

**Combustion Equipment Safety**

**Honeywell** | Combustion Safety

# Agenda

- **Introductions**
- Importance of Combustion Safety
- Combustion Culture
  - People
  - Policy
  - Equipment



# Who I am...

## Bryan Baesel, P.E.

### Background

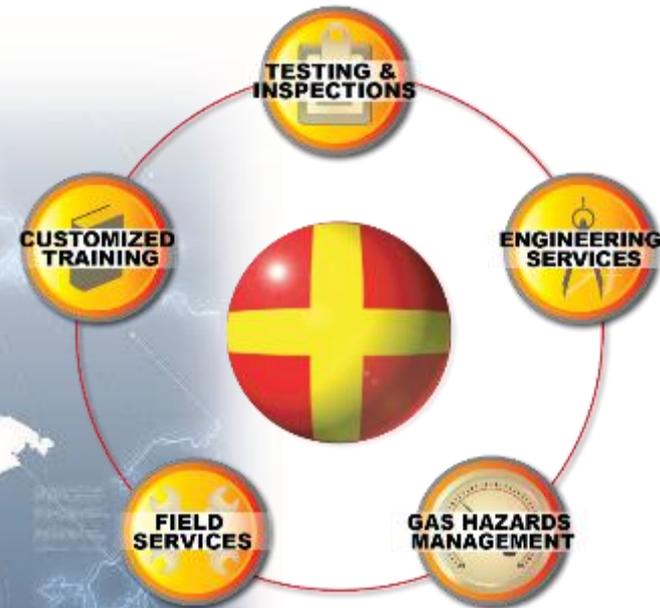
- **Mechanical Engineer**
- **15 Years w Combustion Safety**
- **US Department of Energy - Qualified Process Heating Specialist**
- **Sit on 3 National Combustion Code Committees**

NFPA 85 Boiler and Combustion System Hazards Code

NFPA 86 Standard for Ovens and Furnaces

# Mission

*“To Save Lives and Prevent Explosions  
While Increasing the Efficiency and  
Reliability of Combustion Equipment”*



***30,000+ Combustion Systems at 1,100 Global Programs in Last 15 Years***

# Who I Represent...



How we can help, combustion safety services related to...

- Testing & Inspections
- Engineering Services
- Customized Training
- Gas Hazards Management
- Field Service

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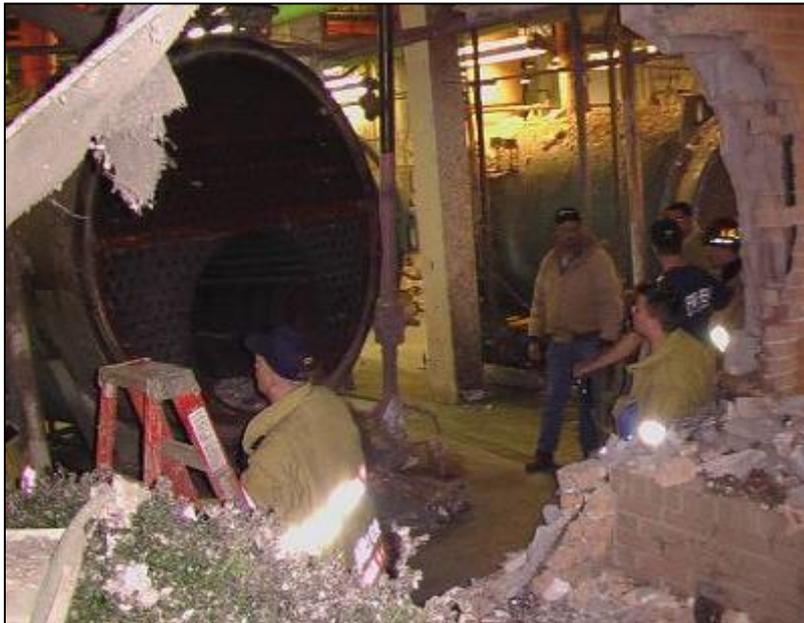
# Just A Few Numbers

Facility	Loss	Dead / Injured	Human Error	Equip. Failure	Lack of Training	Poor Maint.	Improper Procedures	High Risk Culture
Ford Rouge Complex	\$2 Billion	6 / 14	X		X		X	X
Algerian LNG	\$800 MM	31 / 74	?	X	X		X	X
Kaiser Aluminum	\$300+ MM	0 / 23	X	X	X	X		X
Kansas City P&L	\$196 MM	0 / 2		X		X		X
Tosco Refinery	\$71 MM	1 / 46	X		X		X	X
New River Casting	\$30 MM	3 / 7		X		X		X
GM Lordstown	N/A	1 / 0	X	X		X	X	X
Crown Cork & Seal	\$20 MM	0 / 1	X	X		X	X	X



# Just A Few Numbers

- From 1991-2002, Over 23,338 Boiler/Pressure Vessel Accidents<sup>1</sup>
  - 127 Killed & 720 Injured
- From 1990 - 1999, Over \$17.3 Billion in Property Damage from major U.S. explosions and fires (all types of combustion systems/causes)<sup>2</sup>



