ABB/IChemE Webinar 6th May 2021
Alarm Management – A Practical Guide

ABB LIMITED

In this session...

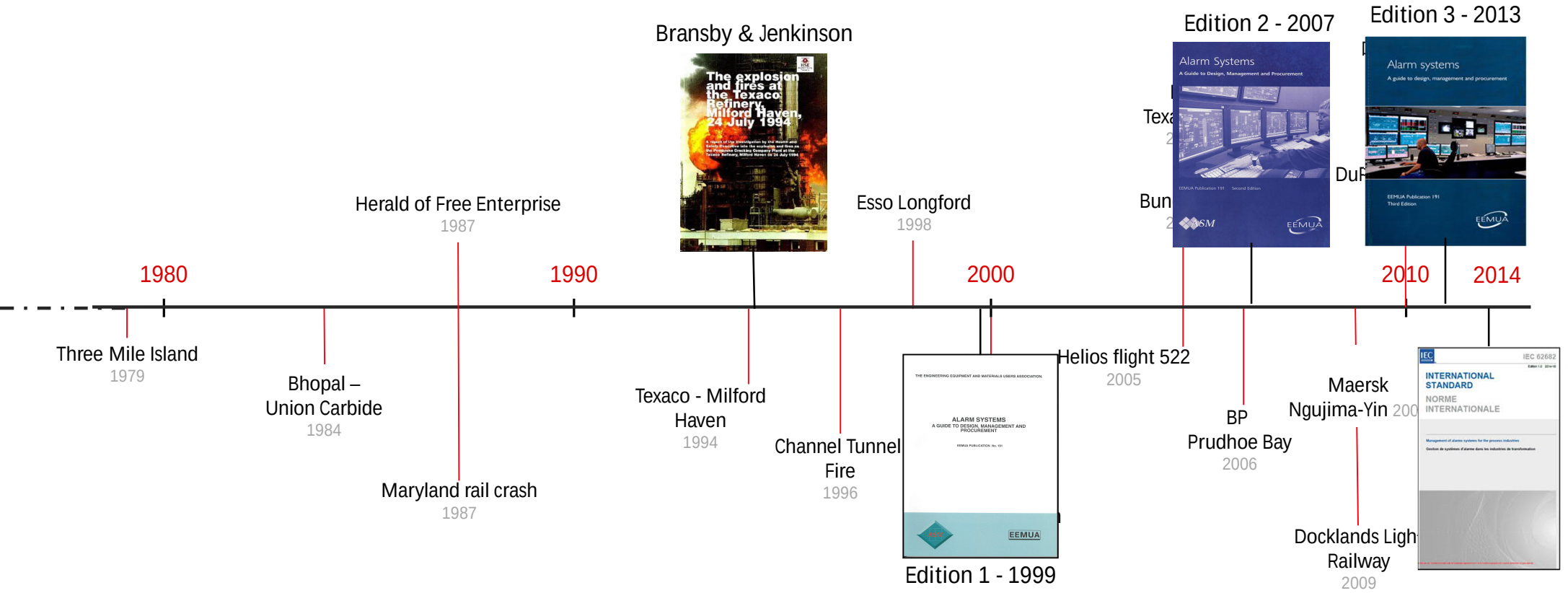
- Major Incident Timeline
- Standards & Guidance
- What is an Alarm?
- Impact of Technology
- Alarm Management Lifecycle
- Alarm Monitoring & Performance
- Alarm Philosophy
- Master Alarm Database (MAD)
- Alarm Rationalisation
- Auditing / Benchmark
- A worthwhile exercise?

Alarm System – Challenges & Responsibilities

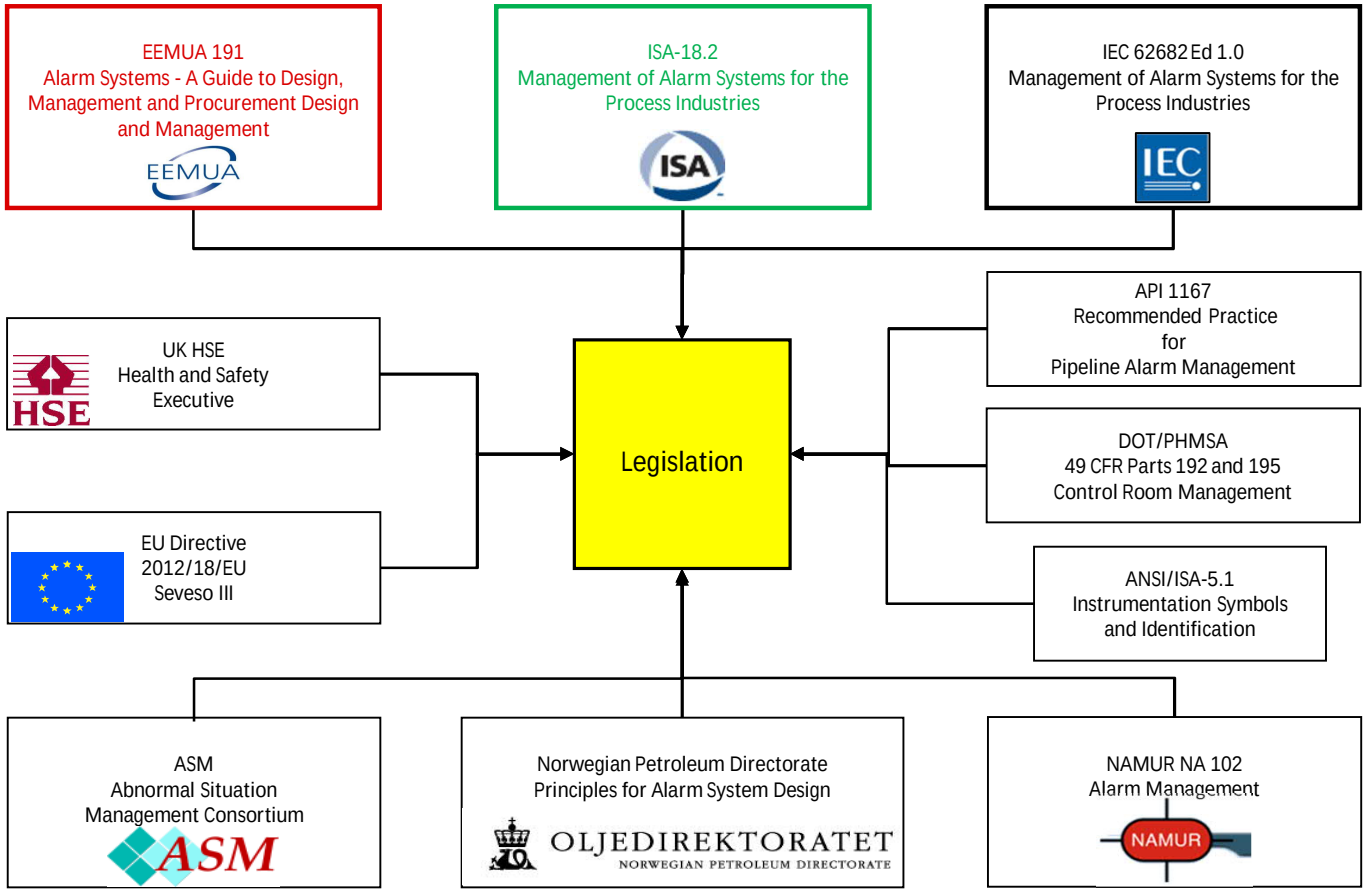
- Does your Alarm System support the operators?
- Does your alarm system meet the requirements of IEC 62682?
- Are you being challenged by the regulatory authorities?
- Do you have unexpected shutdowns, are you losing production?
- Who is responsible for the alarm system?:
  - Process Safety Management
  - Process Engineer
  - Control / Instrument department
  - Operations Management
- Who is the alarm management Champion in your organization?

