TECHNICAL REPORT
ISA-TR84.00.04-2015, Part 1

Guidelines for the Implementation of ANSI/ISA-84.00.01-2004 (IEC 61511 Mod)

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

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Foreword

ANSI/ISA-84.00.01-2004 Part 1 gives requirements for the specification, design, installation, operation and maintenance of SIS, so that it can be confidently entrusted to place and/or maintain the process in a safe state. These requirements are presented in the standard using the safety lifecycle shown in ANSI/ISA-84.00.01-2004 Part 1 Figure 8 and described in ANSI/ISA-84.00.01-2004 Part 1 Table 2.

The ISA84 committee has developed a series of complementary technical reports to provide guidance, as well as practical examples of implementation, on various topics and applications. Three of these technical reports, ISA-TR84.00.02, ISA-TR84.00.03 and ISA-TR84.00.04, provide informative guidance related to specific phases of the Safety Instrumented System (SIS) lifecycle. Figure 8 and Table 2 have been adapted for this foreword as shown in ISA-TR84.00.04 Figure 1 and Table 1, respectively. A brief overview of each technical report is given below including the report's relationship to the lifecycle requirements and the intended scope of each report's guidance.

ISA-TR84.00.02—Safety Integrity Level (SIL) Verification of Safety Instrumented Functions— Lifecycle phase 4 requires verification that the intended or installed SIS meets its specified SIL. To support the calculation of the average probability of failure on demand as required by ANSI/ISA-84.00.01 Clause 11.9, ISA-TR84.00.02 provides guidance on the following: a) assessing random and systematic failures, failure modes and failure rates; b) understanding the impact of diagnostics and mechanical integrity (MI) activities on the SIL and reliability; c) identifying sources of common cause, common mode and systematic failures; and d) using quantitative methodologies to verify the SIL and spurious trip rate. The approaches outlined in this document are performance-based; consequently, the reader is cautioned to understand that the examples provided do not represent prescriptive architectural configurations or MI requirements for any given SIL. Once an SIS is designed and installed, the ability to maintain the specified SIL requires the implementation of a structured MI program as described in ISA-TR84.00.03.

ISA-TR84.00.03—Mechanical Integrity of Safety Instrumented Systems (SIS)—Lifecycle phases 5 and 6 involve the installation and testing of the SIS, the validation that the SIS meets the safety requirements specification, and the assurance that functional safety is maintained during long term operation and maintenance. An important aspect of achieving and maintaining the SIS integrity and its specified SIL is the implementation of an MI program that provides quality assurance of the installed SIS performance. This technical report is an informative document providing guidance on establishing an effective MI program that demonstrates through traceable and auditable documentation that the SIS and its equipment are maintained in the "as good as new" condition. The technical report addresses the identification of personnel roles and responsibilities when establishing an MI plan, important considerations in establishing an effective MI program, and detailed examples to illustrate user work processes used to support various activities of the MI program. Data and information collected as part of the MI program can be used to validate the SIL Verification calculations as discussed in ISA-TR84.00.02 and the selection and continued use of devices as discussed in ISA-TR84.00.04 Annex L.

ISA-TR84.00.04-Guidelines for the Implementation of ANSI/ISA-84.00.01—Lifecycle phases 2, 4, 9 and 10 address the management of functional safety, allocation of safety functions to protection layers, SIS design and engineering, and SIS verification. This technical report is divided into two parts. Part 1 provides an overview of the SIS lifecycle with references to annexes containing more detailed guidance on various subjects. Part 2 provides an end-user example of "how to" implement ANSI/ISA-84.00.01. This report covers many aspects of the safety lifecycle including such topics as: "grandfathering" existing SISs (Clause 3 and Annex A); operator initiated functions (Annex B), separation of the Basic Process Control System (BPCS) and SIS (Annex F), field device and logic solver selection (Annex L), manual shutdown considerations (Annex P), and design/installation considerations (e.g., wiring, power, relationship to BPCS, common mode

impacts, fault tolerance, etc. – Annex N). ISA-TR84.00.02 expands Annex G, which only provides a brief introduction to the topic of failure calculations. ISA-TR84.00.04 does not address the MI program, which is discussed in ISA-TR84.00.03.

