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2010 Emerson Global Users Exchange

What Now? More Standards for Safety and Regulatory Compliance

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Presenters

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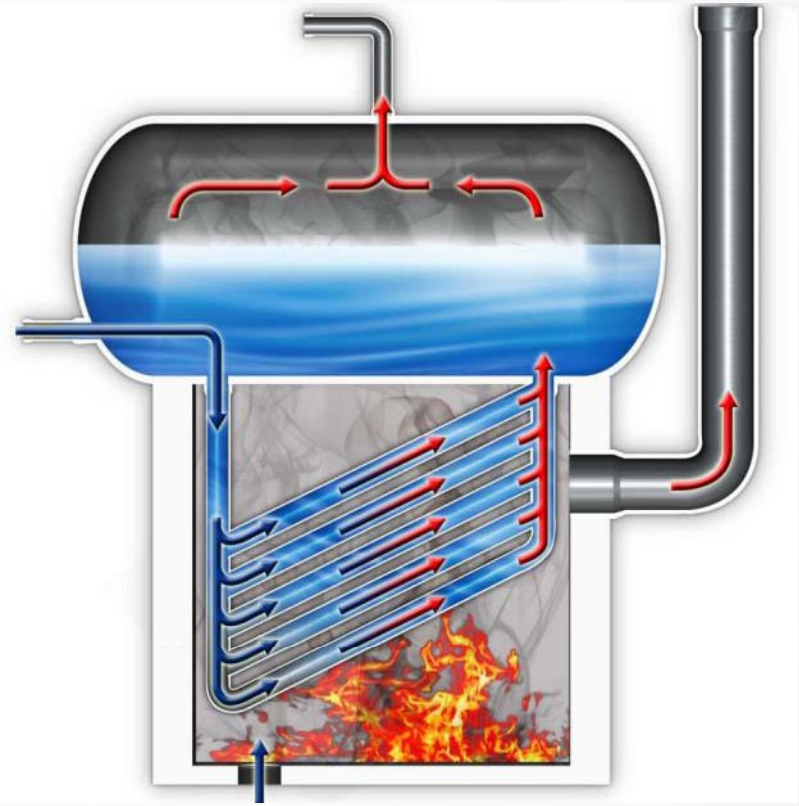
Agenda

- **Industry Standards**
  - API 556
  - ISA-TR84.00.05
  - NFPA 85
  - NFPA 86
- **Integrated Solution**
  - Architecture
  - Smart Field Devices
  - Smart SIS
- **Benefits Summary**
  - Standards
  - Technology

Can the control and protective systems for fired heaters as defined by the standards be reconciled into a comprehensive solution?

Burner Management Systems – Purpose



- **Primary Purpose**
  - To prevent the catastrophic combustion of accumulated fuel
- **Secondary Purpose**
  - To prevent overheating fired equipment and the catastrophic release of process streams that result

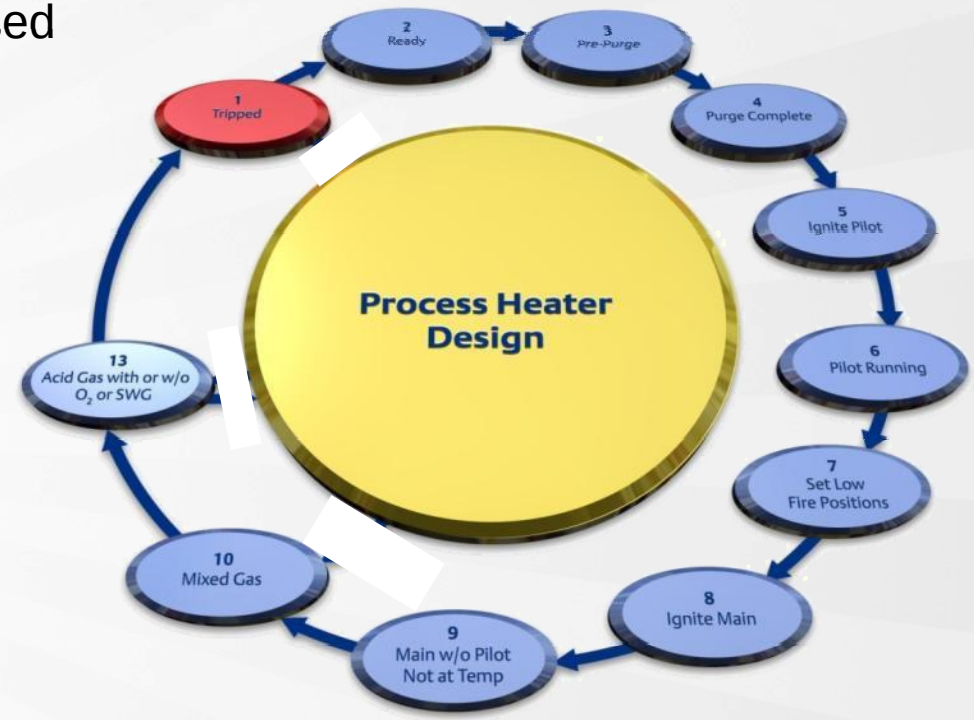
BMS Fundamentals

Burner Management: Sum of All Fears

- Fuel has accumulated while burners are not operating and then ignited when a burner is lit
- Fuel accumulates after a burner goes out while operating, then subsequently finds a source of ignition
- The process fluid is unable to remove sufficient heat

