PROGRAMMABLE AND NETWORKABLE BURNER MANAGEMENT SYSTEMS - a case study

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Abstract:

Downtime can be very costly for all manufacturing organisations. Along with being reliable, systems must also satisfy safety regulations and standards. The Pilz PSS Programmable Safety System, approved by TÜV to IEC/AS 61508 SIL3, and the approved Burner Management software package from Pilz, has greatly enhanced the safety and reliability of furnaces on a Metal Coating Line. The ease of diagnosis on the Pilz system greatly reduces the impact of problems, and also minimises the downtime involved with these problems.

Keywords:

Programmable safety system, burner management system, safe software functions, reliability, safe PLC, SIL 3, AS 61508

Introduction:

The following paper discusses the benefits of Programmability in Burner Management Systems (BMS). There are many BMS systems running today which do not comply with current standards. They are either using non approved standard PLC's or antiquated relay based control systems. Not only is the potential failure to danger a risk to man and machinery but even non dangerous sporadic failures can be difficult to fault find and lead to costly down time. By taking the I/O into the field large distributed applications with many burners can be accommodated economically with minimum install time.

The fact BMS are installed which do not fulfil appropriate safety levels is not the only reason to change such a BMS: often these relay based control systems have reached a life cycle stage where relays do not work reliably any longer. For small BMS it is rather easy to fix such an error. But as many modifications are done during time critical situations (unexpected downtime during a failure: the system has to be made operable again) changes are often not documented which makes the next repair more difficult. .Therefore even small BMS applications with traditional relay control are not maintainable after a certain time. A different reason for a renovation is to reduce emissions and make the system more efficient. Safety can be an additional aspect. Calculations show that after 3 years the investment has paid off for a new BMS system which offers better control possibilities and is efficient.

Besides a relay based control system there are special components in use for the complete system: flame detection, flame control, burner control. The objective is to replace the relay based control systems and to integrate the safety functions into one system. Depending on the size of the BMS different solutions are possible.

The following case study shows how a large existing Burner installation was brought up to current standard by retrofitting an approved distributed safe I/O system. TÜV approved Safe software functions allow for ease of programming, excellent diagnostics and assist in the approval process.

Figure 1 below shows typical functions covered in the BMS software package.

