CASE NOTE

ABB drives reduce energy consumption and CO_2 emissions at coal-fired power plant

The Grosskraftwerk Mannheim Aktiengesellschaft (GKM) operates in Mannheim one of the most efficient coal-fired power plants in Europe. In the course of restructuring the boiler plant in Block 6, two of the three boiler feed pumps were fitted with high-efficiency ACS1000 medium voltage AC drives from ABB. The result is 25% energy saving and a short return on investment.

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The GKM power plant is a high-efficiency coal-fired power plant with up-to-date technology.

GKM is a joint venture between RWE Power AG, EnBW Kraftwerke AG and MVV RHE GmbH. GKM's objective is the economic and environmentally friendly generation of three phase current, traction power and district heat distribution.

The generation of district heating occurs exclusively on the combined heat and power principle. The electrical output at the power plant amounts to 1,675 MW gross and 1,520 MW net. The district heating output (hot water) totals approximately 1,000 MW_{th}.

The use of oil/gas at Block 6 was in the past limited to just a few hours of operation per year because of high oil and gas prices. The goal of the 100-million-euro conversion to the more economical coal in 2005/2006, was to use the plant for the daily generation of power and district heating. Today, Block 6 has a gross output of 280 MW and a net output of 255 MW.

In the course of the conversion, the energy saving potential of the boiler feed pumps in the block were also considered.

Highlights
25 percent energy savings
Reduction of CO_2 emissions
Improved efficiency of pump drive system
Return on investment period: approx. 3 years

Challenge
The three pumps, with a rated output of 5.8 MW each, were still directly connected to the 6 kV grid. Drive regulation was by means of hydraulic clutches, installed during the plant's construction in the 1970s.

A fundamental disadvantage of the turbo clutch is the poor efficiency of only 72 percent, in relation to the operating points. Thus, over 1 MW of heat energy per pump was wasted by heat exchangers.

Solution
ABB's service experts proposed to control the pumps with the ACS1000 medium voltage AC drive. A modern medium voltage AC drive, like ABB's ACS1000, provides the electrical output actually required directly to the pump motor. This results in considerable energy savings.

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01 With the ACS1000 variable speed drives considerable energy savings have been achieved.
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02 The water-cooled ACS1000 medium voltage AC drives were installed ready for connection in special, fully air-conditioned containers.

Given the block's 20 year life expectancy, the GKM board of directors were also attracted by the short three years return on investment.

As a result, ABB received the order to modernize two of the three boiler feed pumps – the third pump serves as a stand-by. For each of the two pumps, the customer ordered a technical package including a robust RESIBLOC input transformer, an ACS1000 medium voltage AC drive, a star-delta re-connection of the existing 6 kV machine and its complete overhaul. The turbo clutch was replaced with a rigid transmission.

Because no suitable central electrical control room was available near the boiler feed pumps, the water-cooled AC drives are housed each within a special, fully air-conditioned container. In order to protect the containers against any flooding by the Rhine river, the containers stand on one meter high steel stilts.

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Benefits

25% energy savings

Take 1,000 kW of savings and multiply it by the operating period of 6,000 hours per annum, along with the producer's price of around 0.05 €/kWh (the accepted EEX electricity tariff): the annual energy saving is € 300,000 per boiler feed pump.

Reduction of CO_2 emissions

The new operating solution also brings a considerably lower environmental burden. The energy savings of 1,000 kW reduces CO_2 emissions by approximately 850 kg per hour.

Over 98% efficiency

The ACS1000 achieves high efficiency levels of 98.5 percent. Together with high efficiency transmission system at 98 percent, the transformer at 99 percent, and the machine at around 97 percent, the total efficiency of the pump drive system is clearly improved.

A further efficiency improvement is achieved by optimizing Sulzer's pump impeller. The lower energy requirement also results in an improvement in the total efficiency of the power plant.

Calculated savings potential achieved

Just in time, during the summer of 2006, ABB service engineers put the first pump into service. It was followed three months later by the second pump. In 2008, after two years of operation, the calculated savings potential and the actual operational savings were almost equal.

Due to the positive experiences, ABB was given a follow-up order for the modernization of the entire drive technology of the district heating water circulation pumps at one of the two heating centers. From this heating center GKM supplies the district heating grids of Mannheim, Heidelberg and Schwetzingen.

Key data of ACS1000 product family	
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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