1. National Board Web Site– Summer 2002
2. 1999 large-Loss Fires and Explosions NFPA Journal Nov/Dec 2000

# Recent Incidents – Gas Line Purging

## ConAgra Garner, NC Site June 2009



All of this from a mistake purging a new 4" gas line



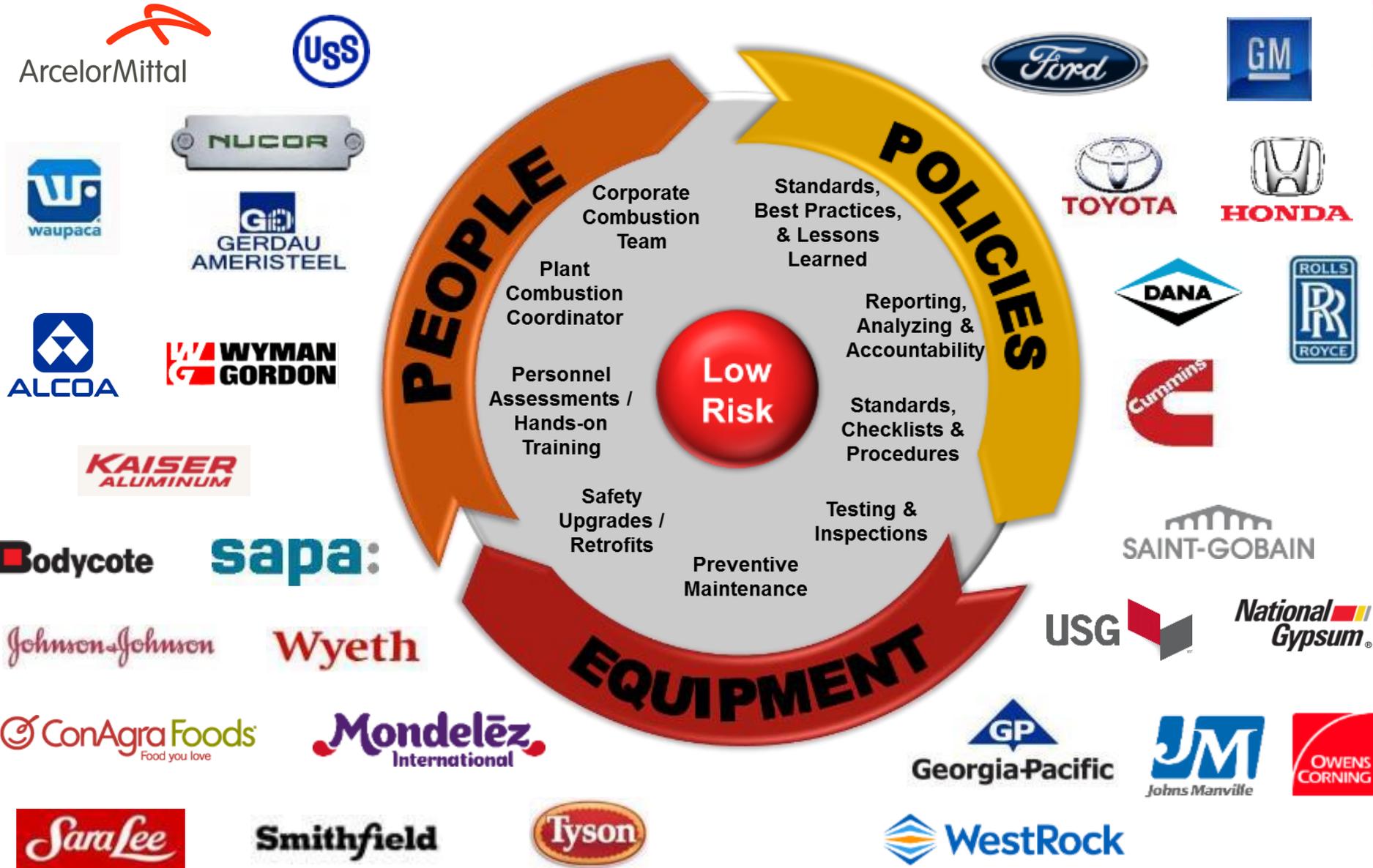
**How do we help prevent these types  
of incidents from happening?**



# Elements of a Successful Culture

- Proactive
  - Identify and implement measures to reduce risks
  - Keep current with safety standards
- Aware
  - Recognize hazards, don't be apathetic!
  - No shortcuts!
- Continuous Improvement
  - Training and Knowledge Demonstration
  - Preventative Maintenance (PM) programs

# The HCS Corporate Risk Reduction Model



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# Question

- **What is the most important safety on a piece of combustion equipment?**



# Answer:

- **A well trained operator!**



“Human error is the leading cause of combustion-related accidents”

# Training

## **2015 NFPA 86 Process Ovens**

### **Section 7.3.3**

All operating, maintenance, and supervisory personnel shall receive regularly scheduled retraining and testing.

### **Section 7.3.2**

The personnel responsible for operating, maintaining, and supervising the furnace shall be required to demonstrate understanding of the equipment, its operation, and practice of safe operating procedures in their respective job functions.

# It's Knowledge And Hands-On Skills



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**Where do I turn to find out the requirements?**



# Codes & Standards

- Minimum Consensus Standards - Built on a foundation of maximum participation and agreement by a broad variety of interests.
- OSHA Act: “the Secretary shall... by rule promulgate as an occupational safety or health standard any national standard...”