What has been the learning?

The on-going timeline of significant incidents.....



Legislation, standards and guidance....



EU legislation

Seveso III

Directive 2012/18/EU of the European Parliament and of the Council of 4 July 2012 on the control of major accident hazards involving dangerous substances, amending and subsequently repealing Council Directive 96/82/EC

Annex III (b)

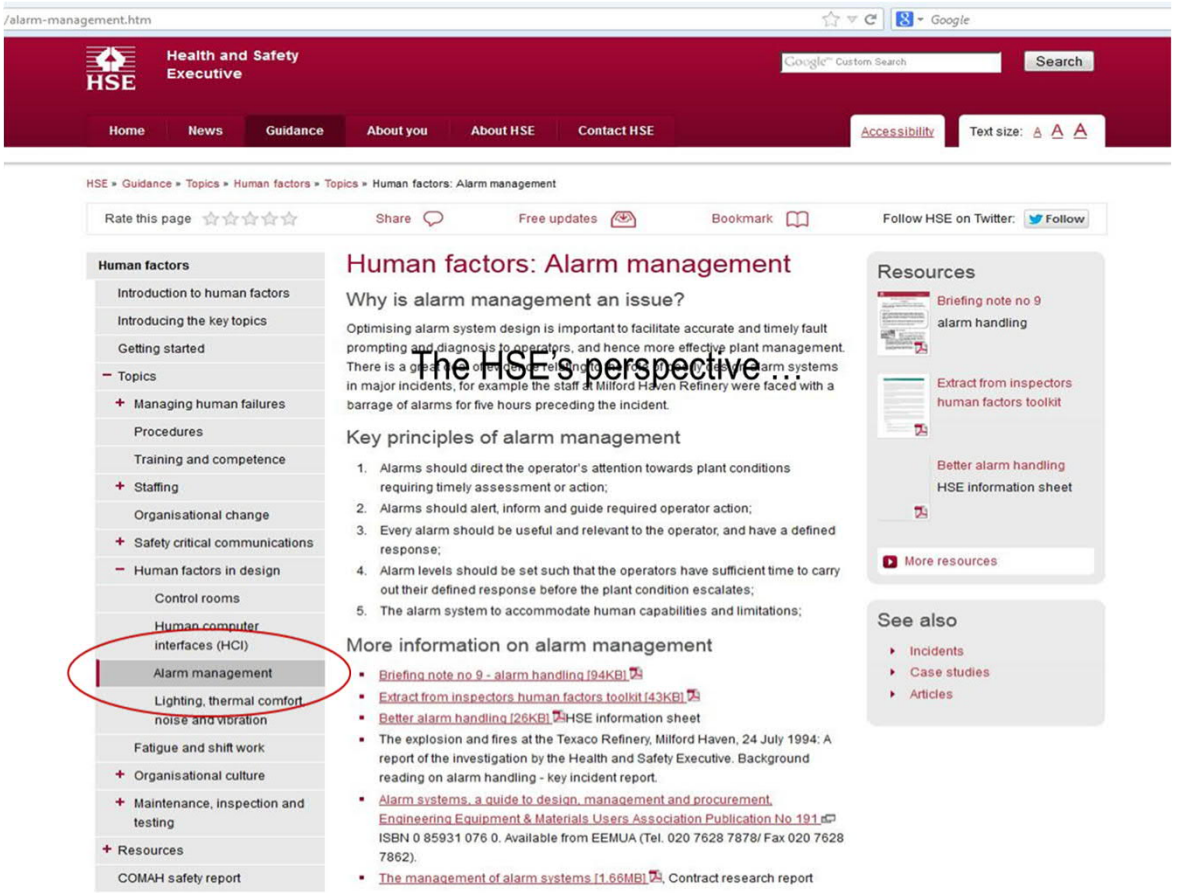
...information on the safety management system and the organisation of the establishment...

(iii) operational control — adoption and implementation of procedures and instructions for safe operation, including maintenance, of plant, processes and equipment, and for alarm management and temporary stoppages; taking into account available information on best practices for monitoring and control, with a view to reducing the risk of system failure; management and control of the risks associated with ageing equipment installed in the establishment and corrosion; inventory of the establishment's equipment, strategy and methodology for monitoring and control of the condition of the equipment; appropriate follow-up actions and any necessary countermeasures;

Implementation in all member states required – in UK as of 1 June 2015

www.hse.gov.uk/seveso/introduction.htm.

The HSE's perspective …

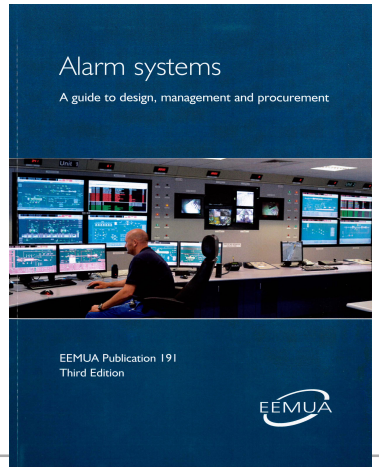


Standards & Guidance

IEC 62682 vs EEMUA 191 - 1

– IEC 62682 is a standard
  - Provides requirements for alarm management and alarm systems
  - Compliance to these normative requirements to demonstrate Recognised and Generally Accepted Good Engineering Practices (RAGAGEP) required under OSHA

– EEMUA 191 is a guidance document
  - Aim of guide is to assist in design, management and procurement of alarm systems
  - Contains no mandatory requirements - one cannot claim to be compliant with EEMUA 191.



What is an alarm?

IEC 62682 3.1.7 definition of an alarm is:

– An audible and/or visible means of indicating to the operator an equipment malfunction, process deviation, or abnormal condition requiring a timely response

EEMUA 191 definition of an alarm is:

– An audible and/or visible means of indicating to the operator an equipment or process malfunction or abnormal condition.

Abnormal condition

– Only present alarms that are linked to response and corrective action to resolve the alarm
  - Equipment malfunction
  - Process deviation
  - Abnormal condition requiring assessment and response

.

Note: Normal events such as “pump stopped” or “valve closed” should not be presented as alarms.

What is an alarm system?