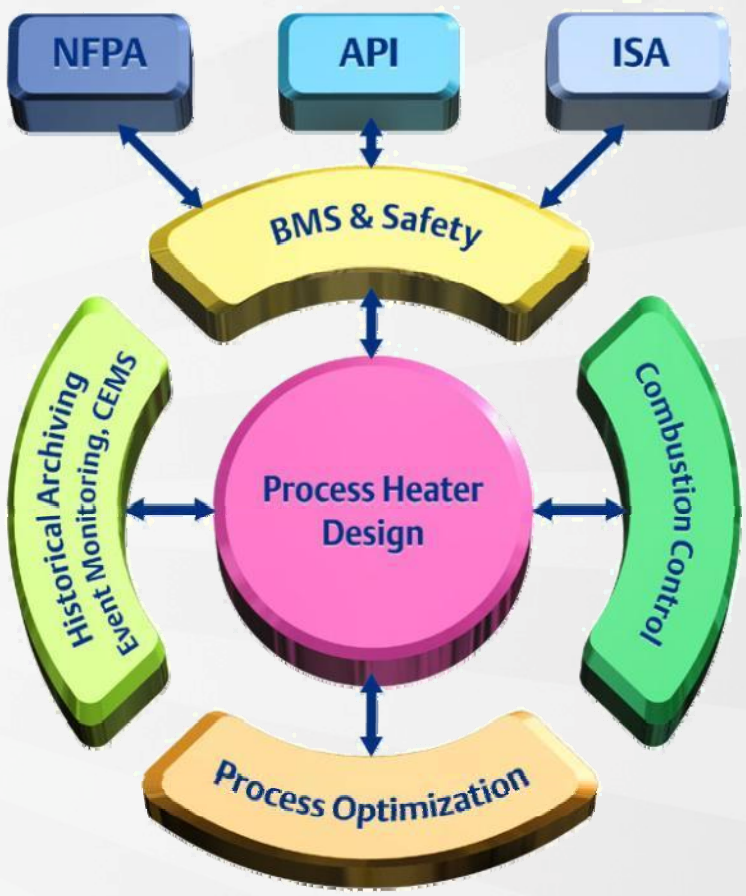
How is a burner managed?

- **Sequence control (permissives)**
  - Fuel block valves proved closed
  - Absence of flame proved
  - Pre-purge flow proved
  - Pre-purge timer complete
- **Shutdowns/trips (interlocks)**
  - Loss of flame
  - Loss of combustion air
  - Low fuel pressure
  - High fuel pressure
  - Loss of actuating energy
  - Power failure
  - Excess process pressure or temperature



BMS Standards

- **NFPA - National Fire Protection Association**
- **ISA - Instrumentation, Systems, and Automation Society**
- **API - American Petroleum Institute**



OSHA's expectations regarding BMS

- **The General Duty Clause**
  "The general duty to furnish each employee with employment and places of employment free from recognized hazards causing or likely to cause death or serious physical harm."

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  "The general duty to furnish each employee with employment and places of employment free from recognized hazards causing or likely to cause death or serious physical harm."
- **RAGAGEP**
  Recognized and Generally Accepted Good Engineering Practice
- **Follow company policies and procedures**
  "Do what you say you will do."

National Fire Protection Association – NFPA

Prescribes: Dictates what to do and how to do it

- **NFPA 85** ***Boiler and Combustion Systems Hazards Code***
  - Applies only to boilers and units that generate steam using the heat generated by combustion
  - Separate sections for single or multiple burners, and for different fuel types, each with different authors

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- **NFPA 86** ***Standard for Ovens and Furnaces***
  - Applies to heated enclosures (furnaces, ovens, dryers) regardless of heat source
  - Single, coherent document

ISA – International Society of Automation

Stipulates: Imposes how to do it

- **ANSI/ISA 84.00.01-2004 (IEC 61511-Mod) Functional Safety: Safety Instrumented Systems for the Process Industry Sector**
  - Applies to safety instrumented systems, regardless of application, with no specific functions defined

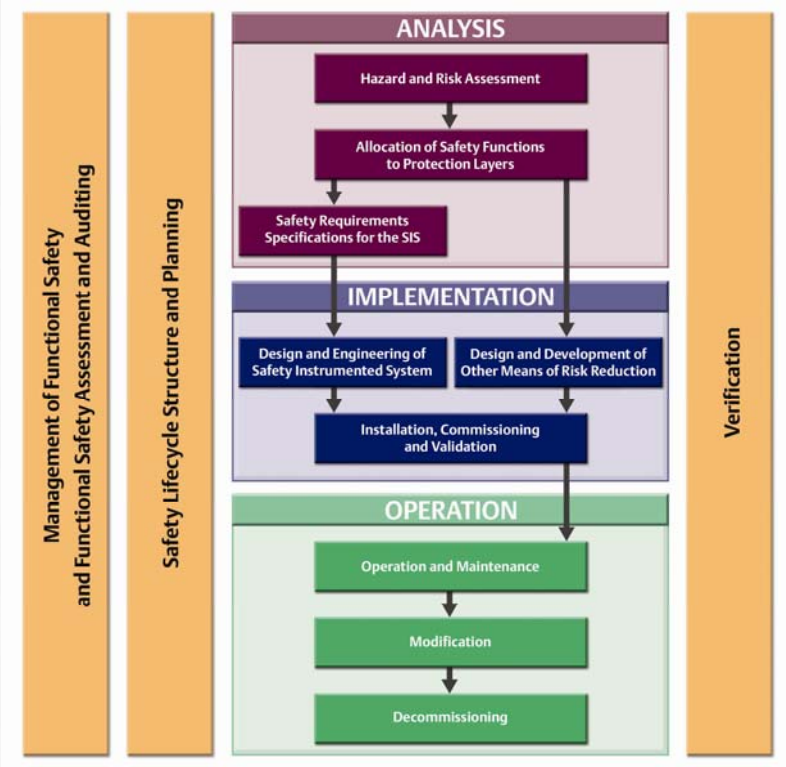
Recommends: Suggests what to do and why to do it

- **ISA TR.84.00.05 The Application of S84-2004 for SIFs in Burner Management Systems**
  - Non-mandatory review of safety instrumented systems used as burner management systems, with examples

