The Alarm Shelving eBook

Alarm Shelving.

Table of Contents
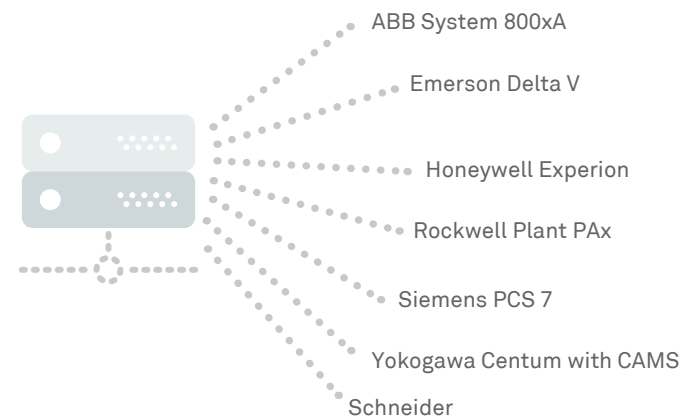
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01: Introduction

In an ideal world, every control system alarm would indicate a malfunction or abnormal condition that required operator action. In reality, alarms that are irrelevant or annunciate excessively—otherwise known as nuisance alarms—pop up from time to time. They pose a risk to successful operation of the plant because they overload operators with nonessential noise and desensitize them to the importance of alarms ("I can ignore this alarm because I know nothing will happen").

Alarm shelving provides a way for the operator to manage these nuisance alarms **safely and securely**. In fact, it is such an important tool for alarm handling that it is now required control system functionality per ISA-18.2-2016 and IEC 62682 (Management of Alarm Systems for the Process Industries).

In this ebook, we will address the benefits of implementing alarm shelving, address common alarm shelving concerns, discuss the considerations for implementing shelving effectively, and compare important features provided by common control systems.

COMMON CONTROL SYSTEM VENDORS

ABB System 800xA

Emerson Delta V

Honeywell Experion

Rockwell Plant PAx

Siemens PCS 7

Yokogawa Centum with CAMS

Schneider

Definition: Alarms

"Audible and/or visible means of indicating to the operator an equipment malfunction, process deviation, or abnormal condition requiring a timely response" (ISA-18.2, IEC 62682)

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02: Defining Nuisance Alarms

Nuisance alarms do not behave like true alarms. Instead, they may not...

- Indicate a malfunction or abnormal condition
- Require an operator corrective action
- Return to normal (clear) after the operator's response

Type of Nuisance Alarm	What It Does
Chattering Alarm	Repeatedly transitions between active state and inactive state in a short period of time (e.g., three times in one minute).
Fleeting Alarm	Same as Chattering Alarm, except it does not repeat rapidly.
Stale Alarm	Remains annunciated (in alarm) for an extended period of time (e.g., 24 hours).
"Bad Actor"	Is one of the top ten or twenty most frequently occurring alarms.

To reinforce the importance of minimizing nuisance alarms, the ISA-18.2 and IEC 62682 standards provide recommended performance metrics.

Additionally, nuisance alarms clutter the alarm summary and process graphic displays, making it harder for the operator to detect when a new alarm has occurred. This information overload causes operators to lose their sense of situation awareness, which compromises the effectiveness of the alarm system. This "alarm fatigue" will cause even the most vigilant operator to become desensitized to true alarms, increasing the likelihood that a problem will be misdiagnosed—or, worse, ignored altogether.

Alarm Performance Metrics *Based upon at least 30 days of data*	
Metric	Target Value
Quantity of chattering and fleeting alarms	Zero, action plans to correct any that occur.
Stale alarms	Less than 5 present on any day, with action plans to address
Percentage contribution of the top 10 most frequent alarms to the overall alarm load	~<1% to 5% maximum, with action plans to address deficiencies.

