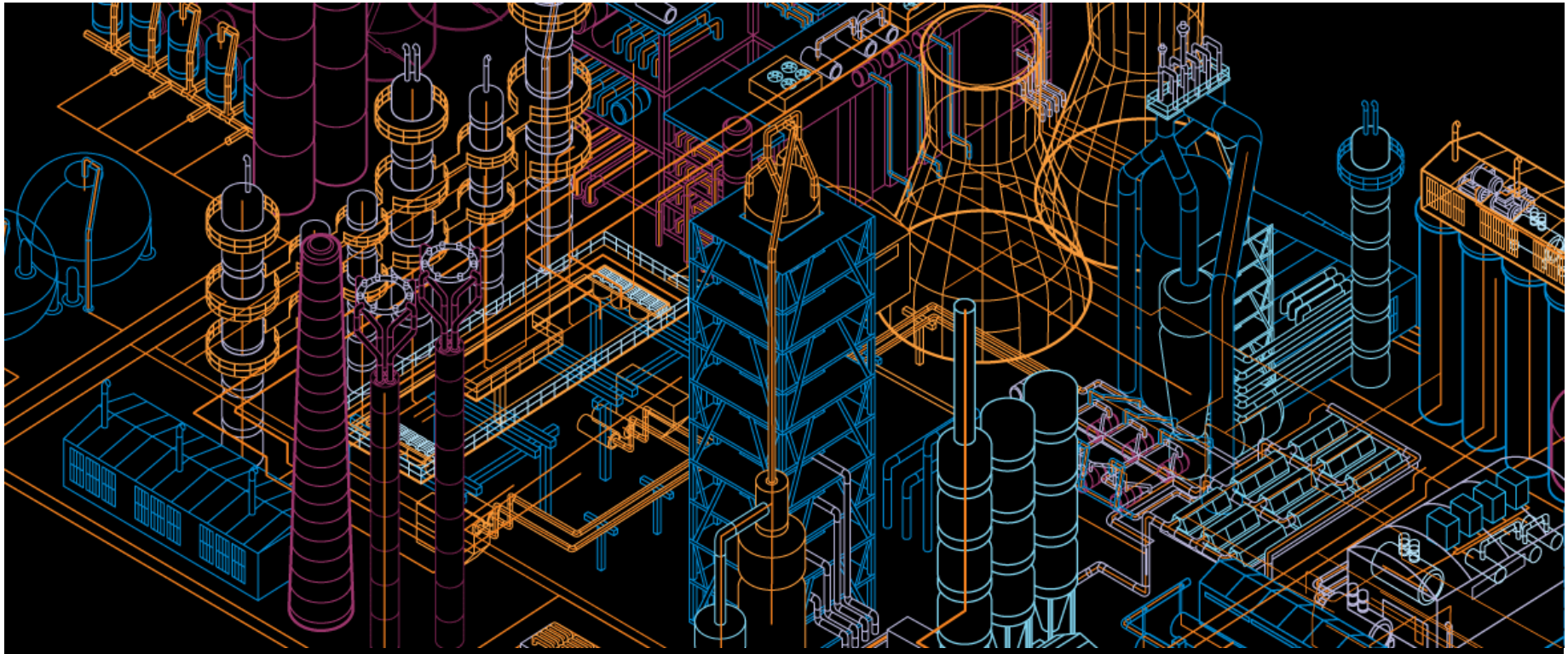

ABB Technology Days

Alarm Management

Power and productivity
for a better world™

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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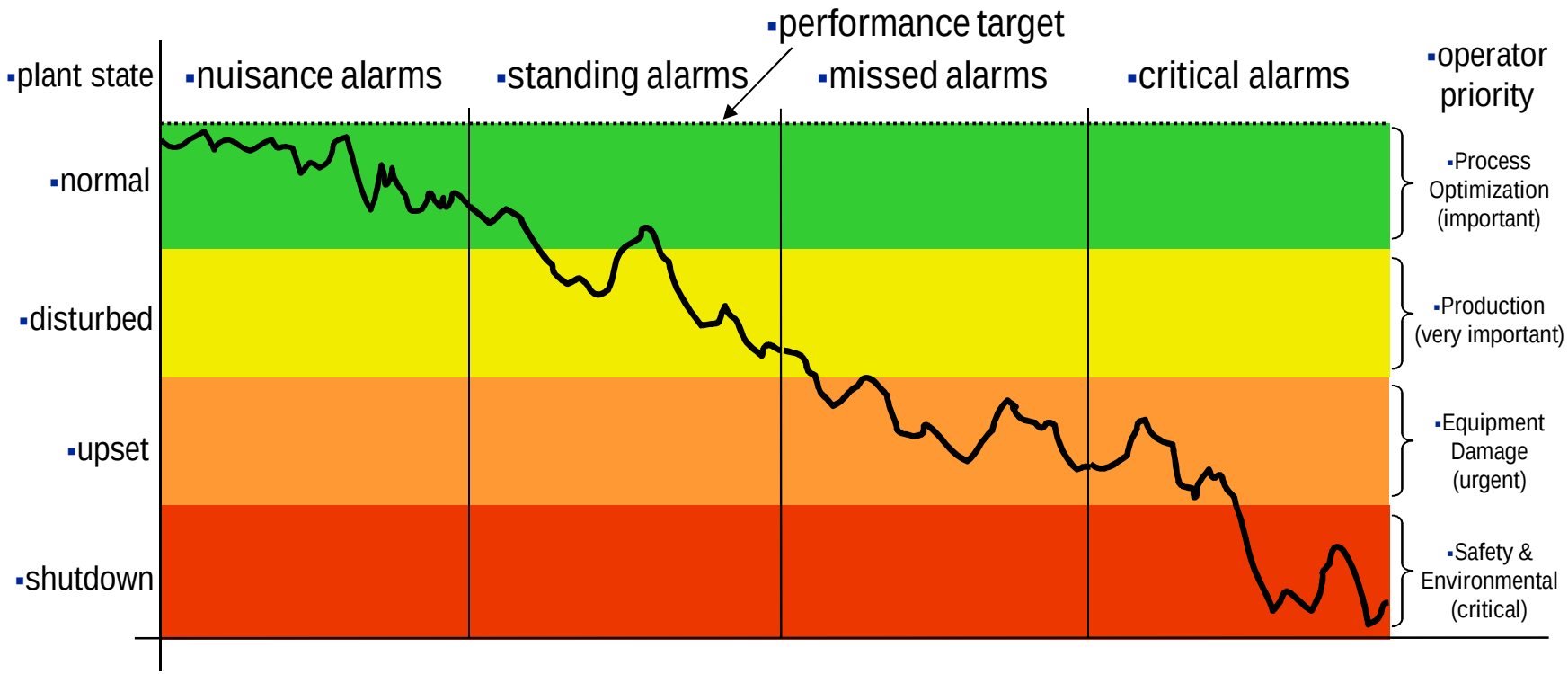
Alarm Management
Financial Impact



- poor control
- energy waste

- material expenses
- containment loss
- excess energy

- more wear & tear
- equipment damage

- injuries/deaths
- environmental violations

