



**BUSTED**

# ***Busting the Myths of Alarm Management***

**Bill Hollifield  
Principal Alarm  
Management Consultant  
PAS**

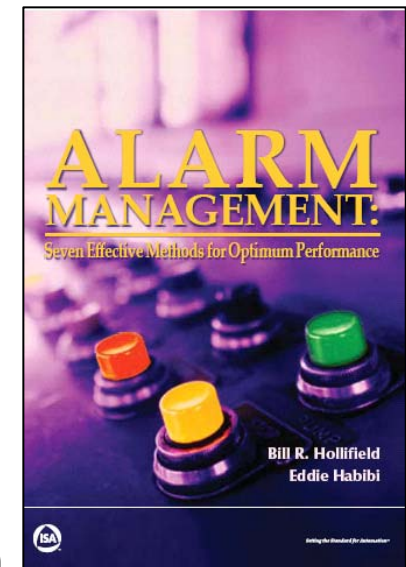
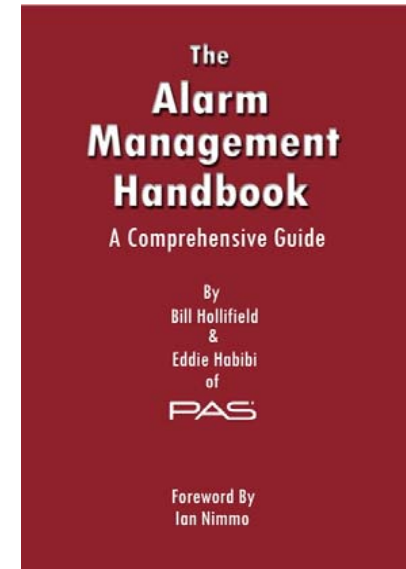
**2008 Pipeline Conference and Cybernetics Symposium  
April 2008, Orlando, FL**

# *Alarm Management Myths Abound!*

- Alarm Management is a major issue
- Inexperienced, self-proclaimed “experts” are out there
- Misinformation is on the internet
- Proper Alarm Management will help improve safety and reliability of industrial plants

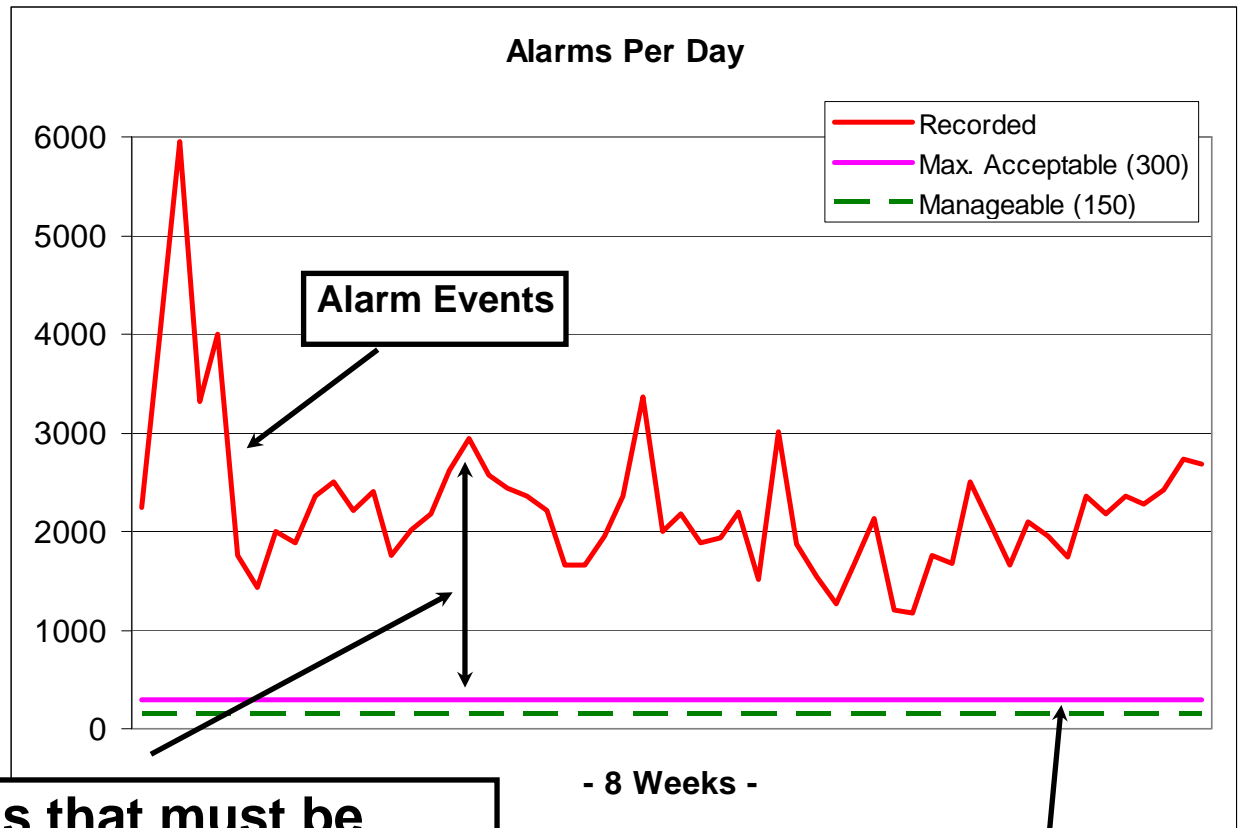
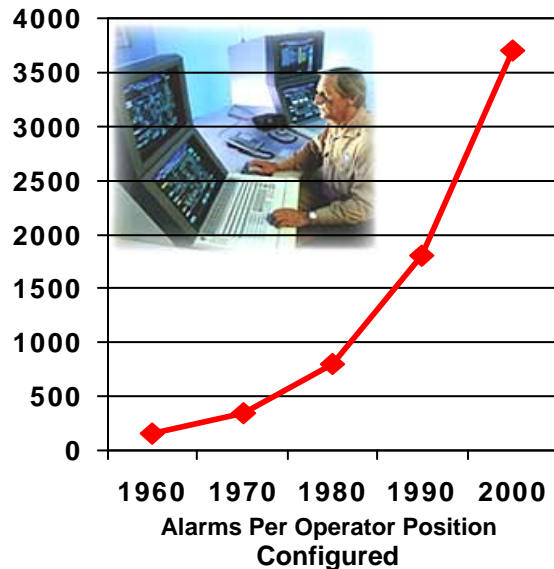
## What went into the book:

- Over 12 years of experience & over 100 person-years of effort
- Comprehensive compilation of best practices
- Lessons learned from hundreds of successful projects
- Practical, field-proven strategies and techniques
- A significant update to EEMUA 191



ISA Version

# How did we get in this mess?



**Thousands of alarms that must be screened / dropped / ignored by the operator!**

**Not a safe or desirable situation!**

**Operator Alarm Handling Capacity**

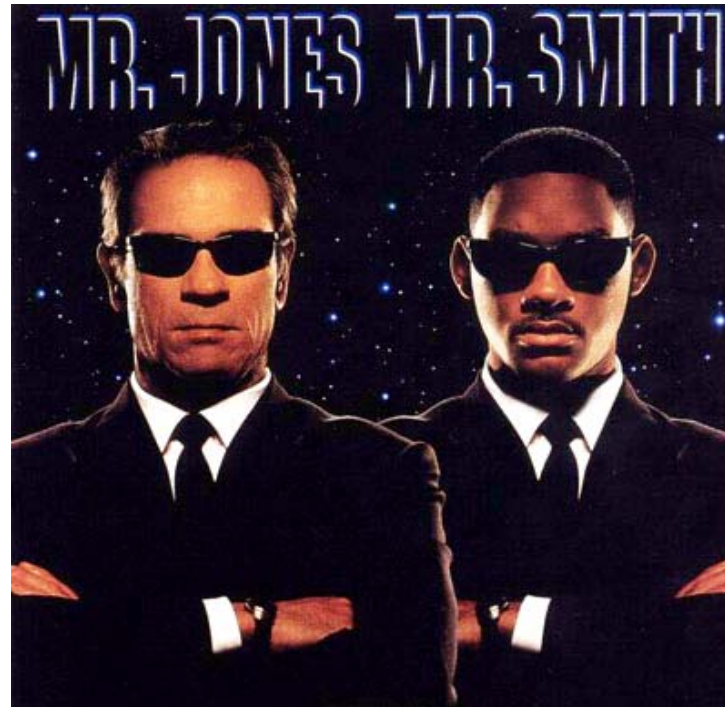
# Some “Benefits” of an Overloaded Alarm System

Be on the TV news! That’s always good.



