



# Procontrol P14

## Complete power plant control system

# Reliable and effective power plant automation



ABB launched Procontrol™ P14 more than 35 years ago in 1977. Throughout its long life Procontrol P14 has proven to be one of the most reliable and efficient power plant automation systems on the market. With 500 installations in 46 countries all over the world it has a large, long-standing and loyal customer base.

Procontrol P14 is a complete power plant control system with a simple and flexible architecture that enables customers all over the world to meet the diverse operating and business needs of their markets. It comprises a total system solution:

- Instrumentation and control
- Operations and information management
- Engineering and documentation
- Configuration and programming
- Diagnosis and maintenance
- Turbine control
- SIL 3 certified boiler protection

And it delivers a comprehensive range of valuable benefits:

- Modular structure with little basic equipment makes the system scalable and ideal for all applications, from the smallest control task to large plant control systems
- Uniform system for all control functions
- Simple straightforward structure and functionalities that are easy to operate
- Easy access to all data
- Fully adaptable to the safety, availability and commercial requirements of the process
- System modification and expansion does not influence existing modules and control applications, and can be performed without the need for plant shutdowns
- Automatic documentation generation by integrated document management system
- Maximum availability thanks to self-monitoring and diagnostic functions
- Forward compatibility with Symphony Plus

# Complete and cutting edge in every respect

ABB continues to invest and evolve Procontrol P14 to ensure that existing P14 customers will continue to have a complete power plant control system with cutting-edge capabilities. Several new products are in the pipeline. The first of which is an upgrade of the old POS human machine interface to ABB's latest state-of-the-art HMI, S+ Operations.

S+ Operations is part of ABB's Symphony™ Plus total plant automation platform for the power generation and water industries. Symphony Plus is the new generation of ABB's highly acclaimed Symphony family of Distributed Control Systems (DCS) - the most widely used DCS in the power generation and water industries.

### S+ Operations

S+ Operations is an intuitive, easy-to-use human machine interface (HMI) that is designed to lead operators to greater awareness, faster response and better decisions. S+ Operations brings all plant information in one place, ready for prompt and swift action.

Designed for high performance

S+ Operations provides operators with distraction-free, state-of-the-art process information and access.

Integrated operations

S+ Operations seamlessly integrates all plant devices and systems.

Seamless life cycle management

S+ Operations allows for seamless and incremental integration of new products, technology and functionality without the time and expense of re-engineering and retraining.

Information management

S+ Operations transforms data into meaningful information and presents it in intuitive user-specific desktop displays for real-time business decisions.

Alarm management

S+ Operations' superior integrated alarm management system includes the industry's leading EEMUA 191-compliant alarm management analysis system.

Security

S+ Operations provides users with a secure and reliable operations environment with built-in security features.

Process optimization

S+ Operations combined with OPTIMAX® optimization applications improves overall plant productivity.

Flexible, scalable fault-tolerant design

S+ Operations unique system architecture is easily adapted to any power or water application.

1 S+ Operations workplace | 2 Information-rich control faceplates



# Universal I/O and control modules

## Procontrol P14 process stations

Procontrol P14 needs only two types of module to perform the main signal conditioning and control tasks - the universal I/O module and the universal control module. These two modules alone cover 80 percent of all power plant control functions. The result is a control system with a clear structure, lower inventory costs and simpler maintenance.

The I/O and control modules are housed in the Procontrol P14 process station along with the coupling modules for the human machine interface (HMI) and external systems like MODBUS RTU, PLCs, and third-party equipment. The station can be connected to the remote bus via an optional bus coupler or it can operate in stand-alone mode.

## Many powerful features

The Procontrol P14 process station has many powerful features:

- Only two types of module are required to perform all signal conditioning and control tasks
- Control modules process the information independently (like a multiprocessor system). No central processing units are required, unlike other distributed control systems

- I/O modules have their own processors. This makes signal acquisition and conditioning more efficient
- Standard cable connections to junction boxes avoid the need for marshaling racks
- Availability of all process variables via remote bus in real-time
- Easy distribution of control tasks between different process stations to best suit plant requirements
- Easy to extend without influencing engineered applications

