SLOVENSKI STANDARD
SIST EN 61660-2:1998

01-oktober-1998

Kratkostični toki v pomožnih enosmernih napeljavah elektrarn in transformatorskih postaj - 2. del: Računanje učinkov (IEC 61660-2:1997)

Short-circuit currents in d.c. auxiliary installations in power plants and substations - Part 2: Calculation of effects

Kurzschlußströme in Gleichstrom-Eigenbedarfsanlagen in Kraftwerken und Schaltanlagen - Teil 2: Berechnung der Wirkungen

Courants de court-circuit dans les installations auxiliaires alimentées en courant continu dans les centrales et les postes - Partie 2: Calcul des effets

Ta slovenski standard je istoveten z: **EN 61660-2:1997**

ICS:

17.220.01	Elektrika. Magnetizem. Splošni vidiki	Electricity. Magnetism. General aspects
29.240.01	Omrežja za prenos in distribucijo električne energije na splošno	Power transmission and distribution networks in general

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EUROPEAN STANDARD

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English version

Short-circuit currents in d.c. auxiliary installations in power plants and substations Part 2: Calculation of effects (IEC 61660-2:1997)

Courants de court-circuit dans les installations auxiliaires alimentées en courant continu dans les centrales et les postes
Partie 2: Calcul des effets
(CEI 61660-2:1997)

Kuzschlußströme in Gleichstrom-Eigenbedarfsanlagen in Kraftwerken und Schaltanlagen
Teil 2: Berechnung der Wirkungen
(IEC 61660-2:1997)

This European Standard was approved by CENELEC on 1997-07-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

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CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

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Foreword

The text of document 73/85/FDIS, future edition 1 of IEC 61660-2, prepared by IEC TC 73, Short-circuit currents, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 61660-2 on 1997-07-01.

The following dates were fixed:

- latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 1998-04-01
- latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 1998-04-01

Annexes designated "normative" are part of the body of the standard.
Annexes designated "informative" are given for information only.
In this standard, annex ZA is normative and annexes A and B are informative.
Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 61660-2:1997 was approved by CENELEC as a European Standard without any modification.

Annex ZA (normative)

Normative references to international publications with their corresponding European publications

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

NOTE: When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

Publication	Year	Title	EN/HD	Year
IEC 60865-1	1993	Short-circuit currents - Calculation of effects Part 1: Definitions and calculation methods	EN 60865-1	1993
IEC 60865-2	1994	Part 2: Examples of calculation	-	-
IEC 60949	1988	Calculation of thermally permissible short-circuit currents, taking into account non-adiabatic heating effects	-	-
IEC 60986	1989	Guide to the short-circuit temperature limits of electric cables with a rated voltage from 1,8/3 (3,6) kV to 18/30 (36) kV	-	-
IEC 61660-1	1997	Short-circuit currents in d.c. auxiliary installations in power plants and substations Part 1: Calculation of short-circuit currents	EN 61660-1	1997

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Partie 2: Calcul des effets

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Part 2: Calculation of effects

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

SHORT-CIRCUIT CURRENTS IN DC AUXILIARY INSTALLATIONS IN POWER PLANTS AND SUBSTATIONS –

Part 2: Calculation of effects

FOREWORD

1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the 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, the IEC publishes International Standards. 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. The 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 the 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 National Committees.

3) The documents produced have the form of recommendations for international use and are published in the form of standards, technical reports or guides and they are accepted by the National Committees in that sense.

4) In order to promote international unification, IEC National Committees undertake to apply IEC International Standards transparently to the maximum extent possible in their national and regional standards. Any divergence between the IEC Standard and the corresponding national or regional standard shall be clearly indicated in the latter.

5) The IEC provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with one of its standards.

6) Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. The IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 61660-2 has been prepared by IEC technical committee 73: Short-circuit currents.

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

FDIS	Report on voting
73/85/FDIS	73/98/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.

Annexes A and B are for information only.

