Effective Alarm Rationalisation

Introduction

You've been tasked with rationalising the alarm population in your control system(s), and you're wondering what you can do to maximise your chance of successfully completing the process effectively, with minimal challenges.

This white paper will give you some hints, some obvious and some less obvious, on how you ensure your rationalisation project runs as smoothly as possible.

What is 'rationalisation'?

The definition of rationalisation in the alarm management standards IEC 62682[1] and ISA 18.2[2] 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*".

In practice, this means reviewing every alarm in your system to see if it meets the criteria for a good alarm, demoting to event or removing those alarms which do not meet the criteria; prioritising, documenting, and adjusting parameters where required for those alarms which do. Assuming each alarm review should take no more than 10 minutes, for a medium sized facility with 5,000 alarms; at worst, this represents 139 6-hour days of alarm rationalisation.

Of course, rationalisation needn't take 10 minutes for every alarm, as there are likely to be many opportunities to bulk copy from one alarm to many. Where bulk copying between alarms is possible, the rationalisation process can be massively sped up. Indeed, on one plant with four identical units and a total of around 30,000 alarms, the author was able to complete up to 1,200 alarm reviews a day on several days, simply by copying alarms.

After rationalisation, only those alarms which are required for the safe and efficient operation of the plant should remain; and typically, somewhere between 40%-60% of the originally configured alarms may be removed during the process.

Despite what some people may try to tell you, rationalising your alarm population is very unlikely to be completed in a couple of weeks or less. If you are told by anyone it will be a quick exercise, either they don't understand what rationalisation is, or are talking about a completely different process.

The key to success - Planning

As Benjamin Franklin is reputed to have said, '*By failing to prepare, you are preparing to fail*'. So, what preparations do you need to take?

Expectations

Firstly, ensure everyone's expectations are aligned with reality. Your senior management will need to understand that rationalisation is not a 5-minute job. They may have to sanction monies and perhaps allow temporary changes to individual roles for many months to facilitate the review sessions.

In some cases, it may be extremely difficult to justify any costs or role changes to senior management; however, they may have no choice but to accept, albeit reluctantly, if you have received an improvement notice from a regulator.

Scope

Your Alarm Philosophy includes your prioritisation methodology, definitions of alarms, alerts, events, etc., and your rationalisation methodology which forms the basis of your terms of reference for your rationalisation project.

If you don't have an Alarm Philosophy, MAC Solutions' white paper 'A philosophy for your alarms' outlines why you should have one, what the benefits are and how to set about creating one.

In addition to documenting the operator action, cause of the alarm and consequence of failure to respond to the alarm, which according to clause 3.1.6.4 of the EEMUA[3] guidelines '*should form part of the review of each alarm*'; you may also wish to document other information such as P&ID references. Just remember, the more fields you review and document, the longer the process will take.

To prevent 'scope creep', your rationalisation methodology should define what will be included AND excluded from your review sessions; so when a helpful team member suggests you could also review some extra parameters or design masking logic, (which will significantly extend the project timeframe), you can tell them that is not part of the team's current remit and will be part of a different project. Your rationalisation project end date remains firm.

Tools

Ensure you have the right tools for the job.

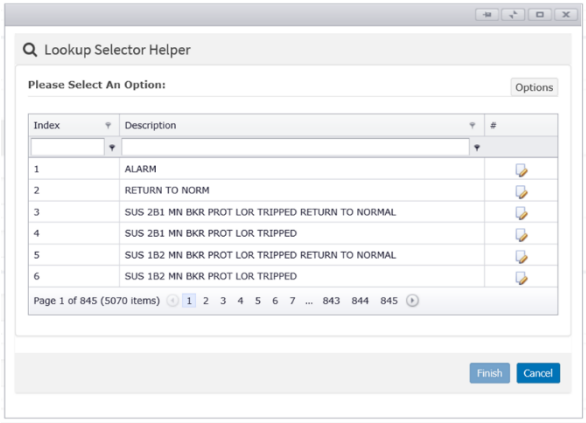
Using a spreadsheet as a master alarm database (MADb) is not really an option. To begin with, accurately copying data is fraught with difficulty and there is no audit trail. A spreadsheet tool will not support managing alarm changes throughout the lifetime of your plant, which is what a MADb must do.