IEC 62682 3.1.28 definition:

– “Operator support system for generating and handling alarms for managing abnormal situations”

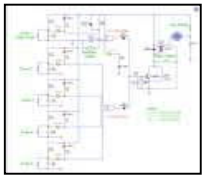
EEMUA 191:

– The complete system for generating and handling alarms, including field equipment, signal conditioning and transmission, alarm processing and alarm display

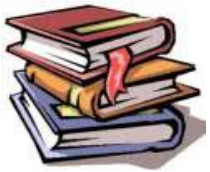
– It also includes hardware, software and supporting information (e.g. alarm response procedures, management controls).

The components of an alarm system

Equipment



Signal conditioning
And transmission



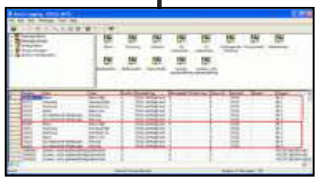
Procedures / MAD

Alarm System

Workstation displays

Competent Personnel

Control room displays



Alarm configuration

Alarm analysis.

The impact of technology advances

The way we were versus the way we are now…

Until the 1970s process plant was controlled from local control rooms with panel layouts

- All information displayed to the operator simultaneously
- Simple interface allowed easy diagnosis using pattern recognition
- Alarms cost space as well as engineering time and effort to specify and implement. Individual alarms had to be justified, as a result fewer Alarms.

Modern Systems allow alarms to be configured with a simple click of a mouse

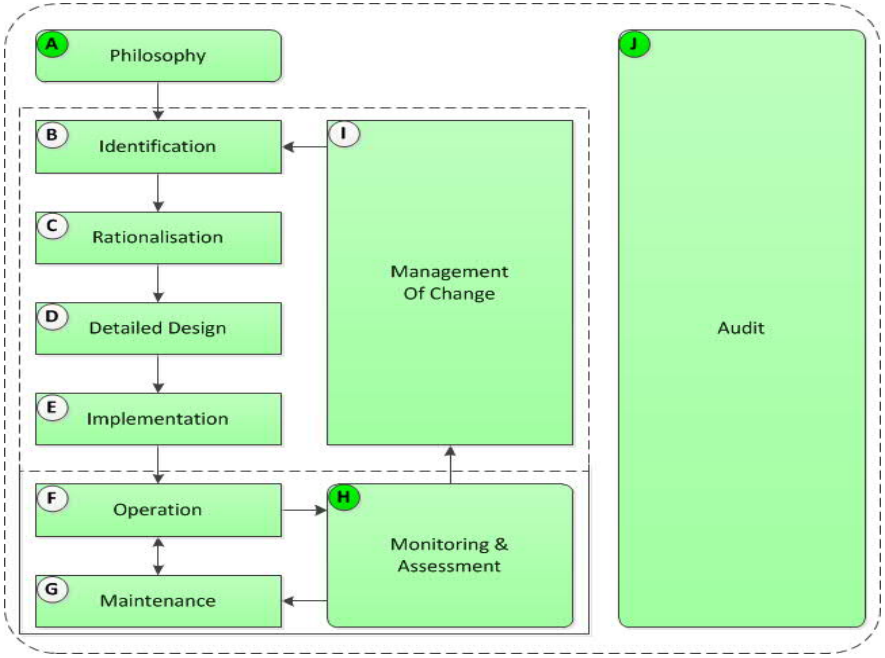
- The operator's view is restricted to a moving window on the process
- Process plant can generate a wealth of data for the control room
- Alarms are effectively "free" with little incremental cost per alarm
- Many more "alarms", often used for a range of indicators and notifications
- "Alarms" not restricted to abnormal process conditions.

IEC 62682

The Alarm Management Lifecycle

– Entry points

- A - New installations develop Alarm Philosophy to establish the objectives of the alarm system
- H - Existing installation monitor the alarm system and assess it’s performance
- J - New/ existing installation audit or benchmark of all aspects of alarm management against a set of documented practices (e.g. IEC 62682).