IEC 61660 consists of the following parts, under the general title: Short-circuit currents in d.c. auxiliary installations in power plants and substations:

– Part 1: 1997: Calculation of short-circuit currents
– Part 2: 1997: Calculation of effects
– Part 3: 199X: Examples of calculations (in preparation)

SHORT-CIRCUIT CURRENTS IN DC AUXILIARY INSTALLATIONS IN POWER PLANTS AND SUBSTATIONS –

Part 2: Calculation of effects

1 General

1.1 *Scope*

This part of IEC 61660 describes a method for calculation of the mechanical and thermal effects on rigid conductors caused by short-circuit currents in d.c. auxiliary installations in power plants and substations. Such systems may contain the following items of equipment which act as sources, as well as contributing to the short-circuit currents:

– rectifiers in three-phase a.c. bridge connection for 50 Hz;

– stationary lead-acid batteries;

– smoothing capacitors;

– d.c. motors with independent excitation.

This standard provides a method which has wide application, and which gives results of sufficient accuracy. The calculation method is based on substitute functions, which cause approximately the same maximum stresses in the conductors and the same forces on the supports as the actual electromagnetic force.

The standardized calculation procedures of clauses 2 and 3 are applicable for the electromagnetic effect on rigid conductors and the thermal effect on bare conductors and electrical equipment, respectively.

For cables and insulated conductors, however, reference is made to IEC 60949 and IEC 60986, for example.

Only d.c. auxiliary installations in power plants and substations are dealt with in this standard.

In particular, the following points should be noted:

– The calculation of short-circuit currents should be based on IEC 61660-1.

– Short-circuit duration used in this standard depends on the protection concept, and should be considered in that sense.

– These standardized procedures are adjusted to practical requirements, and contain simplifications with safety margins. Testing or more detailed methods of calculation or both may be used.

– In clause 2 of this standard, only the stresses caused by short-circuit currents are calculated. Furthermore, other stresses can exist, such as those caused by dead-load, operating forces, or earthquakes. The combination of these loads with the short-circuit loading should be part of an agreement and/or given by standards, for example erection codes.

1.2 *Normative references*

The following normative documents contain provisions which, through reference in this text constitute provisions of this part of IEC 61660. At the time of publication, the editions indicated were valid. All normative documents are subject to revision, and parties to agreements based on this part of IEC 61660 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 60865-1: 1993, *Short-circuit currents — Calculation of effects – Part 1: Definitions and calculation methods*

IEC 60865-2: 1994, *Short-circuit currents — Calculation of effects – Part 2: Examples of calculation*

IEC 60949: 1988, *Calculation of thermally permissible short-circuit currents, taking into account non-adiabatic heating effects*

IEC 60986: 1989, *Guide to the short-circuit temperature limits of electric cables with a rated voltage from 1,8/3 (3,6) kV to 18/30 (36) kV*

IEC 61660-1: 1997, *Short-circuit currents in d.c. auxiliary installations in power plants and substations – Part 1: Calculation of short-circuit currents*

1.3 *Symbols and units*

All equations used in this standard are quantity equations in which quantity symbols represent physical quantities possessing both numerical values and dimensions.

The symbols used in this standard and their exemplary SI units are given in the following lists.

1.3.1 *Symbols for clause 2: electromagnetic effects*

A_i	Impulse for determining the parameters of the substitute rectangular function	A^2s
A_s	Cross-section of one subconductor	m^2
a	Centre line distance between conductors	m
a_m	Effective distance between neighbouring main conductors	m
a_s	Effective distance between subconductors	m
a_{1n}	Centre line distance between subconductor 1 and subconductor n	m
a_{1s}	Centre line distance between subconductors	m
b	Dimension of a subconductor perpendicular to the direction of the force	m
b_m	Dimension of a main conductor perpendicular to the direction of the force	m
c	Factor for the influence of connecting pieces	1
D	Outer diameter of tubular conductor	m
d	Dimension of a subconductor in the direction of the force	m

