Procontrol P14

Complete power plant control system

Reliable and effective power plant automation

ABB launched Procontrol™ P14 more than 40 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 more than 500 installations in 34 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

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

Effective plant management with System 800xA Operations

Operator Workplace
This is the main work environment for operators, providing them with control and supervision of the underlying processes. Process data, as well as data from systems integrated in System 800xA, are all presented in the operator workplace.

The Operator Workplace coordinates and manages toolbars, graphic displays, alarm lists, faceplates, etc., to give operators the best possible user experience. Built-in rules make sure that the information required is always visible or easily accessible.

Navigation concepts, mainly the context menu, provide operators with easy access to all information in the system. In addition, the Operator Workplace is highly configurable.

Each workplace can be configured with up to four screens and several Operator Workplaces can be combined to one unit to create even better control possibilities for the operator. Operator Workplace also comes with a predefined layout with details of what to show on each screen and where on each screen the toolbars and displays will be presented.

Process Graphics
Process Graphics is integrated in the Operator Workplace to present graphic displays with live data to the operator. Live data is fetched via OPC and presented to the user in real time. Expressions in the graphic display can be used to calculate live data based on one or more OPC properties. Graphical libraries will provide standardized graphical elements that can be reused in different graphic displays, contributing to a clean and well thought out look and feel. A set of new High Performance HMI elements based on the best-practice principles in Human Machine Interfaces have been added to the graphics library.

Right clicking on an object in a graphic display will launch the context menu, allowing the operator to navigate within the operator workplace, launch the object's faceplate, acknowledge alarms, etc. Left clicking will launch the default aspect on the selected object – typically the faceplate.

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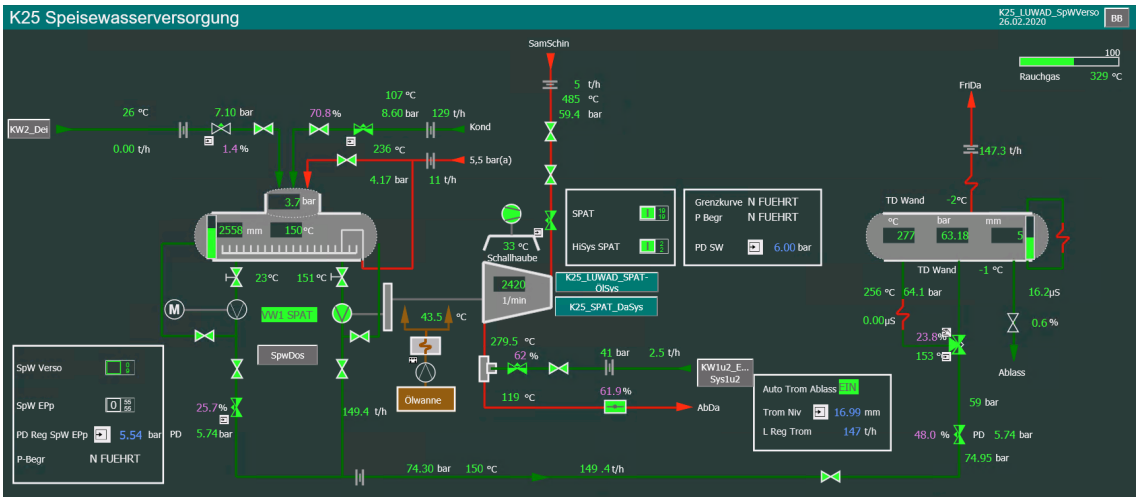
01 Mimic diagram 800xA



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02 Faceplates 800xA

Faceplates
Faceplates are designed mainly for operators to monitor and control a process. Each object can have up to three different sized faceplates, depending on the needs of the object and the user.

The faceplate framework, a part of the operator workplace, helps ensure that product-supplied faceplates are straightforward and intuitive. Three standard sizes of faceplates (reduced, normal and extended) provide the operator with the number of details required.

Alarm & Event management
Alarm & Event management is supported at several levels throughout the system. Alarms and events are treated in a consistent way (an alarm is an event that alerts the user of an abnormal state and that needs to be acknowledged).