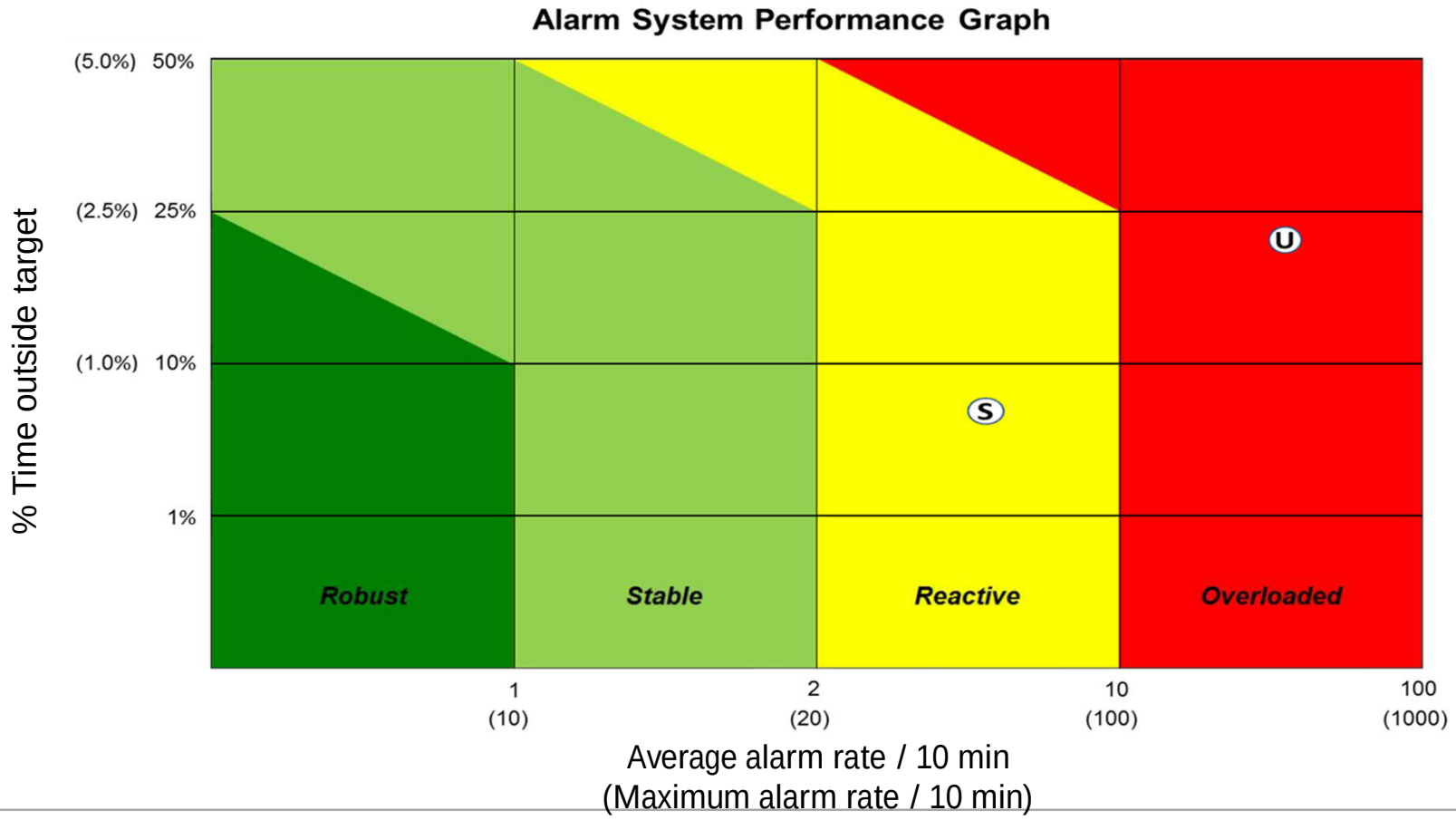
Alarm Management Lifecycle

IEC 62682 vs EEMUA 191 – KPIs

Metric	IEC	EEMUA
Average alarm rate (normal operation)	1 in 10 minutes (acceptable)	<1 in 10 minutes
Peak alarm rate (abnormal operation)	<10 in first 10 minutes	<10 in first 10 minutes
Top 10 alarms as percentage of total	1 to 5% of total	Discussed but no target
Standing/stale alarms	<5	<10
Shelved alarms		<30
Usefulness of alarms [1]		<2
Percentage of hours containing more than 30 alarms	<1%	
Percentage of 10 minute periods containing more than 10 alarms	<1%	
Percentage of time exceeding peak target	<1%	
No of Chattering or fleeting alarms	0	
No of unauthorised suppressions	0	
No of unauthorised attribute changes	0	
Number of incidents where alarm system was a factor		Discussed but no target
Alarm Floods	< 1% of reporting period	

[1] EEMUA Publication 191 for a definition of 'Usefulness'

EEMUA 191 - Performance level (Ed 3)



Overview of the Alarm Management Framework

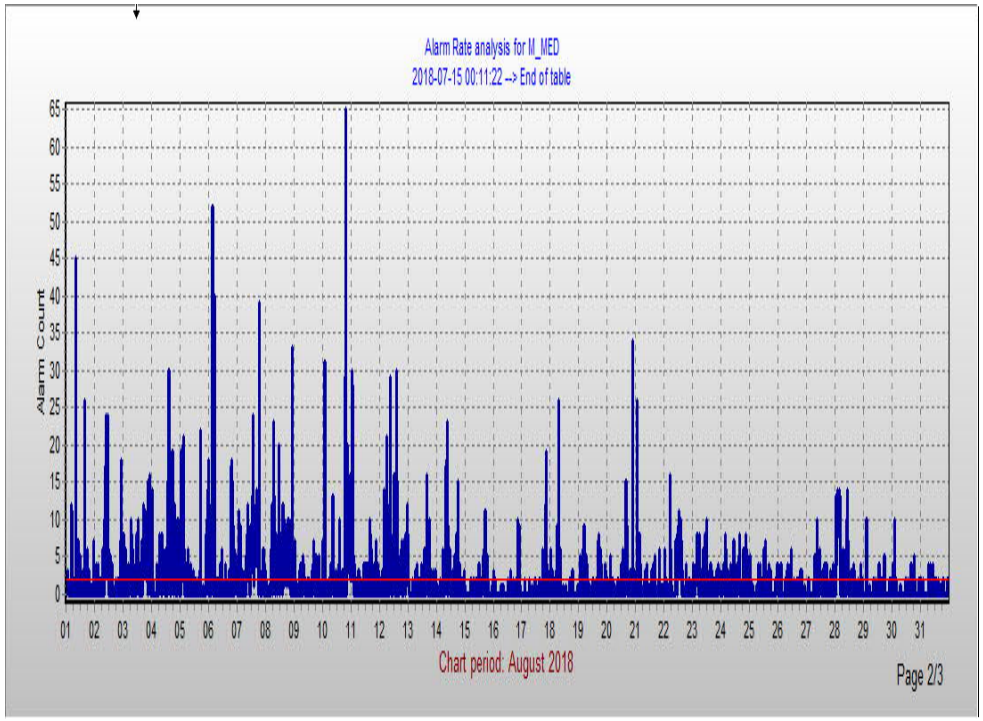
- Alarm Philosophy
- Alarm & Operator Action Journal Analysis
- Nuisance Alarm Identification and Resolution
- Develop Alarm HMI Philosophy
- Implement Alarm HMI Design

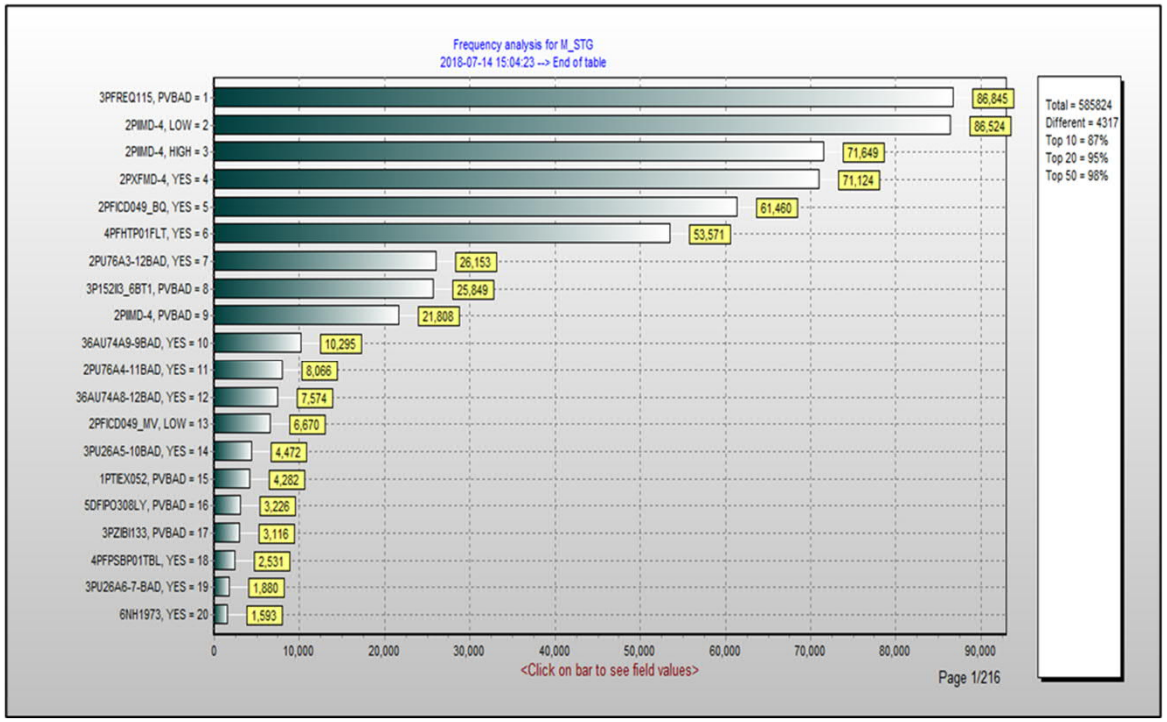
- Alarm System Management of Change
- Alarm Trip Point Audit and Enforcement
- Alarm Benchmark assessment
- Alarm Rationalisation and Change Implementation
  - Alarm Shelving
  - Alarm Grouping
  - On-Line Operator Response Manual
- Publication and Distribution of Alarm Metrics