# Some “Benefits” of an Overloaded Alarm System

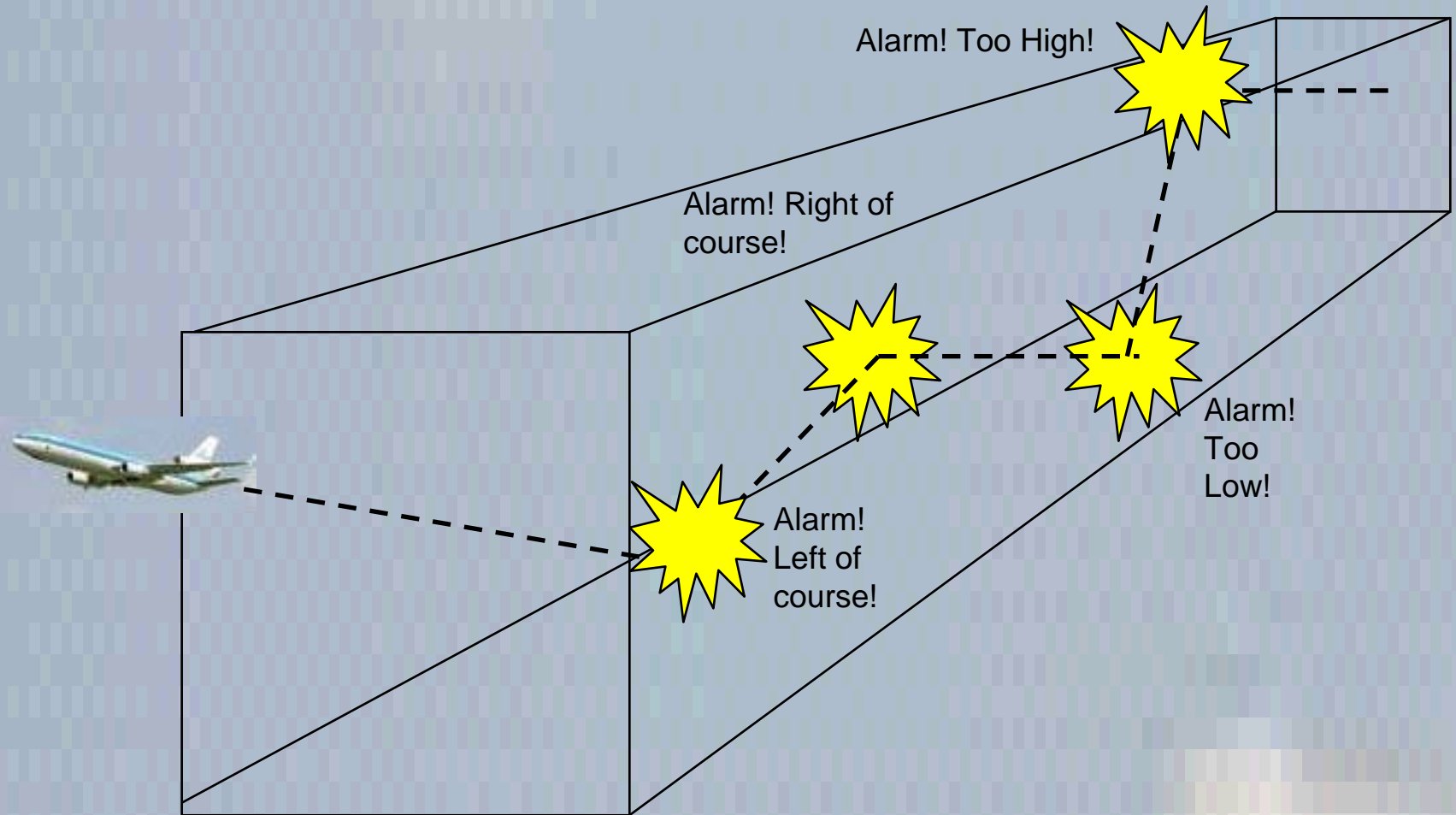
- Get to know your OSHA inspectors really well. They just want to help you.



 OSHA

# *Poor Alarm Systems Encourage “Operating by Alarm”*

**No way to run a process:**



# *The Main Myths of Alarm Management*

- You don't need an **“Alarm Philosophy”**
- Alarm Management is about **Software!**
- Alarm Management is about **Counting Your Alarms**
- Alarm Management is about **Getting Rid of Alarms**
- Alarm Management is something you can **“buy”**
- Alarm Management is about **Endless Consulting Services**

# Overloaded Alarm Systems are Easy to Create

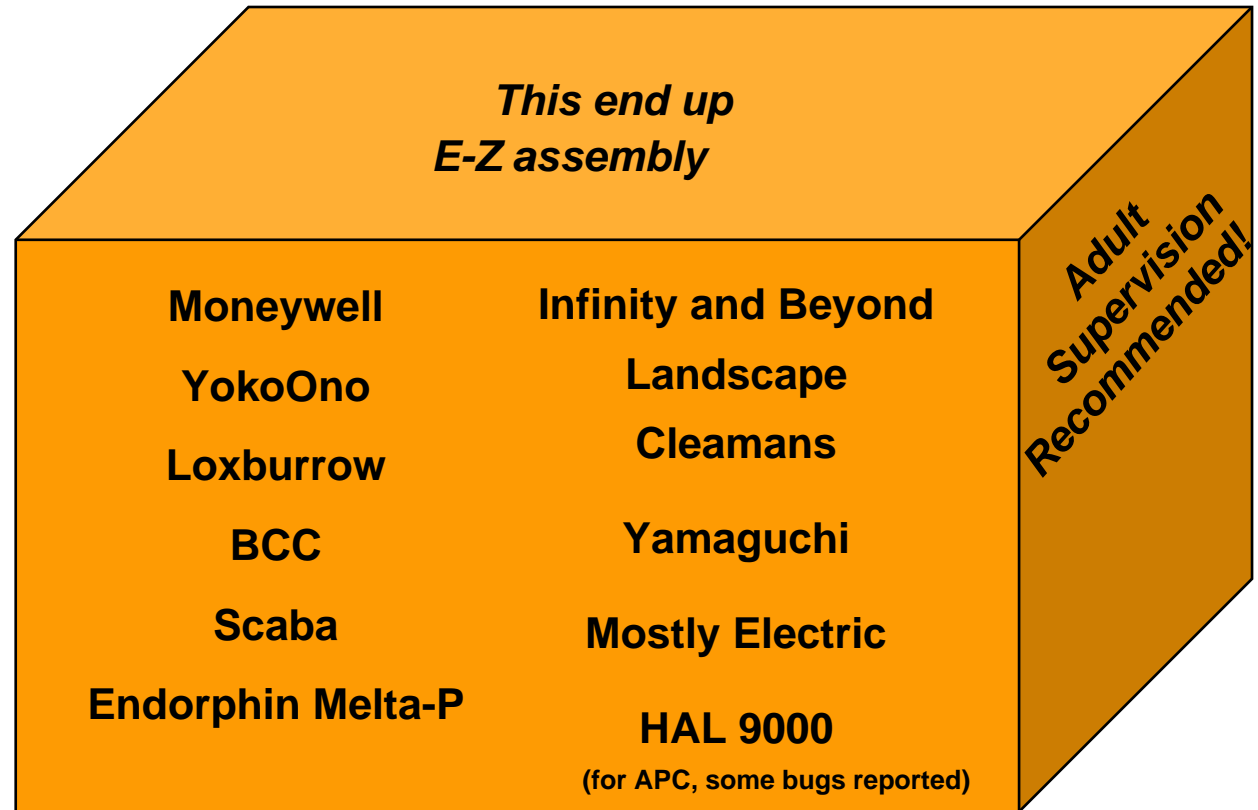
## Step 1:

Unpack the DCS  
Box

## Step 2:

Turn on all the  
alarms supplied  
by the  
manufacturer  
(They're free!)

Step 3: Mission  
accomplished!  
Enjoy!



HI-HI Value

HI Value

LO Value

LO-LO Value

Rate-of-Change Positive

Rate-of-change Negative

Significant Change

Deviation High

Deviation Low

Output High

Output Low

Value Out-Of-Range

Configuration Error

Non-Normal Mode

Off-Normal

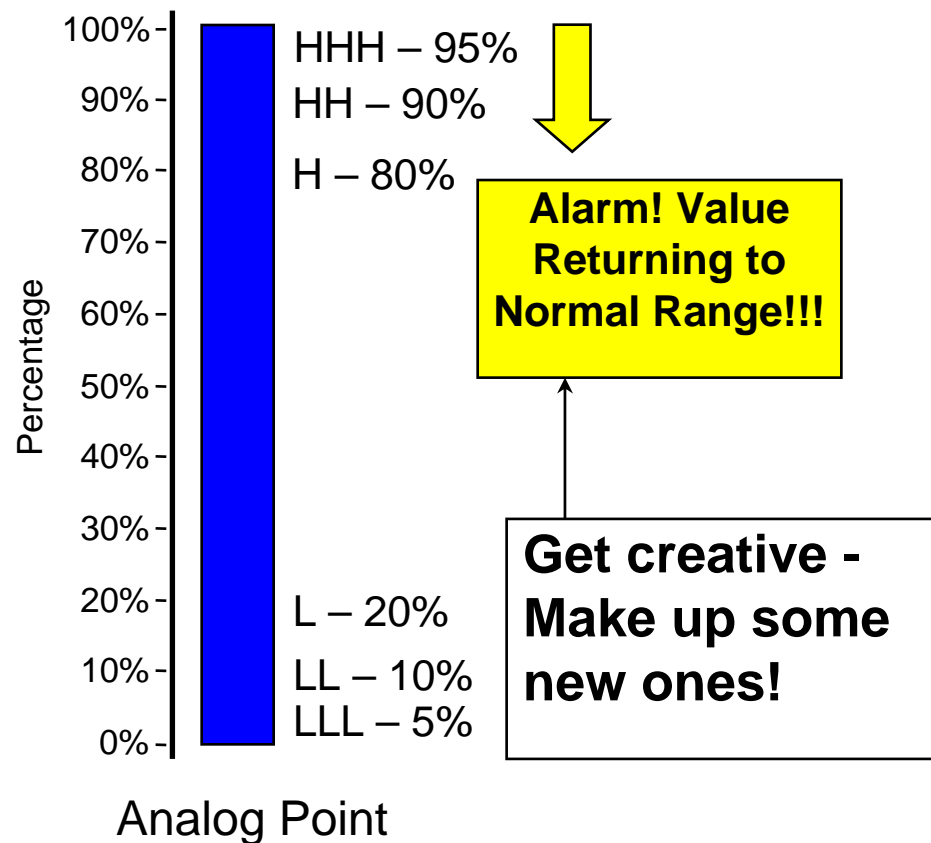
Command-Disagree

Logic Output and more...

