A solution for executing alarm management improvement projects based on industrial best practice

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Agenda

- Abnormal Situations - Background
- PAS Experience
- Alarm Management Performance Benchmarking
  - Performance Metrics
  - Performance Levels
- Alarm Management Improvement Planning
  - Performance Goal Selection Criteria
  - Performance Level Prescriptive Improvement Actions
- Conclusions
- Workshop Statements
Process Plants now embrace advanced control and optimization as a standard practice

Process Plants continue to increase operating runtimes between routine maintenance inspections and repairs as a standard practice

– consistently driving production assets to their limits for maximum profit generation and ROA performance

A single unplanned production outage eliminates all of the profits from advanced control and increased runtimes

Process Plants are ready to embrace Asset Reliability Improvement Solutions as a standard practice

– ready for new solutions to increase asset reliability for maximum profit generation and ROA performance
**FACT:** A single unscheduled shutdown can wipe out all the benefits realized from APC and Optimization!
Abnormal Situations – Costs, Challenges, & Opportunities

$20 Billion lost to Abnormal Situations annually
- Loss of production, equipment and life
- Off-spec/Scrap Product
- Environmental Excursions

Challenges
- Consolidation & Centralization
- Complexity & Coupling of Automation
- Operator Loading
- Extended Equipment Runtimes

Recognized as a business improvement opportunity
- Corporate-wide initiatives by industry leaders
- Abnormal Situation Management™ (ASM) Consortium
- Engineering Equipment and Materials Users Assoc. (EEMUA)
- Process Industries Safety Management (PRISM)
Layers of Protection

Untapped Areas of Major Opportunity

Safety Shutdown
Process Shutdown Point
Equipment Damage Prevention

Emergency Notification
Incident
Limits of Operability Point
Safety, Health & Environmental Protection
Abnormal Situation Management as a Best Practice

Safety Management Best Practice

ASM Best Practice

- Fatality
- Lost Time Injury
- Total Recordable Incidents
- First Aids & Near Misses

- Major Incident
- Equip. Damage
- Environmental Excursion
- Process Upsets
- Production Loss
- Operator Intervention Events
PAS’s vision is to become the leading supplier of People and Asset Solutions™ to the process industries worldwide.

Mission

PAS’s mission is to provide solutions to our customers that increase asset utilization and financial returns enabling them to gain competitive advantage in the global economy.
PAS has completed alarm management improvement projects on more than 70 different process units. The following is a sample listing of some of our project customers.

Celanese Chemical Company
Shell & DEA
Grace Manufacturing
BP Chemical
Chevron Phillips Chemical Company
Akzo Nobel
Conoco
DSM
Huntsman
Motor Oil
Dow

With alarm management software installed at over 100 different sites in all regions of the world, our software is the most widely used alarm management improvement utility for improving alarm management systems.
Software Products For Improving Plant Reliability

**Integrity.MOC**
- Level 1 Asset Models
  - Field Instrument System
- Level 2 Asset Models
  - DCS/PLC/SIS/APC/Historian
- Asset Explorer
  - Browse/Query Objects & Prop.
- Integrity Manager
  - Integrity Checking
- Relationship Viewer
  - Control Maps, Loop Sheets, Logic Drawings
- Maintenance Manager
  - MOC, Work Order Initiation, Configuration Mgmt
- Report Writer
  - Custom Report Generator
- Level 3 Integration
  - CMMS, Fixed Assets
- DOC3000
  - Honeywell TPS
    - System Management

**PlantState Suite**
- Engineering Studio
  - Configuration Engineering
- Alarm Configuration Enforcer
  - Master Alarm Database Auditing & Enforcement, MOC
- State Manager
  - Dynamic State & Transition Mgmt.
- TuneWizard & ControlWizard
  - Control Loop Performance & Disturbance Rejection Analysis
- EquipmentWizard
  - Condition Monitoring
    - Performance Analysis
- Abnormal Situation Analyzer
  - & Performance Metrics
    - Root Cause & Performance Analyses & Metrics
- Abnormal Situation Advisor
  - Fault Detection, Diagnostics, & Critical Corrective Actions
- AMO Suite/Plus
  - Foundation
    - Critical Condition Mgmt.

