TECHNICAL REPORT

ISA-TR18.2.3-2015

Basic Alarm Design

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ISA
67 Alexander Drive
P.O. Box 12277
Research Triangle Park, North Carolina 27709

E-mail: standards@isa.org

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The following served as active members of ISA18 Work Group 3 (WG3) to develop this technical report:

NAME	COMPANY
Todd Stauffer, Co-Chair	Exida Co.
Patrick O'Donnell, Co-Chair	BP
Joseph Alford	Consultant
Alan Bryant	Oxy Inc.
Bill Hollifield	PAS
Colin Lunty	Suncor
Douglas Metzger	DPM Consulting
Arshad Muhammad	Emerson Process Management
Graham Nasby	Eramosa Engineering Inc.
Harry Pigler	Pigler Automation LLC
Nicholas Sands	DuPont
David Strobhar	Beville Engineering Inc.
Kim Van Camp	Emerson Process Management

The following people acted as voting members of ISA18 in approving publication of this technical report:

NAME	COMPANY
Donald Dunn, Co-Chair	Phillips 66
Nicholas Sands, Co-Chair	DuPont
Joseph Alford	Consultant
Stephen Apple	Schneider-Electric
John Bogdan	J. Bogdan Consulting LLC
Kevin Brown	Enbridge Inc.
Alan Bryant	Oxy Inc.
Michael Carter	SIS-TECH Solutions
Lieven Dubois	UReason
Bridget Fitzpatrick	Wood Group Mustang Inc.
Bill Hollifield	PAS
Sakthivel Kandasamy	Chevron Energy Technology Co.
Darwin Logerot	ProSys Inc.
Colin Lunty	Suncor
Michael Marvan	Matrikon Inc.
Douglas Metzger	DPM Consulting
Leila Myers	Consultant
Graham Nasby	Eramosa Engineering Inc.
Patrick O'Donnell	BP
George Plowman	Rockwell Automation
Douglas Rothenberg	D Roth Inc.
Todd Stauffer	Exida Co.
David Strobhar	Beville Engineering Inc.
Beth Vail	URS PS / AECOM
Kim Van Camp	Emerson Process Management

David Visnich	Burns & McDonnell
Robert Weibel	Tips Inc.

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NAME	COMPANY
N. Sands, Vice President	DuPont
D. Bartusiak	ExxonMobil Chemical Co.
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I. Verhappen	Orbis Engineering
W. Weidman	WCW Consulting
J. Weiss	Applied Control Solutions LLC
M. Wilkins	Yokogawa IA Global Marketing (USMK)
D. Zetterberg	Chevron Energy Technology Co.

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Foreword

In 2009, ANSI/ISA-18.2-2009, *Management of Alarm Systems for the Process Industries*, commonly referred to as ISA-18.2, was issued. In that same year the ISA18 committee established working groups to develop a series of technical reports with guidance on how to implement the practices outlined in ISA-18.2. In 2012, a seventh working group was also added. The seven independent technical reports are described below:

- ISA-TR18.2.1, *Alarm Philosophy* [TR1], provides guidance on the alarm philosophy. TR1 is limited to the scope of Clause 6 in ISA-18.2. The alarm philosophy provides guidance for successful management of the alarm system. It covers the definitions, principles, and activities by providing overall guidance on methods for alarm identification, rationalization, classification, prioritization, monitoring, management of change, and audit.

- ISA-TR18.2.2, *Alarm Identification and Rationalization* [TR2], provides guidance on alarm identification and rationalization. TR2 was limited to the scope of Clauses 8 and 9 in ISA-18.2. Identification and rationalization covers the activities to determine the possible need for an alarm or a change to an alarm; systematically compare alarms to the alarm philosophy; and determine the alarm setpoint, consequence, operator action, priority, and class. Activities include, but are not limited to, identification, justification, prioritization, classification, and documentation.

- ISA-TR18.2.3, *Basic Alarm Design* [TR3], provides guidance on basic alarm design. TR3 focuses on the scope of Clause 10 of ISA-18.2 and may include other clauses as needed (e.g., Clause 14 on operations and Clause 15 on maintenance). Basic alarm design covers the selection of alarm attributes (e.g., types, deadbands, and delay times) and may be specific to each control system.

- ISA-TR18.2.4, *Enhanced and Advanced Alarm Methods* [TR4], provides guidance on enhanced and advanced alarm methods. TR4 focuses on the scope of Clause 12 of ISA-18.2. Enhanced alarm design covers guidance on additional logic, programming, or modeling used to modify alarm behavior. These methods may include: dynamic alarming, state-based alarming, adaptive alarms, logic-based alarming, and predictive alarming, as well as most of the designed suppression methods.