*Add many more for Fieldbus!*

# Overloaded Alarm Systems Are Easy To Create!

**#1. Don't waste time thinking. Use rules of thumb instead!**



- Turn on all the Analog Limit alarms
  - Turn on all the Rate-of-change alarms
  - Turn on all of the Deviation alarms
  - Turn on all of the Off-Normal alarms
- and so forth...

# *The Cure: Seven Steps to Highly Effective Alarm Management*

**Step 1: Develop, Adopt, and Maintain an Alarm Philosophy**

**Step 2: Collect Data and Benchmark Your Systems**

**Step 3: Perform “Bad Actor” Alarm Resolution**

**Step 4: Perform Alarm Documentation and Rationalization (D&R)**

**Step 5: Implement Alarm Audit and Enforcement Technology**

**Step 6: Implement Real Time Alarm Management**

**Step 7: Control and Maintain Your Improved System**

Always Needed

Often Done Simultaneously

Needed Based Upon Performance

# Myth: You Don't Need an Alarm Philosophy

## Alarm Philosophy:

**A complete, customized, and comprehensive document covering how to do alarms right at your location.**

### CONTENTS Of An Alarm Philosophy

1.0 Alarm Philosophy Introduction	8.0 Specific Alarm Design Considerations
2.0 Purpose and Use	8.1 Handling of Alarms from Instrument Malfunctions
3.0 Alarm Definition and Criteria	8.2 Alarms for Redundant Sensors and Voting Systems
4.0 Alarm Annunciation and Response	8.3 External Device Health and Status Alarms
4.1 Navigation and Alarm Response	8.4 ESD Systems
4.2 Use of External Annunciators	8.5 ESD Bypasses
4.3 Hardwired Switches	8.6 Duplicate Alarms
4.4 Annunciated Alarm Priority	8.7 Consequential Alarms
5.0 Alarm System Performance	8.8 Pre-Alarms
5.1 Alarm System Champion	8.9 Flammable and Toxic Gas Detectors
5.2 Alarm System KPIs	8.10 Safety Shower and Eyebath Actuation Alarms
5.3 Alarm Performance Report	8.11 Building-Related Alarms
6.0 Alarm Handling Methods	8.12 Alarm Handling for Programs
6.1 Nuisance Alarms	8.13 Alarms to Initiate Manual Tasks
6.2 Alarm Shelving	8.14 DCS System Status Alarms
6.3 State-Based Alarms	8.15 Point and Program References to Alarms
6.4 Alarm Flood Suppression	8.16 Operator Messaging System
6.5 Operator Alert Systems	9.0 Management of Change
7.0 Alarm Rationalization	10.0 Training
7.1 Areas of Impact and Severity of Consequences	11.0 Alarm Maintenance Workflow Process
7.2 Maximum Time for Response and Correction	
7.3 Priority Matrix	Plus Appendices
7.4 Alarm Documentation	
7.5 Alarm Trip Point Selection	
7.6 The Focused D&R Option	

- If you do not specify how to do alarms **right**, hundreds of world-wide examples indicate that alarms will be done **wrong**.
- Alarm Philosophies must be *developed*, they cannot just be “*bought*.”

# *The Primary Principles for Alarm Creation*

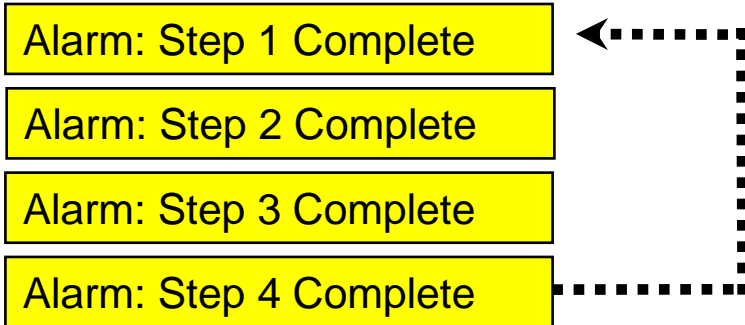
***Alarms notify the operator  
of events requiring action***

- **The commonly violated rules:**
  - **Alarmed events must require *operator action***
  - **Alarm must be based on the best indicator of the situation's root cause**
  - **Alarm must result from a truly abnormal situations, never from normal situations**
- **Alarm systems are so easy to use that they are used for all sorts of inappropriate purposes!**

# Common Ways to Violate these Principles

**Create alarms that indicate the system is working as expected, or normally.**

## Wrong: Alarm Successful Operation

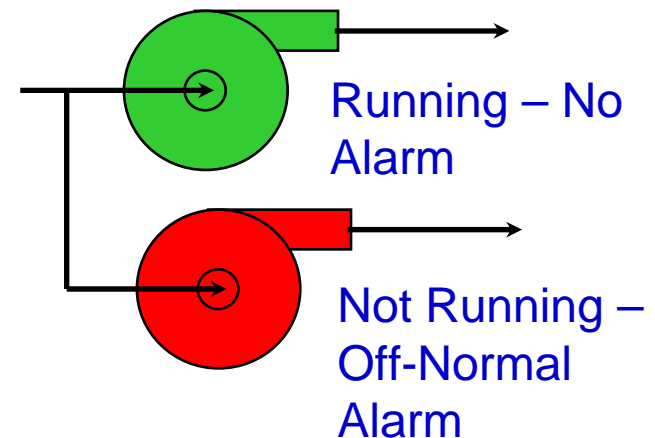


## •Right: Alarm Unsuccessful Operation

Alarm: Step 2 Failed to Complete

Status changes are shown via graphics, not by misusing the alarm system!

## Spare Pumps: commonly alarmed incorrectly:



Do not alarm things that are “off.” Alarm them only when they are “off” but are **supposed to be on!**

# ***Myth: Alarm Management is About Software***

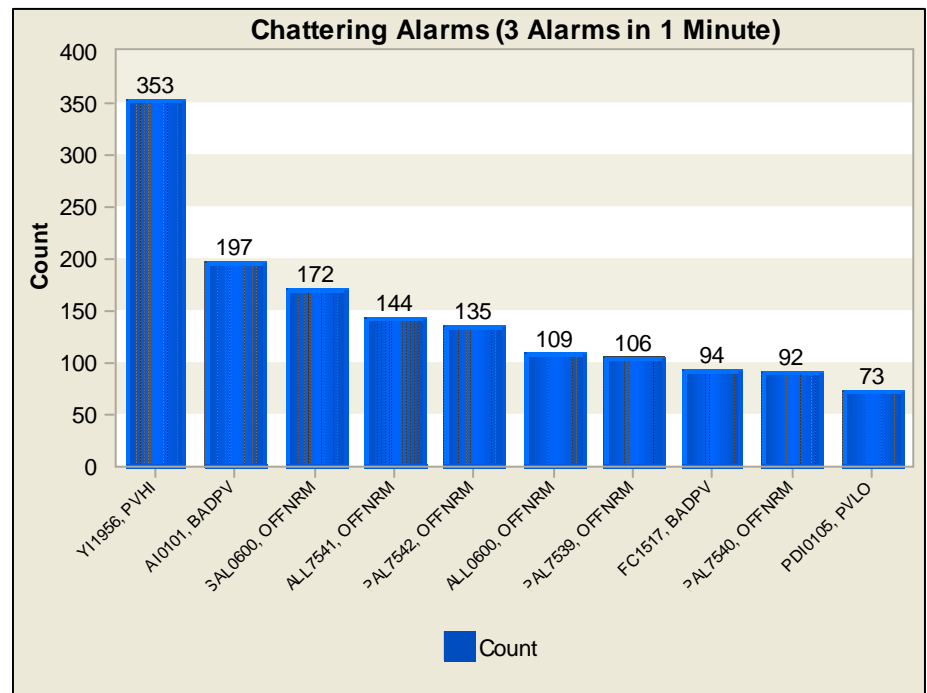
- **Poorly performing alarm systems do not create themselves!**
- **Proper Work Practices are needed to correct or create a properly performing alarm system**
- **Software is just a tool to identify problems and augment proper Work Practices**

## **Common improper Work Practices relative to alarm systems:**

- ***Uncontrolled Alarm Suppression***
- ***Improper alarm creation practices***
- ***Improper alarm prioritization***
- ***Uncontrolled change of alarm settings***
- ***Failure to fix nuisance alarms***
- ***Failure to monitor and report performance***
- ***Failure to document alarms***
- ***Improper use of alarm types***

