

NO CAUSE FOR ALARM



STEVE ELWART, ERGON REFINING, INC., USA, EXPLAINS HOW ALARM MANAGEMENT WITH MINIMAL UP FRONT CUSTOMISATION YIELDED PROCESS IMPROVEMENTS AT ERGON'S VICKSBURG REFINERY.

Ergon's Vicksburg refinery, Mississippi, USA, has grown to be among the largest manufacturers of naphthenic process oil in the world, with a crude processing capacity of up to 23 000 bpd. These naphthenic oils are used primarily as a petrochemical feedstock in the manufacture of tires, metal working fluids, greases, industrial lubricants, printing inks, transformer fluids and other products.

Currently, the Vicksburg refinery is controlled by two automation systems, an older distributed control system (DCS) that is approximately 20 years old, and a newer Emerson DeltaV control system that was installed in 2008 when the refinery went through an expansion.

The Ergon refinery alarm management philosophy and practices were not serving operators well, so a decision was made to deploy new tools. The refinery opted to integrate this into its new system to streamline its operation. Like many process plant alarm systems, this refinery produced a large number of alarms on a regular basis, even during steady state operation. When process upsets occurred, alarm flooding was an issue, often causing operator confusion and delays in response. There were also other issues related to alarm management, including:

- False alarms that did not indicate actual process problems.
- Alarm flooding upon process upsets.
- Excessive unresolved alarm issues.
- Alarm issues not prioritised.
- Lack of operator confidence in alarm information.

A solution was needed that would meet several goals. The first aim was to eliminate nuisance alarms: conditions that were often within the bounds of normal operation but were erroneously being flagged as problems. Second, group and prioritise alarms in order to create actionable items and facilitate quick operator response. Third, a solution was needed that would not consume an excessive amount of plant personnel man hours, both in implementation and ongoing operation.

The expectation was that analysing alarms would also lead to process improvements, so refinery personnel were eager to implement a solution.

Searching for a solution

The initial thought was to manage alarms in a manual fashion. This meant looking at each alarm in detail and determining whether that alarm was a valid condition requiring response. It also required examination of alarms and determination of interrelationships in order to establish logical groupings. These manual efforts were overwhelming for plant staff, so the next step was to investigate alarm management software that would automate these tasks.

The first alarm management system evaluated appeared to be very capable, and the vendor was able to show refinery personnel where the system had succeeded in process plants similar to the Vicksburg refinery. Yet upon more detailed review, it was determined that the system would require excessive man hours for analysing the data and building the custom reports needed, making it infeasible.

Emerson Process Management, the supplier of the newer DCS, had recently introduced a new alarm management software system called DeltaV Analyze. Emerson's other software products associated with the DCS performed well, so there was an evaluation of this new product with the expectation of a significant advance over the existing alarm management solution. Specifically, the software was touted as being easy to implement and maintain, a necessary feature for Ergon.

As at many process plants, the main task for Ergon's automation professionals is to keep the facility up and running, as opposed to spending inordinate amounts of time implementing and maintaining new solutions. In Ergon's experience, many automation vendors propose solutions in alarm management and other process improvement areas that

provide benefits in theory, but in practice cannot be implemented with existing staff.

The alternative is to hire outside consultants for implementation, but this requires substantial commitment of time to identify and manage the consultants, and does nothing to solve the problem of maintaining these solutions over time. Continuous improvements are required for optimal operation, and it is very difficult to continually modify and improve solutions designed and installed by others.

Minimising the time required for plant personnel to implement and operate the alarm management system would be a key to success, and these time requirements would be primarily dependent on two factors. First, the alarm management software had to be easy to install and operate. Second, the software had to integrate with existing automation system with minimal effort. The Analyze product seemed to address both these issues, particularly the integration issue with respect to interface with the DeltaV automation system.

In the past, excessive man hours had been spent integrating various automation products that supposedly were completely open and compatible, so integrating an alarm management system with the DeltaV from a vendor other than Emerson was a situation to be avoided if possible.

Besides easy integration, the Analyze software claimed to provide alarm performance information that would help pinpoint excessive alarming. The software is based on the ISA S18 and EEMUA 191 alarm metric standards to simplify alarm analysis, and in theory this would allow the quick spotting of areas and modules having the most alarms in a given time period. This would be accomplished by linking Analyze to embedded historical alarms and events.

The evaluation process showed that Analyze fitted Ergon's needs, and success with the DeltaV system in terms of performance and ease of use results confirmed Analyze was the best choice for alarm management. The next step was implementation, closely followed by evaluation of results.