ANSI/ISA 84.00.01 2004

Assesses BMS within context of Safety Lifecycle

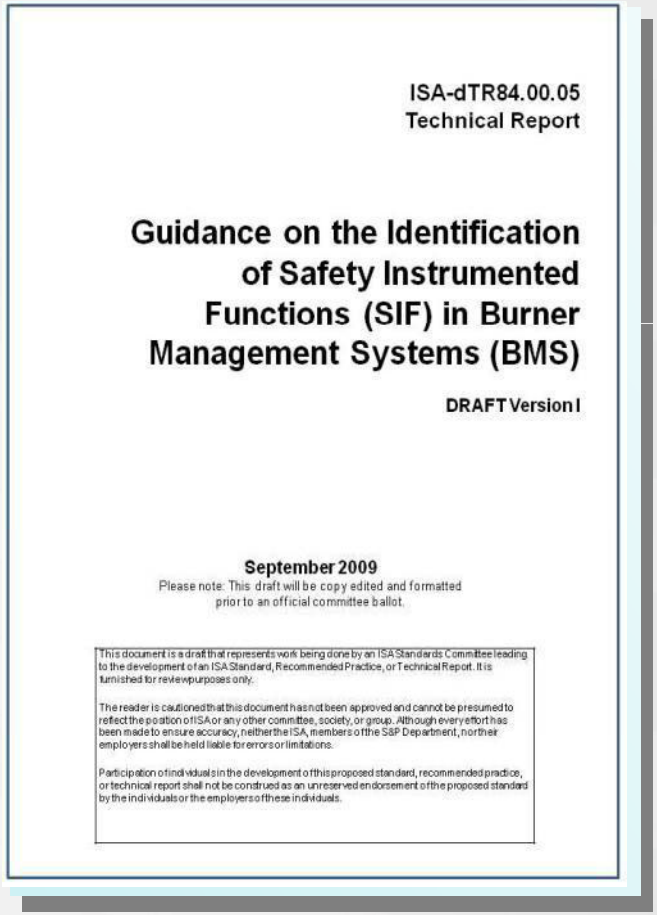
- Identification of hazardous events
- Assessment of their risks
- Comparison to risk tolerance criteria
- Allocation of safety functions
- Documenting requirements (SRS)
- Validating performance
- Operational procedures
- Maintenance procedures
- Management of change



ISA-TR84.00.05

- **Reference to Other Practices**
  - NFPA 85 (ref. 4.3)
  - NFPA 86 (ref. 4.4)
  - API 556 (ref. 4.5)
  - ASME CSD-1 (ref. 4.6)
  - API RP 14C (ref. 4.7)

- **Provide safety assessments for**
  - Boilers (single burner)
  - Fired process heaters (multi-burner)
  - Thermal oxidizers
  - Oil Heater Treaters
  - Glycol Reboilers



ISA-dTR84.00.05
Technical Report

Guidance on the Identification of Safety Instrumented Functions (SIF) in Burner Management Systems (BMS)

DRAFT Version I

September 2009
Please note: This draft will be copy edited and formatted prior to an official committee ballot.

This document is a draft that represents work being done by an ISA Standards Committee leading to the development of an ISA Standard, Recommended Practice, or Technical Report. It is furnished for review purposes only.

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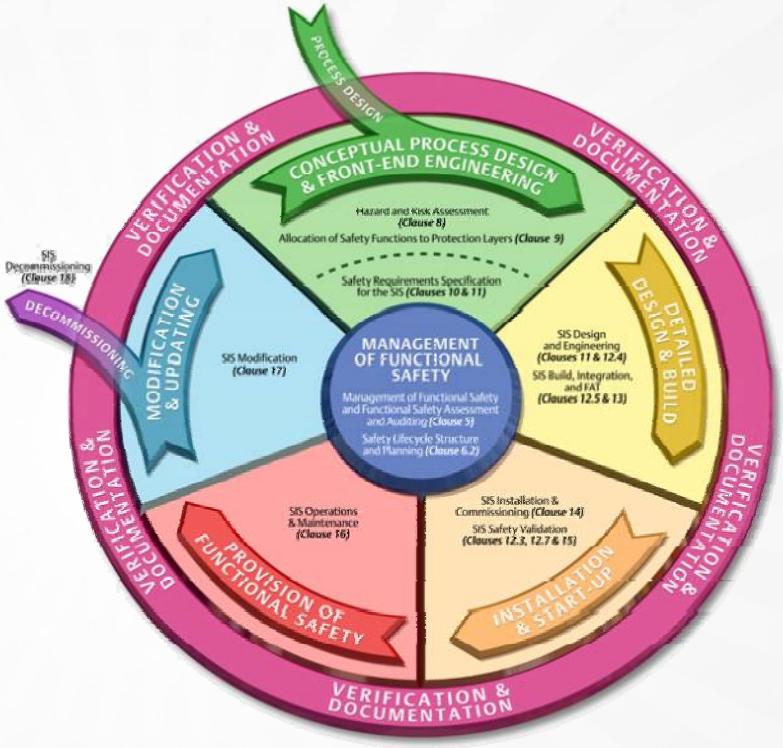
Participation of individuals in the development of this proposed standard, recommended practice, or technical report shall not be construed as an unreserved endorsement of the proposed standard by the individuals or the employers of these individuals.

API – American Petroleum Institute

Guides: Suggests what to do and how to do it

- **API RP 560** ***Fired Heaters for General Refinery Services***
  - Applies to design and construction of heaters, excluding steam reformers and pyrolysis furnaces
  - Three pages of 263 page document on instrumentation
- **API RP 556** ***Instrumentation, Control, and Protective Systems for Gas Fired Heaters***
  - Intended for refineries, petrochemical, and chemical plants
  - Gas only, and not for boilers, incinerators, or pyrolysis furnaces
  - Not prescriptive, but uses “shall” 39 times

API RP 556 – Consistent With SIS Standards



API RP 556 suggests need for

- SIL Assignment
- Nuisance Trip Avoidance
- Diagnostics and On-Line Testing
- Separation of Control and Safety Functions
- Redundancy Requirements
- Layers of Protection Analysis
- Reducing Demand on the Safety System
- Common Mode Assessment
- Formal Operating and Maintenance Procedures

