

Flexible Cost Effective BMS Design Using Safety PLC

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Topics Covered

- The Purpose of Burner Management Systems (BMS)
- Brief History of Burner Management
- Rules, Regulations, Best Practices
- Current Designs of Burner Management Systems
- Advantages of PLC Based Burner Management Systems
- Advantages of Using Safety PLCs Versus Standard PLCs.
- Using Safety PLCs for Burner Management Systems

Why Have a Burner Management System?



The Purpose of a Burner Management System

- Protect Personnel
- Protect Boilers, Furnaces, Kilns, etc from damage.
- Protect Buildings and Surroundings
- A REAL potential for steam or fuel explosions exists.

With proper Burner Management Solutions explosions can still occur, but fewer are occurring than in the past.

Note: Burner Management Systems **do not** protect against fuel/air ratio upsets, or some feed water supply related explosions.



Where are BMS Systems Used

- Any fuel fired equipment: regardless of type of fuel: coal, natural gas, bio mass, fuel oil
 - Boilers: water tube, fire tube, flex tube, other boiler designs
 - Rotary Kilns: drying various materials, aggregates
 - Furnaces and Ovens
 - Flares

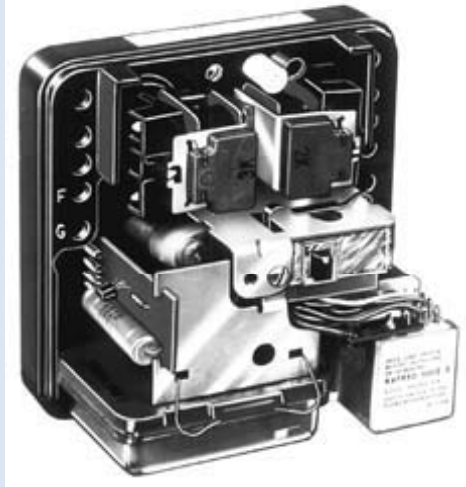
Burner Management Evolution

- Original Burner Management Systems, Completely Manual. LOP---Light the Burner, Observe, and Pray
- Explosions or injuries were not uncommon.
- Flame Scanners revolutionized burner management.
- Early systems used flame scanners and relays.
- Next evolution: electronic systems combined timers, relays, and flame scanners/amplifiers

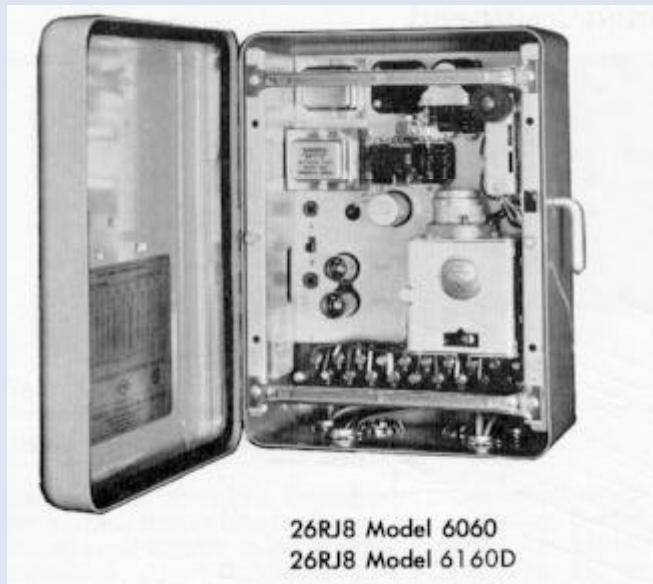


Non Programmable BMS Controls

Honeywell RA 890



Fireye 70D40



1960's Vintage Fireye

The Early Years

Non Programmable Hardware

- Fireye, Honeywell, and other companies developed simple flame safeguard systems.
 - Minimal information regarding burner shutdowns
 - Simple implementation of burner management logic.
 - Very limited capability and flexibility

Microprocessor Burner Management

- Fireye, Honeywell, and other companies developed microprocessor based versions of the original hardware
- More information was available via display modules regarding shutdowns and the sequence of events than the earlier hardware
- These systems were/are most successful in the fire tube boiler market
- These systems are still used today

Microprocessor Based BMS

Equipped with Display



Programmable Logic Controller (PLC) Based BMS

- PLCs originally were considered “relay and timer replacers”
- PLC systems are more versatile and powerful than relay based systems and microprocessor systems. Early systems used lights, push buttons, selector switches for the operator control.
- Current PLC based systems include human machine interfaces (HMI) and communications capabilities. The HMI provides the operator interface.

