Honeywell

Solution Note

HC900: The Ideal Safety Logic Solver For Burner Management Systems

What is a Burner Management System?

Fired equipment is found throughout the process industries in many applications, including various types of heaters and boilers. The hazards associated with burner operation are managed by an instrumented system commonly referred to as the Burner Management System (BMS).

The BMS provides interlocks and permissives to prevent mis-operation of equipment and to safely handle faults caused by equipment failure. These events potentially result in uncontrolled fires, explosions, or implosions and in the unintended release of the materials being heated.

(From ISA-TR84.00.05-2009 Guidance on the Identification of Safety Instrumented Functions (SIF) in Burner Management Systems).

The specific objectives of a BMS are to:

- Sequence the burner through safe startup and non-flame detection.
- Ensure a complete pre-purge of the system.
- Supervise the safety limits during operation.
- Supervise the flame presence during operation.
- Sequence a safe shutdown at end of cycle or in the event of failure.
- Integrate with the combustion system to regulate proper fuel and air flows.

Each BMS should be designed in accordance with guidelines to control and monitor all sequences of the startup and shutdown of the burner. The main guidelines are:

- National Fire Protection Association (NFPA 85/86 or others).
- Industrial Risk Insurers (IRI).
- ISA 84.
- Factory Mutual loss prevention guidelines.
- Gastec for Europe.

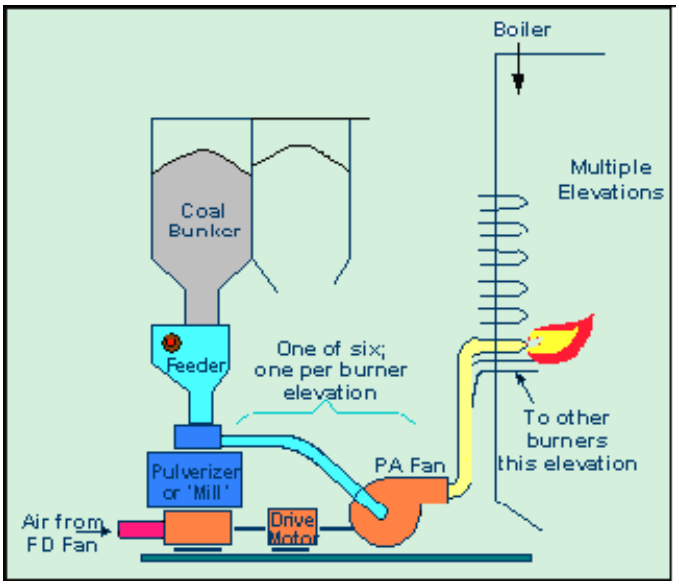

Figure 1. A typical mill/burner arrangement

Additionally, a BMS should be designed to accomplish a safety shutdown in the event of an unsafe condition (fail-safe operation).

Scope of Application

The function of the BMS is to safely perform the functions of:

- Automatically placing burners and igniters in service.
- Monitoring flame conditions.
- Removing burners and igniters from service.

The system controls boiler purge, fuel header(s), and burner field devices allowing sequential control of the startup and shutdown of any of the burners.

The primary objectives of the BMS are personnel safety and furnace protection. The secondary objective is to aid plant operating personnel. The BMS is designed to direct the operator through a step-by-step procedure for both startup and shutdown of the boiler.

The typical arrangement of mills-to-burners is to have one mill/pulverizer per burner elevation. A burner elevation can typically have up to eight burners. There may be up to eight elevations in larger units (Figure 1).

Burner startup is prevented if proper conditions have not been met, unusual conditions are annunciated, and shutdown is initiated if unsafe conditions exist. The BMS continuously monitors supervisory interlocks, fuel valve positions, flame status, and field devices. The control strategy normally utilized is the ‘de-energize to trip’ method. Smart alarms provide ‘fail to open’, ‘fail to start’, ‘fail to close’, and ‘fail to stop’ information.