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

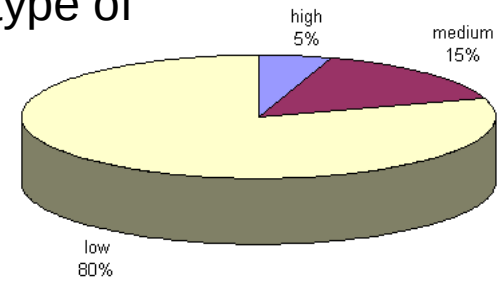
Define standards for configuration

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:

impact / reaction time	< 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
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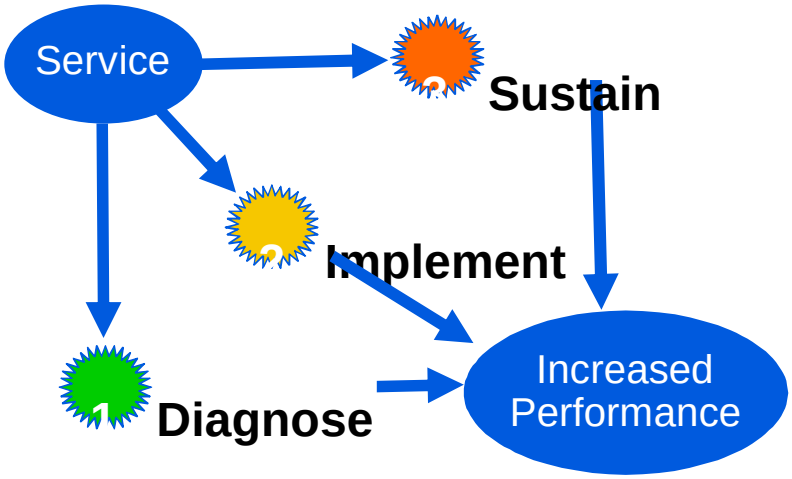
Optimization Services
Methodology

- **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?