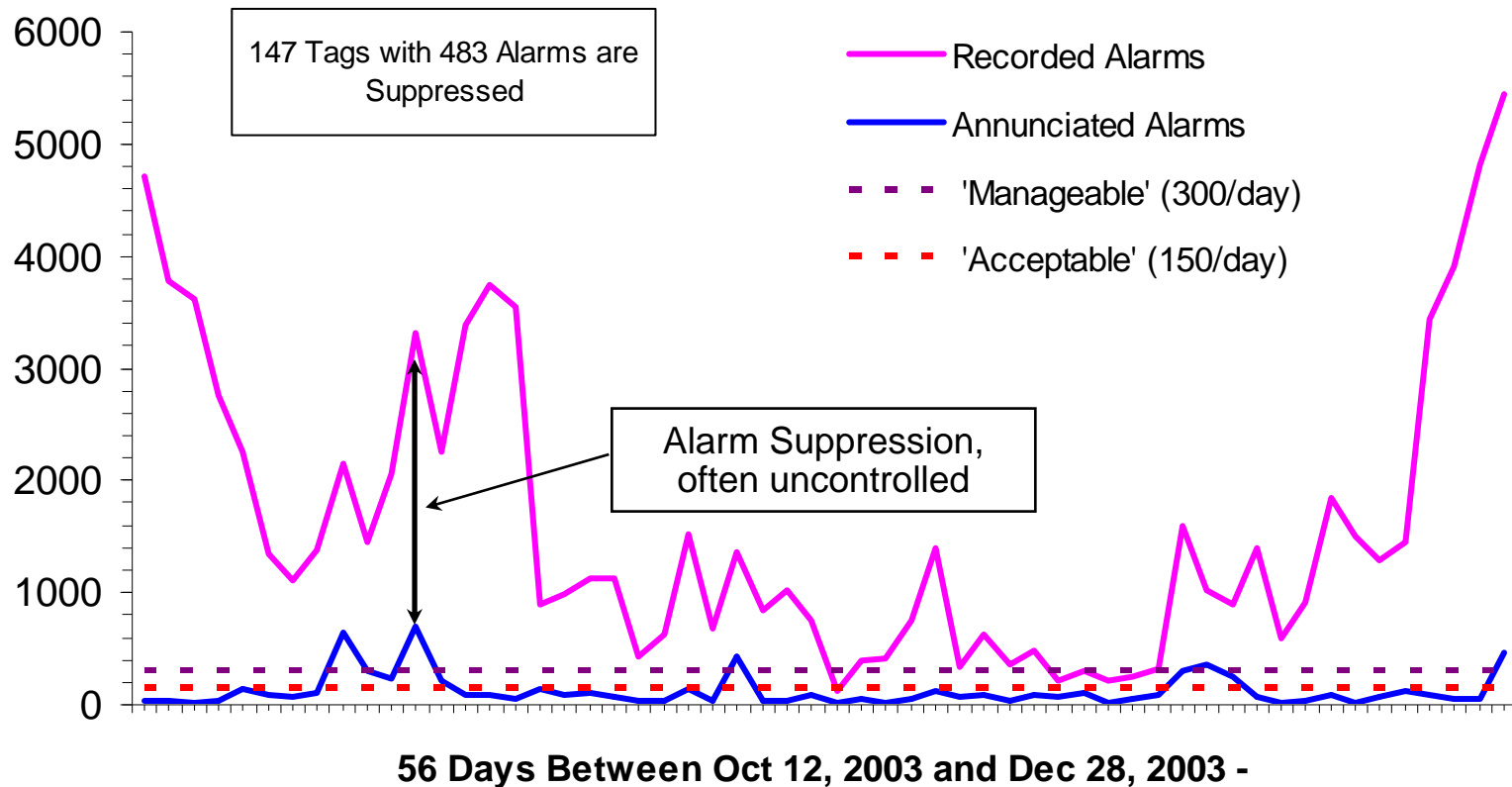
# Myth: Counting Alarms is Alarm Management

- Yes, and weighing myself will get rid of my extra pounds!
- **Alarm Analysis** is an essential part of alarm management, but is only a tool to identify problems that require work to correct.
- Some important Alarm System Performance Measurements:
  - Alarms Per Day
    - Annunciated and Suppressed
  - Alarms Per 10 Minutes
  - Alarm Floods
  - Alarm Priority Distribution
  - Most Frequent Alarms
  - Chattering Alarms
  - Alarms By Type
  - Stale Alarms



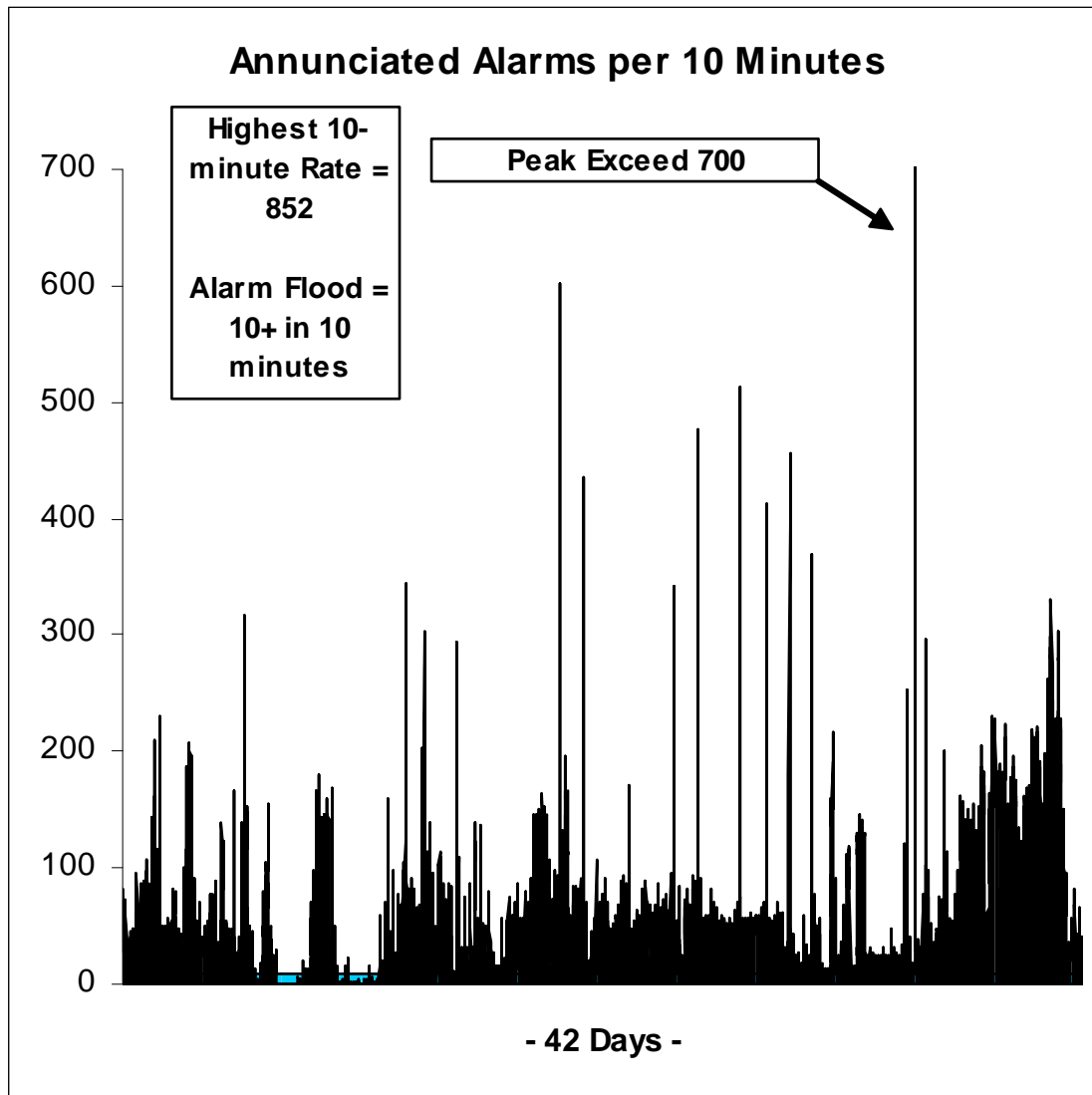
# Example: Alarms Per Day – Annunciated and Suppressed