- Advanced Alarm Management
  - Alarm Suppression
  - Redundant Alarms
  - Eclipsing Alarms
  - Out of Service Alarms
  - Operating Mode Alarms
  - Critical Event Alarms
  - Loop Performance Analysis

Alarm Performance Data

Poorly Rationalized Alarm System





Nuisance Alarms

Common causes:

- Poor control loop tuning
- Little or no hysteresis (deadband) applied to noisy signals
- Alarm set points set too close together
- Alarms that are really events
- Faulty instrumentation
- Change in process rate

Batch plant specific:

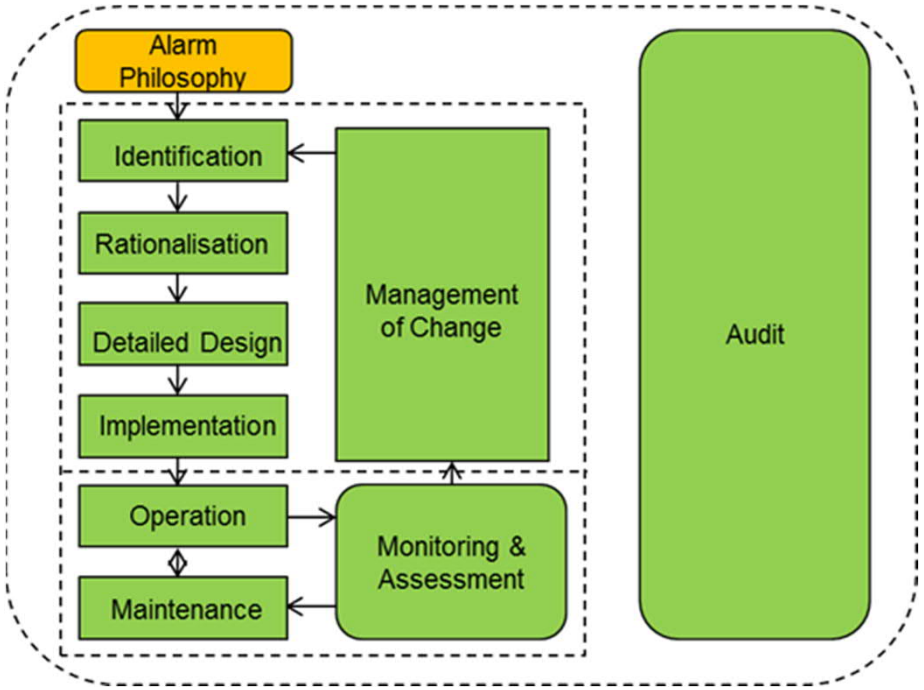
- Alarms enabled in an inappropriate phase
  - e.g. Not turning off an alarm on completion
- Product changes without consideration of alarm settings.

What is an Alarm Philosophy?

The Alarm Philosophy defines requirements across the whole alarm management lifecycle.

A *useful* Alarm Philosophy

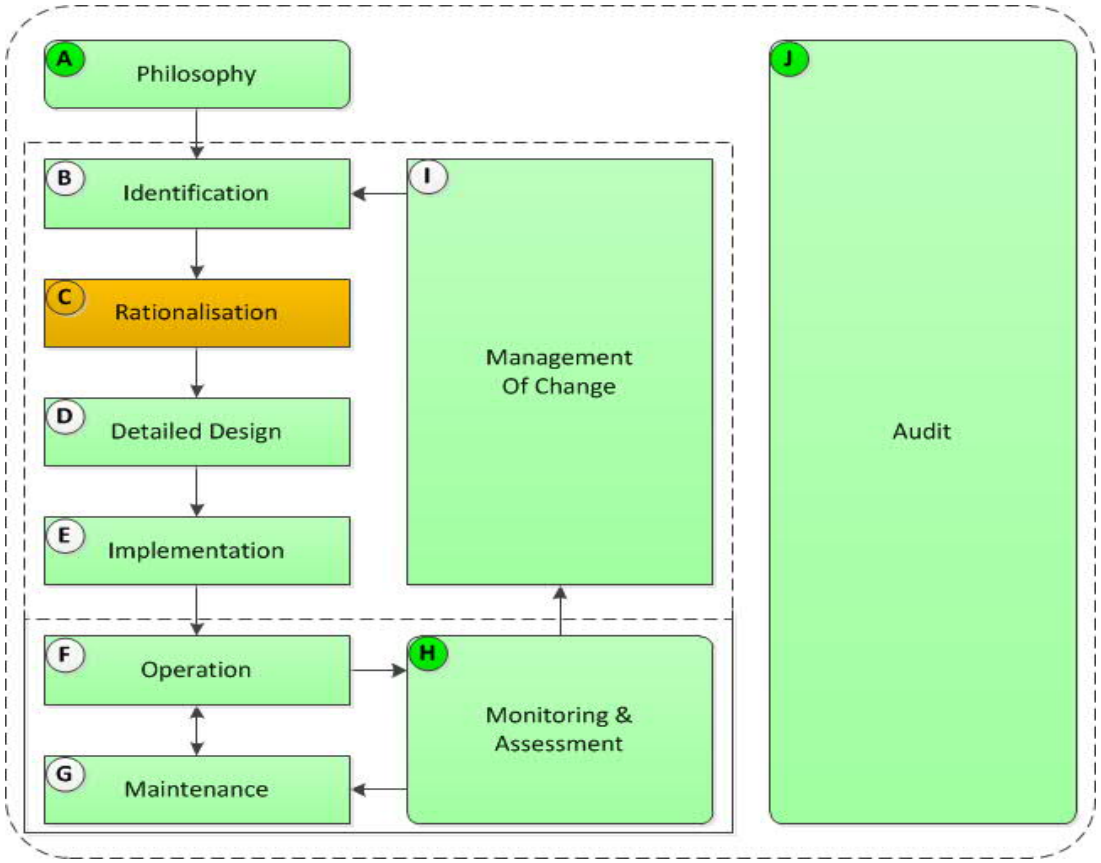
- Defines responsibilities for managing the alarm system
- Sets out review process for continuous improvement
- Ensures new projects do not add excessive numbers of alarms
- Highlights safety role of alarm system
- Facilitates system consistency



Alarm management lifecycle

What is Alarm Rationalisation?

