

# INTERNATIONAL STANDARD

# NORME INTERNATIONALE



**Functional safety – Safety instrumented systems for the process industry sector –  
Part 2: Guidelines for the application of IEC 61511-1: 2016**

**Sécurité fonctionnelle – Systèmes instrumentés de sécurité pour le secteur  
des industries de transformation –  
Partie 2: Lignes directrices pour l'application de l'IEC 61511-1:2016**



## THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2016 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

Droits de reproduction réservés. Sauf indication contraire, aucune partie de cette publication ne peut être reproduite ni utilisée sous quelque forme que ce soit et par aucun procédé, électronique ou mécanique, y compris la photocopie et les microfilms, sans l'accord écrit de l'IEC ou du Comité national de l'IEC du pays du demandeur. Si vous avez des questions sur le copyright de l'IEC ou si vous désirez obtenir des droits supplémentaires sur cette publication, utilisez les coordonnées ci-après ou contactez le Comité national de l'IEC de votre pays de résidence.

IEC Central Office  
3, rue de Varembe  
CH-1211 Geneva 20  
Switzerland

Tel.: +41 22 919 02 11  
Fax: +41 22 919 03 00  
[info@iec.ch](mailto:info@iec.ch)  
[www.iec.ch](http://www.iec.ch)

### About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

### About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigenda or an amendment might have been published.

#### IEC Catalogue - [webstore.iec.ch/catalogue](http://webstore.iec.ch/catalogue)

The stand-alone application for consulting the entire bibliographical information on IEC International Standards, Technical Specifications, Technical Reports and other documents. Available for PC, Mac OS, Android Tablets and iPad.

#### IEC publications search - [www.iec.ch/searchpub](http://www.iec.ch/searchpub)

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee,...). It also gives information on projects, replaced and withdrawn publications.

#### IEC Just Published - [webstore.iec.ch/justpublished](http://webstore.iec.ch/justpublished)

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and also once a month by email.

#### Electropedia - [www.electropedia.org](http://www.electropedia.org)

The world's leading online dictionary of electronic and electrical terms containing 20 000 terms and definitions in English and French, with equivalent terms in 15 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

#### IEC Glossary - [std.iec.ch/glossary](http://std.iec.ch/glossary)

65 000 electrotechnical terminology entries in English and French extracted from the Terms and Definitions clause of IEC publications issued since 2002. Some entries have been collected from earlier publications of IEC TC 37, 77, 86 and CISPR.

#### IEC Customer Service Centre - [webstore.iec.ch/csc](http://webstore.iec.ch/csc)

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: [csc@iec.ch](mailto:csc@iec.ch).

### A propos de l'IEC

La Commission Electrotechnique Internationale (IEC) est la première organisation mondiale qui élabore et publie des Normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

### A propos des publications IEC

Le contenu technique des publications IEC est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

#### Catalogue IEC - [webstore.iec.ch/catalogue](http://webstore.iec.ch/catalogue)

Application autonome pour consulter tous les renseignements bibliographiques sur les Normes internationales, Spécifications techniques, Rapports techniques et autres documents de l'IEC. Disponible pour PC, Mac OS, tablettes Android et iPad.

#### Recherche de publications IEC - [www.iec.ch/searchpub](http://www.iec.ch/searchpub)

La recherche avancée permet de trouver des publications IEC en utilisant différents critères (numéro de référence, texte, comité d'études,...). Elle donne aussi des informations sur les projets et les publications remplacées ou retirées.

#### IEC Just Published - [webstore.iec.ch/justpublished](http://webstore.iec.ch/justpublished)

Restez informé sur les nouvelles publications IEC. Just Published détaille les nouvelles publications parues. Disponible en ligne et aussi une fois par mois par email.

#### Electropedia - [www.electropedia.org](http://www.electropedia.org)

Le premier dictionnaire en ligne de termes électroniques et électriques. Il contient 20 000 termes et définitions en anglais et en français, ainsi que les termes équivalents dans 15 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

#### Glossaire IEC - [std.iec.ch/glossary](http://std.iec.ch/glossary)

65 000 entrées terminologiques électrotechniques, en anglais et en français, extraites des articles Termes et Définitions des publications IEC parues depuis 2002. Plus certaines entrées antérieures extraites des publications des CE 37, 77, 86 et CISPR de l'IEC.

