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ENGINEERED SOLUTIONS

Nobody likes a Nuisance (Alarm) E-book

FEBRUARY 2025

Put your hand up if you thought that as technology advanced it would become faster, smaller and more efficient? Not just me, you did too? Go figure!

With the introduction of more boutique automation systems, more stand-alone controllers and more cloud software packages, the shop floor can become a tricky environment to navigate; not only for operation and maintenance, but also from an alarm response perspective too.

In general, alarm management can go one of two ways – too many alarms or insufficient alarms. Either way, production can be impacted by poor decisions or lack of training, causing loss of product, unscheduled down time or potentially a safety incident.

But, taking it back to basics, what is alarm management and why is it important?

What is Alarm Management & Why is it so Important?

ISA18.2 defines an alarm as…

“An audible and/or visible means of indicating to the operator an equipment malfunction, process deviation or abnormal condition requiring a response”

What does it all mean?!

What this means is when an automated process detects an **abnormal event**, a message is triggered by the system **causing a visual or audible signal**. In many cases this event often requires manual intervention by an operator or technician.

In many processing industries, **alarms are used to notify operators**, maintenance technicians and in some industries, quality personnel, when a process condition has deviated from normal operation. These systems can be implemented to monitor a number of different processes – for example, production lines in food and beverage facilities, HVAC and utility systems or safety systems such as life safety or gas monitoring systems.

These systems are often **visualized on a control screen** or Human-Machine Interface (HMI) either in the production facility or a control room. Additionally, they can be **coupled with a paging or message system** to notify management or staff, in real time, if they are not in the facility or the alarm is triggered afterhours.

Alarm and paging systems are one part of an end-to-end alarm management process. And, without a holistic process – from alarm definition to operator training – this could cause a major incident that may impact product and, in some cases, business reputation if there is a safety incident or fatality.

Well, is the process standardised?

- There are a number of standards that can be followed for alarm management; however, the most prevalent standard is ISA-18 *Instrument Signals and Alarms*, specifically ISA-18.2 *Alarm Management Lifecycle*.
- This standard was written by the International Society of Automation (ISA) and is accompanied by a number of technical papers.

Within the standard, the alarm management lifecycle is detailed and can be followed for any new or existing automation system.

Figures 1 and Table 1 provide a high-level summary of the lifecycle model for alarm management presented in ISA-18.2.

