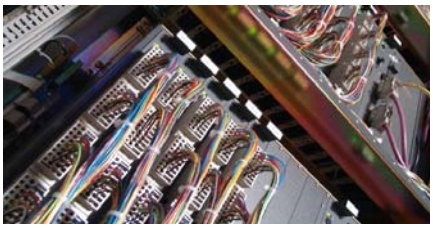
Unit C of the Scholven Power Plant Automated with System 800xA



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The plant

Originally, the plant was intended to serve as a power generation facility supplying auxiliary power to a mine located in a Gelsenkirchen district. In the meantime, the Scholven site has turned into a large-scale power plant delivering a gross output of 2,200 MW and is one of the largest power facilities in Europe.

Within 1968 and 1971, Units B through E – nearly identical units – went on line. Units G and H followed in 1974 and 1975 (50% held by RWE Power). In 1979, Unit F started its service; and by the end of 1985, the Buer district-heat generating plant (FWK) began its operation.

The power produced in the Scholven power plant covers approximately 3% of the overall power demand in Germany. Units B through E, the Buer district-heat generating plant, and the Scholven steam power plant are delivering steam to nearby chemical plants and district heat to a number of cities in the area.

The task

E.ON developed clear specifications as to what was expected of the new control system. The specific requirements were:

- Fully automatic operation of the entire power plant process during startup procedures, load variations, shutdown procedures, standstills, as well as under disturbance conditions
- Operation and monitoring of the entire plant from a single control room with the help of individual screens and one large-screen display
- Quick and accurate fault analysis to prevent failures and minimize downtimes if a failure does occur
- Time- and fuel-optimized startups, while fully utilizing the given material limits. Quick shift from oil-based to coal-based mode, and vice versa.

The replacement project had to be oriented to the following scope of automation:

I&C Functions	Quty.
Analog signal conditioning	900
Binary signal conditioning	1000
Digital-control actuators/ solenoid valves	370
Analog-control actuators	150
FG-controls (sequencers)	85
Automatic mode features/ Auot-switchover features	240
Master controllers	40
Graphic displays	150

Bill of quantities for the I&C project

Because of the new market situation, unit C – which was initially intended for base-load operation – is now being used in the medium-load range. An inlet-pressure control mode (the turbine controlling the pressure and thus supporting the boiler), plus natural and modified sliding-pressure modes, with an adjustable degree of turbine throttling (turbine or boiler following mode), need to be implemented for power operation. In order to be able to follow the signal issued by the network controller, the control concept must provide for frequent load ramps and load deltas with high load variation rates, without any equilibrium conditions during load reversals for secondary control purposes.

