

Case note

ACS 1000 variable speed drives improve efficiency of power and district heating plant

Mälarenergi replaced resistors and slip-ring motors, which controlled district heating pumps, with four ACS 1000 variable speed drive systems (each rated at 1765 kW (2365 hp)). Thus, the heat losses caused by the flow control method were reduced considerably and the production of electrical energy was increased by about 35 GWh per year.



View of the ACS 1000 drives, motors and district heating pumps at Mälarenergi's power and district heating plant in Västerås

Background

Mälarenergi AB is a city-owned electric power and district heating provider based in Västerås, Sweden. It has around 540 employees and three sister corporations: Elnät AB, Stadsnät AB and Hydro Power AB.

The company, which owns a vast district heating network and supplies electricity, has an annual income of approximately 2.4 billion SEK (US\$ 400 million).

Plant efficiency

The basic indicator for efficiency and environmental impact of power generation is the total efficiency achieved. The more effectively the plant is able to convert the fuel's thermal energy – either to electricity or to heat – the higher is the efficiency of the plant. In recent years the focus has been on increased electricity production.

Challenge

When Mälarenergi installed its first equipment in the 1960s, the attitude towards energy was different than today. Energy was cheap and was amply available. However, the environmental pollution of recent years, has changed this awareness. EU directives, electricity certificates and the Kyoto protocol have all contributed to the need for a more environmentally friendly and efficient production of electricity and heat.

During the 1990s, Mälarenergi started to invest in a more cost-efficient and environmentally friendly electricity production by modernizing old plants, introducing biofuel and scrutinizing its energy consumption.

Highlights

Increased electricity production by more than 5 %
Reduced CO ₂ emissions
Accurate pressure and better stability in the district heating network
Better utilization of the district heating
Improved process control
Payback on investment period: 1 year

District heating pump control

Mälarenergi had been using resistors connected to slip-ring motors to control the speed and hence the flow in the district heating pumps. The heat from the resistors was used in the production of district heat. This method of using the heat created by the losses can be compared with using electricity to produce district heating – an expensive way considering the cost of electric energy today.

In 2003 ABB made an energy analysis, which revealed that a lot of energy could be saved by upgrading the pump and fan applications with the latest variable speed control method.

Solution

ABB replaced the resistors and slip-ring motors, which controlled the district heating pumps, with four ACS 1000 variable speed drive systems (each rated at 1765 kW), including drives, motors and transformers.

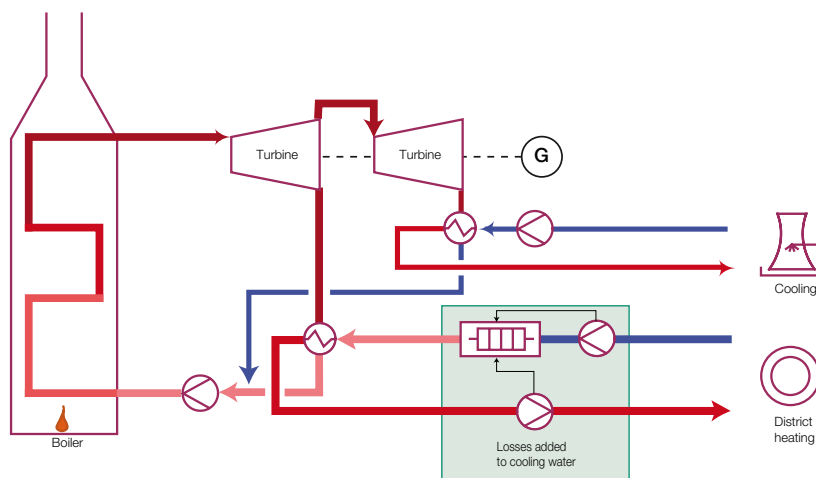
Benefits

After initial evaluation, Mälarenergi stated the following benefits:

Increased plant efficiency

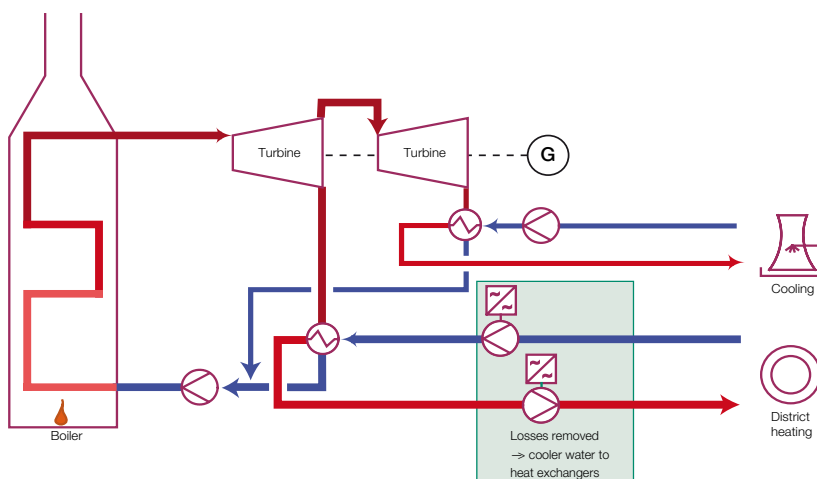
Since the installation of ABB's variable speed drives, the losses caused by the flow control method have been reduced considerably. The reduced production of district heat has been replaced by a higher production of electrical energy in the process that generates both heat and electricity.

Pump control with slip-ring motors and resistors



Picture 1

Pump control with electric variable speed drives



Picture 2



By installing variable speed drives, the plant's efficiency is considerably increased.

- The pump speed control with slip-ring motors and resistors resulted in heat losses (picture 1) which were heating up the cooling water.
- After the installation of variable speed drives, the cooling water was no longer heated up by the losses of the resistors (picture 2). Consequently, the temperature difference in the power generation process increased, resulting in a higher electricity production.

The losses were removed from the district heating system, which increases the cooling water temperature difference across the heat exchangers in the district heating circuit. This results in an increase in saleable electricity of about 35 GWh/year.

Reduced CO₂ emissions

The increased plant efficiency results in a reduction of CO₂ emissions.

Accurate pressure and improved stability in district heating network

As the pressure of the district heating pumps, which supply customers with heat, has to be kept at a constant level, the differential pressure is continuously controlled. Previously this was done manually. Since the installation of the ACS 1000 drives, and a new control system, the differential pressure is controlled automatically. This results in an accurate and more stable pressure in the district heating piping system and a lower temperature of the return water, which allows a better utilization of the heat by the consumers.

Reduced maintenance costs

The existing motors were old and in great need of maintenance. Had Mälarenergi not decided to replace them, they would have been forced to send them for an extensive maintenance overhaul.



The manual control of the differential pressure in the district heating piping system resulted in considerable fluctuations.



Since the installation of the ACS 1000 variable speed drives and a new control system, the differential pressure has been controlled automatically, which resulted in a more accurate and stable pressure in the district heating piping system.

Customer satisfaction

As of today, Mälarenergi has seven ACS 1000 and one ACS 6000 drive from ABB installed at its facility. They control four district heating pumps (4 x 1765 kW), a boiler feed pump (5750 kW), an accumulator pump (800 kW) and a fan and a pump for a new bio-fuelled boiler.

Sven Olof Kindstedt, System Engineer at Mälarenergi, states: “In the beginning it was difficult for us to understand how much the overall efficiency would improve with ABB’s variable speed drive systems. But ABB managed to visualize this very well. Thanks to ABB’s level of technical competence we have today a more efficient operation, an improved heat rate of our plant, and better balance in the district heating network.”



ACS 1000 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

For more information please contact:

ABB Switzerland Ltd
Medium Voltage Drives
CH-5300 Turgi
Phone: +41 58 589 27 95
Fax: +41 58 589 29 84
E-Mail: mvdrives@ch.abb.com

www.abb.com/drives

Mälarenergi AB
Sjöhagsvägen 3
SE-721 03 Västerås
Phone: +46 21 39 50 00
Fax: +46 21 39 50 17
E-Mail: post@malarenergi.se

www.malarenergi.se

Power and productivity
for a better world™

