IEC 61400-25-1

Edition 2.0 2017-07

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Wind energy generation systems – Part 25-1: Communications for monitoring and control of wind power plants – Overall description of principles and models

Systèmes de génération d'énergie éolienne – Partie 25-1: Communications pour la surveillance et la commande des centrales éoliennes – Description globale des principes et des modèles

IEC 61400-25-1:2017-07(en-fr)

IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00
info@iec.ch
www.iec.ch

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WIND ENERGY GENERATION SYSTEMS –

Part 25-1: Communications for monitoring and control of wind power plants – Overall description of principles and models

FOREWORD

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International Standard IEC 61400-25-1 has been prepared by IEC technical committee 88: Wind energy generation systems.

This second edition cancels and replaces the first edition published in 2006. This edition constitutes a technical revision.

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

a) general harmonization of text and overview models with the other parts of the IEC 61400-25 series,
b) harmonization of definitions in other related standards.

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

CDV	Report on voting
88/587/CDV	88/622/RVC

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

The title of TC 88 was changed in 2015 from *Wind turbines* to *Wind energy generation systems*.

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

The users of IEC 61400-25 have formed a community, USE61400-25. For further information see http://www.use61400-25.com.

Attached to the release of the IEC 61400-25 standard series and in addition to the standard IEC maintenance process, a specific maintenance process is set up to handle technical issues raised after publication. Here are the main principles:

- Technical issues (called TISSUES) are collected from the release of the new document in cooperation with the user group for the IEC 61400-25 standard series USE61400-25.
- The collected TISSUES can be categorized in two groups:
  - TISSUES that can threaten interoperability between implementations of the standard and that need either corrections or clarifications ("IntOp" TISSUES),
  - TISSUES that propose new features that will be implemented in future versions of the standard ("next edition" TISSUES).
- IntOp TISSUES require immediate clarification and are following a transparent fixing process handled by the user group for the IEC 61400-25 standard series together with the editors of the IEC 61400-25 standard series.
- The detailed specification of this process, the list of TISSUES, associated fix, their status and impact on implementation and certification are accessible through the USE61400-25 web site http://www.use61400-25.com.
- IEC recommends implementing the proposed fixes to IntOp TISSUES, as soon as they have reached the "green" status. The list of TISSUES which are implemented in an intelligent electronic device (IED) should be transparently stated by its manufacturer.

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.

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INTRODUCTION

IEC 61400-25 (all parts) is intended for vendors (manufacturers, suppliers), operators, owners, planners, and designers of wind power plants as well as system integrators and utility companies operating in the wind energy market. IEC 61400-25 (all parts) is intended to be accepted and to be used world-wide as the international standard for communications in the domain of wind power plants.

IEC 61400-25 (all parts) has been developed in order to provide a uniform communications basis for the monitoring and control of wind power plants. It defines wind power plant specific information, the mechanisms for information exchange and the mapping to communication protocols. In this regard, IEC 61400-25 (all parts) defines details required to exchange the available information with wind power plant components in a manufacturer-independent environment. This is done by definitions made in this part of IEC 61400-25 or by reference to other standards.

The wind power plant specific information describes the crucial and common process and configuration information. The information is hierarchically structured and covers for example common information found in the rotor, generator, converter, grid connection and the like. The information may be simple data (including timestamp and quality) and configuration values or more comprehensive attributes and descriptive information, for example engineering unit, scale, description, reference, statistical or historical information. All information of a wind power plant defined in IEC 61400-25 (all parts) is name tagged. A concise meaning of each data is given. The standardized wind power plant information can be extended by means of a name space extension rule. All data, attributes and descriptive information can be exchanged by corresponding services.

The implementation of IEC 61400-25 (all parts) allows SCADA systems (supervisory control and data acquisition) to communicate with wind turbines from multiple vendors. The standardized self-description (contained either in an XML file or retrieved online from a device) can be used to configure SCADA applications. Standardization of SCADA applications are excluded in IEC 61400-25 (all parts) but standardized common wind turbine information provides means for re-use of applications and operator screens for wind turbines from different vendors. From a utility perspective, unified definitions of common data minimize conversion and re-calculation of data values for evaluation and comparison of all their wind power plants.

IEC 61400-25 (all parts) can be applied to any wind power plant operation concept, i.e. both individual wind turbines, clusters and more integrated groups of wind turbines. The application area of IEC 61400-25 (all parts) covers components required for the operation of wind power plants, i.e. not only the wind turbine generator, but also the meteorological system, the electrical system, and the wind power plant management system. The wind power plant specific information in IEC 61400-25 (all parts) excludes information associated with feeders and substations. Substation communication is covered within IEC 61850 (all parts).

