

Meet the Experts – Sept. 20/21., 2011

# Alarm Management

# Alarm Management Outline

- Typical Problems
- Financial Impact
- Industry Guidelines
- ABB Fingerprint
- Typical Findings
- Recommendations

# Alarm Management

## How is your alarm system performing?

### **Do you recognize any of these behaviors?**

- Operators acknowledge / silence alarms without looking at or acting on them?
- Incidents or near-incidents where operators missed alarms?
- Too many alarms without well-defined actions?
- Alarms disabled / suppressed for long periods without review?

### **Do you measure?**

- Number of alarms / hour?
- Number of alarms disabled / suppressed?
- Time to silence / acknowledge?

### **How stressed are your operators?**

### **Do you have a documented alarm philosophy?**

- Have you described roles and responsibilities?
- How do you review and modify alarm settings?

# Alarm Management

## Example: Texaco Milford Haven 1994

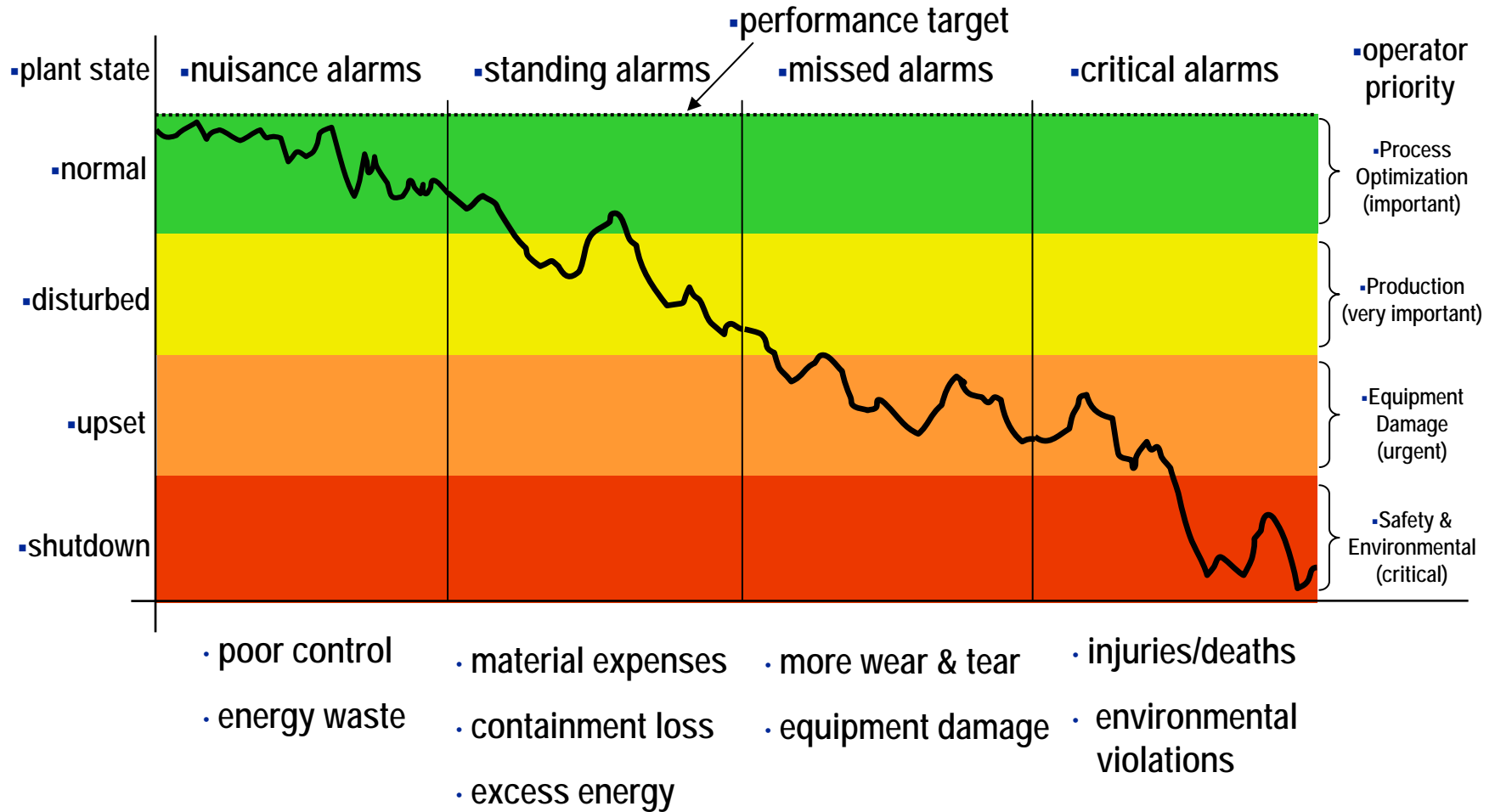


- Explosion injured 26 people and caused damage of around \$70 million
- Key factors included:
  - There were too many alarms and they were poorly prioritized
  - In the last 11 minutes before the explosion, the operators had to recognize, acknowledge and act on 275 alarms

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# Alarm Management Financial Impact



# Alarm Management Benefits

- Avoid unintended shutdowns from missing alarms or responding too slowly to alarms
  - Lower equipment repair costs and increased operational efficiency and/or production rates.
- Increase operator availability and effectiveness with reduction in average alarm and event rate
  - If initial rate is 25/hour/operator and each consumes an average of 45 seconds, then workload can be reduced almost 1 hour per 12 hour shift if rate is reduced by 25%.
- Reduce Minor and Major Incidents from better alarm management

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# Alarm Management Guidelines and Standards

- Engineering Equipment and Materials Users' Association (EEMUA) has published guideline
  - EEMUA 191: Alarm Systems - A Guide to Design, Management and Procurement
