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Sistemi za proizvodnjo energije na veter - 1. del: Zahteve za načrtovanje - Dopolnilo A1

Wind energy generation systems - Part 1: Design requirements - Amendment 1

Windenergieanlagen - Teil 1: Auslegungsanforderungen

Systèmes de génération d'énergie éolienne - Partie 1: Exigences de conception

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IEC TC 88 : WIND ENERGY GENERATION SYSTEMS	
SECRETARIAT: Denmark	SECRETARY: Mrs Christine Weibøl Bertelsen
OF INTEREST TO THE FOLLOWING COMMITTEES:	PROPOSED HORIZONTAL STANDARD: ☐ Other TC/SCs are requested to indicate their interest, if any, in this CDV to the secretary.
FUNCTIONS CONCERNED: ☐ EMC ☐ ENVIRONMENT	☐ QUALITY ASSURANCE ☐ SAFETY
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TITLE:

Amendment 1 – Wind energy generation systems – Part 1: Design requirements

PROPOSED STABILITY DATE: 2025

NOTE FROM TC/SC OFFICERS:

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

WIND TURBINES –

Part 1: Design Requirements

AMENDMENT 1

FOREWORD

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Amendment 1 to IEC 61400-1:2019 has been prepared by IEC technical committee 88: Wind energy generation systems.

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

Draft	Report on voting
XX/XX/XXXX	XX/XX/XXX

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

The language used for the development of this Amendment is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications/.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under 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- withdrawn,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.

1 Normative references

2 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 61400-1:2019 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

Add

damage equivalent load
Constant amplitude load derived from the load spectrum and a given S-N curve exponent that results in an equivalent fatigue damage

reference loads
The loads that had been utilised for detailed structural verification of the wind turbine components are called reference loads.

serviceability
ability of a structure or structural element to perform adequately for normal use under all expected actions

serviceability limit state
state which corresponds to conditions beyond which specified service requirements for a structure or structural element are no longer met

S1 - SLS characteristic load
serviceability limit state load level equal to the characteristic value of the loads from ultimate limit states classified as N (Normal)

S2 - SLS 10^{-4} frequent load case
serviceability limit state load level for frequent actions, which are exceeded for 10^{-4} of the lifetime,

S3 - SLS 10^{-2} frequent load case
serviceability limit state load level for the equivalent to frequent actions, which are exceeded for 10^{-2} of the lifetime.

3 Symbols and abbreviated terms

4.2 Abbreviated terms

Add

DEL Damage equivalent load, S_{eq}, determined from the approach that it leads to the same damage for a given reference number of load cycles, n_{eq}, as the real load spectrum under the assumption that the damage can be determined on basis of the load cycles from a linear S-N curve with a given slope, m. Let the discrete load spectrum be specified by the number of cycles n_i for the load S_i, $i = 1, 2, \ldots, n_S$. Then the equivalent load can be calculated from the equation

$$S_{eq} = \left(\frac{\sum_{i=1}^{n_S} n_i S_i^{\ m}}{n_{eq}}\right)^{1/m}$$

EM Electro Magnetic

EMC Electro Magnetic Compatibility

NTM90 Normal Turbulence Model, representative value of 90% percentile value of distribution

6.2 Wind turbine class

Replace paragraph 2 with

Class T assumes all wind model parameters to be the same and allows the combination of $V_{\text{ref,T}}$ with all turbulence categories. It does not cover all the areas prone to tropical cyclones. The evaluation of the 1-year return period storm wind speed should be done independently of the 50-year return period storm. A site assessment based on Clause 11 is needed, as a minimum assessing that V_{50} is below V_{ref} of class T ($V_{\text{ref,T}}$), and that V_1 is below the classification value.