Beware also, of using tools which are not designed as a MADb. Some tools exist which utilise mathematical approaches to changing alarm settings. This effectively hides alarms by moving the setpoints on a subset of a few hundred alarms, and these tools cannot be used to prioritise alarms or document the rationale for each alarm. These tools do not help you with alarm rationalisation and are sometimes sold on the premise of removing the need to do rationalisation.

Ensure your MADb includes a prioritisation tool, configured to match your specific prioritisation methodology and that it includes the functionality to accurately bulk copy any tag and alarm data from one tag to many. Ideally, your MADb should also contain a batch edit facility to allow specific fields to be bulk edited.

Your MADb should also allow the addition of extra fields, which are not imported from the control system's configuration, to meet with your business's specific documentation requirements.

To aid with data entry consistency, good MADb tools, such as MAC Solutions' ProcessVue Guardian, will also allow you to create drop-down boxes for small lists of text, and look-up tables such as the one shown, to select from tables from your control system which may contain tens, hundreds or even thousands of entries.



Selecting the right tool to support you throughout the lifetime of your plant is essential.

Rationalisation approaches

Your rationalisation methodology is of course documented in your Alarm Philosophy, however; to minimise rationalisation timescales, you may be advised that you only need to rationalise a subset of alarms, or that pre-populating the database will save time.

Are these approaches realistic rationalisation methodologies, or are they, as is the author's opinion, flawed methodologies.

Pre-population

The premise for pre-population is that the multidisciplinary team that will review and prioritise the alarms, will not have to wait while cause, consequence and operator actions etc. are entered, and can simply spend time prioritising alarms based on the pre-populated information. All the time and work to populate the necessary information will have been done prior to the review sessions by one or possibly two people.

This approach will not necessarily cut down the overall length of the rationalisation project; but should minimise the time the whole team spends on the process.

However, be very wary of this approach. Who is going to pre-populate the database, and where are they getting their information from? How experienced and knowledgeable are they?

Unless you have an experienced operator pre-populating your database, it is possible that the information may not be valid.

The author's experience with pre-population is being given data to pre-populate by a client which had been obtained from work done by site personnel. When the review sessions started, almost all the consequences and operator responses were questioned and had to be changed during the sessions. No time saving. When the data source was questioned, it became apparent that the information was in the process of being gathered and was a 'work in progress' that 'may not be correct'.

The client stopped providing pre-population information and the database was populated during the review sessions. This meant the rationalisation process took longer when considering the time wasted due to the initial data gathering and pre-population time.

As mentioned earlier, be very careful with this approach. If you intend to pre-populate; ensure the information you use for pre-population is validated or you risk wasting a huge amount of time.

Other strategies

Some people suggest using other strategies to reduce rationalisation timescales by rationalising only a subset of all the alarms, as "they know" that's where the real problems lie.

For example, people may suggest rationalising only the High priority alarms as the regulator wants to see alarm responses for High priority alarms, only rationalising the top 10 nuisance alarms, or alarms that are generated during start-up, shutdown or process trips.

In the author's opinion, these strategies are fundamentally flawed.

Why are these strategies flawed?

To explain, consider why you are seeking to rationalise your alarms.

Your alarm system is likely to be suffering from high numbers of alarms that have been inadequately prioritised, without reference to any formal prioritisation methodology where consequence and time to respond have been considered. Perhaps all priorities were simply set by the control system vendor to default values.

