Alarm Management and Operator Graphics

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for

Institution of Chemical Engineers
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Agenda

• Alarm Management
  - Awareness: “The Alarm Management Problem”
  - Progress to Date
  - What Next?

• Operator Graphics
  - Experience
  - ASM Guidance
  - Applications

• Summary
Problem Awareness ...
More recently ...
ASM Consortium

- Charter:
  - Research the causes of abnormal situations and create technologies to address this problem
- Deliverables:
  - Technology, best practices, application knowledge, prototypes, metrics
- History:
  - Started in 1994
  - Co-funded by US Govt (NIST)
  - Budget: +$16M USD
- Current Status:
  - Honeywell leadership
  - Expanding membership

Customer Driven Solution Drives 3-8% Additional Capacity
Experience from Projects

- No plant-wide philosophy and guidelines for alarms
- Minor operating upsets generate significant numbers of alarms
- Documentation and graphics support varies widely
- Major operating upsets generate alarm “floods”
- Some alarms “stand” for long periods of time
- Alarm configuration management is poor
- When nothing is wrong, there are active alarms
- Alarm Prioritization is inconsistent
- Alarm activations occur without need for operator action
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Forces Driving Honeywell Alarm Solutions

- **ASM Consortium**
  - “Effective Alarm Management Practices” document

- **Honeywell Customers**
  - Shell ESP
    - “We know our limits and we operate within those limits all the time.”
  - ExxonMobil
    - Mutual Development Funding
  - Others...

- **EEMUA 191**
  - “The de facto standard”

- **Standards**
  - IEC 61508/61511
  - UK HSE Document
  - OSHA 1910.119
  - Etc.

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EEMUA … “the de-facto standard”

The ASMC is very much concerned with Alarm Systems
EEMUA 191

• A huge step forward!
• Heavy focus on redesign ("rationalisation"):  
  - Removal of meaningless “alarms”
  - Better use of priorities (e.g. for use during floods):
    - ~ 5% URGENT
    - ~ 10% HIGH
    - ~ 85% LOW
  - Wider limits – “alarms” not useful for minor deviations
  - More effective use of existing alarm configuration parameters

• Targets for activation frequency

• EEMUA also calls for other improvements which are often neglected (MOC, alarm suppression etc.)
## The Three Common Problems

<table>
<thead>
<tr>
<th>Problem Type</th>
<th>Solution Approach</th>
<th>Target (e.g. from EEMUA)</th>
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<tbody>
<tr>
<td>Standing alarms</td>
<td>Mode-based alarming. Shelving.</td>
<td>&lt; 10</td>
</tr>
<tr>
<td>Background alarms</td>
<td>Alarm rationalisation (just “Bad Actors” ?)</td>
<td>&lt; 10 per hour</td>
</tr>
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<td>Alarm floods</td>
<td>Full alarm rationalisation. Enhanced processing.</td>
<td>&lt; 10 in first 10 minutes of upset</td>
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ASM Consortium
Alarm System Performance
Metrics Benchmarking
Project
Alarms/10 mins (ASM ® Consortium Data)

- Average alarm rates (the “background” rate) have improved
- Sites can meet and sustain the EEMUA targets (“Manageable” or “Very Likely Acceptable”)

ASM is a registered US trademark of Honeywell Inc.
• The peak alarm rate is not closely correlated with the degree of rationalization
• Peak alarm rates exceeding 100 alarms per 10 minute window were experienced at least once by 60% of the consoles
### Three Problems Summary

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- **Tools and progress**
  - Considerable progress
  - The most difficult problem

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Safety-Related Alarms

• As noted in the EEMUA Guide:
• Most process plant alarms are DCS-based and are covered by the International Standard IEC 61508.
• Many countries expect compliance with IEC 61508.
• According to the standard, an alarm system is safety-related if:
  - It is a claimed part of the facilities for reducing risks from hazards to people to a tolerable level
  - AND ... the claimed reduction in risk provided by the alarm system is “significant”
• “Significant” means a claimed Average Probability of Failure on Demand of less than 0.1/demand

• Terminology!!!
Safety-Related Alarms

• If an alarm system is considered as a safety-related system then:
  - It should be designed, operated and maintained in accordance with IEC 61508.
  - It should be independent and separate from the process control system (unless the process control system is itself safety-related and conforms to IEC 61508).