6.3 Wind conditions

6.3.1 General

Replace paragraphs 3 and 4 with

The wind regime for load and safety considerations is divided into the normal wind conditions, which will occur frequently during normal operation of a wind turbine, and the extreme wind conditions that are defined as having a 1-year or 50-year return period.[1]

The wind conditions include a constant mean flow combined, in many cases, with either a varying deterministic gust profile or with turbulence. In all cases, an upwards inclination of the mean flow with respect to a horizontal plane of 8° shall be considered. This flow inclination angle shall be assumed to be invariant with height.

6.3.2.3 Normal turbulence model (NTM)

Replace the clause with

For the normal turbulence model, the turbulence standard deviation, σ_1, shall be defined for the standard wind turbine classes based on the Weibull distribution in equation (10) for the given hub height wind speed.

The Weibull distribution for σ_1 shall either be applied as a distribution with scale and shape parameters as in equation (11) or by the 90% quantile value in equation (12)[2]:

$$P_W\left(\sigma_1 < \sigma_0\right) = 1 - \exp\left[-\left(\frac{\sigma_0}{C}\right)^k\right] \qquad (1)$$

[1] The return period of the extreme event is independent of the design lifetime of the turbine as the largest value for the normal failure probability is given for a single year (see Annex K)

[2] The choice of NTM model affects the level of reliability against fatigue failure. Using the Weibull distribution is more robust for inclusion of non-linear effects, but the resulting fatigue loads have no bias and therefore result in a lower reliability level in most cases compared to using the 90% quantile value.

where

$$k = 0{,}27\ V_{\text{hub}}\left(\text{s/m}\right) + 1{,}4$$

$$C = I_{\text{ref}}\left(0{,}75V_{\text{hub}} + 3{,}3\ \text{m/s}\right) \qquad (11)$$

$$\sigma_1 = I_{\text{ref}}\left(0{,}75V_{\text{hub}} + b\right); \quad b = 5{,}6\ \text{m/s} \qquad (2)$$

Values for the turbulence standard deviation σ_1 and the turbulence intensity σ_1/V_{hub} are shown in Figure 1.