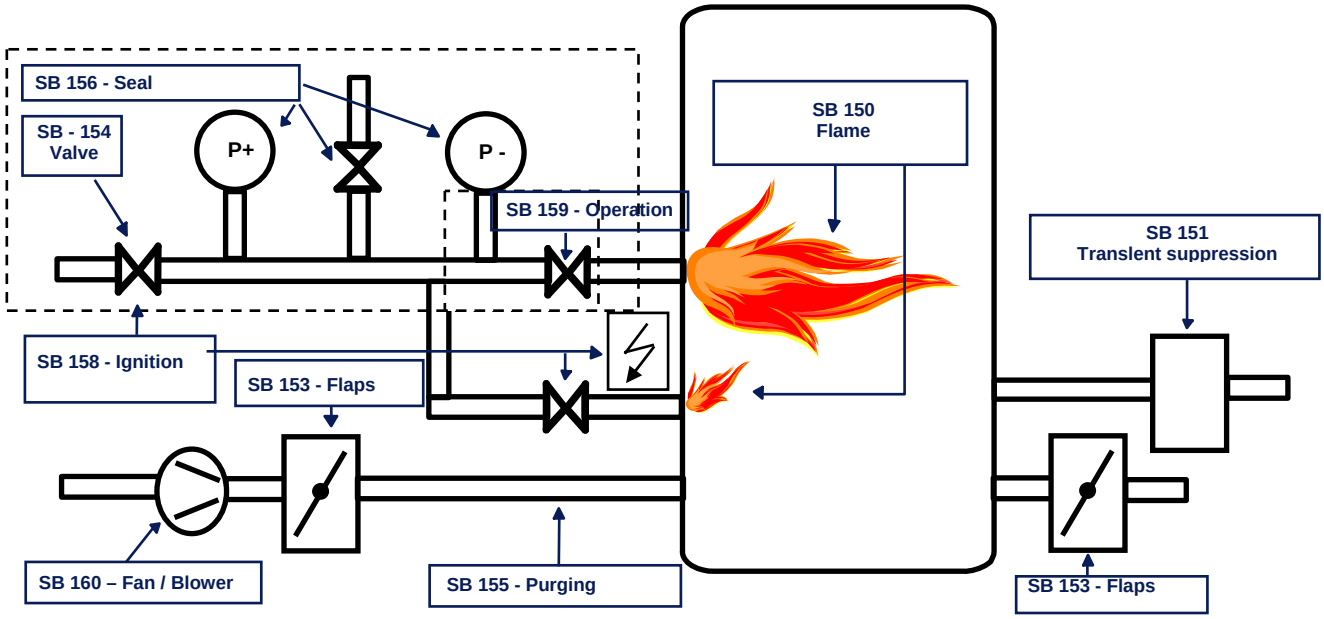


Figure 1 : Typical BMS software package function

The example system was based on a safety PLC. The safety requirements for the new system were:

- Replacement of the burner control device
- Control of the flame detectors
- Control of the safety sequence
- Control of E-stops

Beside the safety aspects the system fulfilled some non safety related functions:

- Communication to the SCADA system
- First level error diagnostics

It is an appropriate example to show how in new solutions software replaces hardware functions. In the safety system there is software function blocks used which offer typical BMS functions. A major concern certainly is to be sure that the software is safe. This includes application software (program, programming tool, and software blocks) as well as the operating system. There are two major possibilities why software can be unsafe: technical reasons like changed signals during download or upload from the program editor hardware to the controller or human mistakes.

Alterations in the application can lead to unexpected results such as an E-stop perhaps will not shut down or other actions are not performed. Therefore software based systems for safety require certain measurements which prevent unsafe conditions.

Figure 5 shows a typical sequence of a software block for a BMS application.

Those controller/software based safety systems are able to serve small burner applications with just one oven or up to huge applications even for power and steam generation. The example BMS application shows a system with 69 Burners.

To summarize: BMS electronic safety devices such as safety PLC's offer a good foundation to optimize a relay based control system. Flexibility and the diagnostics are of great benefit for maintenance. From the point of view of production it is obvious that these wear-free solutions offer a clear advantage in availability.

Case Study: Steel Metal Coating Line Furnace Upgrade

This example discusses the upgrade of the control system on a Metal Coating Line where a series of 69 Burners are used as part of a heat treatment process.

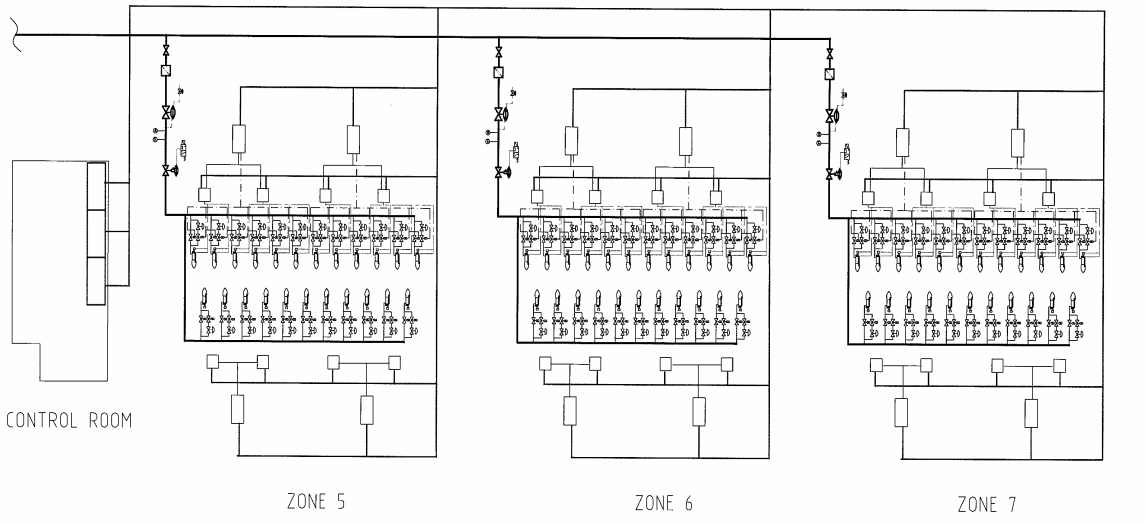


Figure 2 : System Layout Schematic

1. *Reason for Upgrade:*

The Metal Coating Line Furnace had been in operation for many years using traditional control devices which did not meet current standards. It was decided to upgrade this line to increase its operational efficiency and bring into line with current gas safety standards.