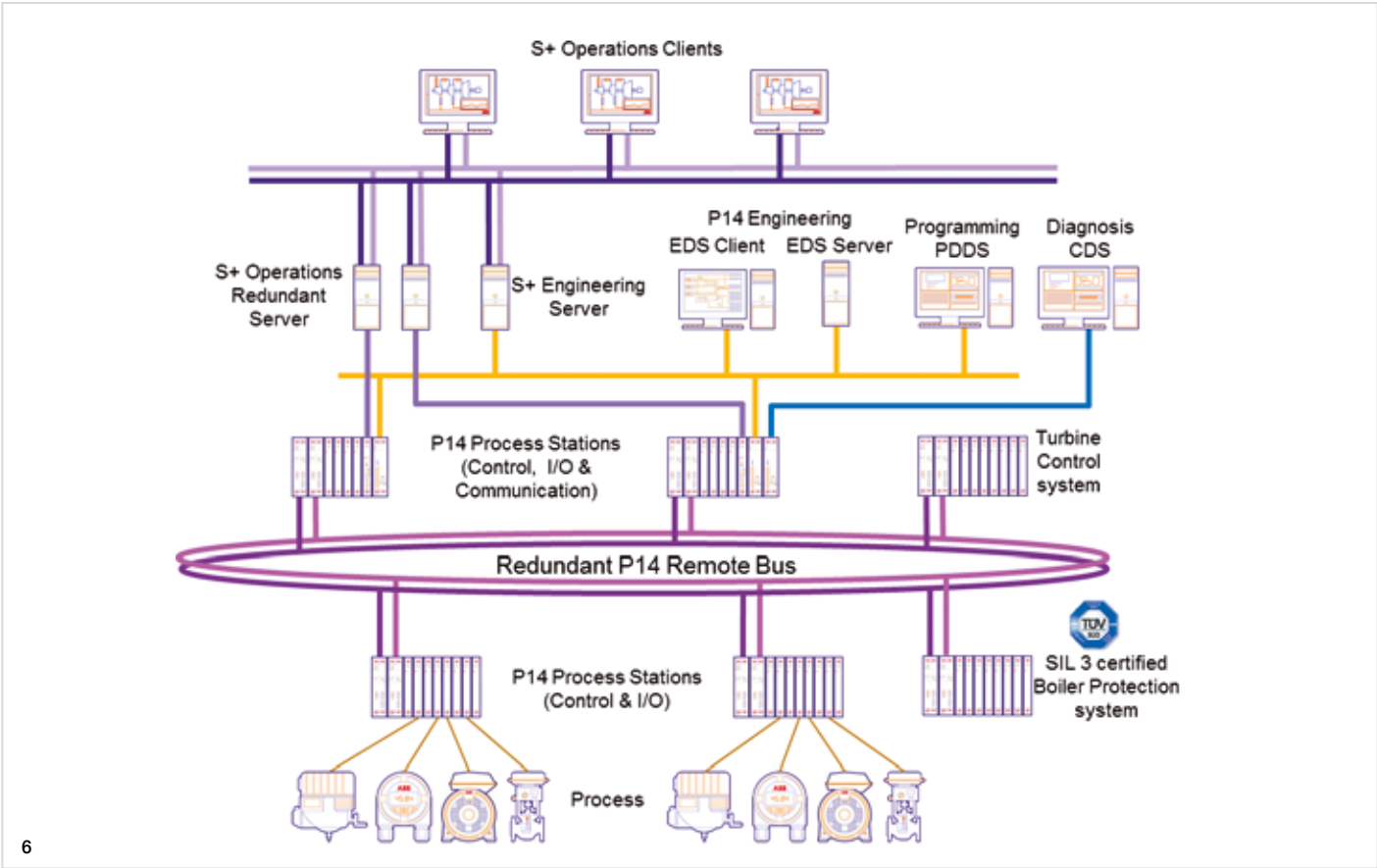
## Perfectly simple

The programmable universal input module includes many features that were not previously available. All types of transmitters used in power plants can be connected to the I/O modules.

The programmable universal controller is used for all binary and analog control functions. The programming determines whether the controller has to control a drive, a function group, a discrete regulation task or a complex processing function.

Interfaces are available for connecting to external and third-party control systems and automation devices.

# Single communication system with exceptional flexibility



6 Procontrol P14 system structure with S+ Operations

## One of Procontrol P14’s unique features and greatest strengths is its data transfer system.

In the P14 data transfer system the station bus and the remote bus form a single communication system. All process signal changes are available in real time on the station bus for each station in the system. This enables related functions such as signal acquisition, signal conditioning and binary and analog control to be located either together in one station (stand-alone system) or distributed between different stations (according to control functions).

