Wind energy generation systems - Part 27-1: Electrical simulation models - Generic models

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NATIONAL FOREWORD

See Eesti standard EVS-EN IEC 61400-27-1:2020 sisaldab Euroopa standardi EN IEC 61400-27-1:2020 ingliskeelset teksti.	This Estonian standard EVS-EN IEC 61400-27-1:2020 consists of the English text of the European standard EN IEC 61400-27-1:2020.
Standard on jõustunud sellekohase teate avaldamisega EVS Teatajas	This standard has been endorsed with a notification published in the official bulletin of the Estonian Centre for Standardisation.
Euroopa standardimisorganisatsioonid on teinud Euroopa standardi rahvuslikele liikmetele kättesaadavaks 11.09.2020.	Date of Availability of the European standard is 11.09.2020.
Standard on kättesaadav Eesti Standardikeskusest.	The standard is available from the Estonian Centre for Standardisation.

Tagasisidet standardi sisu kohta on võimalik edastada, kasutades EVS-i veebilehel asuvat tagasiside vormi või saates e-kirja meiliaadressile standardiosakond@evs.ee.

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English Version

Wind energy generation systems - Part 27-1: Electrical simulation models - Generic models (IEC 61400-27-1:2020)

Systèmes de génération d'énergie éolienne - Partie 27-1: Modèles de simulation électrique - Modèles génériques (IEC 61400-27-1:2020)

Windenergieanlagen - Teil 27-1: Elektrische Simulationsmodelle - Generische Modelle (IEC 61400-27-1:2020)

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

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

European foreword

The text of document 88/762/FDIS, future edition 2 of IEC 61400-27-1, prepared by IEC/TC 88 "Wind energy generation systems" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN IEC 61400-27-1:2020.

The following dates are fixed:

- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2021-06-03
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2023-09-03

This document supersedes EN 61400-27-1:2015 and all of its amendments and corrigenda (if any).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC shall not be held responsible for identifying any or all such patent rights.

Endorsement notice

The text of the International Standard IEC 61400-27-1:2020 was approved by CENELEC as a European Standard without any modification.

Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 1 Where an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cenelec.eu.

Publication	Year	Title	EN/HD	Year
IEC 60050-415	1999	International Electrotechnical Vocabulary -- Part 415: Wind turbine generator systems	--	-
IEC 61970-301	-	Energy management system application program interface (EMS-API) - Part 301: Common information model (CIM) base	EN IEC 61970-301	-
IEC 61970-302	-	Energy management system application program interface (EMS-API) - Part 302: Common information model (CIM) dynamics	EN IEC 61970-302	-

IEC 61400-27-1

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Wind energy generation systems –
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WIND ENERGY GENERATION SYSTEMS –

Part 27-1: Electrical simulation models – Generic models

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.
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International Standard IEC 61400-27-1 has been prepared by IEC technical committee 88: Wind energy generation systems.

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

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

FDIS	Report on voting
88/762/FDIS	88/771/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 publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

This second edition cancels and replaces the first edition, published in 2015. This edition constitutes a technical revision and a restructure of the content into two parts. The new structure joins the models in part 27-1 and the validation procedures in part 27-2.

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

a) "Wind turbines" changed to "Generic models" because wind power plant models are also included, and the model validation is moved to IEC 61400-27-2;
b) specification of models for wind power plants including plant control, communication system model and aggregation procedure for power collection system in addition to the wind turbine models in the previous edition;
c) moving validation prodedures for wind turbine models from this edition to part 27-2;
d) a more detailed modular structure separating wind turbine control into pitch control and generator system control and extracting grid measurement modules from the control modules. Figures are revised accordingly;
e) inclusion of model for STATCOM;
f) inclusion of electrical components modules.

A list of all parts in the IEC 61400, published under the general title *Wind energy generation systems*, can be found on the IEC website.

Future standards in this series will carry the new general title as cited above. Titles of existing standards in this series will be updated at the time of the next edition.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

INTRODUCTION

IEC 61400-27-1 specifies standard dynamic electrical simulation models for wind turbines and wind power plants. The specified wind turbine models can either be used in wind power plant models or to represent wind turbines without wind power plant relationships. Apart from the wind turbine models, the wind power plant model may include models for auxiliary equipment such as STATCOMs which are often used in wind power plants.

The increasing penetration of wind energy in power systems implies that Transmission System Operators (TSOs) and Distribution System Operators (DSOs) need to use dynamic models of wind power generation for power system stability studies. The models developed by the wind turbine manufacturers reproduce the behaviour of their machines with a high level of detail. Such level of detail is not suitable for stability studies of large power systems with a huge number of wind power plants, firstly because the high level of detail increases the complexity and thus computer time dramatically, and secondly because the use of detailed manufacturer specific models requires a substantial amount of input data to represent the individual wind turbine types.