- International Society of Automation (ISA) has published standard
  - ISA-18.2: Management of Alarm Systems for the Process Industries

# Alarm Management

## Definition of an Alarm System

### EEMUA 191

- Purpose of an alarm system is to direct the operator's attention towards plant conditions requiring timely assessment or action
- Each alarm should
  - alert, inform and guide
  - be useful and relevant to the operator
  - have a defined response
- Adequate time should be allowed for the operator to carry out his defined response

# Alarm Management System Management Guidelines

## **Define responsibilities**

- Design
- Management
- Operation

## **Define procedures and standards**

- Design
- Implementation
- management
- operation

## **Alarm Philosophy document**

- Define what to alarm
- Standards for alarm annunciation and messages
- How the operator will interact with alarms

## **Alarm System Design document**

- Define purpose
- Priority
- Operator response for each alarm

## **Define standards for configuration**

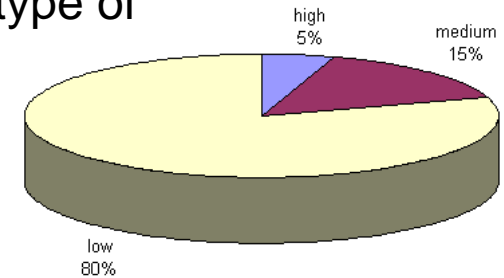
# Alarm Management System Management Guidelines

- Define methods to address nuisance alarms and standing alarms
- Define alarm priorities based on impact and reaction time
- Provide alarm system training for operators, engineers and technicians
- Define procedures for management of changes to the alarm system
- Create reports, records and tools for monitoring alarm system performance

# Alarm Management

## EEMUA 191 Recommended priorities

- The use of three priority bands within any one type of display is ergonomically effective
- High – Medium – Low ( + sometimes critical)
- Written rules on priority assignment required.



**Example:**

<b>impact</b> <b>reaction time</b>	< 1000 \$	< 10000 \$	> 10000 \$
> 10 Min.	Low	Low	Medium
3 to 10 Min.	Low	Medium	High
< 3 Min	Medium	High	High

# Alarm Management Industry Findings vs. Guidelines

	EEMUA	Oil & Gas	PetroChem	Power	Other
Average Alarms per Day	144	1200	1500	2000	900
Average Standing Alarms	9	50	100	65	35
Peak Alarms per 10 Minutes	10	220	180	350	180
Average Alarms/ 10 Minute Interval	1	6	9	8	5
Distribution % (Low/Med/High)	80/15/5	25/40/35	25/40/35	25/40/35	25/40/35

