



Expert Report

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BOSCH
 Invented for life

Future-proof regulating and control technology boiler systems

Bosch Industriekessel GmbH was the first boiler manufacturer to use SPC-based controls as standard for shell boilers in 2001. The concept was a sweeping success in the market and has since become standard equipment.

The control systems are continually being further developed. Thanks to graphically guided and intuitively operated touchscreen displays in conjunction with programmable logic controllers, the highest levels of connectivity and transparency of operating data are achieved.

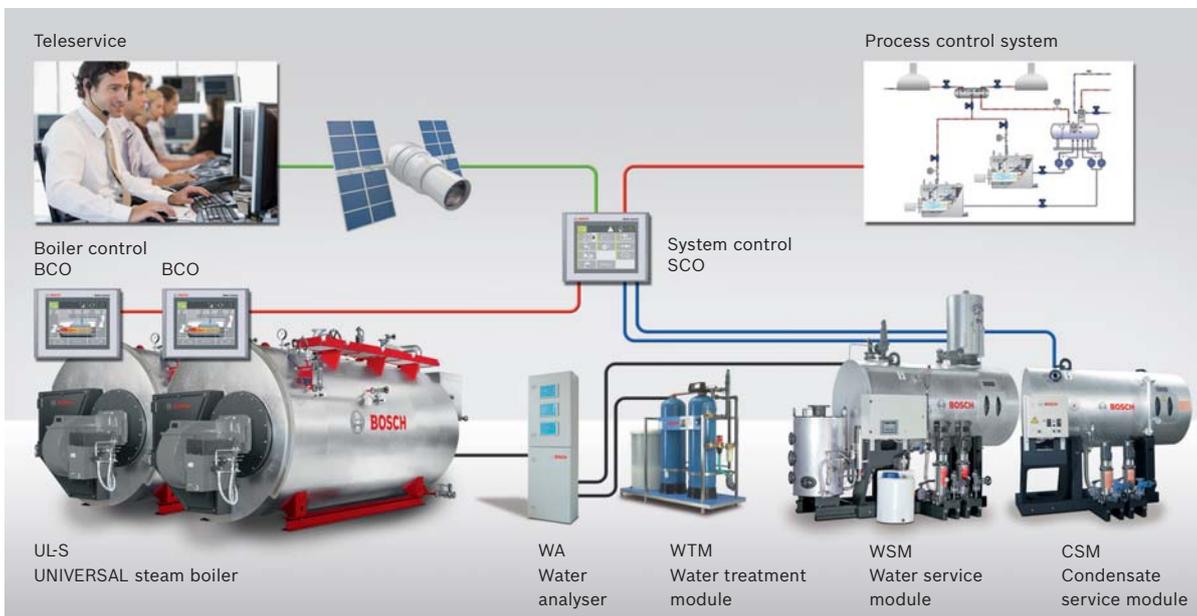


Fig. 1:
 Second-generation
 Boiler Control,
 System Control BCO/
 SCO modular SPC
 control system

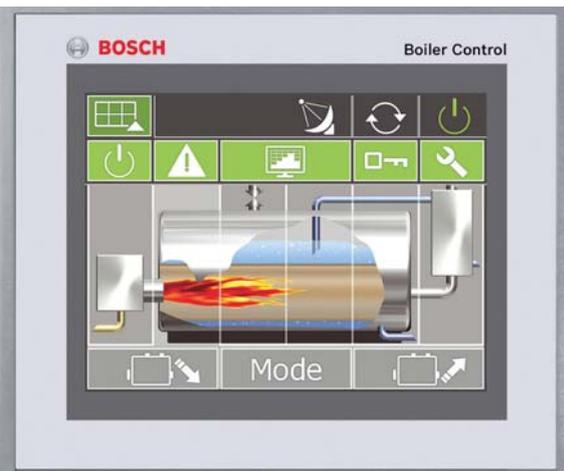


Fig. 2: Touch-screen display on the Boiler Control BCO on a steam boiler with Economiser

Development history

The Bosch Industriekessel GmbH has been operating its own switchgear construction unit since the beginning of the 1960s. The development and manufacture of its own electronically based boiler control and safety systems has led to major safety improvements in the operation of steam and hot water boilers.