Permissives

		NFPA 85	NFPA 86	S84-TR5	API 556
1.1	**Fuel block valves proved closed**	✓	✓	✓	✓
1.2	**Absence of flame proved**	✓	✓	✓	✓
1.3.1	**Pre-purge flow proved**	✓	✓	✓	✓
1.3.2	**Pre-purge timer complete**	✓	✓	✓	✓
1.4	Air proved at low fire rate	✓		✓	✓
1.5	Fuel pressure in correct range	✓		✓	✓
1.6	Pilot flame detected within time	✓	✓	✓	
1.7	Main fuel set at low fire position	✓	✓	✓	
1.8	Main flame detected within time	✓	✓	✓	
1.9.1	Post purge flow proved	✓			
1.9.2	Post purge timer complete	✓			
1.10.1	Adequate process level			✓	
1.10.2	Adequate process flow				✓

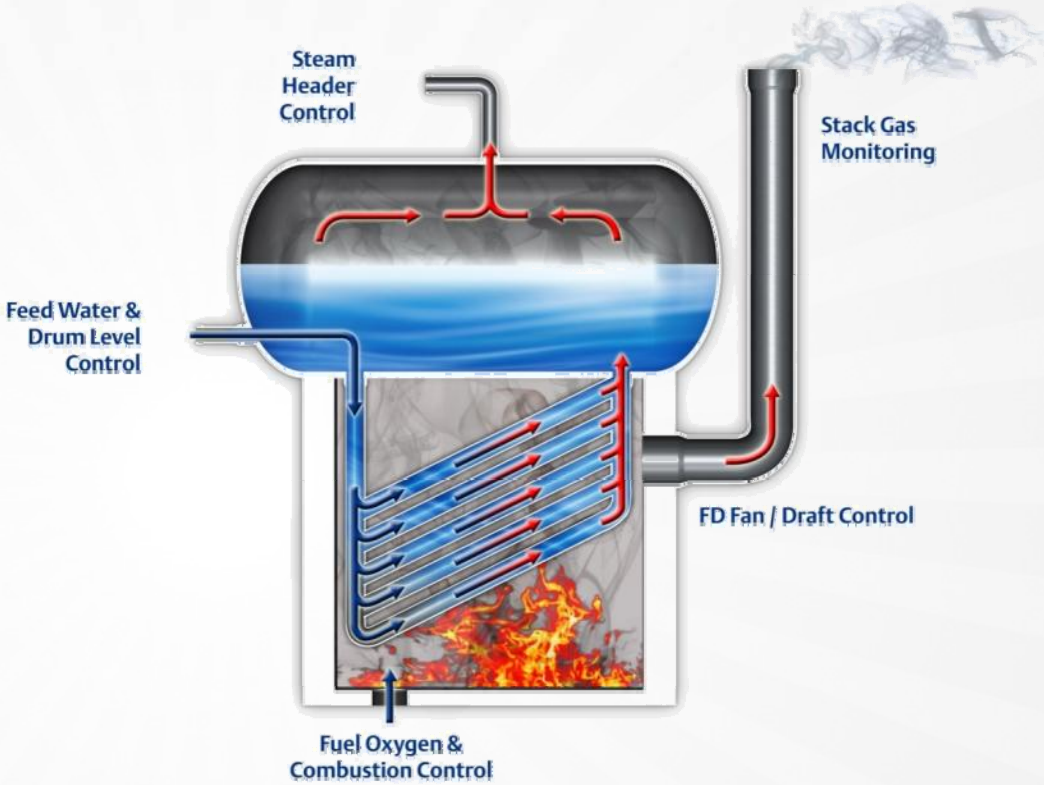
Interlocks – Ignition, Air, and Fuel

		NFPA 85	NFPA 86	S84-TR5	API 556
2.1	**Loss of flame**	✓	✓	✓	✓
2.2	**Loss of combustion air**	✓	✓	✓	✓
2.3	Low furnace pressure				✓
2.4	High furnace pressure	✓			✓
2.5	**Low fuel pressure**	✓	✓	✓	
2.5.1	Low fuel pressure – at pilot	✓		✓	✓
2.5.2	Low fuel pressure – at main burner	✓			✓
2.6	**High fuel pressure**	✓	✓	✓	
2.6.1	High fuel pressure – at pilot	✓		✓	✓
2.6.2	High fuel pressure – at main burner	✓			✓
2.7.1	Loss of atomizing medium	✓	✓	✓	N/A
2.7.2	Heated oil – Low temp/High visc	✓	✓		N/A
2.7.3	High heated oil temperature	✓	✓		N/A

Interlocks – Systems and Processes

		NFPA 85	NFPA 86	S84-TR5	API 556
3.1	**Loss of actuating energy**	✓	✓	✓	✓
3.2	**Power failure**	✓	✓	✓	✓
3.3	Emergency Shutdown	✓	✓		✓
4.1	Low (water) level	✓		✓	✓
4.2.1	**Excess (steam) pressure**	✓	✓	✓	✓
4.2.2	**Excess (water) temperature**	✓	✓	✓	✓
4.3	Low process flow		✓	✓	✓
4.4	High furnace discharge temp			✓	✓
4.5	High skin temperature				✓

Other BMS Requirements



Required BMS Functionality

- Pre-purge volume – typically four or more system volumes
- Maximum response time of 4 sec
  - Flame failure to de-energization (NFPA 85)
  - Flame failure response (NFPA 86)
- External monitor (watchdog timer)
- Master fuel trip relay, with dedicated manual switches
- Double-block-and-bleed
- Post purge of at least 15 sec

Standards Challenges

Challenges & Goals

- Offering thorough guidance to neophytes
- Anticipating every possible application
- Discouraging users from “gaming” the standards
- Ensuring safety while maximizing availability
- Providing rigor while not stifling innovation

“Nothing in this standard is intended to prevent the use of … equivalent or superior…effectiveness, durability, and safety over those prescribed by this standard.”

Industry Challenges

Challenges & Goals

- Cost control
- Ensuring safety
- Equipment reliability, and process availability
- Establish predictive maintenance
- Competency, training and evaluation
- Retirement of experienced maintenance and operations staff
- Develop process and safety expertise

Both culture and competency must be considered as vital part of the design, implementation and operations process.