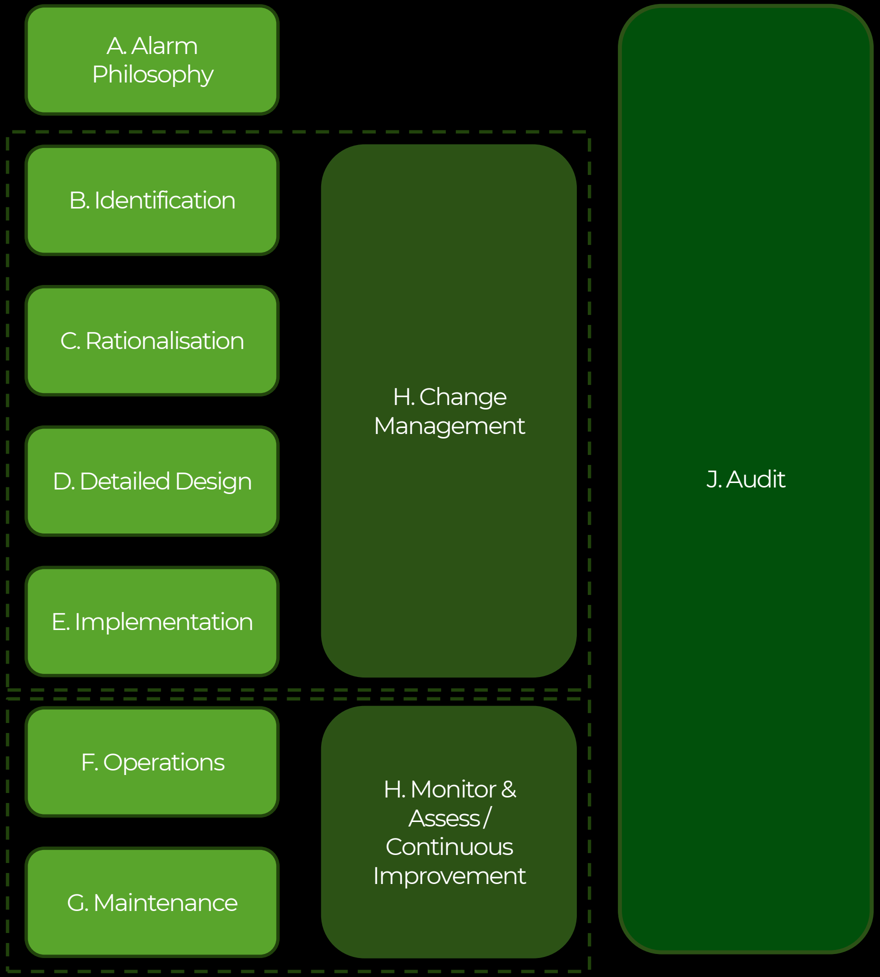


Figure 1: ISA-18.2 Lifecycle Model for Alarm Management

Table 1: Tabulated representation of the ISA-18.2 Lifecycle Model for Alarm Management including high level description of each stage within the cycle

Stage	Title	Activity
A	Alarm Philosophy	Alarm management definition and system requirements / specification
B	Identification	Determine all potential alarms
C	Rationalisation	Rationalise, classify, prioritise and document all alarms selected
D	Detailed Design	Design alarm – basic and detailed, HMI design, visual indication design
E	Implementation	Initiate and test alarms, initial training of operations / maintenance teams
F	Operations	Alarm system live for operators / maintenance team to receive and respond to, on-going / refresher training of team
G	Maintenance	Maintenance repair / replacement of hardware, periodic testing of software
H	Change Management	Process of defining, documenting and approving changes / modifications made to alarm system
I	Monitor & Assess / Continuous Improvement	On-going monitoring and reporting of alarm system to minimize nuisance alarms
J	Audit	Periodic audit of alarm management system and reports / processes

This lifecycle is a great starting point for alarm management, however as equipment providers are releasing more automated equipment with stand-alone controllers or dedicated computerised systems, this can result in a facility with a number of individualised controlled with their own, individual alarm methodologies.

As companies diversify equipment packages, the ISA-18.2 alarm management lifecycle is missing a few key steps to provide an end-to-end process.

So…What’s missing?

Imagine if...

You're a new operator standing the control room surrounded by a number of monitoring stations.

There is one for BMS, PCS, EMS, Power Management, Energy Management, Fire Control System, Security Systems, Gas Safety System and various stand-alone stations for critical equipment items.

Very quickly, this can become very overwhelming.

Now, consider three operating stations:

- One for BMS, including power management and energy management,
- One for critical processing, including stand-alone controlled equipment, PCS and EMS, and,
- One for safety systems, including security systems, fire control mimic panel and gas safety system.

Completing an initial **System Consolidation** is the first critical step to defining the alarm management philosophy and subsequent design and operations.

System Consolidation is a key design factor that should be considered as part of the alarm philosophy phase. By understanding the number of automated systems that will exist in a facility, this will allow for the following:

- Reduced number of control screens or HMIs
- Reduced amount of alarm management hardware – e.g. on-call phones, computers to host paging software etc.
- Reduced operator error due to missed alarms
- Reduced training burden on operators and staff
- Improved efficiencies in operations, potentially leading to reduction in resources or cost

However, a key design consideration is how the back-end data is consolidated into a single source. This may require a middleware or data lake solution. Alternatively, as part of the automation back-end design a centralised historian could be implemented. From here, alarms can be identified, visualised or paged from a centralise source. But this is just one option. Best leave those design decisions to the experts!

- Another important reason to complete system consolidation is that is simplifies how alarms are defined and prioritised.
- Each stand-alone software package will prioritise and classify alarms in different ways. For example, one package may prioritise using 1, 2, 3, 4 where 1 is the highest priority. Whereas, other packages may use priority 11, 12, 13, 14, where 14 is the highest priority.
- As part of the Alarm Philosophy stage, a client-based priority or classification system should be defined as each automation system often differs.
- If it is possible to consolidate, this makes it easier for the client (especially in regulated environments) to manage the alarm management process, including how alarms are defined and prioritised.

Once alarms are consolidated into a central system or historian (or as much as possible), an **aligned Paging System** can be considered. In some cases, it may be difficult to have a single paging system – for example, in Australia, life safety paging systems cannot be consolidated.