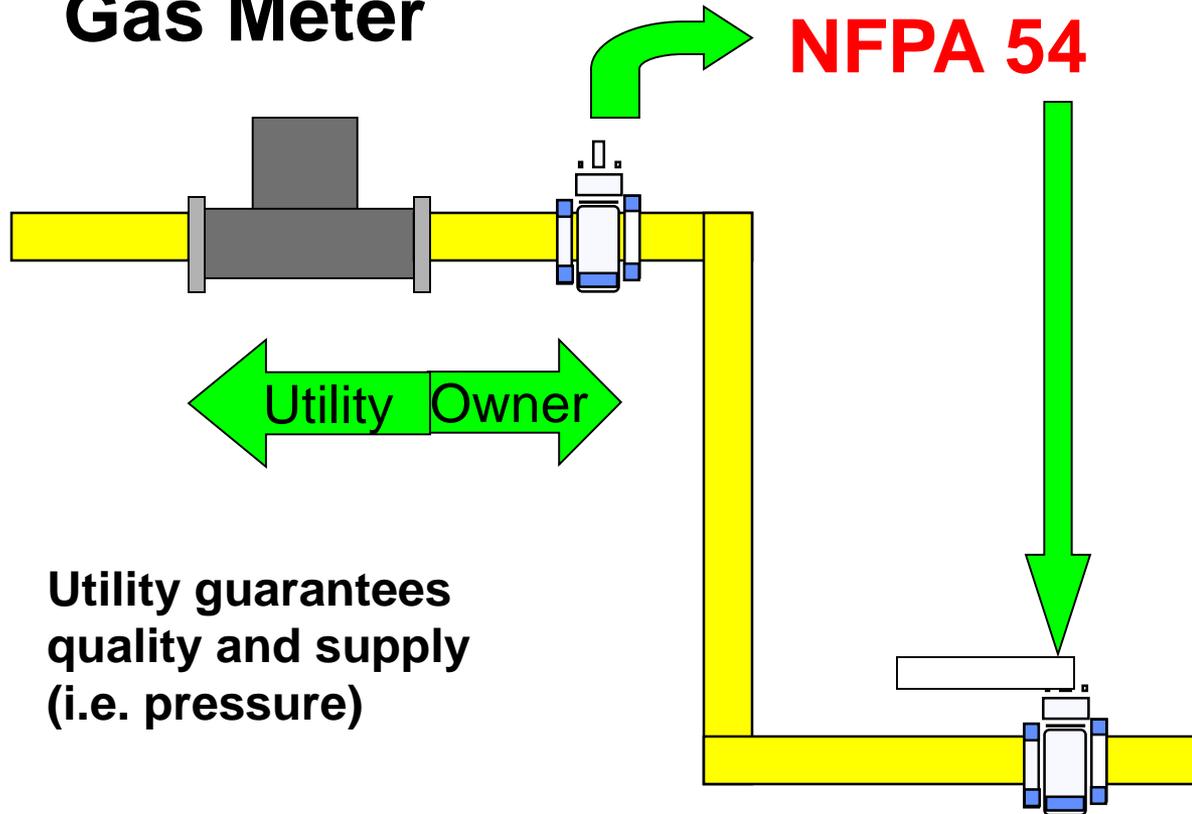
# Standards Developing Organizations

- National Fire Protection Association (NFPA)
  - **NFPA 85 – Boilers (> 12.5 MMBtu)**
  - **NFPA 86 – Ovens & Furnaces**
  
- American Society of Mechanical Engineers (ASME)
  - **ASME CSD-1 – Boilers (0.4 to 12.5 MMBtu)**

# Other Important Codes & Standards

- NFPA 54 National Fuel Gas Code
- NFPA 70 National Electric Code (NEC)
- OSHA 29 CFR 1910.147 Control of Hazardous Energy

# Gas Meter



**NFPA 85**  
**NFPA 86**  
**ASME CSD-1**



**Utility guarantees  
quality and supply  
(i.e. pressure)**

# Natural Gas Fuel Supply System

# Authorities Having Jurisdiction (AHJ)

- Occupational Safety & Health Administration (OSHA)
- Applicable State & Local Authorities
- Jurisdictional Boiler Inspector
- Corporate Insurance Provider

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    - A. Safety Testing
    - B. Documentation
    - C. Service



# A. Testing

## **NFPA 86 (2015 Edition)**

7.4.4 All safety interlocks shall be tested for function at least annually.

7.4.5 The set point of temperature, pressure, or flow devices used as safety interlocks shall be verified at least annually.