Vendor Challenges

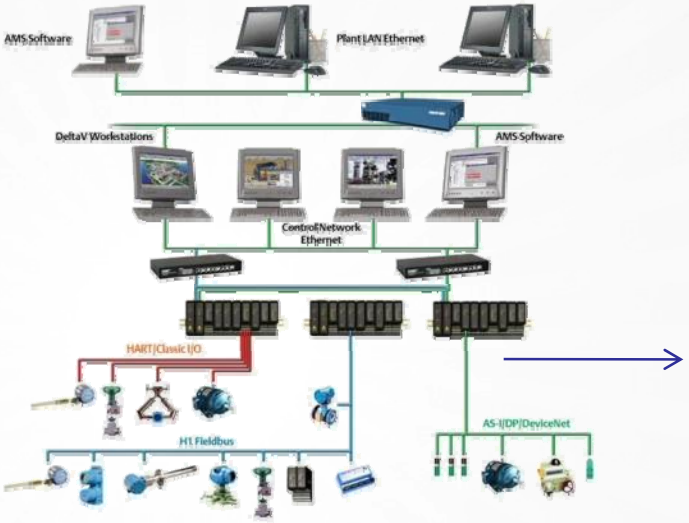
Challenges & Goals

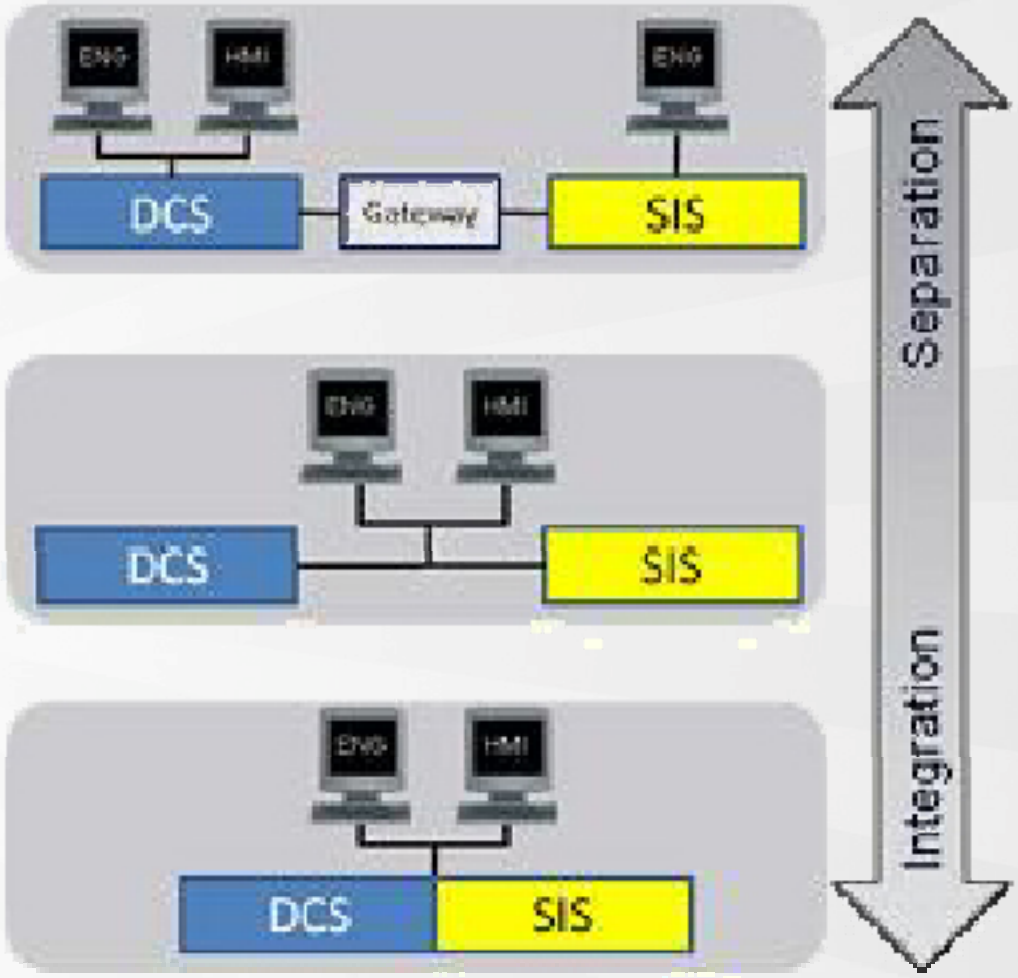
- Improve asset performance
- Reduce installed cost (CapEx)
  - System design
  - Installation
  - Commissioning
  - Operation/maintenance planning
- Reduce operational costs (OpEx)
  - System simplicity
  - Communications reliability
  - Self-diagnostic functionality
  - Reduce unscheduled downtime
- Streamline training

Technology Challenges

- Increase operator attention and avoid alarm overload
- Early identification of problems
- 20/20 diagnostics
- Integrate Control and Safety Instrumented Systems
- Integration of smart devices
- Avoiding unexpected shutdowns via device status
- Remote Verification and Calibration of Field devices
- Automated documentation of testing
- Wireless access to maintenance and SIS testing records
- Provide an audit trail for management of change