• Many plants use (or claim to use!) a separate, high-reliability system for safety-related alarms.

• The traditional DCS (including Honeywell ones) are NOT engineered to IEC 61508 specifications and should NOT be used for safety-related alarms.
IEC 61511

... generally reinforces the generic requirements of IEC 61508 as far as process industry alarms are concerned
IEC 61511

• “It should be noted that a risk reduction of up to a factor of 10 might be claimed without the need to comply with IEC 61511. Where such claims are made, the human factor issues will need to be carefully considered”

• “Any claims for risk reduction from an alarm should be supported by a documented description of the necessary response for the alarm and that there is sufficient time for the operator to take the corrective action and assurance that the operator will be trained to take the preventive actions”
IEC 61511

• An alarm system can be used as a method of risk reduction by reducing the demand rate on the SIS providing:
  - the sensor used for the alarm system is not used for control purposes where loss of control would lead to a demand on the SIF.
  - the sensor used for the alarm system is not used as part of the SIS.
  - limitations have been taken into account with respect to risk reduction that can be claimed for the BPCS and common cause issues.

• Some plants seem to be unaware of the IEC 61508/61511 guidance or mistakenly believe that they are following it
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More Work Required?

• So ... some incidents have raised awareness and EEMUA has given us a framework to move forward
• A lot of work has been done ...
• ... but significant problems remain:
  - Many plants have considerably improved their performance ... but large variations between the best and the worst (even within the same site and/or company)
  - The ASMC study (and anecdotal evidence) has shown that alarm floods are still a major problem
  - Rationalisation can be time-consuming and expensive ... lots of interest in better techniques/tools
  - Safety-Related alarms are a source of real concern

• Need for effective tools (not just analysis tools) and the work-process
Shell ESP Program

Operations Management Pro is the Productization of Shell ESP

• Ensure Safe Production is a Shell Global Solutions initiative to establish work processes to…
  - **Establish Limits** for plant operations -- based on equipment, health, safety, and environmental concerns/regulations
    • assure consistency across application disciplines
  - **Validate** daily operating **targets** against these limits
  - **Monitor and control** deviations
    • monitor and report deviations
    • common approaches for notifying appropriate plant personnel
  - **Learn and Improve** -- assess plant performance
    • common end of shift logs
    • drill-down plant level access
    • deviation and alarm system metrics

• Joint Shell / Honeywell development

• Currently being installed at the 9 US Shell refineries

**Major commitment by Shell - $11M**
Safe Operating Boundaries

- Operating within safe operating boundaries is key to safety. Many major incidents have been attributed to operations unknowingly or knowingly running outside safe operating boundary.
- Boundaries are often not well documented and maintained today.

Source of Limits:
- PVHH Alarm Limit
- Manager UserAlert Hi-Hi Alert Limit
- PVHI Alarm Limit
- Environmental Engr. UserAlert Limit
- APC Limit
- Operational Target Limit
- Joe Operator UserAlert Limit
- PVLO Alarm Limit

Location of Limits:
- Safety
- Corrosion
- Environmental
- Design
- Process
- Reliability
  - xxx
  - yyy
Boundary Management

- Consistent reference point based on facts, documented and available to the entire operating team and other applications
- Thorough PHA, HAZOP, and alarm system design with cross functional team
  - Clear definition of safe upper and lower limits (OSHA 1910.119)
  - Identify what to monitor (alarms, alerts, production targets)
  - Capture and make available knowledge from PHA, HAZOP, AOA, other processes
Experion Enterprise Model

• What is the Enterprise Model?
  - Allows organization of Experion platform to reflect structure of the plant including assets and boundaries
  - Will become the basis for other models/views that reflect other aspects of the enterprise

• Applications organized around the hierarchical asset model
  - Existing area-based mechanisms enhanced to work with more richly structured asset model
  - More effective integration since application parameters are based on the same core enterprise model
Define Equipment

Define Constraints

Map Constraints To Tags
Map Boundaries to Alarm & Alerts

- Management of Change (MOC) for all changes – intended for offline use
- Manage multiple types
  - Design
  - Environmental
  - Safe operating limits
  - Environmental
  - Corrosion
  - (etc.)

