SLOVENSKI STANDARD

SIST EN 61400-1:2004

september 2004

Sistemi generatorjev vetrne turbine – 1. del: Varnostne zahteve (IEC 61400-1:1999, spremenjen)

Wind turbine generator systems - Part 1: Safety requirements

ICS 27.180

Referenčna številka
SIST EN 61400-1:2004(en)

EUROPEAN STANDARD **EN 61400-1**

NORME EUROPÉENNE

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ICS 27.180 Supersedes ENV 61400-1:1995

English version

Wind turbine generator systems
Part 1: Safety requirements
(IEC 61400-1:1999, modified)

Aérogénérateurs
Partie 1: Spécifications de sécurité
(CEI 61400-1:1999, modifiée)

Windenergieanlagen
Teil 1: Sicherheitsanforderungen
(IEC 61400-1:1999, modifiziert)

This European Standard was approved by CENELEC on 2003-11-01. 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

Central Secretariat: rue de Stassart 35, B - 1050 Brussels

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Foreword

The text of the International Standard IEC 61400-1:1999, prepared by IEC TC 88, Wind turbines, together with the common modifications prepared by the Technical Committee CENELEC TC 88, Wind turbine systems, was submitted to the formal vote and was approved by CENELEC as EN 61400-1 on 2003-11-01.

This European Standard supersedes ENV 61400-1:1995.

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) 2004-11-01

- latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 2006-11-01

Annex ZA has been added by CENELEC.

Formulae which are additional to those in IEC 61400-1 are prefixed Z.

Endorsement notice

The text of the International Standard IEC 61400-1:1999 was approved by CENELEC as a European Standard with agreed common modifications as given below.

COMMON MODIFICATIONS

Introduction

Replace the first existing paragraph by:

The standard contains some requirements for a safe operation of wind turbine generator systems falling in the scope of Article 118a of the EC Treaty. Users of this Standard should, with the respect to these requirements, be aware that standards have no formal legal relationship with Directives which may have been made under Article 118a of the Treaty. In addition, national legislation in the Member states may contain more stringent requirements than the minimum requirements of a Directive based on Article 118a. Information on the relationship between the national legislation implementing Directives based on Article 118a and this Standard may be given in a national foreword of the national standard implementing this Standard.

1.1 Scope

Add the following fifth paragraph:

The standard contains requirements which directly address the operator of wind turbine generator systems. These requirements for a safe operation, however, constitute recommendations for the manufacturer, designed to support him in drafting the operation instruction handbook.

6.3.2.1 Extreme wind speed model (EWM)

Replace the whole subclause by the following:

The EWM shall be either a steady or a turbulent wind model. The wind models shall be based on the reference wind speed, V_{ref}, and a fixed turbulence standard deviation σ_1.

For the steady extreme wind model, the 50 year extreme wind speed V_{e50} and the one year extreme wind speed V_{e1} shall be based on the reference wind speed V_{ref}. For wind turbine designs in the standard wind turbine classes, V_{e50} and V_{e1} shall be computed as a function of height z using the following equations:

$$V_{e50}(z) = 1{,}4\, V_{ref}\,(z/z_{hub})^{0{,}11} \tag{10}$$

$$V_{e1}(z) = 0{,}8\, V_{e50}\,(z) \tag{11}$$

For the turbulent extreme wind speed model, the 10 min average wind speeds as functions of height z with recurrence intervals of 50 and 1 year, respectively, shall be given by the following equations:

$$V_{50}\,(z) = V_{ref}\,(z/z_{hub})^{0{,}11} \tag{Z1}$$

$$V_{1}(z) = 0{,}8 \times V_{50}(z) \tag{Z2}$$

In the turbulent extreme wind model, the mean wind speed at hub height, V_{hub}, shall be V_{ref} or 0,8 V_{ref}, respectively, and shall be used in the Turbulence Model (NTM) together with a turbulence standard deviation of $\sigma_1 = 0{,}11\ V_{hub}$.