#### Service Clients - [webstore.iec.ch/csc](http://webstore.iec.ch/csc)

Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions contactez-nous: [csc@iec.ch](mailto:csc@iec.ch).

# INTERNATIONAL STANDARD

# NORME INTERNATIONALE



**Functional safety – Safety instrumented systems for the process industry sector –**

**Part 2: Guidelines for the application of IEC 61511-1: 2016**

**Sécurité fonctionnelle – Systèmes instrumentés de sécurité pour le secteur des industries de transformation –**

**Partie 2: Lignes directrices pour l'application de l'IEC 61511-1:2016**

INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

COMMISSION  
ELECTROTECHNIQUE  
INTERNATIONALE

ICS 13.110; 25.040.01

ISBN 978-2-8322-3227-9

**Warning! Make sure that you obtained this publication from an authorized distributor.  
Attention! Veuillez vous assurer que vous avez obtenu cette publication via un distributeur agréé.**

## CONTENTS

FOREWORD.....	9
INTRODUCTION.....	11
1 Scope.....	13
2 Normative references .....	13
3 Terms, definitions, and abbreviations .....	13
Annex A (informative) Guidance for IEC 61511-1.....	14
A.1 Scope .....	14
A.2 Normative references .....	14
A.3 Terms, definitions and abbreviations.....	14
A.4 Conformance to the IEC 61511-1:–.....	14
A.5 Management of functional safety .....	14
A.5.1 Objective .....	14
A.5.2 Guidance to "Requirements".....	14
A.6 Safety life-cycle requirements.....	23
A.6.1 Objectives.....	23
A.6.2 Guidance to "Requirements".....	23
A.6.3 Guidance to "Application program SIS safety life-cycle requirements" .....	24
A.7 Verification.....	25
A.7.1 Objective .....	25
A.7.2 Guidance to "Requirements".....	25
A.8 Process hazard and risk assessment (H&RA) .....	27
A.8.1 Objectives.....	27
A.8.2 Guidance to "Requirements".....	27
A.9 Allocation of safety functions to protection layers .....	30
A.9.1 Objective .....	30
A.9.2 Guidance to "Requirements of the allocation process".....	30
A.9.3 Guidance to "Requirements on the basic process control system as a protection layer".....	32
A.9.4 Guidance to "Requirements for preventing common cause, common mode and dependent failures" .....	35
A.10 SIS safety requirements specification .....	36
A.10.1 Objective .....	36
A.10.2 Guidance to "General requirements".....	36
A.10.3 Guidance to "SIS safety requirements" .....	36
A.11 SIS design and engineering.....	40
A.11.1 Objective .....	40
A.11.2 Guidance to "General requirements".....	40
A.11.3 Guidance to "Requirements for system behaviour on detection of a fault".....	47
A.11.4 Guidance to "Hardware fault tolerance" .....	47
A.11.5 Guidance to "Requirements for selection of devices".....	50
A.11.6 Field devices .....	53
A.11.7 Interfaces .....	53
A.11.8 Guidance to "Maintenance or testing design requirements" .....	55
A.11.9 Guidance to "Quantification of random failure".....	56
A.12 SIS application program development.....	62