Alarms are always presented to the operator in obvious and clear ways inside the Operator Workplace. In addition to alarm indications in graphic displays and on faceplates.

Events are presented in chronologically-ordered event lists (like the alarm lists) but without the possibility to acknowledge. Event lists display all events matching the configured filter for that list.

Trend display
Trend displays are one of the most important tools associated with operating and analyzing industrial processes. The Operator Workplace addresses this need by presenting the operator with an extensive set of trending features and functions. Trend Display presents data seamlessly from both run-time and historical data.

A trend display can display several trend traces in the same display, e.g. one trace for the value and another for an alarm limit. Users can modify the time and time resolution on the display when working with the trend. Values can be presented in relation to each other in an XY-plot diagram.

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 TCP/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.

03 Universal I/O module 81EU50

04 Universal control module 83SR50

05 Remote bus coupling module 88TK50

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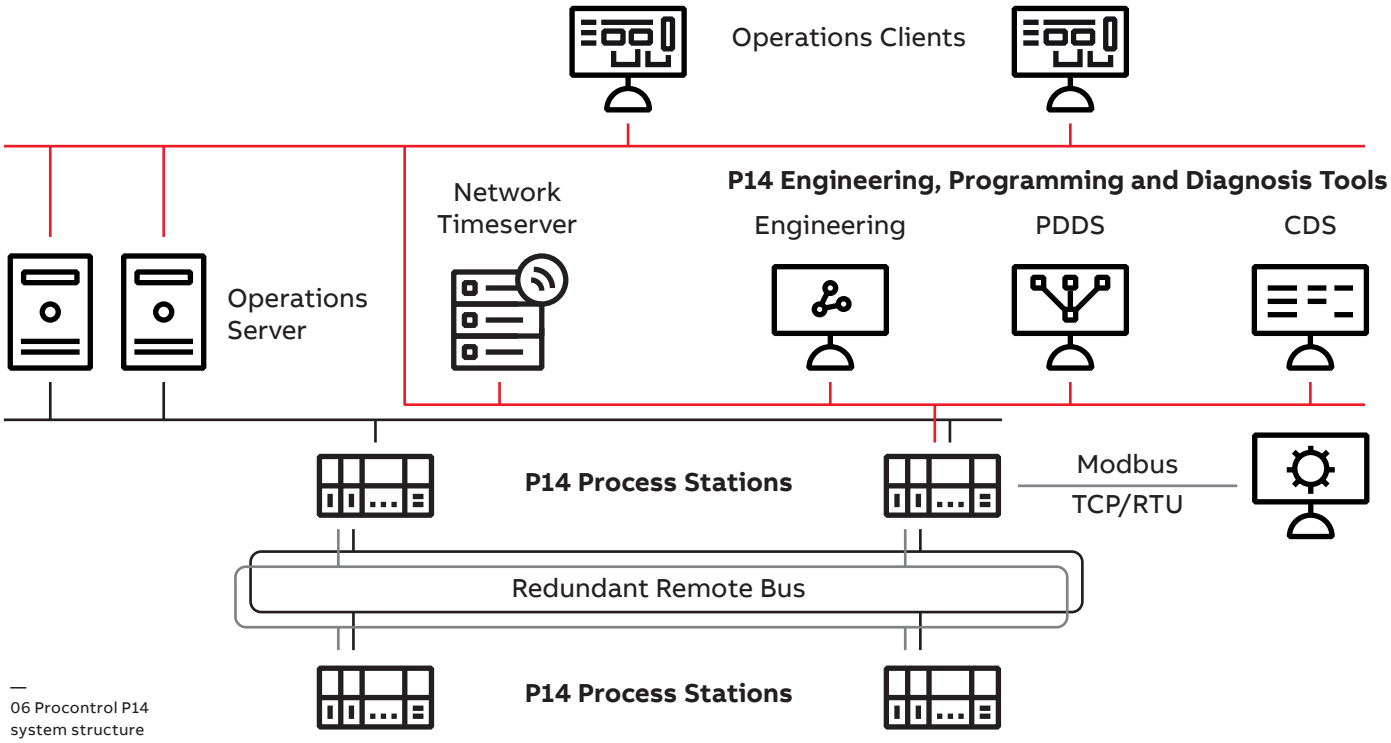
Single communication system with exceptional flexibility



06 Procontrol P14 system structure

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.