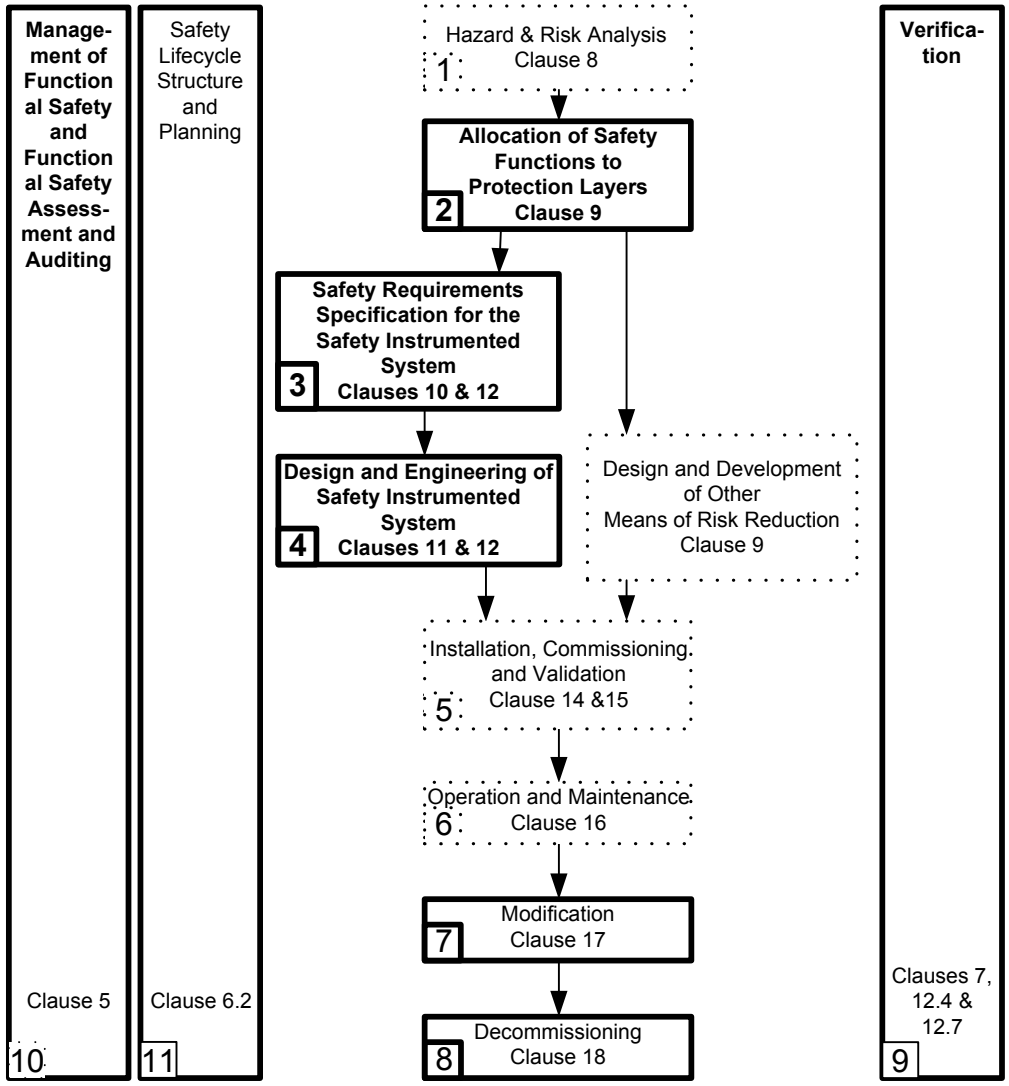

Figure 1 – SIS Safety Lifecycle (modified ANSI/ISA-84.00.01-2004-1 Figure 8)

Table 1 - SIS Safety Lifecycle overview (modified ANSI/ISA-84.00.01-2004-1 Table 2)

Safety lifecycle phase or activity		Objectives	ANSI/ISA-84.00.01-2004 Requirements Clause	ISA84 Technical Report Reference
Figure 1 box number	Title			
1	Hazard and Risk Analysis	To determine the hazards and hazardous events of the process and associated equipment, the sequence of events leading to the hazardous event, the process risks associated with the hazardous event the requirements for risk reduction and the safety functions required to achieve the necessary risk reduction.	8	None
2	**Allocation of safety functions to protection layers**	**Allocation of safety functions to protection layers and for each safety instrumented function, the associated safety integrity level.**	**9**	**ISA-TR84.00.04 Annexes B, F, and J**
3	**SIS safety requirements specification (SRS)**	**To specify the requirements for each SIS, in terms of the required safety instrumented functions and their associated safety integrity, in order to achieve the required functional safety.**	**10**	**No specific guidance on documenting the SRS. An example is shown in ISA-TR84.00.04 Part 2. All three technical reports (ISA-TR84.00.02, 03, and 04) provide fundamental considerations for SRS development.**
4	**SIS design & engineering**	**To design the SIS to meet the requirements for safety instrumented functions and safety integrity.**	**11 & 12.4**	**ISA-TR84.00.04 Annexes F, G, I, K, L, M, N, O, P, and Q** **ISA-TR84.00.02**
5	SIS installation commissioning & validation	To integrate and test the SIS. To validate that the SIS meets, in all respects the requirements for safety in terms of the required safety instrumented functions and the required safety integrity.	12.3, 14, 15	ISA-TR84.00.03
6	SIS operation and maintenance	To ensure that the functional safety of the SIS is maintained during operation and maintenance	16	ISA-TR84.00.03