Source: Matrikon

# Alarm Management Outline

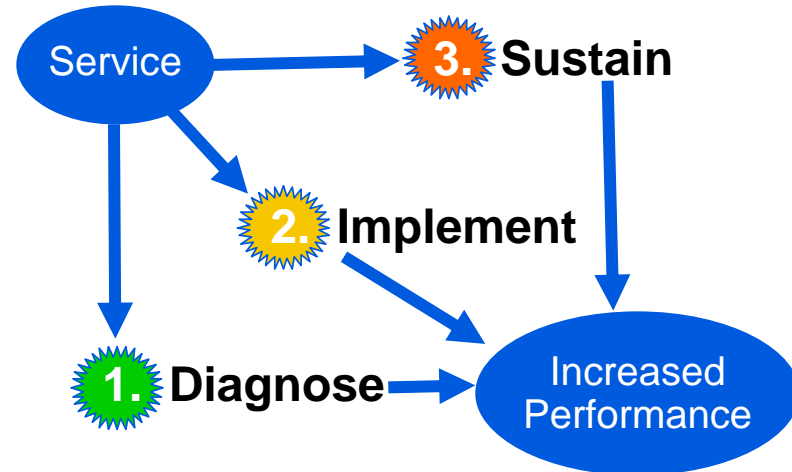
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# Optimization Services Methodology

- **Diagnose**
  - Measure and Benchmark
  - Detailed Improvement Plan
  - Document Goals, KPI's
- **Implement**
  - Improve Performance
  - Apply corrective actions
- **Sustain**
  - Maintain Performance
  - Continued Improvement

## Proactive Solutions – not Reactive

- Six Sigma Similarities





# Alarm Management Lifecycle

- Alarm Design Strategy
- Culture Change
- Alarm Rationalization
- Alarm Management
- Training



## 1. Where are we now?

- Assess the Current Position
- Typically a short focussed assessment by experienced consultant engineer
- Assessed against benchmarks and targets

## 2. Where do we want to be?

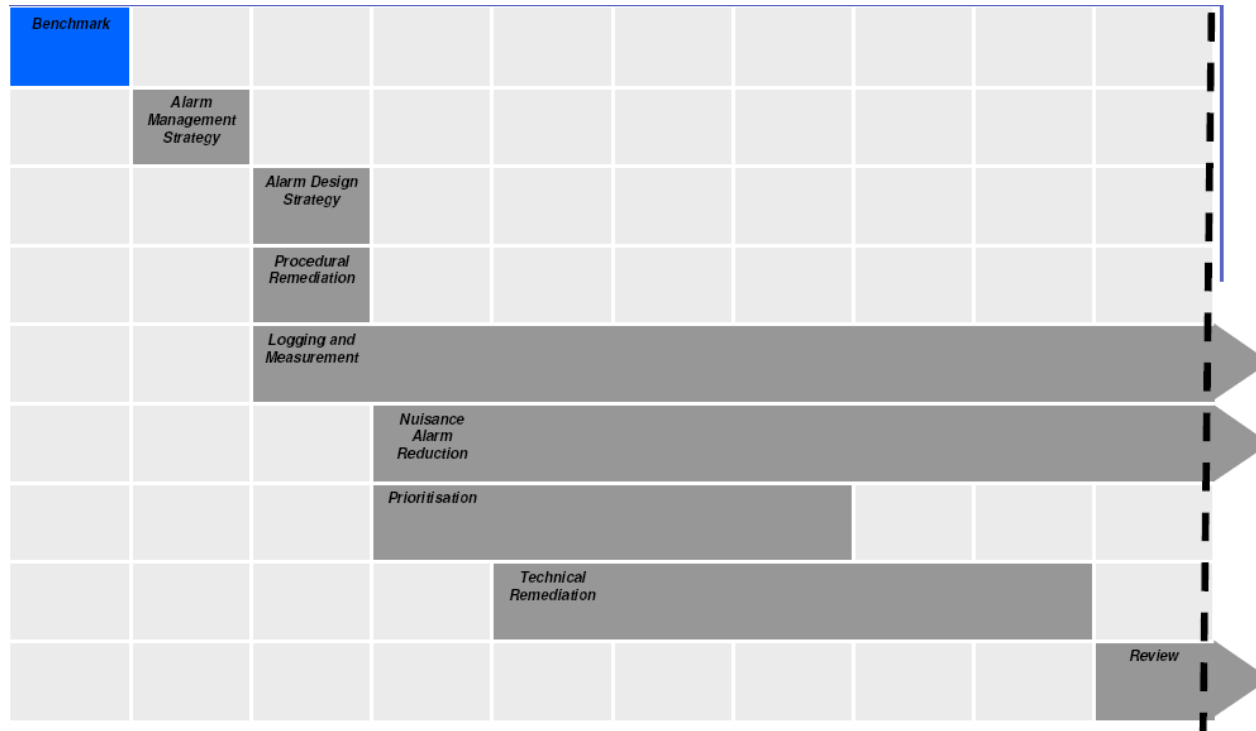
- Identify the Change Program
- Goal Setting (KPIs, Project success criteria)
- Identify deficiencies and corrective actions
- Planning/Budgeting