Replace Table 2 by the following:

Table 2 – Design load cases

Design situation	DLC	Wind condition [a]	Other conditions	Type of analysis	Partial safety factors
1) Power production	1.1	NTM $V_{in} \le V_{hub} \le V_{out}$		U	N
	1.2	NTM $V_{in} < V_{hub} < V_{out}$		F	*
	1.3	ECD $V_{hub} = V_r$		U	N
	1.4	NWP $V_{hub} = V_r$ or V_{out}	External electrical fault	U	N
	1.5	EOG_1 $V_{hub} = V_r$ or V_{out}	Loss of electrical connection	U	N
	1.6	EOG_{50} $V_{hub} = V_r$ or V_{out}		U	N
	1.7	EWS $V_{hub} = V_r$ or V_{out}		U	N
	1.8	EDC_{50} $V_{hub} = V_r$ or V_{out}		U	N
	1.9	ECG $V_{hub} = V_r$		U	N
2) Power production plus occurrence of fault	2.1	NWP $V_{in} < V_{hub} < V_{out}$	Control system fault	U	N
	2.2	NWP $V_{in} < V_{hub} < V_{out}$	Protection system or preceding internal electrical fault	U	A
	2.3	NTM $V_{in} < V_{hub} < V_{out}$	Control or protection system fault	F	*
3) Start up	3.1	NWP $V_{in} < V_{hub} < V_{out}$		F	*
	3.2	EOG_1 $V_{hub} = V_{in}$, V_r or V_{out}		U	N
	3.3	EDC_1 $V_{hub} = V_{in}$, V_r or V_{out}		U	N
4) Normal shut down	4.1	NWP $V_{in} < V_{hub} < V_{out}$		F	*
	4.2	EOG_1 $V_{hub} = V_r$ or V_{out}		U	N
5) Emergency shut down	5.1	NWP $V_{hub} = V_r$ or V_{out}		U	N
6) Parked (standing still or idling)	6.1	EWM *50 year recurrence interval*		U	N
	6.2	EWM *50 year recurrence interval*	Loss of electrical power network	U	A
	6.3	EWM *1 year recurrence interval*	Extreme yaw misalignment	U	N
	6.4	NTM $V_{hub} < 0{,}7\ V_{ref}$		F	*
7) Parked and fault conditions	7.1	EWM *1 year recurrence interval*		U	A
8) Transport, assembly, maintenance and repair	8.1	To be stated by the manufacturer		U	T

[a] If no cut-out wind speed V_{out} is defined, the value of V_{ref} should be used.

For abbreviations see below.

– DLC Design load case
– ECD Extreme coherent gust with direction change (see 6.3.2.5)
– ECG Extreme coherent gust (see 6.3.2.4)
– EDC Extreme direction change (see 6.3.2.3)
– EOG Extreme operating gust (see 6.3.2.2)
– EWM Extreme wind speed model (see 6.3.2.1)
– EWS Extreme wind shear (see 6.3.2.6)
– Subscript Recurrence period in years
– NTM Normal turbulence model (see 6.3.1.3)
– NWP Normal wind profile model (see 6.3.1.2)
– F Fatigue
– U Ultimate
– N Normal and extreme
– A Abnormal
– T Transport and erection

* Partial safety factor for fatigue (see 7.6.3)

7.4.6 Parked (stand-still or idling) (DLC 6.1 - 6.2)

Replace the whole subclause and its title by the following:

7.4.6 Parked (stand-still or idling) (DLC 6.1 - 6.4)

In this design situation, the rotor of a parked wind turbine is either in a stand-still or idling condition. In DLC 6.1, 6.2 and 6.3 this situation shall be considered with the extreme wind speed model (EWM).

In the case of a rigid or well-damped wind turbine with little dynamic action, the steady extreme wind model may be used for the analysis. For more flexible wind turbine structures liable to resonant amplification the turbulent extreme wind model shall be used for turbulence simulation analysis or quasi-steady analysis with correction for gusts and dynamic response.

The characteristic load shall be calculated as the expected value of the largest extreme load during the design load case, e.g. calculated from a sufficient number of simulations.

In DLC 6.1, a yaw misalignment of up to ± 15° using the steady extreme wind model or ± 8° using the turbulent wind model shall be assumed, provided that no slippage in the yaw system can be assured. If not, a yaw misalignment of up to ± 180° shall be assumed.

In DLC 6.2 a loss of the electrical power network at an early stage in the storm containing the extreme wind situation, shall be assumed. Unless power back-up for the control and yaw system with a capacity of 6 h of operation is provided, the effect of a yaw misalignment of up to ± 180° shall be analysed.

