PD IEC TR 61400-21-3:2019

BSI Standards Publication

Wind energy generation systems

Part 21-3: Measurement and assessment of electrical characteristics — Wind turbine harmonic model and its application

bsi.

National foreword

This Published Document is the UK implementation of IEC TR 61400-21-3:2019.

The UK participation in its preparation was entrusted to Technical Committee PEL/88, Wind turbines.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Published by BSI Standards Limited 2019

ISBN 978 0 539 02201 8

ICS 27.180

Compliance with a British Standard cannot confer immunity from legal obligations.

This Published Document was published under the authority of the Standards Policy and Strategy Committee on 30 September 2019.

Amendments/corrigenda issued since publication

Date	Text affected

IEC TR 61400-21-3

Edition 1.0 2019-09

TECHNICAL REPORT

colour inside

Wind energy generation systems – Part 21-3: Measurement and assessment of electrical characteristics – Wind turbine harmonic model and its application

INTERNATIONAL ELECTROTECHNICAL COMMISSION

ICS 27.180

ISBN 978-2-8322-7288-6

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

_____

WIND ENERGY GENERATION SYSTEMS –

Part 21-3: Measurement and assessment of electrical characteristics – Wind turbine harmonic model and its application

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.
2) The formal decisions or agreements of 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 IEC National Committees.
3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
6) All users should ensure that they have the latest edition of this publication.
7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

The main task of IEC technical committees is to prepare International Standards. However, a technical committee may propose the publication of a Technical Report when it has collected data of a different kind from that which is normally published as an International Standard, for example "state of the art".

IEC TR 61400-21-3, which is a Technical Report, has been prepared by IEC Technical Committee 88: Wind energy generation systems.

The text of this Technical Report is based on the following documents:

DTR	Report on voting
88/698/DTR	88/717/RVDTR

Full information on the voting for the approval of this Technical Report can be found in the report on voting indicated in the above table.

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

A list of all parts in the IEC 61400 series, 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 document will remain unchanged until the stability date indicated on the IEC website under "http://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.

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

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

The purpose of this IEC Technical Report (TR) is to provide a methodology that will ensure understanding, consistency and accuracy in application, structure and validation of the harmonic model of grid connected wind turbines (WTs).

There is an understandable requirement from wind power industry shareholders, e.g. transmission system operators (TSOs) and distribution system operators (DSOs), wind power plant (WPP) developers, WT manufacturers, WT component suppliers, academic units, research institutions, certifying bodies and standardization groups (e.g. TC88 MT21), for having a standardized WT harmonic model.

The standardized harmonic model would find a broad application in many areas of electrical engineering related to design, analysis, and optimisation of electrical infrastructure of onshore as well as offshore WPPs. Among others, this could be the evaluation of the WT harmonic performance, system-level harmonic studies, electrical infrastructure design and proposal of harmonic mitigation measures.

Standardized WT harmonic models as a performance measure starts to be important in such multi stakeholder systems as large offshore WPPs where TSOs, WPP developers and operators as well as WT manufacturers need to have a common understanding about harmonic modelling of WTs and harmonic studies in WPPs.

WIND ENERGY GENERATION SYSTEMS –

Part 21-3: Measurement and assessment of electrical characteristics – Wind turbine harmonic model and its application

1 Scope

This part of IEC 61400 provides guidance on principles which can be used as the basis for determining the application, structure and recommendations for the WT harmonic model. For the purpose of this Technical Report, a harmonic model means a model that represents harmonic emissions of different WT types interacting with the connected network.

This document is focused on providing technical guidance concerning the WT harmonic model. It describes the harmonic model in detail, covering such aspects as application, structure, as well as validation. By introducing a common understanding of the WT representation from a harmonic performance perspective, this document aims to bring the overall concept of the harmonic model closer to the industry (e.g. suppliers, developers, system operators, academia, etc.).

A standardized approach of WT harmonic model representation is presented in this document. The harmonic model will find a broad application in many areas of electrical engineering related to design, analysis, and optimisation of electrical infrastructure of onshore as well as offshore WPPs.

The structure of the harmonic model presented in this document will find an application in the following potential areas:

- evaluation of the WT harmonic performance during the design of electrical infrastructure and grid-connection studies;
- harmonic studies/analysis of modern power systems incorporating a number of WTs with line side converters;
- active or passive harmonic filter design to optimize electrical infrastructure (e.g. resonance characteristic shaping) as well as meet requirements in various grid codes;
- sizing of electrical components (e.g. harmonic losses, static reactive power compensation, noise emission, harmonic compatibility levels, etc.) within WPP electrical infrastructure;
- evaluation of external network background distortion impact on WT harmonic assessment;
- standardised communication interfaces in relation to WT harmonic data exchange between different stakeholders (e.g. system operators, generators, developers, etc.);
- universal interface for harmonic studies for engineering software developers;
- possible benchmark of WT introduced to the academia and the industry.

The advantage of having standardized WT harmonic performance assessment by means of the harmonic model is getting more and more crucial in case of large systems with different types of WTs connected to them, e.g. multi-cluster wind power plants incorporating different types of WTs connected to the same offshore or onshore substation.

The WT harmonic model can cover the integer harmonic range up to the 40^{th}, 50^{th}, or 100^{th}. And can be expanded, depending on requirements and application, to higher harmonic range as well as can also cover interharmonic components.