TECHNICAL REPORT

ISA-TR84.00.04-2005 Part 2

Example Implementation of ANSI/ISA-84.00.01-2004 (IEC 61511 Mod)

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NOTE — This example is used with permission from AIChE, CCPS, *Guidelines for Safe Automation of Chemical Processes*, New York, 1993, available from: AIChE, 345 East 47th Street, New York, NY 10017, Tel: (212) 705-7657; and Process Industry Practices (PIP), *Safety Instrumented Systems Guidelines*, available from: Process Industry Practices (PIP), 3925 West Braker Lane (R4500), Austin, TX 78759, Tel: (512) 232-3041, www.PIP.org. The example is modified to meet ANSI/ISA 84.00.01-2004 (IEC 61511 Mod) requirements. This example was chosen to facilitate understanding of SIS application as it progressed from CCPS Guidelines dated 1993 to ANSI/ISA S84.01-1996, to ANSI/ISA 84.00.00.01-2004 (IEC 61511 Mod). This example was also used in Appendix B of AIChE, CCPS, *Layer of Protection Analysis, Simplified Process Risk Assessment,* 2001.

1 Introduction

Used in conjunction with ISA-TR84.00.04-2005 Part 1, the example set forth in this technical report is provided to illustrate how to apply ANSI/ISA-84.00.01-2004 Parts 1-3 (IEC 61511Mod). It is intended to demonstrate one method to meet the requirements of the standards. The reader should be aware that ANSI/ISA-84.00.01-2004 Parts 1-3 (IEC 61511 Mod) is performance based, and that many approaches can be used to achieve compliance. Some of the methods applied in this example include: what-if and HAZOP techniques for hazard and risk analysis, LOPA for allocation of safety functions to protection layers, fault tree analysis for SIL verification, and ladder logic to document the application software requirements. Other techniques and tools could be utilized at each of these steps in the safety lifecycle to meet the requirements of the standards.

NOTE — Throughout this technical report, the term "ISA-84.01-2004" is used to refer to ANSI/ISA-84.00.01-2004 Parts 1-3 (IEC 61511 Mod).

The example utilizes the similar chemical process presented in AIChE CCPS, *Guidelines for Safe Automation of Process Applications*, 1993, and in PIP PCESS001 1999, *Safety Instrumented Systems Guidelines*.

The safety lifecycle application in the CCPS version was based on the initial version of IEC 61508. The safety lifecycle application in the PIP version was based on ANSI/ISA-S84.01-1996. The safety lifecycle example herein is based on ISA-84.01-2004. As a result, the evolution of new design requirements can be assessed by comparing this example with previous versions.

This example selects a subsystem of a process and applies to it the design philosophy, procedures, techniques, and verification methodology discussed in ISA-84.01-2004.

This example shows cradle-to-grave documentation for each SIF. This documentation pedigree gives auditors and plant personnel the means to track the SIF through the safety lifecycle phases back to the process hazards analysis (PHA) that created it. Each SIF is clearly identified in each document to facilitate tracking between lifecycle phases. A vital part of safety is the ability to demonstrate to others (e.g., auditors, regulators, insurance companies) that the risk reduction provided by each SIF is adequate.

This example does not represent a complete design for a polymerization process because of the extensive detail that is required to achieve a high-integrity, safely automated design. As a result, this example includes a number of simplifications.

All references shown refer to information within this example unless otherwise noted.

2 Project Definition

The process is the polymerization of vinyl chloride monomer (VCM),

$$CH_2{=}CHCl$$

to make polyvinyl chloride (PVC),

$$[{-}CH_2{-}CHCl{-}]_n$$