Flame monitoring equipment provides the logic controller with the flame status of burners and/or igniters. Each flame scanner has its own dedicated flame control module that receives the scanner's flame signal and determines whether this signal represents a flame-on or a flame-off condition. This flame status information is used by the control logic along with other interlocks and limit sensing inputs to prevent burner startup or initiate burner shutdown if preprogrammed operating conditions have not been verified. It is of extreme importance that the flame scanners discriminate accurately between flames in multi-burner applications. Burner Management Systems depend on the flame monitors working properly.

Types of Burner Management Systems

There are many different types of BMS. The earliest systems date back to the 1950s and were hard-wired, relay-driven and timer-driven. These were replaced in the ‘70s and ‘80s by solid state processors and relays which generally involved proprietary hardware. The next evolution was towards microprocessor-based systems such as the Honeywell 7800 series with fixed logic. The latest are PLC-based systems which are much more powerful, expandable and versatile.

A BMS should incorporate a number of design techniques which help detect and act upon unsafe failure modes which can occur in any microprocessor-based system. These design features include the following:

- Critical input checking.
- Critical output channel monitoring.
- Electro-mechanical master fuel trip (MFT) relay.
- Redundant watchdog timers.
- Low water cut-out monitoring during blow down.

A BMS should also include a provision for Multiple Fuel Firing, such as capped gas input during curtailment; changeover from gas to oil at any load; and simultaneous firing of waste and fossil fuels. Other features should include redundant scanners, single or multiple burner applications, and integration of BMS with SCADA. This latter capability allows remote monitoring of the flame status, and remote control of a BMS. It also enables events such as a burner trip to be routed to the historical portion of SCADA for fault evaluation, and allows trending of burner operation over time.

Alarms

Annunciated alarms in a BMS include, but are not limited to:

- Burner fuel gas header high pressure.
- Furnace pressure high pressure limit (if applicable).
- Furnace draft high flow limit (if applicable).
- High stack temperature (each stack where applicable).
- Loss of draft fan (if equipped).
- Furnace airflow low flow limit (if applicable).
- Loss of interlock power.
- Loss of control power.
- Loss of flame (partial and total).
- Valve mismatched position.
- Any source of a master fuel relay trip (cause of trip indication).

Benefits of a Burner Management System

The benefits of a PLC-based BMS include:

- Flexibility and reliability – the programming software allows changes to the system.
- Choice of PLCs.
- Choice of flame scanners.
- Application-specific.
- Quantity of burners/fuels is not restricted.

Such a system is ideal in larger, more complex boiler Installations such as:

- Larger packaged units / field erected units.
- Multiple burners.
- Multiple fuels, on-line fuel changeovers.
- Flue gas re-circulation.
- Replacement of existing relay logic systems.
- Requirement to maintain consistent control platform (spare parts, etc.).

The benefits associated with these latest Burner Management Systems:

- Help improve plant safety.
- Help qualify for reduced insurance cost.
- Reduce startup and downtime with comprehensive alarming and diagnostics.

Honeywell and Safety

Honeywell has a long-standing tradition over many years of ensuring safety in a variety of industrial applications. The company offers complete safety solutions with a wide range of systems. For example, Honeywell's Fail Safe Controller is a Safety Integrity Level (SIL-3) certified integrated safety platform. Based on Quadruple Modular Redundant (QMR®) technology, **FSC supports a wide range of high integrity process control and safety functions including:**

- High-integrity process control.
- Burner/boiler management systems.
- Process safeguarding and emergency shutdown.
- Turbine and compressor safeguarding.
- Fire and gas detection systems.
- Pipeline monitoring.

Another breakthrough Honeywell safety system is Safety Manager, which is the safety solution of the Honeywell Experion Process Knowledge System (PKS). It is also based on QMR technology and provides a Safety Integrity Level (SIL-3) certified integrated safety platform. Safety Manager minimizes incidents, maximizes production uptime, reduces the cost of compliance and manages plant safety. It is targeted at a wide range of industries, including hydrocarbon processing, chemicals, oil and gas, and energy production.

