A SAFE PLANT WHERE OPERATORS ARE NOT OVERWHELMED BY ALARMS - IS THAT POSSIBLE?

Michel Ruel P.E.
President , Top Control Inc.
mruel@topcontrol.com
49, Bel-Air, suite 103 Lévis, Qc
G6V 6K9 Canada

Michael Marvan P.E. (Alberta)
Senior Applications Engineer, Matrikon Inc.
michael.marvan@matrikon.com
#1800, 10405 Jasper Avenue
Edmonton, AB T5J 3N4 Canada

ABSTRACT

This paper provides an overview of how facilities can leverage their investment in alarm management technology for obtaining a maximum benefit for productivity and safety.

The paper will explore the elements that make the best business sense for meeting each facility's goals while fully leveraging the lessons learned within the appropriate industry.

Maximizing the potential of alarm management technology will produce an alarm management model that improves operational performance while meeting regulatory compliance and safety standards.

KEYWORDS

Alarm management, benchmark, audit, assessment, alarm rationalization, performance monitoring, asset management, distributed control system, abnormal situation management

INTRODUCTION

Alarm Management is not simply about the reduction of alarms. It is about improving plant safety by helping operators take timely intervention. This requires getting the right information to the operator at the right time. With this misconception dispelled, let's clear the air on Alarm Management and get the facts straight.

WHAT IS ALARM MANAGEMENT?

Description

Alarm Management is the set of processes and practices for determining, documenting, designing, monitoring, and maintaining alarm systems. It is not a software package you can purchase from a vendor regardless of feature count. Software packages are designed to reduce the work load when adopting an Alarm Management lifecycle. They are simply tools to help execute an Alarm Management strategy.

What is the problem?

The Alarm Management problem stems from poor configuration practices during control system integration. In the 1960's and 70's, alarms were difficult and expensive to add. Each alarm needed a physical wire from the field device to a dedicated light on the control console. Consequently, careful thought went in to each configured alarm. With the advent of the Distributed Control System (DCS), alarms became "free" to add. With an abundance of alarms available for each tag, the general practice became to add alarms rather than exclude them. This practice lead to both an excess of alarms and improperly prioritized alarms.

Why Alarm Management?

The alarm system is the primary tool for identifying abnormal operations and helping plant personnel take timely, appropriate action to move the process back to operational targets. Effective alarm systems create effective operators; ineffective alarm systems pose a serious risk to safety, the environment, and plant profitability.

ALARM MANAGEMENT METHODOLOGY

The overall structure of a successful alarm management project is fundamentally the same across industries, regardless of plant size:

1. Benchmark & Evaluate Current Performance. This is also the time to identify your biggest alarm system problems and your biggest opportunities for improvement
2. Develop an Alarm Philosophy Document: this document clearly outlines key concepts and governing rules (what constitutes an alarm, risk categorization, etc.), alarm priorities, alarm management roles and responsibilities, change management procedures, and project goals
3. Alarm Rationalization: Target and eliminate the top 20 to 30 bad actors to significantly impact alarm levels, and perform a complete alarm system configuration review
4. Implementation: Control system re-configuration to minimize nuisance alarms and give operators useful information to solve problems in a timely manner
5. Continuous Improvement: Long-term performance monitoring to identify new opportunities to improve
6. Maintenance: Integrate alarm management practices into plant workflow at various levels, including operations, engineering, maintenance, and management

The checklist of successful alarm management practices and the corresponding mistakes that should be avoided will follow the same alarm management project path.

THE VALUE OF BENCHMARKING

If you don't know where you stand, then how can you know where to step? Benchmarking is the first and most critical step in any alarm management project, yet some plants attempt to improve their alarm systems without taking stock of what they're trying to improve.

Benchmarking's triple role

Benchmarking plays a triple role in a successful alarm management project. First, it's essential to assess your current performance so that you can set realistic performance targets.

Second, by doing a benchmarking assessment, you can identify key opportunities for improvement and key pain points that need to be addressed. Finally, benchmarking makes it possible to measure the success of your project by providing a baseline for comparison as you solve the problems.