The intention of IEC 61400-25 (all parts) is to enable components from different vendors to communicate with other components, at any location. Object-oriented data structures can make the engineering and handling of large amounts of information provided by wind power plants less time-consuming and more efficient. IEC 61400-25 (all parts) supports scalability, connectivity, and interoperability.

IEC 61400-25 (all parts) is a basis for simplifying the contracting of the roles the wind turbine and SCADA systems have to play. The crucial part of the wind power plant information, the information exchange methods, and the communication stacks are standardized. They build a basis to which procurement specifications and contracts could easily refer.

IEC 61400-25 is organized in several parts.

- IEC 61400-25-1 offers an introductory orientation, crucial requirements, and a modelling guide.
- IEC 61400-25-2 and IEC61400-25-6 contain the description of the information model, a uniform, component-oriented view of the wind power plant data, including extensions for condition monitoring.
- IEC 61400-25-3 describes the information exchange model. It reflects the functionality of the server.
- IEC 61400-25-4 presents five alternative mappings of the information model and information exchange model to a standard communication profile. The choice depends on the application and the functionality and performance needed.
- IEC 61400-25-5 describes test cases for conformance testing of implementations.

NOTE Performance of IEC 61400-25 (all parts) implementations are application specific. IEC 61400-25 (all parts) does not guarantee a certain level of performance. This is beyond the scope of IEC 61400-25 (all parts). However, there is no underlying limitation in the communications technology to prevent high speed application (millisecond level responses).

WIND ENERGY GENERATION SYSTEMS –

Part 25-1: Communications for monitoring and control of wind power plants – Overall description of principles and models

1 Scope

The focus of IEC 61400-25 (all parts) is on the communications between wind power plant components such as wind turbines and actors such as SCADA systems. Internal communication within wind power plant components is beyond the scope of IEC 61400-25 (all parts).

IEC 61400-25 (all parts) is designed for a communication environment supported by a client-server model. Three areas are defined, that are modelled separately to ensure the scalability of implementations:

1) wind power plant information models,
2) information exchange model, and
3) mapping of these two models to a standard communication profile.

The wind power plant information model and the information exchange model, viewed together, constitute an interface between client and server. In this conjunction, the wind power plant information model serves as an interpretation frame for accessible wind power plant data. The wind power plant information model is used by the server to offer the client a uniform, component-oriented view of the wind power plant data. The information exchange model reflects the whole active functionality of the server. IEC 61400-25 (all parts) enables connectivity between a heterogeneous combination of client and servers from different manufacturers and suppliers.

As depicted in Figure 1, IEC 61400-25 (all parts) defines a server with the following aspects:

– information provided by a wind power plant component, for example, ‘wind turbine rotor speed’ or ‘total power production of a certain time interval’ is modelled and made available for access. The information modelled in IEC 61400-25 (all parts) is defined in IEC 61400-25-2 and IEC 61400-25-6,
– services to exchange values of the modelled information defined in IEC 61400-25-3,
– mapping to a communication profile, providing a protocol stack to carry the exchanged values from the modelled information (IEC 61400-25-4).

IEC 61400-25 (all parts) only defines how to model the information, information exchange and mapping to specific communication protocols. IEC 61400-25 (all parts) excludes a definition of how and where to implement the communication interface, the application program interface and implementation recommendations. However, the objective of IEC 61400-25 (all parts) is that the information associated with a single wind power plant component (such as a wind turbine) is accessible through a corresponding logical device.

This part of IEC 61400-25 gives an overall description of the principles and models used in IEC 61400-25 (all parts).

NOTE IEC 61400-25 (all parts) focuses on the common, non-vendor-specific information. Those information items that tend to vary greatly between vendor-specific implementations can for example be specified in bilateral agreements, in user groups, or in amendments to IEC 61400-25 (all parts).

