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Safety Fieldbus Design Considerations for Process Industry Sector Applications

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Introduction

Safety Fieldbuses are currently being used in various industrial sectors, such as automotive and machinery, but they have only recently been introduced within the process sector for safety instrumented systems (SISs). ISA84 committee members are concerned that generic Fieldbuses may be incorrectly implemented in SIS applications. Consequently, the ISA84 committee formed Working Group 1 (ISA84 WG1) to develop guidance on the implementation of Safety Fieldbuses as part of an SIS for communicating between a safety logic solver and field devices.

A generic Fieldbus is multi-drop digital network consisting of digital communication cable, terminators, hubs, links/couplers, power supplies, hosts and protocols, along with Fieldbus-compatible devices (Figure 1). It is used to communicate process information to and from multiple field devices within a segment. Fieldbus is a network structure that allows daisy-chain, star, ring, branch, and tree topologies.

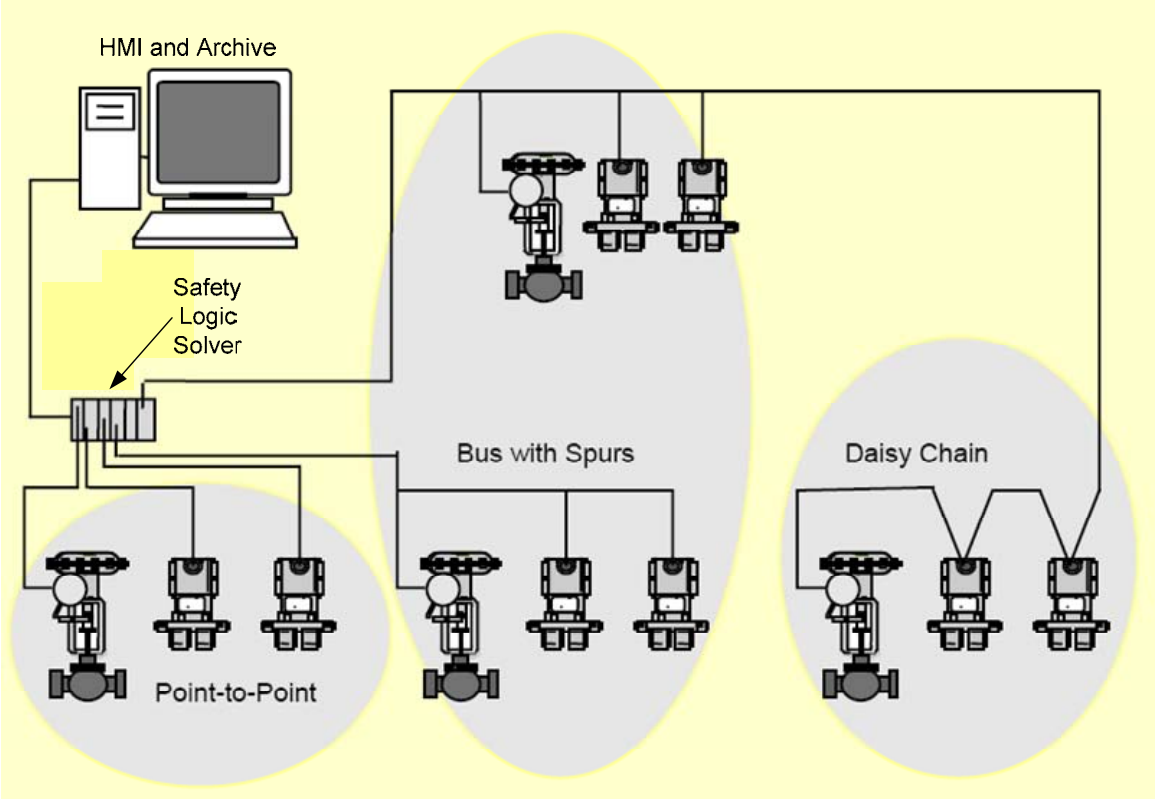

Figure 1 – Generic Safety Fieldbus (adapted from ANSI/ISA-84.01-1996)

ANSI/ISA-84.01-1996, *Application of Safety Instrumented Systems for the Process Industries*, was developed under the assumption that each field device would be wired to the logic solver using dedicated field wiring. That standard did not address the use of a digital bus communications, such as a Fieldbus, for field device communications.

ANSI/ISA-84.01-1996 stated in clause 7.4.1.3, “Each individual field device shall have its own dedicated wiring to the system.” Clause 1.2.10 stated that the standard does not address

technologies not currently utilized in safety systems (e.g., Fieldbuses), but that revisions to the standard will address new technologies as they become available.

ANSI/ISA-84.00.01-2004, Clause 11.6.3 reflects ANSI/ISA-84.01-1996, Clause 7.4.1.3 above, with an added statement that addresses the alternative of “a digital bus communication with overall safety performance that meets the integrity requirements of the SIF (safety instrumented function) it services.” Therefore, a Safety Fieldbus adds to the generic Fieldbus the additional hardware and software features necessary to be compliant with ANSI/ISA-84.00.01-2004.

This technical report addresses the use of Fieldbus for multi-drop digital network communication for implementation of Safety Instrumental Function (SIF) within a safety logic solver designed and managed in compliance with ANSI/ISA-84.00.01-2004. If the reader chooses to implement the safety logic in the Fieldbus segment only, the fieldbus and any instruments executing the safety logic should be evaluated as a logic solver under the requirements of ANSI/ISA-84.00.01-2004. This technical report does not address implementation of the SIF logic within the Fieldbus segment.

1 Scope

1.1 This technical report:

- provides guidance on implementing Safety Fieldbus protocols and devices in safety instrumented systems in the process industries
- recommends additional considerations and practices for the implementation of Safety Fieldbus that are not currently included in ANSI/ISA-84.00.01-2004.

1.2 This technical report addresses Safety Fieldbus design and management. It does not provide detailed implementation guidance, which would be different for each Fieldbus technology.

1.3 This technical report is limited to the application of Safety Fieldbus to communicate between the safety logic solver (i.e., compliant with ANSI/ISA-84.00.01-2004) and multiple field devices. It does not address implementation of the logic within the Fieldbus segment.

2 Criteria

2.1 Safety Requirements

2.1.1 The Safety Fieldbus should meet the requirements of the highest safety integrity level (SIL) of any safety instrumented function (SIF) it supports, as measured by the:

a. hardware integrity

b. hardware fault tolerance

c. systematic integrity

d. data communications integrity

2.1.2 The software/firmware used to carry out the Safety Fieldbus diagnostics should meet the requirements of the highest SIL it supports.

2.1.3 The likelihood of random hardware undetected failures for the Safety Fieldbus should be sufficiently low in comparison to the overall safety integrity requirements. As a rule of thumb, for a demand mode SIS, the Safety Fieldbus should have a PFDavg less than 1% of the target PFDavg for the SIF.

2.1.4 The Safety Fieldbus protocol should be compliant with IEC 61508 requirements to the applicable SIL claim limit.

2.1.5 Open (non-proprietary) protocols should be used to enhance interoperability and integration.

2.2 Speed of Response

2.2.1 The response time of the Safety Fieldbus should be incorporated in the calculation of the overall response time of the SIF (e.g., the time from process deviation detection through the process response to final element action). It is good engineering practice that overall response time should be no more than one-half the process safety time allocated to the SIF.