However, where possible, a facility should have a single consolidated paging system for critical production alarms.

This ensures:

- Simplification of paging hardware – less to fail / maintain
- Simplification of software – including firmware upgrades / disturbances
- Reduction in software & hardware costs
- Simplification of training
- Simplification of paging syntaxes – i.e. different types of text messages to operators

The last item is important when it comes to operator interpretation of the messaging system. For example, consider two different paging systems, each of the messages could look like the following:

System One

"Alarm, Priority: 14 Date: 17/12/2024 HI-TT-0123: High Temp Alarm on Freezer 0123"

System Two

"17/12/2024 04:46PM BMS HVAC Pressure Alarm Active"

In cases where there are two or more paging systems, alarm syntax can become complex as an operator needs to be trained on how to interpret each messages and quickly react to intervene. By reducing the number of paging types, this ensures a simpler process can be followed when an alarm activates.

At this point, robust **Engineering Continuity Plans or Business Continuity Plans (BCP)** are required.

In a paper published by ISPE titled, “Alarm Response Procedures – A Marriage of PCS and MES” presented by Bruce Greenwald[1], it is suggested that including an “Alarm Response Procedure or ARP” on the HMI screen when an alarm or warning is activated is one solution to ensure operators always have access to the necessary response plan for each alarm.

Alternatively, having paper copies (or QR codes if the facility is paperless) of each plan, including a simple escalation process, is another solution.

Ideally, to consolidate further, the response should be standardised. For example:

- Priority 3 Alarms = Turn equipment / utility off and make-safe
- Priority 2 Alarms = Flush system to drain and make-safe
- Priority 1 Alarms = Turn equipment / utility off and evacuate

Regardless, having these plans in place is necessary to ensure all operators, maintenance and management staff understand what is the expected response and escalation process for each alarm.

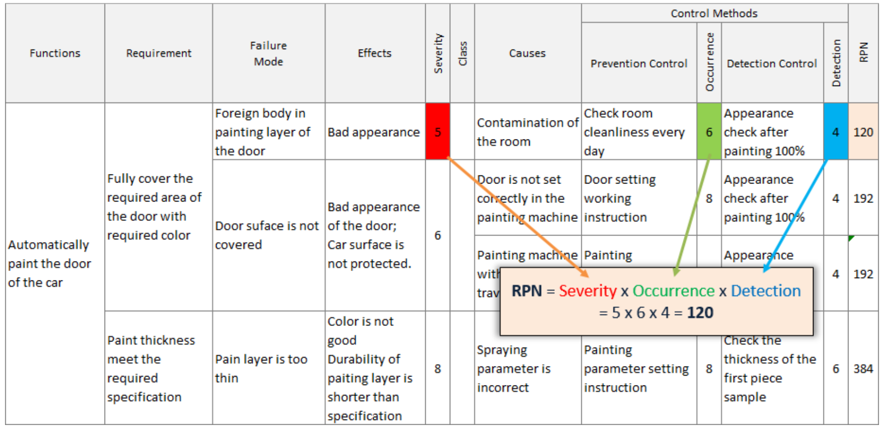
Now this is where **rationalisation** comes into consideration.
If the alarms are not rationalised this leads to extra work at the implementation stage, meaning that **rationalisation is the most critical part of the alarm management process**.

Risk Based Rationalisation

Risk assessments are a critical part of designing any facility or system, and automation systems should be no exception. Often when thinking of automation or computerised systems, cyber security assessments are the first to come to mind, but in the case of alarm management, an FMEA or Failure Modes and Effect Analysis, can be used to document each alarm based on function, failure mode, effect and cause. See example in Figure 2.

Taking a risk-based approach can quickly rationalise your alarms based on critical parameters defined by client or end-user to ensure that the number of alarms occurring on the shop floor or in the control room are minimised to those which require operator or maintenance intervention.

The aim is not only to reduce the number of nuisance alarms received, but also to ensure that the overall alarm management process, from system consolidation to engineering continuity plans, is streamlined.