Defining the Integrated Solution



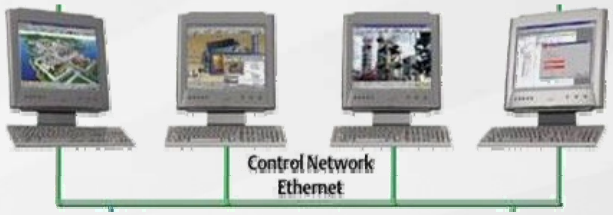


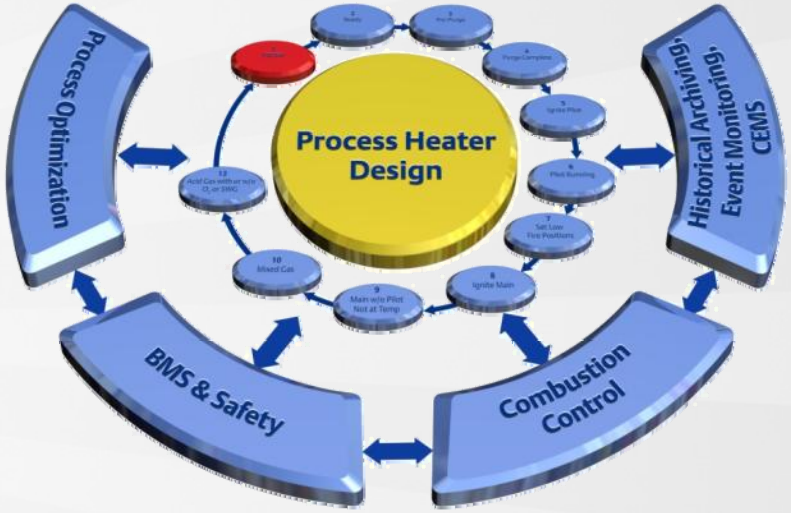
Source: ARC Research Group

Integrated Architecture

Integration by Design

- Common Configuration Database
- User Security Management
- Program Audit Trail / Version Control
- Access Control with Audit Trail
- Management of Change
- Data Historian
- Sequence of Events Recording
- Asset Management Capabilities
- Automated Loop Checking
- Native File Process Simulation
- Multiple Cyber Security Options
- Field Device Health Monitoring
- ISA 18.2 Alarm Management Capability
- Native File Operator Training Systems





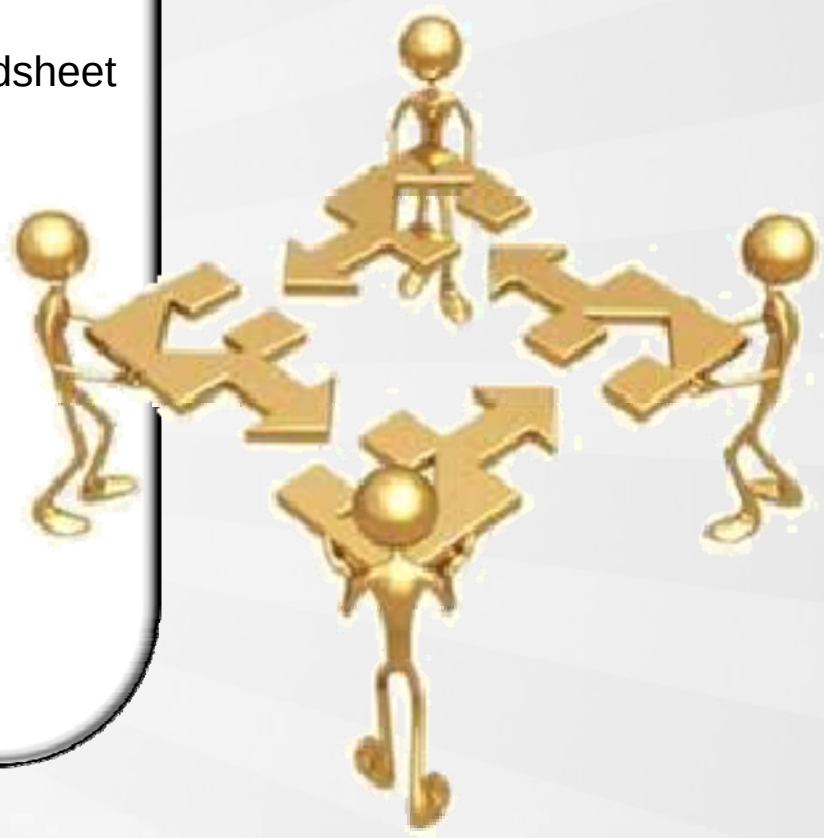
"Integrated operations, engineering and maintenance functions for the DCS and SIS should be seamless:"

EMERSON GLOBAL USERS EXCHANGE

ICSS Reduces Engineering

Meeting Tight Project Schedules

- Centralized configuration database
- Bulk import capability from 3rd party spreadsheet
- High speed communication system
- Flexible redundancy to ensure availability
- Scalability from 25 to 100K I/O
- On click access to alarms, trends and on-line help screens
- Embedded predictive diagnostics
- Enterprise access to data
- Multi-bus support
- Add system components without shutdown



ICSS – Open Field Device Communication

HART® FIELD COMMUNICATIONS PROTOCOL

Increasing safety by revealing a wider range of previously Dangerous Undetected failures in real-time

ICSS Utilizes Intelligent Field Devices

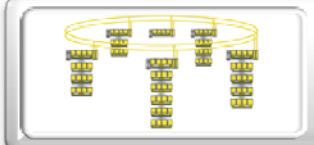
Diagnostics & Alerts

- Plugged impulse line
- Reverse flow
- Calibration error
- Device health
- Empty pipe
- Sensor probe suspect
- RTD drift
- Travel pressure high
- Travel accumulation
- Cycle counter
- Valve signature
- Valve drive signal
- Signal saturation
- PV out of range
- Valve stem position

Long term OpEx improvement begins with intelligent field devices that anticipate problems, report current device health, control variability and perform multiple measurements.