- 1965** Fault alarm and display device with memory (German Patent)
- 1966** Electronically based furnace monitoring device (German Patent)
- 1977** Self-monitoring electrode control and monitoring (German Patent)
- 1994** Device for monitoring the water level of a boiler (German Patent)
- 2000** Method for regulating the performance of a steam boiler (German Patent)
- 2001** SPC-based boiler and system control system BCO/SCO
- 2004** Fully automatic water analysis device WA
- 2007** Second generation boiler and system control system BCO / SCO with touch-screen display
- 2010** Automatic start-up equipment for steam boiler systems
- 2013** Condition Monitoring basic

The hardware

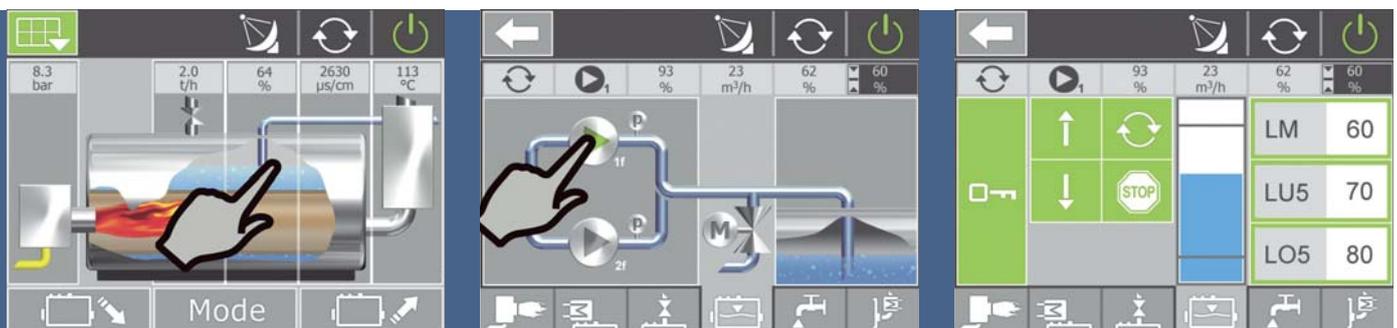
Industry-proven hardware in the area of stored-program controllers is used in the innovative boiler management systems. The devices take over all the control and regulating functions of the boiler or boiler system and can communicate via bus systems or networks with other controls (e.g. burner management systems, separate controls for boiler house modules, higher-level control systems). The safety chain is carried out using conventional contactor and relay technology.

All control software is saved on a Micro Memory Card. There is thus no need for contactor batteries or Eeproms to protect against power losses. The devices are space-saving, modular and are screwed together on a profile bar to create a robust structure with appropriate EMC. Depending on requirements, optional devices such as additional inputs and outputs or a Profibus DP communication processor for connection to the central management system can be added. An Industrial Ethernet network for connecting several control modules or as preparation for the Teleservice system are further options. A secure connection to the network is created via an analogue or ISDN connection if the Teleservice is used. Control parameters can be analysed and optimised, remote diagnosis can be created or sources of faults eliminated. This means that every operating step taken locally by the operator can be followed exactly, or the system can be remote-controlled by the service operator under the supervision of the user. This means that first-class support services or training measures are now possible.

A graphic TFT display with touch-sensitive interface is used for display and operation. Its extremely long working life plus its intensive light and contrasts mean that it is ideal for the toughest industrial use. The customer can choose between two sizes.

The entry-level class, at 8", provides plenty of space for boiler system display and operation.

Fig. 3: If the feed water connector piece is touched, the pump settings and regulating parameters can be changed in the next operating pictures



A 10" version is also available as an option. Both panels have a resolution of 640 x 480 pixels and 65 536 colours, allowing even the most complex situations to be displayed in clear detail.