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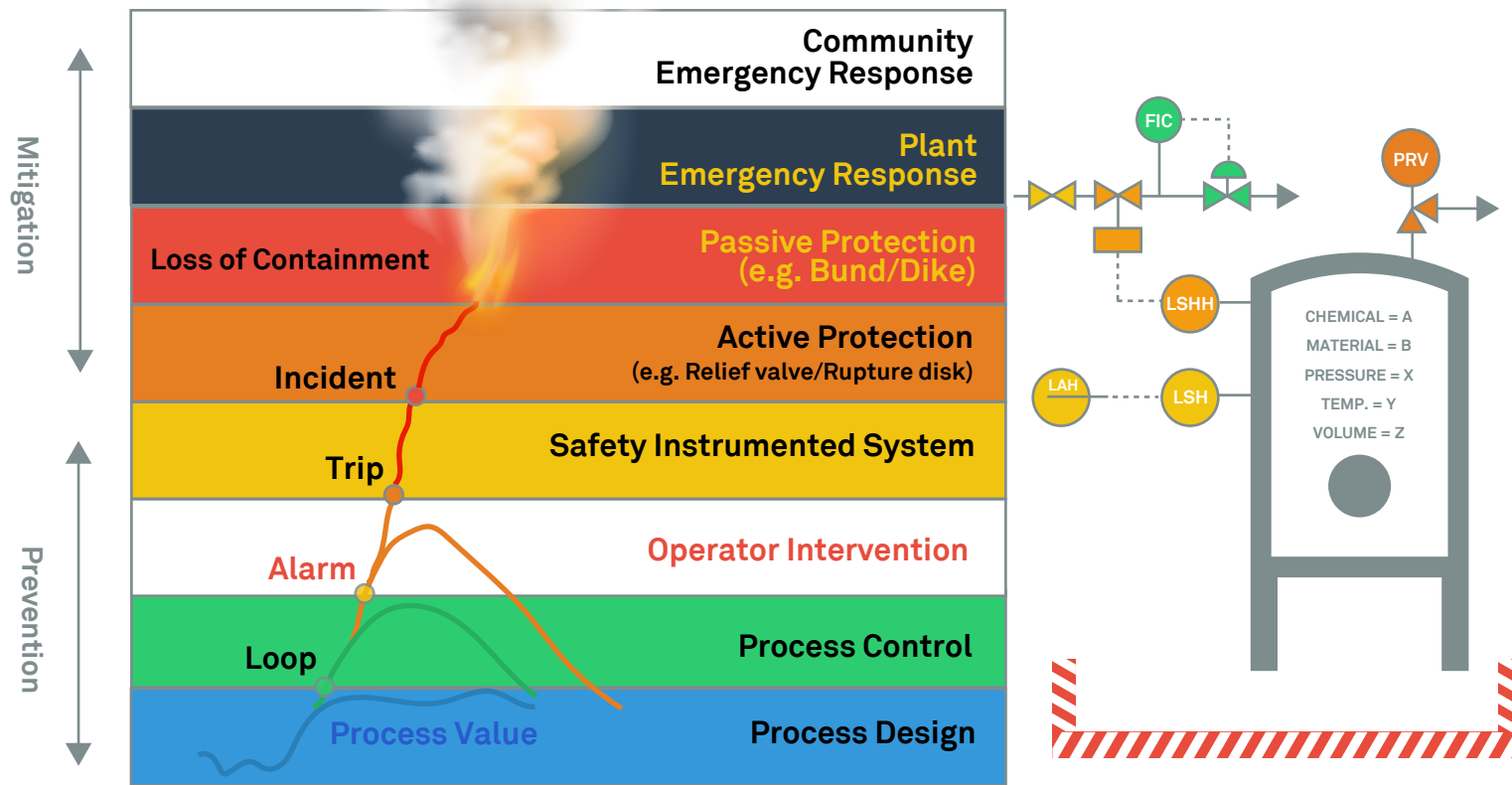
Key takeaway: If you allow nuisance alarms to persist, you are compromising the reliability of the operator's response to an alarm. If you are claiming an alarm as a layer of protection or a safeguard, it may not work when needed, potentially leading to an incident or additional demands on a safety instrumented system (SIS). Thus, you should not "take credit" for alarms if you have significant nuisance alarm issues.
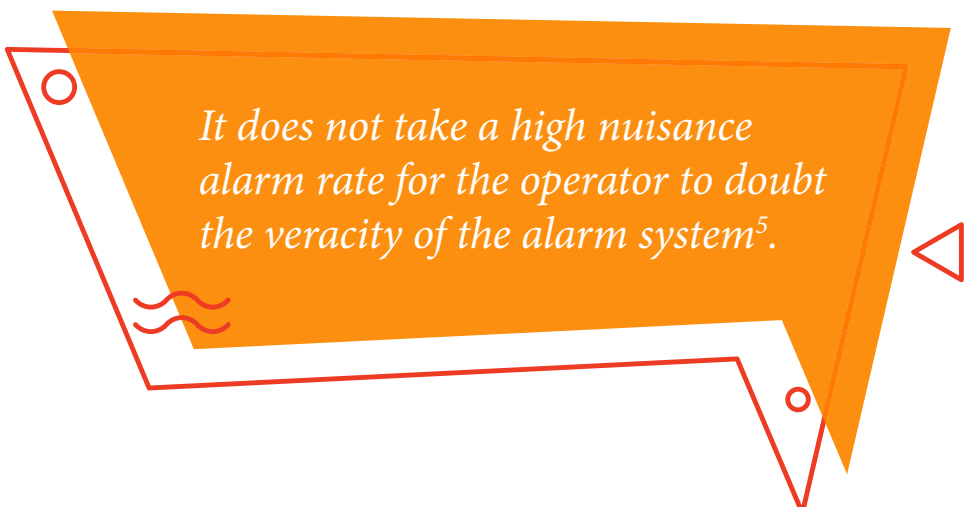
03: Why Nuisance Alarms Undermine Operator Situation Awareness

Good process plant operators have keen situation awareness (SA), which is the ability to perceive, comprehend, and anticipate changes in one's environment. A high level of awareness helps them accurately observe alarm events, as well as understand the full meaning and impact of those alarms in both the present and future.