Functions	Requirement	Failure Mode	Effects	Severity	Class	Causes	Control Methods				RPN
							Prevention Control	Occurrence	Detection Control	Detection	
Automatically paint the door of the car	Fully cover the required area of the door with required color	Foreign body in painting layer of the door	Bad appearance	5		Contamination of the room	Check room cleanliness every day	6	Appearance check after painting 100%	4	120
		Door suface is not covered	Bad appearance of the door; Car surface is not protected.	6		Door is not set correctly in the painting machine	Door setting working instruction	8	Appearance check after painting 100%	4	192
						Painting machine with trav	Painting		Appearance	4	192
	Paint thickness meet the required specification	Pain layer is too thin	Color is not good Durability of paiting layer is shorter than specification	8		Spraying parameter is incorrect	Painting parameter setting instruction	8	Check the thickness of the first piece sample	6	384

RPN = Severity x Occurrence x Detection
= 5 x 6 x 4 = **120**

Figure 3: Example of Process FMEA and Risk Priority Number (RPN)[2]

So how many alarms are too many?

If you count the total number of alarms activated over a month and divide it by the number of operator hours worked in that same month, if the total number is **more than six alarms per operator hour**, then the **alarm system is operating at high risk** and requires rationalisation[3].

Higher number of alarms essentially leads to task saturation of your operators. Ultimately causing alarm fatigue and staff missing, or ignoring, critical notifications that could impact operations.

So, what’s the new lifecycle?

If we take Figure 1 and Table 1 and augment them slightly, a new more holistic lifecycle can be considered which includes the additions discussed in previous sections:

- System Consolidation
- Paging System Alignment
- Engineering Continuity Plans & Business Continuity Plan (BCP)
- Rationalisation & Risk Assessment