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(Table 1 continued from previous page)

Safety lifecycle phase or activity		Objectives	ANSI/ISA-84.00.01-2004 Requirements Clause	ISA84 Technical Report Reference
Figure 1 box number	Title			
7	SIS modification	To make corrections, enhancements or adaptations to the SIS, ensuring that the required safety integrity level is achieved and maintained.	17	Apply appropriate safety lifecycle phase during management of change activity
8	Decommissioning	To ensure proper review, sector organization, and ensure Safety Instrumented Function (SIF) remain appropriate.	18	Apply appropriate safety lifecycle phase during project execution
9	SIS verification	To test and evaluate the outputs of a given phase to ensure correctness and consistency with respect to the products and standards provided as input to that phase.	7, 12.7	ISA-TR84.00.04 Annex C, ISA-TR84.00.03, and ISA-TR84.00.02
10	SIS functional safety assessment	To investigate and arrive at a judgement on the functional safety achieved by the SIS.	5	ISA-TR84.00.04 Clause 3 and Annexes A, C, D, E, and S

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1 Purpose

This guideline provides discussion on various topics associated with ANSI/ISA-84.00.01-2004 Parts 1-3 (IEC 61511 Mod) and includes examples of practical ways to implement the standard. This guideline is informative and provides non-mandatory methods or techniques.

There is nothing in this guideline that precludes, replaces, or makes obsolete any requirement of ANSI/ISA-84.00.01-2004 Part 1.

2 Introduction

In the United States of America, the Occupational Safety and Health Administration (US-OSHA) regulation, 29CFR1910.119 (OSHA 1910.119), requires the identification and management of the instrumented systems responsible for safe operation. ISA Standards Panel 84 (ISA84) developed ANSI/ISA-84.01-1996 to define how to manage Safety Instrumented Systems (SIS) using a lifecycle approach. The standard provided a formal, documented process for addressing the design, operation, maintenance, testing and management of change for SIS. The efforts of the ISA84 committee resulted in US-OSHA recognizing ANSI/ISA-84.01-1996 as representing good engineering practice for SIS.

During its initial development, the ISA84 committee relied on existing US functional safety practices, such as those documented in OSHA 1910.119 and by the Center for Chemical Process Safety (CCPS) "*Guidelines for the Safe Automation of Chemical Processes.*" Working in parallel to the ISA84 committee effort, the International Electrotechnical Commission (IEC) was developing IEC 61508. Concepts introduced in the draft international standard were incorporated into ANSI/ISA-84.01-1996, resulting in ANSI/ISA-84.01-1996 being accepted as the US functional safety standard for the process sector. Through ANSI/ISA-84.01-1996, owner/operators have become familiar with terms such as safety integrity levels, safety instrumented systems, and safety instrumented functions.

Since 1996, some countries have utilized ANSI/ISA-84.01-1996, while others have used their own national standard or adopted IEC 61508 when it was released in 1999. In an era where design, engineering, and operation can occur in multiple countries, this diversity of standards resulted in an immediate need for an international, consensus process sector standard.

- The IEC 61511 committee was formed to specifically address safety instrumented systems in the process sector. IEC 61511 was originally developed under the framework of IEC 61508, but over time it has evolved into a completely independent standard with only a few references to IEC 61508. The international consensus standard was issued in 2003. With the completion of IEC 61511, the ISA84 committee accepted IEC 61511 as ISA-84.00.01-2004 (IEC 61511 modified). Once the standard was accepted by ISA, the ISA84 committee immediately initiated the development of this guideline. ANSI approved the new standard as ANSI/ISA-84.00.01-2004 in September 2004.
- ISA-TR84.00.04-1 Annex S provides an overview of the differences between ANSI/ISA-84.01-1996 and ANSI/ISA-84.00.01-2004.
- ISA-TR84.00.04 is intended for readers who are familiar with ANSI/ISA 84.91.01-2012, ISA-TR84.00.02, ISA-TR84.00.03, and ANSI/ISA-84.00.01-2004 (IEC 61511 modified).
- The 2nd edition of ISA-TR84.00.04-1 amended and updated guidance throughout the document. Significant changes were made to guidance related to the user approval (Annex L) and two new annexes were added to address setpoint determination (Annex Q), and performance metrics (Annex R).
- This 3rd edition of ISA-TR84.00.04-1 amends and updates guidance related to existing SIS (Clause 3 and Annex A) and safety alarms (Annex B).