PLC vs. Microprocessor BMS

Microprocessor BMS such as Fireeye and Honeywell

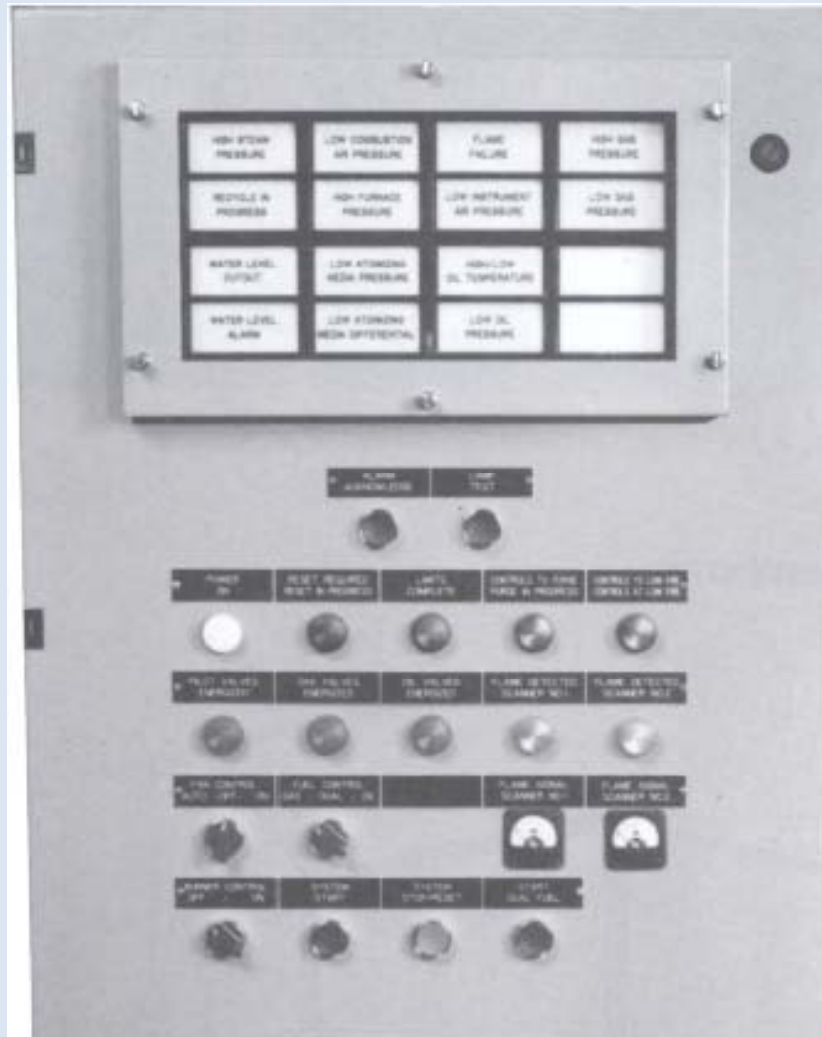
- Limited flexibility
- Not appropriate for multi burner systems
- Single flame scanner
- Limited information regarding status and shutdowns
- Communications can be cumbersome



Programmable Logic Controller (PLC) Based BMS

- PLC BMS Provide Tremendous Flexibility
- Extensive Communications Capability
- Single and Multiburner Capability
- More Information and Diagnostics Capability
(if programmed into the PLC)
- Easier to Troubleshoot
- Various Flame Scanners May Be Used

Early Vintage PLC System Using Operator Lights and Switches



Rules, Regulations, Best Practices

- **NFPA, U.L., Factory Mutual**
- **NFPA 85** Boilers <12.5 million Btu/hr
- **NFPA 86** Ovens and Furnaces- Covers practically all applications other than boilers
- **U.L. 795** < 400,000 Btu/hr
- Factory Mutual Guidelines- various topics
- Construction Standards- U.L. 508A
- Generally Accepted Design Standards, Non Documented- These can vary based on the manufacturer.

PLC Burner Management Systems

- Implementation is strictly governed by NFPA
- Implementation of the PLC logic and the other equipment such as watch dog timers and relays is crucial for a safe system.
- SIL ratings can be affected by improper implementation of the hardwired portion of the burner management system (relays etc).
- The BMS system design is critical !!!!!

BMS Safety Key Design Features

- Design Features can be either implemented via software, hard wired design, or internal PLC architecture and internal software (safety PLC)
 - Complies with NFPA requirements
 - MFT and other hard wired shutdown
 - Input checking logic
 - Redundancy for fuel valve circuits
 - Watch Dog Timers, or other methods
 - Systems fail to a safe state. Generally valves and other devices are de energized

Other Design Features

- Easy to operate. Intuitive design.
- Sufficient alarm and shutdown information is provided to the operator.
- System is designed for environmental conditions, NEMA 4/12/4X, classified environments
- Design for electrical loads. Breakers and fuses. Protects field devices such as valves.
- Diagnostic information to aid troubleshooting.