With both display and operating units, both the graphic menu structures and operating messages and the process value archive are saved on an MMC Multi-Media-Card.

The software

Software function modules that are specially tailored to the relevant boiler and boiler system regulating requirements and tested at the factory meet the complex, demanding requirements of safe boiler operation. Customers benefit from a wide range of systems in which the individual software modules have already been used and tested many times over in practice. Special individual programs, as is normal with other manufacturers, are only required in rare exceptional cases.

Graphic user guidance with maximum operating data transparency

For easy operation, the symbols, graphics and user menus on the touch-screen displays have been designed in accordance with the latest developments in ergonomics and usability. All the available control and regulating functions can be called up intuitively, and actual and setpoint values can be shown or changed in the colour display.

Even with the basic version of BCO, many operating statuses, measured values and operating data are shown in the graphic display. These always include, for example, the operating hours for the boiler, the burner (in the case of two burners per boiler, separately for both burners) and the number of burner starts. All the set switching points, switching differences and limit contacts can be shown.

Important process data are saved within a specified interval on the memory card of the boiler or system control. Depending on the size of the memory card and the intervals, the data can be called up for days or weeks in this process value archive. The archive is structured on a rolling basis – once the memory capacity has been reached, the oldest process data are deleted and the newest are archived. These can then be called up on the displays in the form of graphic curve diagrams.

It is also possible for the Customer Service to read out the process value archive. The data can be further processed as required within word-processing or table editing systems.

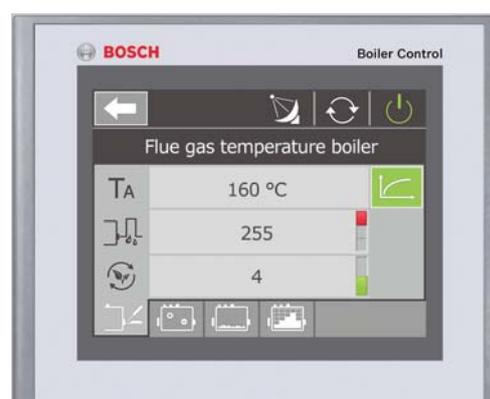
Analyses of fuel consumption, steam production or temperatures are easier than ever before. The outstanding operating data transparency means that it is easy to optimise the regulating parameters, thus lowering energy consumption, pollutant emissions and wear and tear to the boiler.

Integrated protective functions help prevent incorrect operation

Protective functions are integrated into all the control and regulating mechanisms in the boiler or system. BCO/SCO, for example, makes sure that speed-regulating pumps can only be operated in their permitted ranges, i.e. that the flow quantities do not go above or below the minimum or maximum levels. Programmed delay times prevent the pulsing operation of burners and the negative effect this has in terms of increased wear and fuel consumption. If an integrated water analysis device detects a change in hardness, the make-up water valve is closed and the system is protected against the negative consequences. The position is similar if contaminated condensate flows are detected – the condensate is discharged immediately without any damage to the system.

But the systems are also protected against incorrect operation. The operator can only change settings within ranges that are unproblematic in terms of operating technology and safety. All other parameters which could cause severe damage or safety risks are integrated in a deeper, access-protected administrative level of the control devices. Only Customer Service engineers can make interventions at this level.

Fig. 4: Detailed view with a new, visual message in the form of a „traffic light function“