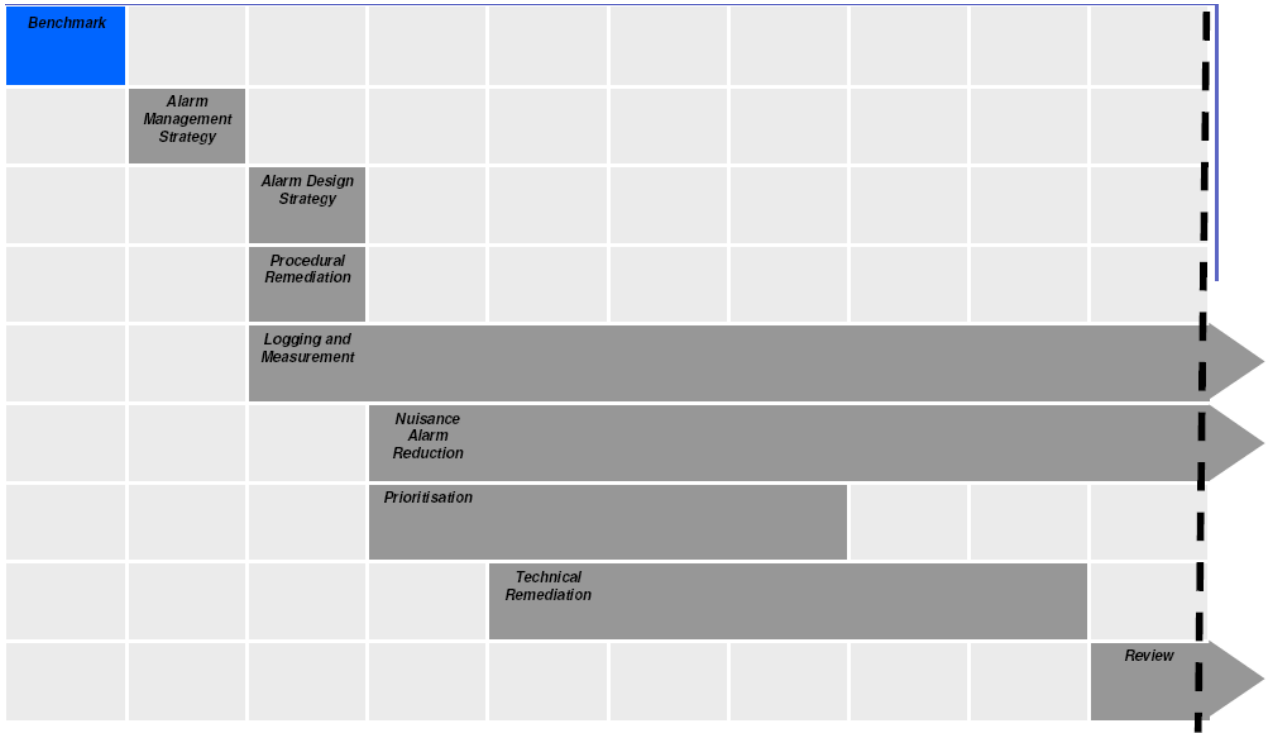
- Identify the Change Program
- Goal Setting (KPIs, Project success criteria)
- Identify deficiencies and corrective actions
- Planning/Budgeting

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, 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

Table of Contents

Alarm Management
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- Typical Problems
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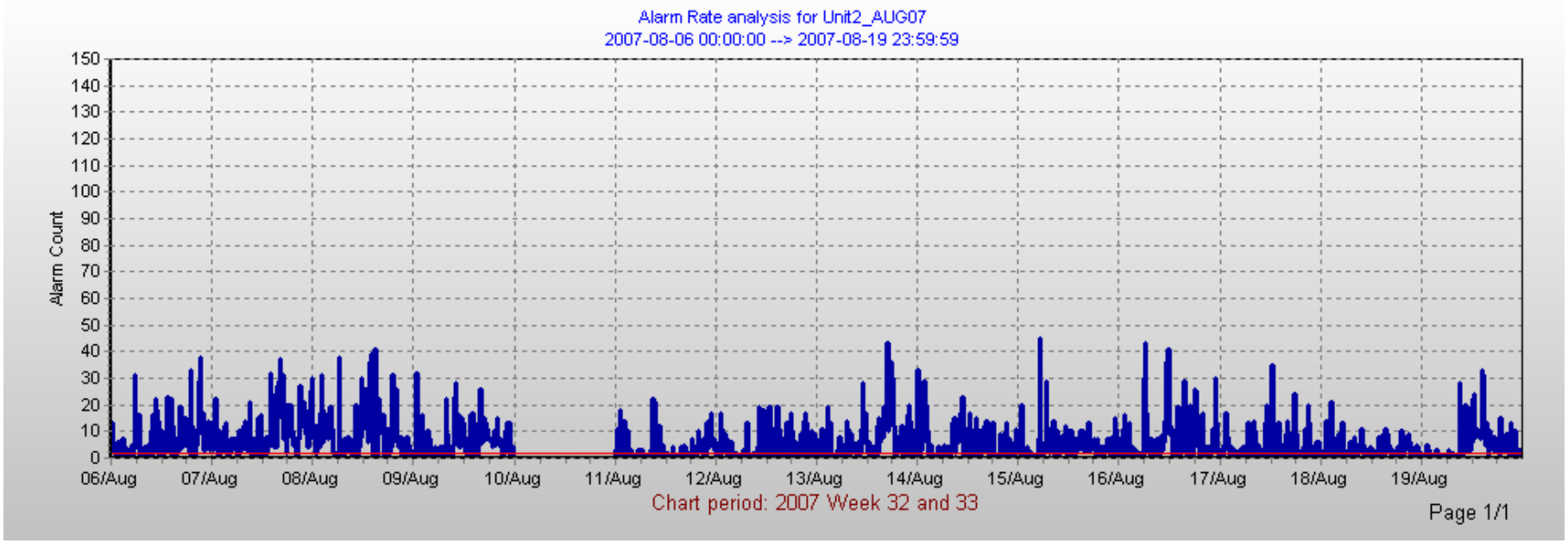
Alarm Management
Alarm Rate vs. EEMUA Guideline