## Recorded Alarms Per Day



**Uncontrolled Suppression: NOT the way to solve an alarm problem!**

# Example: Alarms Per 10 Minutes



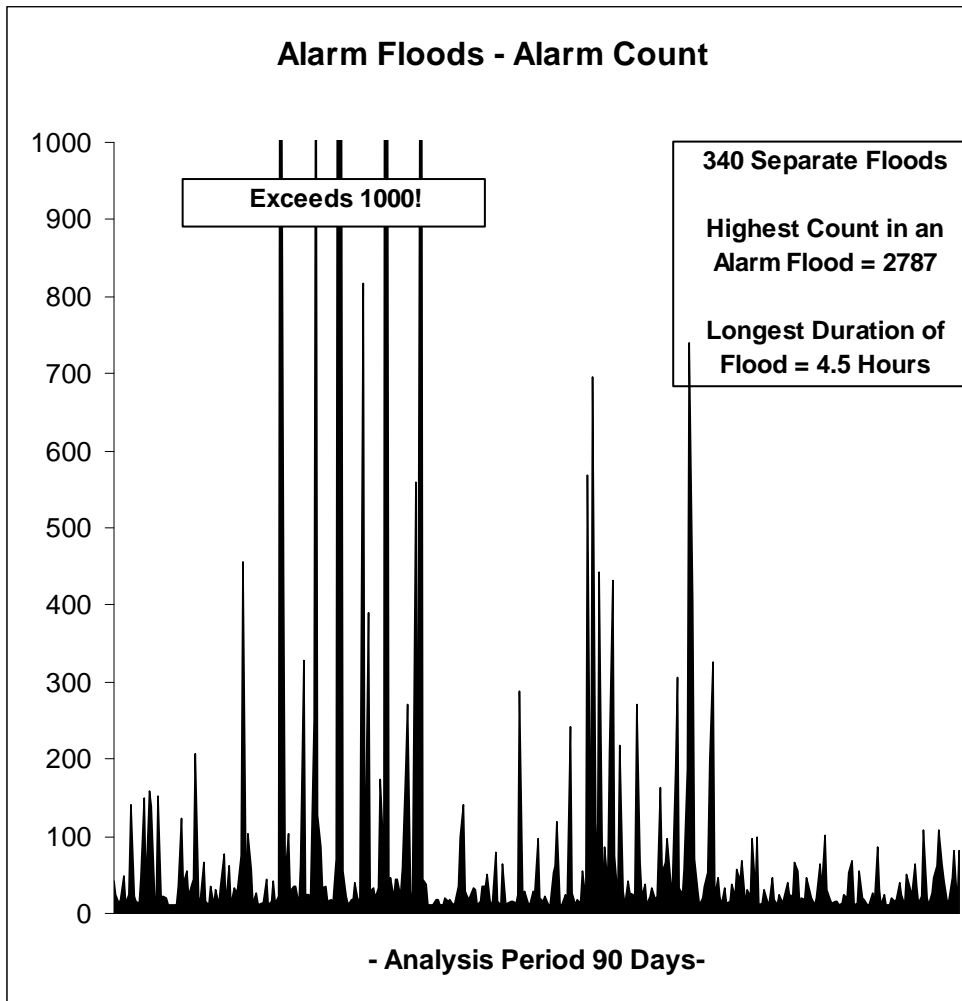
Alarm floods begin when alarms rates exceed 10 alarms in 10 minutes

Alarms rates seen from >1,000 to >5,000 alarms in 10 minutes.

Bursts in the hundreds are common.

During a flood, important alarms are very likely to be overlooked

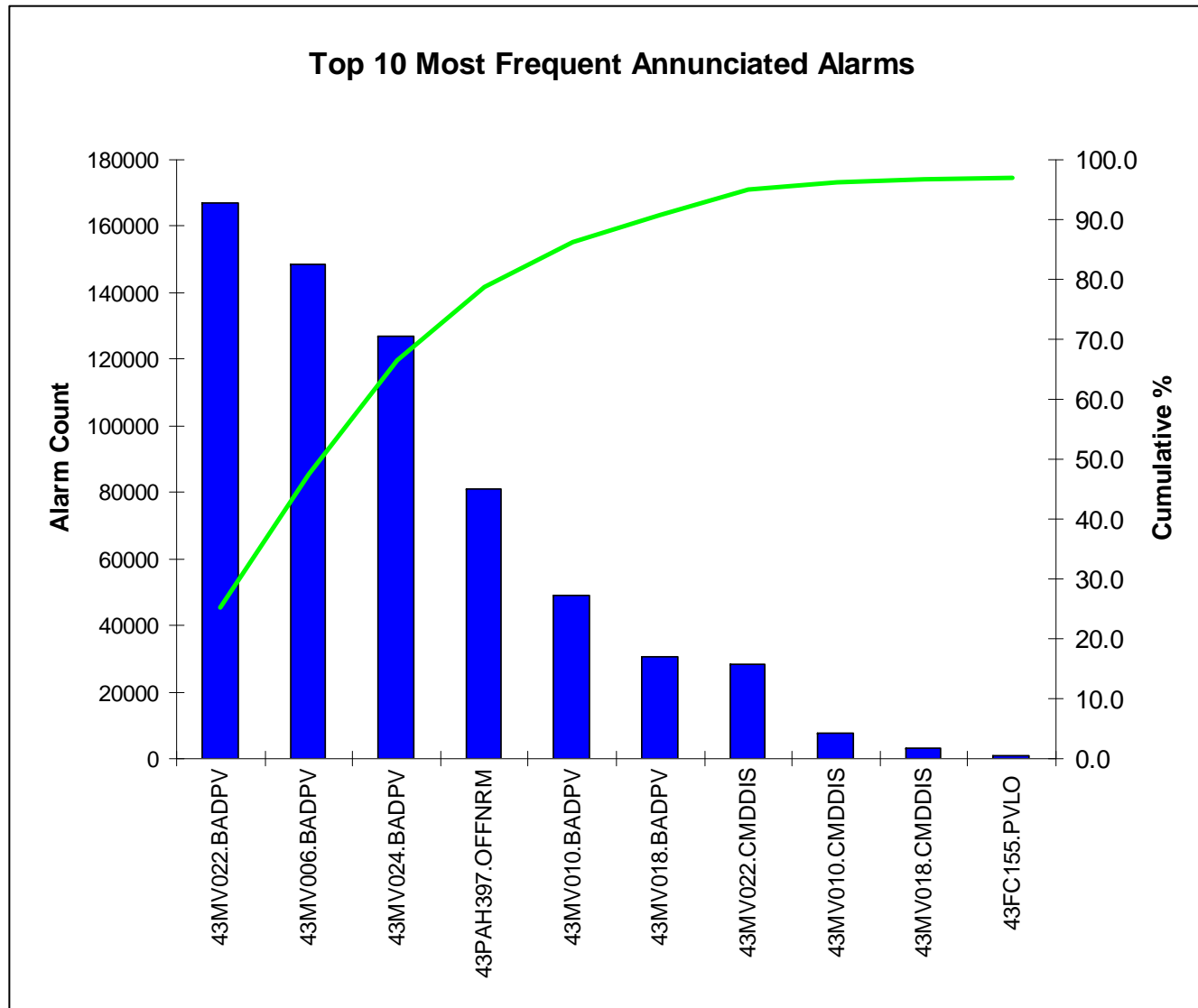
# Example: Alarm Floods – Count and Duration



Alarm Flood Analysis	
Number of Floods	340
Floods Per Day	3.8
Total Alarms in All Floods	30,447
Average Alarms per Flood	90
Highest Alarm Count in a Flood	2,787
Percentage of Alarms in Floods vs. All Annunciated Alarms	71.5%
Total Duration of Floods, in Hours	149
Percentage of Time Alarm System is in a Flood Condition	6.90%

**Alarm Systems in flood have little protective capacity  
and interfere with managing an abnormal situation**

# Example: Most Frequent Alarms

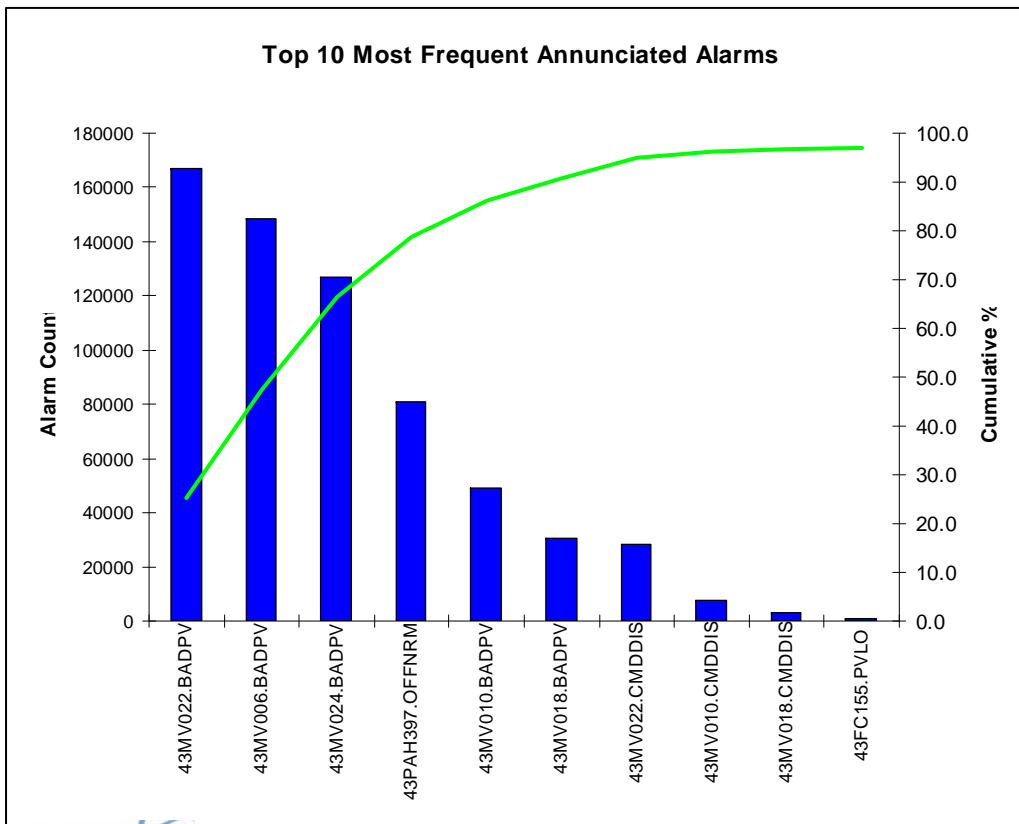


- 98% of this system's alarm events come from only 10 alarms!