PROCONTROL P14

P14 Engineering – Engineering, Configuration and Service System

Configuration, Engineering, Information, Documentation and Service
Since it is directly connected to the PROCONTROL P14 bus, P14 Engineering has access to all the modules of the internal control system throughout the plant. Integrated database management ensures that the plant data and its appertaining documentation are always consistent and “up-to-date”.

A network links P14 Engineering to the HMI system and the Programming, Diagnosis and Display System (PDDS).

P14 Engineering is designed for the Microsoft Windows® operating system and runs on standard personal computers. An extendable client/server architecture supports multiple users operating in a network environment.

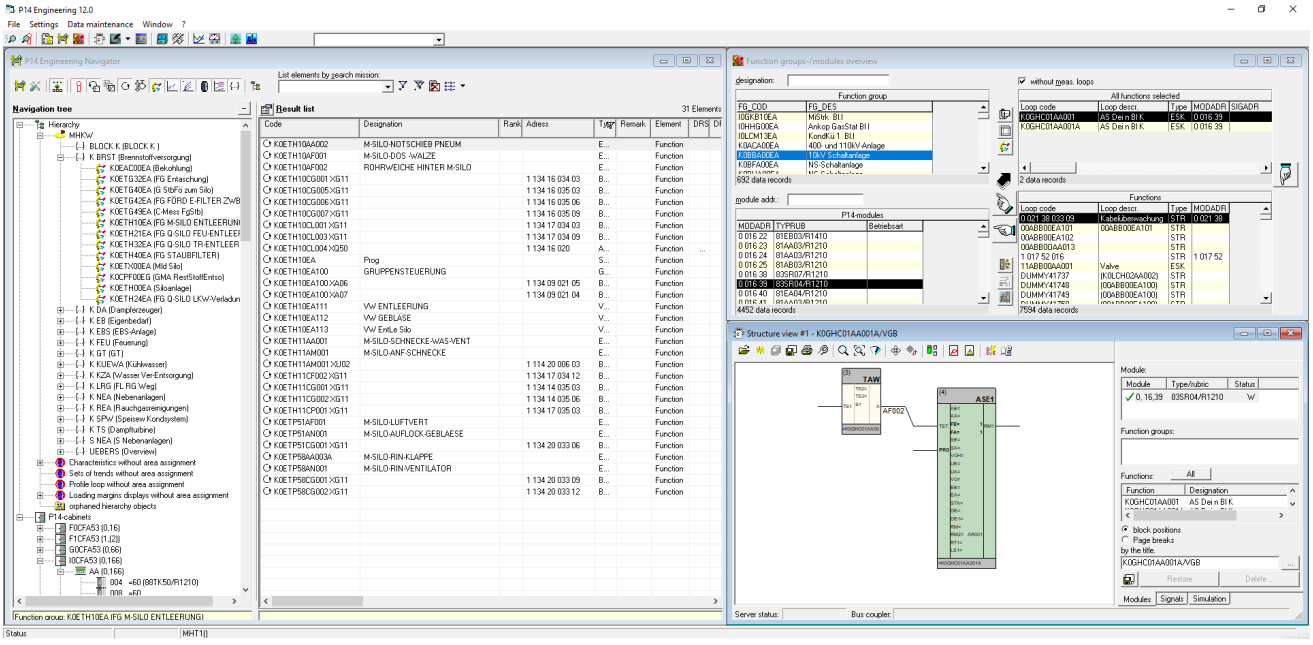
The main tasks of P14 Engineering are:
- Hierarchical data structure in the P14 Engineering Navigator
- Data input for the acquisition and maintenance of measurement and drive data
- Functional planning - a must for cross-system engineering
- Graphic re-documentation
- Online function plan - service made easy
- System planning
- Wiring planning
- Service and diagnostics
- User and rights management
- Documentation and Information Management
- Import / export functions - processing mass data

P14 Engineering offers both a function-oriented as well as a location-oriented way of working. The power plant designation system or the device location can be used to identify engineering objects. A function is displayed graphically in a functional chart in which the user can make all changes directly.