2. *Choice of control system.*

Several different options were investigated. A Pilz Programmable Safety System (PSS) was chosen. The PSS system offered a number of key attributes and advantages:

1 – TÜV Approval of Hardware to IEC/AS 61508 SIL3 and DIN V 19250 AK6 allowing it be accepted for use by the Office of Gas Safety

2 – TÜV approved Software functions for Burner Management Systems making the programming task not only simpler in application but aiding in the approval process.

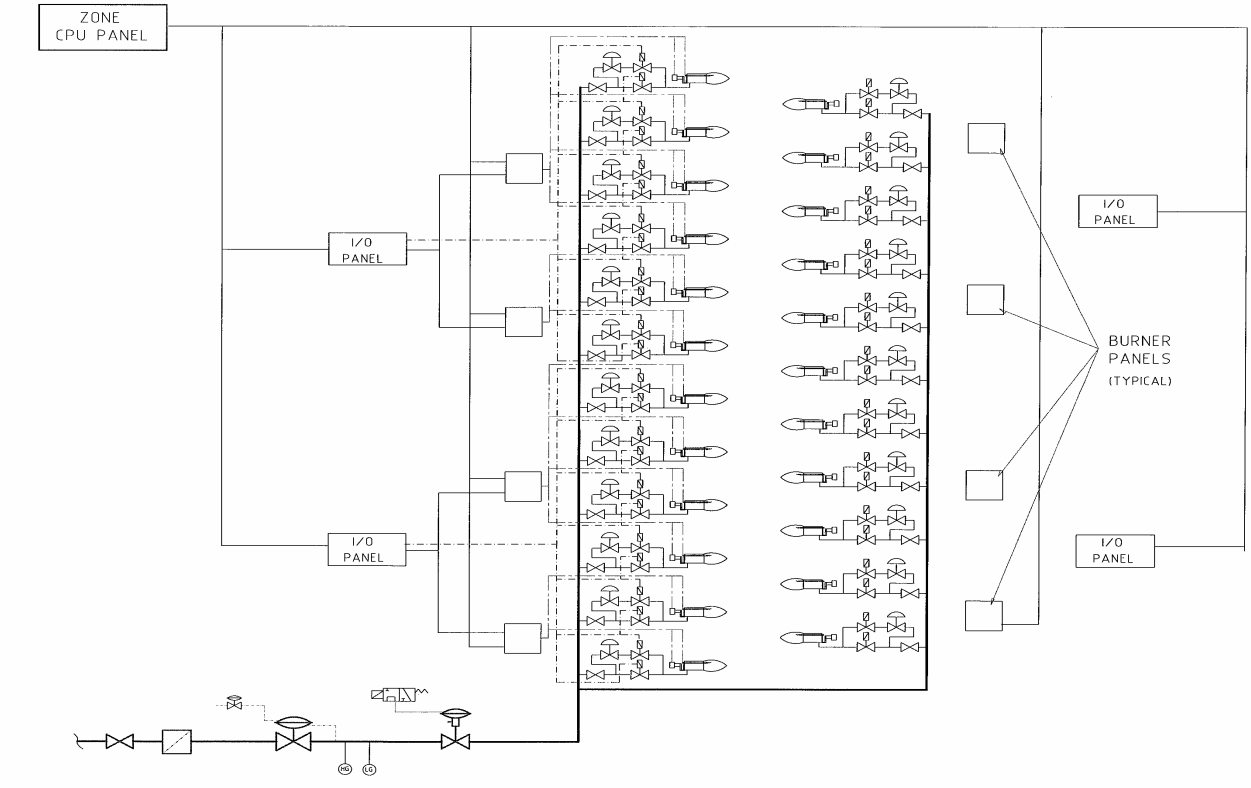
3 – Distributed Safe IO allowing for lower installation costs due to much less wiring and faster installation time.