7.4.6 Safety devices testing shall be documented at least annually.

## **ASME CSD-1 (2015 Edition)**

### CM-130 Periodic Maintenance and Testing

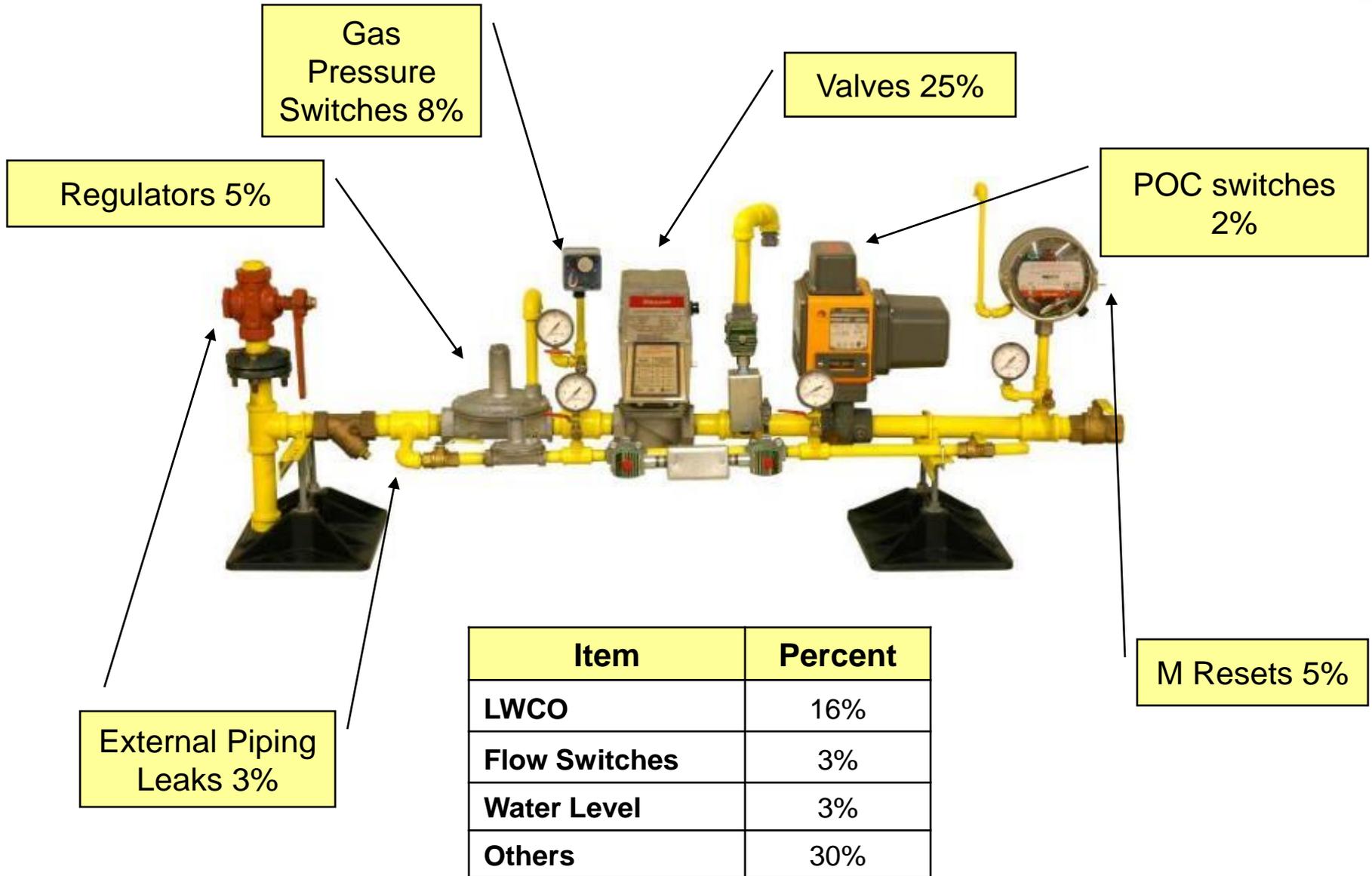
The owner or user of an automatic boiler system shall develop and maintain a formal system of periodic preventive maintenance and testing. Tests shall be conducted on a regular basis, and the results shall be recorded in the boiler log or in the maintenance record or service invoice.

## **NFPA 85 (2015 Edition)**

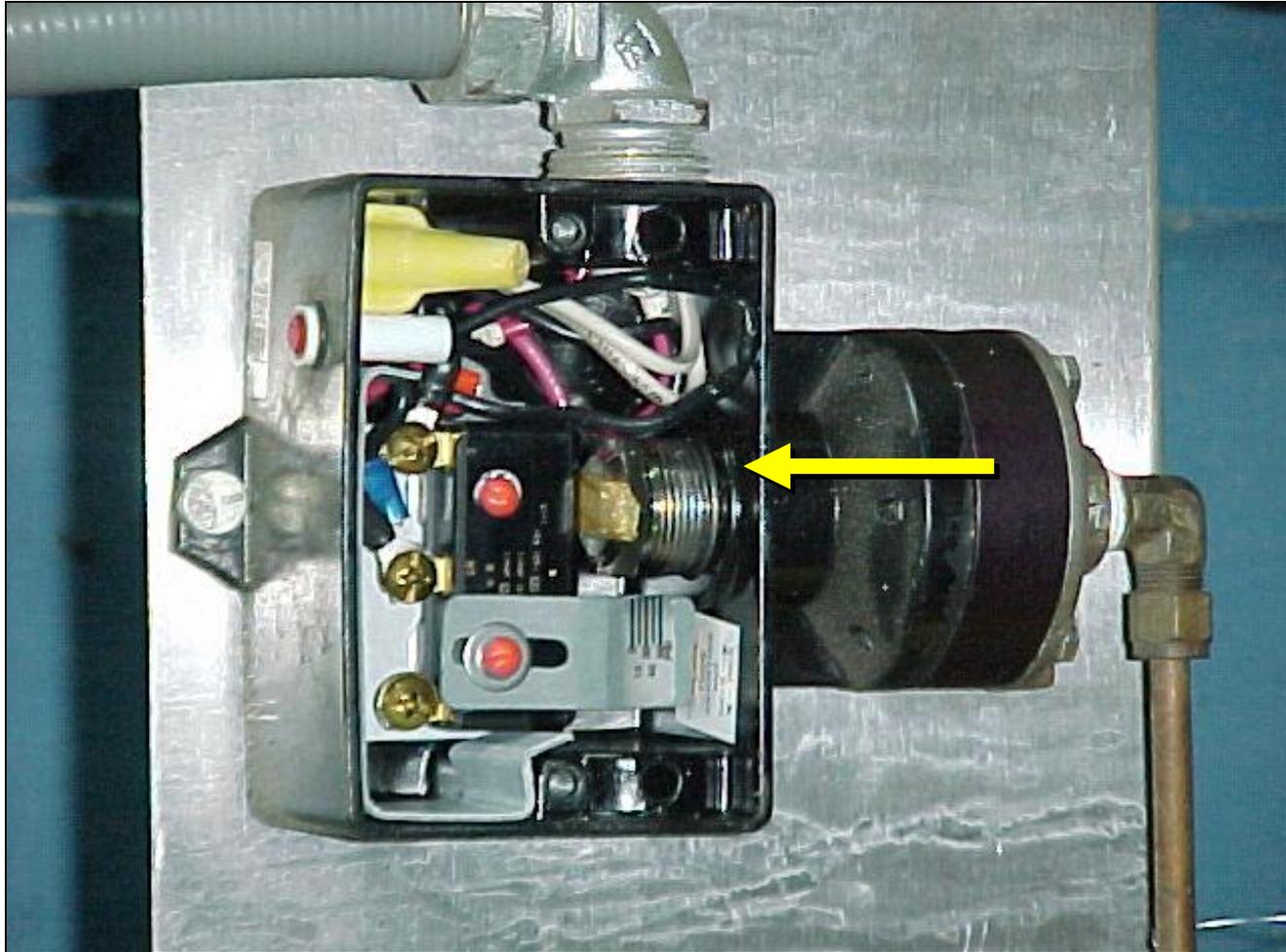
4.4.1.3 Operation, set points, and adjustments shall be verified by testing at specified intervals, and the results shall be documented.



