Fisher-Rosemount Systems

2003 Customer Guide
For
Boiler Control Package

Introducing the Boiler Control Package

This document has been written for Fisher-Rosemount customers considering new or upgraded boiler controls.

What's a Boiler Control Package (BCP)?

Fisher-Rosemount's Boiler Control Package provides a pre-engineered control strategy for gas-fired (and optionally oil-fired) boilers. These controls comply with National Fire Protection Association 8501 guidelines. They include feedwater and 3-element drum level, plus combustion controls with boilermaster, parallel metered air and fuel, with oxygen trim. Steam header control for two boilers is standard with the package.

Configuration software is provided via e-mail or with the DeltaV system. One electronic copy of documentation in PDF format is provided that includes design, an operator's manual, and a startup and maintenance manual.

The Boiler Control Package is designed for application by anyone experienced with DeltaV hardware and software configuration. First developed in 1989, this package addresses small-, medium-, and larger-sized boiler applications. In addition to the package, we can customize the package specific to your boiler.

Why improve boiler controls?

Reasons include: Automating a new installation where reliable boiler controls is essential, retrofitting existing units to eliminate upsets that impact plant operations, or for reduced fuel cost by improving boiler efficiency. On gas-fired boilers, a 1% fuel savings with fuel cost of $4/therm could save $44k/year. Larger boilers favor even greater economic savings. Boilers using jackshafts are often inefficient with fuel and offer higher return on investment.

Since boilers are a key element to keeping any operation running smoothly, customers need a reliable, efficient, and well-engineered solution. The Fisher-Rosemount Boiler Control Package has been used successfully in more than 100 installations including those firing single fuels, gas or oil fuel, multiple fuels, waste fuels, stoker fired boilers, and with steam capacities ranging from 15 to 400 KPPH.

Why use pre-configured software?

Because it includes the best control techniques, BCP saves a lot on engineering and provides significant economic advantage. Cost is typically less than half that required for a custom solution, even when using an integrator who's knowledgeable in boiler control and experienced with the control system. Customers with multiple sites prefer to standardize their boiler control systems to avoid the mistakes and inconsistencies in design and implementation that often arise when using different personnel from different companies.

What controls are provided?

The following is a more detailed description of the boiler controls. The control strategy includes the following capabilities:

- A plant steam header pressure loop provides adaptive gain for one or two boiler units. Load changes are rate-limited to allow feedwater systems to keep up with firing rates. Systems with only one standalone boiler or for those with more than two boilers are available as an option.

- A boiler master loop dedicated to each boiler regulates air and fuel flow control and provides individual unit load biasing. Transfers to the plant master for firing rate are bumpless and use ramping for smooth transitions to and from standalone operation.

- Fuel gas controls use parallel metering and cross-limiting with airflow. Cross-limiting means coordinated flow of fuel and air; i.e. as demand increases, air flow increases before the fuel does, and as demand decreases, fuel flow decreases before airflow. Fuel flow includes a low limit when in automatic mode, with manual control allowed over the full range. The base package is designed for use with single gas fuel, or for gas or oil firing (not-simultaneously).

- Airflow control uses parallel metering and cross-limiting with fuel flow, and is characterized with fuel. Because fuel is balanced with air at all loads, this enhances the performance of the unit over those strategies based simply on fuel BTU.

- Excess air trim is provided with stack oxygen and is adapted with load. The operator is allowed to bias fuel-to-air ratios within normal operating limits. For multiple fuels, the setpoint is adapted with fuel type and load.

- Drum level controls provide for 1- or 3-element operation. 1-element is automatically selected at low steam loads, when signals from field devices are bad, or whenever the operator wants to override. Selection of 3-element mode is either automatic (based on steam load) or can be held in 1-element mode by the operator. 3-element mode uses a cascade arrangement of level to feedwater flow with steam flow as a feedforward. If feedwater flow is not metered, an optional 2-element drum level control strategy is available.

- Mode transfers are bumpless and balanceless.

- To reduce hazards, all analog inputs used with control are monitored to detect loss of signal. When bad integrity is detected, the loop is automatically changed manual mode and alarmed to assure the operator kept aware of any problems.