In DLC 6.3, the extreme wind with a 1-year recurrence interval shall be combined with an extreme yaw misalignment. An extreme yaw misalignment of up to ± 30° using the steady extreme wind model or ± 20° using the turbulent wind model shall be assumed.

If significant fatigue damage can occur to some components (e.g. from weight of idling blades), the expected number of hours of non-power production time at each appropriate wind speed shall be considered in DLC 6.4.

If the wind turbine has a yaw system where the yaw braking capacity will be exceeded at the extreme wind situations (e.g. free yaw or semi-free yaw) the turbulent wind model shall be used.

If the wind turbine is subject to large yaw movements or change of equilibrium during wind speed increase from normal operation to the extreme situation this behaviour shall be included in the analysis.

7.4.7 Parked plus fault conditions (DLC 7.1)

Add a new second paragraph:

In DLC 7.1, a yaw misalignment of up to ± 15° using the steady extreme wind model or ± 8° using the turbulent wind model shall be assumed, provided that no slippage in the yaw system can be assured. If not, a yaw misalignment of up to ± 180° shall be assumed.

8.4 Functional requirements of the control and protection system

Add a new second paragraph:

The protection system shall include two or more braking systems (mechanical, electrical or aerodynamic) capable of bringing the rotor to rest or to an idling state from any operating condition.

Replace the second sentence with:

It is recommended that at least one braking system operate on an aerodynamic principle, and as such acts directly on the rotor. If this recommendation is not met at least one braking system shall act on the low speed shaft or on the rotor of the wind turbine.

Delete Annex C.

Replace “Annex D (informative) Bibliography” by:

“Bibliography”

Add Annex ZA.

Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

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

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 60204-1	1997	Safety of machinery - Electrical equipment of machines Part 1: General requirements	EN 60204-1 + corr. September	1997 1998
IEC 60364 (mod)	Series	Electrical installations of buildings	HD 384	Series
IEC 60721-2-1	1982	Classification of environmental conditions Part 2: Environmental conditions appearing in nature - Temperature and humidity	HD 478.2.1 S1 [1]	1989
IEC 61000-3-2 (mod)	2000	Electromagnetic compatibility (EMC) Part 3-2: Limits - Limits for harmonic current emissions (equipment input current up to and including 16 A per phase)	EN 61000-3-2	2000
IEC 61000-3-3	1994	Part 3: Limits - Limitation of voltage fluctuations and flicker in low-voltage supply systems for equipment with rated current ≤ 16 A	EN 61000-3-3 + corr. July	1995 1997
IEC 61000-4-2	1995	Part 4-2: Testing and measurement techniques - Electrostatic discharge immunity test	EN 61000-4-2	1995
IEC 61000-4-3 (mod)	1995	Part 4-3: Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test	EN 61000-4-3 [2]	1996
IEC 61000-4-4	1995	Part 4-4: Testing and measurement techniques - Electrical fast transient/burst immunity test	EN 61000-4-4	1995
IEC 61000-4-5	1995	Part 4-5: Testing and measurement techniques - Surge immunity test	EN 61000-4-5	1995
IEC 61024-1	1990	Protection of structures against lightning Part 1: General principles	-	-
IEC 61312-1	1995	Protection against lightning electromagnetic impulse Part 1: General principles	-	-
ISO 2394	1986	General principles on reliability for structures	-	-

1) HD 478.2.1 S1 includes A1:1987 to IEC 60721-2-1.

2) EN 61000-4-3:1996 is superseded by EN 61000-4-3:2002, which is based on IEC 61000-4-3:2002.

INTERNATIONAL STANDARD

IEC 61400-1

Second edition
1999-02

Wind turbine generator systems –

Part 1:
Safety requirements

Aérogénérateurs –

Partie 1:
Spécifications de sécurité

International Electrotechnical Commission 3, rue de Varembé Geneva, Switzerland
Telefax: +41 22 919 0300 e-mail: inmail@iec.ch IEC web site http://www.iec.ch

Commission Electrotechnique Internationale
International Electrotechnical Commission
Международная Электротехническая Комиссия

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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WIND TURBINE GENERATOR SYSTEMS –

Part 1: Safety requirements

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.
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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 61400-1 has been prepared by IEC technical committee 88: Wind turbine systems.

This second edition of IEC 61400-1 cancels and replaces the first edition published in 1994.

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

FDIS	Report on voting
88/98/FDIS	88/103/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, B and C form an integral part of this standard.

Annex D is for information only.

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