However, this ability can be undermined by various factors, which are dubbed **SA demons**[3,4]

1. **Attention tunneling:** Focusing on one area or issue to an extent that alarms from another area or issue are ignored.
2. **Misplaced salience:** Incorrect alarm priority or HMI representation of alarm importance and other status information.
3. **Errant mental models:** Incorrect interpretation of what an alarm indicates or mistakenly ignoring relevant alarms.

Moreover, **signal detection theory** quantifies an operator's ability to discern between useful patterns that provide information and random patterns that distract from necessary information—i.e., **noise**. As noise increases, the operator's ability to discriminate a true alarm from a false alarm decreases. As little as a **25% false-alarm rate** is enough for operators to **stop relying on the system to detect an abnormal event**[3].

It does not take a high nuisance alarm rate for the operator to doubt the veracity of the alarm system[5].

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Why Do Operators Ignore Alarms?

There are numerous examples of where the ignoring of nuisance alarms led to a process safety incident[3]. An operator's reluctance to respond immediately to a system that produces many false alarms is a rational and expected behavior, because responding takes time and attention away from other important tasks[4]. Therefore, the best way to reduce human error in alarm management is to eliminate nuisance alarms.

Alarm shelving provides a means for reducing the impact of a nuisance alarm until it can hopefully be addressed.

04: How Alarm Shelving Reduces Nuisance Alarm Fatigue

Alarm shelving enables operators to temporarily remove nuisance alarms until the underlying problem can be addressed.

Alarm shelving is…

- » Temporary
- » Different from disabling the alarm
- » A safe and secure way to suppress an alarm
- » A form of alarm suppression initiated and controlled by the operator

The alarm is temporarily moved from the alarm summary display to a shelved alarm display, otherwise known as a "shelf." It stays on this shelf until it is cleared by the operator, or when the maximum shelving time period is reached. It is also tracked in the system.

Alarm shelving is different than disabling or deactivating the alarm, which would need to be tracked outside of the system and is more likely to be forgotten.

Shelved alarms are configured to return after a designated period of time.

Remember: Alarm shelving does NOT disable or deactivate the alarm

There are two types of alarm shelving, and each handle nuisance alarms differently. Some control systems provide both types, while others support just one type (continuous).

Shelving Type	Behavior (If the alarm clears and re-annunciates within the shelving time period…)	Best for
Continuous Shelving	It will automatically be re-shelved without additional action by the operator.	Chattering Alarms, Fleeting Alarms
One-Shot Shelving	The new alarm instance will be displayed to the operator and must be re-shelved.	Stale Alarms

05: Answers to Common Concerns about Alarm Shelving

1. "Our operators cannot be trusted with alarm shelving."

We trust operators to monitor and control critical processes with expensive equipment and to make the correct decision when something goes wrong. So why wouldn't we trust them to use alarm shelving appropriately? All you need to do is train your operators on the importance of alarm shelving, when to use it, and proper procedures.

2. "Our operators will miss important alarms if we shelve them."

The purpose of alarm shelving is to temporarily hide nuisance alarms. This keeps operators from becoming desensitized to important alarms without disabling them altogether. Shelved alarms are automatically unshelved after a designated period of time (typically on the order of hours).

Definition: Alarm Rationalization

The process of reviewing alarms to ensure necessity, assign priority, and document the rationale (i.e., cause, consequence, corrective action, time to respond).

3. "Operators will forget which alarms are suppressed."

To ease concerns about forgetting suppressed alarms, operators and managers should regularly review the alarms on the suppressed alarm list, especially prior to equipment startup and during shift changes.

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4. "Alarm shelving will enable our operators to continue ignoring the alarms instead of addressing the issue."

With training, operators will learn the correct protocol when they shelve an alarm, such as creating a maintenance work order. To ensure these alarms are not being ignored indefinitely, management should regularly review shelved alarm reports and ensure that the underlying issues are being corrected in a timely fashion.

5. "We do not need alarm shelving if we perform alarm rationalization or dynamic alarming."

Alarm rationalization and dynamic alarming work well for expected situations. However, nuisance alarms develop for scenarios outside of rationalization, such as sensor malfunctions, process changes, and severe weather conditions.

Nuisance alarms cannot be avoided, and alarm shelving will help plant safety by keeping this nonessential information from desensitizing your operators to the importance of alarms.

Definition: Dynamic Alarming
The automatic modification of alarm attributes based on process state or conditions.

06: Alarm Shelving Guidelines for Your Alarm Philosophy

Once you've decided to move forward with alarm shelving, you need to create guidelines and add them to your alarm philosophy.