## 3. How successful were we?

- On-Going Alarm Management
- owned by operations/ maintenance
- Audit and Measurement programme

# Alarm Management Fingerprint – The first step

- Goal: reduce alarms that are not useful to the operator, clarify alarms that are important



# Alarm Management Fingerprint

## Alarm System Performance

- Calculate alarm statistics
- Compare to EEMUA guidelines

## Alarm System Management

- Evaluate alarm system documentation
- Evaluate methods and procedures for configuring, operating, and managing alarm system
- Compare to EEMUA guidelines

## Recommendations for improvements

# Alarm Management Fingerprint Steps

## Interviews

- Operators, Supervisors, Process Engineers, Technicians

## Review of procedures and instructions

- Documentation
- Methods

## Measurement of Alarm System Performance

- Alarm Rates in steady state and upset conditions
- Frequency of alarms - nuisance alarms
- Standing and Shelved alarms
- Prioritization

# Alarm Management Fingerprint

- Findings and recommendation described in the report



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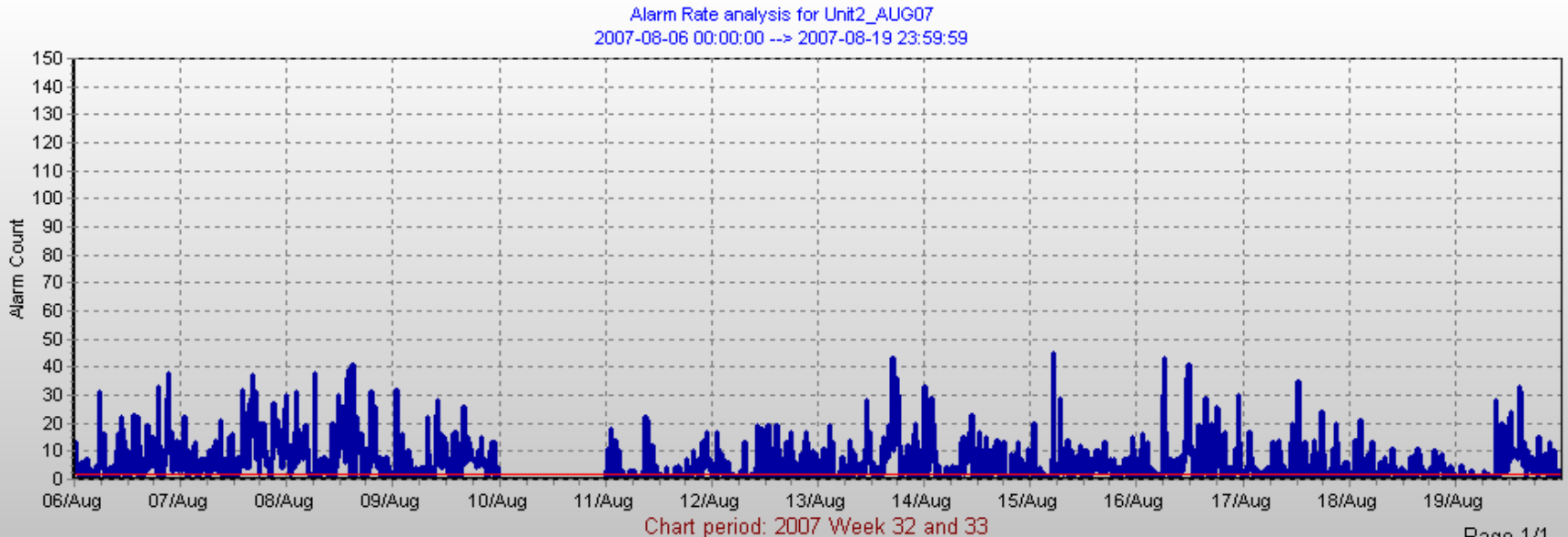
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# Alarm Management