**DOT Products**
- Star Controller
  - Adaptive Multivariable Controller
- Nova Optimizer
  - Rigorous Equation Based Optimization & Modeling System
- NLC
  - Non-Linear Rigorous Equation Model Based Control
- Galaxy
  - Integrated Multivariable Control & Optimization with Adaptive Technology
Solution Services for Improving Plant Reliability

**Plant Reliability Improvement**

**Define**

**Measure**

**Analyze**

**Improve**

**Control**

- **DCS Systems Engineering**
  - Operator Interface, Regulatory Control, Database Configuration, System Support Services

- **Safety Instrumented Systems Engineering**
  - Requirements Specification, Design, & Implementation

- **Advanced Process Modeling & Control**
  - APC, Optimization, & Regulatory Control Services

- **Operator Centered Services**
  - Operator Competency Models, Console Design & Consolidation, Ergonomic User Interface

- **Alarm Management**
  - Alarm Philosophy, Rationalization, Dynamic Alarm Management, Alarm Configuration Management

- **Dynamic State & Transition Management**
  - Dynamic State (Alarms, Models, Event Knowledge, and much more) & Transition Automation Services

- **Early Fault Detection & Diagnostics**
  - Process Fault Detection & Diagnostics Services

- **Critical Corrective Actions**
  - Procedural Automation Services

**6σ Results**
Why Benchmark Alarm Management?

Alarm management issues are pervasive throughout the process industries.

Recognized as a critical component of operator effectiveness by regulatory agencies.

Alarm management performance evaluation helps establish problem severity.

Existence of and proof of the effectiveness of solutions on the market.
What is Performance Benchmarking?

- Baseline assessment against established performance metrics
  - EEMUA 191 Performance Standards
  - PAS Best Practices

- Combination analysis to resolve overall performance to established levels
  - Overloaded
  - Reactive
  - Stable
  - Robust
  - Predictive

PAS Body of Knowledge derived from projects empirical data and EEMUA 191 Performance Standards
**Alarm Benchmark sources**
Public data from Associations (EEMUA), Consortiums (ASM)
PAS has an extensive Body of Knowledge in Alarm Management

**Quantifying Criteria**
Combination of several metrics allows identification of alarm system performance/maturity levels

**This is not the entire story**
Considerations outside the alarm system may be strong contributors
- Operator Competency
- Operating Environment
- Operator Loading
- Other
Alarm Management Performance Levels

- **Overloaded**
  - Alarm system is difficult to use during normal operation and in practice ignored during plant upset as it becomes unusable.

- **Reactive**
  - Alarm system is more stable and useful during normal operation, but is often unusable in practice during plant upsets.

- **Stable**
  - Alarm system is well defined for normal operation, but less useful during plant upsets with improvements in both the average alarm and peak alarm rates as compared to reactive.

- **Robust**
  - Alarm system is reliable during all plant modes, including normal operation and plant upsets.

- **Predictive**
  - Alarm system is stable at all times and provides the operator with the right information at the right time to avoid process upset or minimize the impact of any upset that does occur.
Critical to Quality (CTQ) Tree

Business Goal

"Reduce Alarm Frequency"

Critical to Quality (CTQ)

Metric

Target

Average Number of Alarms Per Hour

Benchmark

"Reduce Incident Risk Due to Operator Overload From Alarms"

Critical to Quality (CTQ)

Metric

Target

Maximum Number of Alarms Per Hour

Benchmark

"Reduce Alarm Floods"

Critical to Quality (CTQ)

Metric

Target

% of Time Alarm Rate Exceeds Threshold

Benchmark

"Reduce the Time the Alarm System is Overloaded"