Your alarm shelving guidelines should clarify the following:

1. Which alarms can be shelved? Which cannot?

2. What is the maximum number of alarms that can be shelved at one time?

3. What are your shelving procedures?

   » What is the authorization, reauthorization, and approval process to allow an alarm to be shelved?

   » When should alarms be unshelved?

   » Should an approval process take place before extending the shelf time?

   » When are interim alarms required, and what is the procedure for use?

   » What action should the operator take after the alarm is shelved (e.g., write a work order, contact maintenance)?

   » When is MOC authorization required?

What is an Alarm Philosophy?
Guidelines that establish how your firm handles all aspects of alarm management, from alarm criteria, prioritization, and classification, as well as Management of Change (MOC).

Per IEC 62682, operators should record the reasons for shelving alarms that extend beyond a single operating shift.

4. What type of training will be provided to operators to learn the correct alarm shelving procedures?

5. What action should be taken upon discovery of operator misuse of alarm shelving?

Alarm Shelving Best Practices

» Train your operators on the purpose of alarm shelving, when to use it, and proper protocol

» Ensure your operators always have easy access to the list of shelved alarms

» Make it standard procedure for operators to review the shelved alarm list during shift handover

» Ensure that action is taken to address alarms on the shelved alarm list; the number of alarms on the shelved list should not continue to grow

» Review shelving reports regularly to identify unauthorized shelving, as well as which alarms are being shelved and how often (most control systems provide this capability)

07: Alarm Shelving Functionality and Display Requirements (ISA-18.2)

The ISA-18.2 and IEC 62682 alarm management standards define requirements and recommendations for alarm shelving functionality.

The following information can be used as a checklist to help evaluate and leverage the functionality provided by your control system supplier.

Alarm Shelving Functionality (ISA-18.2-2016)

Function	Required (REQ) or Recommended (REC)
❏ the ability to shelve alarms	REQ
❏ displays of shelved alarms, or equivalent list capabilities to indicate all alarms shelved	REQ
❏ a time limit for shelving (time limit is a function that unshelves the alarm when the time period expires)	REQ
❏ access control for shelving of individual alarms	REQ
❏ the ability to unshelve alarms	REQ
❏ a record of each alarm shelved	REQ
❏ prevent alarm floods when active alarms are automatically unshelved	REC

Information to be shown in a Shelved Alarm Display (ISA-18.2-2016)

Information	Required (REQ) or Recommended (REC)
❏ tag name for alarm	REQ
❏ tag description or alarm description for alarm	REQ
❏ alarm type	REQ
❏ the alarm status (i.e., active or not active)	REQ
❏ the ability to unshelve alarms	REQ
❏ the alarm priority	REQ
❏ the shelved time remaining or the time and date the alarm was shelved.	REQ

Functionality of a Shelved Alarm Display (ISA-18.2-2016)

Function	Required (REQ) or Recommended (REC)
❑ sorting of alarms by chronological order of shelving or shelved time remaining	REQ
❑ sorting of alarms by priority	REQ
❑ individual unshelving of alarms	REQ
❑ sorting of alarms by tag	REC
❑ filtering of alarms by priority	REC
❑ filtering of alarms by alarm state	REC
❑ filtering of alarms by process area	REC
❑ operator entry of the reason the alarm was shelved	REC
❑ group unshelving of alarms	REC
❑ navigational link to a process display	REC
❑ navigational link to the tag detail display	REC

08: Overview of Alarm Shelving Functionality in Common Control Systems

Alarm shelving is an important alarm handling tool for the operator. As a result of the adoption and promulgation of the ISA / IEC alarm management standards, control system suppliers have enhanced their offerings to provide alarm shelving as a core function in the control system. Each supplier has implemented suppression functionality differently. The following section provides an overview of shelving functionality for several of the most common control systems.

If your control system is not discussed, then please consider reaching out to your supplier to learn more. In fact, even if your system is discussed, you should treat this as an introduction and prompt for follow-up questions for your supplier.

