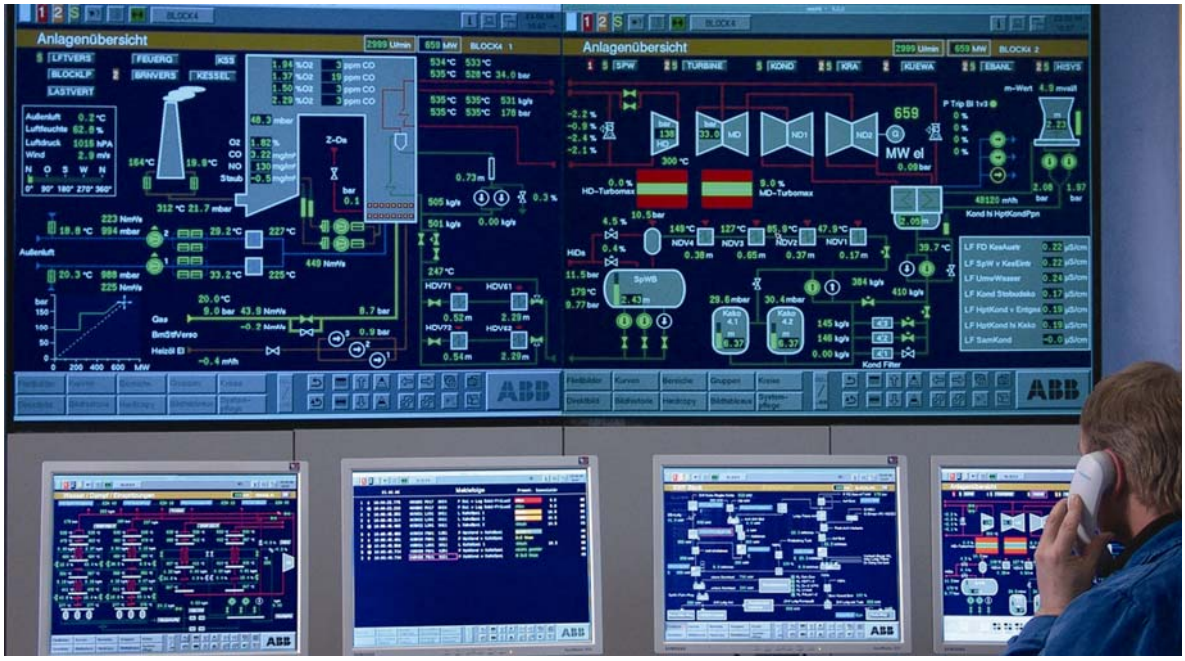
New Electrical and I&C Equipment for Unit 4 of the Staudinger Power Plant within Only Six Weeks



The plant

Unit 4 of the Staudinger power plant started its service in 1977. The unit delivers a rated net output of 622 MW and is usually gas-fired. Alternatively, extra light fuel oil can be used. The power plant is located south of Grosskrotzenburg and is connected to a harbor on the Main river.

The power plant has been designed for peak-load operation. All design activities and economic studies were based on a full-load service time of 2,600 hours per year. Another important aspect to be considered is that the plant's operation is scheduled by the load dispatch center, depending on the power demand. The unit is started-up several times a day, as needed. It is imperative for a typical peak-load unit to be able to handle short startup times and quick load variations.

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The task

The service lives of a number of electrical and I&C systems had come to an end. In order to enable continuation of the unit's operation for another 25 years – while taking into account that the usage is expected to increase – the aged components had to be replaced. For this purpose, the power plant unit was put to a six-week standstill.

Since the actual number of operating hours (approx. 20,000 hrs) was relatively low, the mechanical and electrical condition of the plant was rather good. Because the unit had been operating already at a high level of automation, there was no significant need for retrofitting electric actuators. However, the sensors of the unit had to be renewed completely; binary transmitters had to be replaced by analog instruments. In the area of the turbine, some major improvements were necessary regarding the hydraulic protection and control facilities.

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

Functions	Quty.
Analog signal conditioning	1596
Binary signal conditioning	1141
Serial interfaces/number of signals	4/900
Unidirectional drives	227
Actuators	191
Solenoid valves	293
Function groups	147
Single-loop analog controls	160
Master controller	52
Electronics cabinets	18

Installing new electrical equipment

Electrical components were improved and adapted to match the new control system:

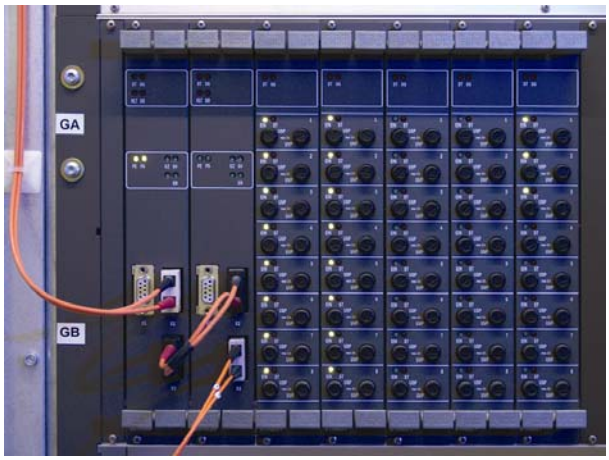
- Renewal of protection devices for the auxiliary power supply system and the unit
- Renewal of the synchronization system; renewal of the voltage regulator
- Replacement of two cascades for the feedwater pumps
- Replacement of the interposing relays in the substations
- Renewal of the 220V DC and 24V DC systems

At first, the power converter cascades of two out of three boiler feed pumps were upgraded. The pumps are being operated via variable-speed, subsynchronous converter cascades; the driving power per pump is 15 MW. The new power electronics consist of two rectifiers and two inverters of the ABB power converter series DCS600.