- 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

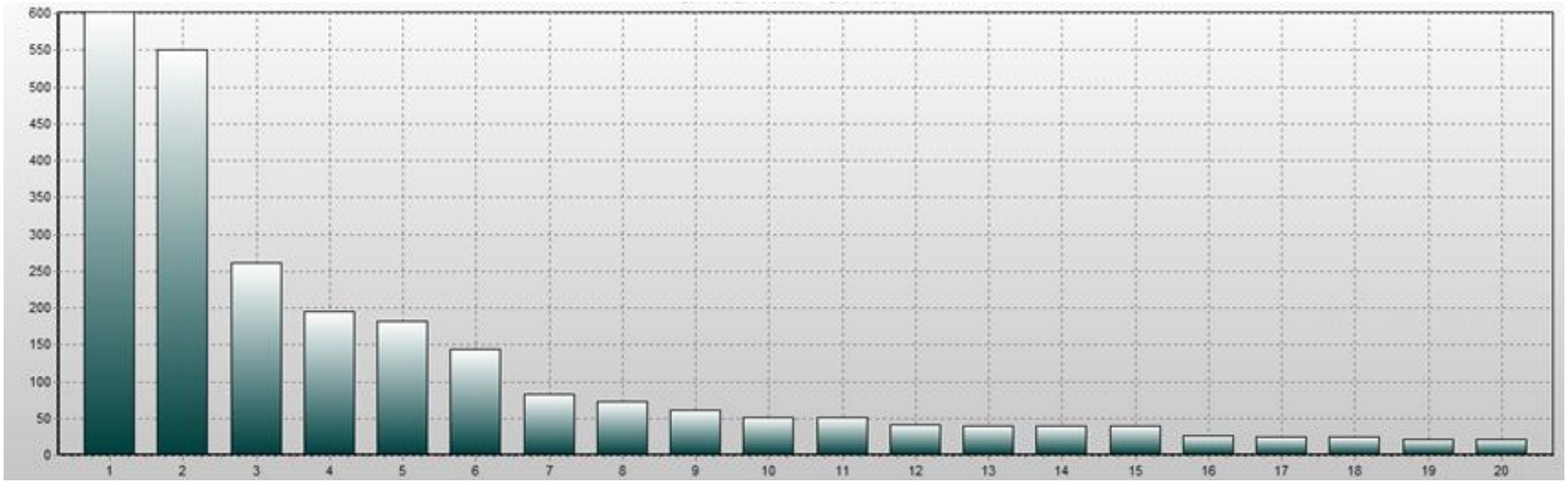
- Calculate burst alarm rates for each 10 minute period
- Compare to EEMUA burst rate guideline of 10 alarms per 10 minute period

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

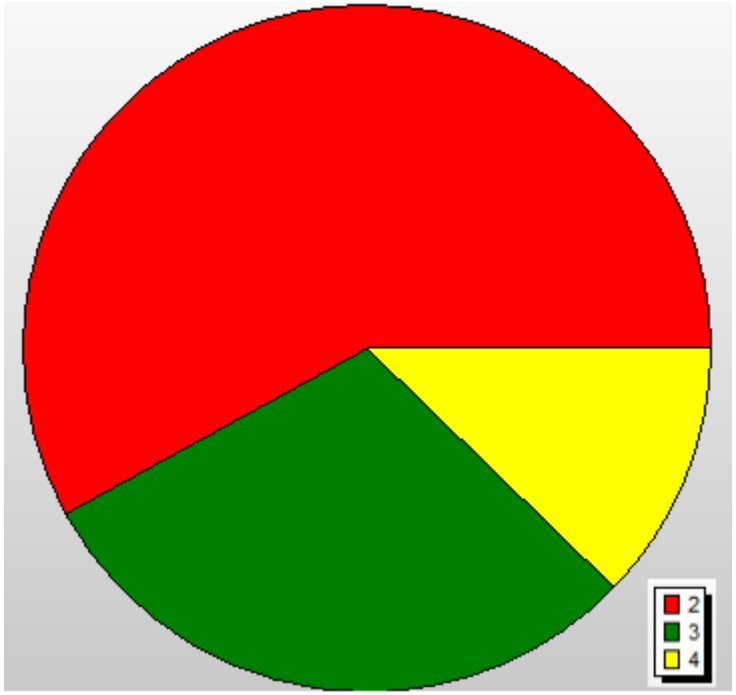
Alarm Management
Alarm Frequency Analysis

- A small number of tags are often responsible for a large percentage of the total alarms.
  - Top 10 represent 67% of alarms
  - Top 15 represent 73% of alarms