So, when the alarms that are currently configured as High priority are reviewed appropriately, they are quite likely to be re-classified as Medium or Low priority alarms; or may even be demoted to events if they are associated with equipment trips. More importantly; some alarms that should really be High priority alarms, will be wrongly configured as Medium or Low priority alarms.

By only focussing on what are currently configured as High priority alarms, and omitting to review the current Medium and Low priority alarms, have you met the regulator's requirement of documenting your High priority alarms and providing responses for them? NO.

Similarly, reviewing only top 10 nuisance alarms, or those alarms which occur during start up, shutdown or a plant trip, is short sighted.

Due to the fact these alarms occur frequently, it is very unlikely that they will be critical alarms which if not responded to have the potential to cause injury, harm to the environment or significant financial loss.

By adopting any of these limited approaches to rationalisation, you are potentially leaving your plant vulnerable to major problems which could be avoided, by not identifying the important alarms which are currently, erroneously classified as Medium or Low priority and may never have annunciated, … yet!

And remember, these limited approaches are not truly rationalisation, rationalisation is the review of each alarm, i.e. every alarm in your system!

Facilitator

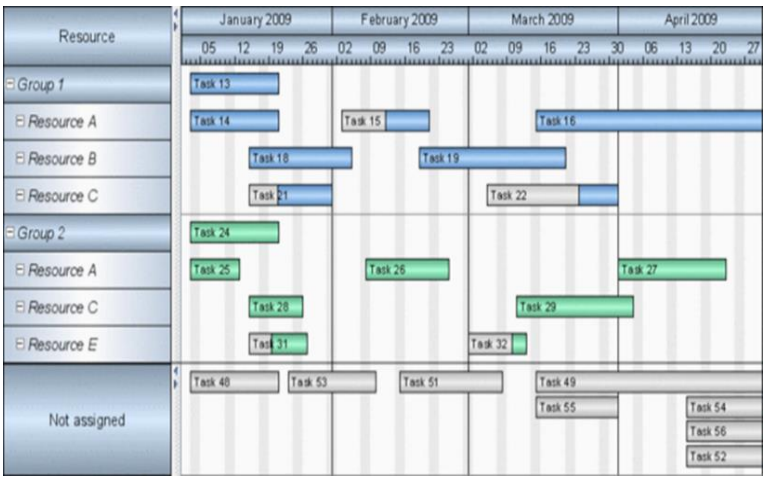
You should appoint a knowledgeable and experienced facilitator who will be responsible for running the review sessions, who understands not only the intricacies of alarm management, but also your rationalisation process.

The facilitator needs to be a robust person, capable of shutting down unnecessary chatter during the review meetings, limiting each alarm discussion to no more than 10 minutes and keeping the focus on the agreed process and deliverables to ensure 'scope creep' does not set in.

It is useful if the facilitator is independent and not a site-based person, as he/she will be able to cut through any potential internal issues clouding the review process, by asking questions that perhaps site-based personnel feel they cannot ask.

Schedule and attendance

Create and publish a schedule which could be a simple spreadsheet showing attendees on the Y-axis and review session dates on the X-axis. Ensure it is reviewed by all; and updated to account for holidays and other business requirements.



Easy, but if you're an independent facilitator managing review sessions, especially for an offshore asset, don't assume everyone will attend simply because a schedule has been agreed and published.

On one occasion when facilitating review sessions for an offshore operator, the author had no-one attend the first planned review session.

Why? The attendance schedule had been published in advance following amendments to account for holidays and shift rotations, so why did no-one turn up?

The operators were employed by a third-party company that provided operational and maintenance staff to the offshore industries. Although the client, the third-party company and all the operators had received and agreed to the schedule, the third-party company failed to amend the travel and accommodation plans for the operators; so on their return to the beach, the operators simply went home as per their normal travel plans. Oops! Day one, no attendees, the author had to eat all the bacon rolls!

If you are a facilitator and any of the staff involved in review sessions are employed by third-party companies, check, check, and check again, that their attendance is confirmed. Never assume.