A.12.1	Objective .....	62
A.12.2	Guidance to "General requirements" .....	62
A.12.3	Guidance to "Application program design" .....	64
A.12.4	Guidance to "Application program implementation" .....	66
A.12.5	Guidance to "Requirements for application program verification (review and testing)" .....	67
A.12.6	Guidance to "Requirements for application program methodology and tools" .....	70
A.13	Factory acceptance testing (FAT) .....	73
A.13.1	Objectives .....	73
A.13.2	Guidance to "Recommendations" .....	73
A.14	SIS installation and commissioning .....	73
A.14.1	Objectives .....	73
A.14.2	Guidance to "Requirements" .....	73
A.15	SIS safety validation .....	74
A.15.1	Objective .....	74
A.15.2	Guidance to "Requirements" .....	74
A.16	SIS operation and maintenance .....	74
A.16.1	Objectives .....	74
A.16.2	Guidance to "Requirements" .....	75
A.16.3	Proof testing and inspection .....	76
A.17	SIS modification .....	78
A.17.1	Objective .....	78
A.17.2	Guidance to "Requirements" .....	79
A.18	SIS decommissioning .....	79
A.18.1	Objectives .....	79
A.18.2	Guidance to "Requirements" .....	79
A.19	Information and documentation requirements .....	80
A.19.1	Objectives .....	80
A.19.2	Guidance to "Requirements" .....	80
Annex B (informative)	Example of SIS logic solver application program development using function block diagram .....	81
B.1	General .....	81
B.2	Application program development and validation philosophy .....	81
B.3	Application description .....	82
B.3.1	General .....	82
B.3.2	Process description .....	82
B.3.3	Safety instrumented functions .....	83
B.3.4	Risk reduction and domino effects .....	84
B.4	Application program safety life-cycle execution .....	84
B.4.1	General .....	84
B.4.2	Inputs to application program SRS development .....	84
B.4.3	Application program design and development .....	87
B.4.4	Application program production .....	101
B.4.5	Application program verification and testing .....	101
B.4.6	Validation .....	101
Annex C (informative)	Considerations when converting from NP technologies to PE technologies .....	102

Annex D (informative) Example of how to get from a piping and instrumentation diagram (P&ID) to application program .....	104
Annex E (informative) Methods and tools for application programming .....	107
E.1 Typical toolset for application programming .....	107
E.2 Rules and constraints for application program design .....	108
E.3 Rules and constraints for application programming .....	108
Annex F (informative) Example SIS project illustrating each phase of the safety life cycle with application program development using relay ladder language .....	110
F.1 Overview .....	110
F.2 Project definition .....	110
F.2.1 General .....	110
F.2.2 Conceptual planning .....	111
F.2.3 Process hazards analysis .....	111
F.3 Simplified process description .....	111
F.4 Preliminary design .....	113
F.5 IEC 61511 application .....	113
F.5.1 General .....	113
F.5.2 Step F.1: Hazard & risk assessment .....	117
F.5.3 Hazard identification .....	117
F.5.4 Preliminary hazard evaluation .....	117
F.5.5 Accident history .....	117
F.6 Preliminary process design safety considerations .....	120
F.7 Recognized process hazards .....	120
F.8 Process design definitions strategy .....	121
F.9 Preliminary hazard assessment .....	124
F.9.1 General .....	124
F.9.2 Step F.2: Allocation of safety functions .....	128
F.10 SIF safety integrity level determination .....	129
F.11 Layer of protection analysis (LOPA) applied to example .....	129
F.12 Tolerable risk criteria .....	130
F.13 Step F.3: SIS safety requirements specifications .....	133
F.13.1 Overview .....	133
F.13.2 Input requirements .....	133
F.13.3 Safety functional requirements .....	134
F.13.4 Safety integrity requirements .....	135
F.14 Functional description and conceptual design .....	136
F.14.1 Narrative for example reactor system logic .....	136
F.15 SIL verification calculations .....	137
F.16 Application program requirements .....	144
F.17 Step F.4: SIS safety life-cycle .....	151
F.18 Technology and device selection .....	151
F.18.1 General .....	151
F.18.2 Logic solver .....	151
F.18.3 Sensors .....	152
F.18.4 Final elements .....	152
F.18.5 Solenoid valves .....	152
F.18.6 Emergency vent valves .....	153
F.18.7 Modulating valves .....	153
F.18.8 Bypass valves .....	153