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ABB System 800xA

Continuous ✓

One Shot ✓
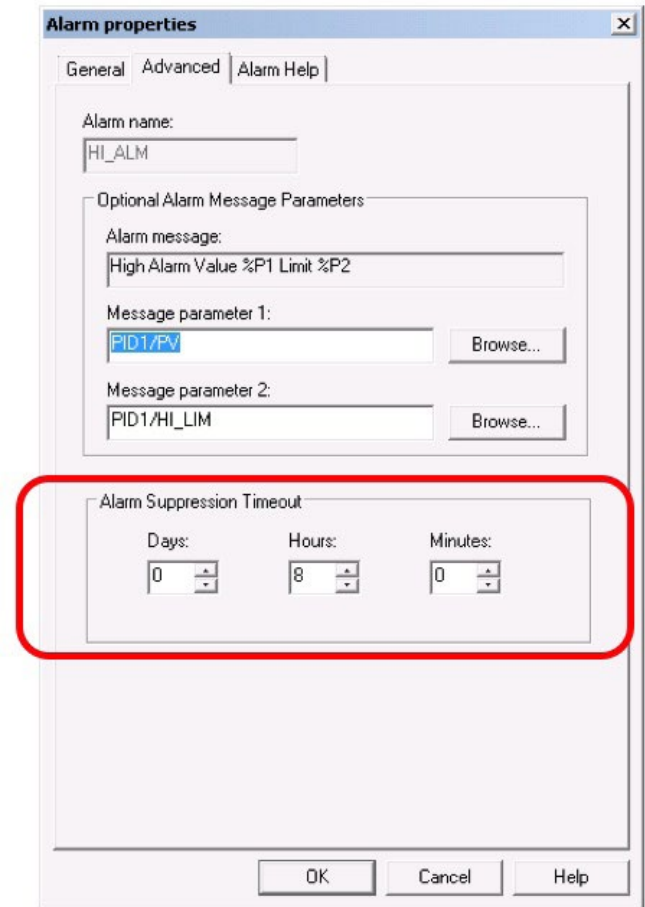
- » Shelving can be enabled / disabled for the system

- » When shelving an alarm, the operator can select from predefined shelving period (2 hours is the default).

- » Maximum shelving time period can be defined for the system. It can be set to ∞ (i.e., no time limit).

- » When shelving an alarm, the operator can document the reason for shelving by selecting from a list of predefined reasons.
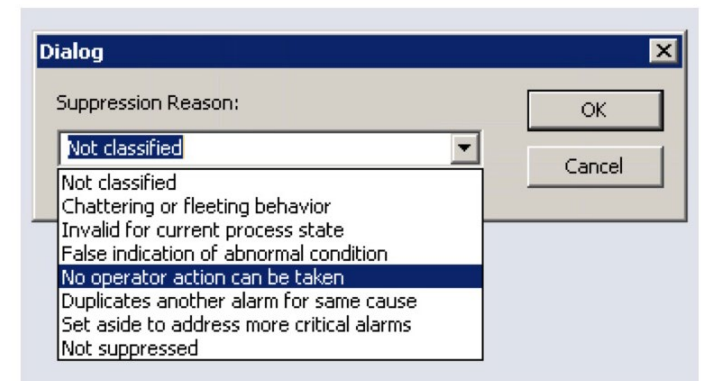
- » Operator selects type of shelving (i.e., continuous or one-shot).

- » Operator can enter an optional free-form comment to provide additional information.

- » Alarm bands on process graphics indicate whether there any shelved alarms in a particular process area.

- » Can be defined to require no authentication, operator authentication, or authentication by operator and supervisor (dual signature).
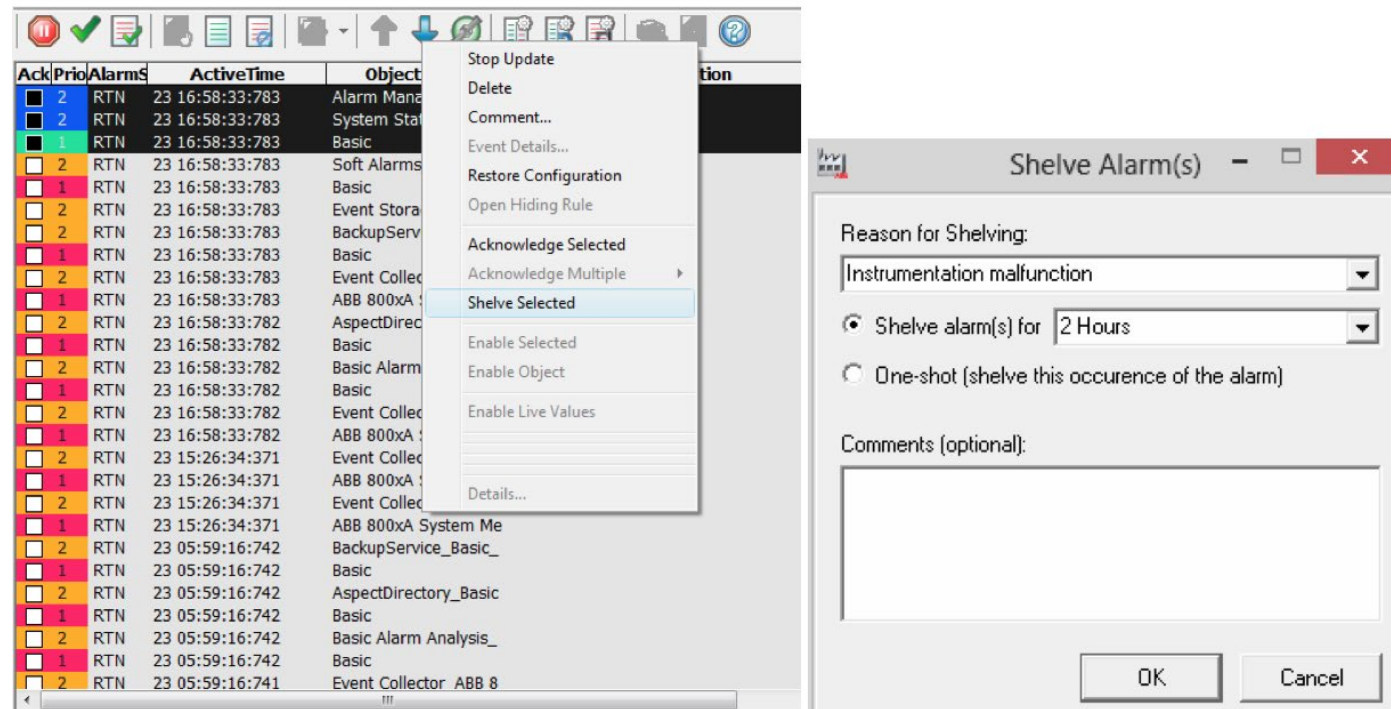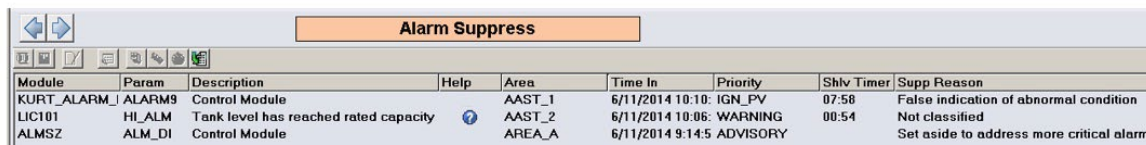
Emerson DeltaV