WHY CREATE AN ALARM PHILOSOPHY DOCUMENT?

When benchmarking is complete, you can begin to identify where you want your alarm management project to take you. The alarm philosophy document outlines key alarm management concepts, goals, and roles and responsibilities of the personnel involved in the project.

Corporate standards

Although most plants take the time to identify their alarm management goals, some neglect this important step. In order to get consistent results you have to create guidelines for performing alarm rationalization. These should clearly define the criteria you use to identify legitimate alarms (as opposed to messages that don't require operator intervention) and the criteria used to set alarm priorities. These guidelines will help direct your organization's alarm management efforts.

Roles and responsibilities

The Alarm Philosophy document plays a critical role by identifying who is responsible for each phase of the alarm management project and who is responsible for maintaining the improvements made. Failing to specify these roles and responsibilities is the single most common mistake that plants make, and it's the single most important step you can take to ensure you reap the benefits of an alarm management program and sustain them over time.

Our experience has shown that it's best to list the maintenance and continuous improvement tasks at an early stage in the project and assign them to plant personnel prior to project completion. This will give personnel the longest learning period possible and the opportunity to pose a lot of questions to the Alarm Management service providers while they are still readily available during project execution.

ALARM RATIONALIZATION CHALLENGES

Once you have created your Alarm Philosophy document, you can start rationalizing your alarm system. The rationalization stage includes prioritization of alarms, validation of alarm parameters, evaluation of alarm organization and functionality, evaluation of field equipment and process design, and documentation for the purpose of assessment, improvement, and regulatory compliance.

Start with the low hanging fruit

Alarm rationalization can be a time consuming exercise. Rather than waiting months to finish before yielding benefits, your return on investment can be maximized by taking a two pass approach to alarm rationalization. First, identify and resolve obvious bad actors within the alarm system. Frequent alarms can be easily identified by using an alarm and event historian to collect, store, and analyze alarms from the control systems.

Once your alarm load is improved, rationalize the remaining control system using a systematic and comprehensive approach.

Separate suppressed alarms

Often frequent alarms are incorrectly identified. This happens because many control systems continue to send alarms to the journals even though the alarms are not audible. Be careful to select an alarm and event historian that distinguishes between audible and non-audible alarms. Naturally the audible alarms are more important and should be addressed first. Also, by separating this data from other alarm and event data, you provide a true picture of alarm system performance.

Don't forget the operator!

The panel operator is the end consumer of alarm optimization initiatives and must have input during the rationalization. The only person who can perform this role well is an experienced panel operator who is intimately familiar with the process area being reviewed and the problems that unit faces.

Note that it is also important to include an experienced meeting facilitator in the rationalization process. Without one, your project will take longer than it should, yield poor results, and ultimately will have to be redone. Results aside, a facilitator will keep the rationalization discussions focused and will push the alarm management team to meet deadlines.

MINIMIZING IMPLEMENTATION PROBLEMS

After rationalizing the alarm system, you're ready to make the necessary changes to improve your alarm performance. Implementation is the most critical phase of the alarm management process, and there are several things you can do to help ensure a successful project.

Get the right software

Alarm rationalization can become ineffective without good alarm and event archiving and analysis software. Similarly, without automated punch list generation (e.g. automatically comparing engineered values to their online counterparts), deployment will be time-consuming. Many vendors offer both alarm archiving and master alarm database tools that can provide the foundation for your alarm management initiatives. Be sure to research them thoroughly to make sure they meet your plant's needs. A couple key questions to ask your vendor include:

- Does the solution calculate alarm-related key performance indicators as outlined in EEMUA #191 for your alarm rates and configuration?
- Does the solution automate the management of change process and reconcile the DCS against the engineered alarm settings in the master alarm database?

Further, if operators don't have access to alarm causes and consequences then you'll only receive marginal benefits from your efforts. To maximize value, provide easy access to this information when DCS changes are brought online.