The purpose of this International Standard is to specify generic dynamic models, which can be applied in power system stability studies. The IEEE/CIGRE Joint Task Force on Stability Terms and Definitions [11][1] has classified power system stability in categories according to Figure 1.

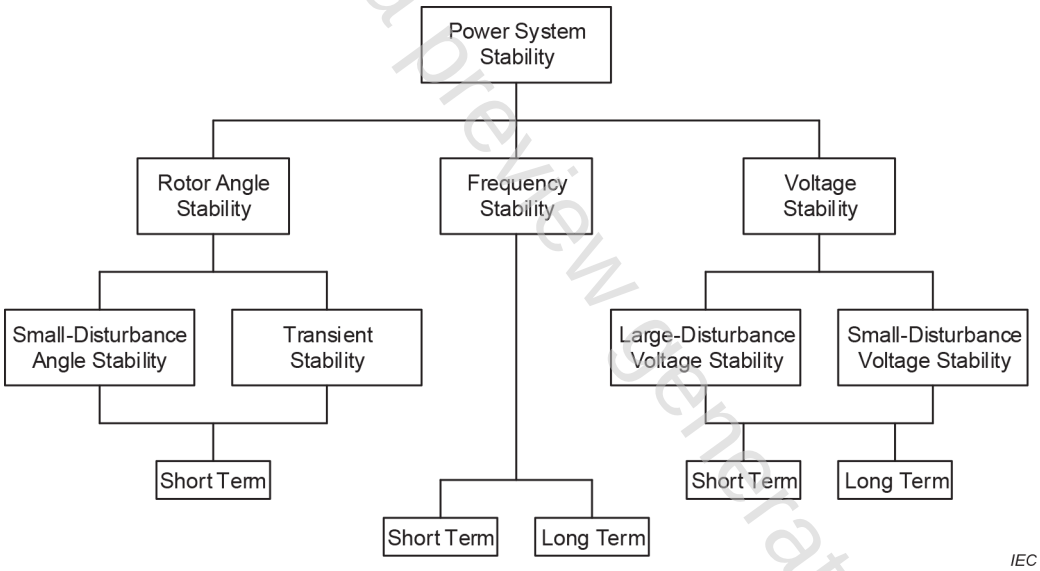

Figure 1 – Classification of power system stability according to IEEE/CIGRE Joint Task Force on Stability Terms and Definitions [11]

Referring to these categories, the models are developed to represent wind power generation in studies of large-disturbance short term stability phenomena, i.e. short term voltage stability, short term frequency stability and short term transient stability studies referring to the definitions of IEEE/CIGRE Joint Task Force on Stability Terms and Definitions in Figure 1. Thus, the models are applicable for dynamic simulations of power system events such as short-circuits (low voltage ride through), loss of generation or loads [12], and system separation of a synchronous system into more synchronous areas.

[1] The numbers in square brackets refer to the Bibliography.

The models shall be complete enough to represent the dynamic behavior of the wind power plant at the point of connection and of the wind turbine at the wind turbine terminals, but shall also be suitable for large-scale grid studies. Therefore, simplified models are specified to perform the typical response of known technologies.

The wind power plant models specified in this document are for fundamental frequency positive sequence response[2].

The models have the following limitations:

– The models are not intended for long term stability analysis.
– The models are not intended for investigation of sub-synchronous interaction phenomena.
– The models are not intended for investigation of the fluctuations originating from wind speed variability in time and space. This implies that the models do not include phenomena such as turbulence, tower shadow, wind shear and wakes.
– The models do not cover phenomena such as harmonics, flicker or any other EMC emissions included in the IEC 61000 series.
– The wind generation systems are highly non-linear and simplifications have been made in the development of the models. Thus, linearisation for eigenvalue analysis is not trivial nor necessarily appropriate based on these simplified models.
– This document does not address the specifics of short-circuit calculations.
– The models are not applicable to studies where wind turbines are islanded without synchronous generation.
– The models are not intended for studies of situations with short-circuit ratios less than 3. The short circuit limitation depends on wind turbine types, control modes and other settings. The WT manufacturer can specify a lower limit for the applicable short-circuit ratio provided that this application is validated according to part 27-2.
– The models are limited by the functional specifications in Clause 5.

The following stakeholders are potential users of the models specified in this document:

– TSOs and DSOs are end users of the models, performing power system stability studies as part of the planning as well as the operation of the power systems.
– Wind plant owners are typically responsible to provide the wind power plant models to TSO and/or DSO prior to plant commissioning.
– Wind turbine manufacturers will typically provide the wind turbine models to the owner.
– Developers of modern software for power system simulation tools will use the standard to implement standard wind power models as part of the software library.
– Certification bodies in case of independent wind turbine model validation.
– Consultants who use models on behalf of TSOs, DSOs and/or wind plant developers.
– Education and research communities, who can also benefit from the generic models, as the manufacturer specific models are typically confidential.

2 This document is dealing with balanced as well as unbalanced faults, but for unbalanced faults, only the positive sequence components are specified.