Continuous ✓

» Each alarm has an individually configurable alarm shelving time period (in engineering mode).

» Maximum shelving time period for an alarm is 999 days.

» Default shelving time period is 8 hours.

» Setting the shelving time period of an alarm to 0:0:0 D:H:M prevents the alarm from being shelved.

» In V12 and earlier, one form of manual suppression was available. It can be used for shelving or out-of-service (long-term suppression) depending upon the value of the shelving time period. In V13 and later, alarm shelving and out-of-service are separate and independent functions.

» Easy access to shelved alarm list.

» Shelved alarm list displays time remaining until alarm comes off the shelf.

» When shelving an alarm, the operator can document the reason for shelving by selecting from a list of predefined reasons.

Honeywell Experion

Continuous ✓

» When shelving an alarm, the operator can document the reason for shelving by selecting from a list of predefined reasons.

» For each shelving reason, a range of shelving time periods can be established, along with a default shelving time period.

» The operator can enter the desired shelving time period based on the range associated with the shelving reason.

» When shelving an alarm, the operator can enter an optional free-form comment to provide additional information.

» Symbols on graphic display indicate both that alarm is shelved and the priority that alarm would be.

» Alarm summary display indicates how many alarms are shelved.

Reason for Shelving	Shelving Period	Default Shelving Time Period	Enter Comment (Detail Reason) for Shelving)
Nuisance Alarm	30 mins - 8 hrs	2 hrs	Yes
Standing Alarm	30 mins - 8 hrs	4 hrs	Yes
Maintenance	30 mins - 1 wk	1 day	Yes
Maintenance (Long Term)	30 mins - 3 wks	1 week	Yes
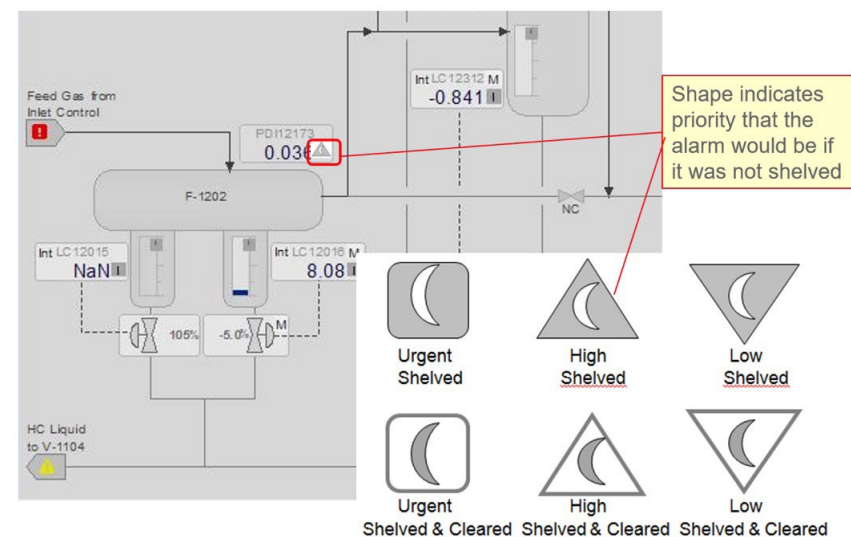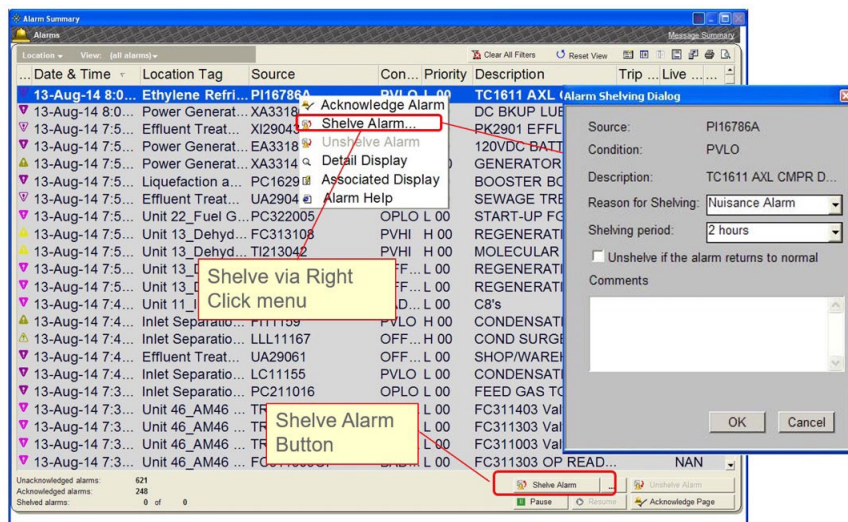
Rockwell PlantPAx