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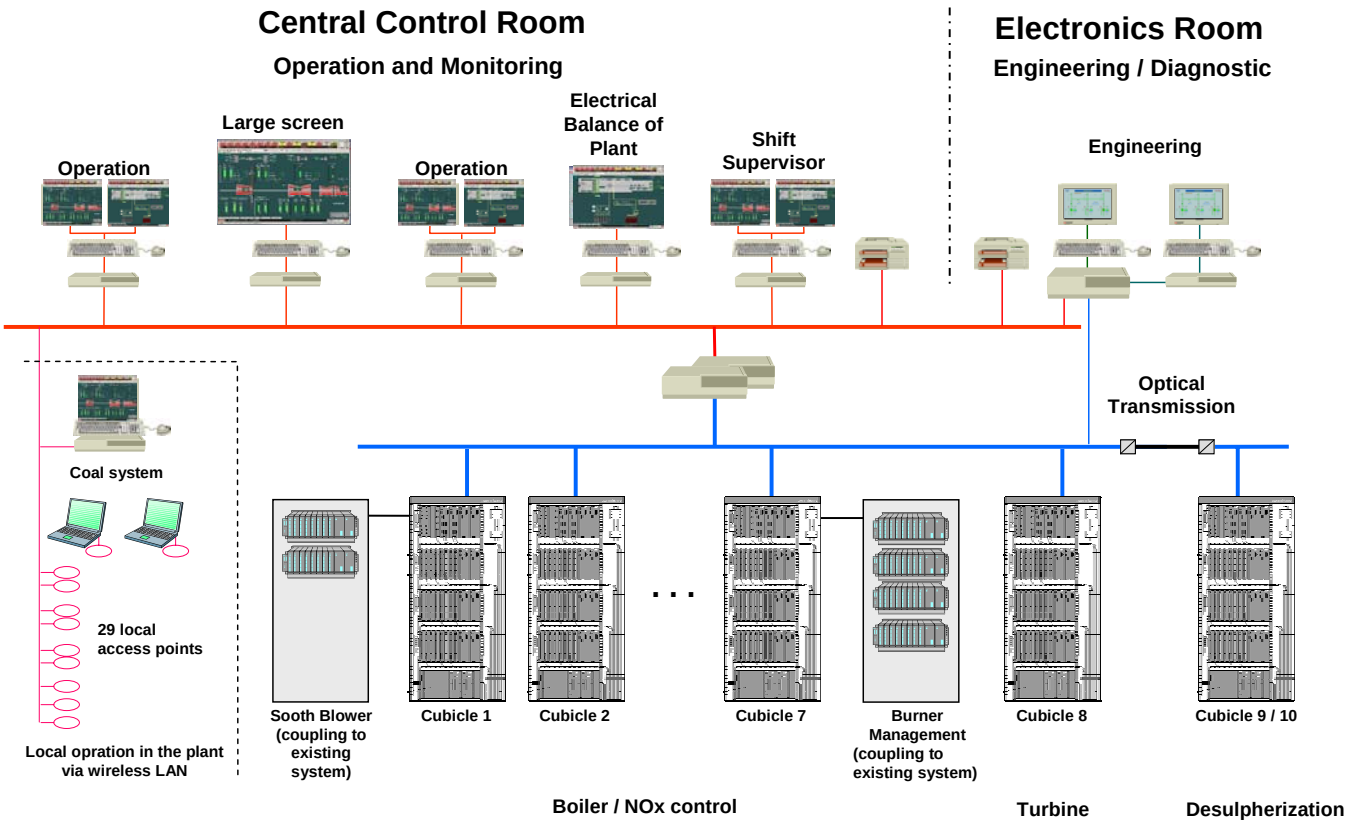
The solution

E.ON opted for system 800xA in combination with AC 870P controllers, a process control system that offers a series of new functionalities while maintaining a consistent user interface philosophy. The range of functions exceeds traditional operating and monitoring systems by far and integrates information management and engineering functions as well.

In order to be able to meet the demanding requirements with regard to the system's suitability for primary and secondary control, ABB employed its MODAN automation concept. MODAN provides for model-based coordination of the two main correcting variables, namely fuel setpoint and turbine control valves, with the help of dynamic parallel models.

MODAN consistently combines model-based feedforward controls and dynamic setpoint control functions – both for turbine control and for position, main-steam pressure and fuel control.



Configuration System 800xA in combination with AC 870P controllers

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Operating and monitoring

The control room for Unit C was set-up in a new dual-unit control room for Units B and C. The control room concept consists of clearly delimited working areas for the operator, the shift supervisor, the electrician (electrical balance of plants), and for safety-isolation management.

Control room of Unit C

Data access, data archiving and data management are based on ABB's patented aspect/object technology. "Objects" represent system components of a varying complexity, e.g. drives, measuring instruments, coal pulverizers, feed pumps, turbines, or boiler units. "Aspects" provide certain characterizing information which is attributable to said components and is needed for optimal plant operation and real-asset preservation.

Aspect data are archived only once and can be activated from different objects. Aspects may be:

- Microsoft Excel documents (spreadsheets, adapted reports, etc.
- Microsoft word documents (operating and calibrating instructions, data sheets, etc.)
- AutoCAD drawings
- Function charts
- Functions of the Maintenance Management System
- Camera monitoring
- PDF files for scanned, non-editable documented, e.g. manuals
- Suppliers' Websites

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Users can personalize the process displays to match their specific needs and preferences. Fast, flexible and safe access to all relevant displays and information enables operators to perform their activities, such as monitoring and operating, efficiently and accurately.