F.18.9	Human-machine interfaces (HMIs).....	153
F.18.10	Separation.....	154
F.19	Common cause and systematic failures.....	155
F.19.1	General.....	155
F.19.2	Diversity.....	155
F.19.3	Specification errors.....	155
F.19.4	Hardware design errors.....	155
F.19.5	Software design errors.....	156
F.19.6	Environmental overstress.....	156
F.19.7	Temperature.....	156
F.19.8	Humidity.....	156
F.19.9	Contaminants.....	157
F.19.10	Vibration.....	157
F.19.11	Grounding.....	157
F.19.12	Power line conditioning.....	157
F.19.13	Electro-magnetic compatibility (EMC).....	157
F.19.14	Utility sources.....	158
F.19.15	Sensors.....	159
F.19.16	Process corrosion or fouling.....	159
F.19.17	Maintenance.....	159
F.19.18	Susceptibility to mis-operation.....	159
F.19.19	SIS architecture.....	159
F.20	SIS application program design features.....	160
F.21	Wiring practices.....	161
F.22	Security.....	161
F.23	Step F.5: SIS installation, commissioning, validation.....	162
F.24	Installation.....	162
F.25	Commissioning.....	163
F.26	Documentation.....	164
F.27	Validation.....	164
F.28	Testing.....	165
F.29	Step F.6: SIS operation and maintenance.....	178
F.30	Step F.7: SIS Modification.....	181
F.31	Step F.8: SIS decommissioning.....	181
F.32	Step F.9: SIS verification.....	181
F.33	Step F.10: Management of functional safety and SIS FSA.....	182
F.34	Management of functional safety.....	183
F.34.1	General.....	183
F.34.2	Competence of personnel.....	183
F.35	Functional safety assessment.....	183
Annex G (informative)	Guidance on developing application programming practices.....	184
G.1	Purpose of this guidance.....	184
G.2	Generic safe application programming attributes.....	184
G.3	Reliability.....	184
G.3.1	General.....	184
G.3.2	Predictability of memory utilisation.....	185
G.3.3	Predictability of control flow.....	186
G.3.4	Accounting for precision and accuracy.....	188
G.3.5	Predictability of timing.....	190

G.4	Predictability of mathematical or logical result.....	190
G.5	Robustness.....	191
G.5.1	General .....	191
G.5.2	Controlling use of diversity .....	191
G.5.3	Controlling use of exception handling .....	192
G.5.4	Checking input and output.....	193
G.6	Traceability .....	194
G.6.1	General .....	194
G.6.2	Controlling use of built-in functions.....	194
G.6.3	Controlling use of compiled libraries .....	194
G.7	Maintainability.....	194
G.7.1	General .....	194
G.7.2	Readability.....	195
G.7.3	Data abstraction.....	198
G.7.4	Functional cohesiveness .....	199
G.7.5	Malleability .....	199
G.7.6	Portability .....	199
	Bibliography .....	201
	Figure 1 – Overall framework of IEC 61511 series.....	12
	Figure A.1 – Application program V-Model.....	25
	Figure A.2 – Independence of a BPCS protection layer and an initiating source in the BPCS .....	34
	Figure A.3 – Independence of two protection layers allocated to the BPCS .....	35
	Figure A.4 – Relationship of system, SIS hardware, and SIS application program.....	39
	Figure A.5 – Illustration of uncertainties on a reliability parameter.....	60
	Figure A.6 – Illustration of the 70 % confidence upper bound .....	61
	Figure A.7 – Typical probabilistic distribution of target results from Monte Carlo simulation.....	62
	Figure B.1 – Process flow diagram for SIF 02.01 .....	83
	Figure B.2 – Process flow diagram for SIF 06.02 .....	84
	Figure B.3 – Functional specification of SIF02.01 and SIF 06.02.....	85
	Figure B.4 – SIF 02.01 hardware functional architecture .....	85
	Figure B.5 – SIF 06.02 hardware functional architecture .....	86
	Figure B.6 – Hardware specification for SOV extracted from piping and instrumentation diagram.....	86
	Figure B.7 – SIF 02.01 hardware physical architecture .....	87
	Figure B.8 – SIF 06.02 hardware physical architecture .....	87
	Figure B.9 – Hierarchical structure of model integration .....	91
	Figure B.10 – Hierarchical structure of model integration including models of safety properties and of BPCS logic .....	93
	Figure B.11 – State transition diagram .....	94
	Figure B.12 – SOV typical block diagram.....	95
	Figure B.13 – SOV typical model block diagram .....	96
	Figure B.14 – Typical model block diagram implementation – BPCS part.....	98
	Figure B.15 – SOV application program typical model implementation – SIS part .....	99