Installation and configuration

Analyze and Microsoft Office were installed on the existing DeltaV ProPlus Station, meaning that it was not necessary to purchase and integrate a separate PC. This allowed the software to immediately begin gathering information from the existing DeltaV Event Chronicle database.

The software package has a documented installation procedure which takes very little time. The heart of Analyze is the event chronicle data, which is readily available from the DeltaV automation system. On most installations, including Ergon's, there is actually nothing at all to configure as the system automatically starts analysing data after installation.

John H. Carter Company, Emerson's local business partner, performed a number of services to the project, the most significant of which was the addition of a software 'button' at each DeltaV operator station. This button gave each operator access to all the alarm reports, and also allowed each operator to view other alarm information in various formats of their choosing. This feature was extremely important to successful implementation as it helped to reinforce with the operators that Analyze was going to be tool to help them, and not a club for management to wield.

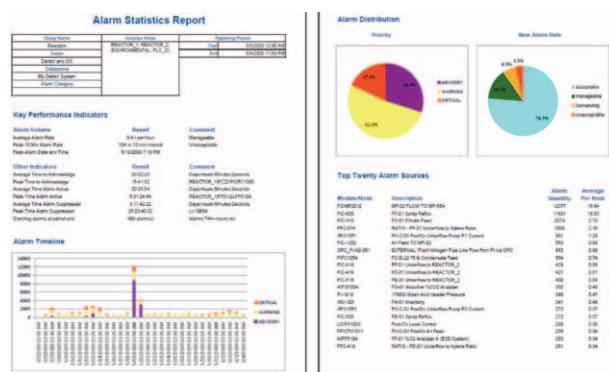


Figure 1. This standard preformatted Excel alarm distribution report shows the top twenty alarm sources along with other related information.

Once Analyze was installed, the built in access functionality was utilised to allow viewing of standard preformatted Excel reports at existing DeltaV stations, and via web browser as Analyze makes use of Microsoft's built in web server functionality. The web server/browser feature meant that no additional software had to be installed on various PCs to enable remote access, a significant time saver up front and on an ongoing basis.

All of the required reports were provided out of the box, and custom reports were available using the software's built in configuration tools. Time and money savings came from not having to buy a new PC, from having report generation software built in, and from avoiding the integration effort that would have been required to interface new report generation software to Analyze.

Although Emerson personnel were available to assist with the installation, Ergon's in house staff were able to perform most of the installation tasks without outside help. This was very important, as experience has shown that it is much easier to support a system when in house people are able to perform the initial installation and configuration.

Once the software was installed and configured, the next step was to view the standard reports and determine remedial actions.

Standard reports, custom results

The first step was to examine the overview page, a report screen that graphically depicts alarm information including active alarms, user actions in response to these alarms, and total events. The overview also shows alarms grouped by area, and all information is presented over time so that trends can be identified.

Like the overview page, the alarm statistics page is a standard report that reveals a wealth of detailed information about the current state of the alarm management system including average alarm rate, peak 10 minute alarm rate, and peak alarm activity date and time. This page also shows average time to acknowledge, peak time to acknowledge and other system wide alarm data.

While the overview page and the alarm statistics page showed overall alarm system information and provided a good baseline, Ergon needed more specifics in order to take



Figure 2. The Vicksburg refinery has grown to be among the largest manufacturers of naphthenic process oil in the world, necessitating efficient alarm management.

corrective action. The alarm distribution page (another standard screen) was utilised to gather that information. This page showed the top 20 alarms in total quantity and average per hour, immediately revealing problematic areas.

For example, one transmitter was generating approximately 100 alarms an hour, flooding the operators with information. The problem found was not an actual alarm condition, but static in the connection between the transmitter and the automation system. This problem was quickly remedied, eliminating a significant source of nuisance alarms.

In addition, a couple of points were each going into alarm at the rate of approximately 14 000 times per day. The problems found were due to wiring issues, easily corrected once the problem was identified with Analyze.

Other nuisance alarms found could be attributed to improper tuning. Retuning the loops not only eliminated the nuisance alarms, but also improved process control.

In another instance, one tank level alarm went high, and then went high-high within three minutes. The level information was being transmitted from a continuous level instrument, so it was relatively easy to change the alarm set points.

Investigation showed that it was not feasible to troubleshoot the first alarm within the three minute time period, meaning the second alarm was superfluous. The solution was simple: increase the three minute time period to a value that would allow the first alarm to be addressed. Although this was just a simple problem, it was not detected before deploying Analyze, and resolution of the problem eliminated yet another nuisance alarm.