- IEC 62682 3.1.71
  - Rationalisation is the process to review potential alarms using the principles of the alarm philosophy, to select alarms for design and to document the rationale for each alarm.
- EEMUA 191 (3.3.2 table 7) The objectives of alarm review
  - Minimise the number of alarms consistent with proper protection of people, plant and the environment
  - Ensure that all alarms are relevant, truthful and understandable at all times
  - Ensure that alarm rates are manageable
  - Ensure that all alarms have defined responses
  - Ensure that alarms are properly prioritised

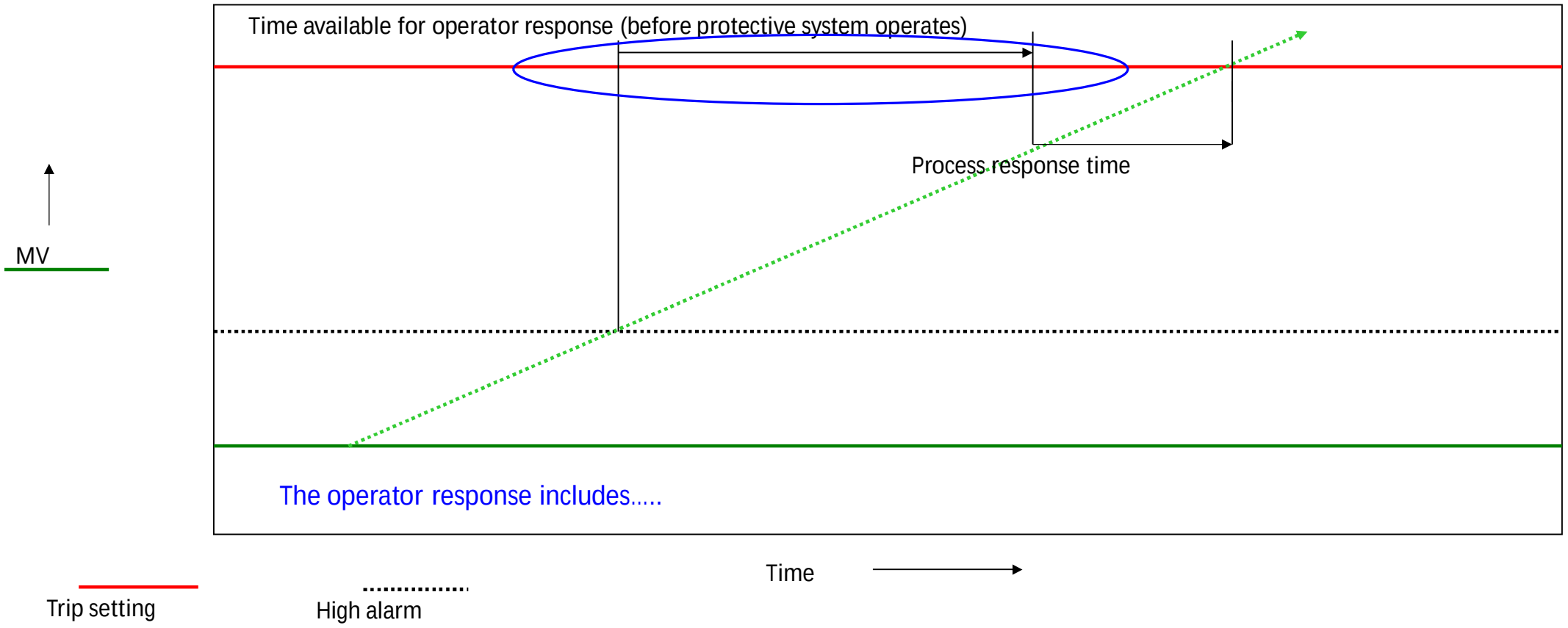


What is alarm prioritisation?

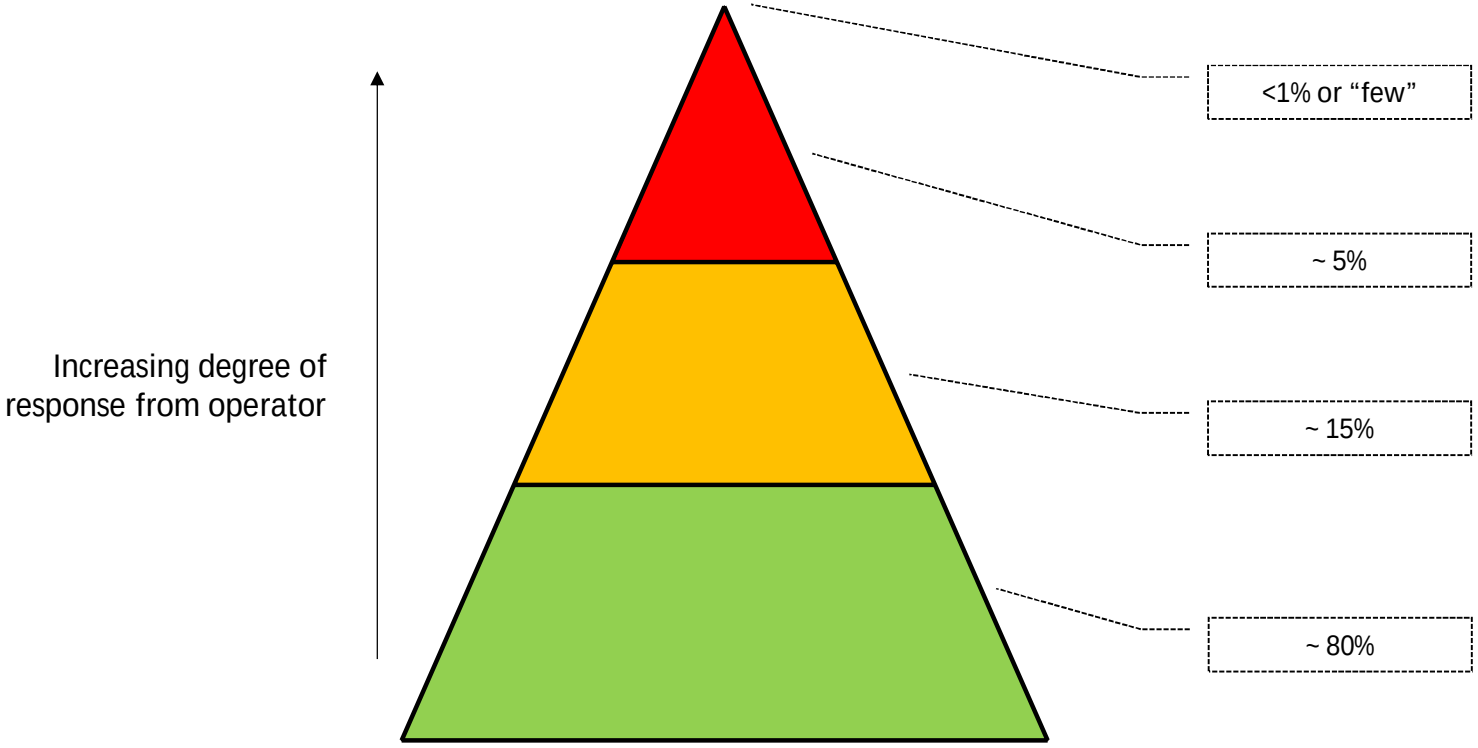
IEC 62682 (3.1.22) - Alarm Priority

“The relative importance assigned to an alarm within the alarm system to indicate the urgency of response i.e., a function of seriousness of consequences and allowable response time”.

Operator response time - principles



The prioritisation pyramid



Remember Texaco Milford Haven?