Stage implementation

Implementation should be a staged activity. Making implementation too complicated will only ensure that it never gets done. Recognizing this will help plant personnel break the execution strategy into easy and manageable steps. By making the strategy easier to implement, you allow operations to get accustomed to the changes gradually, thus increasing your chance of success. In general, the procedure is as follows:

1. Write alarm configuration changes for existing tags to the DCS
2. Create "smart alarm" applications, or other logic changes that are needed to take into account process state transitions or conditional settings
3. Remove alarms from the original points where they are now no longer necessary

Training

The benefits of effective training are obvious, but the issue is important so it needs to be mentioned. Alarm Management systems and procedures must be implemented and maintained by qualified personnel who understand the technology and the way in which it impacts life in the control room. Likewise, operators must understand each and every alarm they are expected to manage. This often introduces a necessary lag in the project timeline.

CONTINUOUS IMPROVEMENT AND MAINTENANCE

Continuous improvement initiatives are attempts to find new ways to reduce nuisance alarms and further optimize your alarm system. Maintenance initiatives aim to prevent losing the benefits you've already achieved. These final two phases of the alarm management methodology have the same fundamental requirements, and so we will discuss them together.

Integrated alarm management

First, successful continuous improvement and maintenance initiatives both require that plant personnel make alarm management practices a part of daily work processes.

Long term monitoring

An alarm and event monitoring solution is important both for continuous improvement initiatives and maintenance.

If left to their own devices (excuse the pun), control strategies gradually degrade. To combat this, continuous, long-term monitoring will help to quickly identify problems so that they can be fixed before they become serious. Additionally, tracking operator actions can lend to quick diagnosis of both loop problems (i.e. frequent mode and output changes) and automation opportunities (i.e. frequent set point changes – why is there no cascade master?).

Change management

The benefits of effective alarm management can be lost over time as incremental, untracked changes have a negative impact on alarm system performance. In most plants today, change management is a manual process, resulting in increased workload, inconsistencies, and errors that can derail long-term performance. The answer is a proper change management solution: a system that automates and enforces the change approval process.

ALARM MANAGEMENT WORK PROCESSES

Just generating results is not sufficient. To realize value from your alarm monitoring investment, the results generated must be acted upon. This requires the technology to interact with the plant workflow processes and be fully integrated with daily standard operating practices. Clear roles and responsibilities are usually defined in the Alarm Philosophy for every player:

- Plant/Operations Manager
- Operating Supervisors
- Engineers
- Maintenance Technician
- Panel Operator

DEFINED METRICS FOR TRACKING

An important item for the success of alarm management is to clearly define performance metrics. These can be broken down by their functional roles and should be monitored and integrated into standard plant reporting.

Plant Management (Monthly Reporting)

High-level reports consolidate facility alarms into an indication of plant operating stability and safety. Key Performance Indicators (KPI) can be used to identify whether the plant is running within or near industry guidelines such as those defined within EEMUA 191. A plant can be assigned to one of these performance grades based on a number of factors:

- Overloaded
- Reactive
- Stable
- Robust
- Predictive

The objective of the KPIs are to ensure that the business and safety objectives of the facility are not being compromised by alarm system performance and to identify areas that are compliant with the goals of the organization. These metrics are typically visible in the facility monthly reporting structure.

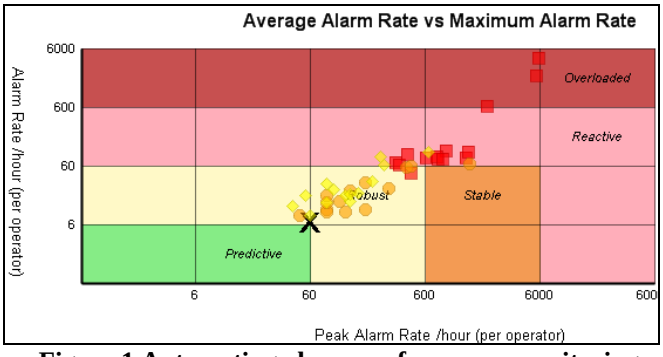

Figure 1 Automating alarm performance monitoring

Operating Supervisors (Weekly or Daily Reporting)

The role of the Operating Supervisor is to review alarm system performance on a daily or weekly basis, in an effort to

ensure that performance targets are met and that violations are related to actual operating problems.