ICSS & Smart Safety Instrumented Systems

Improved process reliability



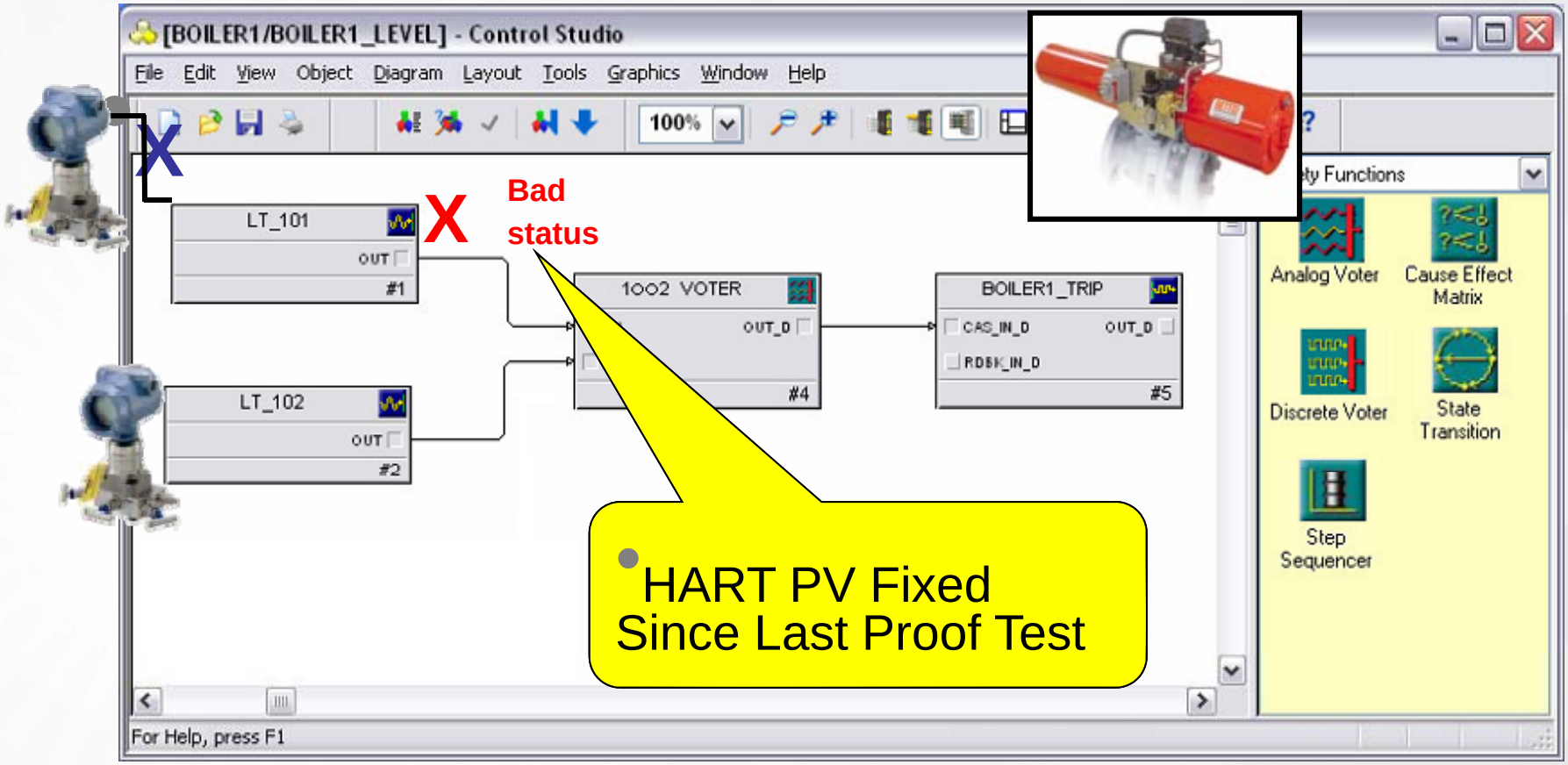
Flexibility to meet project needs

Increased visibility into process

Reduced engineering and complexity

Simplified regulatory compliance

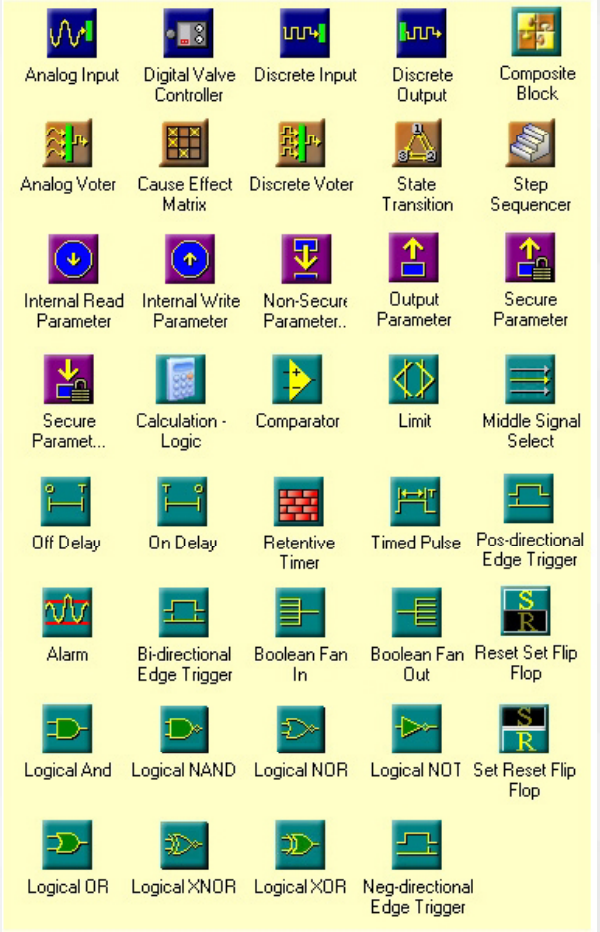
ICSS and Smart Safety – Diagnostics



Smart Safety – Intelligent Function Blocks

Programming Standards

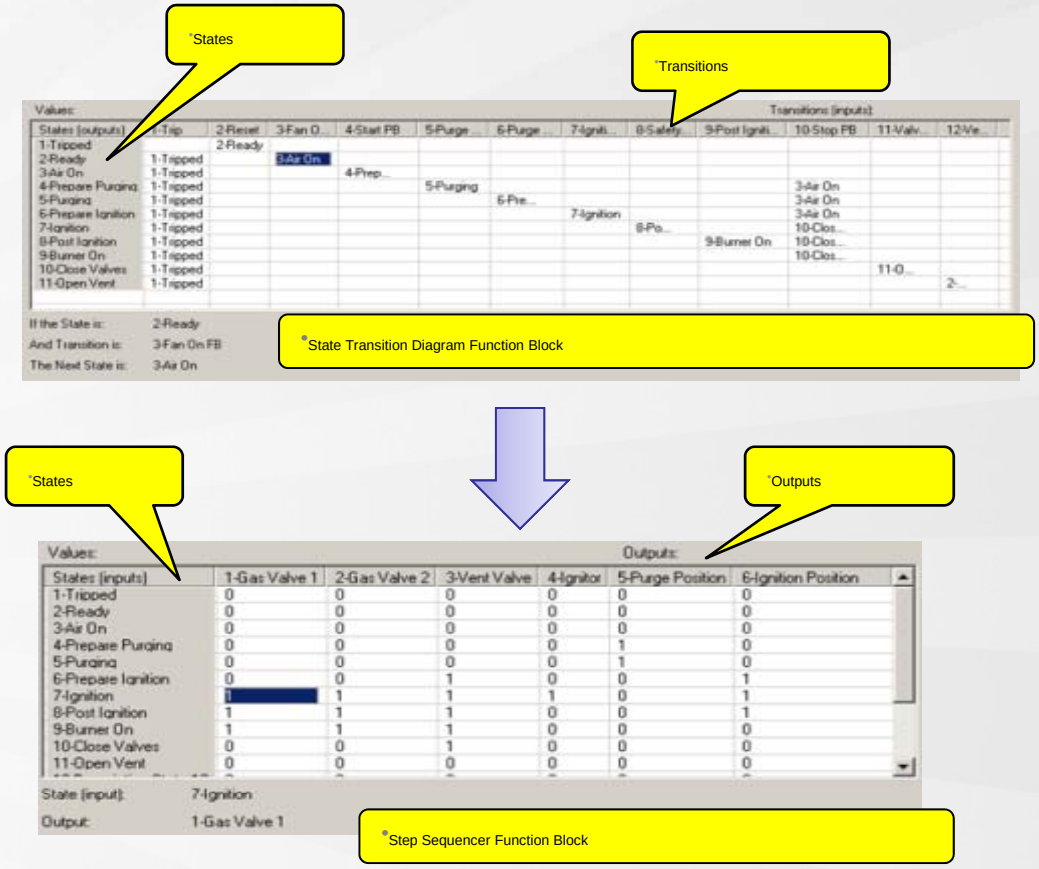
- Built-in sequence of events handler with automatic first-out trapping.
- Built-in bypass handling
- Built-in override bundling
- Automatic MOC compliance to the API, IEC and ANSI/ISA standards
- File based off-line simulation and Operator Training Solutions
- Advanced alarm management system
- Asset Management interface.



Smart Safety – Reduces Engineering

Program Standards & Functionality

- The ICSS should include intelligent function blocks specifically designed for combustion control. These function blocks should include facilities to define transitions from state-to-state during all phases of startup, normal operation and shutdown.
- The function blocks should be exactly the same as the intelligent field device function blocks.



- **Complicated mapping for field function blocks to legacy data structures should be avoided**

Documentation & Regulatory Compliance

It is important to know what documentation is required and to consider the means of generation, archiving & support.

- Safety Instrumented Function list
- Safety Requirement Specification
- SIL Verification Calculations
- Cause and Effect Table
- P&IDs
- SIS Logic
- Loop Diagrams
- Logic Solver Panel Design
- Factory Acceptance Test
- Site Acceptance Test
- Verification /Validation Checklist
- Functional Safety Assessment
- Installation and Commissioning QA/QC records
- Operating and Maintenance Procedures
- Executed Proof Test Procedures
- SIS Demand and Failure Tracking Log
- SIS Practice and Recording
