

# INTERNATIONAL STANDARD

# NORME INTERNATIONALE



HORIZONTAL STANDARD  
NORME HORIZONTALE

**Insulation co-ordination –  
Part 2: Application guidelines**

**Coordination de l'isolement –  
Partie 2: Lignes directrices en matière d'application**

Withdrawing



**THIS PUBLICATION IS COPYRIGHT PROTECTED**  
**Copyright © 2018 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  
[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 - [webstore.iec.ch/advsearchform](http://webstore.iec.ch/advsearchform)

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 21 000 terms and definitions in English and French, with equivalent terms in 16 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

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

67 000 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: [sales@iec.ch](mailto:sales@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 - [webstore.iec.ch/advsearchform](http://webstore.iec.ch/advsearchform)

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 21 000 termes et définitions en anglais et en français, ainsi que les termes équivalents dans 16 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

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

67 000 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: [sales@iec.ch](mailto:sales@iec.ch).

# INTERNATIONAL STANDARD

# NORME INTERNATIONALE



HORIZONTAL STANDARD  
NORME HORIZONTALE

**Insulation co-ordination –  
Part 2: Application guidelines**

**Coordination de l'isolement –  
Partie 2: Lignes directrices en matière d'application**

INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

COMMISSION  
ELECTROTECHNIQUE  
INTERNATIONALE

ICS 29.080.30

ISBN 978-2-8322-5405-9

**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 .....	8
1 Scope .....	10
2 Normative references .....	10
3 Terms, definitions, abbreviated terms and symbols .....	11
3.1 Terms and definitions .....	11
3.2 Abbreviated terms .....	11
3.3 Symbols .....	11
4 Representative voltage stresses in service .....	16
4.1 Origin and classification of voltage stresses .....	16
4.2 Characteristics of overvoltage protection devices .....	17
4.2.1 General remarks .....	17
4.2.2 Metal-oxide surge arresters without gaps (MOSA) .....	17
4.2.3 Line surge arresters (LSA) for overhead transmission and distribution lines .....	19
4.3 Representative voltages and overvoltages .....	19
4.3.1 Continuous (power-frequency) voltage .....	19
4.3.2 Temporary overvoltages .....	20
4.3.3 Slow-front overvoltages .....	23
4.3.4 Fast-front overvoltages .....	29
4.3.5 Very-fast-front overvoltages [13] .....	33
5 Co-ordination withstand voltage .....	34
5.1 Insulation strength characteristics .....	34
5.1.1 General .....	34
5.1.2 Influence of polarity and overvoltage shapes .....	35
5.1.3 Phase-to-phase and longitudinal insulation .....	36
5.1.4 Influence of weather conditions on external insulation .....	36
5.1.5 Probability of disruptive discharge of insulation .....	37
5.2 Performance criterion .....	38
5.3 Insulation co-ordination procedures .....	39
5.3.1 General .....	39
5.3.2 Insulation co-ordination procedures for continuous (power-frequency) voltage and temporary overvoltage .....	40
5.3.3 Insulation co-ordination procedures for slow-front overvoltages .....	40
5.3.4 Insulation co-ordination procedures for fast-front overvoltages .....	45
6 Required withstand voltage .....	46
6.1 General remarks .....	46
6.2 Atmospheric correction .....	46
6.2.1 General remarks .....	46
6.2.2 Altitude correction .....	46
6.3 Safety factors .....	48
6.3.1 General .....	48
6.3.2 Ageing .....	48
6.3.3 Production and assembly dispersion .....	48
6.3.4 Inaccuracy of the withstand voltage .....	48
6.3.5 Recommended safety factors ( $K_S$ ) .....	49
7 Standard withstand voltage and testing procedures .....	49