- Normal situation is 20% to 80%!

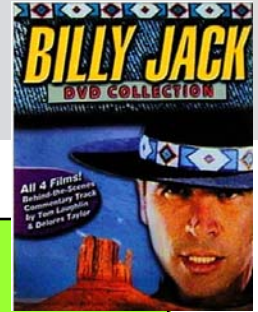
- All can be fixed

# Step 3: Fix Your “Bad Actor” Alarms!



- The “top 10” alarms usually make up 20% to 80% of the entire alarm system load
- Chapter 14: *“Common Alarm Problems and How to Solve Them”*
- These methods are easy to learn and apply!

# BAD ACTOR Alarms: Expected Gain



## Common Nuisance Alarm Types:

- Chattering Alarms
- Fleeting Alarms
- Stale Alarms
- Duplicate Alarms
- Nuisance Diagnostic Alarms
- Alarms that do not represent events requiring Operator Action

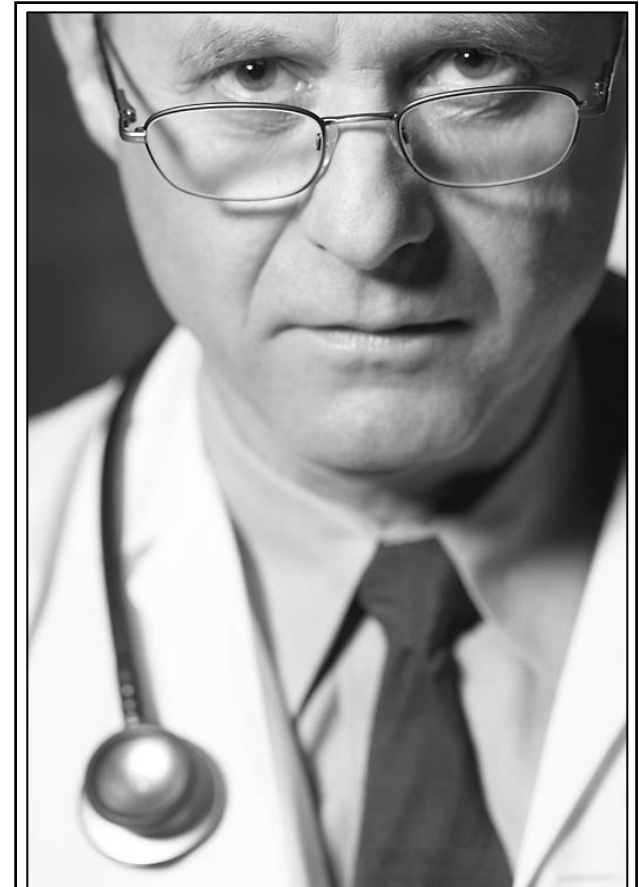
**Average system load improvement is ~60% from resolving Bad Actor alarms**

PAS Bad Actor Alarm Work Process Results	Baseline Alarms	Reduction from PAS Bad Actor Recommendations	% Reduction
System 1	339,521	325,423	95.8%
System 2	225,668	133,307	59.1%
System 3	414,887	333,395	80.4%
System 4	64,695	46,749	72.3%
System 5	93,848	71,372	76.1%
System 6	79,434	72,935	91.8%
System 7	482,375	413,094	85.6%
System 8	644,487	593,904	92.2%
System 9	183,312	77,417	42.2%
System 10	106,212	38,566	36.3%
System 11	91,686	29,188	31.8%
System 12	39,305	8,625	21.9%
System 13	33,115	22,646	68.4%
System 14	44,527	24,882	55.9%
System 15	58,049	51,782	89.2%
System 16	13598	4138	30.4%
System 17	21071	8516	40.4%
System 18	20739	13152	63.4%
System 19	5567	2247	40.4%
System 20	1271	868	68.3%

## ***Step 4: Alarm Documentation and Rationalization***

Alarm Rationalization: A Rigorous, Effective, Best Practice Methodology That Achieves Excellent Results When Done Properly

- **Quotes from operators after alarm system improvement projects:**
  - “Finally the alarm system makes sense.”
  - “The alarm system is useful now. It sure wasn’t before.”
  - “You can understand the alarms now – they have real meaning.”
  - “I’m not constantly dealing with a bunch of incomprehensible alarms anymore.”
  - “The alarm system is now under control!”



**Fix problems while they are small – don’t wait until they get big!**

# Step 4: Alarm Documentation and Rationalization

## Alarm Rationalization:

- Insures your actual alarms comply with your alarm philosophy (operator actions, priorities, time to respond, etc.)
- Documents your alarms (Trip Points, Causes, Consequences, Corrective Actions), creating a **Master Alarm Database** for

- Operator Information
- Audit / Enforce and Management of Change
- Dynamic State-Based Alarm Management



Alarm	State	Trip Point	P
BADPV	Default		L
PVLO	Default	1600	H

Cause	Verification	Action
Pump blockage		Troubleshoot pump system
Pump Tripped		Swap filters
Clogged filter		

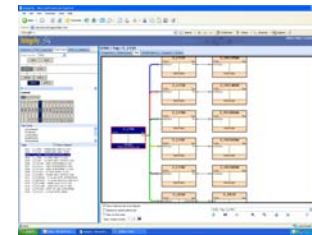
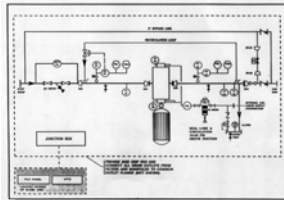
Consequences	Impact	Severity
Off-Spec Production	Loss of limb / life	None
	Environmental	None
	Equipment Damage	None
	Production Loss	Medium

# Alarm Documentation & Rationalization Methodology

- A team-based effort involving people with knowledge of your process.

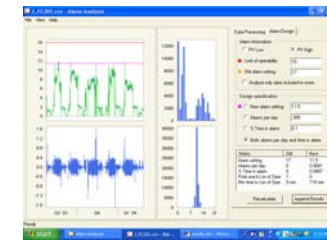
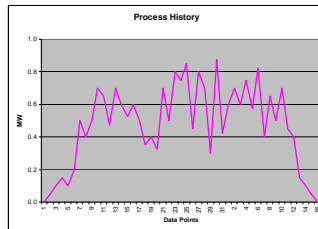
**P&IDs and  
Operating  
Graphics**

**ESD / APC  
Experts**



**Alarm and  
Control  
Configuration**

**Process  
History**



**Alarm  
Statistical  
Analysis**

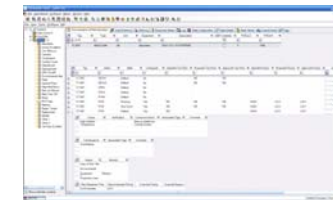
**SOP  
EOP  
HAZOP  
Etc...**



## Plant Experience & Knowledge

Process, Equipment, Operations, Procedures

- Board Operators
- Process & Control Engineers
- Safety, Health, Environmental
- Production & Maintenance Engineers



**D&R Software  
Tools**

- **Myth: You can “buy” Alarm Rationalization.  
Wrong! You can get experienced help, but only you have the  
necessary detailed knowledge of your process!**

# Alarm Priority Determination

Typical Grid-Based Priority Determination:

Impact Category	NONE	MINOR	MAJOR	SEVERE
Personnel	No injury or health effect	Alarms where operator action is the primary method by which harm to a person is avoided shall be configured at the highest DCS priority		
Public or Environment	No effect	Minimal exposure. No impact. Does not cross fence line. Contained release. Little, if any, clean up. Source eliminated. Negligible financial consequences.	Exposed to hazards that may cause injury. Hospitalizations and medical first aid possible. Damage Claims. Contamination causes some non-permanent damage.	Uncontained release of hazardous materials with major environmental impact and 3 <sup>rd</sup> party impact. Exposed to life-threatening hazard. Disruption of basic services. Impact involving the community. Catastrophic property damage. Extensive cleanup measures and financial consequences.
Costs or Value of Production Loss	No loss	Event costing <\$10,000, notification only at Department Head level	Event costing \$10,000 - \$100,000, notification at Site Manager level	Event costing >\$100,000, notification above Site Manager level

Severity of Consequence,  
Plus:

Time Available to Respond
> 30 Minutes
10 - 30 Minutes
3 - 10 Minutes
<3 Minutes

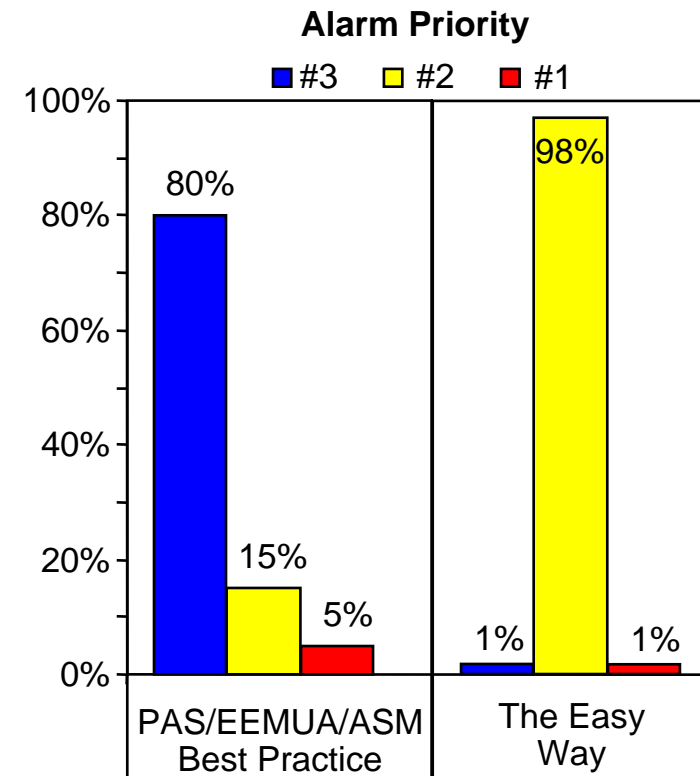
Alarm Priority Determination				
	Severity of Consequences			
Time Available	None	Minor	Major	Severe
> 30 Mn	No Alarm	Re-engineer the Alarm for Urgency		
10 - 30 Mn	No Alarm	LOW	LOW	HIGH
3 - 10 Mn	No Alarm	LOW	HIGH	HIGH
<3 Mn	No Alarm	HIGH	EMERGENCY	EMERGENCY