# Top 10 Boiler Criticals



# Has it Been Broken?



# Has Yours Been Tested Lately?



## B. Documentation

- Document operating conditions (set points)
- Procedures
- Review and document changes
- System operation parameters
- Maintenance & Testing Records
- Component Capabilities

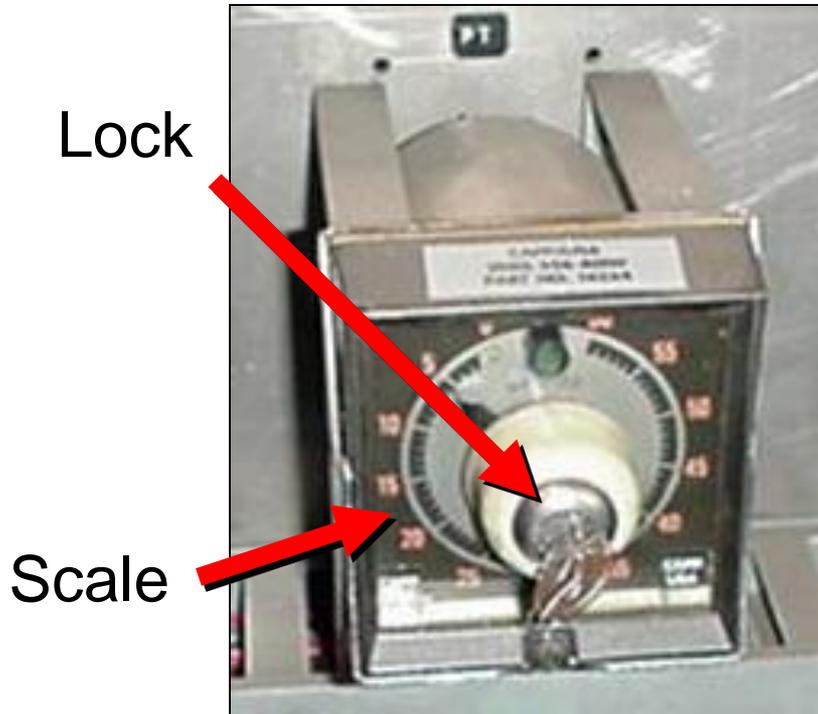
# Is This Set Right?

People's Lives Depend On The Answer!

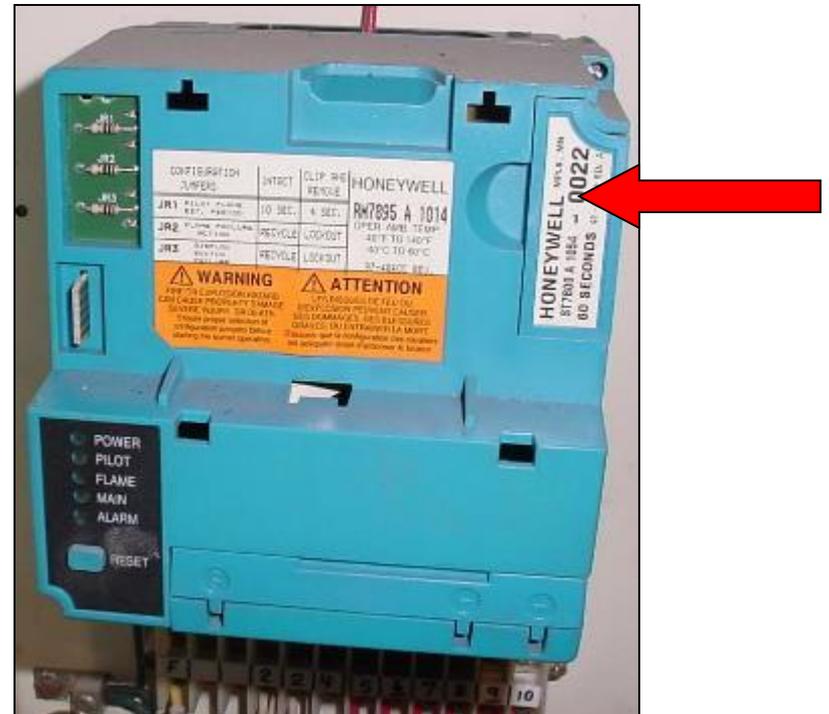


Where Do I Find Set Points?