- ISA-TR18.2.5, *Alarm Monitoring, Assessment, and Audit* [TR5], provides guidance on monitoring, assessment and audit of alarms. TR5 focuses on the scope of Clauses 16 and 18 in ISA-18.2. Monitoring, assessment, and audit cover the continuous monitoring, periodic performance assessment, and recurring audit of the alarm system.

- ISA-TR18.2.6, *Alarm Systems for Batch and Discrete Processes* [TR6], provides guidance on the application of ANSI/ISA-18.02-2009 alarm lifecycle activities to batch and discrete processes, expanding on multiple clauses of ISA-18.2.

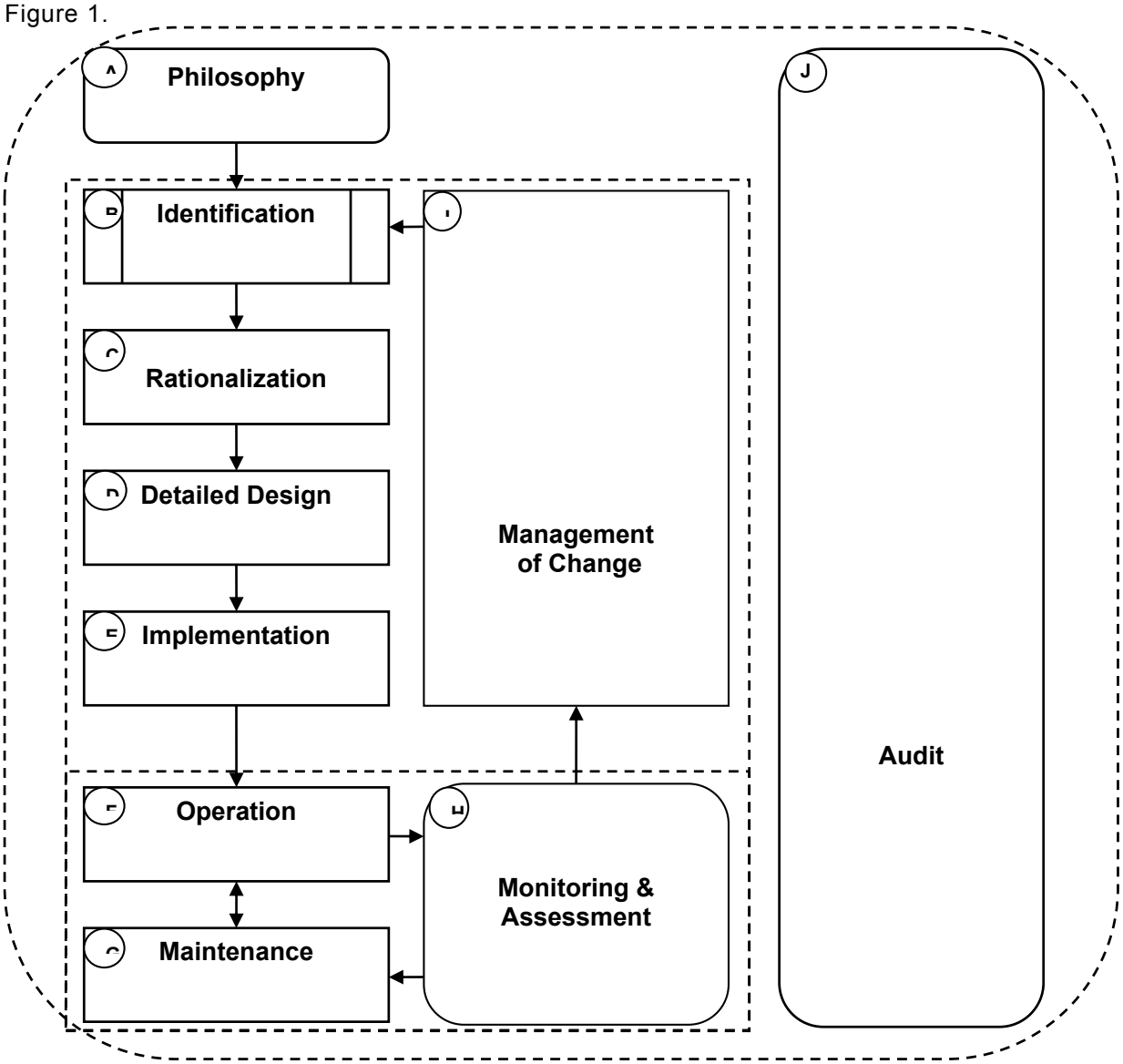
- ISA-TR18.2.7, *Alarm Management when Utilizing Packaged Systems* [TR7], provides guidance on the application of ANSI/ISA-18.2-2009 to plants utilizing packaged systems, expanding on multiple clauses of ANSI/ISA-18.02-2009.