Alarm System Performance Reporting
Alarm Priority Analysis

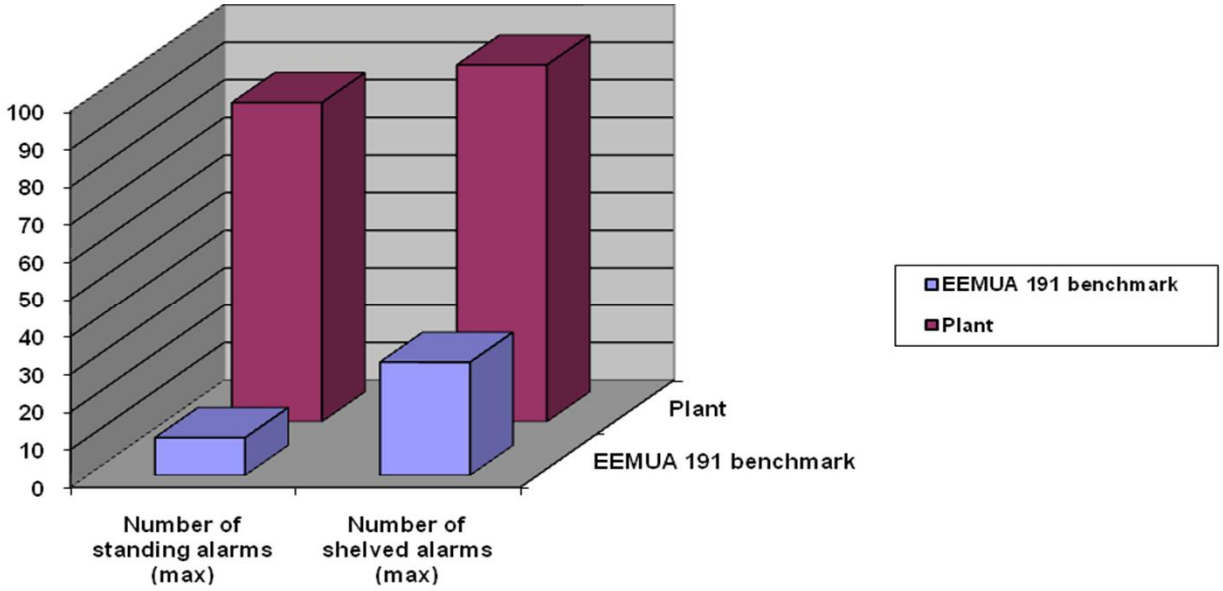
Alarm priority distribution



Priority	Alarms during analysis period	Occurrence Percentage	Configured Percentage	EEMUA Guideline
Priority 1 (Critical)	0	0%	0%	Few only
Priority 2 (High)	6914	58.01%	56.40%	5%
Priority 3 (Medium)	3544	29.74%	33.12%	15%
Priority 4 (Low)	1460	12.25%	10.48%	80%

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
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Alarm Management
Recommendations

- Reduce Nuisance Alarms
  - Eliminate instrument malfunctions
  - Tune chattering control loops
  - Optimize alarm parameters to limit transitions into and out of alarm state
- Reduce Alarm Flooding
  - State based alarming to inhibit alarms
  - Alarm grouping