## Alarm Rate vs. EEMUA Guideline

- Calculate alarm rates for each 10 minute period
- Compare to EEMUA guideline of 1 alarm per 10 minute period



# Alarm Management

## Alarm Rate vs. EEMUA Guideline - Burst Rate

- Calculate burst alarm rates for each 10 minute period
- Compare to EEMUA burst rate guideline of 10 alarms per 10 minute period

08-AUG 8:22	318 / 20 min or 15.9/min
19-SEP 11:00	681 / 20 min or 34.1/min
20-OCT 00:40	719 / 20 min or 36.0/min
09-DEC 07:45	61 / 2 min or 30.5/min
22-JAN 12:10	410 / 20 min or 20.5/min

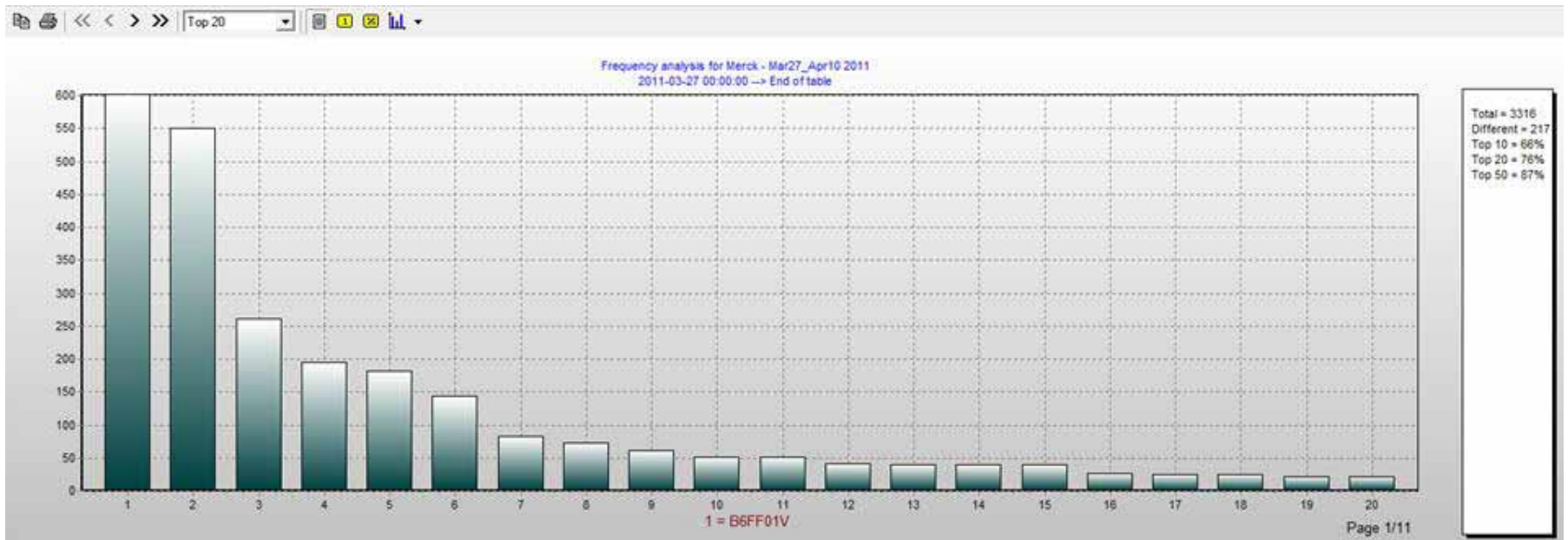
**750 incidents of 10/min in 6 months**



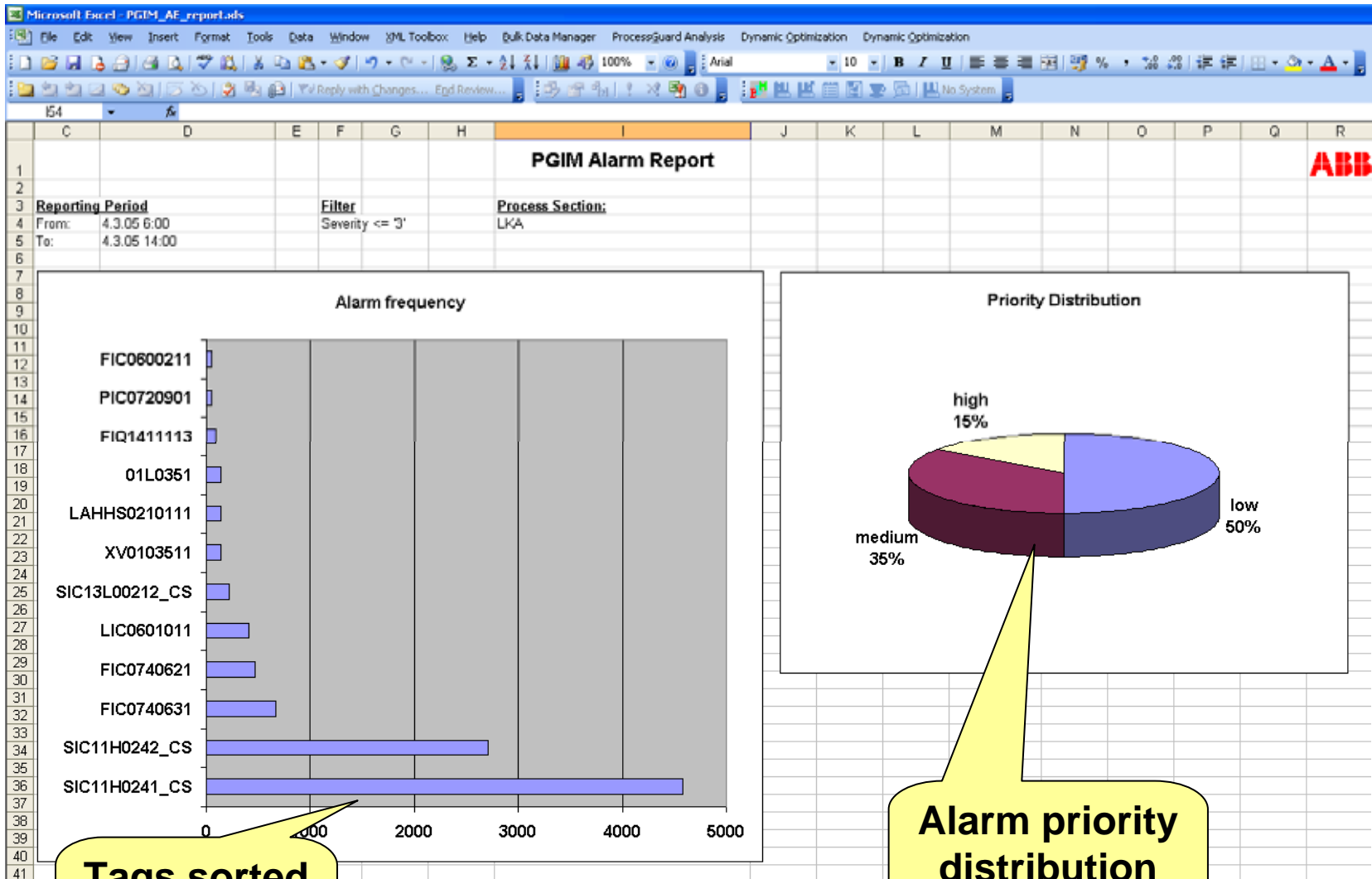
# Alarm Management

## Alarm Frequency Analysis

- A small number of tags are often responsible for a large percentage of the total alarms.
  - Top 10 represent 66% of alarms