Burner Status

Limits Not Satisfied

Operator Functions

To Check Limits Not Satisfied, Press The "Limits Screen" Button Below

Limits
Screen

FD Fan
Auto Off On

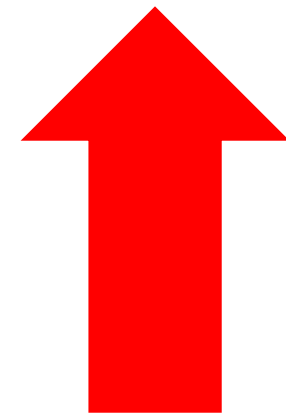


Acknowledge

Acknowledge All

Red Trips / Yellow Alarms

Low Water Level Float



BCS

Burner
Limits

Boiler
Trend

Alarms

Screen
Select

Burner Limits

Watchdog Timer

E-Stop Pushbutton

High Furnace Press

Critical Input Failure

Fan Starter Interlock

Critical Output Failure

Low Instrument Air Press

Low Combustion Air Press

Extra High Steam Press

False Flame Scanner 1

Reset Lockout Complete

False Flame Scanner 2

Low Water Drum Cutout

Single Fuel Selected

Low Water Drum Float

Gun In Place

Blowdown Bypass PB Fail

Close

Gas Limits

Low Gas Press

High Gas Press

Gas SSOV Proof of Closure

Oil Limits

Low Oil Press

High Oil Press

Low Oil Temperature

High Oil Temperature

Oil SSOV Proof of Closure

Steam Limits

Low Atomizing Steam Press

Low Atomizing Steam Flow

AUTO

MANUAL

AUTO

MANUAL

Settings

Print

Screen
Select

Trim
nar
1.7
.8
.8
.8
.0
.0
.0
.0
.0
.0
0.0

Other BMS Design Considerations

- Communications to other systems– DCS, building automations systems
- Remote monitoring and alarming
- Historical information- trips, run time
- Easy retrofit to existing equipment



Don't Be Fooled



- Go with the “Big Boys” Use major manufacturer hardware and software
 - Avoid “Off Brand” PLC hardware
 - Avoid “Off Brand” HMI software
- All PLCs and HMIs become Obsolete
 - Upgrade Path is important
- Support and Service
 - Don't be shackled to the system supplier

The Advantages Of Safety PLCs

- Reliable and proven safety logic for PLC inputs and outputs.
 - Assured that the critical input checking logic is designed and operates correctly
 - Assured that the safety outputs to the safety valves are operating correctly. Outputs are constantly tested to verify they have not failed.
- Safety PLC Logic and hardware developed by experts
- With proper implementation the BMS system exceeds NFPA requirements
- Program security and integrity memory card

Safety PLC Advantages Continued

- Safety Code is password protected
- Program changes are logged and recorded
- SIL integrity can be achieved. SIL is coming. SIL 2 standard, SIL 3 achievable
- The system is flexible. Applicable to any boiler, furnace, oven, or other fired equipment
- Integrates with other PLC systems for communication
- Compatible with standard operator HMIs
- **Safety PLC Hardware at a standard PLC price**

Summary of Key BMS Features

- Proper hardware choice
 - Safety PLC provides maximum protection
- Proper implementation
 - Correctly implement the PLC software
 - Correctly design the hard wired portion of the BMS
MFT, Relay Redundancy, Watch Dog Timer
- Substantial operating and diagnostic information for the operator via an HMI.
- Flexible system. Can be retrofit to existing equipment. Adapts to customer requirements.

The “New” Style

-Simple Operator Instructions-

Burner Status

Burner Trip System Reset Required

✓ Ack ⓧ Ack All

Red Trips / Yellow Alarms

Ignitor Safety Shutoff Valves Not Being Energized
Alarm fault cleared: Alarm input quality is good
Main Gas Safety Shutoff Valves Not Being Energi...