7.1	General remarks .....	49
7.1.1	Overview .....	49
7.1.2	Standard switching impulse withstand voltage .....	49
7.1.3	Standard lightning impulse withstand voltage .....	50
7.2	Test conversion factors .....	50
7.2.1	Range I .....	50
7.2.2	Range II .....	51
7.3	Determination of insulation withstand by type tests .....	51
7.3.1	Test procedure dependency upon insulation type .....	51
7.3.2	Non-self-restoring insulation .....	52
7.3.3	Self-restoring insulation .....	52
7.3.4	Mixed insulation .....	52
7.3.5	Limitations of the test procedures .....	53
7.3.6	Selection of the type test procedures .....	54
7.3.7	Selection of the type test voltages .....	54
8	Special considerations for overhead lines .....	55
8.1	General remarks .....	55
8.2	Insulation co-ordination for operating voltages and temporary overvoltages .....	55
8.3	Insulation co-ordination for slow-front overvoltages .....	55
8.3.1	General .....	55
8.3.2	Earth-fault overvoltages .....	56
8.3.3	Energization and re-energization overvoltages .....	56
8.4	Insulation co-ordination for lightning overvoltages .....	56
8.4.1	General .....	56
8.4.2	Distribution lines .....	56
8.4.3	Transmission lines .....	57
9	Special considerations for substations .....	57
9.1	General remarks .....	57
9.1.1	Overview .....	57
9.1.2	Operating voltage .....	57
9.1.3	Temporary overvoltage .....	57
9.1.4	Slow-front overvoltages .....	58
9.1.5	Fast-front overvoltages .....	58
9.2	Insulation co-ordination for overvoltages .....	58
9.2.1	Substations in distribution systems with $U_m$ up to 36 kV in range I .....	58
9.2.2	Substations in transmission systems with $U_m$ between 52,5 kV and 245 kV in range I .....	59
9.2.3	Substations in transmission systems in range II .....	60
Annex A (informative) Determination of temporary overvoltages due to earth faults .....		61
Annex B (informative) Weibull probability distributions .....		65
B.1	General remarks .....	65
B.2	Disruptive discharge probability of external insulation .....	66
B.3	Cumulative frequency distribution of overvoltages .....	68
Annex C (informative) Determination of the representative slow-front overvoltage due to line energization and re-energization .....		71
C.1	General remarks .....	71
C.2	Probability distribution of the representative amplitude of the prospective overvoltage phase-to-earth .....	71

C.3	Probability distribution of the representative amplitude of the prospective overvoltage phase-to-phase .....	71
C.4	Insulation characteristic .....	73
C.5	Numerical example .....	75
Annex D	(informative) Transferred overvoltages in transformers .....	81
D.1	General remarks .....	81
D.2	Transferred temporary overvoltages .....	82
D.3	Capacitively transferred surges .....	82
D.4	Inductively transferred surges .....	84
Annex E	(informative) Lightning overvoltages .....	88
E.1	General remarks .....	88
E.2	Determination of the limit distance ( $X_p$ ) .....	88
E.2.1	Protection with arresters in the substation .....	88
E.2.2	Self-protection of substation .....	89
E.3	Estimation of the representative lightning overvoltage amplitude .....	90
E.3.1	General .....	90
E.3.2	Shielding penetration .....	90
E.3.3	Back flashovers .....	91
E.4	Simplified method .....	93
E.5	Assumed maximum value of the representative lightning overvoltage .....	95
Annex F	(informative) Calculation of air gap breakdown strength from experimental data .....	96
F.1	General .....	96
F.2	Insulation response to power-frequency voltages .....	96
F.3	Insulation response to slow-front overvoltages .....	97
F.4	Insulation response to fast-front overvoltages .....	98
Annex G	(informative) Examples of insulation co-ordination procedure .....	102
G.1	Overview .....	102
G.2	Numerical example for a system in range I (with nominal voltage of 230 kV) .....	102
G.2.1	General .....	102
G.2.2	Part 1: no special operating conditions .....	103
G.2.3	Part 2: influence of capacitor switching at station 2 .....	110
G.2.4	Part 3: flow charts related to the example of Clause G.2 .....	112
G.3	Numerical example for a system in range II (with nominal voltage of 735 kV) .....	117
G.3.1	General .....	117
G.3.2	Step 1: determination of the representative overvoltages – values of $U_{rp}$ .....	117
G.3.3	Step 2: determination of the co-ordination withstand voltages – values of $U_{CW}$ .....	118
G.3.4	Step 3: determination of the required withstand voltages – values of $U_{rw}$ .....	119
G.3.5	Step 4: conversion to switching impulse withstand voltages (SIWV) .....	120
G.3.6	Step 5: selection of standard insulation levels .....	120
G.3.7	Considerations relative to phase-to-phase insulation co-ordination .....	121
G.3.8	Phase-to-earth clearances .....	122
G.3.9	Phase-to-phase clearances .....	122
G.4	Numerical example for substations in distribution systems with $U_m$ up to 36 kV in range I .....	123
G.4.1	General .....	123