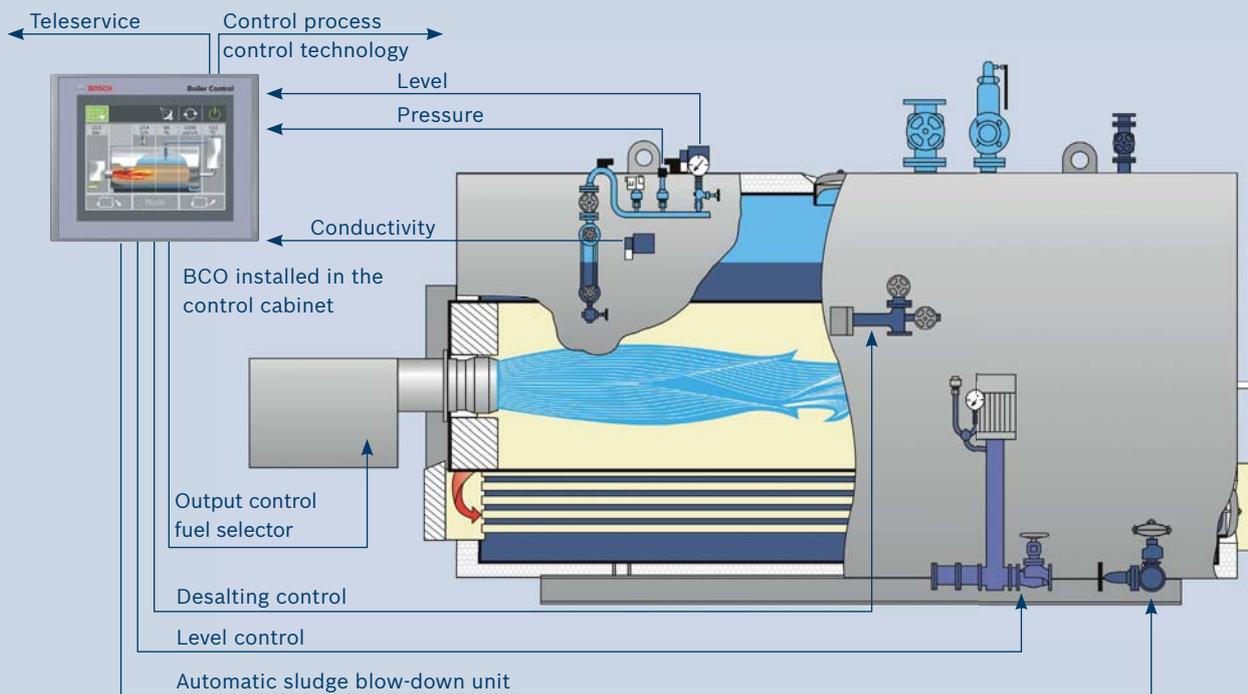


Condition Monitoring basic

CM_{basic} offers the customer the opportunity of monitoring not only the efficiency of his system but also its proper operation. The system data is analysed, evaluated and displayed transparently by means of a traffic light model. The calculation algorithms are aimed at

providing a detailed diagnostic forecast. Operating methods, which result in inefficiency, increased wear or unplanned stoppages, can therefore be detected at an early stage and thereby avoided. CM_{basic} has a positive effect on maintaining a consistently high level of system efficiency and availability in the boiler system.

Fig. 5: Basic function of BCO boiler control for steam boilers



Functions in detail

Functions in steam boiler systems

Boiler Control BCO for steam boiler systems

Regulation of the boiler output is suitable for gas, oil or dual burners with electronic or mechanical network. BCO can be used with boiler systems with stage-controlled or modulating burners.

Level regulation can be made as two-step or continuous regulation. A continuous regulation can be realised using speed-regulated feed pumps with integrated pump protection functions or using a continuous regulating module with overflow return flow.

Desalting regulation and automatic blowdown are further BCO functions.

Above and beyond these 4 basic functions, with which almost every modern steam boiler is equipped, BCO can be expanded using additional options and functions, e.g.:

- ▶ Automatic start-up from cold status (see technical report "Automatic start-up equipment for steam boiler systems").
- ▶ Measuring and control of the flue gas temperature for boilers with an economiser.
- ▶ Measuring and control of the superheated steam temperature for boilers with a superheater.