The dynamic alarm system metrics most often tracked include:

Alarm metrics	Should be
Average Alarm Rate	< 6 /h/operator
Peak Alarm Rate	< 10 alarms in 10 min.
Percent Upset	< 1%
Standing Alarms	< 10 (on average)
Top 20 Alarm Percent	< 50% of total
Top 20 Action Percent	< 50% of total
Priority Distribution	High << Med << Low

Table 1 Alarm metrics

In addition, it is typically an operational function to ensure that suppressed alarms are reviewed and understood by the panel operator. Each suppressed alarm represents a measurable risk to facility safety and must be managed carefully. Any alarm that will not function should have interim measures put in place. Sometimes this requires simple short-term field checks whereas sometimes this mandates interim equipment measures be put in place.

Engineers (Monthly or Weekly Reporting)
The Engineer plays a key role in designing and sustaining any alarm management system.

The engineer typically tracks:

- Frequent alarms and interventions
- Discrepancies between the master alarm database (engineered settings) and the online alarm settings
- Changes made or requested to the alarm settings

PUTTING THEORY TO PRACTICE

Alarm Management need not always be deployed under the umbrella of "operational safety". Abitibi Consolidated's Fort Frances site implemented a variability reduction initiative with a focus on two aspects of asset optimization: control loop performance monitoring to improve ***process induced*** variability; and alarm optimization to reduce ***operator induced*** variable. The net goal was to drive operational improvement.

The Alarm Management problems at Fort Frances included: alarms being acknowledged without taking notice; Operator complaints concerning excessive nuisance alarms; confusing alarms; and – most importantly – incidents where important alarms were missed.

The approach taken was to install the necessary tools to collect and analyze data: Matrikon Alarm Manager and Matrikon Control Performance Manager. Sufficient data was collected to lend to meaningful analysis and a team was assigned including representation from operations, engineering, and a Matrikon facilitator.

Prior to the project, single frequent alarms occurred as often as 8,000 alarms per week and operators were receiving several alarms each minute. Following the revisions, "most frequent" alarms in a week peaked at 52 and the overall alarm load was reduced by approximately 80%. This is typical of an alarm improvement project.

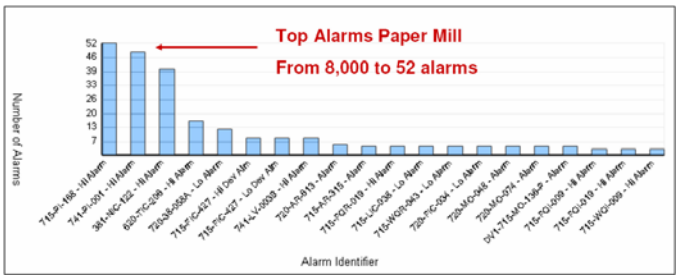

Figure 2 Top alarms at Fort Frances (post project)

CONCLUSION

Alarm management solutions can significantly improve plant safety, reliability, and profitability, but will only succeed if they are implemented and maintained by qualified personnel. If you follow the project methodology described then your alarm management project will have the greatest chance of success and yield a maximum return-on-investment.

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ABOUT THE AUTHORS:

Michel is a registered professional engineer, university lecturer, and author of several books and publications on instrumentation and control. He is the president of Top Control Inc. Michel has over 30 years of plant experience. He is experienced in solving unusual process control problems and is also a pioneer in the implementation of fuzzy logic in process control.

Michel is a member of ISA, O.I.Q., I.E.E.E., TAPPI, and P.E.O.

Michel Ruel, P.E. President TOP Control Inc.

mruel@topcontrol.com

Michael (Mik) Marvan is a Senior Applications Engineer with Matrikon in Edmonton, Alberta. He is a voting member of the ISA SP18.02 committee (future Alarm Management standard). Mik began his alarm management experience with NOVA Chemicals in 1998 and joined Matrikon in 2002. He has a strong background in Distributed Control Systems, Advanced Process Control, and executing alarm management projects.

Michael Marvan, P.E. (Alberta), Senior Applications Engineer, Matrikon Inc.

michael.marvan@matrikon.com