Determines Alarm Priority

## Myth: Alarm Management is about “Getting Rid of Alarms”

- In Alarm Rationalization, you will “get rid” of many alarms. That is a *side effect* of the initial poor configuration.
- Alarm Rationalization is about getting the alarm settings right.
  - To ensure alarms are engineered properly
  - To ensure consistency in alarm settings
  - To eliminate duplicate alarms
  - To ensure proper and meaningful Priority and Alarm Trip Point settings

***Experienced and targeted consulting services can be valuable when learning how to do D&R.***



# Not-So-Great Alarm Designs Present and Past



PRESENT:

One of the worst alarm designs in history!



Past: The “1201” alarm almost cost the U.S. over 1 billion dollars.

## Step 5: Alarm Settings Audit and Enforcement



### True or False?



True False



Your Operators do not have the keys or passwords that enable them to change alarm settings.



Your engineers would never make an improper change in your control system.



Your maintenance personnel wouldn't even think of changing your alarm system, even if the operators ask.



Control Systems Contractors working on-site would never alter the system, even if asked by someone who signs their check.

***If all are TRUE, you don't need to audit / enforce your alarm settings***

# Step 5: Alarm Settings Audit and Enforcement

## Typical Data:

### Summary of Changes in Alarms

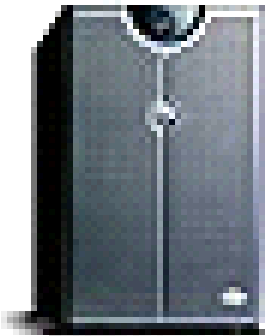
**Examine your own data!**

Type of Change	Quantity During Analysis Period
Alarm Suppression	79
Alarm Trip Points	181
Alarm Priority	92
Tag Range	121
Tag Execution Status	175
<b>Total</b>	<b>648</b>
<b>Average Per Day</b>	<b>5.6</b>

- Company: “No one here changes alarms without getting authorization and following MOC!”
- *Me: “Have you seen this data?”*
- Company: “Uh... That must have been part of a project!”
- *Me: “These changes were typically done between midnight and 6 AM.”*
- Company: “Hmmm... maybe we do have a problem...”

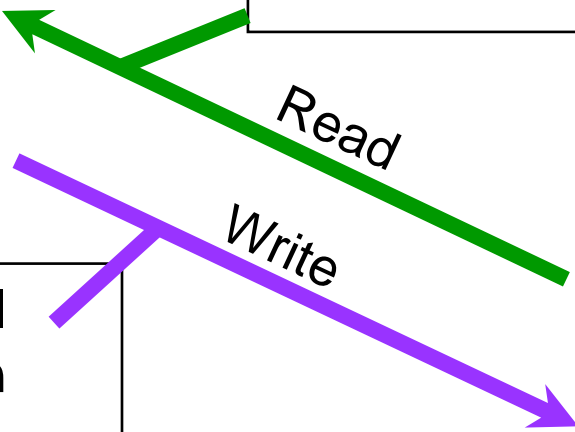
# Alarm Audit and Enforce

Master Alarm Database

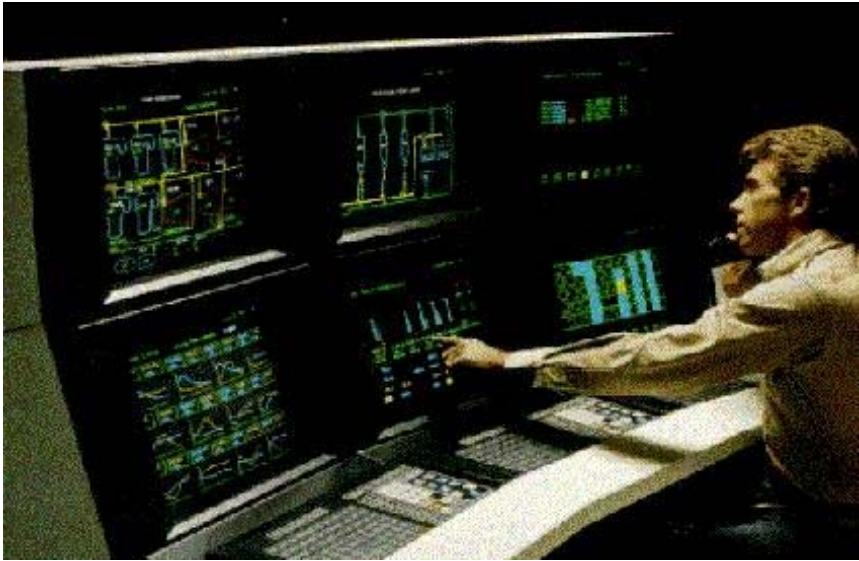


Audit alarm values from DCS, compare to Master Alarm database

Generate Exception Reports



Optional and with Control:  
Enforce alarm settings to DCS



*The foundation for other advanced alarm management techniques*

# Alarm Shelving

- The safe, controlled, and effective way to temporarily suppress alarms
- Generally beyond the capability of a DCS “as-shipped.”
- Addresses concerns about DCS alarm suppression:
  - All Shelved alarms are visible and cannot be “forgotten about”
  - Limit the time an alarm can be out of service
  - Shelves individual alarms, not all alarms on a tag
  - Tracking of all shelved alarms, with reports
  - Security allows shelving, but not other alarm changes.



# Does One Size Fit All?



## STATE-BASED ALARMING

### IF Your Process:

- Makes Multiple Products or Grades
- Uses Multiple Differing Feedstocks
- Has Parallel Operating Trains
- Has Different Modes of Operation
- Runs at Different Rates

### Then:

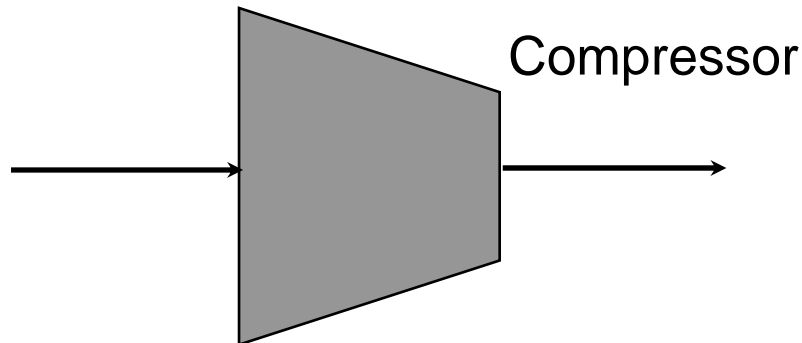
Don't have only ONE set of unchanging, compromise alarms settings for your alarms.

State-based alarming technology, lets you have multiple alarm settings that are optimum and correct for all your operating conditions.

Detect Plant State Change

Automatically Alter Alarm Settings to Match New State

# Alarm Flood Suppression – Equipment Trips



States:  
***RUNNING*** (default)  
and  
***TRIPPED***

Detect the ***TRIPPED*** state, and immediately address the following ***expected diagnostics*** – plus closely related, ***expected*** process alarms:

*Low Flow*  
*Low Discharge Pressure*  
*High Suction Pressure*  
*Low Oil Pressure*  
*Low Amps*  
*Low Speed*  
*Several BAD VALUE alarms*

