

Alarm Management: EPRI Survey on the State of Technology

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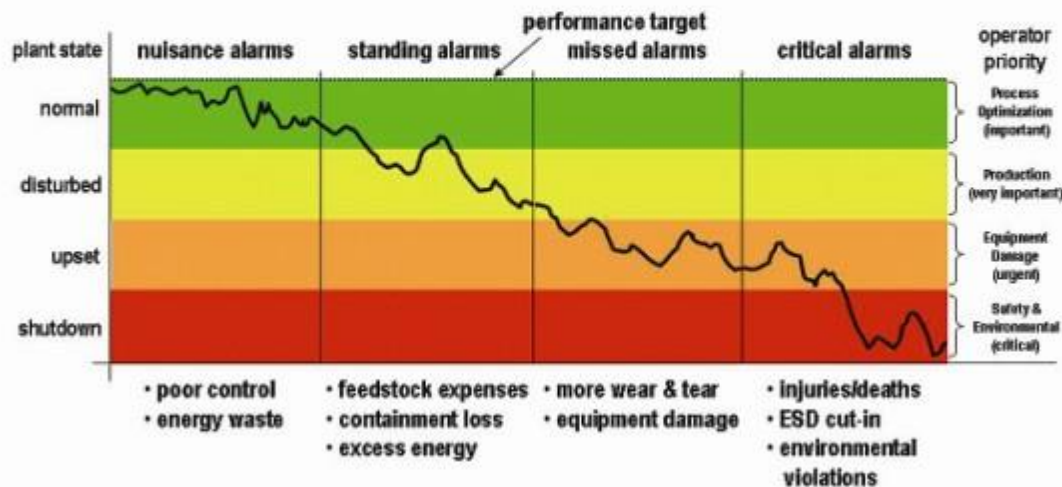


General Alarm Management Background

Alarm Management is critical to safe and reliable grid operation

Cost of Poor Alarm Management

Operator's job: keep process running at optimal



Application Areas

- Electric Power Industry
- Process Industries
- Transportation

EPRI 2014 Alarm Management Project

EPRI Members: Increasing number of Alarms becoming a challenge

EPRI Response: Industry survey and White Paper

Industry Survey

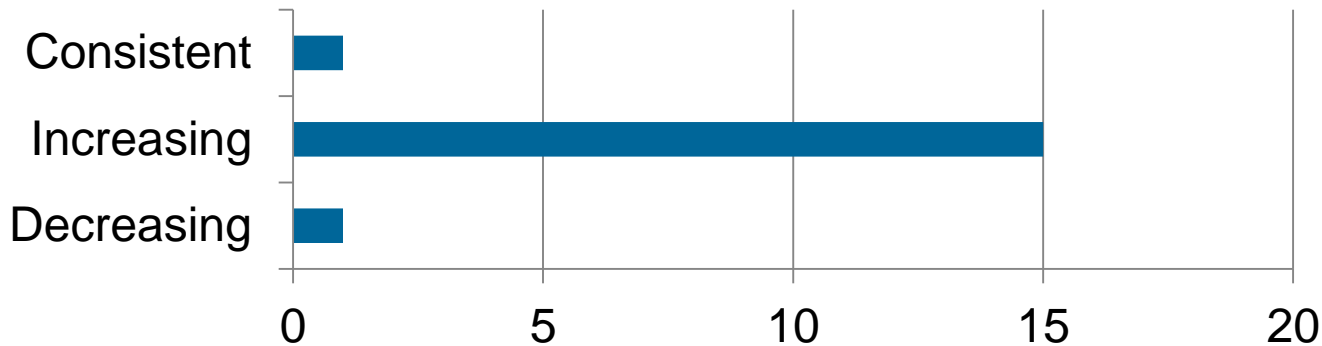
- Results from 17 system operators, 5 Vendors
- Guidance from NERC, PJM, ISO-NE, ERCOT

Whitepaper Goals

- Identify needs & existing capabilities
- Determine gaps for demonstration and further R&D

Survey Highlight: Alarm Quantity

Trend for Number of Alarms in Control Center



Increasing number of alarms from:

- Protection and control devices
- New equipment and substation sensors
- New analysis systems

Example EEMUA 191 Guidance: Benchmark for Assessing Alarm Rates

Long-term Avg. Normal Operations

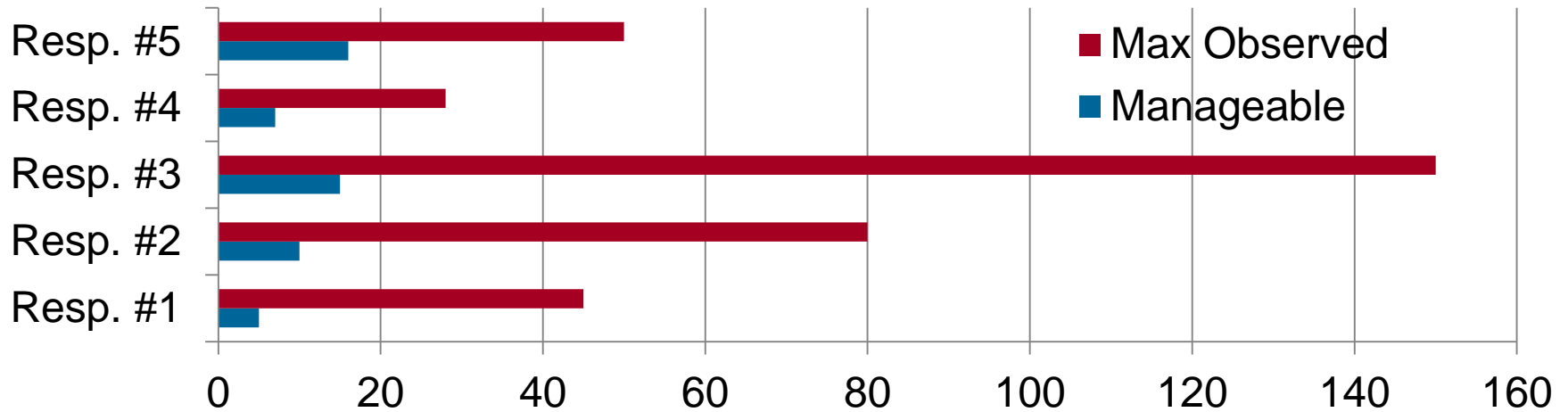
| Long term average alarm rate in steady operation | Acceptability |
|--------------------------------------------------|-----------------------------------------------------------------|
| More than one per minute | Very likely to be unacceptable |
| One per 2 minutes | Likely to be over-demanding (industry average in HSE survey) |
| One per 5 minutes | Manageable |
| Less than one per 10 minutes | Very likely to be acceptable |

Alarms/10 min After Disturbance

| Number of alarms displayed in 10 minutes following a major plant upset. | Acceptability |
|-------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|
| More than 100 | Definitely excessive and very likely to lead to the operator abandoning use of the system |
| 20 – 100 | Hard to cope with |
| Under 10 | Should be manageable – but may be difficult if several of the alarms require a complex operator response. |