The guidance as presented in this document is general in nature, and should be applied to each system as appropriate by personnel knowledgeable in the manufacturing process and control systems to which it is being applied. This guidance will evolve with experience and technology advancements.

Introduction

Alarm Management Lifecycle

ISA-18.2 defines requirements that address alarm systems for facilities in the process industries to improve safety, quality, and productivity. The general principles and processes in ISA-18.2 are intended for use in the lifecycle management of an alarm system based on programmable electronic controller- and computer-based Human-Machine Interface (HMI) technology. These requirements are presented in the standard, using the alarm management lifecycle shown in Figure 1.



Note 1: The box used for stage B represents a process defined outside of ISA-18.2.
Note 2: The independent stage J represents a process that connects to all other lifecycle stages.
Note 3: The rounded shapes of stages A, H, and J represent entry points to the lifecycle.
Note 4: The dotted lines represent the loops in the lifecycle.

Figure 1 – Alarm management lifecycle (ISA-18.2, Figure 2)

Basic Alarm Design

This technical report is designed to provide guidance, rationale, and examples on the Basic Alarm Design process described in ISA-18.2 Clause 10. Basic alarm design, which is a step in the Detailed Design stage of the lifecycle, covers the selection of alarm attributes (e.g., types, deadbands, and delay times) and may be specific to each control system.

Following the recommended guidance in this technical report will not necessarily ensure that alarm management problems will be avoided. It will, however, help to identify and address alarm management vulnerabilities and help minimize the existence of nuisance alarms that could compromise and impair the operator's awareness, understanding, and response to abnormal situations.

Purpose of this technical report

This technical report provides details on the basic alarm design process described in ISA-18.2 Clause 10. Following the lifecycle model shown in Figure 1, this report assumes that alarms to be addressed in basic alarm design have completed rationalization where attributes such as alarm setpoint and priority have been defined.

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1 Scope

1.1 General applicability

This technical report addresses alarm systems for facilities in the process industries to improve safety, quality, and productivity.

In the design stage, the alarm attributes are specified and designed based on the requirements found in the alarm philosophy and determined by rationalization (e.g., alarm priority and setpoint). There are three areas of design: basic alarm design, HMI design, and design of advanced alarming techniques. This technical report addresses considerations for the basic alarm design. Note that HMI design detailed requirements and recommendations can be found in ISA-18.2 Clause 11 and guidance on advanced alarming techniques is provided in TR4.

1.2 Basic alarm design vs. enhanced and advanced alarm methods

This technical report, TR3, addresses basic alarm design while TR4 is focused on enhanced and advanced alarm methods. The purpose of this subclause is to provide clarity as to what methods and techniques are treated as basic alarm design vs. those that are treated as advanced alarm design. In general, basic alarm design principles should be applied first. In some cases though, such as dynamically changing processes (e.g., most batch processes), advanced techniques need to be considered up front. The use of advanced alarm design techniques typically carry with them added complexity and cost, and as such, are typically applied only when basic techniques are inadequate to address the necessary alarm functionality.

1.2.1 Basic alarm design

Basic alarm design covers the design and configuration of individual process variables (raw measurements or calculated variables) and the selection of appropriate alarm types. Alarm attributes such as setpoint, deadband, priority and on/off delay are set to single values designed to accommodate all operating conditions.

Process variable (PV) calculations, analog and logical, are considered part of the control system and basic alarm design. PV calculations can be complex, yet have basic alarming functionality. This includes such techniques as:

a) common alarms, e.g., a common high-temperature alarm coming from multiple temperature transmitters on a tank, or a common toxic-gas alarm coming from multiple gas detectors;

b) numeric calculations within the control system used with basic alarming, such as rate calculations (producing rate-of-change alarms), statistical calculations (producing statistical alarms, such as alarming on standard deviations, etc.) and other complex calculations;

c) simple to complex models used to estimate process values online, often referred to as virtual sensors;

d) high-speed counters and accumulators, often needed in discrete manufacturing applications, which accumulate and aggregate within the control system before applying basic alarming;

e) logic calculations within the control system to create an alarm only when it is a valid alarm (e.g., a calculation including a logical AND of low pressure and the associated pump run status to create a logical PV that is alarmed).

NOTE If the alarm is created by the control system, and logic is added to conditionally suppress it, this falls under the definition of advanced alarming and is discussed in TR4.

1.2.2 Enhanced and advanced alarm methods

The enhanced and advanced alarm methods in TR4 include ways to modify alarm attributes dynamically for one or more process variables. Different from basic alarm design, advanced alarm design often has a larger scope (applies to multiple variables at once) and ensures that alarm attributes track the process (are relevant for different operating states). Additional layers of logic, programming, modelling, or a combination thereof beyond basic alarming methods, are used to