- To help prevent errors and comply with NFPA, fuel flow, airflow, and boiler master modes are interlocked to provide correct operation during changes, or equipment failures.

- Standard displays include one typical for boiler details plus for one boiler plant overview or for use with maintaining steam header.

- Simulation of BCP is included: The simulation uses DeltaV logic that is separate and removed prior to operation.

What's not included?

Services are required to modify database or displays, plus startup support. Database is modified with specific tag names, descriptions, engineering units and ranges, words and limits used for alarms, and merging within the existing system. Additional services may also be required for functional modifications, additional controls, or monitor-only data.

Does the package provide burner management?

No. Burner Management System (BMS) functions are separate from boiler controls. Clients may retain their existing BMS or choose to modernize with a BMS based on DeltaV, PLC, or dedicated microprocessor.

Usually boiler controls are interfaced to the BMS for purge or light off. The advantages are faster lightoffs and fewer delays in getting the boiler operating. Options are available for single-burner gas fuel, or for gas or oil firing. When the BMS interface is requested, the minimum requirement with only one fuel is two discrete inputs. For gas or oil firing, five discretes are required. A detailed description will be provided with a proposal.

What documentation is provided?

The manual for Boiler Control Package is clearly and extensively documented. Configuration software is modular with thorough comments to clearly indicate purpose and activities. Manuals are not provided without purchase of a license and are supplied in PDF format.

What options are available?

We realize not all boilers are alike. To help meet individual customer needs, a number of options are available and additionally, we can support a wide variety of custom modifications like the following:

Questions to Consider	***Options***
Who can provide the technical services for modifying the database, displays, or merging with the existing database?	Technical services are available locally from local FR representatives to customize tags, descriptors, I/O configuration to reflect plant-naming conventions, and custom hardware

	layout.
How many boilers does the steam header pressure loop control?	The standard package controls two boilers. Options are available for controlling only one boiler or for more than two boilers.
How many fuels and type are fired?	The standard package has two versions: one for a single fuel, and the other for gas or oil firing (not simultaneously). An interface with Burner Management System for purge and light-off requests for use with gas or oil firing, is included. Combination firing with waste fuels is commonly done. Let us know if there are other fuels or differences and we can provide optional services to match the boiler.
Are any transmitters required to be redundant?	For boilers requiring high availability, this option is sometimes considered for steam header pressure, drum level, or oxygen.
Do the air fans use variable speed drive? Is a damper used in combination with VSD?	A variable speed drive may be used directly. However, where a damper is also used in combination with speed control additional services may be required.
Is furnace pressure controlled? If so, are there multiple pressure transmitters?	A furnace pressure control option is available for induced draft (ID) fans. For large units, three transmitters may be required to comply with NFPA.
How many elements are used for level control?	If feedwater flow is measured, 3-element control is used. If feedwater flow is not measured, then a drum level logic option is available for 2-element control (level and steam flow).
What if we have two or more burners?	If one fuel valve serves all burners, BCP requires no changes.

Is operator training available?	Operators are trained using the simulator included with BCP. This allows operators and engineers to experiment with both normal and abnormal conditions that affect unit operation. The training simulator is also useful for testing and verifying that the control strategy performs the correct actions.
Can fuel oil pressure be controlled with DCS?	This can be done as an option: however, this may be done using a standalone back-pressure regulator.

What about hardware architecture and function location?

High reliability is achieved with a simplex controller and I/O cards dedicated to each boiler. This allows each unit to be down separately and without impact on other parts of utility plants. Redundant controllers or I/O may be used for higher reliability, or where common utility items are required such as plant header pressure controls, deaerator, feedwater pumps, or water treatment.

Burner Management System (BMS) inputs for purge or low-fire should always be hardwired to the controller. BMS monitor inputs, which are not control-related, can be communicated by a serial input card.

Is there a software warranty?

Warranty on BCP licensed software is provided for 90 days after shipment and covers defects in workmanship and design. Any changes made in functionality not provided by factory consultation are not warranted and the customer may incur cost for any required assistance. During the warranty period, notification of possible problems and corrections are provided as updates.