4 – Interrogation and Diagnostic capabilities and the ability to integrate this information into their SCADA system.

5 – System availability.

3. System Description:

The 69 burners are broken down into 3 zones of 23 (see Figure 2). One remote I/O module is used per burner. The Zone CPU Panels are located in the furnace control room where operators initiate Start/Stop sequences and have feedback on the operating status of each burner via local text displays.



Zone I/O panels are distributed along the line; each of these panels houses a series of remote I/O modules for the nearby burners. Control panels house UV relays and Ignition Transformers. Controls located on these panels allow operators direct access to start/stop and restart zones without the need to enter the main control room. Ammeters indicate the status of the UV flame detectors.

Burner Equipment:

The Burner Equipment consists of Burner Gas Isolation Valve, Start Gas Regulator, Start Gas Double Block Safety Shut Off Valve, Main Gas Double Block Safety Shut Off Valve (SSOV), Spark Electrode and U.V. Detector.

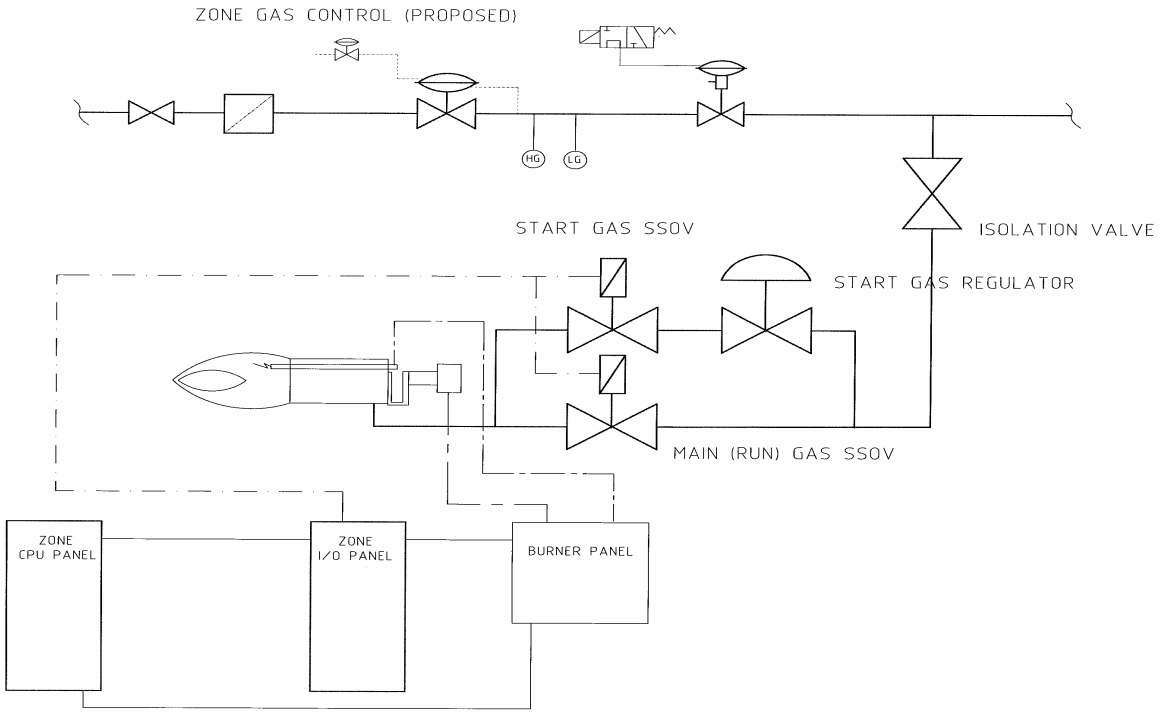


Figure 4 : Basic Schematic for One Burner

4. *Burner Run Sequence*:

The TÜV approved safe function blocks (SB's) from the Pilz Burner Management Package are used to create a Step by Step functionality that ensures the correct operational sequence is performed every time.