Low Water Level Float

Operator Functions

Press The "System Reset" Pushbutton

FD Fan
Auto Off On

Fuel Control
Gas Dual Oil

Limits Screen

System Reset

Alarm Silence

Screen Select

Burner Status

Limits Not Satisfied

Operator Functions

To Check Limits Not Satisfied, Press The "Limits Screen" Button Below

Limits
Screen

FD Fan
Auto Off On



Acknowledge

Acknowledge All

Red Trips / Yellow Alarms

Low Water Level Float

BCS

Burner
Limits

Boiler
Trend

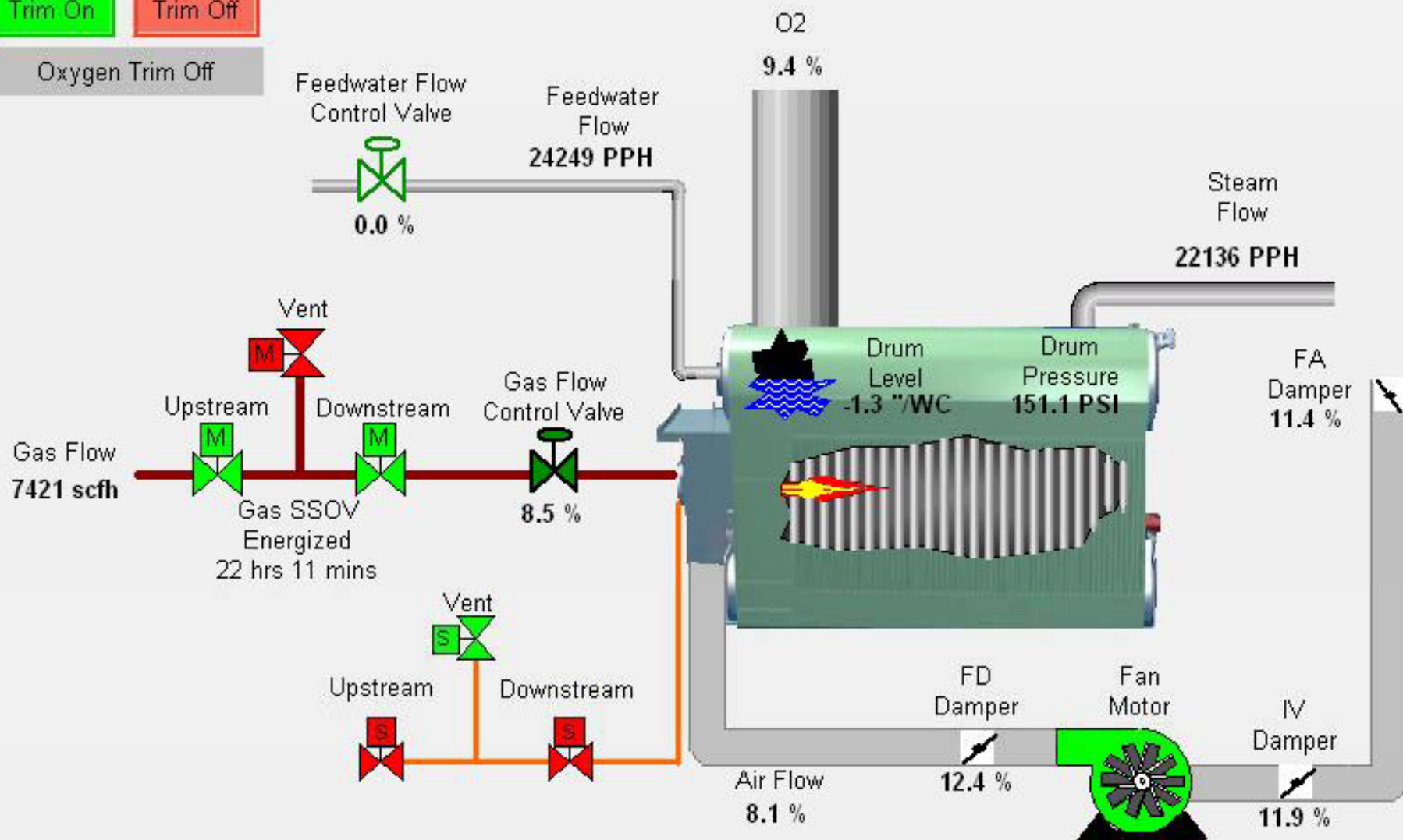
Alarms

Screen
Select

Oxygen
Trim On

Oxygen
Trim Off

Oxygen Trim Off



Gas & Oil Selected

Release To Modulate

Boiler Master
10.0 %

Screen
Select

PLC Transmitter Ranges Can Be Set From The Service Screen

Transmitter	Min Range	Max Range
Air Flow Range	0.0	0.0
Atomizing Steam Pressure Range	0.0	0.0
Boiler Drum Level Range	0.0	0.0
Boiler Drum Pressure Range	0.0	0.0
Feedwater Flow Range	0.0	50.0
Gas Flow Range	0.0	0.0
Oil Flow Range	0.0	0.0
Oil Pressure Range	0.0	0.0
Oxygen Percentage Range	0.0	0.0
Steam Flow Range	0.0	0.0

Screen Select

Display Range Setup Clear Clear All

Typical Burners



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