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Process analysis technology systems as part of safety instrumented systems

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TECHNICAL REPORT

Process analysis technology systems as part of safety instrumented systems

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

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PROCESS ANALYSIS TECHNOLOGY SYSTEMS AS PART OF SAFETY INSTRUMENTED SYSTEMS

FOREWORD

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IEC TR 63176, which is a Technical Report, has been prepared by subcommittee 65B: Measurement and control devices, of IEC technical committee 65: Industrial-process measurement, control and automation.

The text of this technical report is based on the following documents:

Enquiry draft	Report on voting
65B/1111/DTR	65B/1131/RVDTR

Full information on the voting for the approval of this technical report can be found in the report on voting indicated in the above table.

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This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

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INTRODUCTION

This Technical Report is designed as a recommendation to aid users of process analyzer technology that measures installations as part of safety instrumented systems and should be treated exclusively as a recommendation. Formulations of a binding character encountered in the recommendation are due to the safety-related content. However, the advisory character of this document is maintained as a whole. Process analyzer technology measuring equipment is used, for example, in the process industry as sensor components of safety instrumented systems. In many cases, they represent the only or most efficient method for monitoring a process variable, which, for its part, enables a reliable evaluation of designated use of the system to be protected. Owing to the direct material interaction with the process medium, process analyzer technology measuring equipment is in general more susceptible to failure and requires more maintenance than the sensors widely used for pressure, temperature, filling level and flow measurement. A consequence of this interaction is the inability to avoid systematic failure completely. This problem is usually countered by checking the measuring equipment at short, regular intervals.

The variety of process analytical measurement variables and methods and, consequently, the comparatively limited number of process analyzer technology measuring devices used in each case for a single, precisely limited, application makes a quantitative evaluation of functional safety in accordance with IEC 61511 difficult in most cases. Beside the often-inadequate specifications of manufacturers for evaluating components as safety instrumented systems, there are an insufficient number of comparable applications. However, several hundred safety instrumented systems have been successfully realized in the last 30 years among the process analyser community using process analyzer technology measuring equipment.

Measures are proposed in areas where normative requirements cannot be fulfilled, or only inadequately. These measures lead to an equivalent level of safety when applied carefully.

Requirements concerning functional safety of electrical and electronic systems are described in IEC 61508, specified for “Safety instrumented systems for the process industry sector” in the sector standard IEC 61511. The aim of this document is to describe a procedure for the use of process analyzer technology measuring devices as part of safety instrumented systems in a guideline.

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PROCESS ANALYSIS TECHNOLOGY SYSTEMS AS PART OF SAFETY INSTRUMENTED SYSTEMS

1 Scope

This document encompasses recommendations for planning, installation and operation (incl. maintenance) of process analyzer technology measuring equipment in process industry safety instrumented systems. It covers all necessary steps for the qualification of safety equipment and supplements the safety management of safety instrumented system equipment through the addition of special requirements for process analyzer technology equipment. This document does not encompass the entire safety management of safety instrumented system equipment.

The term “qualification” used in this recommendation refers exclusively to the testing of the suitability of the process analyzer technology system for use in a safety instrumented system device. It is different from the term "qualification" used in the pharmaceutical environment.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 61508 (all parts), *Functional safety of electrical/electronic/programmable electronic safety-related systems*

IEC 61508-6:2010, *Functional safety of electrical/electronic/programmable electronic safety-related systems – Part 6: Guidelines on the application of IEC 61508-2 and IEC 61508-3*

IEC 61511 (all parts), *Functional safety – Safety instrumented systems for the process industry sector*

IEC 61511-1:2016, *Functional safety – Safety instrumented systems for the process industry sector – Part 1: Framework, definitions, system, hardware and application programming requirements*

IEC 61326-3-1:2017, *Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 3-1: Immunity requirements for safety-related systems and for equipment intended to perform safety-related functions (functional safety) – General industrial applications*

IEC 61326-3-2:2017, *Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 3-2: Immunity requirements for safety-related systems and for equipment intended to perform safety-related functions (functional safety) – Industrial applications with specified electromagnetic environment*

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

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ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1.1
PAT measuring equipment
process analysis technology systems as entirety of all equipment and media necessary for realization of the substance-related measurement function

Note 1 to entry: An exemplary, but not necessarily complete list includes sampling equipment, sample conveying equipment, sample conditioning equipment, sample recirculation equipment, the analyser, PAT control units and infrastructural equipment such as supply, reference and calibration media and the necessary power supply. From case to case, a required cabinet or the location in an analyser house or room should be included.

3.1.2
basic testing
possible preselection of suitable analytical equipment for safety instrumented systems without any reference to a specific measuring task

Note 1 to entry: This applies exclusively to the testing of analytical equipment according to the criteria mentioned in Annex A.

3.1.3
application testing
test that ensures that the measuring task can be successfully realized with the PAT system

Note 1 to entry: This includes checking the configuration and, occasionally, programming of analytical equipment to correspond to the measuring task, taking the influence of sample processing into consideration, especially its accuracy, determining the influences of the matrix and state variables (pressure, temperature, flow), both of the medium and the analytical equipment environment, and knowledge of the stability over time.

3.1.4
operational experience
knowledge available prior to using an analyser, including the required accessories for comparable measuring tasks

Note 1 to entry: It therefore involves exclusively experience gained through actual use of comparable analytical equipment for comparable measuring tasks.

3.1.5
in-service testing
monitored operation of the PAT system as part of a safety instrumented system during production operation

Note 1 to entry: An explicit differentiation is made here between the procedure in the case of proven operational performance of PAT systems and the corresponding procedure for safety instrumented system equipment.

Note 2 to entry: The test work to be realised, the timetable, specifications for the evaluation of results, additional measures for the fulfilment of the safety function required from case to case during in-service testing and the responsible personnel in this phase should be documented.

3.1.6
proven performance
entirety of knowledge that is part of the final decision in favour of or against the suitability of a proposed process analyser installation as part of a safety instrumented system

Note 1 to entry: Proven performance will be achieved by sufficient operation experience including approvement of suitability of the measuring task. If not practicable, proven performance can be achieved through in-service testing.

Note 2 to entry: Proven performance of PAT is finally determined by a team of experts and differs in the manner of its determination from the method usually used for field devices and PLCs.

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