# Tamperproof ?

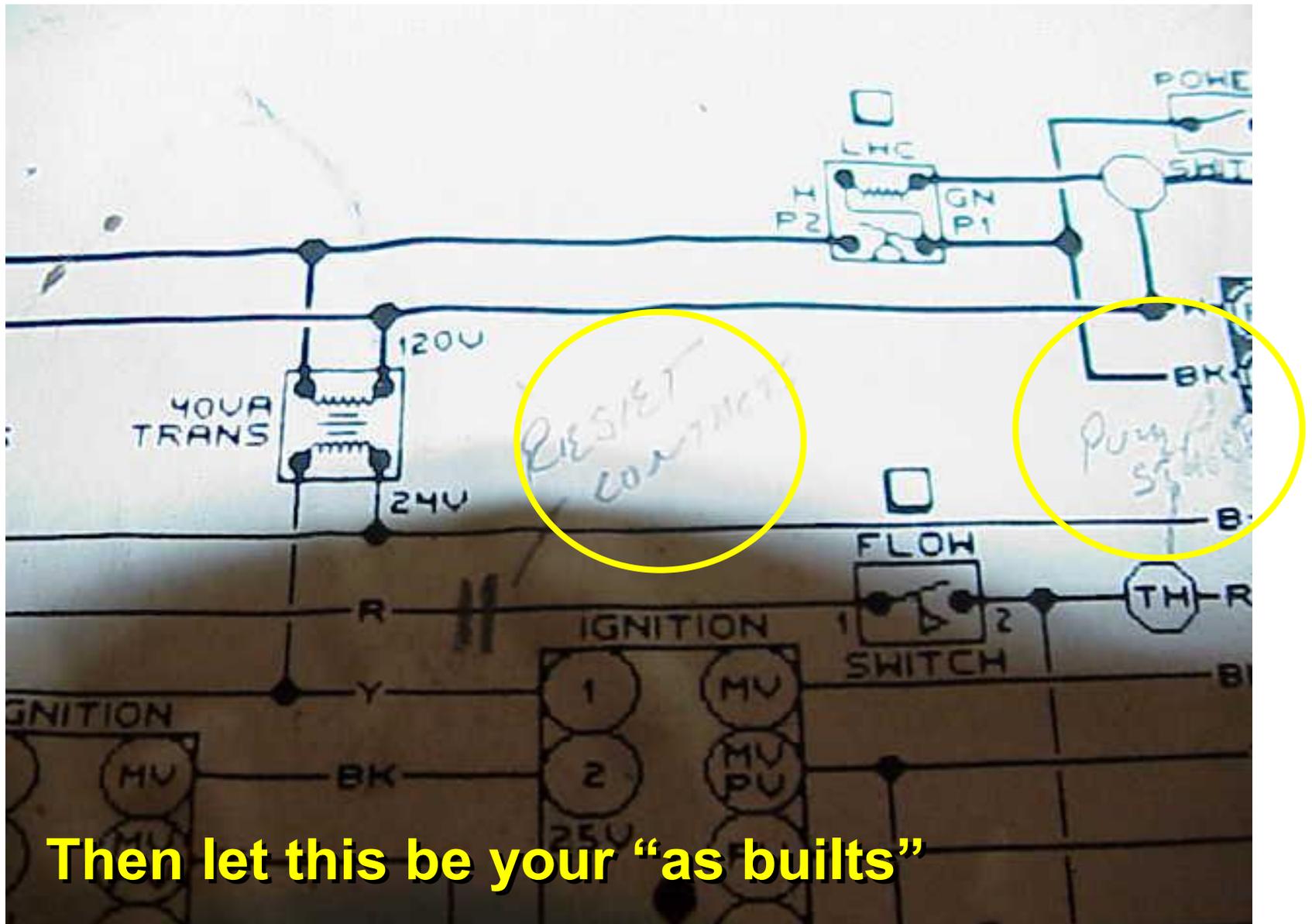


**Resettable/Lockable**



**Solid State Purge  
Timing Chip**

# Want Human Error?



Then let this be your "as built"

## And Is This What Your Panels Look Like?



**Often no wire numbers, accurate schematics, or manufacturer's literature**

## C. Service

- Safe Piping Repairs
- Burner Service
- Preventative Maintenance



# Gas Is Different!

- Electrical wires don't need to be purged after shutdown – *gas does*
- No leakage of current that stores up - *gas does*
- Most electrical panels, one lock fits all - *not gas*