...and so forth

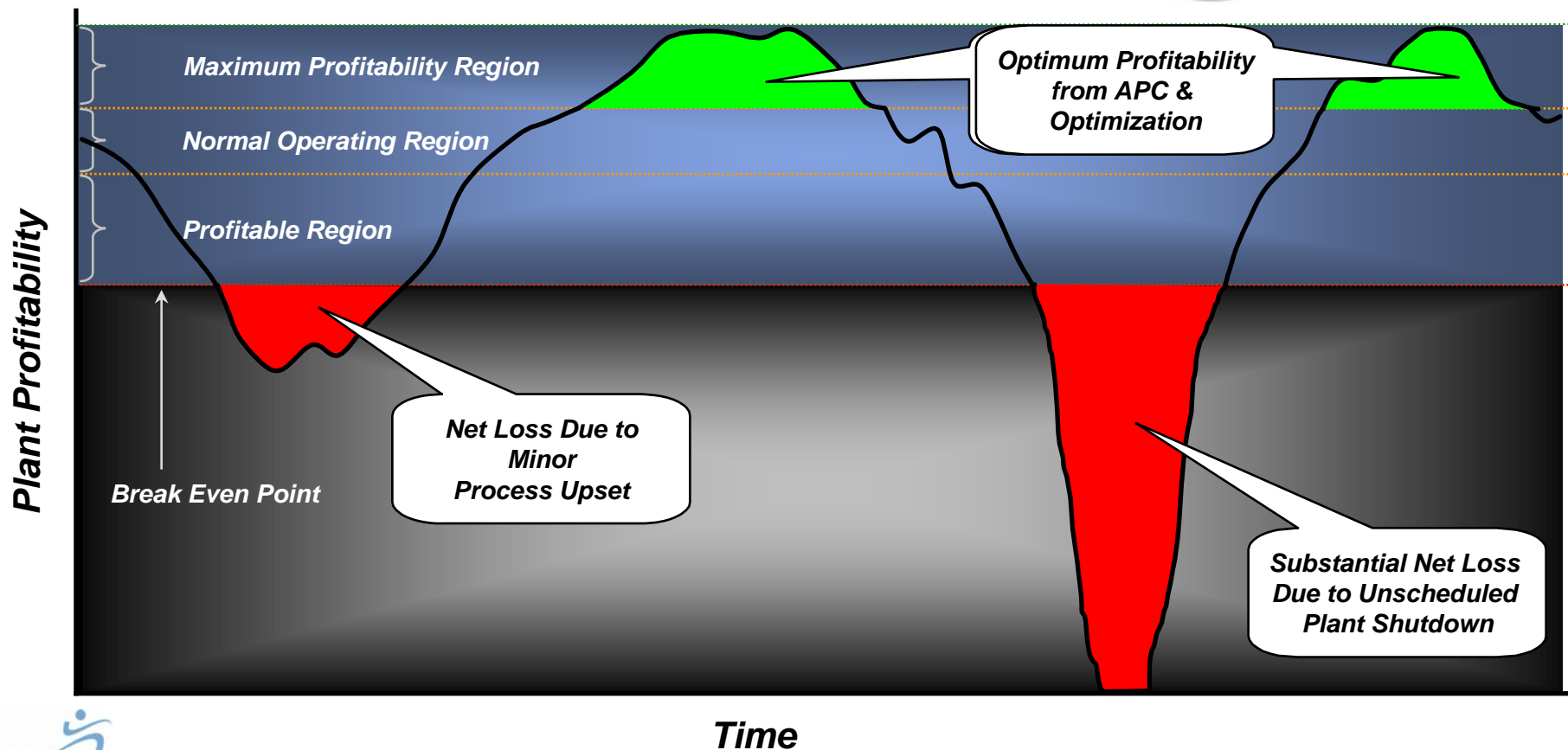
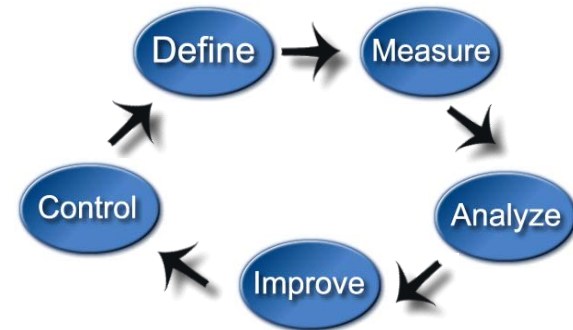
Post-Shutdown, the ***important*** alarms are from the remainder of the process as it adjusts to the loss of the compressor.

***Diagnostics are a temporary distraction.***

# Step 7: Control and Maintain your Improved Performance

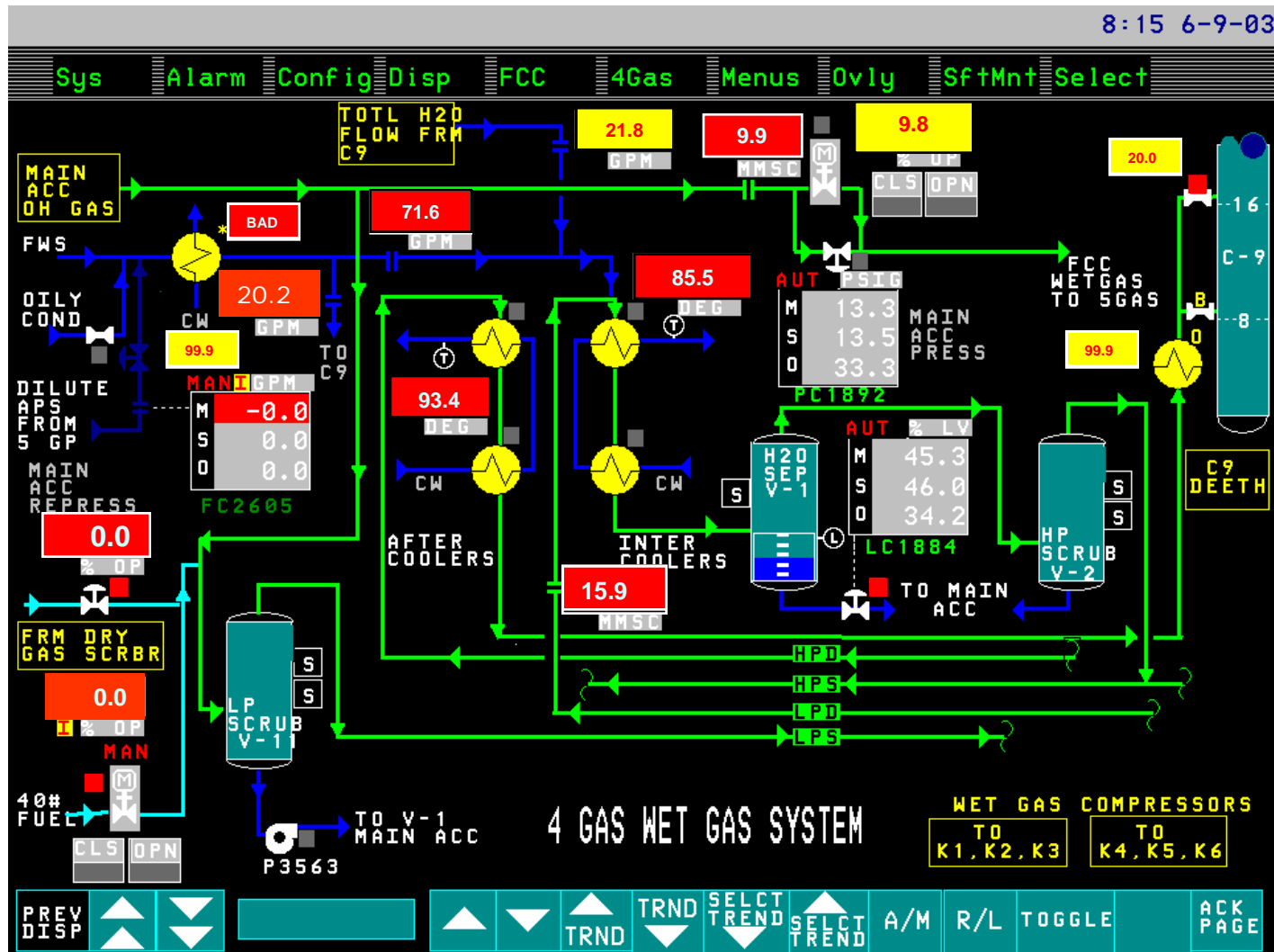
**FACT:** A single unscheduled shutdown can wipe out all the benefits realized from APC and Optimization!

**FACT:** A few “slightly-worse-than-normal” production loss incidents can do the same thing.



And while  
we're at it...

# Let's fix some of these TERRIBLE Graphics!



but that's another book entirely...

# *The Main Myths of Alarm Management*

**BUSTED**

You don't need an "Alarm Philosophy"

**BUSTED**

Alarm Management is about Software!

**BUSTED**

Alarm Management is about Counting Your Alarms

**BUSTED**

Alarm Management is about Getting Rid of Alarms

**BUSTED**

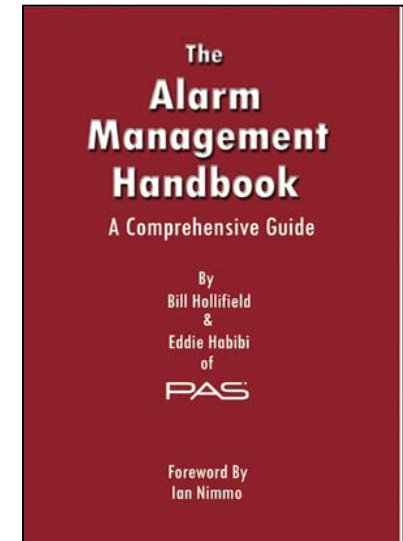
Alarm Management is something you can "buy"

**BUSTED**

Alarm Management is about Endless Consulting Services

# Key Points

- **Massively overloaded alarm systems are a common problem everywhere!**
- **They will occur wherever DCS systems are configured and maintained without a comprehensive alarm philosophy, documenting *how to do alarms right*.**
- **Such systems are proven significant contributing factors to minor upsets and even major accidents.**
- **The solutions to the problems are *well known and fully documented*.**



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And at  
 [amazon.com](http://amazon.com)

# Q & A



Any Questions?

- Bill Hollifield (Bhollifield@pas.com)
- www.pas.com (281) 286-6565