Installing new control equipment

The installation of a new Procontrol P power plant control system made it possible to achieve:

- A higher level of system availability
- Early warning of disturbances
- A more flexible utilization and better maneuverability of the unit
- Minimized startup and shutdown losses
- Shorter downtimes for overhauls
- Reduced maintenance costs
- Time-optimized startups



Interfacing to the bus, with output modules, for the Procontrol P boiler protection system

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The renewal of the I&C equipment included:

- Replacing the entire unit control equipment, including burner control, boiler protection, turbine control and protection systems
- Replacing the power controllers

New 380V power controller cabinets

- Installing new interposing relay cabinets for supplying the 48 V solenoid valves
- Installing new power supply cabinets for a secure 220V AC supply
- Renewing the voltage supply for the control system
- Entirely new control cabling
- New subdistributors
- Modifying the entire hydraulic turbine equipment for regulation and protection purposes
- Renewing all turbine sensors for monitoring and protection purposes

Installing new sensors

The underlying basic conception of the upgrade requires, among other things, consistent diagnosing of and parameter setting for the field instrumentation in place. This was not possible with the previous instrumentation. Therefore, all sensors had to be exchanged for new ones. Binary transmitters had to be replaced by analog measuring devices.
The new instrumentation meets the following requirements:

- 24V DC auxiliary supply via a 2-wire-type of arrangement; in exceptional cases 230V AC (with miniature circuit breaker monitoring)
- A 4-20mA signal level
- Complete transmitter monitoring (for short-circuit, earth fault, strand break)
- A measuring accuracy of class 0.1; provided that the process system does not pose higher demands

New transducers on the existing measuring rack

A higher level of automation

In order to increase the level of automation, manually operated valves had to be motorized and automated by integrating them into the new control concept. In addition, local indicators were replaced by remote measuring facilities if the measurements were logged in operational-check rounds before.

ABB substantially enhanced the unit's startup response by implementing the BoilerMax concept for predictive startup optimization. In cooperation with Alstom, ABB improved turbine operation with a newly developed turbine controller. In order to be able to respond rapidly to fast load variations, the steam generation system and the turbine are coordinated via model-based MODAN unit control.

Installing a new control room

The existing unit control room was renewed completely. Unit 4, along with its auxiliary systems, can now be operated and monitored by only one operator.

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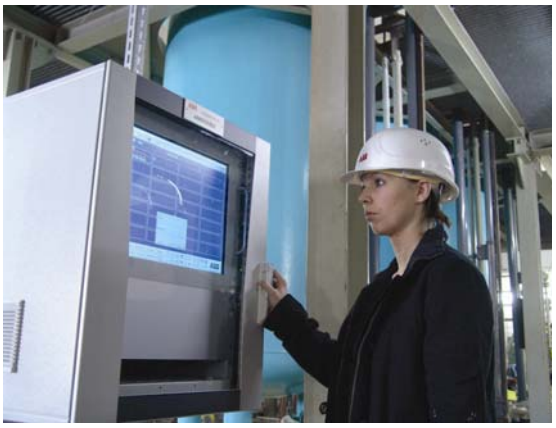
Additional operator consoles were set up in the control room of Unit 3 (for operating the cooling tower), in the condensate-polishing plant, in the H_2 plant, and other operational areas, using the WLAN (wireless LAN) technology and mobile terminals.



Local operator console in the condensate-polishing plant

The control room is laid out to support cross-unit operation, providing for short distances and direct visual connection across all areas for fast exchange of information.

View from the chief unit operator's desk onto the Unit 4 control room

Implementation of the project

The entire switchover to the new electrical and I&C systems was accomplished during a six-week period. During this time, all switchover and recommissioning activities were completed.

By the use of mobile notebooks, the process operation functions were available throughout the entire plant, using WLAN and access points. This significantly reduced the time required for recommissioning.

The overall project implementation consisted of five stages:

- An engineering stage starting on the contracting date
- An installation stage, during which the major installation work was performed in advance, while the unit remained in service
- An overall preliminary testing / commissioning phase using a temporary control room
- A modification and commissioning stage during the unit's standstill
- Another stage during which temporary installations were removed and the final system status was established.

The engineering activities for the new process control system were conducted on site. The engineering teams comprised ABB control engineers, power plant operators and consultants from E.ON-Engineering. Further ABB experts supported the process through remote access to the Engineering and Process Operator Station. It was possible to meet the target dates thanks to computer-aided schedule monitoring and documentation of the installation and commissioning activities on site.

On 30 October 2005, the time had come: Unit 4 of the Staudinger power plant went on line again, after a downtime of only six weeks.

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