There are, therefore, no restrictions on where the modules can be located; any free slot can be used. This makes Procontrol P14 especially suitable for refurbishing existing power plants. Expansion of existing control systems is easy: it is achieved without having to shut the system down and without creating interface problems between modules.

## High-speed redundant remote bus

The high-speed remote bus is based on the FDDI (fiber distributed data interface) token ring network architecture in accordance with ISO 9314. It is connected to the station bus via remote bus coupling modules.

Optical fiber cables are used for the connections. These are insensitive to electromagnetic interference and can transmit data over distances of up to 2,000 m between stations and at a high data transfer rate of 100 Mbit/s. Maximum network sizes of up to 100 km can be achieved.

The remote bus does not require any common central components and can therefore restructure the system and maintain communication itself in the event of a fault, such as a cable interruption. In this way it fulfills the highest demands for availability.

## Single station bus

The station bus is the backbone of the P14 process station. It links the I/O, processing and communication modules to the system. It comprises backplane Printed Circuit Boards (PCBs) on all the racks, which are connected together by system cables.

3 Universal I/O module 81EU50 | 4 Universal control module 83SR50 | 5 Remote bus coupling module 88TK50





# Engineering and documentation

## Efficient engineering for the entire life cycle

EDS is the engineering, documentation and service system for Procontrol P14. It supports the engineering, commissioning and optimization of control system functions. Since it is directly connected to the Procontrol P14 bus, EDS has access to all the modules of the control system throughout the plant. It is linked to the process operator stations via a network.

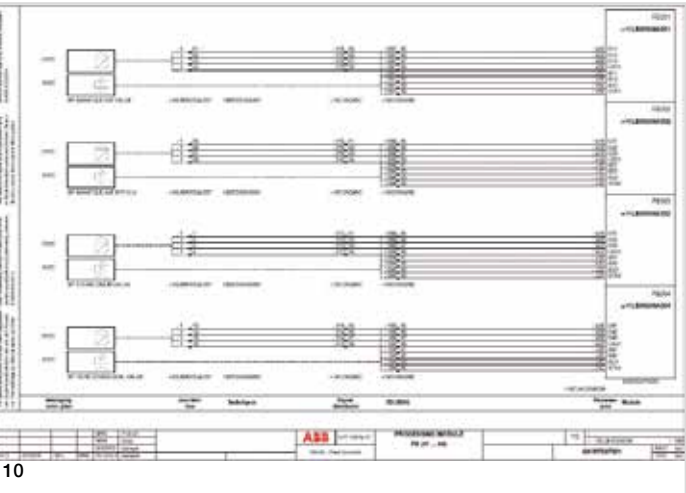
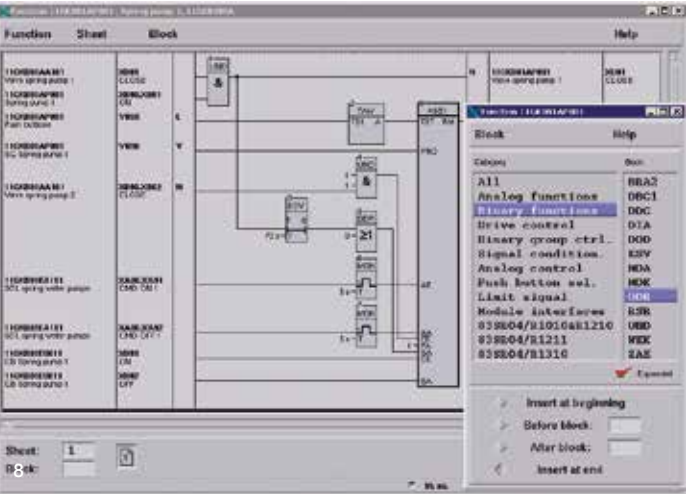
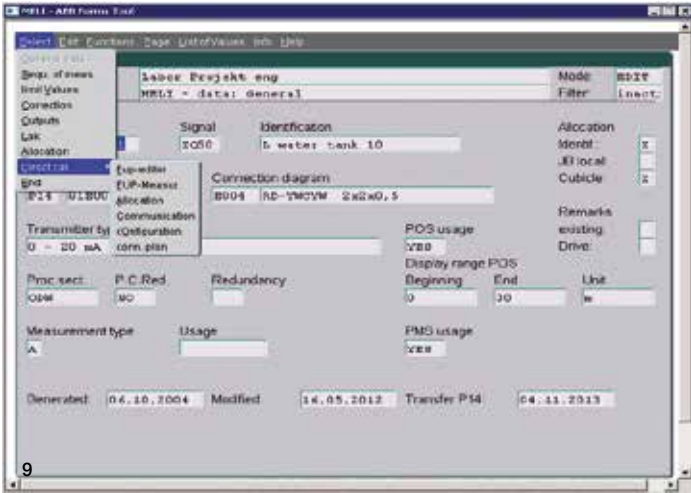
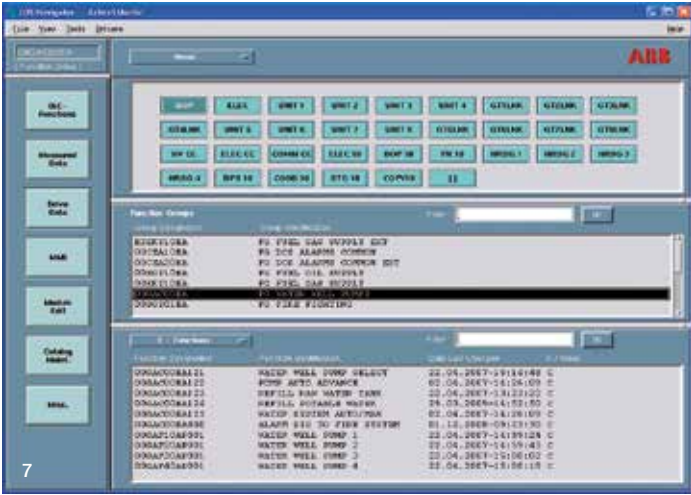
- The main tasks performed by EDS are:
- Data entry and maintenance of all measurement and actuator data of the plant
  - Generating and editing function charts for I&C functions
  - Assignment of sensors and actuators to control modules
  - Generation of all data and automated data download onto the modules
  - Debugging and online testing of function charts
  - Automatic document generation of wiring and connection diagrams and connection and cable lists
  - Comprehensive and easy to use documentation management
  - Printout of document packages including cover sheet, table of contents and common footer data