# Is It Open or Closed?



# Is It Locked?



**Fits On to Valve**



**Built Into Valve**



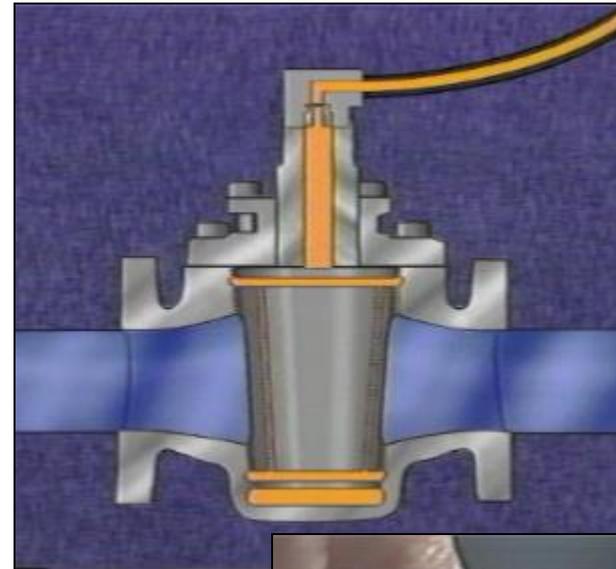
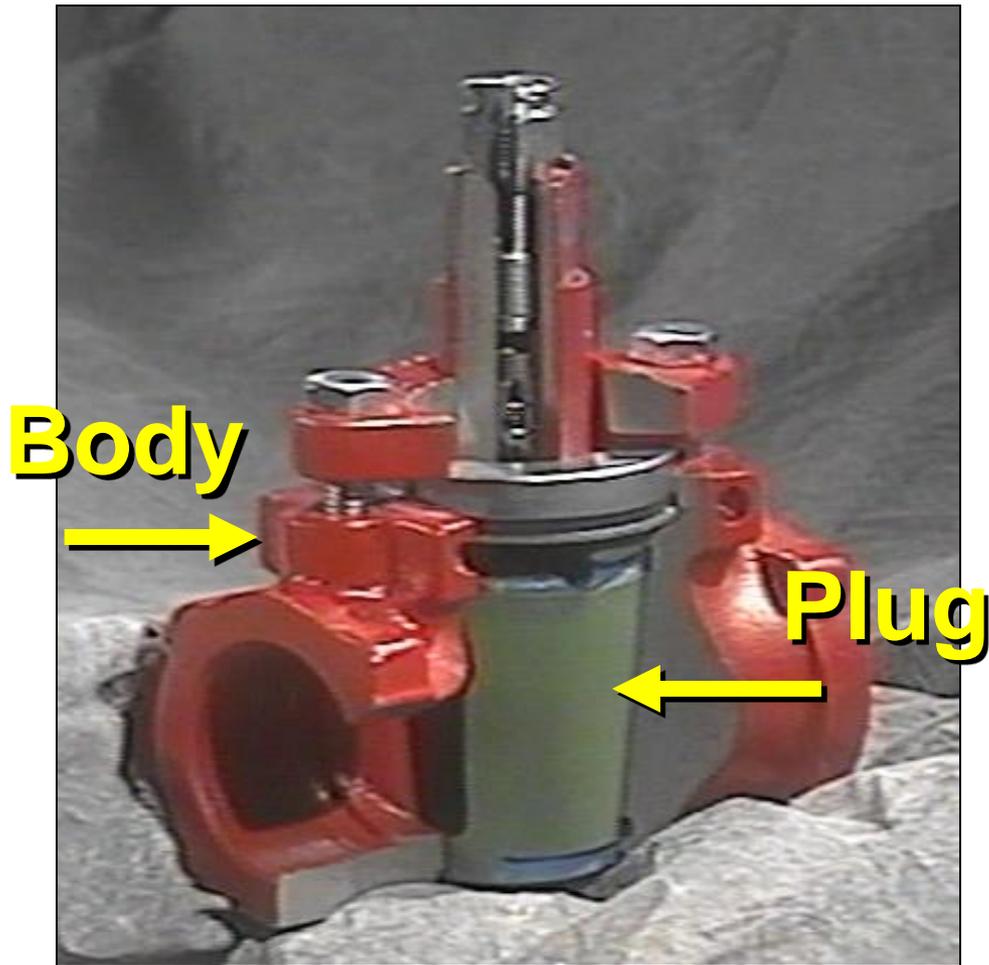
**Built Into Handle**

# Gas Train Lockout For Repair

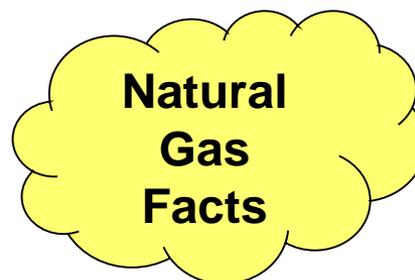
- Many sites lack lockout equipment
- Even if they do, 60% of plug cocks leak
- Many do not own equipment to seal / lubricate valves