- Equipment constraints
- Variable boundaries
- Boundary Reference Documentation Link
- Applications use boundaries
  - Production monitoring
  - Process monitoring (alarm & alerts)
  - Exposed via OPC
Boundary Information Availability

• ACM Information exposed:
  - Boundary Values and Alarm Limits (operating mode aware)
  - Alarm Help
  - Alarm Documentation

• Uses:
  - GUS & HMI Web Displays
  - OI/OM Integration
  - UserAlert – boundary alerts
  - APC – model constraints
  - Etc
Common Database for Managing Limits

Common configuration management
- Cross-checking
- Audit tracking
- Enforcement
- Mode change management

Operating boundaries
- Range High
- Critical High
- Standard High
- Target High
- Target Low
- Standard Low
- Critical Low
- Range Low

Operating limits established by Operating Instructions

Operating limits used by Operations Monitoring

Process alarm trip-points

UserAlert limits
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An “effective” graphic?

Pick out the alarms in this display.
An “effective” graphic?
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ASM Consortium Guidelines
“Effective Operator Display Design”

(Version 4.00 19/June/2002)
ASM Guidance

• The detailed guidance is only available to ASM Consortium members

• Honeywell project teams can also use the guidance on non-ASM Consortium projects

• But some parts derive from public-domain information …
Level 1: Process Area Overview Displays

- Level 1 graphics show the broadest available view of the facilities under the operator’s control.
- Primary purpose is to provide situational awareness of the operators entire span of control.
- Summarized on a limited number of displays.
- Contains multiple units, with the process values or safety signals being read-only from a control perspective.
- The operator is not allowed to execute any control from this display.
- Simplified process flow diagrams of a whole plant area.
- Often a combination of KPI values, trends and alarms.
Level 2: Process Unit Overview Displays

- Main control interface for performing routine operational tasks
- One for every major process unit
- Enough information to control plant under normal conditions
- Allows operators to perform common tasks without changing graphics
- Used to provide information regarding key elements of the process unit
Level 3: Detailed Displays

- Exhaustive in their detail and contain all available information of smaller pieces of the process unit.
- All control loops (?) and indicators are shown on the Level 3 displays.
- Used for detailed investigations and interventions that are not time-critical.
- May also be used to show detailed alarm information (e.g. PVLL)
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Level 1 example
Level 3 Example
Nova Chem, Joffre, Alberta

• By using the ASM concepts in one of their process units
  - ASM graphics
  - Alarm management
  - Etc ...
• >35% improvement in recognizing process deviations before an alarm
• 25% improvement in their ability to solve the problem
• 35-48% improvement in operator response time to deviations
• As compared to other units that were using US station type technologies as their control room environment, operators were able to orient to problems faster, more completely resolve the problems, and generally deal with abnormal situations faster

~ C$1M per year in savings
Honeywell is also applying the EEMUA guidance and ASM Graphics guidance to its Alarm Summary as well as in the HMIWeb Solution Pack.
Experion PKS Alarm Summary

Create and store “views” of areas, filters, and sorting

One-click sorting!

Enter comments on alarms for later analysis!

Presents instructions for each alarm

Enter comments on alarms for later analysis!

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Asset Model shows alarm counts per ‘asset’ in the hierarchy.
Alarm Summary Filtering

Filter alarm display based on ‘asset’ selected
Repeated Alarm Handling

- **Number of times the alarm has occurred**
- **Initial time the alarm was raised**
- **Most recent time the alarm was raised**
Summary

• Considerable progress has been made in Alarm Management, particularly since the publication of the EEMUA 191 guidance.

• Safety Regulators and Insurers are also giving added momentum throughout the world.

• But much remains to be done, particularly in the area of “alarm floods”.

• The use of an Asset Model and associated work processes gives a promising way forward.

• Operator Graphics vary enormously in effectiveness. Good graphics give real benefits.

• The ASM Consortium has it’s own guidance in both areas – being applied extensively in Experion PKS.
Contact Information

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