d_m	Dimension of a main conductor in the direction of the force	m
E	Young's modulus	N/m^2
F	Force acting between two, parallel, long conductors during a short circuit	N
F_R	Force between main conductors caused by the substitute rectangular function	N
F_{Rs}	Force between subconductors caused by the substitute rectangular function	N
F_d	Force on support (peak value)	N
F_m	Force between main conductors during a short circuit (peak value)	N
F_s	Force between subconductors during a short circuit	N
f_c	Relevant natural frequency of a main conductor	Hz
f_{cs}	Relevant natural frequency of a subconductor	Hz
g_n	Value of acceleration of gravity	m/s^2
I_g	Value for determining of the parameters of the substitute rectangular function	A^2s^3
I_R	Current of the substitute rectangular function for the calculation of the force between main conductors	A
I_{Rs}	Current of the substitute rectangular function for the calculation of the force between subconductors	A
I_k	Quasi steady-state short-circuit current	A
i_p	Peak short-circuit current	A
i_1, i_2	Instantaneous values of current in conductors in the sections of the standard approximation function	A
i_{L1}, i_{L2}	Instantaneous values of currents in the conductors L1 and L2	A
J	Second moment of main conductor area	m^4
J_s	Second moment of subconductor area	m^4
k	Number of sets of spacers or stiffening elements	1
k_{1n}	Factor for effective conductor distance between subconductor 1 and subconductor n	1
k_{1s}	Factor for effective conductor distance	1
l	Centre line distance between supports	m
l_s	Centre line distance between connecting pieces	m
m'	Mass per unit length of main conductor	kg/m
m'_s	Mass per unit length of subconductor	kg/m
m_z	Total mass of one set of connecting pieces	kg
m_{g1},m_{g2}, m_{lg1},m_{lg2}, $m_{\theta 1}$,$m_{\theta 2}$	Factors for determining the parameters of the substitute rectangular function	1
n	Number of subconductors of a main conductor	1
p	Ratio I_k/i_p	1
q	Factor of plasticity	1
$R_{p\ 0,2}$	Stress corresponding to the yield point	N/m^2
s	Wall thickness of tubes	m

T_k	Short-circuit duration	s
T_{me}	Vibration period of the main conductor	s
T_{mes}	Vibration period of the subconductor	s
t_p	Time to peak	s
t_R	Time of substitute rectangular function for the calculation of the force between main conductors	s
t_{Rs}	Time of the substitute rectangular function for the calculation of the force between subconductors	s
V_F	Ratio of dynamic and static force on supports	1
V_σ	Ratio of dynamic and static main conductor stress	1
$V_{\sigma s}$	Ratio of dynamic and static subconductor stress	1
Z	Section modulus of main conductor	m^3
Z_s	Section modulus of subconductor	m^3
α	Factor for force on support	1
β	Factor for main conductor stress	1
γ	Factor for relevant natural frequency estimation	1
μ_0	Magnetic constant, permeability of vacuum	H/m
σ_m	Bending stress caused by the forces between main conductors	N/m^2
σ_s	Bending stress caused by the forces between subconductors	N/m^2
σ_{tot}	Resulting conductor stress	N/m^2
τ_1	Rise-time constant	s
τ_2	Decay-time constant	s

1.3.2 *Symbols for clause 3: Thermal effects*

A	Main conductor cross-section	m^2
A_i	Impulse for determining of the parameters of the substitute rectangular function	A^2s
I_{th}	Thermal equivalent short-time current (r.m.s.)	A
I_{thr}	Rated short-time withstand current (r.m.s.)	A
K	Factor for calculating S_{thr}	$As^{0,5}/m^2$
S_{th}	Thermal equivalent short-time current density (r.m.s.)	A/m^2
S_{thr}	Rated short-time withstand current density (r.m.s.)	A/m^2
T_k	Short-circuit duration	s
T_{kr}	Rated short-time	s
t_p	Time to peak	s
θ_b	Conductor temperature at the beginning of the short circuit	°C
θ_e	Conductor temperature at the end of the short circuit	°C