Regarding burner management, Honeywell takes a flexible approach. Honeywell can provide its own NFPA-certified BMS solution, or, if the customer prefers, Honeywell can team with one of the traditional standalone BMS suppliers to provide an integrated burner management solution.

The Honeywell HC900 Burner Management System

The SIL-2 certified Honeywell HC900 Process and Safety System is an advanced process and logic controller with a modular, scalable design that is built to work with a wide range of process equipment in a cost-effective way.

HC900 is capable of delivering a Safety solution for Burner Management Systems that is fully compliant with the performance-based standards IEC 61508 and IEC 61511 standards as well as the prescriptive-based standards NFPA 85, NFPA 86 and ISA 84.

The HC900 Process and Safety System:

- Is targeted at SIL-2 safety applications and critical control applications.
- Delivers high availability, safety and reliability for process control and SIL-2 safety applications.
- Provides easy engineering and development capabilities with a common set of hardware/software tools for process and safety applications.
- Provides the lowest total cost of ownership.
- Provides high accuracy and auto-tuning capabilities using Accutune III™.
- Is proven to be reliable and trustworthy in the field for a number of years.
- Is highly flexible and scalable with a modular design and hence can easily scale to various BMS system requirements.

HC900 is capable of delivering a Safety solution for Burner Management Systems that is fully compliant with the performance-based standards IEC 61508 and IEC 61511 standards as well as the prescriptive-based standards NFPA 85 and NFPA 86.

HC900 SIL-2 is proven in the field with over 13,000 installations globally across process control and critical applications. The system complies with most major standards and regulations such as CSA/FM CL1/DV2, ATEX, ABS, UL, and CE Conformity.

The system is ideal for a process/safety software environment. Its non-interfering software environment means that the HC900 system is capable of hosting process control and safety applications, providing control, monitoring, password protection for configuration, alarm processing and data acquisition for process applications.

High reliability and availability is ensured by redundant CPU, rack power supply, communications and networking, as well as by features such as removal and insertion under power, online monitoring, edits and hardware maintenance during running operation. Its hardware, communications and sensor level diagnostics are robust, and the system provides early warning notification of pending sensor failure.

HC900: Easiest to use and engineer- improves productivity

HC900 comes with a touch-screen operator interface which makes it very easy to operate. It possesses a flexible architecture that can accommodate the most demanding application, and with its advanced features and versatile connectivity is capable of customized pinpoint control. HC900 also simplifies the documentation process and eliminates filing errors.

TÜV certified function blocks including I/O validation blocks suited to individual application needs reduce configuration time. These I/O blocks can be used specifically for BMS application needs such as determining the interlocks, active trip state, and sequence of steps required to start a burner.

Each sequencer supports up to 16 digital outputs that may be either on or off in each of 50 states e.g. PURGE, IGNITION, RELEASE TO MODULATION, etc. The sequencer may have up to 64 sequential steps that activate within the states of the process. Steps of the sequencer may be configured to advance based on time, on digital event (2 per step), or a manual advance. A separate jog function is also provided. The function can also configure an analog output on a step basis. The operational sequence for the steps is retained in a separate sequence file in the memory of the controller that may be selected on-demand through a user interface or via a recipe. These function blocks along with recipes and a set point programmer are definitely suited for other applications as well.

The system is quick to startup thanks to its HC Designer intuitive software. Powerful Accutune III^{TM} auto-tuning algorithms enable control loops to be quickly and easily tuned to reduce startup time and lessen the impact of process upsets.

Advanced monitoring and debugging tools are easy to use and engineer, and the system provides an integrated operator interface and open Ethernet communications as well as central and remote I/O capability.

The system is fully scalable, allowing a customer to purchase only what the process currently needs, while enabling future expansion as the process expands.

