Invoking the Equivalency Clause in NFPA standards for designing compliant Burner Management Systems

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BMS Prescriptive Standards


**NFPA 86** - Standard for Ovens and Furnaces – 2011

**NFPA 87** - Recommended Practice for Fluid Heaters - 2011
Applies to different applications

Cookie Oven

Thermal Oxidizer
Prescriptive Standard (NFPA 85 & 86)

Key Point:
Performance based standards tell us how well we must implement the prescriptive standard. Both types of standards are important in BMS design; with the release of TR05, the performance and prescriptive standards will be tied together.

Performance Standard (ISA TR 84.00.05)
1.5* Equivalency. Nothing in this standard is intended to prevent the use of systems, methods, or devices of equivalent or superior quality, strength, fire resistance, effectiveness, durability, and safety over those prescribed by this standard.

1.5.1 Technical documentation shall be submitted to the authority having jurisdiction to demonstrate equivalency.

1.5.2 The system, method, or device shall be approved for the intended purpose by the authority having jurisdiction.

Key Point:
All NFPA Standards provide the ability to offer alternative designs than what is prescribed.
Chapter 8  Safety Equipment and Application

8.1* General. For the purpose of this chapter, the term furnace heating system shall include the heating source, associated piping and wiring used to heat the furnace, auxiliary quenches, and the work therein.

8.2 Safety Device Requirements.

8.2.1 All safety devices shall meet one of the following criteria:

(1) Be listed for the service intended
(2) Be approved if listed devices are not available
(3) Be programmable controllers applied in accordance with Section 8.4
Either your PLC has to be “listed” or follow the rules.....
The 1999 edition of NFPA 86 included changes to the technical requirements in several areas and many refinements that clarified the technical requirements. Changes were also provided to more clearly distinguish mandatory, since listed controllers were no longer available. Former (3) relocated to Annex A. Where appropriate, repetitive text was replaced by tables. The former Chapter 14, Inspection, Testing and Maintenance, was renumbered and renamed as Chapter 7, Commissioning, Operations, Maintenance, Inspection, and Testing. Requirements for operations and maintenance throughout the standard were then relocated to that chapter.

In the 2011 edition, the scope of NFPA 86 has been clarified to exclude fluid heaters, and reference is made to the NFPA 85, Portable Greenhouse Fire Protection, for information on that subject. The following is excerpted from Chapter 8.4.2 PLCs, except those listed for combustion safety service, shall be used in accordance with 8.4.2.1 through 8.4.2.3.
NFPA 86, PLC requirements (section 8.4.2.1)

(E) The PLC shall detect the following conditions:

1. Failure to execute any program or task containing safety logic
2. Failure to communicate with any safety input or output
3. Changes in software set points of safety functions
4. Failure of outputs related to safety functions
5. Failure of timing related to safety functions

Eh... well... looks about right to me!
NFPA 86, Safety PLC (section 8.4.5)

8.4.5 Safety PLCs.

(A) Where used for combustion safety service, safety programmable logic controllers shall have the following characteristics:
How does anyone really comply?

(B) Safety PLCs shall not implement the following:
(1) Manual emergency switches
(2) Continuous vapor concentration high limit controllers
(3) Combustion safeguards
(4) Excess temperature limit interlocks
NFPA 86, PLC Interlock requirements

Where:
R1 = PLC interlock
R2 = E-Stop
R3 = High Temperature Interlock
R4 = Flame scanner Interlock
Per NFPA 86 Hardwired Requirements
Spurious Trip Rate Performance

Assumptions:

- $\text{MTTF}_{sp} \text{ relay} = 30 \text{ yrs}$
- $\text{MTTF}_{sp} \text{ PLC} = 15 \text{ yrs}$

Where:

$\text{MTTF}_{sp} \text{ System} = \frac{1}{((1/15) + (1/30) + (1/30) + (1/30))} = 6 \text{ years}$

(PLC part) (R1 part) (R3 part) (R4 part)
Safety Performance for High Temperature

Assumptions:

- $\text{MTTFd}_{\text{relay}} = 30 \text{ yrs, 0\% diagnostics}$
- $\text{MTTFd}_{\text{PLC}} = 15 \text{ yrs, 75\% diagnostics}$
- All components tested perfectly annually

Where:

PFD system = \[
\left(\frac{1}{30}\right) \times \left(\frac{1}{15} \times 0.25\right)\] / 3 = 1.9 e-4

RRF = 1/PFD = 5400 = SIL 2

Note: Logic solver generally accounts for only 10\% of the system
Proposed design
Conclusions

✓ MTTFsp improved significantly
✓ PFD slightly degraded
✓ Simpler design
✓ Safety Lifecycle procedures (e.g. MOC)