In addition, check that the right people are attending the most appropriate sessions. Schedule your sessions with a clear target of which equipment/plant areas you are going to review and who, apart from core attendees, really needs to be there. Your rotating machines expert is very unlikely to have a positive contribution to make to the review sessions which concentrate on your water treatment plant. Everyone's valuable time is wasted, and this will potentially contribute to people questioning, "why should I bother to turn up?".

Review meeting timings

Make sure the review sessions are of an appropriate length and frequency. Rationalisation is a protracted process, but one which will not benefit from trying to schedule too many hours each day.

Ideally; review sessions should not be scheduled for more than six hours per day so that participants do not become review fatigued and meal and refreshment breaks should be factored into the schedule.

Aim to schedule review sessions on no more than three days in each week. This leaves two days a week free should it be necessary to gather more information regarding queries that may arise during the reviews and for everyone to deal with issues from their normal day job, which will inevitably crop up.

Location

Ideally, review sessions should be held offsite to minimise disruption. If held onsite, it's all too easy for a key person to be hijacked for just a couple of minutes. Those minutes often extend to an hour, a morning/afternoon, the whole day.

If your key person is offsite or absent due to holidays or illness, any issues cropping up will have to be dealt with in their absence, so why when they are on site, is it necessary to interrupt the planned review sessions.

In most cases, the person interrupting wants to abdicate responsibility and have someone else do the job for them. Your facilitator must be robust in minimising interruptions and keeping key personnel in the review sessions, if not, your schedule will slip.

Whatever your location, if you can source two projectors/display devices, then use them. It is so much easier to have your rationalisation tool displayed on one screen while documentation is reviewed when necessary on a second screen, than flipping back and forth between the tool and the documentation on one screen.

What else should I think of?

Expectations are set, scope is defined, you have the right tools and necessary documentation, your MADb is fully populated and your meetings are all set up. What more do you need to consider? Rules and implementation!

Rules

If your Alarm Philosophy has been written in accordance with the requirements of the alarm management standard IEC 62682, then some rules will already have been addressed as per clause 6.2.23 (Specific alarm design considerations), to which you can refer during your rationalisation project.

Making sure you think about rules before starting rationalisation will smooth the process, minimise repetitive discussions (arguments), and provide consistency to the prioritisation of your alarms. Rules should cover, for example, how alarms are to be configured for protective systems such as Fire & Gas or ESD systems.

The rules should identify whether control system HMI alarms or events are required for protective systems which already generate and annunciate alarms on hard wired mimic panels in the control room. Any alarms replicated to the control system from safety systems, such as high gas, confirmed gas etc., are effectively duplicate alarms. Remember, one of the objectives of any rationalisation process is to remove duplicate alarms!

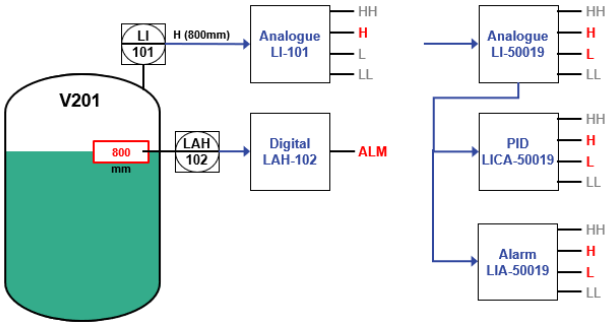
Consider how notifications shall be generated for the application of inhibits and overrides. If these are applied by the operator and therefore the notifications are a consequence of an operator action, should these simply be classified as events, or is there a case for these to be set to alarm?

What about trip alarms? If alarms are configured to annunciate when the plant or a piece of equipment trips as they often are, (usually High priority), will these be demoted to event on the basis there is no operator response which can be defined to prevent the trip which has already happened?

The issues noted above should be obvious candidates for rules, but have you thought about duplicate alarms from diverse technologies?