HC900: High performance – enhances quality

The standard fuzzy logic of the HC900 prevents process overshoot and provides tighter control, thus increasing throughput and efficiency, reducing scrap and energy utilization, and minimizing energy costs.

The SIL-2 certified CPU displays a digital throughput of only 10 ms will help capture process changes quicker, thus increasing process efficiency.

Its external watchdog timer with independent clock provides a safeguard for detecting and correcting spurious CPU lock-ups. Internal faults are monitored and add to robustness and performance of the system. An external watchdog timer is advantageous over internal watchdog timers which can be damaged if the CPU is damaged.

The system provides RAM and Flash memory enhancements, while its ECC memory circuitry corrects single faults and detects double faults, thus correcting memory corruption conditions. This ensures robustness, performance and reliability of data transmission.

HC900: Low total cost of ownership -maximizes profitability

HC900 provides similar hardware/software tools for process control and safety-related applications, thus reducing training costs because customers will not have to be trained on new programming tools.

The system integrates easily and smoothly with the HMI (HC900 Control Station), Experion HS (SCADA solution), and Matrikon OPC (third-party solutions) thus easily providing all safety-related BMS information to operators and other Basic Process Control System operator interfaces.

A low total cost of ownership is ensured by:

- Universal Analog Inputs, which minimizes hardware to buy, thus reducing inventory and spare parts.
- No annual software license fee.
- Free software web-based downloads for product enhancements.
- Worldwide product support with a toll-free GTS.
- Reduced training costs with common tools for process and safety applications.
- One Vendor for BMS solutions – integration with a portfolio of Honeywell products.
- Same I/O modules for process & safety thus reducing inventory costs

HC900 enables a company to work with one single vendor for their Burner Management Solutions, integrating with a portfolio of Honeywell products such as:

- FM listed/SIL-3 certified, Honeywell C7061 Self-checking Ultra-Violet Flame Scanner (ECC).
- FM listed/SIL-3 certified, Honeywell RM7800 Programming Burner Controller (ECC).
- SIL-2 rated process and safety instrumented field transmitters from Honeywell, such as:
    - SmartLine Gauge Pressure, Differential Pressure, Flow/Absolute Pressure, and Level Transmitters.
    - Honeywell STT 3000 – STT250 SIL-2 certified Temperature Transmitters.
    - FM listed/SIL-3 certified Maxon Safety Shutoff Valves.

Specific Advantages of HC900 over Other Conventional PLCs

The HC900 Safety Logic Solver offers additional advantages over other conventional PLCs:

- Provides redundancy and I/O checking.
- Redundancy of CPU, power supply and communication is easily achieved.
- Easy to use function blocks including recipe, sequencers and accurate PID control.
- Voting capability on the inputs and output validation.
- Flexibility in programming allows the program to be developed by experts thus helping exceed the NFPA codes.
- Program security and protection through password protection.
- Affordable SIL-2 solution can be achieved right out-of-the-box, thus helping achieve compliance to industry standards.
- System flexibility allows it to be used with any fired equipment such as ovens, furnaces, boilers etc.
- Communicates easily with other third-party PLCs.
- Integrated HMI and a global database easily reduce operator errors.
- Multiple burners, multiple scanners can be used for burner related applications (as compared to microprocessor based BMS systems).
- Critical information and advanced diagnostics for improved operations.

Conclusion

Honeywell's HC900 Burner Management System allows burner management to be included as an integral part of the plant's overall control strategy. It inhibits startup when unsafe conditions exist, and protects against unsafe operating conditions and the admission of improper quantities of fuel to the furnace.

HC900 provides operators with status information and therefore helps them make better decisions in a more timely manner. It initiates a safe operating condition or shutdown interlock if unsafe condition exists, and operates reliably to eliminate spurious trips.

HC900 also allows for customer preferences in selecting equipment, and provides the security and functionality needed to meet regulatory agency requirements.

For More Information
To learn more about HC900 and Honeywell's Burner Management Solutions visit our website www.honeywellprocess.com or contact your Honeywell distributor.

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