Turbine control system

The turbine control system for the 400MW Siemens steam turbine of Unit C is based on the structure of the Turbotrol turbine control system – a control concept which has been updated and optimized on a continual basis over decades. For this project, the turbine control system has been implemented in line with the unit control system, i.e. on the basis of System 800xA system combined with AC 870P controllers.

- Consistent and familiar tools for planning and maintentance tasks
- Consistent and joint operator station with coordinated operating and alarm concepts
- Uniform and consistent documentation
- Consistent and joint spare parts supply concepts

The turbine control system is of a redundant design. The turbine protection system consists of three channels and is based on a fail-safe closed-circuit concept. A load program provides for automatic loading of the turbine up to current boiler output.

In addition to the replacement of the turbine control system, ABB also upgraded a series of mechanical and hydraulic components. For example, the existing mechanical / hydraulic protection devices at the front control rack (e.g. thrust bearing trip, overspeed bolt) were removed and substituted by a 3-channel electronic protection system using a hydraulic 2-out-of-3 trip unit. This 2-out-of-3 trip unit by ABB is SIL3-certified to IEC 61508 / EN 61508.

Redundant turbine control

Turbine protection channel 1

Turbine protection channel 2

Turbine protection channel 3

Power supply

Turbine automation and protection system

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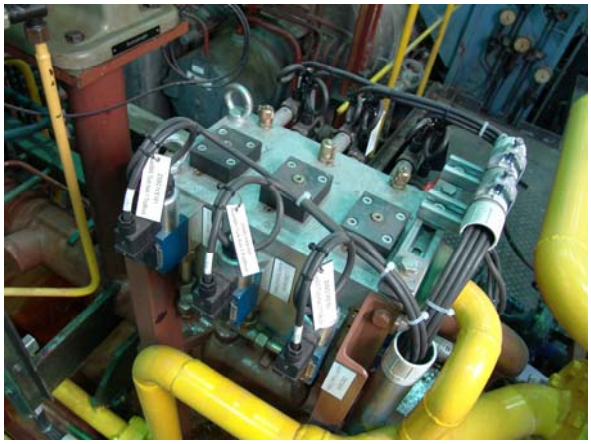
Since there are no more mechanical protection devices and thus no inspection and maintenance work required on such equipment, operation and maintenance activities have been simplified significantly.



SIL3-certified 2-out-of-3 trip unit

Implementation of the project

The equipment was replaced during a ten-week overhaul standstill in fall 2005. For the implementation of the project, it was important to take into account that there would be no new localities available for the I&C room and the control room. Only minimal advance activities were possible prior to the actual date of the overhaul standstill. For example, setting-up the new control cabinets was possible only after the old cabinets had been taken apart and cable routes replaced. When the unit's standstill began, around 70 cabinets had to be taken apart and removed. Also, the entire core of the control room had to be taken out.

Important duties, such as coordinating all trades and collecting the necessary data for the preplanning phase, were performed by personnel of E.ON Engineering. The functionalities required for a fully automatic unit operation were worked out in joint engineering meetings. The power plant staff was able to contribute valuable information based on their experience with the previous unit operation. On-time mains connection was possible thanks to the power plant staff's knowledge of the plant specifics – a circumstance which was especially helpful during installation and commissioning.

Prospects

Following a successful and on-time recommissioning of Unit C, E.ON decided to place another order with ABB for modifying the control equipment of Unit E with System 800xA combined with an AC 870P controller. The switch-over is scheduled to take place during the 2006 overhaul standstill. In another step, the I&C equipment of Unit B will be upgraded during the 2007 overhaul standstill. This time-frame will allow synergy potentials to be utilized in the best possible way.

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Turbine hall of Unit C – parts of the hydraulic system modified by ABB in the front

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