Figure 3: Augmented ISA-18.2 Lifecycle Model for Alarm Management

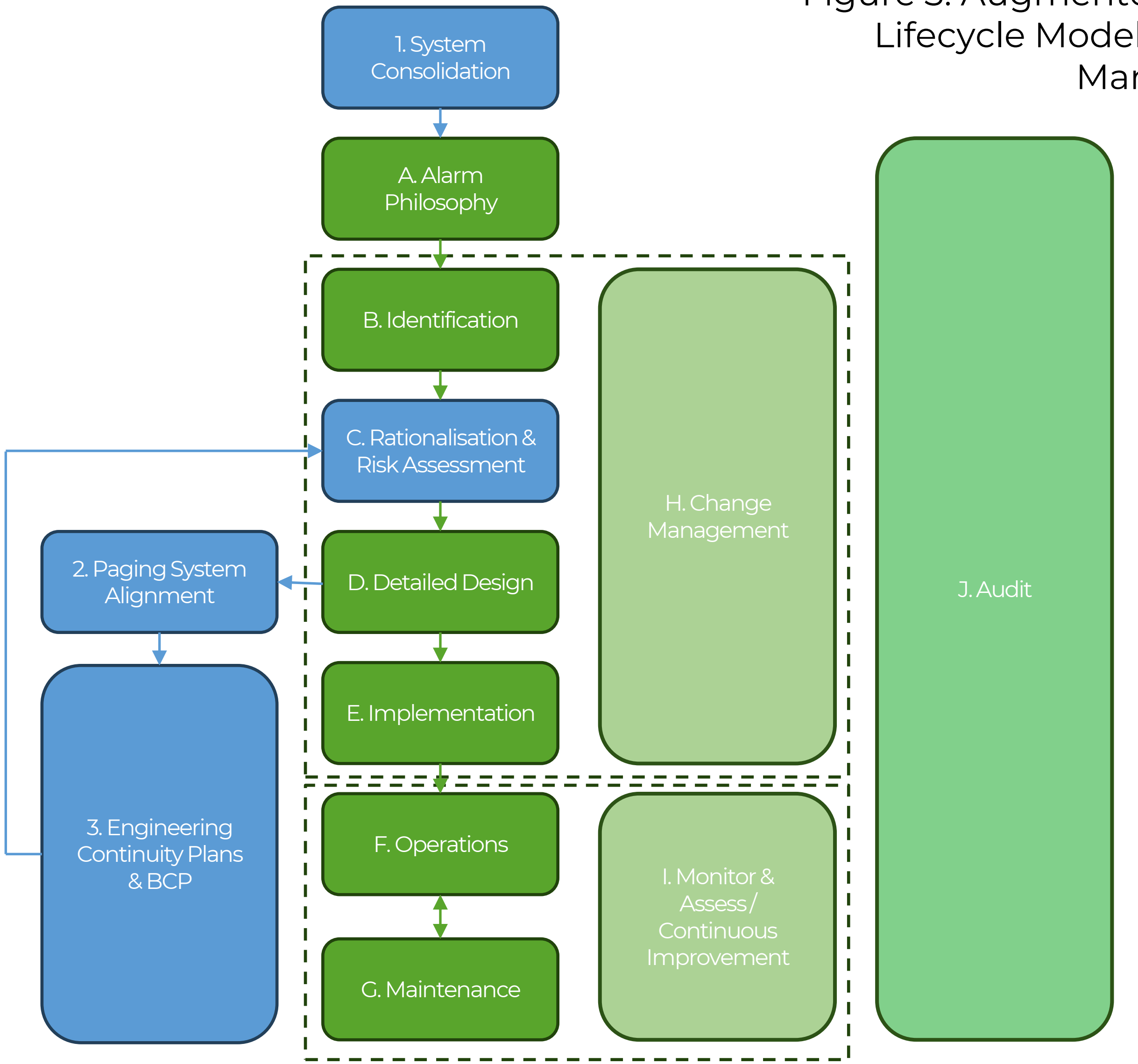


Table 2: Augmented table representation of the ISA-18.2 Lifecycle Model for Alarm Management including high level description of each stage within the cycle

Stage	Title	Activity
1	System Consolidation	Collating a list of all automation system that generate alarms and summarizing how they classify alarms
A	Alarm Philosophy	Alarm management definition and system requirements / specification
B	Identification	Determine all potential alarms
C	Rationalisation & Risk Assessment	Rationalise, classify, prioritise and document all alarms selected Determine, by risk assessment, which alarms are business / product / safety critical based on client requirements
D	Detailed Design	Design alarm – basic and detailed, HMI design, visual indication design
2	Paging System Alignment	Design how all the automated systems will be paged to operators / maintenance
E	Implementation	Initiate and test alarms, initial training of operations / maintenance teams
F	Operations	Alarm system live for operators / maintenance team to receive and respond to, on-going / refresher training of team
G	Maintenance	Maintenance repair / replacement of hardware, periodic testing of software
3	Engineering Continuity Plans & BCP	Engineering Continuity Plans will define how operators / maintenance team will respond. BCP will define how the business will respond to major system outages
H	Change Management	Process of defining, documenting and approving changes / modifications made to alarm system
I	Monitor & Assess / Continuous Improvement	On-going monitoring and reporting of alarm system to minimize nuisance alarms
J	Audit	Periodic audit of alarm management system and reports / processes

Now I Understand!

Alarm systems, and the subsequent management of these, are critical for any facility. With the introduction of more automated systems to increase production efficiency, this can create a tricky environment for operators to navigate. With inefficient alarm and paging systems, this can lead to task saturation, alarm fatigue and, in some cases, missed alarms, which can impact operations.

ISA-18.2, written by the International Society of Automation, contains an alarm management lifecycle which can be followed for any new or existing automation system. As discussed, there are some missing elements within the lifecycle and a more holistic version should be considered. Some additional sections would include:

- System Consolidation
- Paging System Alignment
- Engineering Continuity Plans & BCP
- Rationalisation & Risk Assessment

Overall, the standard sets a foundation, but does not consider the ever-increasing number of automation platforms being released every year. By considering these additional sections, it allows the lifecycle to consider an end-to-end process, ensuring facilities are running an efficient alarm management system to protect product, people and, in some industries, patients.

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How can we help?

Here at EngCor we are action-oriented, results-driven engineers and consultants who navigate ambiguous projects with multiple stakeholder.

Key services we provide (but not limited to):

- Process Design Engineering Services in food, beverage and pharmaceutical
- Business Augmentation and Planning
- **Alarm Management and Rationalisation**
- Outsource Mobilisation and Scope / Contract Preparation – including IFM services
- Document and Training Development for regulated environments
- Governance / Tiered Accountability Preparation and Consolidation
- Roles & Responsibility Development / Workshops
- Asset Verification & CMMS Mobilisation

We have a passion for streamline processes and driving efficient operations. Reach out to us at admin@engcor.com.au to schedule a **free call** or visit our website at engcor.com.au

Thanks for reading!

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