EDS provides function-oriented as well as implementation views. It uses the German KKS standard identification system to identify engineering items; addresses or other specific control system data are not required. A function is selected by its designation and displayed graphically as a function chart on the screen. The user executes any changes directly in the function chart.

The function chart editor knows all the Procontrol P14 function blocks and the rules for connecting them. When generating a function using EDS, the user selects a function block and connects it to other function blocks by mouse operation. EDS automatically arranges function blocks and their interconnections in the chart in relation to the syntax rules.

The data used by the function generator is also needed to program the control modules and to configure the communication systems. This principle ensures absolute consistency between the programming of the control system, the configuration of the communication systems and the associated documentation. EDS automatically updates any other function charts and the connections to them. All cross-references are therefore always up-to-date, and it is possible to navigate horizontally through the function charts by clicking on inputs and outputs. The same applies when making modifications: EDS automatically updates the other function charts. Any wrong connections are detected and rejected immediately.

7 Navigator | 8 Function diagram editor | 9 Measurement data editor | 10 Connection diagram





Easy and efficient configuration and programming

Self-diagnosis and rapid corrective action

The programming, diagnosis and display system (PDDS) is used to download Procontrol P14 instruction lists to the P14 modules or to read back instruction lists from the modules for modification.

Modifications to instruction lists can be performed online or offline. Online change means that the interaction of the automation system with the process will not be interrupted, and the module will operate with the modified data in the next processing cycle. Offline change means that the control operation of a module will be interrupted for receiving new data only.

The PDDS also displays current signals and simulated signals. It includes file management facilities for handling the lists and for PROM operation.