Continuous ✓

» Alarm shelving can be enabled / disabled on an alarm-by-alarm basis.

» A maximum alarm shelving time can be defined individually for each alarm (default is 8 hours).

» When shelving an alarm, the operator can set the shelving duration to any time that is less than or equal to the maximum shelving time defined for the alarm.

» When shelving an alarm, the operator can enter an optional, free-form comment to document the reason for shelving.

» Symbols on graphic display indicate that alarm is shelved (inhibited).
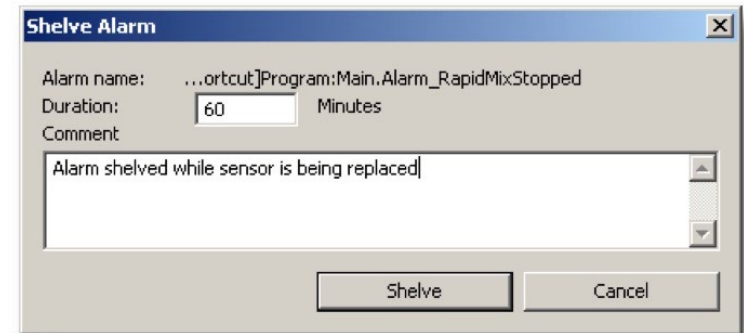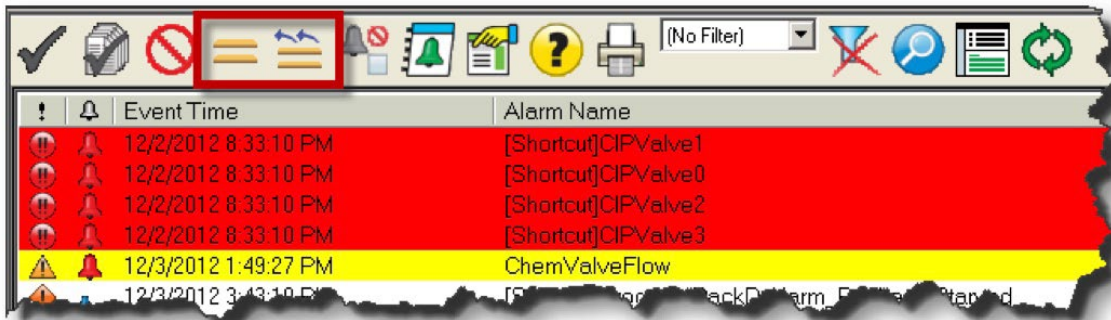
Siemens PCS 7

Continuous ✓

» Single setting to enable alarm shelving throughout the application.

» Single setting for alarm shelving time that gets used for all alarms.

» Maximum alarm shelving time is 9 days, 23 hours, and 59 minutes.

» Operator has ready and easy access to the list of alarms that are shelved.

» Separate Shelved alarm lists for alarms that are shelved but not active (List of messages to be hidden) and those that are active and shelved (Hidden List)

» When shelving an alarm, the operator can enter an optional, free-form comment to document the reason for shelving.


» Separate list and clear difference from alarm out-of-service (Locking).

Yokogawa Centum with CAMS

Continuous ✓

One Shot ✓

» Alarm shelving can be enabled / disabled on an alarm-by-alarm basis (SIS alarm has shelving disabled by default).