Alarm Management
Recommendations

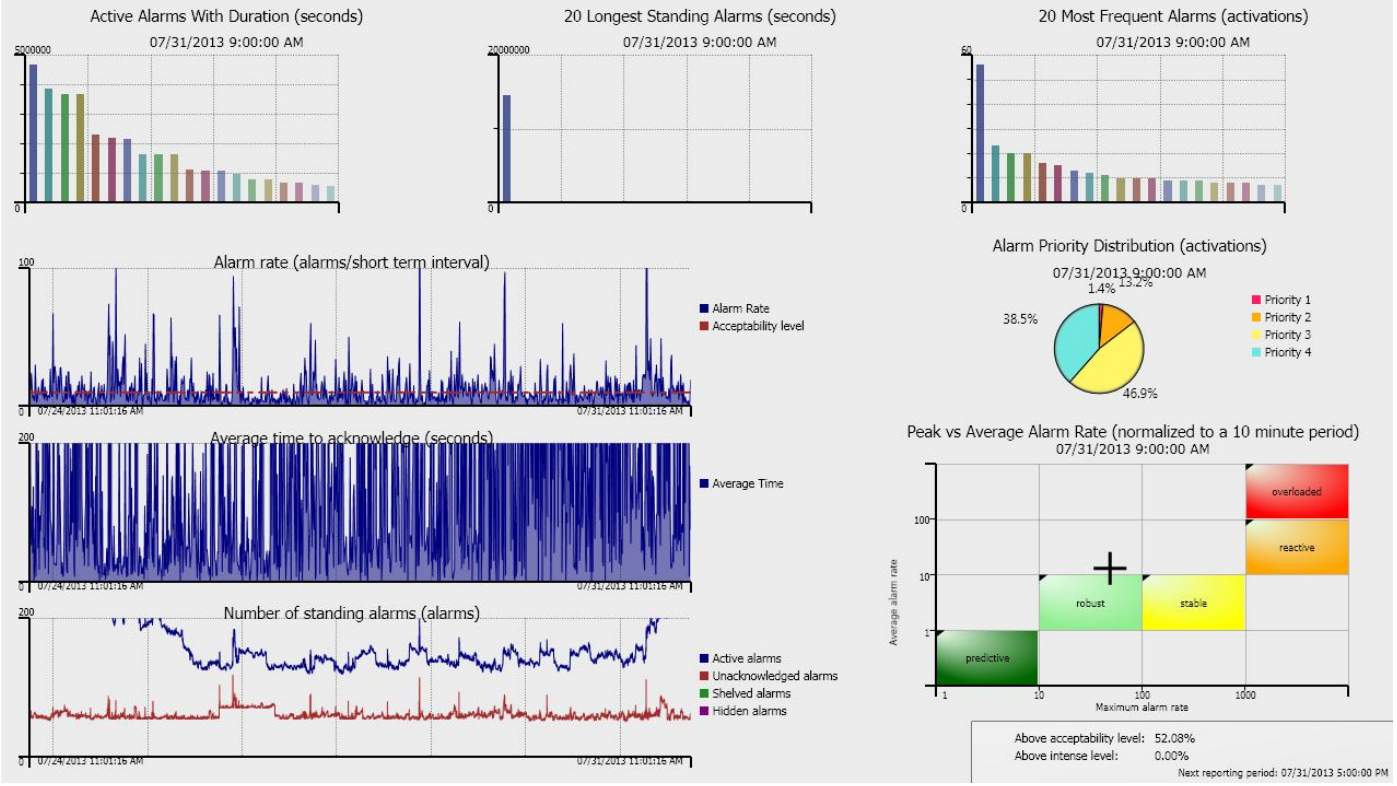
- Address Standing and Shelved Alarms
  - Follow up on long standing alarm issues
  - Shelve / Deactivate alarm if problem not fixed
  - Keep list of shelved alarms and periodically reevaluate
- Preventive Maintenance
  - Use a control loop management tool to identify instrumentation problems

Alarm Management
Alarm Rationalization

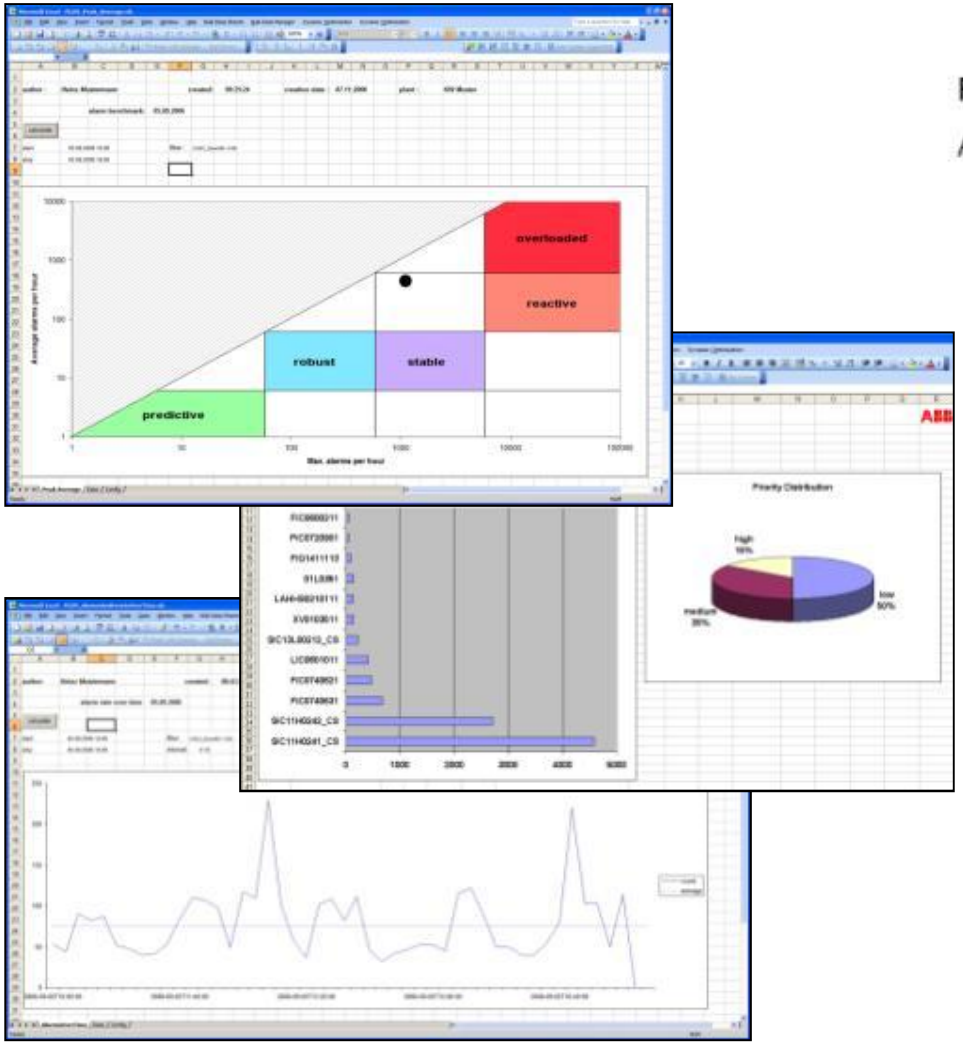
- Form team to review all alarms
- Define purpose of each alarm – some alarms may be reclassified as events
- Define new priorities using EEMUA and ISA recommendations
- Determine required operator response and alarm description
- Remove redundant alarms
- Create Alarm Design documentation