G.4.2	Step 1: determination of the representative overvoltages – values of $U_{rp}$ .....	123
G.4.3	Step 2: determination of the co-ordination withstand voltages – values of $U_{cw}$ .....	124
G.4.4	Step 3: determination of required withstand voltages – values of $U_{rw}$ .....	125
G.4.5	Step 4: conversion to standard short-duration power-frequency and lightning impulse withstand voltages .....	126
G.4.6	Step 5: selection of standard withstand voltages .....	126
G.4.7	Summary of insulation co-ordination procedure for the example of Clause G.4 .....	127
Annex H (informative) Atmospheric correction – Altitude correction .....		129
H.1	General principles .....	129
H.1.1	Atmospheric correction in standard tests .....	129
H.1.2	Task of atmospheric correction in insulation co-ordination .....	130
H.2	Atmospheric correction in insulation co-ordination .....	132
H.2.1	Factors for atmospheric correction .....	132
H.2.2	General characteristics for moderate climates .....	132
H.2.3	Special atmospheric conditions .....	133
H.2.4	Altitude dependency of air pressure .....	134
H.3	Altitude correction .....	135
H.3.1	Definition of the altitude correction factor .....	135
H.3.2	Principle of altitude correction .....	136
H.3.3	Standard equipment operating at altitudes up to 1 000 m .....	137
H.3.4	Equipment operating at altitudes above 1 000 m .....	137
H.4	Selection of the exponent $m$ .....	138
H.4.1	General .....	138
H.4.2	Derivation of exponent $m$ for switching impulse voltage .....	138
H.4.3	Derivation of exponent $m$ for critical switching impulse voltage .....	141
Annex I (informative) Evaluation method of non-standard lightning overvoltage shape for representative voltages and overvoltages .....		144
I.1	General remarks .....	144
I.2	Lightning overvoltage shape .....	144
I.3	Evaluation method for GIS .....	144
I.3.1	Experiments .....	144
I.3.2	Evaluation of overvoltage shape .....	145
I.4	Evaluation method for transformer .....	145
I.4.1	Experiments .....	145
I.4.2	Evaluation of overvoltage shape .....	145
Annex J (informative) Insulation co-ordination for very-fast-front overvoltages in UHV substations .....		152
J.1	General .....	152
J.2	Influence of disconnector design .....	152
J.3	Insulation co-ordination for VFFO .....	153
Bibliography .....		155
Figure 1 – Range of 2 % slow-front overvoltages at the receiving end due to line energization and re-energization .....		25
Figure 2 – Ratio between the 2 % values of slow-front overvoltages phase-to-phase and phase-to-earth .....		26
Figure 3 – Diagram for surge arrester connection to the protected object .....		33

Figure 4 – Distributive discharge probability of self-restoring insulation described on a linear scale ..... 41

Figure 5 – Disruptive discharge probability of self-restoring insulation described on a Gaussian scale ..... 41

Figure 6 – Evaluation of deterministic co-ordination factor  $K_{Cd}$  ..... 42

Figure 7 – Evaluation of the risk of failure ..... 43

Figure 8 – Risk of failure of external insulation for slow-front overvoltages as a function of the statistical co-ordination factor  $K_{CS}$ ..... 45

Figure 9 – Dependence of exponent  $m$  on the co-ordination switching impulse withstand voltage ..... 47

Figure 10 – Probability  $P$  of an equipment to pass the test dependent on the difference  $K$  between the actual and the rated impulse withstand voltage ..... 53

Figure 11 – Example of a schematic substation layout used for the overvoltage stress location ..... 57

Figure A.1 – Earth fault factor  $k$  on a base of  $X_0/X_1$  for  $R_1/X_1 = R = 0$ ..... 62

Figure A.2 – Relationship between  $R_0/X_1$  and  $X_0/X_1$  for constant values of earth fault factor  $k$  where  $R_1 = 0$ ..... 62

Figure A.3 – Relationship between  $R_0/X_1$  and  $X_0/X_1$  for constant values of earth fault factor  $k$  where  $R_1 = 0,5 X_1$  ..... 63

Figure A.4 – Relationship between  $R_0/X_1$  and  $X_0/X_1$  for constant values of earth fault factor  $k$  where  $R_1 = X_1$  ..... 63

Figure A.5 – Relationship between  $R_0/X_1$  and  $X_0/X_1$  for constant values of earth fault factor  $k$  where  $R_1 = 2X_1$  ..... 64

Figure B.1 – Conversion chart for the reduction of the withstand voltage due to placing insulation configurations in parallel ..... 70

Figure C.1 – Example for bivariate phase-to-phase overvoltage curves with constant probability density and tangents giving the relevant 2 % values ..... 77

Figure C.2 – Principle of the determination of the representative phase-to-phase overvoltage  $U_{pre}$  ..... 78

Figure C.3 – Schematic phase-phase-earth insulation configuration..... 79

Figure C.4 – Description of the 50 % switching impulse flashover voltage of a phase-phase-earth insulation ..... 79

Figure C.5 – Inclination angle of the phase-to-phase insulation characteristic in range "b" dependent on the ratio of the phase-phase clearance  $D$  to the height  $H_t$  above earth ..... 80

