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Wind energy generation systems -
Part 60: Validation of computational models

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Wind energy generation systems - Part 60: Validation of computational models

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IEC PAS 61400-60 was prepared by IEC technical committee 88: Wind energy generation systems. It is a Publicly Available Specification.

The text of this Publicly Available Specification is based on the following documents:

Draft	Report on voting
88/1164/DPAS	88/1206/RVDPAS

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 Publicly Available Specification 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, [and the ISO/IEC Directives, JTC 1 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/publications.

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

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– withdrawn, or

– revised.

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INTRODUCTION

The wind energy industry has experienced significant growth over the past 30 years. Computational models have already been used for a long time and the use of these models both for product design, siting, grid compliance and other areas of the wind energy industry is still increasing. In 2018, the need for a more transparent and data-driven statistical approach was recognized within the industry, which has ultimately led to the establishment of the documents under IEC PAS 61400-60 (all parts). These documents are used in conjunction with relevant design and measurement standards.

IEC PAS 61400-60 consists of the following parts, under the general title *Model Validation of computational models for the use within the wind energy industry.*

– IEC PAS 61400-60: Validation of computational models

– IEC PAS 61400-60-1 [1]: Validation of computations models for loads and power performance.[1]

Further parts (or updates to these parts) are foreseen for the specific model validation process for other technology areas, such as offshore loads modelling, and site energy assessment modelling is expected to follow.

[1] Under preparation. Stage at the time of publication IEC PAS/CD 61400-60-1:2025.

1 Scope

It is the purpose of this document that it will be applied to existing models already in use within the wind energy sector, as well as to future models (and updates of models) that will be used within the wind energy sector. As such, this document does not set specific requirements to model accuracy and precision but aims to transparently establish the performance of models in terms of accuracy and precision, both for the intended use as covered by measurements as well as the predictive capability of the model.

This document (and all documents under IEC PAS 61400-60 (all parts) aims at model validation but not model development.

Specifically, this document further defines the model validation requirements in the following standards and operational documents:

IEC 61400-1:2019,

IEC 61400-5:2020,

IEC 61400-27-2:2020,

OD-501:2018 [2],

OD-501:2022 [3],

IECRE Clarification sheet CSH022 Ed 2.0[1]

2 Normative references

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.

IEC 61400-1:2019, *Wind energy generation systems - Part 1: Design requirements*

IEC 61400-5:2020, *Wind energy generation systems - Part 5: Wind turbine blades*

IEC 61400-11:2012/AMD1:2018, *Amendment 1 - Wind turbines - Part 11: Acoustic noise measurement techniques*

IEC 61400-12-1:2022, *Wind energy generation systems - Part 12-1: Power performance measurements of electricity producing wind turbines*

IEC 61400-13:2015/AMD1:2021, *Amendment 1 - Wind turbines - Part 13: Measurement of mechanical loads*

IEC 61400-27-2:2020, *Wind energy generation systems - Part 27-2: Electrical simulation models - Model validation*

ISO/IEC Guide 98-3:2008, *Uncertainty of measurement - Part 3: Guide to the expression of uncertainty in measurement (GUM:1995)*

ISO/IEC Guide 98-3:2008/Suppl 1:2008, *Uncertainty of measurement - Part 3: Guide to the expression of uncertainty in measurement (GUM:1995) - Supplement 1: Propagation of distributions using a Monte Carlo method*

ISO/IEC/IEEE 15288:2023, *Systems and software engineering - System life cycle processes*

EN IEC 61400-1:2019, *Wind energy generation systems - Part 1: Design requirements*

IEC 61400 (all parts), *Wind energy generation systems*

IEC PAS 61400-60 (all parts), *Validation of computational models*

IECRE Clarification sheet CSH022 Ed 2.0

3 Terms, definitions and abbreviated terms

For the purposes of this document, the following terms and definitions apply.

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

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

3.1 Terms and definitions

3.2
accuracy and precision
formulation or metric for characterising the discrepancy between experimental results on one side and model output (3.1.11) and/or co-simulation results (3.1.5) on the other side

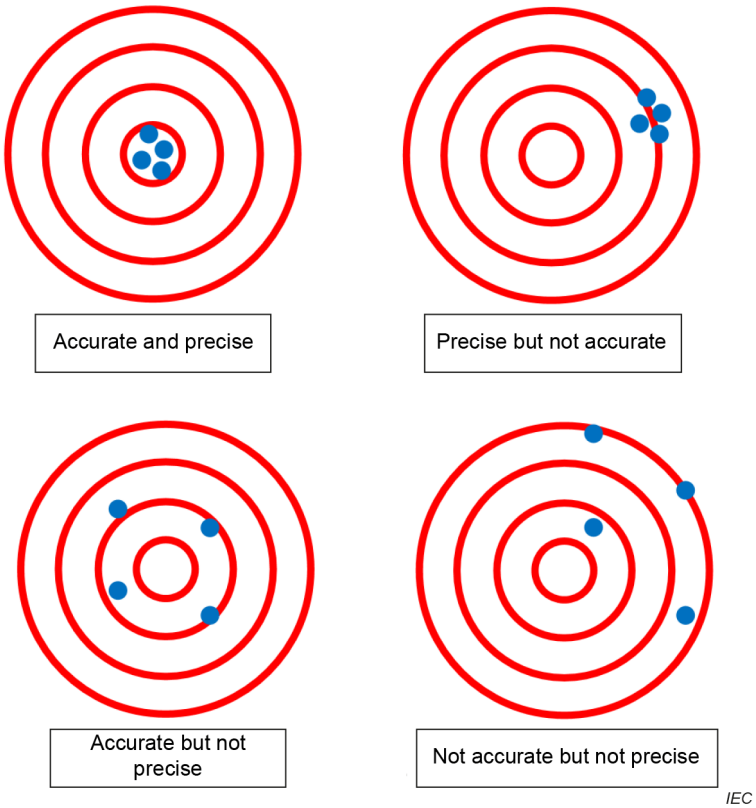


Figure 1 – Accuracy and precision (3.1.1)

Note 1 to entry: The accuracy is defined as the average discrepancy and the precision is defined as a standard deviation of the discrepancy.