Alarm Management
Alarm System Performance Monitoring

- ABB 800xA Alarm Analysis
  - Computes alarm statistics for comparisons with EEMUA guidelines
  - Monitor performance improvements over time



S+ Operations
Integrated alarm analysis tools



Supports EEMUA 191 Standard

Report types

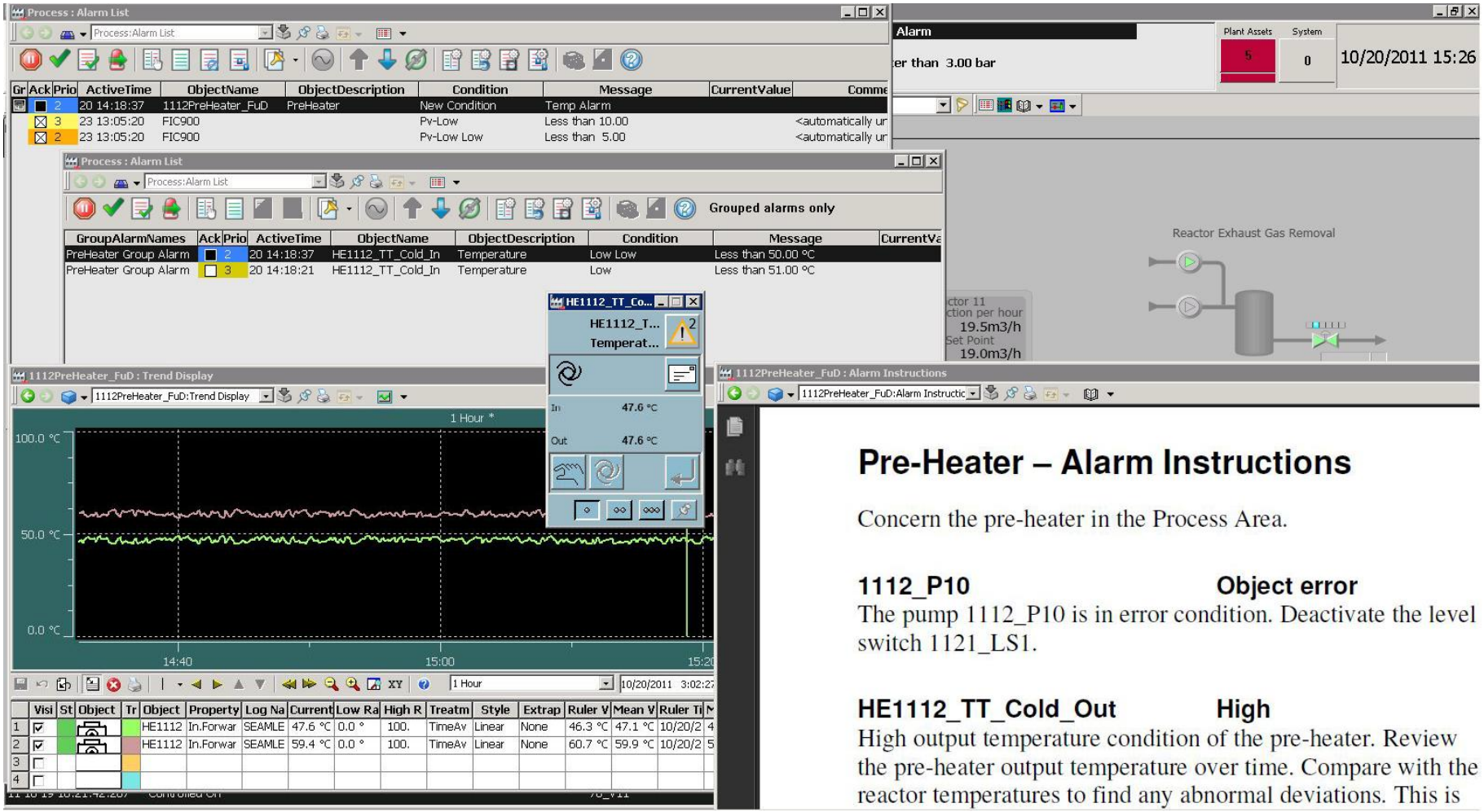
At the moment the following report types are available:

1) Alarm and/or Event frequency
2) Alarms and Events over time
3) Priority Distribution
4) Alarm Duration
5) Time to Acknowledge
6) Alarm performance levels
7) Control loops in hand mode
8) Operator actions
9) Intervals exceeding threshold
10) Distribution in plant areas
11) Standing alarms
12) CoOPccurences
13) Distribution
14) Detailed event sequence

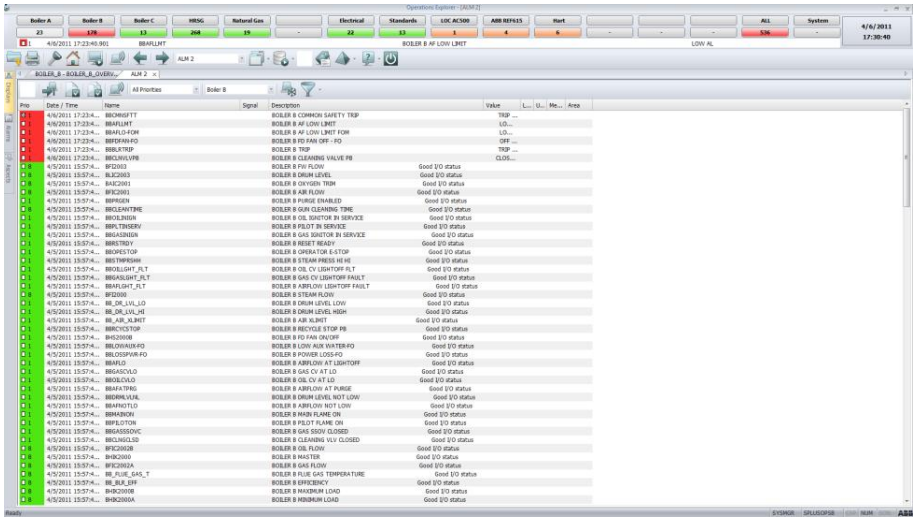
Alarm Management
Features in System 800xA

- 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 for period of time
- Built-in, operator accessible alarm analysis

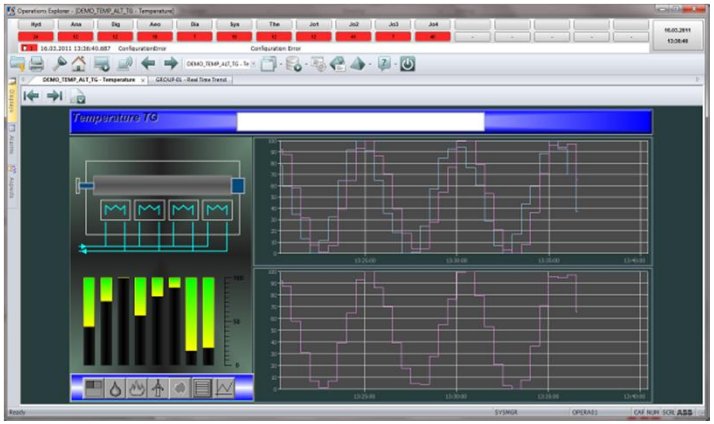
Alarm Management
Features in System 800xA

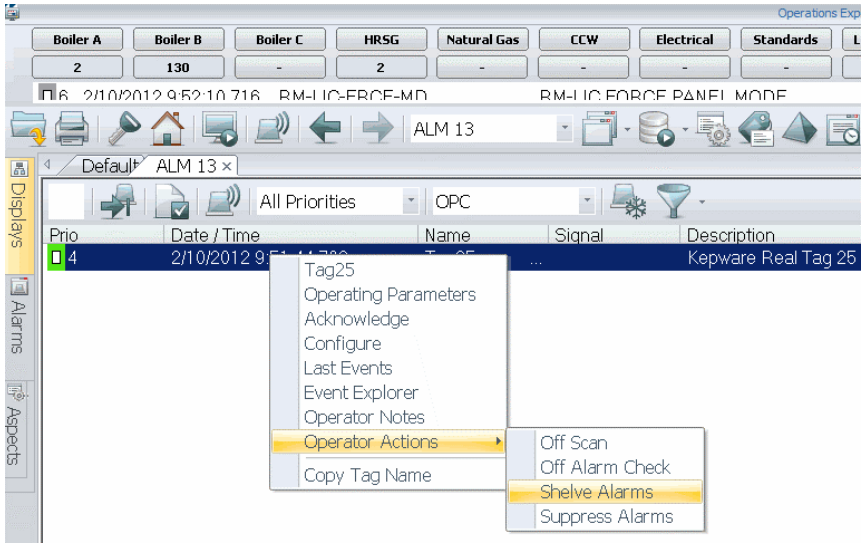


S+ Operations
Alarm and trending



- Alarming
  - 32 alarm priorities
  - 1024 alarm groups
  - Alarm filtering
  - Primary display from alarm list
  - Operator actions





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