EESTI STANDARD

EVS-EN 61400-27-1:2015

Wind turbines - Part 27-1: Electrical simulation models - Wind turbines

EESTI STANDARDIKESKUS
ESTONIAN CENTRE FOR STANDARDISATION

EESTI STANDARDI EESSÕNA	NATIONAL FOREWORD
See Eesti standard EVS-EN 61400-27-1:2015 sisaldab Euroopa standardi EN 61400-27-1:2015 ingliskeelset teksti.	This Estonian standard EVS-EN 61400-27-1:2015 consists of the English text of the European standard EN 61400-27-1:2015.
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 16.10.2015.	Date of Availability of the European standard is 16.10.2015.
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 turbines - Part 27-1: Electrical simulation models - Wind turbines (IEC 61400-27-1:2015)

Eoliennes - Partie 27-1: Modèles de simulation électrique - Eoliennes
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Windenergieanlagen - Teil 27-1: Elektrische Simulationsmodelle - Windenergieanlagen
(IEC 61400-27-1:2015)

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European Committee for Electrotechnical Standardization
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Europäisches Komitee für Elektrotechnische Normung

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European foreword

The text of document 88/510/FDIS, future edition 1 of IEC 61400-27-1, prepared by IEC TC 88 "Wind turbines" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 61400-27-1:2015.

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)	2016-04-16
• latest date by which the national standards conflicting with the document have to be withdrawn	(dow)	2018-03-20

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Endorsement notice

The text of the International Standard IEC 61400-27-1:2015 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following note has to be added for the standard indicated:

IEC 61400-25 (Series) NOTE Harmonised as EN 61400-25 (Series).

Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

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

NOTE 1 When 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	series	International Electrotechnical Vocabulary	-	series
IEC 61400-21	-	Wind turbines -- Part 21: Measurement and assessment of power quality characteristics of grid connected wind turbines	EN 61400-21	-

CONTENTS

INTRODUCTION

The IEC 61400-27 series specifies standard dynamic electrical simulation models for wind power generation. IEC 61400-27-1 specifies wind turbine models and model validation procedure. IEC 61400-27-2 will specify wind power plant models and model validation procedure.

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 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 has classified power system stability in categories according to Figure 1.

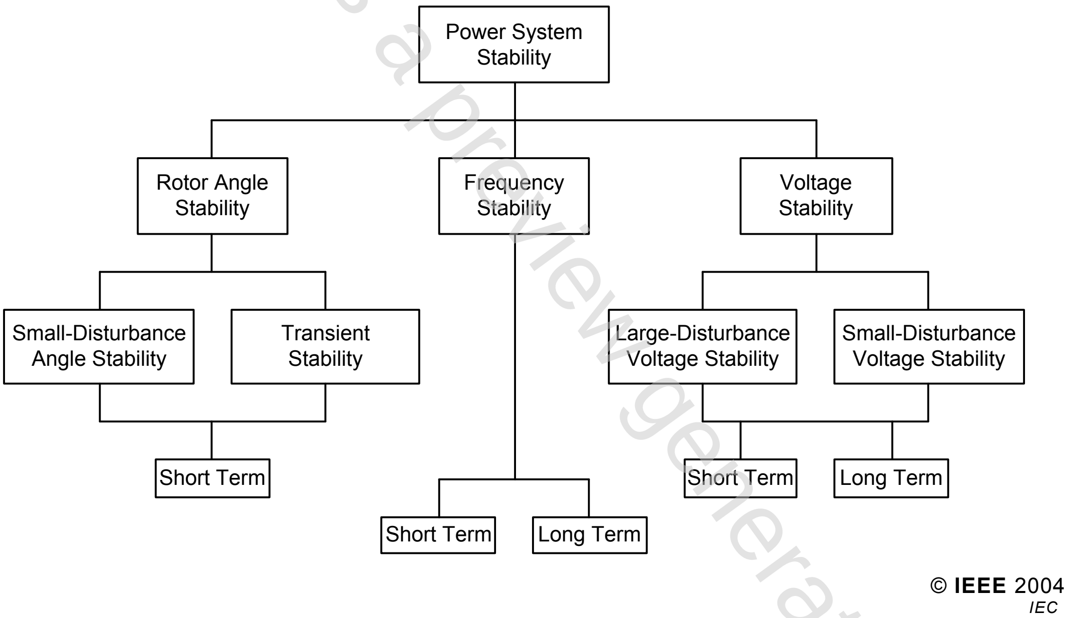

Figure 1 – Classification of power system stability according to IEEE/CIGRE Joint Task Force on Stability Terms and Definitions

Referring to these categories, the models are developed to represent wind power generation in studies of large-disturbance short term voltage stability phenomena, but they will also be applicable to study other dynamic short term phenomena such as rotor angle stability, frequency stability and small-disturbance voltage stability. 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, and system separation of one synchronous area into more synchronous areas as specified in the scope.

The models have to be complete enough to represent the dynamic behaviour at the wind turbine terminals, but must also be suitable for large-scale grid studies. Therefore simplified wind turbine models are specified to perform the typical response of known wind turbine technologies.

The wind turbine models specified in this standard are for fundamental frequency positive sequence response[1]. 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 models have not been developed explicitly with eigenvalue calculation (for small signal stability) in mind[2].
– The models specified here apply only to wind turbines, and therefore do not include wind power plant level controls and additional equipment such as SVCs, STATCOMs and other devices which will be covered by IEC 61400-27-2. The wind turbine models interface to the wind power plant controller models in IEC 61400-27-2.
– This standard does not address the specifics of short-circuit calculations.
– The models are not applicable to studies of extremely weak systems including situations where wind turbines are islanded without other synchronous generation.
– The models are limited by the technical specifications in 5.2.

The validation procedure specified in this standard is intended to be applied to standard models and other fundamental frequency wind turbine models. The validation procedure has the following limitations:

– The validation procedure does not specify any requirements to model accuracy. It only specifies measures to quantify the accuracy of the model[3].
– The validation procedure does not specify test and measurement procedures, as it is based on tests specified in IEC 61400-21.
– The simulation model validation is not intended to justify compliance to any grid code requirement, power quality requirements or national legislation.
– The test and measurement procedures introduce errors which limit the possible accuracy as specified in the validation procedure.
– The validation procedure does not include steady state validation, but focuses on validation of the dynamic performance of the model.

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

– 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.

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

2 These wind generation systems are highly non-linear and simplifications have been made in the development of the proposed models. Thus, linearisation for eigenvalue analysis is not trivial nor necessarily appropriate based on these simplified models.

3 Clause 6 specifies a large number of measures for model accuracy. The importance of the individual measure depends on the type of grid and type of stability study. Annex B describes limits to the possible accuracy of the models.

– 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.
– Education and research communities, who can also benefit from the generic models, as the manufacturer specific models are typically confidential.