- PDDS incorporates a comprehensive range of essential features:
- Creation and modification of instruction lists in online and offline mode
  - Archiving of instruction lists
  - Downloading of instruction lists to the modules
  - Read-back of instruction lists from the modules
  - Printout of instruction lists
  - Display and printout of bus signals and internal module signals
  - Simulation of module input signals
  - File management
  - List operation
  - System diagnosis

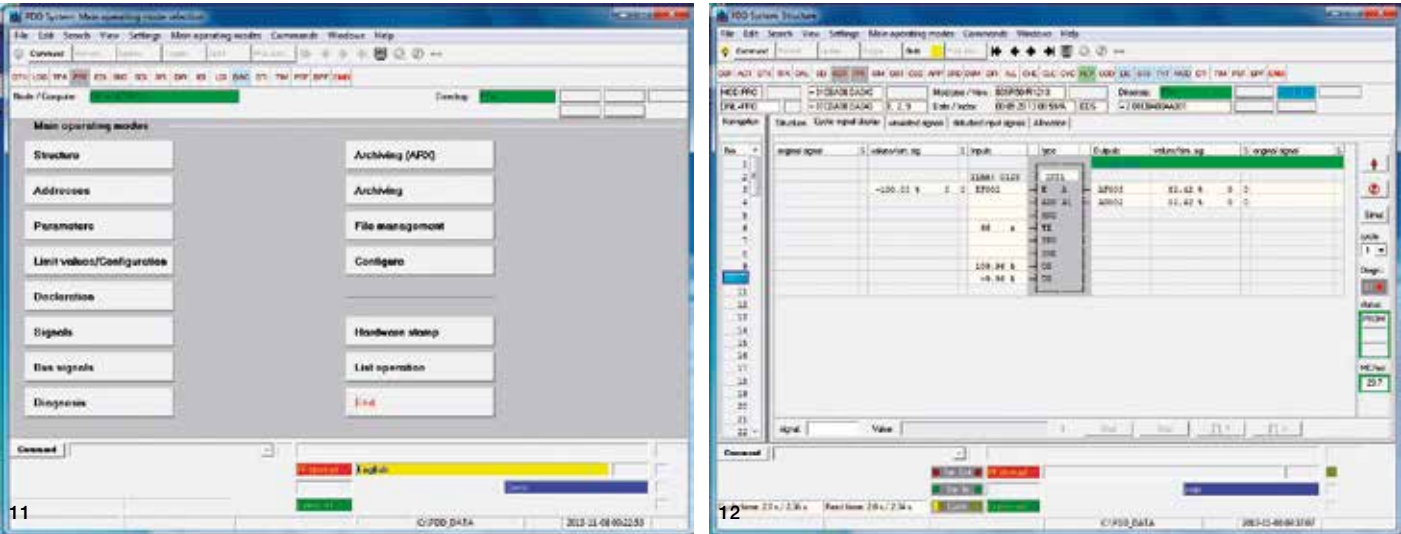
**Diagnosis and maintenance**

The control diagnostic system (CDS) builds on two of Procontrol P14’s unique features: that each I/O has its own microprocessor and is therefore independent and able to monitor and diagnose itself; and that all process data is available via the bus to all other modules within the system. As a result, CDS is able to recognize all the modules in the system and display them graphically together with their current status information.