SB149 – Sequence Control, ties all the steps together.
SB150 – Flame Monitor – Ensures Safe Shutdown under flame out.
SB152 – Start/Stop – push buttons and other blocks such as SB150 for safe shut down.
SB153 – Control and Position monitoring of Flaps
SB154 – Control and Position monitoring of Valves
SB155 – Pre Ignition Purge
SB156 – Leak test can be performed if required.
SB158 – Ignition – ensures flame establishment
SB159 – Run – monitors flame continuously during operation
SB160 – Blower/Fan – Turns on the blower or fan.

In conjunction with these other safe functions such as SB63 for Emergency Stops can be included.

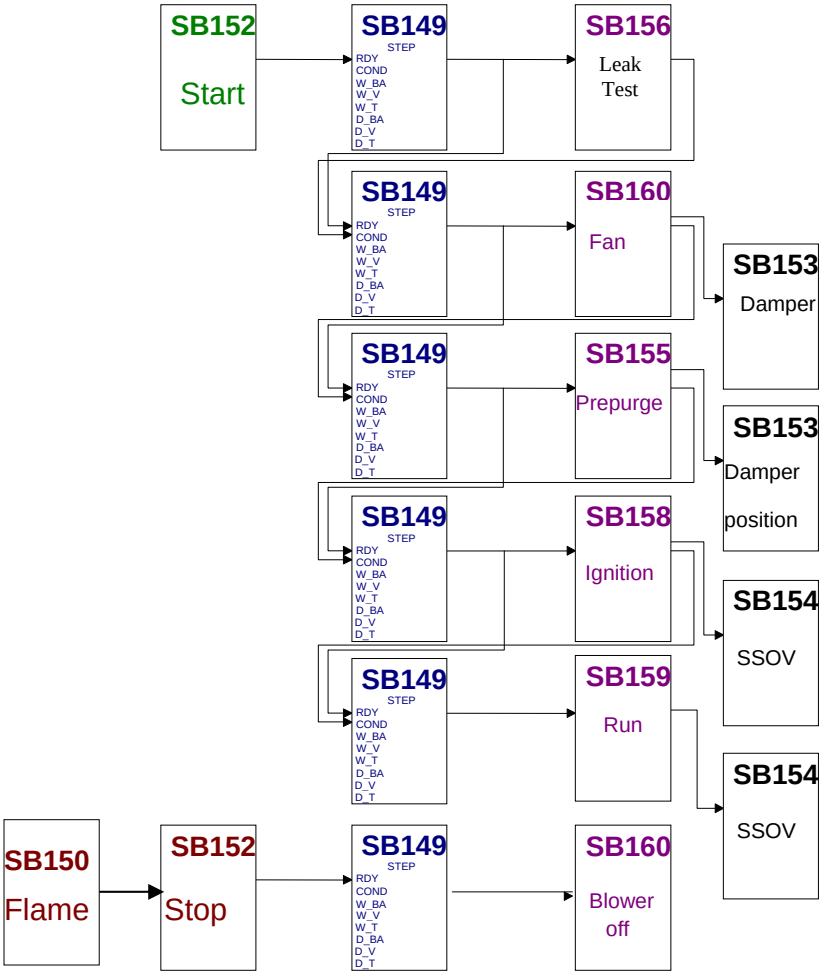


Figure 5 : Example Burner Software Sequence

Special requirements on MCL4 Upgrade:

To test for failures in single devices such as the flame detector each burner is switched off once every 24 hours for self checking. This takes place automatically as it is programmed in the Fail Safe (FS) section of the PSS.

Diagnostics:

The Standard function blocks include in-built diagnostics which provide clear diagnostic status of all modes. This information is displayed on Text screens in the control room. Apart from the many pre-configured texts, user text has also been created to define certain specific operating modes. A Profibus-DP connection links the PSS systems to an existing SCADA network, allowing for information on the operating status of the burner system to be received anywhere on the site.

Conclusion:

The Metal Coating Line project has been successful in improving reliability of the system. If a problem occurs with a burner it is recognized quickly with the diagnostics helping to resolve problems in least amount of time. The approved and pre-written software functions meant the actual amount of PLC programming and debugging was minimized.

By using Fail Safe Remote I/O the upgrade installation was able to take place in a very short time frame. Cabinets were built off site and with the connection between them all and the main control room being a single 3 core cable huge time savings were realised over traditional hard-wired solutions.

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