SLOVENSKI STANDARD
SIST EN 61660-1:1998

01-oktober-1998

Kratkostični toki v pomožnih enosmernih napeljavah elektrarn in transformatorskih postaj - 1. del: Računanje kratkostičnih tokov (IEC 61660-1:1997)

Short-circuit currents in d.c. auxiliary installations in power plants and substations - Part 1: Calculation of short-circuit currents

Kurzschlußströme in Gleichstrom-Eigenbedarfsanlagen in Kraftwerken und Schaltanlagen - Teil 1: Berechnung der Kurzschlußströme

Courants de court-circuit dans les installations auxiliaires alimentées en courant continu dans les centrales et les postes - Partie 1: Calcul des courants de court-circuit

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EN 61660-1

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Version française

Courants de court-circuit dans les installations auxiliaires alimentées en courant continu dans les centrales et les postes
Partie 1: Calcul des courants de court-circuit
(CEI 61660-1:1997)

Kurzschlußströme in Gleichstrom-Eigenbedarfsanlagen in Kraftwerken und Schaltanlagen
Teil 1: Berechnung der Kurzschlußströme
(IEC 61660-1:1997)

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

La présente norme européenne a été adoptée par le CENELEC le 1997-07-01. Les membres du CENELEC sont tenus de se soumettre au Règlement Intérieur du CEN/CENELEC qui définit les conditions dans lesquelles doit être attribué, sans modification, le statut de norme nationale à la norme européenne.

Les listes mises à jour et les références bibliographiques relatives à ces normes nationales peuvent être obtenues auprès du Secrétariat Central ou auprès des membres du CENELEC.

La présente norme européenne existe en trois versions officielles (allemand, anglais, français). Une version dans une autre langue faite par traduction sous la responsabilité d'un membre du CENELEC dans sa langue nationale, et notifiée au Secrétariat Central, a le même statut que les versions officielles.

Les membres du CENELEC sont les comités électrotechniques nationaux des pays suivants: Allemagne, Autriche, Belgique, Danemark, Espagne, Finlande, France, Grèce, Irlande, Islande, Italie, Luxembourg, Norvège, Pays-Bas, Portugal, Royaume-Uni, Suède et Suisse.

CENELEC

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

Secrétariat Central: rue de Stassart 35, B - 1050 Bruxelles

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Avant-propos

Le texte du document 73/84/FDIS, future édition 1 de la CEI 61660-1, préparé par le CE 73 de la CEI, Courants de court-circuit, a été soumis au vote parallèle CEI-CENELEC et a été approuvé par le CENELEC comme EN 61660-1 le 1997-07-01.

Les dates suivantes ont été fixées:

- date limite à laquelle la EN doit être mise en application au niveau national par publication d'une norme nationale identique ou par entérinement (dop) 1998-04-01
- date limite à laquelle les normes nationales conflictuelles doivent être annulées (dow) 1998-04-01

Les annexes appelées "normatives" font partie du corps de la norme.
Les annexes appelées "informatives" ne sont données que pour information.
Dans la présente norme, l'annexe ZA est normative et l'annexe A est informative.
L'annexe ZA a été ajoutée par le CENELEC.

Notice d'entérinement

Le texte de la norme internationale CEI 61660-1:1997 a été approuvé par le CENELEC comme norme européenne sans aucune modification.

Annexe ZA (normative)

Références normatives à d'autres publications internationales avec les publications européennes correspondantes

Cette norme européenne comporte par référence datée ou non datée des dispositions d'autres publications. Ces références normatives sont citées aux endroits appropriés dans le texte et les publications sont énumérées ci-après. Pour les références datées les amendements ou révisions ultérieurs de l'une quelconque de ces publications ne s'appliquent à cette norme européenne que s'il y ont été incorporés par amendement ou révision. Pour les références non datées, la dernière édition de la publication à laquelle il est fait référence s'applique (y inclus les amendements).

NOTE: Dans le cas où une publication internationale est modifiée par des modifications communes, indiqué par (mod), il faut tenir compte de la EN / du HD approprié(e).

