump speed to the varying loads, significant energy savings can be achieved.

Solution
ABB supplied four ACS1000i medium voltage variable speed drives with integrated transformer, rated at 1520 kW, including induction motors. The drives control the fully redundant feed water pumps at Valle 1 and Valle 2.

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Benefits

High-pressure feed water pumps can be controlled either mechanically with hydraulic couplings, throttling valves or inlet guide vanes or electrically with variable speed drives. Compared to mechanical control methods, the use of electric variable speed drives results in the following benefits.

Better plant efficiency

Controlling feed water pumps with electric variable speed drives results in an improved efficiency of the feed water pump system and thus in an improved power plant efficiency.

For systems with varying load, such as solar power plants, variable speed pumps are an attractive option. As the system demand changes, the variable speed drive adjusts the pump speed to meet this demand, reducing energy consumption.

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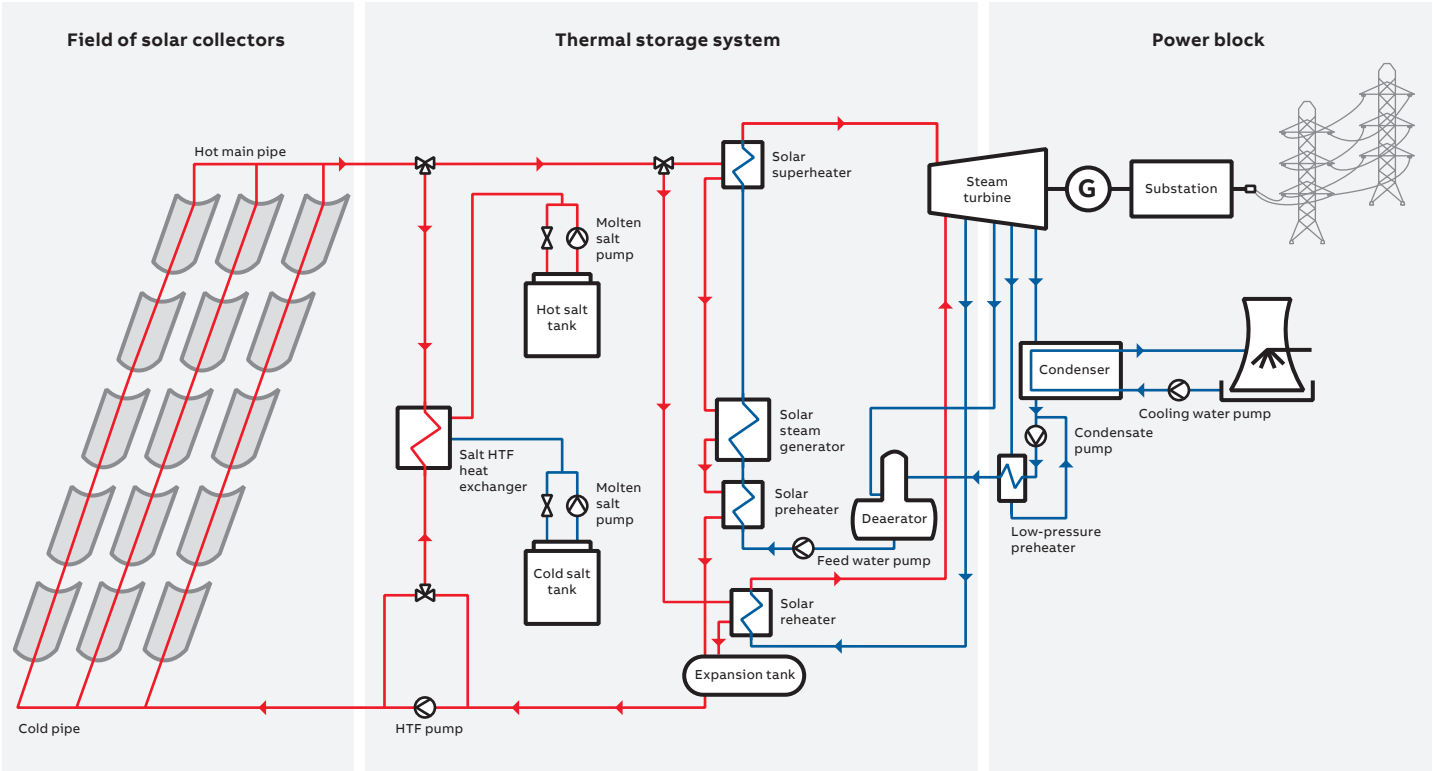
Simplified process diagram of a solar power plant with parabolic trough technology.



Easy installation

The ACS1000i is a fully integrated drive which includes input transformer and, optionally, input contactor. This simplifies installation and commissioning, saving civil works and installation costs.

Saving valuable space

Space in power plants is very limited. The ACS1000i with integrated transformer saves valuable space. Longer lifetime of equipment Variable speed drives reduce the stress on pump and piping systems by smoothly accelerating and decelerating the motor, resulting in a longer lifetime of the mechanical equipment.

Increased network stability

Soft starting motors with variable speed drives eliminates starting current peaks, avoiding voltage drops on the electrical network.

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Torresol Energy

Torresol Energy was founded in 2008 through an alliance between SENER, a Spanish multinational technology leader (owner of 60 percent of the company), and MASDAR, an alternative power company in Abu Dhabi (owner of 40 percent).

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SENER

SENER founded in 1956, is is an engineering and technology group headquartered in Spain. This company has been responsible for leading the EPC and commissioning works of the plants as well as for supplying all the technology and the basic and detail engineering design.

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Four ACS1000i variable speed drives, rated at 1520 kW, control the highpressurefeed water pumps at the Valle 1 and Valle 2 solar power plants.

ACS1000 key data	
Inverter type	Three-level Voltage Source Inverter (VSI)
Power range	Air cooling: 315 kW - 2 MW Water cooling: 1.8 MW - 5 MW
Output voltage	2.3 kV, 3.3 kV, 4.0 kV, 4.16 kV (optional: 6.0 kV - 6.6 kV with step-up transformer)
Maximum output frequency	66 Hz (optional: 82.5 Hz)
Converter efficiency	Typically > 98%
Type of motor	Induction motor

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Aerial view of one of the storage systems and the power blocks at Valle 1 and Valle 2 solar thermal power plants.
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For more information please contact:

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www.sener.es

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