SIPOS meets challenges of world's largest lignite plant

photo: Heinz-Jörg Wurzbacher

In 1999, the actuator division of Siemens received an order to supply the RWE power plant BoA1 in Niederaussem near Cologne with electric actuators. Later that year, the actuator division supplying the technology was outsourced and reformed as SIPOS Aktorik. The power plant, which has been successfully online since 2003, was the biggest of its kind at that time and the scheme stole a march on any similar development. A number of distinctive features of the mono-block design included a cooling tower, the scale of which is such that it would completely enclose the City of Cologne's cathedral dome.

By Holger Scholz, Key Account Manager, SIPOS Aktorik

With a main control system that had to fulfill the exacting requirements of RWE, and a requirement for over 1,000 electric actuators, the task for actuation technology was formidable and it required considerable confidence in the supplier. The actuators that met the challenges of the installation were a new generation product from Siemens offering variable speed capabilities: the products represented a solution that was a completely new concept and technology for the industry.

SIPOS Aktorik received an order in 2007 to equip RWE's BoA 2/3 power plant in Neurath, also near Cologne in Germany. This represented a contract of a new order of magnitude for SIPOS. The company, which has already fulfilled a

number of significant and challenging power industry contracts worldwide including, for example, Majuba blocks 4, 5 and 6 (South Africa), Hanfeng (China), Olkiluoto NPP (Finland) and GKM (Germany), reports that BoA 2/3 represents an installation that is also unique in its demands.

As the largest contract fulfilled to date by SIPOS Aktorik, over 2,500 actuators are being supplied to the double-block plant. With requirements for the highest control results, the diagnosis tools provided by the SIPOS 5 Flash actuator meet the scheme's needs which include, among other things, recording torque reference curves and storing / evaluating operating parameters. Additionally, RWE's specification included raising the standard of communication between the control system and electric actuators. SIPOS' adoption of PROFIBUS DP V2 services meets this need, ensuring that the transmitted data will increase in its significance and ease of analysis.

The Rhineland's lignite-fired power plants provide 15% of Germany's energy supply and around 50% of the electricity needs of the state of North Rhine-Westphalia (NRW). Like other large lignite-based power plants, the Neurath power plants work in base load using lignite from open cast mines. Over 450 employees, more than thirty years' experience and high generation availability combine to make the Neurath power plant a competitive supplier on the electricity market.

Approval from the government

In June 2005, the Düsseldorf regional government gave its approval for the construction and operation of two additional lignite fired power stations with optimised plant technology (BoA) at the Neurath site. The two power plants, BoA 2 and 3 will have a gross capacity of over 1,100 MW each and an efficiency of over 43%. The most striking components are the two buildings for the steam generators (boilers) and the two cooling towers: the structures will be some 170m high.

With significant improvements to plant parts and processes, combustion of the lignite in the steam generator converts the energy chemically bound in the fuel into thermal energy. This energy is used to evaporate water under high pressure and at high temperatures. The steam drives a turbine and a connected generator converts the rotational energy of the turbine shaft into electric energy. SIPOS' actuators support all key processes in the plant, specifically aiding the goal of increasing the plant's efficiency.

The technology

The requirements of the electric actuators supplied to BoA 2/3 are comprehensive and exacting, these are:

- Output speed change during operation
- Redundant PROFIBUS DP with V2 services
- Internal positioner for modulating actuators
- External COM-SIPOS connection
- IP-67 enclosure
- 230 V (preferred) / 400V power supply
- All actuators with wall mounted electronics/controls

In the different process systems of the plant, a large variety of valves are utilised including globe, gate, butterfly valves and special valves. The variety of designs dictate different movement types (rotary, linear, or part-turn) and specific mechanical interfaces of the actuators.

Globe or gate valves, without a rising stem, are predominantly served with rotary actuators incorporating B1/B2/B4 interfaces, supplied according to DIN ISO 5210. Penstocks, most of which have rising stems, feature an A-type interface with stem nut in the actuator. Butterfly valves predominantly require part-turn actuators with a stroke of 95° and the mechanical interface requirements for special valves can require linear thrust units that exceed the standard range of 50-400mm

The SIPOS 5 Flash actuators supplied for this application cater for every type of valve, movement or required force, providing the advantage of variable speed during operation. Through programmable stroke-output speed curves, the output speed can be adjusted according to the degree of opening.
The critical valve positions can be pre-set and valve closure speed adjusted to reduce / avoid cavitation or water hammer. Also a degree of valve protection unique to SIPOS' technology is possible by the variable speed capabilities. In contrast to conventional electric actuators, the SIPOS 5 Flash actuators reduce the speed in the end position ranges: this provides a number of advantages including avoiding valve discs being ripped from the soft seal – instead, they are detached slowly, but with full torque.
The foundation of these functions is the integrated frequency converter and the advanced control electronics of the SIPOS 5 Flash actuator series. The combination of these components is specifically designed for use in SIPOS' electric actuators enabling the following characteristics: variable speed, soft start and soft stop, high tolerance to fluctuations in the power supply (± 15-20% without effect on the actuator performance), buffering of the power supply to uphold the function of the control electronics and elimination of mechanical switches for torque or limit.

Connection to the main control system

SIPOS reported that the RWE installations highlight the fact that the actuator supplier needs to address the way in which actuators are connected to the control system as this can vary, even within the same power plant. Taking the example of the Neurath power plant, a double channel PROFIBUS DP network was established, together with the Siemens control system SPPA T-3000.

Basic data for PROFIBUS DP, double channel (redundant):

The actuators are connected via two 2-wire copper or fibre optic cables with the DCS. Control and feedback is performed via digital communication (data exchange with bus telegrams). Depending on the selected BUS network topology, the connection can be star (each slave connected directly to the DCS – extensive cabling necessary), line or ring (from one slave to the next with reduction of the cabling). Redundancy of the communication link is ensured by using two separately laid lines. Should one cable break, the data exchange can be performed via the remaining cable.
Additionally the different functional levels of the PROFIBUS DP protocol relating to actuators are utilised depending on the control strategy.

• Functional level DP-V0

This approach takes a cyclical reading of input data from the master and writing output data as a fieldbus slave with a transmission rate of up to 1.5 Mbaud.

• Functional level DP-V1

For this, acyclical data exchanged with a master controller (DP master Class 1) or engineering station and DP master Class 2 is supported. The Class 2 master can be deployed for configuration and diagnostics as all actuator parameters are accessible.

• Functional level DP-V2

This functional level builds on DP-V1, but additionally offers time stamp and slave redundancy according to the 'RedCom' profile. The PROFIBUS DP V2 time stamping of events, and the upgraded redundancy concept, ensure higher availability of the actuators.
The adoption of PROFIBUS DP V2 services was a key requirement for the Neurath power plant and, combined with the implemented Siemens control system SPPA T-3000, all features can be utilised.