Publication	Année	Titre	EN/HD	Année
CEI 60038 (mod)	1983	Tensions normales de la CEI[1)]	HD 472 S1	1989
CEI 60050(151)	1978	Vocabulaire Electrotechnique International (VEI) Chapitre 151: Dispositifs électriques et magnétiques	-	-
CEI 60050(441)	1984	Chapitre 441: Appareillage et fusibles	-	-
CEI 60896-1	1987	Batteries stationnaires au plomb Prescriptions générales et méthodes d'essai Partie 1: Batteries au plomb du type ouvert		
+ A1	1988		EN 60896-1	1991
A2	1990		A2	1992
CEI 60909 (mod)	1988	Calcul des courants de court-circuit dans les réseaux triphasés à courant alternatif	HD 533 S1	1991
CEI 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	EN 61660-2	1997

1) Le HD 472 S1 a comme titre: Tensions nominales des réseaux électriques de distribution publique basse tension.

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Partie 1: Calcul des courants de court-circuit

Short-circuit currents in d.c. auxiliary installations in power plants and substations –

Part 1: Calculation of short-circuit currents

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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

Part 1: Calculation of short-circuit currents

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 61660-1 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
73/84/FDIS	73/97/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.

Annex A is 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).

The contents of the corrigenda of February 1999 and March 2000 have been included in this copy.

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

Part 1: Calculation of short-circuit currents

1 General

1.1 *Scope and object*

This part of IEC 61660 describes a method for calculating short-circuit currents in d.c. auxiliary systems in power plants and substations. Such systems can be equipped with the following equipment, acting as short-circuit current sources:

– rectifiers in three-phase a.c. bridge connection for 50 Hz;
– stationary lead-acid batteries;
– smoothing capacitors;
– d.c. motors with independent excitation.

NOTE – Rectifiers in three-phase a.c. bridge connection for 60 Hz are under consideration. The data of other equipment may be given by the manufacturer.

This standard is only concerned with rectifiers in three-phase a.c. bridge connection. It is not concerned with other types of rectifiers.

The purpose of the standard is to provide a generally applicable method of calculation which produces results of sufficient accuracy on the conservative side. Special methods, adjusted to particular circumstances, may be used if they give at least the same precision. Short-circuit currents, resistances and inductances may also be ascertained from system tests or measurements on model systems. In existing d.c. systems the necessary values can be ascertained from measurements taken at the assumed short-circuit location. The load current is not taken into consideration when calculating the short-circuit current. It is necessary to distinguish between two different values of short-circuit current:

– the maximum short-circuit current which determines the rating of the electrical equipment;

– the minimum short-circuit current which can be taken as the basis for fuse and protection ratings and settings.

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 edition indicated was 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 60038: 1983, *IEC standard voltages*

IEC 60050(151): 1978, *International Electrotechnical Vocabulary (IEV) – Chapter 151: Electrical and magnetic devices*

IEC 60050(441): 1984, *International Electrotechnical Vocabulary (IEV) – Chapter 441: Switchgear, controlgear and fuses*

IEC 60896-1: 1987, *Stationary lead-acid batteries – General requirements and methods of test – Part 1: Vented types*
Amendment 1 (1988)
Amendment 2 (1990)

IEC 60909: 1988, *Short-circuit current calculation in three-phase a.c. systems*

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

1.3 *Définitions*

For the purpose of this part of IEC 61660, the following definitions apply.

1.3.1 **short circuit:** The accidental or intentional connection, by a relatively low resistance or impedance, of two or more points in a circuit which are normally at different voltages. [IEV 151-03-41]

NOTE – In this standard the connection is assumed to have zero impedance.

1.3.2 **short-circuit current:** An over-current resulting from a short circuit due to a fault or an incorrect connection in an electric circuit. [IEV 441-11-07]

NOTE – It is necessary to distinguish between the short-circuit current at the short-circuit location and in the network branches.

1.3.3 **partial short-circuit current:** The short-circuit current at the short-circuit location being fed from one source with all other sources disconnected.

1.3.4 **common branch:** A network branch with several partial short-circuit currents from different sources.

1.3.5 **initial symmetrical short-circuit current I''_k:** The r.m.s. value of the a.c. symmetrical component of a prospective short-circuit current applicable at the instant of short circuit if the impedance remains at zero time value.