# Alarm System Performance Reporting



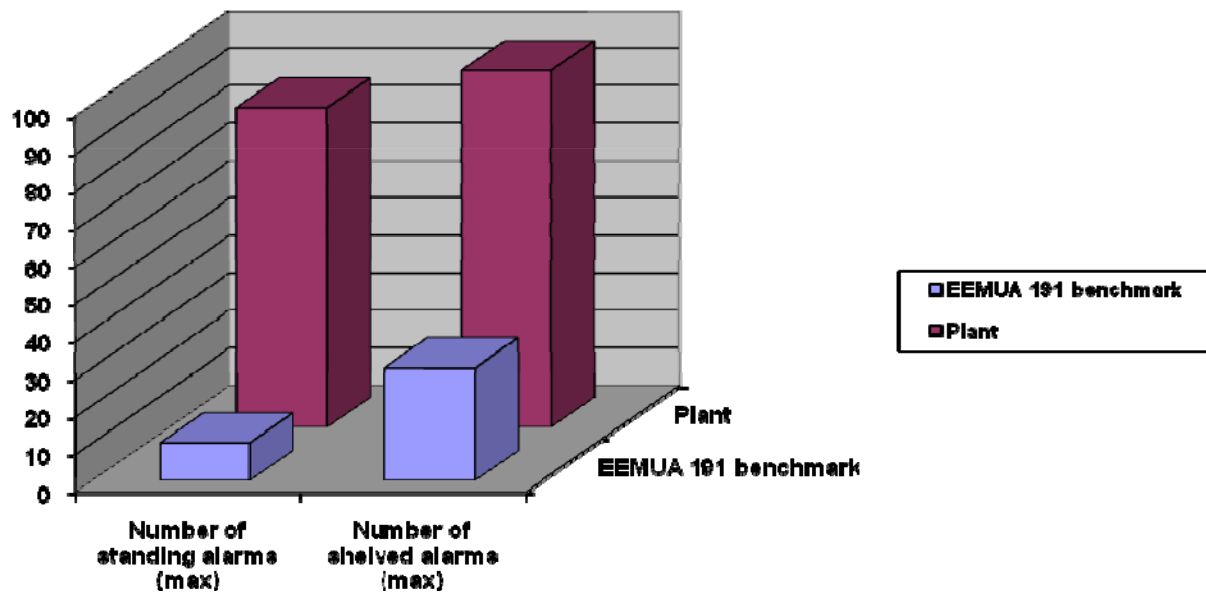
Tags sorted by no. of events

Alarm priority distribution

# Alarm Management

## Standing and Shelved Alarms

- **Shelved Alarm:** An alarm that has been temporarily disabled until an underlying problem can be corrected. Such alarms should only be shelved for a period of time, not permanently disabled.
- **Standing Alarm:** An alarm that has remained in an active alarm state for a significant period of time (e.g. 4 to 8 hrs)



# Alarm Management

## Alarm System Management Findings

- Alarm Philosophy documentation does not exist
- Alarm Design documentation does not exist
  - Alarms defined when control system was commissioned
  - Almost all tags configured as alarms
  - Alarm priority classes seldom utilized
- Changes to alarm system are undocumented
- No methods to monitor alarm system performance

# Alarm Management

## Summary of Findings

- Limited alarm system documentation
- High alarm rates
  - Too many nuisance alarms going into and out of alarm state
  - Too many alarms configured
- Too many standing alarms
  - Equipment that is out of service
  - Bad quality instruments needing maintenance

# Alarm Management Outline

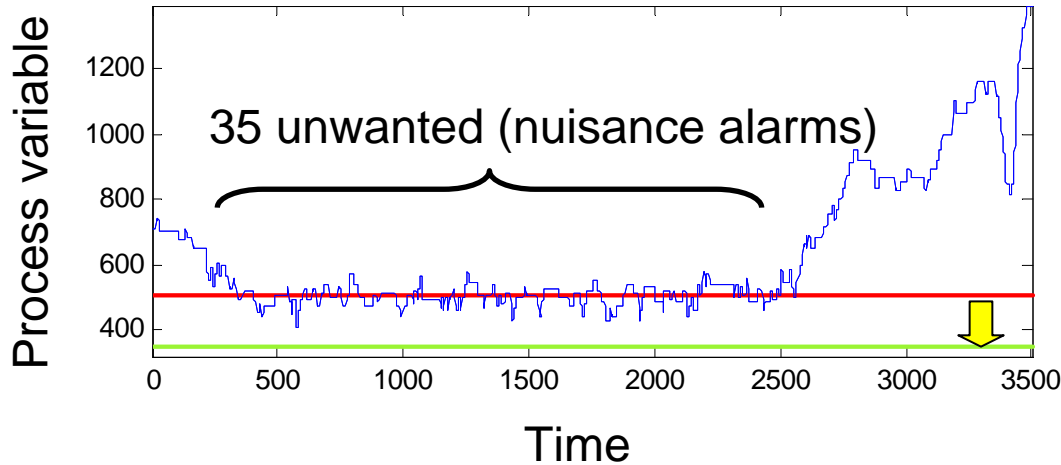
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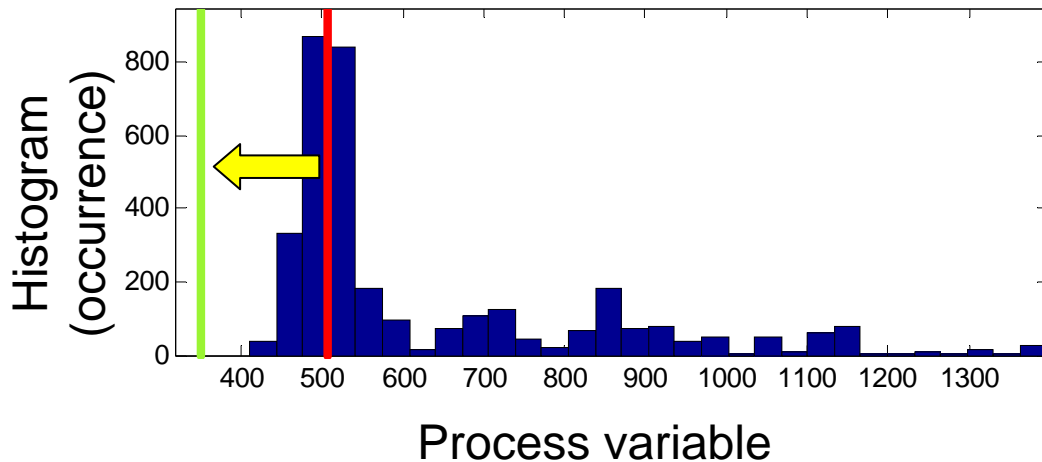
## How to Eliminate Nuisance Alarms