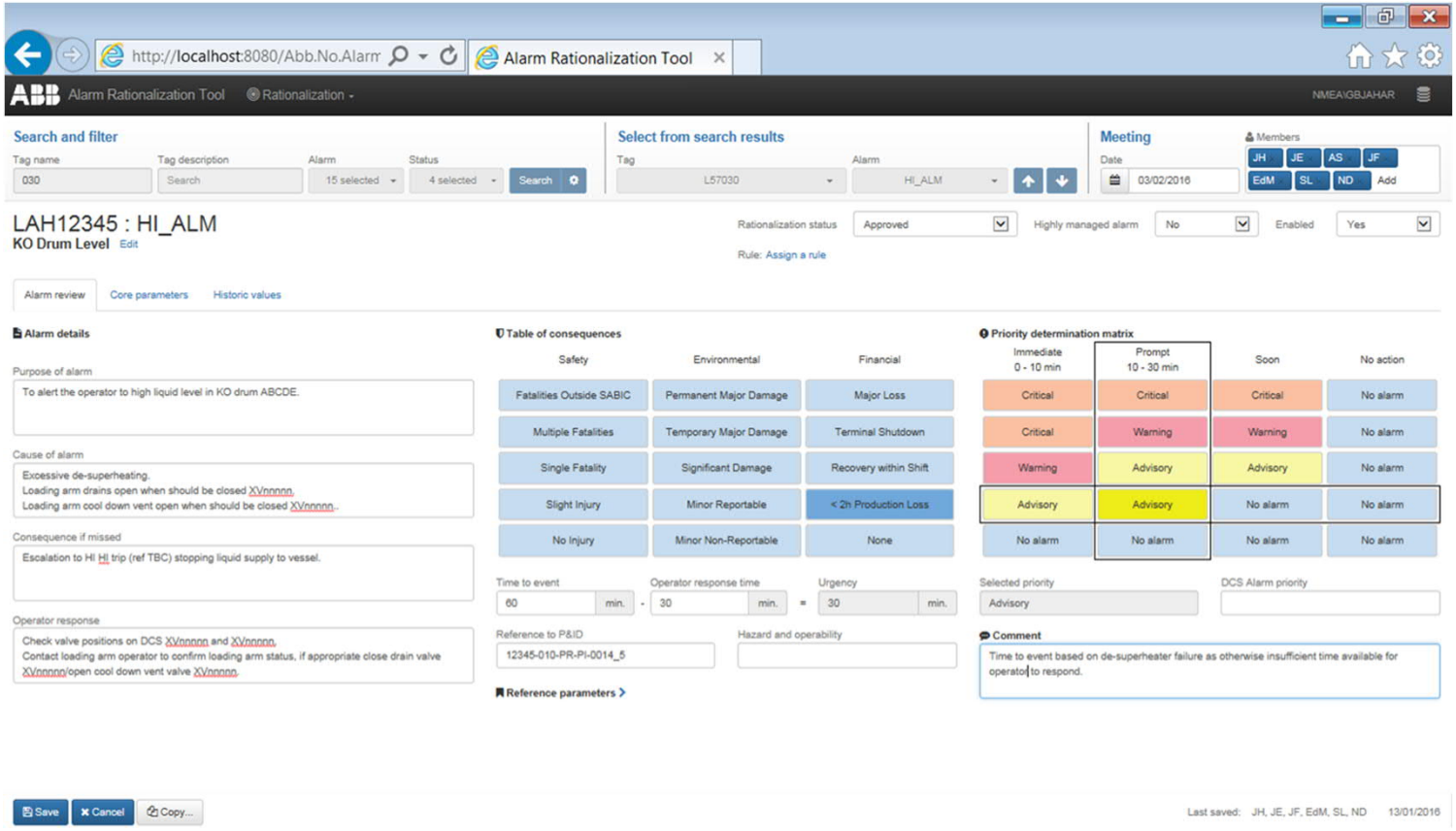
- In order that high priority alarms are treated with due attention it is important that there aren’t too many of them.

Master Alarm Database (MAD)

- Organises and documents alarms
- Focus for Management of Change (MOC)
- Operationally valuable (operator response)
- Documents HMA's / Safety Related Alarms (SRA's)
- Project deliverable (along with alarm philosophy document)
- Up to date, consistent record of a variable plant asset
- Available 24 / 7
- Key resource for alarm system improvement
  - e.g. alarm rationalisation.

Alarm Rationalisation Tools

Example - Platform independent Alarm Insight Alarm Rationalization Tool (ART)



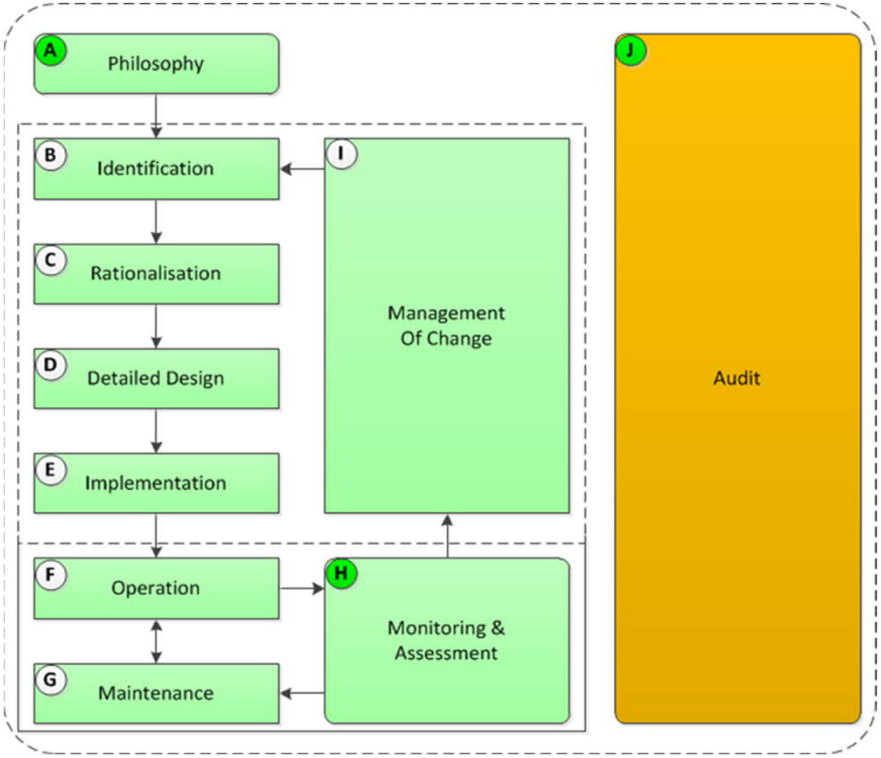
Auditing the Alarm System

This lifecycle step includes:

- Benchmark
- All aspects of alarm management should be audited at the start of an improvement effort
  - An initial audit or benchmark should be made against a set of documented practices e.g. IEC 62682 or corporate standard

Benchmark

“..an initial audit of an alarm system designed to specifically identify problematic areas for the purpose of formulating improvement plans”.



Audit process

Evidence

Standards

Procedures

Audit Recommendations
Action Plans.