Survey Trends: Alarming Rate

Average operator alarms per 15 minute period



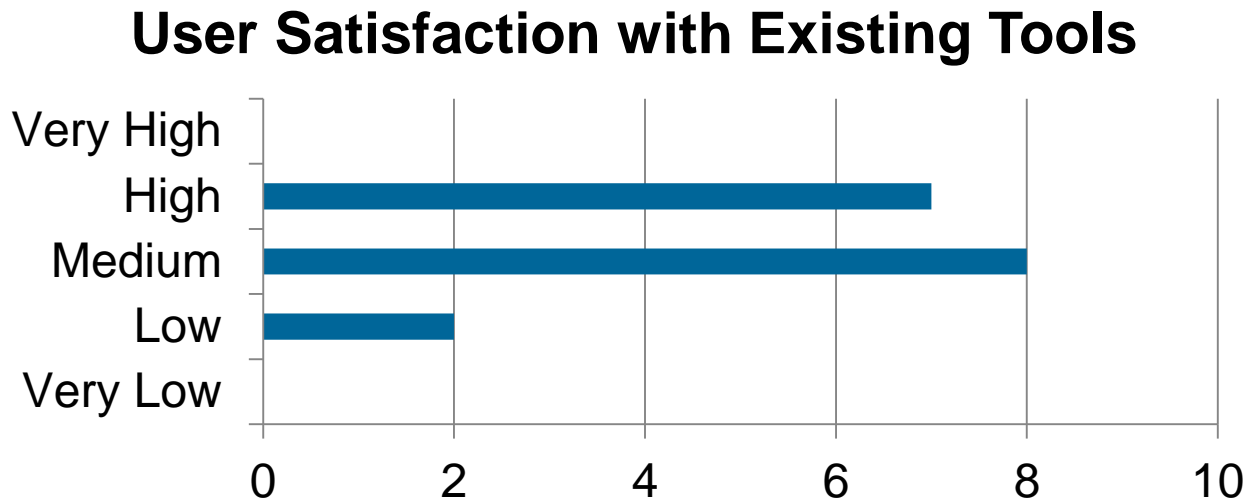
| | EEMUA | Oil & Gas | PetroChem | Power | Other |
|-------------------------------|-------|-----------|-----------|-------|-------|
| Average Alarms per Day | 144 | 1200 | 1500 | 2000 | 900 |
| Average Standing Alarms | 9 | 50 | 100 | 65 | 35 |
| Peak Alarms per 10 Minutes | 10 | 220 | 180 | 350 | 180 |
| Average Alarms per 10 Minutes | 1 | 6 | 9 | 8 | 5 |

Significant difference between guidelines and practice.

Are guidelines wrong or could alarms be managed better?

Source: Matrikon
Benchmarking & Assessment of 39 Plants

Survey Highlight: Existing Tools



All respondents noted that Enhancements are Needed

- More flexible and dynamic alarm filtering and grouping
- Permit users to develop both custom and more intelligent alarms

Survey Gap Analysis: Vendor Capabilities

5 EMS Vendor Responses

Alarm Management Product Features

- 4 had manual prioritization/investigation
- 4 had automatic allocation by assigned roles
- 4 had automated filtering
- 4 had automated intelligence

Products appear to provide everything users want

Survey Gap Analysis: Technical Gaps

Advanced filtering and grouping desired by EMS users

But... vendors report that these features are already available

From follow-up discussions higher order functions seem to be missing

- Better handling of nuisance alarms
- Fast and flexible **user reconfiguration**
- Most configuration performed by EMS engineer, but operators desire the functionality
- Dynamically prioritize alarms based on current system conditions
- Automated root cause analysis
- Linking between complex alarms and operator actions

Long term needs

- Improve alarm definition, both in grouping and text
- Faster processing and automated analysis of very complex situations
- Reduction in alarm rate, especially during disturbances

Some “free” ideas to consider...

Use guidelines from other industries – oil, pharmaceutical, power generation

Better alarm practices

- Take advantage of longer text strings
- Be more informative and make alarm actionable

Analyze existing alarms

- Deal with nuisance alarms – chattering/broken sensors/incorrect limits
- Regularly analyze top 10 most frequent alarms. Fix problems.
- Use EMS migration/upgrade as an opportunity to rationalize alarms?

Guidelines suggest operators can only effectively manage a few alarms:

- One alarm every five minutes under normal conditions?
- Ten alarms in ten minutes during a disturbance?
- Observe how your operators react to different alarms
- Analyze some historical events to identify alarm philosophy improvements

Survey Conclusions

Alarm management differs between system operators

- Some take many information alarms – possible alarm management issues
- Some just take critical alarms – possible situational awareness challenges
- Room for improvement of alarm text and prioritization

Consistent user opinion new alarm management interfaces are needed

Three broad alarm types:

- Actionable: operator should take action in response to the alarm
- Information: alarm may benefit situational awareness, but is not actionable
- Nuisance: negligible value, clutters alarm viewer

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Many control rooms regularly exceed the maximum guideline alarm rate

- Is this a problem?
- Would the operator perform better with less alarms or just more effective alarms?