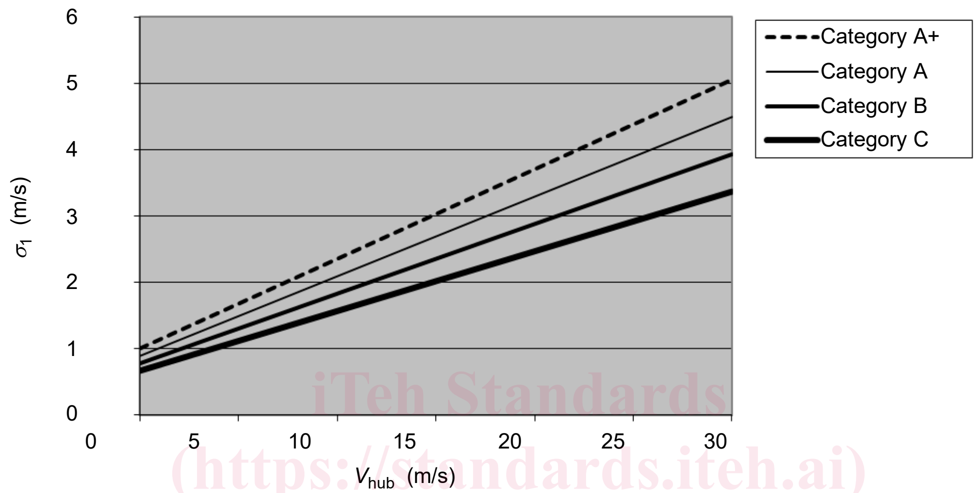

Figure 1a – Turbulence standard deviation

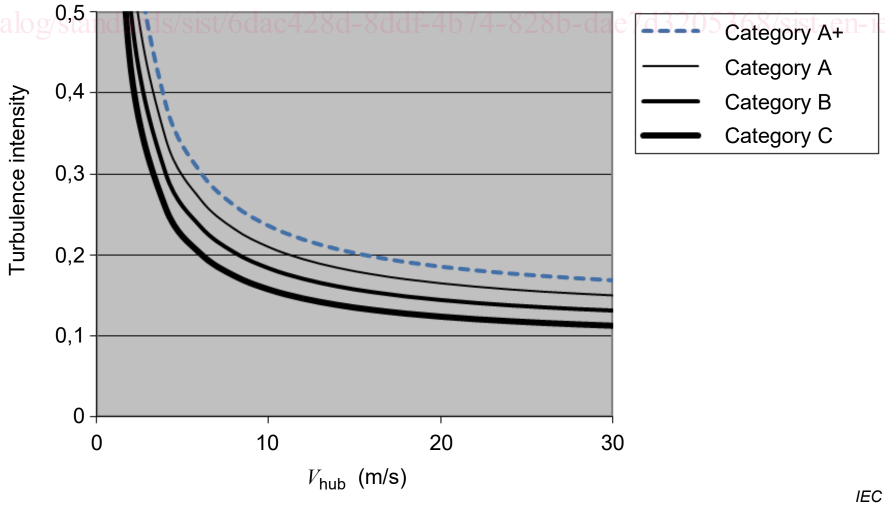

Figure 1b – Turbulence intensity

Figure 1 – Turbulence standard deviation and turbulence intensity for the normal turbulence model (NTM90 values)

Values for I_{ref} are given in Table 1.

6.3.3.2 Extreme wind speed model (EWM)

Replace paragraphs 1 and 2 including eqs.13 and 14 with

The EWM shall be a turbulent wind model. The wind model shall be based on the reference wind speed, V_{ref}, and a fixed turbulence standard deviation, σ_1. If the wind turbine type is designed for a T class reference wind speed, V_{ref} shall be replaced by $V_{ref,T}$ in the extreme wind speed model while keeping other parameters.

Replace footnote 3 with

3 The turbulence standard deviation for the turbulent extreme wind model is not related to the normal (NTM) or the extreme turbulence model (ETM).

7.4.1 General

Add after paragraph 5

Serviceability limit states (SLS) consider the function of the structure or one of its components under normal service conditions or the appearance of the structure.

Serviceability limit states should be verified with serviceability load levels S1, S2 or S3 as required in relevant IEC 61400 standard or technical specification.

For serviceability limit state analyses, S1 is derived from load simulations from the ultimate limit states classified as N (Normal) and for S2 and S3 the same load simulations are used as those used as basis for the fatigue limit state. The partial safety factor for loads shall be:

$$\gamma_f = 1{,}0 \quad (1)$$

7.4.7 Parked (standstill or idling) (DLC 6.1 to 6.4)

Replace paragraphs 2 and 3 with

For design load cases, where the wind conditions are defined by EWM, the response shall be estimated using either a full dynamic simulation or a quasi-steady analysis with appropriate corrections for gusts and dynamic response using the formulation in ISO 4354. If slippage in the wind turbine yaw system can occur at the characteristic load, the largest possible unfavourable slippage shall be added to the mean yaw misalignment. If the wind turbine has a yaw system where yaw movement is expected in the extreme wind situations (e.g. free yaw, passive yaw or semi-free yaw), the yaw misalignment will be governed by the turbulent wind direction changes and the turbine yaw dynamic response. Also, if the wind turbine is subject to large yaw movements or change of equilibrium during a wind speed increase from normal operation to the extreme situation, this behaviour shall be included in the analysis.

In DLC 6.1, for a wind turbine with an active yaw system, a mean yaw misalignment of ±8° using the turbulent extreme wind model shall be imposed, provided restraint against slippage in the yaw system can be assured.

Delete paragraph 5: 'The partial safety factors for loads …'

Replace paragraphs 6 and 7 with

In DLC 6.3, the extreme wind with a 1-year return period shall be combined with an extreme yaw misalignment. A mean yaw misalignment of ±20° using the turbulent wind model shall be assumed.

If for the case DLC 6.2, yaw misalignment is evaluated using discrete values, the increment in yaw misalignment shall be not more than 10° in the sector of the maximum lift force on the blades.