# The Most Common Manual Shut Off Valve Is Just Two Hunks Of Metal



# Understanding Purge Hazards



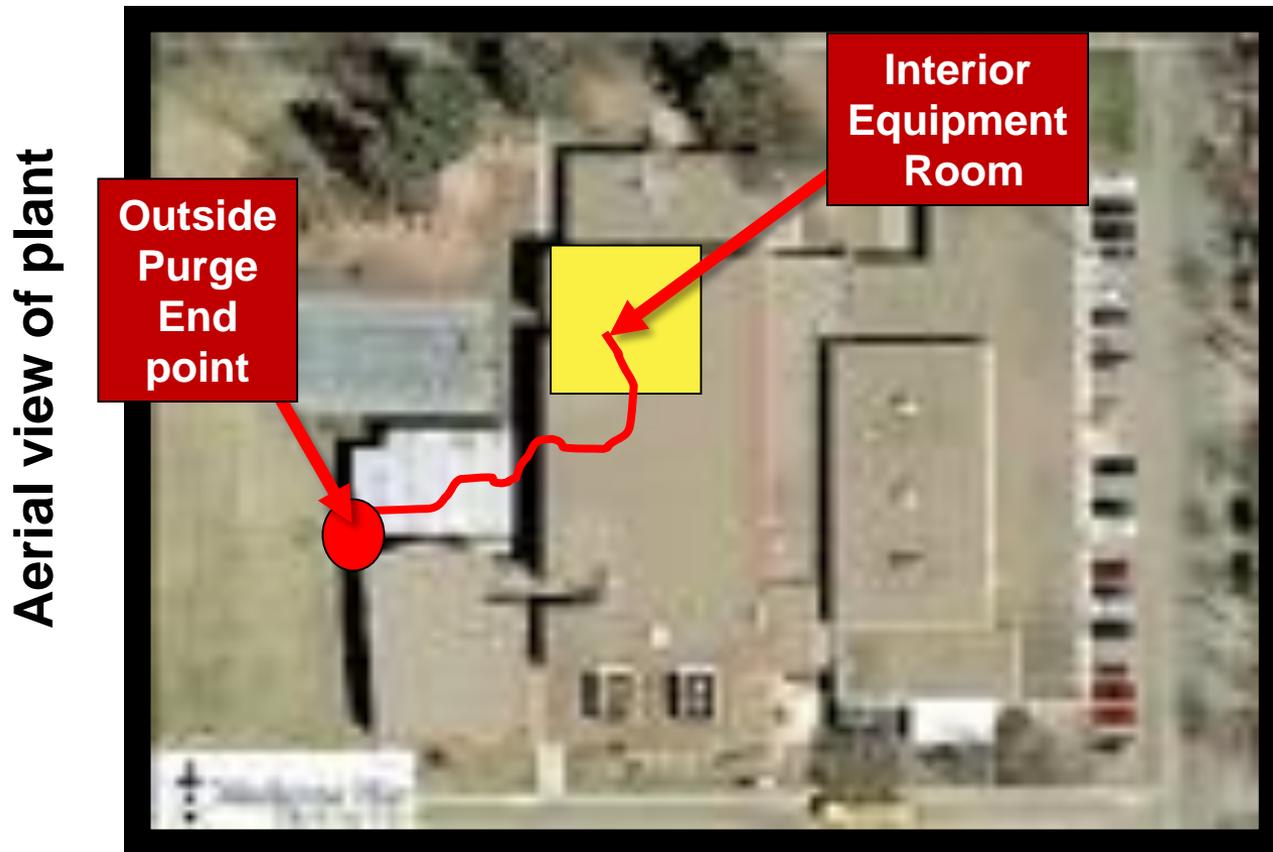
- **It has no natural odor, it is odorized by the utility with Mercaptan.**
- **Utilities Design standard is to detect 1% of gas by volume.**
- **Takes 4.3% to be at LEL, but human smell degrades with age and lots of things like rust and new pipe absorb Mercaptan.**

**YOU CAN'T TRUST THE SMELL!**

# Everything Must Go Outside

**8.3.2.1\* Purging Procedure.** The piping system shall be purged in accordance with one or more of the following:

1. The piping shall be purged with fuel gas and shall discharge to the outdoors.



**You have to plan for equipment in interior parts of a plant**

# Burner Reliability

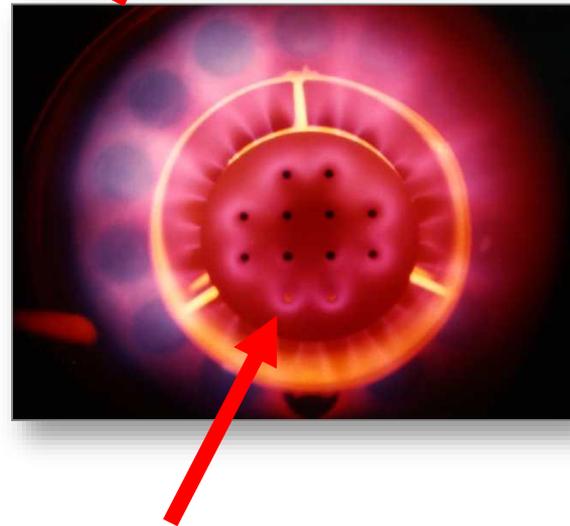
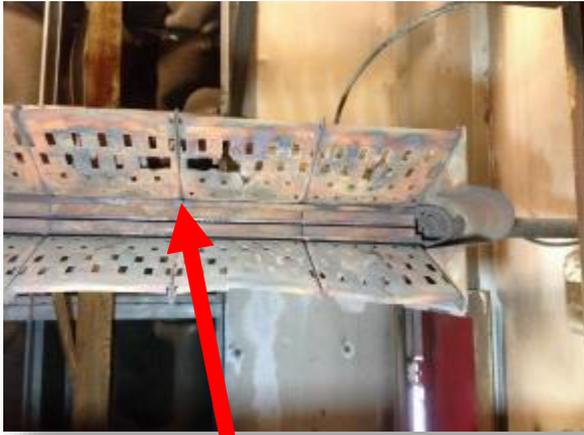
Burners are designed to operate under a specific set of conditions. Without checks of the system they can cause big headaches.

## Burner Reliability Items:

1. Burner Ratio Tuning
2. Air Filters
3. Impingement/Overheating
4. Burner/Nozzle Integrity
5. Flame Signal Strength



# Typical Burner As-Found Issues



**Thank You!**

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**[www.combustionsafety.com](http://www.combustionsafety.com)**

**216.749.2992**