Critical to Quality (CTQ)

Metric

Target

CTQs are the translation of business goals into quantified requirements
Key Performance Metrics

- **Primary Metrics**
  - **Alarm Frequency**: Average Number of Alarms per Hour
  - **Alarm Flood**: Maximum Number of Alarms per Hour
  - **System Overload**: % of Time Exceeding Threshold Alarm Rate

- **Secondary Metrics**
  - Number of Stale Alarms Longer Than Threshold Duration
  - Number of Disabled Alarms Longer Than Threshold Duration
  - Actual Alarms by Priority Distribution %
Project Data to Performance Metrics

**Alarm Frequency**

- Customer Project
- Alarm Floods

**System Overload**

- Customer Project

**Performance Metrics**

- Predictive
- Robust
- Stable
- Reactive
- Overloaded
What is an Alarm Management Improvement Plan?

- Prescriptive plan of action to improve the performance of an alarm management system
  - EEMUA 191 Performance Standards
  - PAS Best Practices

- Work Process Methodology to Deliver Consistent Results
  - Define
  - Measure
  - Analyze
  - Improve
  - Control
Six Sigma Work Process

**Define**
- Identify Project
- Identify Team
- Determine Customer Requirements
- Project Charter
- Develop Current Process Map
- Determine Desired Performance Level

**Measure**
- Establish Metrics and KPI's
- Develop Operational Definitions
- Data Collection Plan
- Collect Data

**Analyze**
- Establish Baseline Performance
- Conduct Problems Root Causal Analyses
- Analyze Process Map
- Determine Solution Alternatives
- Conduct Risk Analysis
- Develop Solution High Level Design

**Improve**
- Develop Solution Detail Design
- Develop Solution Implementation
- Confirm Implementation

**Control**
- Determine Needed Controls
- Implement Controls
- Validate Controls
- Develop Transfer Plan - Process Owner
- Realize Benefits - Post Assessment Audit
- Close Project & Communicate Results
Performance Level Selection Considerations

- Overall operator loading including collaboration with field operations, maintenance, and other activities
- Consequences of failure to act & required response time
- Complexity and interactive nature of process units – what is the collateral/tangential disturbance propagation impact?
- Peak loading scenarios with realistic probability of occurrence (e.g., start-up, disturbances, transitions, failures, etc.)
- Criticality of this specific plant operations in the context of overall site operations
Example – Part of an Improvement Plan

Alarm System Documentation and Rationalization

- Rationalize Alarm System Configuration to comply with Standards in Philosophy (priorities, operator actions, time to respond, etc.)
- Document Alarms (Trip Points, Causes, Consequences, Corrective Actions)

Plant Experience & Knowledge
Process, Equipment, Operations, Procedures
- Board Operators
- Process & Control Engineers
- Safety, Health, Environmental
- Production & Maintenance Engineers
Example – Part of an Improvement Plan

Alarm Rationalization Results at a Polyethylene Unit

Number of Alarms per Day

- All Alarms
- Enabled Alarms

Alarm Setting Implementation Period

January 1 to March 31, 2003 (excluding 3/7 to 3/10)
Conclusions

- Alarm Management benefits are real and substantial.
- There is a prescriptive plan of actions available to move your alarm management performance to an improved desired level.
- Selection of a desired performance level must consider a variety of related factors. An external solutions provider can help establish the right performance level for you to consider in your project plan.
- The Six Sigma DMAIC process will provide a systematic methodology for sustainable improvement. PAS has found that this methodology is most effective in transferring technology to retain the original benefits of the project long after execution is complete.
"In undertaking an alarm improvement project do not always aim for the top level of performance."

"Human error has been classified as the number one cause of abnormal situations in processing plants (above equipment failure and above process related causes). Is the design of today's DCS alarm systems helping to alleviate this issue or is it encouraging it?"