At the left of the picture opposite, two alarms, one digital and one analogue are generated at the exact same level. You ought to discard one as a duplicate of the other.

You should decide up front if you have this situation, which alarm you will keep, digital or analogue, and why! Then apply this rule consistently.



Consider also when multiple alarms are generated by the same point. In the real example at the right-hand side of the picture, high and low alarms were generated at the same setting on the analogue input block, the PID control block and an alarm block. Triplicate alarms!

Which alarms will you keep and why? You choose. Make a decision and stick to it throughout the process. For example, you may choose to keep the PID block alarms, as you will be able to easily view the alarm setpoints by clicking on the controller faceplate.

One last thought about ‘rules’. Consider documenting typical consequence scenarios such as a turbine trip, ESD level 0, Level 1, main plant trip etc. Identify what consequence level is appropriate for each main scenario and document, it will save a lot of discussion during the review process.

For example, if no action is taken in response to an alarm a turbine trip will occur, identify in your consequence matrix what size of financial impact this will be. Then, when a turbine trip is the result of inaction to any alarm being reviewed, the size of the financial consequence is already decided.

If you document main scenarios, although the time to respond may vary, the consequence level will be invariant, thus ensuring a consistency to prioritisation.

Implementation

Although project completion may be many months away, don't forget to consider how updating your control system with your rationalised alarm parameters will be achieved, whilst incurring minimal production impact.

How will you update your control system? Will this be an online update as the parameters to be modified can be updated while online, or do you need to carry out a full offline, initialising update?

How will you test and validate the changes made? Have you budgeted for the time you may need for your system vendor to prepare a test system and carry out testing?

Can you freeze your configuration activities for the duration of your rationalisation project, to minimise the possibility of overwriting parameters which have been modified after you imported your configuration into MADb tool? Shouldn't happen as all changes should be approved via your MADb, but it does!

Remember, your senior management will not thank you if they find out you've just completed several weeks/months of work which cannot be implemented until the shutdown in two years' time; by which time, there may have been many changes carried out which could invalidate your work.

Of course, issues concerning implementation will not be a problem as they are documented and resolved in the alarm rationalisation section of your Alarm Philosophy, …. aren't they?

Finally

Create a short presentation, no more than 10-15 slides, explaining what you are doing, why you are doing it, what you are intending to achieve and what the terms of reference are. Everyone should be aware of what is happening and already be appropriately trained according to their roles in the rationalisation process; but take the time to re-emphasise your definition of a good alarm, how you will be prioritising alarms, and that you won't consider 'double jeopardy' when reviewing alarms; as someone is always going to say, 'but what if that goes wrong as well?'.

Ensure everyone understands that you accept that there is a safe basis of design for the plant and that all safety devices and systems will function correctly when a demand is placed upon them.

If you create such a presentation, when a new person joins the review team for however many sessions, you simply take 15 minutes at the beginning of the day to acquaint them with the process and how alarms are to be reviewed, which will maintain a consistency of approach to the rationalisation of your alarms.

Happy rationalising.

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Educated in Electrical and Electronic Engineering and with over thirty-seven years of experience in the process industries, Ian has accumulated knowledge across a range of sectors, including industrial, chemical, speciality chemical, pharmaceutical, petrochemical, power generation, nuclear and oil & gas; and has held a variety of technical (hardware & software configuration), maintenance management and consultancy roles.

Having successfully led a number of alarm rationalisation projects for clients over the past ten years, which resulted in significant reductions in annunciated alarm rates and improvements to their management of alarms; Ian's expertise covers IEC 62682, ISA 18.2 and EEMUA 191. In addition to being a member of the ISA, he is also a TÜV certified Functional Safety Engineer (6424/13).

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[1] IEC 62682 Edition 1– Management of alarms systems for the process industries
[2] ISA 18.2-2016 – International Society of Automation
[3] EEMUA 191 3rd Edition – Alarm Systems - A guide to design, management and procurement