- ▶ Measuring of the volume flows of steam, feed water and fuel.
- ▶ Automatic feed pump switchover, using pressure, time or fault detection.
- ▶ Time-controlled heat maintenance with pressure reduction.
- ▶ Display of operating hours, start frequency and number of cold starts in the course of the time period.
- ▶ Detection of unfavourable start-up conditions.
- ▶ Detection of water and contamination on the flue gas side, as well as undesirable condensation.
- ▶ Generation of maintenance messages as required.
- ▶ Depiction of any loss of energy due to sludge blow-down and desalination. *
- ▶ Display of fuel and water consumption in the course of the time period. *
- ▶ Display of the steam call-off quantity in the course of the time period. *
- ▶ Display of the boiler load profile in the course of the time period. *
- ▶ Connection to overarching control systems.
- ▶ Teleservice on request or with Teleservice contract.

*The boiler system equipment can be configured to suit individual customer requirements. Due to the measuring and control equipment selected, it is possible that various functions may be restricted or may not be available.

Servo drives, e.g. for the steam removal valve or the flue gas valve, can be controlled automatically or by manual intervention. BCO is also prepared for unsupervised operation for 72 hours (based on EN 12953).

System Control SCO for steam boiler systems

System Control SCO brings the controls of steam boilers and any individual module controls together into an overall management system, opening up a wide range of possibilities.

SCO takes over the sequence control of multiboiler systems. Depending on customer requirements and needs, it is possible to choose from various control and regulating options. The quantity of steam or the network pressure can be taken as the regulating parameter. The follow-on boilers are then switched on by the opening of a steam volume regulating valve or by increasing the boiler pressure, which has been lowered for the stand-by time, to the network pressure.

The innovative water analyzer can also be integrated. The system is thus completely automated and protected from the water side too. Through exact dosage of chemicals and control of the vapour steam valve it is possible to save water, energy, chemicals and operating costs and also to protect the environment.

There is no need for separate control units for deaeration systems, condensate systems, foreign body monitoring system and oil supply devices. All functions can be integrated into the SCO.

Fig. 6: In the SCO overview dialogue, the individual system components, such as feed water tank, multiboiler systems, fuel supply are shown using easy-to-understand symbols – touch the symbol and the component in question is displayed (right-hand picture: feed water tank with deaeration)