- Audit Records
- MOC Records
- Training Records

Conclusions – Standards Benefits

- **ISA TR-5 and API RP 556 provides the design guidance for:**
  - Process Heater Design
  - Primary Measurement Devices
  - Actuating Instruments
  - Combustion Controls
  - Protective systems
  - Alarms
- **ANSI/ISA 84 eliminates downtime by balancing the availability, safety and lifecycle aspects of the system**
  - Clarifies Risk
  - Sets Detailed Design Requirements
  - Defines Testing & Maintenance Requirements
  - Operation Procedures

Conclusions – ICSS Benefits

"The benefits of ICSS and intelligent field devices cannot be fully maximized unless the culture and the organizational competencies are thoroughly and completely developed."

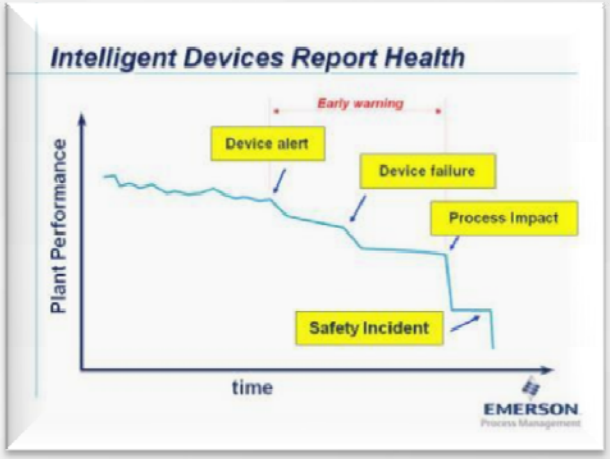
Project and Development Cost Benefits

- Reduced engineering costs from standardized engineering
- Lower implementation costs
- Reduced configuration management
- Reduced commissioning
  - Remote verification
  - Automated loop testing
  - Device configuration
- Reduced training costs
- Automated documentation

Conclusions – ICSS Benefits

Operations & Maintenance Benefits

- Increased plant availability
- Reduced process variability
- Improved safety
- Automated regulatory compliance
- Integrated change management
- On demand documentation
  - Audit trail
  - Device calibration and history
  - BPCS / SIS configuration
  - Process history and event recording
- Human Centered Design
  - 20/20 Maintenance
  - avoid alarm overload



"Under-performing assets are identified through HART Device Alerts, documented and acted upon before they can effect process availability.

Where To Get More Information

- Contact Info

  bluefieldsafety@gmail.com
  chuck.miller@emerson.com

- Bluefield Process Safety Website

  (www.bluefieldsafety.com)
- DeltaV SIS Website

  (www.deltavsis.com)

Thank you…

… Questions and Comments Appreciated?