- Reconfigure alarms that require no operator action as event
- Eliminate instrument malfunctions
- Tune chattering control loops
- Optimize alarm parameters: set limit thresholds, hysteresis
- Advanced Alarming
  - State based alarming
  - Flood suppression

# What-if scenario: Reducing nuisance alarms



Minimum limit: was set too high  
Minimum limit: lower limit gets rid of nuisance alarms



Analyzing the time trend using histograms:  
- Which alarm limits will result in which alarm rate?  
- Find the best alarm limits (e.g. reduce the minimum threshold ←)



# Alarm Management

## Alarm Rationalization

- Form team to review all alarms
- Define purpose of each alarm – some alarms may be reclassified as events
- Define new priority using EEMUA and ISA recommendations
- Determine required operator response and alarm description
- Remove redundant alarms
- Create Alarm Design documentation

# Alarm Management Recommendations

- Maintenance issues
  - Follow up on long standing issues
  - Shelve / Deactivate alarm if problem not fixed
  - Keep list of shelved alarms and periodically reevaluate
- Preventive Maintenance
  - Use a control loop management tool to improve tuning and identify instrumentation problems

# Alarm Management

## Alarm System Performance Monitoring

- ABB Smart Logger software
  - Capture and store alarm data
- ABB Smart Client software
  - Compute alarm statistics and compare with EEMUA guidelines
  - Monitor performance improvements over time

# Alarm Management Features in System 800xA

- Structured organization and single source of truth
- Pre-configured and ad-hoc filtering, live values
- Single click from alarm to multiple informational displays
- Alarm Hiding - Dynamic alarm handling
- Alarm Shelving - Operator based alarm hiding
- Built-in, operator accessible alarm analysis



# Improving Operator Effectiveness

## Effective decision support environment

The screenshot displays the 'DEMO Operator Workplace' interface. At the top, there is a status bar with process information, including 'Process: Electro', 'Safety: Task 100', and 'Object error: High High'. A table of active alarms is visible, listing events like '1112\_P10' and 'R11\_PTCalc'. The main area shows a 'Process Area Display' with a schematic of a reactor system, including a 'PH1112 PreHeater' and an 'R11 Reactor'. A context menu is open over the reactor, listing various diagnostic and operational tools. Several callout boxes are overlaid on the interface, pointing to specific features.

- Consolidated alarms & events**: Points to the top status bar and alarm table.
- Personalized Workplace based on operations philosophy**: Points to the overall interface layout.
- Filterable, separated asset alerts**: Points to the 'MainFaceplate' menu item.
- Right click access to integrated information**: Points to the context menu.
- Configurable Application Bar**: Points to the 'MainFaceplate' menu item.
- Seamless integration of data from multiple systems**: Points to the reactor schematic.
- Graphics based on MS WPF**: Points to the trend display and data visualization elements.

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