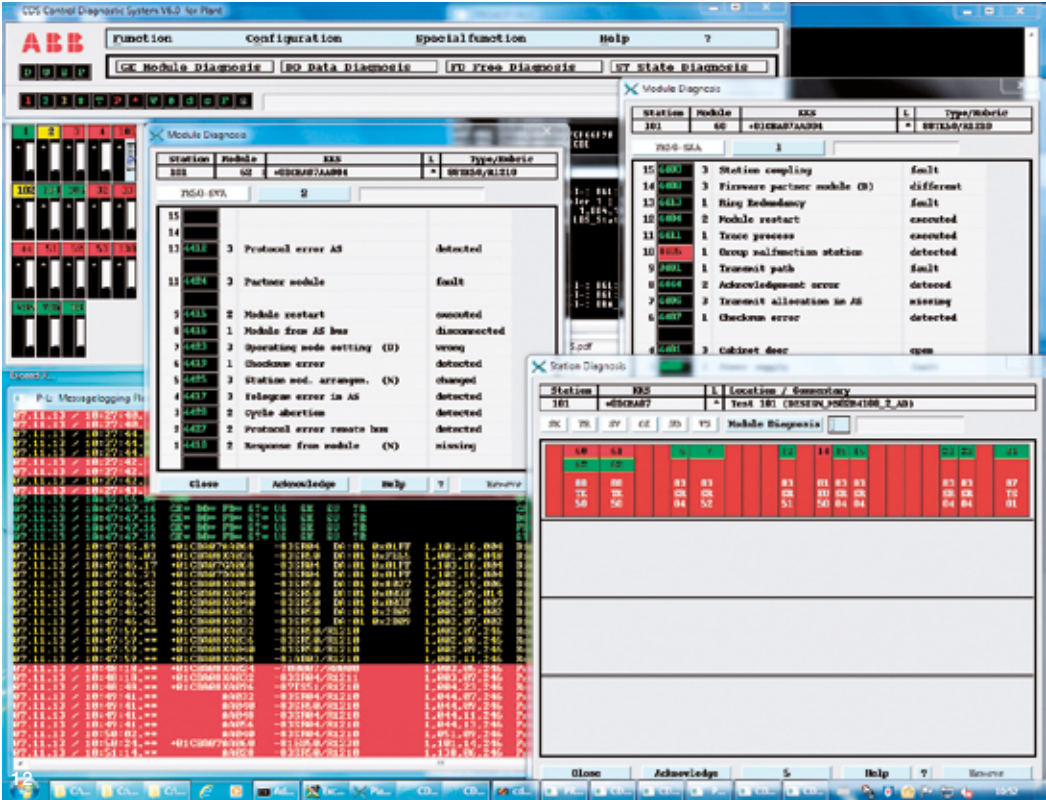
Each I/O module communicates its status data, type and location. From this information, CDS generates the control system graphically on the screen and shows all the cabinets. Cabinets can be individually identified and their states are indicated by different colors. Clicking on a cabinet ‘opens’ its door and shows the modules in their racks graphically. Clicking a second time on a module displays the current contents of the diagnosis register of that module. If a failure occurs CDS guides the user by highlighting the cabinet, module and register concerned and by displaying a description of the cause.

CDS also provides an online recommendation for corrective action. It includes a report function for analyzing control system and process disturbances such as crossing a limit value. Recorded data can be filtered according to period of time, components and type disturbances. CDS’s clear graphic displays enable a comprehensive diagnosis down to the transmitter level without having to be specially configured. This makes it a valuable instrument for efficiently diagnosing and correcting disturbances.

11 PDDS main operating mode | 12 PDDS system structure



13 CDS system overview





# Reliable turbine automation

## Turbine control system

The turbine control system comprises standard Procontrol P14 universal control and I/O modules and includes functions for:

- Signal conditioning
- Protection
- Binary control
- Analog control
- Monitoring

Each of these functions has a clearly defined task while running up or shutting down the turbine and while operating in the load control mode. The measured variables are preprocessed in the electronic input circuits of the binary and analog control modules.



Procontrol P14 components have proved extremely reliable for turbine protection. As with other parts of the power plant control system, the turbine control system has a hierarchical structure and a functionally distributed layout. Control of the turbine is fully automatic. The turbine regulator part of the steam turbine control system is designed to control small to medium-sized turbines in mainly industrial applications, as well as the large re-heater turbines used by power utilities (TURBOTROL).

Highly adaptable standard modules enable a wide range of applications to be covered using standard, well-proven configurations. For example, to raise the efficiency of power plants it is common to tap off some of the steam between IP and LP turbines for district heating. The associated district heating controller can be implemented using TURBOTURN and as an extension to TURBOTROL.

# Boiler protection

## Safe and SIL 3 certified boiler control



14 TÜV certificate | 15 Relay output module 81AR01 | 16 Analog input module 81EA04 | 17 Universal control module 83SR04



Procontrol P14 is a safety-oriented control system that switches the process to a safe state before a potentially dangerous situation can become critical. The P14 boiler protection system, Procontrol PF, is a three-channel 2003 protection system that is SIL 3 certified by TÜV SÜD in accordance with IEC 61511. It includes standard test functions for periodically testing all the protection system components such as input signals, input modules and output signals.

Even during periodic testing, the protection system is in the active state in order to trigger emergency trips if required. The FDDI bus provides Procontrol PF with a non-interacting connection to all the plant control functions. All relevant data for archiving, diagnostics and operation are therefore available throughout the control system at all times.

The use of field-proven modules of identical design requires no additional interfacing efforts and facilitates diagnosis and maintenance activities. Safety-relevant signals and circuits are generated, processed and tested within the protection system.

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