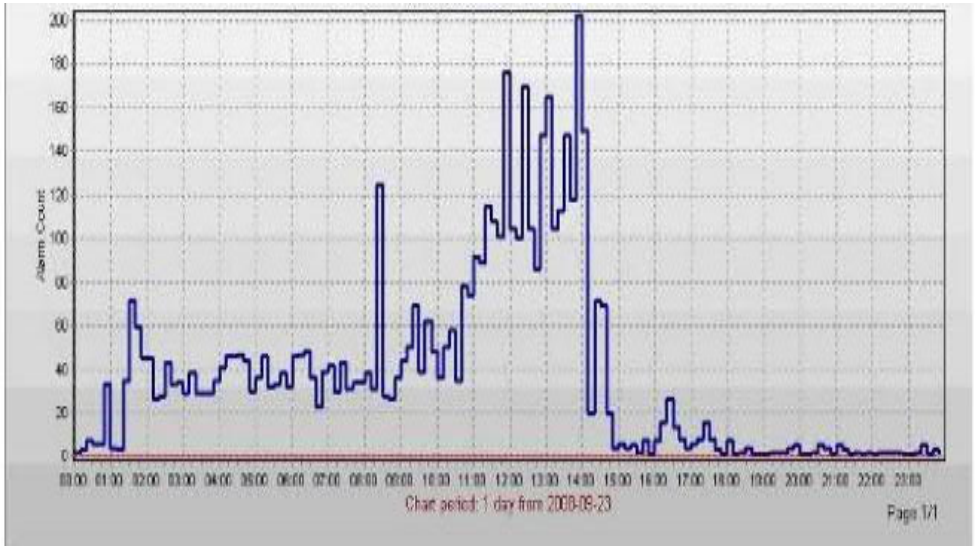
Operational Procedures

IEC 62682 Requirement

- As part of the Alarm Management Lifecycle it is necessary to have supporting procedures, these should include the following:
  - Alarm Response Procedures
  - Alarm Test Procedures (HMA)
  - Alarm Change Request, for changes in alarm points, conditioning, taking out of service, etc.
  - Alarm shelving of nuisance alarms
  - Shift Handover
  - Inhibiting / Suppressing / Overriding Alarm

Examples of success

Power generation, United Kingdom

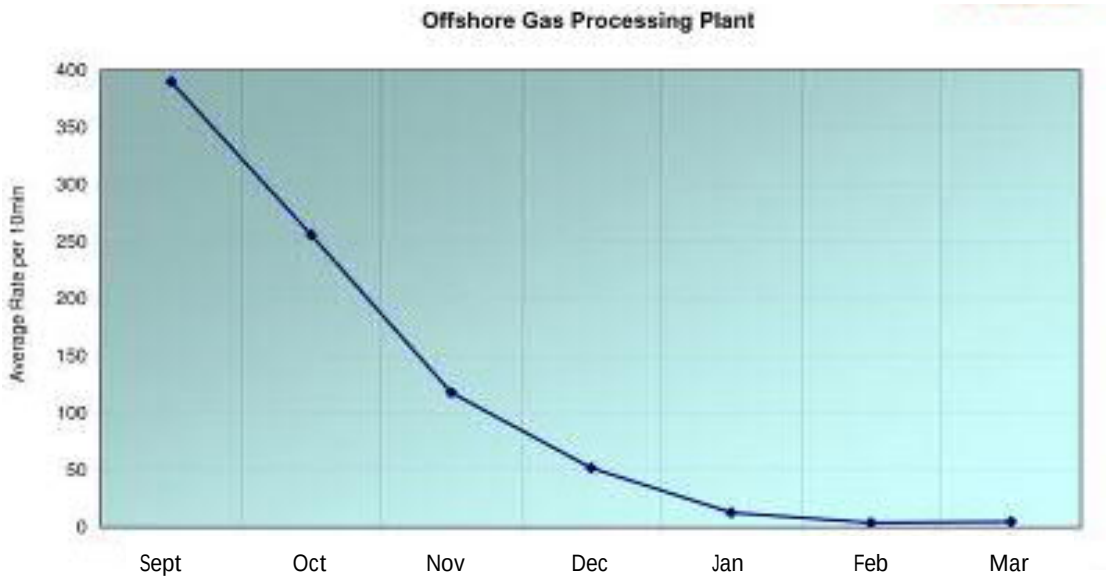


Sudden alarm rate reduction when DCS was bulk updated with new alarm design from alarm Rationalisation

Problem	▪ Operators missing key alarms ▪ Safety compromised
Solution	▪ Alarm system redesign and Rationalisation ▪ Chaired by ABB consulting ▪ Bulk update of DCS controllers
Benefits	▪ Alarm rates significantly reduced ▪ Operators able to proactively identify and prevent problems from escalating ▪ Improved plant uptime ▪ Improved focus on safety

Examples of success

Gas processing, Egypt



Alarm rate reduction over time

Problem

- Too many alarms / safety issue
- Numerous plant shutdowns led to lost production

Solution

- ABB led alarm diagnosis, alarm Rationalisation and implementation of new design

Benefits

- Alarm rates reduced
  - 400 → 8 alarms/10 min
- Improved plant uptime
  - From 25 → 6 shutdowns/yr
- Higher production per year
  - Estimated USD 2M/yr

Alarm Management Benefits

- Bransby & Jenkinson
  - “Plant surveys showed that incidents were frequent with typical costs ranging from $100K to well in excess of $1M per year
  - For example, one plant surveyed had 240 shutdowns per year at a total cost of $8M. Many of these shutdowns were preventable
  - It was found that refineries on average suffer a major incident once every three years costing on average $80M
  - One insurance company’s statistics showed that the industry was claiming on average over $2.2Bn per year due to equipment damage. It is likely that actual total losses to the companies would be significantly higher than what was claimable”.
- Abnormal Situations Management (ASM) Consortium
  - Poor abnormal situation management was costing companies between 3% to 8% in lost productivity, a significant amount is attributed to ineffective Alarm Management

Summary

Poor Alarm Management continues to be a significant contributor to major accident events

Compliance with the Alarm Management legislation and standards is an expectation of the Regulatory Authorities

Alarms are everywhere, can be too easily added and all too often are part of an “out of the box” solution.

Most of the systems we see are Reactive at best and often Overloaded

Alarm Management is a Lifecycle process, not something you do once

Good alarm Management can deliver real benefits.

- Better response from your operators (and less stress for them!)
- Fewer unplanned shutdowns and faster recovery when they occur
- Quality and Efficiency improvements
- A well run Alarm Rationalisation project can capture and retain vital operational knowledge from what might be an aging workforce.

ABB & Alarm Management Update

ABB Alarm Kickstart Initiative

- Rapid intervention to help with justification for Alarm System improvements
- Data Analysis and Performance Benchmark Report based on 1 to 3 months of alarm data
- Recommendations for key improvement actions.

For further information contact: alan.dambrogio@gb.abb.com

Upcoming Alarm Management Training

- IChemE accredited 3 day Alarm Management Practitioners Course
  - New revised modular structure:
  - Day 1 – Alarm Management Essentials (Virtual Course 16th June)
  - Day 2 – Application of Alarm Management (Virtual Course 14th July)
  - Day 3 – Advanced Alarm Management (no virtual date as yet)
  - Full 3 day Course (face to face delivery) 12th to 14th October, Edinburgh

Course details available from:

https://new.abb.com/uk/about/our-businesses/process-automation/consulting/training-events

QUESTIONS?

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