Need more than just controls?

Emerson Process Management offers virtually all the process controls hardware, software, and services a user may need. Here's what can be provided:

- ASCO valves and switches http://www.ascovalve.com/
- Boiler Control Package http://www.easydeltav.com/solutions/boiler.asp
- Valves, positioners, and damper drives http://www.emersonprocess.com/fisher/
- Steam Conditioning Valves and Equipment http://www.emersonprocess.com/fisher/products/tour/contek.html
- On-off valves http://www.emersonprocess.com/valveautomation/

- Regulators for gas fuel regulation and steam atomization http://www.fisherregulators.com/
- Smart transmitters http://www.rosemount.com/
- O2 and combustible analyzers http://www.emersonprocess.com/raihome/
- Damper drives http://www.emersonprocess.com/proanalytic/products/Fandamper/fandampr.html
- Continuous Emissions Monitoring http://www.emersonprocess.com/proanalytic/
- Coriallis mass flow meters http://www.emersonprocess.com/micromotion/
- Brooks flowmeters and totalizers http://www.emersonprocess.com/brooks/
- UPS systems http://www.liebert.com/
- Electrical Motors http://www.usmotors.com/
- Variable speed drives http://www.controltechniques.com/
- Valve services http://www.emersonprocess.com/fisher//
- Educational Services http://www.easydeltav.com/solutions/train/index.asp
- Boiler commissioning services http://www.control-dynamics.com/
- DeltaV based Burner Management Systems http://www.control-dynamics.com/
- DeltaV control systems http://www.emersonprocess.com/systems/
- Machinery health and diagnostics http://www.compsys.com/index.html

How about technical or pre-project Engineering assistance?

For clients who are interested in improving their boiler controls but are lacking in expertise to either determine their specific needs, consider using one of our boiler experts to conduct an on-site study. These studies can vary in both depth and scope. Many just require a one-day visit with a follow-up report that explains what was observed and how controls can improve your boiler operations. More in-depth studies will involve economic justification and may take longer to complete.

I/O Requirements

The following I/O is a minimum for control. For secure architecture, I/O is broken out by controller for each boiler. Additional I/O may be desired for monitoring or controls for deaerator, feedwater treatment, boiler blowdown, etc.

Typical I/O for steam header controls:

I/O Expected	Area	AI 4-20 mA	AO 4-20 mA	DI dry contact	DO dry contact
steam header pressure	common	1			

Typical I/O for one gas fired boiler:

I/O Expected	Area	AI 4-20 mA	AO 4-20 mA	DI dry contact	DO dry contact
steam flow	Boiler	1			
drum level	Boiler	1			
drum pressure	Boiler	1			

boiler feed water flow	Boiler	1	1		
combustion air flow	Boiler	1	1		
fuel gas flow	Boiler	1	1		
fuel gas pressure[1]	Boiler	1			
stack oxygen	Boiler	1			
purge status[2]	Boiler			1	
lowfire status[2]	Boiler			1	
TOTAL	TOTAL	8	3	2	0

Typical I/O for one gas or oil dual fired boiler:

I/O Expected	Area	AI 4-20 mA	AO 4-20 mA	DI dry contact	DO dry contact
steam flow	Boiler	1			
drum level	Boiler	1			
drum pressure	Boiler	1			
boiler feed water flow	Boiler	1	1		
combustion air flow	Boiler	1	1		
fuel gas flow	Boiler	1	1		
fuel gas pressure[1]	Boiler	1			
fuel oil flow	Boiler	1	1		
stack oxygen	Boiler	1			
purge status[2]	Boiler			1	
lowfire status[2]	Boiler			1	
gas fuel selected status[3]	Boiler			1	
oil fuel selected status[3]	Boiler			1	
fuel transfer status[3]	Boiler			1	
TOTAL	**TOTAL**	9	4	5	0

I/O Notes:

1 - optional input for monitoring or pressure-temperature compensation
2 - inputs for burner management interface
3 - additional inputs required for gas or oil firing

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Control Dynamics, based in Midlothian, VA, is a certified FR provider of boiler control services including consulting, studies for project justification, and commissioning services.