1.3.6 **peak short-circuit current i_p:** The maximum possible instantaneous value of the prospective short-circuit current at the d.c. side (figures 1 and 2).

1.3.7 **quasi steady-state short-circuit current I_k:** The value of the short-circuit current at the d.c. side 1 s after the beginning of the short circuit.

1.3.8 **time to peak t_p:** The interval between the initiation of the short circuit and the peak value of the short-circuit current (figures 1 and 2).

1.3.9 **short-circuit duration T_k:** The time interval between the initiation of the short circuit and the breaking of the d.c. short-circuit current.

1.3.10 **nominal system voltage U_n:** Voltage (line-to-line) by which a three-phase a.c. system is designated and to which certain operating characteristics are referred. Values are given in IEC 60038.

1.3.11 **nominal voltage U_{nB} of a lead-acid battery:** The nominal voltage of a lead-acid battery is given by the manufacturer. If the value is unknown, then the nominal voltage of one cell 2,0 V multiplied by the number of cells in series may be used.

1.3.12 **stationary battery:** A battery designed for service in a fixed location and which is permanently connected to the load and to the associated battery charging circuit (see IEC 60896-1).

1.3.13 **final voltage of a battery (end-of-discharge voltage):** The minimum permissible voltage after a specified discharge time.

1.4 *Symbols and subscripts*

All equations are written without specifying units. The symbols represent quantities possessing both numerical values and dimensions that are independent of units, provided a coherent unit system is chosen, for example the International System of Units (SI).

1.4.1 *Symbols*

A	Conductor cross-section
a	Centre-line distance between conductors
d	Thickness of rectangular conductor
C	Capacitance
c	Voltage factor according to IEC 60909
$cU_n/\sqrt{3}$	Equivalent voltage source according to IEC 60909
E_B	Open-circuit voltage of a battery
f	System frequency
b	Height of rectangular conductor
I''_k	Three-phase initial symmetrical short-circuit current
I_k	Quasi steady-state short-circuit current
I_r	Rated current
i	Instantaneous value of current
i_1, i_2	Sections of the standard approximation function
i_{Br}	Short-circuit current in a branch
i_p	Peak short-circuit current
i_{cor}	Corrected current
J	Moment of inertia of the whole rotating part
k_{1C}, k_{2C}	Factors for calculating the rise-time and decay-time constant of the capacitor current
k_{1M}	Factor for calculating the time to peak of the motor current
k_{2M}, k_{3M}	Factors for calculating the rise-time constant of the motor current
k_{4M}	Factor for calculating the decay-time constant of the motor current
L, L'	Inductance, inductance per unit length
L_F	Equivalent saturated inductance of the field circuit at short circuit

L_{OF}	Equivalent unsaturated inductance of the field circuit at no-load
l	Length
M_r	Rated torque of the motor
n,n_o,n_n	Motor speed, no-load motor speed, nominal motor speed
p	Ratio I_k/i_p
R,R'	Resistance, resistance per unit length
R_{joint}	Joint resistance
r	Radius of the conductor
T_k	Short-circuit duration
t	Time
t_p	Time to peak
U	Voltage at the short-circuit location before short circuit
U_n	Nominal system voltage of the three-phase a.c. system, line-to-line (r.m.s.)
U_{nB}	Nominal voltage of a battery
X	Reactance
Z_N	Impedance of the three-phase a.c. network
δ	Decay coefficient
κ	Factor for calculating the peak short-circuit current
λ_D	Factor for calculating the quasi steady-state short-circuit current of the rectifier
μ_o	Absolute permeability of vacuum, $\mu_o = 4\pi \cdot 10^{-7}$ H/m
ρ	Resistivity
σ	Correction factor for the partial short-circuit current
τ_M	Armature time constant of the motor
τ_F	Field circuit time constant of the motor
τ_{mec}	Mechanical time constant of the motor
τ_1, τ_2	Rise-time, decay-time constants of the standard approximation function
ω_o,ω_d	Undamped, damped natural angular frequency

1.4.2 *Subscripts*

a.c.	Alternating current
B	Battery
Br	Branch on the d.c. side
C	Capacitor
cor	Corrected
D	Rectifier
d.c.	Direct current
F	Short-circuit location
F	Field circuit of the motor