Figure B.16 – Complete model for final implementation model checking .....	101
Figure D.1 – Example of P&ID for an oil and gas separator .....	104
Figure D.2 – Example of (part of) an ESD cause & effect diagram (C&E).....	105
Figure D.3 – Example of (part of) an application program in a safety PLC function block programming .....	106
Figure F.1 – Simplified flow diagram: the PVC process .....	112
Figure F.2 – SIS safety life-cycle phases and FSA stages.....	114
Figure F.3 – Example of the preliminary P&ID for PVC reactor unit .....	123
Figure F.4 – SIF S-1 Bubble diagram showing the PFD <sub>avg</sub> of each SIS device.....	139
Figure F.5 – S-1 Fault tree .....	140
Figure F.6 – SIF S-2 Bubble diagram showing the PFD <sub>avg</sub> of each SIS device.....	141
Figure F.7 – SIF S-2 fault tree.....	142
Figure F.8 – SIF S-3 Bubble diagram showing the PFD <sub>avg</sub> of each SIS device.....	143
Figure F.9 – SIF S-3 fault tree.....	144
Figure F.10 – P&ID for PVC reactor unit SIF.....	145
Figure F.11 – Legend (1 of 5).....	146
Figure F.12 – SIS for the VCM reactor.....	160
<b>ITeh STANDARD PREVIEW</b>	
Table B.1 – Modes of operation specification.....	88
Table B.2 – State transition table.....	93
Table F.1 – SIS safety life-cycle overview .....	115
Table F.2 – SIS safety life-cycle – Box 1.....	117
Table F.3 – Some physical properties of vinyl chloride.....	119
Table F.4 – What-If/Checklist .....	125
Table F.5 – HAZOP .....	126
Table F.6 – Partial summary of hazard assessment for SIF strategy development .....	127
Table F.7 – SIS safety life-cycle – Box 2 .....	129
Table F.8 – Tolerable risk ranking .....	131
Table F.9 – VCM reactor example: LOPA based integrity level.....	132
Table F.10 – SIS safety life-cycle – Box 3 .....	133
Table F.11 – Safety instrumented functions and SILs.....	133
Table F.12 – Functional relationship of I/O for the SIF(s) .....	134
Table F.13 – SIS sensors, normal operating range & trip points .....	134
Table F.14 – Cause and effect diagram .....	137
Table F.15 – MTTFd figures of SIS F.1 devices .....	138
Table F.16 – SIS safety life-cycle – Box 4 .....	151
Table F.17 – SIS safety life-cycle – Box 5 .....	162
Table F.18 – List of instrument types and testing procedures used.....	166
Table F.19 – Interlock check procedure bypass/simulation check sheet.....	178
Table F.20 – SIS safety life-cycle – Box 6 .....	178
Table F.21 – SIS trip log .....	179
Table F.22 – SIS device failure log.....	179
Table F.23 – SIS safety life-cycle – Box 7 .....	181

Table F.24 – SIS safety life-cycle – Box 8 .....	181
Table F.25 – SIS safety life-cycle – Box 9 .....	182
Table F.26 – SIS safety life-cycle – Box 10.....	182

**iTeh STANDARD PREVIEW**  
**(standards.iteh.ai)**

[IEC 61511-2:2016](https://standards.iteh.ai/catalog/standards/sist/f93f8b02-1d58-4a76-b321-df8609422e5e/iec-61511-2-2016)

<https://standards.iteh.ai/catalog/standards/sist/f93f8b02-1d58-4a76-b321-df8609422e5e/iec-61511-2-2016>

## INTERNATIONAL ELECTROTECHNICAL COMMISSION

---

**FUNCTIONAL SAFETY –  
SAFETY INSTRUMENTED SYSTEMS  
FOR THE PROCESS INDUSTRY SECTOR –****Part 2: Guidelines for the application of IEC 61511-1:2016**

## FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as “IEC Publication(s)”). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 61511-2 has been prepared by subcommittee 65A: System aspects, of IEC technical committee 65: Industrial-process measurement, control and automation.

This second edition cancels and replaces the first edition published in 2003. This edition constitutes a technical revision. This edition includes the following significant technical changes with respect to the previous edition:

- guidance examples based on all phases of the safety life cycle provided based on usage experience with IEC61511 1<sup>st</sup> edition;
- annexes replaced to address transition from software to application programming.

The text of this standard is based on the following documents:

FDIS	Report on voting
65A/783/FDIS	65A/787/RVD

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

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

This International Standard is to be read in conjunction with IEC 61511-1. It is based on the second edition of that standard.