The graphic editor knows all PROCONTROL P14 function blocks and their link rules. The function blocks and connections are automatically arranged in the functional diagram.

P14 Engineering updates and automatically displays all connections to other function charts. All cross-references are therefore always up-to-date and it is possible to navigate through horizontally-linked function charts by simply selecting the inputs and outputs.

07 P14 Engineering
User-Interface



If changes are made at any point in the control system, P14 Engineering will automatically update all affected function charts. Faulty connections are checked during entry and rejected if necessary.

System Architecture
The system architecture of the P14 Engineering system can range from a single station to a complex client/server architecture. Individual adaption to the size of the control system is possible. One P14 Engineering server can be used for several plants or individual plant parts.

The P14 Engineering server communicates with the clients via the engineering network. In the planning phase P14 Engineering can operate without connection to the control system. Commissioning and maintenance require a connection to the PROCONTROL bus.

Comprehensive Functionalities
The P14 Engineering system contains all applications necessary for a concurrent engineering of the process control system. Starting with the applications for the definition of measuring points and loops, for function design, system and cabinet layout, system wiring and the application for service and diagnostics, all functions are available which allow effective system configuration, documentation, commissioning and maintenance.
The integrated documentation and information management system simplifies the view of design data entered, including the integrated third-party documents. For easy handling, the P14 Engineering applications are arranged in several views. These views support the organization, navigation and localization of control system data and documents.

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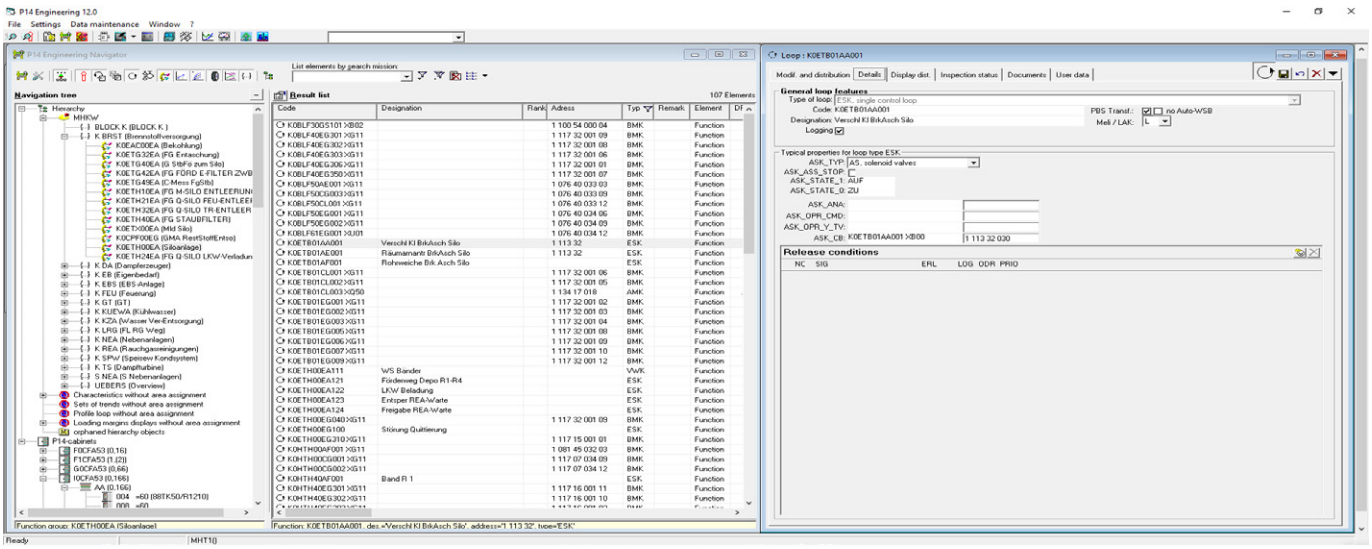
08 P14 Engineering Navigator