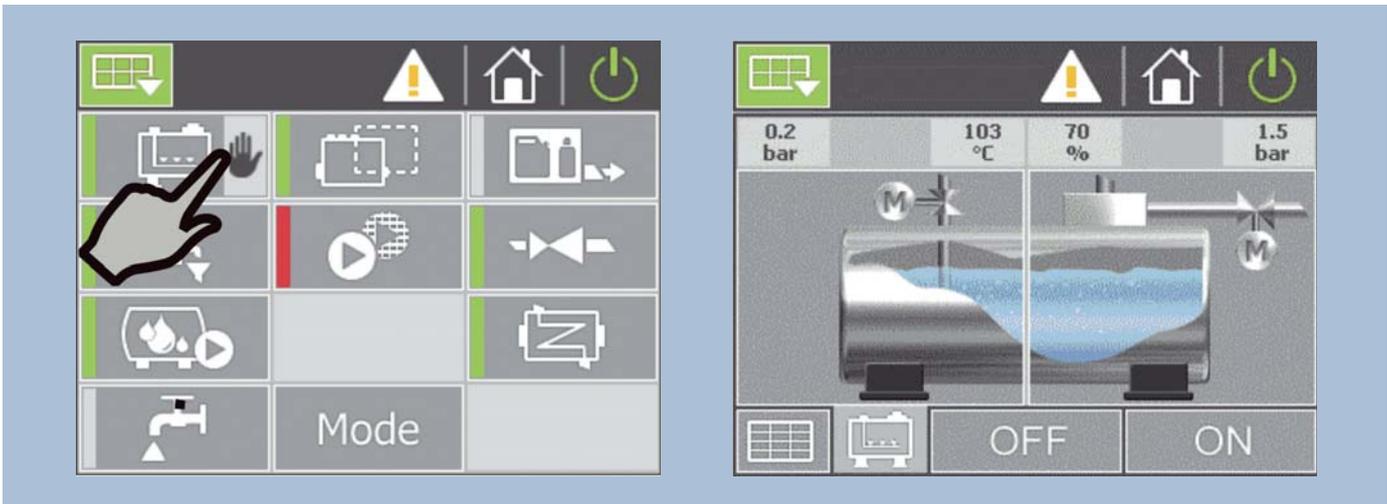
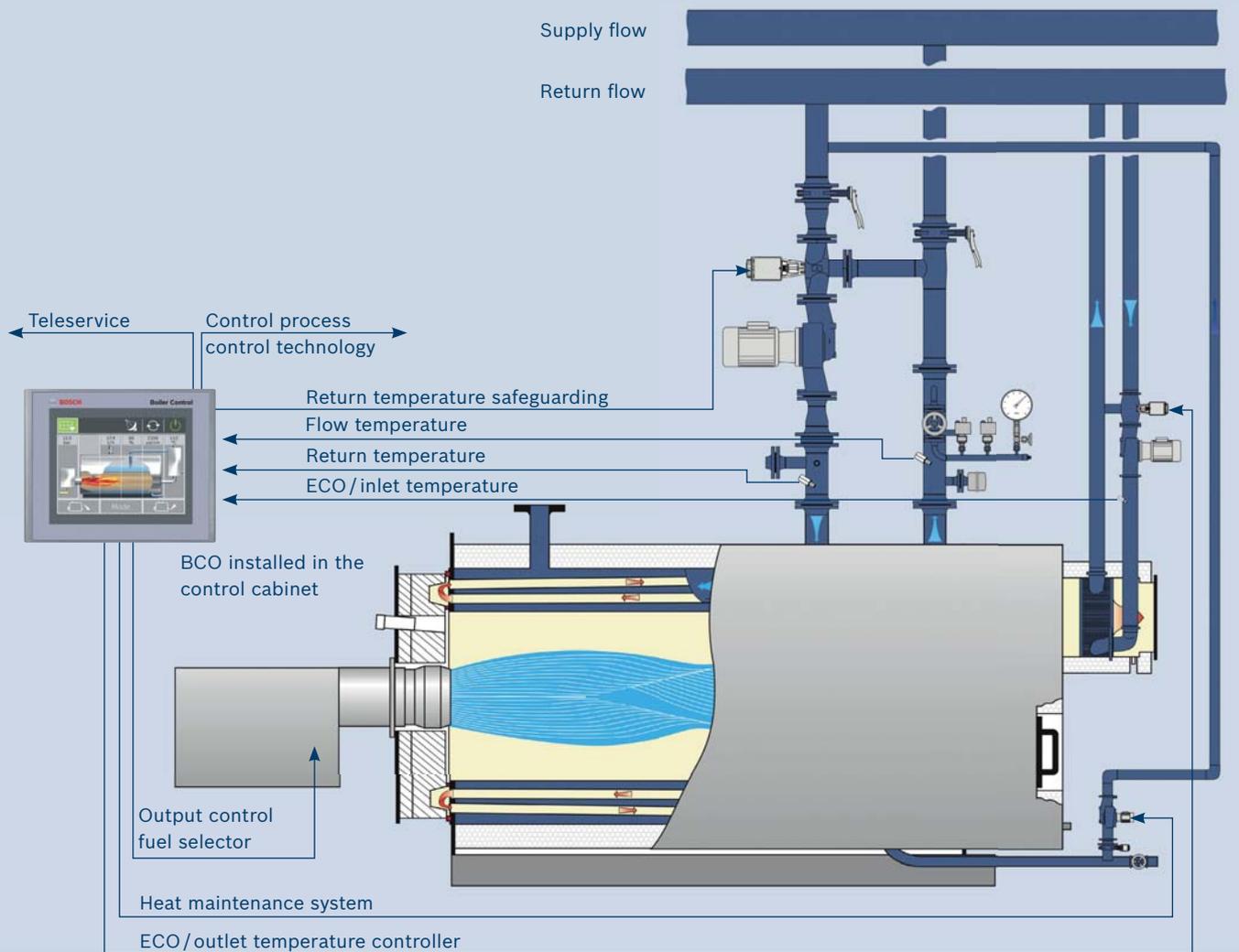