A list of all parts in the IEC 61511 series, published under the general title *Functional safety – Safety instrumented systems for the process industry sector*, can be found on the IEC website.

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

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

**iTeh STANDARD PREVIEW**  
(standards.iteh.ai)

IEC 61511-2:2016

<https://standards.iteh.ai/catalog/standards/sist/d3f8b02-1d58-4a76-b321-361055e01616/iec-61511-2-2016>

**IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.**

## INTRODUCTION

Safety instrumented systems (SISs) have been used for many years to perform safety instrumented functions (SIFs) in the process industries. If instrumentation is to be effectively used for SIFs, it is essential that this instrumentation achieves certain minimum standards.

The IEC 61511 series addresses the application of SISs for the process industries. It also deals with the interface between SISs and other safety systems in requiring that a process H&RA be carried out. The SIS includes sensors, logic solvers and final elements.

The IEC 61511 series has two concepts, which are fundamental to its application; SIS safety life-cycle and the safety integrity level (SIL). The SIS safety life-cycle forms the central framework which links together most of the concepts in this International Standard.

The SIS logic solvers addressed include Electrical (E)/Electronic (E)/ and Programmable Electronic (PE) technology. Where other technologies are used for logic solvers, the basic principles of this standard can be applied to ensure the functional safety requirements were met. The IEC 61511 series also addresses the SIS sensors and final elements regardless of the technology used. The IEC 61511 series has been developed as a process sector implementation of the IEC 61508 series. The IEC 61511 series is process industry specific within the framework of the IEC 61508 series.

The IEC 61511 series sets out an approach for SIS safety life-cycle activities to achieve these minimum standards. This approach has been adopted in order that a rational and consistent technical policy is used. The objective of this part of IEC 61511 is to provide guidance on how to comply with IEC 61511-1:2016.

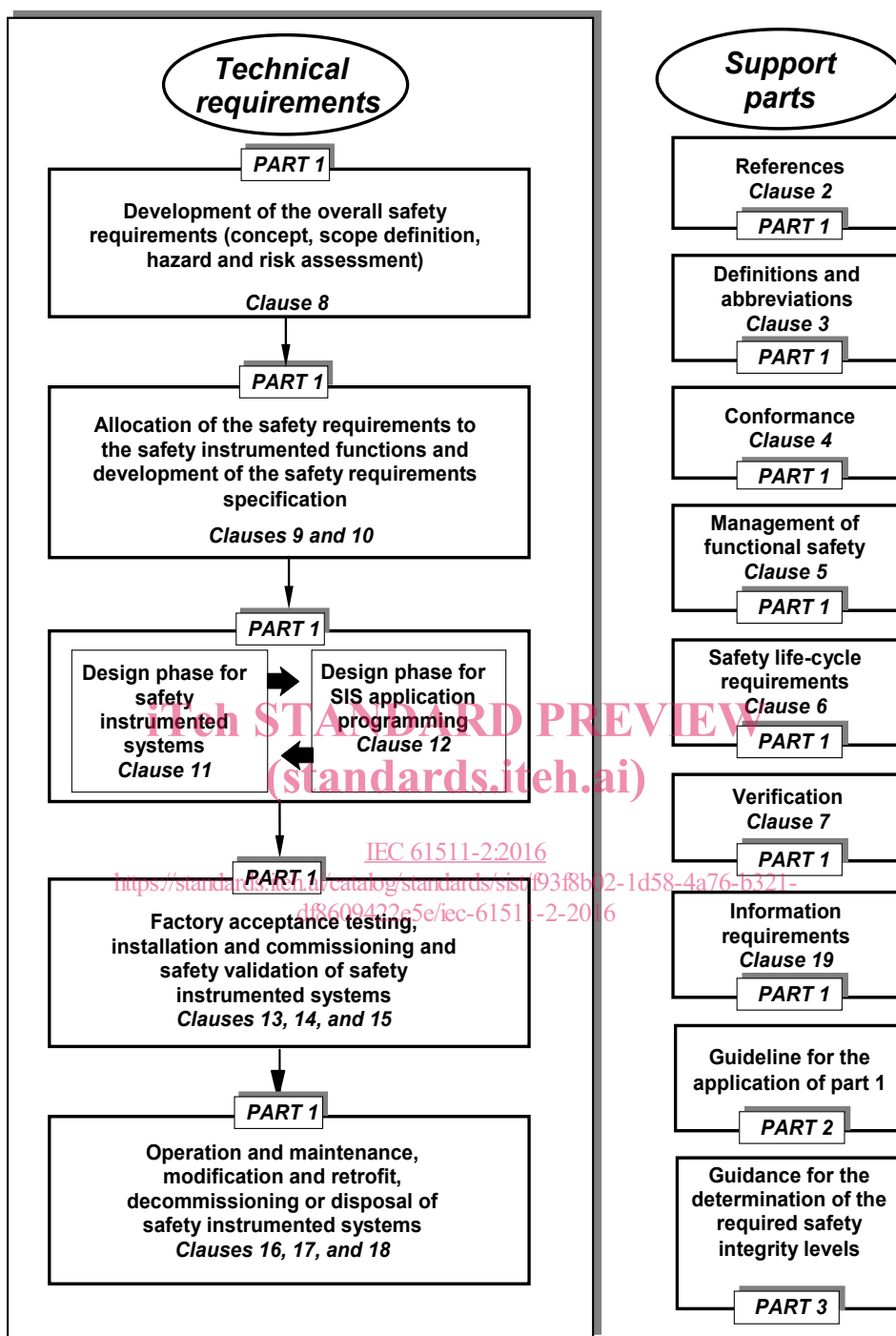
To facilitate use of IEC 61511-1:2016, the clause numbers provided in Annex A (informative) are identical to the corresponding normative text in IEC 61511-1:2016 except for the “A” notation.