Easy and efficient configuration and programming

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

09 PDDS main operating mode

10 PDDS system structure

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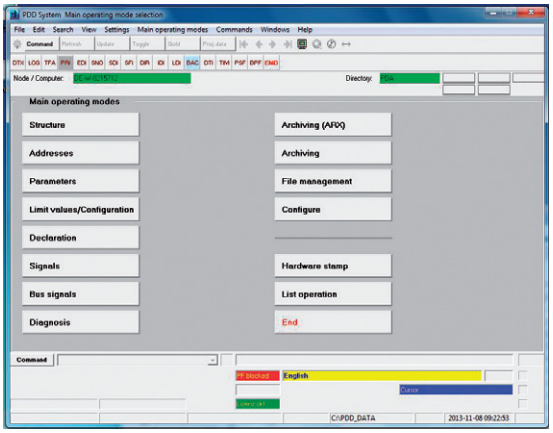

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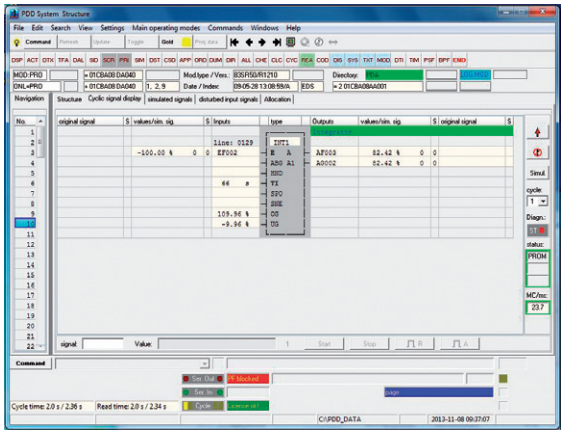

Self-diagnosis and rapid corrective action

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.

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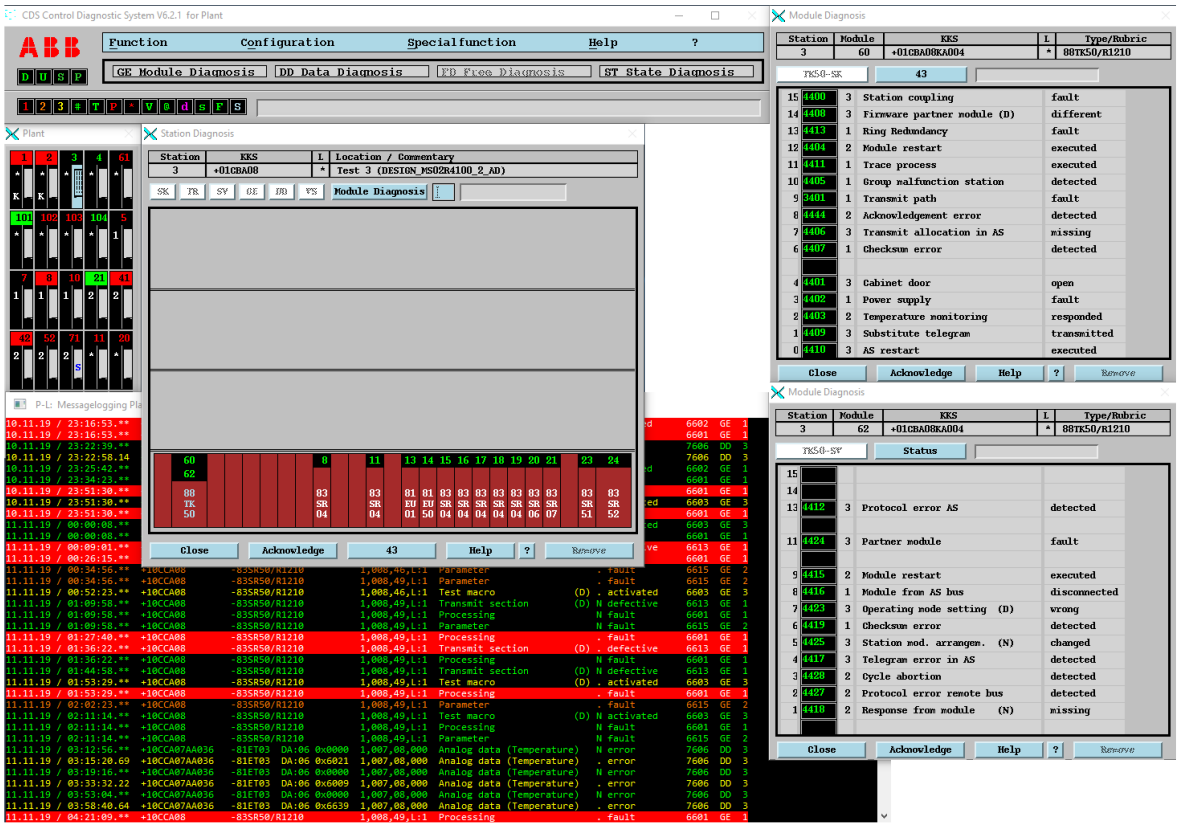
11 CDS system overview



