Issue 122
May 2022
Division of Technical Resources
Office of Research Facilities
National Institutes of Health
Technical News BULLETIN

Alarm Management

Introduction

In a plant, an **alarm** acts as an intentional interruption to an operator indicating an abnormal condition. Meaningful alarms notify the operator to take action to prevent or mitigate the impact of an occurrence with an associated negative consequence, such as a forced equipment outage.

Active alarms are presented to a human operator by an alarm display, which may be located on a computer monitor or an annunciator panel. The operator's ability to view, acknowledge, and respond to each alarm is limited by the human factor of cognition, notably the individual's ability to filter out data that is extraneous to making appropriate decisions. This cognitive ability may become overloaded during an **alarm flood**, which is a period of excessive and rapid alarm rates, resulting in an operator unintentionally missing or ignoring important alarms because they are overwhelmed by the number of alarms. Alarm floods can grow in intensity and frequency if the system is configured with poor alarming practices – such as bad actor alarms and poor alarm prioritization – which hinder the operator in assessing and resolving the source of the abnormal situation.

Alarm management addresses the flaws in alarm system controls, processes, and designs to allow the plant to promote good stewardship and usability by the operations staff. The concepts can be applied in plants as well as building operations or other processes where alarm use is critical.

Alarm Philosophy

An alarm philosophy is an alarm management handbook developed by the plant's alarm team and customized specifically for their site. This comprehensive document provides guidance to ensure that the alarm system is developed, implemented, and maintained to effectively help the operator take the correct action at the correct time. The handbook compiles the rules for alarm selection, priority setting, configuration, response, handling methods, system monitoring, roles and responsibilities, and system maintenance.

Benchmarking/Reporting/Analysis

The data collected by the alarm system is used to build analyses that reflect the system's health and performance as an operator tool. These analyses are compared to target performance metrics and the alarm management program's initial benchmarking to identify critical issues and gauge the effectiveness of mitigations and improvements.

Alarm Change Management

Alarm reporting may highlight alarms with behaviors that are categorized as a nuisance or are irrelevant to the operator. These are interchangeably classified as **nuisance alarms** or **bad actor alarms**.

Bad actor or nuisance alarms are notifications that don't meet the definition of an alarm (such as alarms without a required operator action) and are thus not meaningful; those that are triggered by normal operations (e.g., status alarms); or those that are chattering (rapidly repeating) or fleeting (occurring and clearing in very short intervals). Once identified, these bad actors may be resolved by the alarm management team through the introduction of one or several control tools – primarily deadbands (which prevent alarms from returning to normal until the alarm condition is cleared by a defined increment, preventing successive alarms), process filters, and delays.

As nuisance alarms are controlled, valid alarms are prioritized through documentation and rationalization (D&R). D&R is the methodology of alarm rationalization by which alarms are determined to be valid, assigned meaningful priority and setpoint values, and then documented to ensure consistent alarm configuration in accordance with the alarm philosophy. The most frequent method of alarm rationalization is the grid-based method, which combines the severity of the alarm's consequences with the maximum time available for response and mitigation.

Real Time Alarm Management

Advanced alarm capabilities may be necessary to resolve certain alarming issues. Equipment may have different operating modes (e.g., running, startup, tripped) where a static alarm configuration would produce inconsistent results; a static configuration can result in an alarm triggering despite the condition being normal for the equipment's current state. To rectify this, **state-based alarming algorithms** dynamically alter equipment alarm configurations (e.g., alarm setpoint and priority) based on changes to the equipment's detected operating state. **Alarm flood suppression** temporarily eliminates expected and distracting alarms from a unit trip or forced outage, displaying only the most relevant alarms to assist the operator in managing the post-trip resolution.

Conclusion

Alarm management is a continuous improvement process that requires an ongoing – and frequently automated – program of system analyses and monitoring by a dedicated alarm management team. Effective alarm management helps maintain an improved level of performance and prevent various alarm problems from being reintroduced into the alarm system.

Additional Reading

Hollifield, Bill R., and Eddie Habibi. *Alarm Management: A Comprehensive Guide: Practical and Proven Methods to Optimize the Performance of Alarm Management Systems*. International Society of Automation, 2011.

ANSI/ISA-18.2-2016, Management of Alarm Systems for the Process Industries Copyright: 2016