Finally, many alarms were not correctly set up. They were either too low and always in alarm, or too high and never activated. Either way, the operators were relying on bad information that could have caused serious problems in the future.

During implementation, Analyze guided plant personnel through a process of grouping alarms with associated equipment or processes. As is common with many process plants, the main items of equipment, such as compressors and pumps, generated multiple alarms upon failure.

The alarm grouping function allowed grouping of these multiple alarms into one overall trouble alarm for a specific area, a procedure that is expected to greatly reduce alarm flooding. Once an overall trouble alarm is acknowledged, an operator will now be able to drill down to a screen associated with the particular piece of equipment to ascertain the source of the problem.

The standard reports provided with Analyze, and the easily configurable custom reports, allowed plant personnel to create a baseline for alarm management performance, and to detect many of the most egregious problems. Once these problems were resolved, a new baseline was established for evaluation of future improvements.

Results

Within six weeks of deploying the software, the refinery was able to reduce the number of alarms by 40%, primarily by using information provided in the standard preformatted Excel reports. As the number of alarms was reduced, it



Figure 3. The new alarm management system means operators spend less time dealing with alarms, thus creating opportunities to examine and improve refinery processes.

became easier to focus on the smaller amount of remaining items, to troubleshoot these items, and to further reduce the number of alarms. Much of the stress on the operators has been relieved, allowing them to concentrate more on the process and less on continually pressing the acknowledge button.

Instrument reliability also improved as the standard reports revealed field instrument problems that were, for the most part, easily corrected. This was very important as plant operators have to be able to believe readings from the instruments in order to take decisive and correct actions.

Ergon relied on preformatted Excel reports to analyze alarm frequency and operator response. When further analysis was desired, staff were able to use the data directly from the Excel report. The Excel report is just a standard spreadsheet, so the data could be easily manipulated from there as desired.

During weekly operations meetings, refinery staff review standard Analyze reports (Figure 1) and examine the data. These reports allow the staff to measure for continuous improvement using key performance indicators such as alarm volume, average time to acknowledge, and peak active alarm time. A summary report is also issued on a monthly basis to senior staff throughout the refinery.

The goal is to get to a point where every alarm is significant and can be addressed through a predetermined and readily known course of action. Some alarm conditions can be quite complex and require extensive troubleshooting from experienced plant personnel, but most should be remedied in short order. Ultimately, the only alarms should be those associated with process upsets, and there should be no alarms during steady state operation.

The evaluation process showed that there were multiple suppliers capable of providing a first rate alarm management system. The biggest difference among these systems was not the ultimate level of performance, but instead the time and level of expertise required to implement, operate and maintain a functioning system.

ALARM MANAGEMENT AND KNOWLEDGE CAPTURE

Emerson has provided a number of enhancements to the DeltaV Analyze alarm management software since this initial installation. For example, the newest version of the DeltaV system software incorporates a WIKI-like alarm help feature that can be used to capture best practices.

Like many process plants, Vicksburg is going through a generation shift with its operators. While the newer operators tend to be very computer savvy, they do not have the wealth of operating knowledge possessed by more experienced personnel. This issue is being solved by using the alarm help function to capture and transfer knowledge among the operators.

Specifically, the alarm help function is used as a knowledge capture system to enter alarm related comments into the DeltaV system. These comments are then available for instant retrieval by pulling up the faceplate or accessing the alarm summary screen when that alarm is next encountered. The knowledge capture function will allow staff to document how specific alarm conditions are dealt with, and where to look first to find root causes of trouble.

Analyze is being used by the Vicksburg refinery to improve processes as well as our alarm management. There are plans to use the knowledge capture function to also store best practices concerning overall plant operation. This will allow staff to share both operating and alarm management expertise among all of Ergon's plant operators and automation professionals.

Analyze was both seen as a more suitable product and as better equipped to deliver significant quantifiable results without requiring an inordinate amount of time and experience from plant personnel. The Vicksburg refinery has since been asked to be a resource to Ergon's other divisions on the topic of alarm management.

It is the responsibility of plant operators to handle alarms, but most of the problems identified by Analyze were not operator issues. Instead, these issues were process problems that required solutions from engineering.

Once these solutions were implemented, not only did alarm management improve, but so did the overall operation of the plant. The end result for operators has been a better running plant that requires less time to be spent dealing with alarms, creating opportunities to examine and improve processes.

Ergon has come to look at Analyze as not just an alarm management system, but more importantly as a tool to improve operational performance. Evaluating the results achieved from an alarm management perspective alone greatly understates the software's value, as including process improvements shows significantly improved return on investment. 