Fig. 7: BCO functions for hot water boilers



Functions in hot water boiler systems

Boiler Control BCO for hot water boiler systems

The basic functions of the BCO for hot water boilers correspond to the boiler control for steam boiler systems. Beside these basic functions, there are also other possible measuring and control functions specially for hot water boiler systems:

- ▶ Measuring and control of the heat exchanger inlet temperature for boilers with an economiser or flue gas condenser.
- ▶ Measuring and control of the flow temperature.
- ▶ Return flow temperature safeguard by means of an admixing pump.
- ▶ Time-controlled heat maintenance.
- ▶ Display of operating hours, start frequency and number of cold starts in the course of the time period.
- ▶ Detection of unfavourable start-up conditions.
- ▶ Detection of water and contamination on the flue gas side, as well as undesirable condensation.
- ▶ Generation of maintenance messages as required.
- ▶ Display of fuel and water consumption in the course of the time period. *
- ▶ Display of the boiler load profile in the course of the time period. *
- ▶ Connection to overarching control systems.
- ▶ Teleservice on request or with Teleservice contract.

*The boiler system equipment can be configured to suit individual customer requirements. Due to the measuring and control equipment selected, it is possible that various functions may be restricted or may not be available.

System Control SCO for hot water boiler systems

As with steam boiler systems, System Control brings together the individual hot water boiler control systems into a higher-level management system. SCO is used for the sequence control of multiboiler systems, the integration of deaeration systems, water analysis devices, foreign body monitoring systems, fuel supply devices, all sorts of pressure and temperature regulation systems, return flow temperature maintenance or weather-based boiler regulation.

Benefits at a glance

Advantages for planners and plant contractors

Conventional relay logic with electromechanical operating elements, switches, individual digital regulators, time switches and operating and control signals has been almost completely replaced.

Maximum planning and functional reliability is achieved through the use of tried and tested industrial standards and factory-tested software modules used in series. Connection with overarching visualisation and control systems is possible by means of an optional bus interface. The reduction in the number of appliances reduces coordination and arrangement requirements. Assembly and commissioning times are simplified and shortened through the use of plug-in connections and presettings at the factory.

Benefits to the customer

The central BCO/SCO automation device contains all the operating and functional logistics required in a steam boiler or hot water boiler system.

- ▶ BCO/SCO allows all measuring and regulating functions to be easily optimised. Energy consumption, pollutant emissions and wear and tear are minimised.
- ▶ BCO/SCO guarantees maximum supply and operating reliability. An extensive operating message memory with integrated early warning system means that badly set regulating parameters can be detected and corrected before any shut-down due to faults.
- ▶ BCO/SCO gives maximum operating data transparency. A wide range of operating states, operating data and measured data can be shown in the graphic touch-screen display.

- ▶ BCO/SCO generates maintenance messages as required.
- ▶ BCO/SCO monitors the efficiency and proper operation of the system.
- ▶ BCO/SCO meets all the special requirements of modern boiler control and is suitable for later expansion, modification and updating.
- ▶ BCO/SCO provides intuitive operation through the use of graphic symbols and displays on modern touch-screen colour monitors.
- ▶ BCO/SCO prevents incorrect operation through its integrated protective functions.
- ▶ BCO/SCO is prepared for data exchange with higher-level control systems and the Teleservice facility.
- ▶ The Teleservice option allows the operating interface to be mirrored and provides rapid assistance in the event of operating problems and the search for faults.

With the control modules of BCO boiler control and SCO system control, you are ideally set up for the challenges of the future.

Production facilities:

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Factory 2 Schlungenhof

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Factory 3 Bischofshofen

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