» When shelving an alarm, the operator chooses the maximum shelving time by dragging the alarm to a shelving folder with a predefined timeout (e.g., 30 mins, 1 hour, 8 hours, or 24 hours).

» Maximum time an alarm can be shelved is 24 hours.

» Operator has ready and easy access to the list of alarms that are shelved.

» Operator can unshelve any alarm at any time.

» When shelving time has elapsed, the operator must manually unshelve the alarm by dragging it back to the active alarm list.

» Security & Access control can be used to manage which shelving times are selectable by the user.
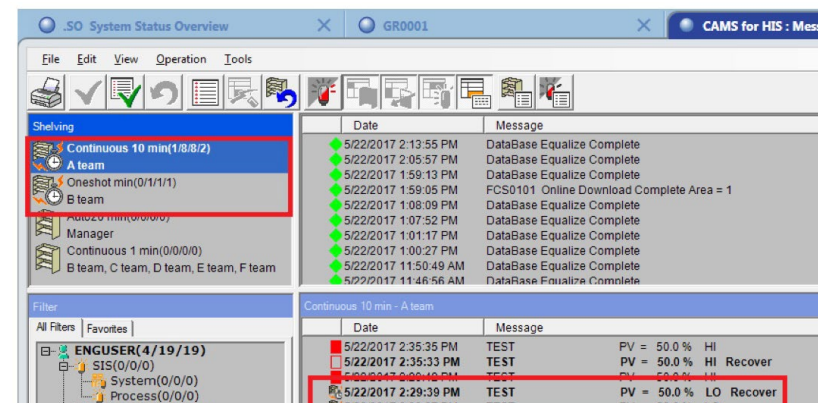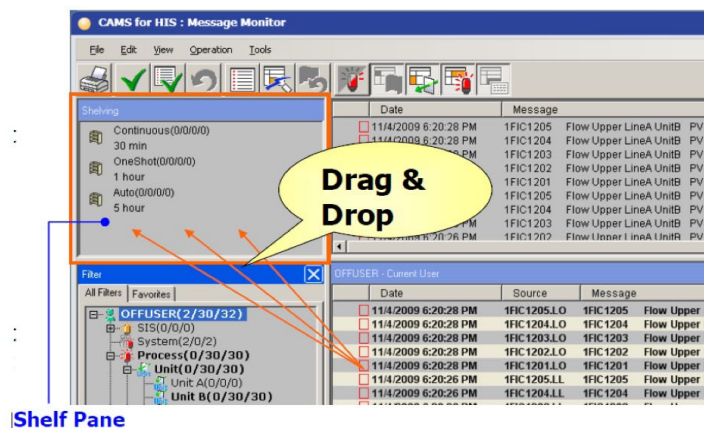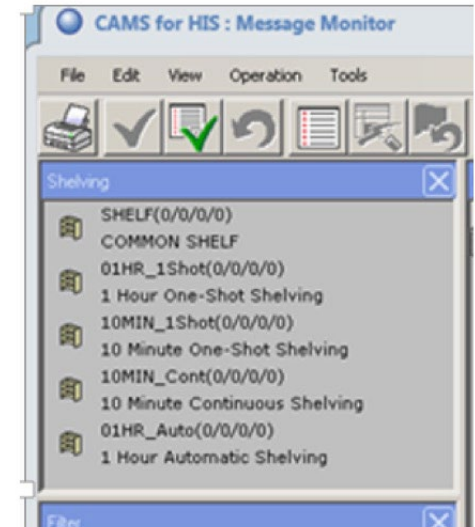
09: Conclusion

Alarm shelving is an important tool for helping operators deal with nuisance alarms. Long-term exposure to nuisance alarms desensitizes operators to the importance of alarms and causes them to distrust the control system.

Alarm shelving is also mandatory functionality to be provided by a control system, as defined in the ISA-18.2-2016 and IEC 62682 alarm managements standards.

End users should explore the alarm shelving functionality provided by their supplier and establish a procedure that meets their operational requirements. They should also be sure to put in place the checks and balances that ensure shelving is being used properly and that underlying alarm issues are being addressed.

For more information on exida Alarm Management services visit exida.com/Alarm-Management

10: References

[1] ANSI/ISA-18.2-2016. "Management of Alarm Systems for the Process Industries."

[2] IEC 62682:2014. "Management of alarm systems for the process industries."

[3] Dunn, D.G., et al, "When Good Alarms Go Bad: Learning from Incidents," 70th Annual Instrumentation and Automation Symposium, Texas A&M Univ. (Jan. 2015)

[4] Endsley, M., "Designing for Situation Awareness: An Approach to User-Centered Design," CRC Press, Boca Raton, FL (2012).

[5] Sands, Nicholas P., et al, "Plug the Holes in the Swiss Cheese Model," Chemical Engineering Progress, an AIChE publication (Sept. 2017).