Reliable turbine automation

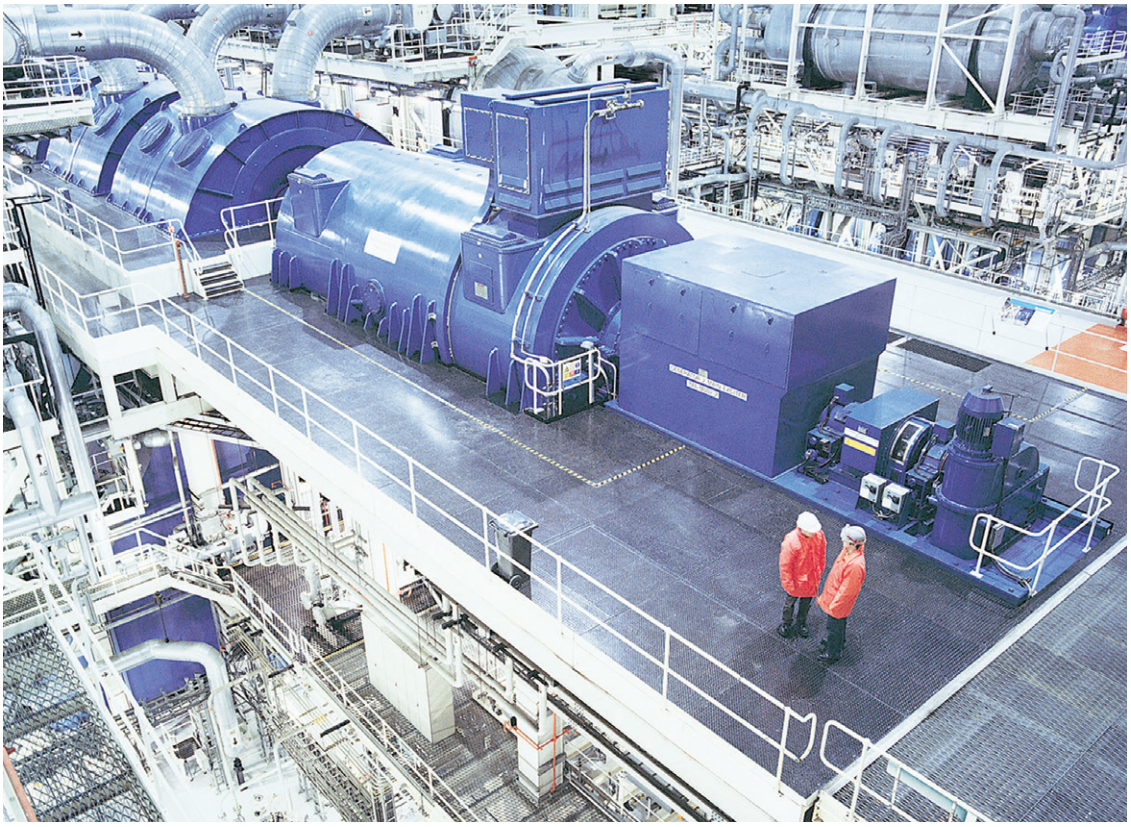
Turbine control system
The turbine control system comprises standard Procontrol P14 universal control and I/O modules and includes functions for:

- 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.



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