In most situations, safety is best achieved by an inherently safe process design whenever practicable, combined, if necessary, with a number of protective systems which rely on different technologies (e.g., chemical, mechanical, hydraulic, pneumatic, electrical, electronic, thermodynamic (e.g., flame arrestors), programmable electronic) which manage any residual identified risk. Any safety strategy considers each individual SIS in the context of the other protective systems. To facilitate this approach, IEC 61511-1:2016:

- requires that a H&RA is carried out to identify the overall safety requirements;
- requires that an allocation of the safety requirements to the safety functions and related safety systems, such as the SIS(s), is carried out;
- works within a framework which is applicable to all instrumented methods of achieving functional safety;
- details the use of certain activities, such as safety management, which may be applicable to all methods of achieving functional safety.
- addresses relevant SIS safety life-cycle stages from initial concept, through design, implementation, operation and maintenance and decommissioning;
- enables existing or new country specific process industry standards to be harmonized with this standard.

The IEC 61511 series is intended to lead to a high level of consistency (e.g., of underlying principles, terminology, information) within the process industries. This should have both safety and economic benefits.

Figure 1 below shows the overall framework of the IEC 61511 series.



IEC

Figure 1 – Overall framework of IEC 61511 series

# FUNCTIONAL SAFETY – SAFETY INSTRUMENTED SYSTEMS FOR THE PROCESS INDUSTRY SECTOR –

## Part 2: Guidelines for the application of IEC 61511-1:2016

### 1 Scope

This part of IEC 61511 provides guidance on the specification, design, installation, operation and maintenance of SIFs and related SIS as defined in IEC 61511-1:2016.

NOTE 1 Annex A (informative) has been organized so that each clause and subclause number therein addresses the corresponding clause and subclause number in IEC 61511-1:2016 except for being preceded by "A".

NOTE 2 Annex A now contains material previously in the body of the first edition. These changes are required for compliance with IEC rules which prohibit a standard being wholly informative.

NOTE 3 To achieve maximum use of this guideline;

- review the section guidance as well as the specific clause guidance. (e.g., when looking for guidance on 5.2.6.1.3, consider guidance in 5.2.6);
- when specific clause guidance is not provided (e.g.; no further guidance provided), consider reviewing the section guidance as well, as it can be applicable.

NOTE 4 Examples given in the Annexes of this Standard are intended only as case specific examples of implementing IEC 61511 requirements in a specific instance, and the user should satisfy themselves that the chosen methods and techniques are appropriate to their situation.

[IEC 61511-2:2016](#)

### 2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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

### 3 Terms, definitions, and abbreviations

For the purposes of this document, the terms, definitions, and abbreviations given in IEC 61511-1:–, Clause 3 apply.