Figure D.1 – Distributed capacitances of the windings of a transformer and the equivalent circuit describing the windings ..... 86

Figure D.2 – Values of factor  $J$  describing the effect of the winding connections on the inductive surge transference ..... 87

Figure H.1 – Principle of the atmospheric correction during test of a specified insulation level according to the procedure of IEC 60060-1 ..... 130

Figure H.2 – Principal task of the atmospheric correction in insulation co-ordination according to IEC 60071-1 ..... 131

Figure H.3 – Comparison of atmospheric correction  $\delta \times k_h$  with relative air pressure  $p/p_0$  for various weather stations around the world ..... 133

Figure H.4 – Deviation of simplified pressure calculation by exponential function in this document from the temperature dependent pressure calculation of ISO 2533 ..... 135

Figure H.5 – Principle of altitude correction: decreasing withstand voltage  $U_{10}$  of equipment with increasing altitude ..... 136

Figure H.6 – Sets of $m$ -curves for standard switching impulse voltage including the variations in altitude for each gap factor .....	140
Figure H.7 – Exponent $m$ for standard switching impulse voltage for selected gap factors covering altitudes up to 4 000 m .....	141
Figure H.8 – Sets of $m$ -curves for critical switching impulse voltage including the variations in altitude for each gap factor .....	142
Figure H.9 – Exponent $m$ for critical switching impulse voltage for selected gap factors covering altitudes up to 4 000 m .....	142
Figure H.10 – Accordance of $m$ -curves from Figure 9 with determination of exponent $m$ by means of critical switching impulse voltage for selected gap factors and altitudes .....	143
Figure I.1 – Examples of lightning overvoltage shapes .....	147
Figure I.2 – Example of insulation characteristics with respect to lightning overvoltages of the SF <sub>6</sub> gas gap (Shape E) .....	148
Figure I.3 – Calculation of duration time $T_d$ .....	148
Figure I.4 – Shape evaluation flow for GIS and transformer .....	149
Figure I.5 – Application to GIS lightning overvoltage .....	150
Figure I.6 – Example of insulation characteristics with respect to lightning overvoltage of the turn-to-turn insulation (Shape C) .....	150
Figure I.7 – Application to transformer lightning overvoltage .....	151
Figure J.1 – Insulation co-ordination for very-fast-front overvoltages .....	154
Table 1 – Test conversion factors for range I, to convert required SIWV to SDWV and LIWV .....	51
Table 2 – Test conversion factors for range II to convert required SDWV to SIWV .....	51
Table 3 – Selectivity of test procedures B and C of IEC 60060-1 .....	53
Table B.1 – Breakdown voltage versus cumulative flashover probability – Single insulation and 100 parallel insulations .....	67
Table E.1 – Corona damping constant $K_{co}$ .....	89
Table E.2 – Factor A for various overhead lines .....	94
Table F.1 – Typical gap factors $K$ for switching impulse breakdown phase-to-earth (according to [1] and [4]) .....	100
Table F.2 – Gap factors for typical phase-to-phase geometries .....	101
Table G.1 – Summary of minimum required withstand voltages obtained for the example shown in G.2.2 .....	109
Table G.2 – Summary of required withstand voltages obtained for the example shown in G.2.3 .....	111
Table G.3 – Values related to the insulation co-ordination procedure for the example in G.4 .....	128
Table H.1 – Comparison of functional expressions of Figure 9 with the selected parameters from the derivation of $m$ -curves with critical switching impulse .....	143
Table I.1 – Evaluation of the lightning overvoltage in the GIS of UHV system .....	148
Table I.2 – Evaluation of lightning overvoltage in the transformer of 500 kV system .....	151

## INTERNATIONAL ELECTROTECHNICAL COMMISSION

## INSULATION CO-ORDINATION –

## Part 2: Application guidelines

## 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 60071-2 has been prepared by IEC technical committee 28: Insulation co-ordination.

This fourth edition cancels and replaces the third edition published in 1996. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- a) the annex on clearance in air to assure a specified impulse withstand voltage installation is deleted because the annex in IEC 60071-1 is overlapped;
- b) 4.2 and 4.3 on surge arresters are updated;
- c) 4.3.5 on very-fast-front overvoltages is revised. Annex J on insulation co-ordination for very-fast-front overvoltages in UHV substations is added;
- d) Annex H on atmospheric correction – altitude correction is added.

e) Annex I on evaluation method of non-standard lightning overvoltage shape is added.

The text of this International Standard is based on the following documents:

FDIS	Report on voting
28/255/FDIS	28/256/RVD

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

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

It has the status of a horizontal standard in accordance with IEC Guide 108.

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.

**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.**