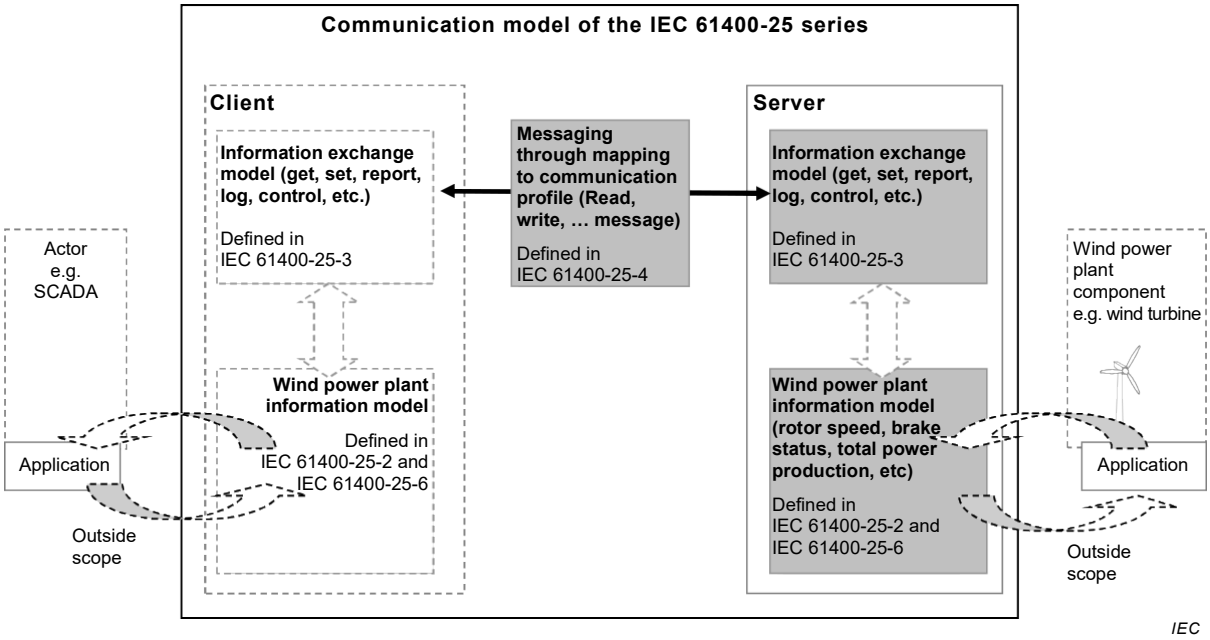

Figure 1 – Conceptual communication model of the IEC 61400-25 series

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 61400-25 (all parts), *Wind turbines – Part 25: Communications for monitoring and control of wind power plants*

IEC 61400-25-2:2015, *Wind turbines – Part 25-2: Communications for monitoring and control of wind power plants – Information models*

IEC 61400-25-3:2015, *Wind turbines – Part 25-3: Communications for monitoring and control of wind power plants – Information exchange models*

IEC 61400-25-4, *Wind energy generation systems – Part 25-4: Communications for monitoring and control of wind power plants – Mapping to communication profile*

IEC 61400-25-6, *Wind energy generation systems – Part 25-6: Communications for monitoring and control of wind power plants – Logical node classes and data classes for condition monitoring*

IEC 61850-7-1:2011, *Communication networks and systems for power utility automation – Part 7-1: Basic communication structure – Principles and models*

IEC 61850-7-2:2010, *Communication networks and systems for power utility automation – Part 7-2: Basic information and communication structure – Abstract communication service interface (ACSI)*

3 Terms and definitions

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

3.1
actor
role a system plays in the context of monitoring and control, while it is not directly involved in wind power plant operation, such as supervisory control and data acquisition system (SCADA)

Note 1 to entry: There are many other designations for example central management system, monitoring and control system, remote control system

3.2
alarm
wind power plant state information
statement of safety intervention by the wind turbine control system (i.e. on/off)

3.3
characteristic values
properties of analogue information (min., max., avg, dev, etc.)

3.4
command
controllable data for system behaviour

EXAMPLE Enable/disable, activate/deactivate.

3.5
communication function
function used by an actor to configure, perform and monitor the information exchange with wind power plants

EXAMPLE Operational function, management function.

3.6
control
operational function used for changing and modifying, intervening, switching, controlling, parameterization and optimizing of wind power plants

3.7
counting value
total number of occurrences of a specific event

3.8
data retrieval
operational function used for collecting of wind power plant data

3.9
diagnostics
management function used to set up and provide for self-monitoring of the communication system

3.10
electrical system
set of electrical components working together as parts of a wind turbine or wind farm for collecting and transmitting the produced electricity in a wind power plant

3.11
event
state transition (status, alarm, command)

3.12
intelligent electronic device
IED
any device incorporating one or more processors, with the capability to receive data from an external sender or to send data to an external receiver

EXAMPLE Wind turbine controller.

Note 1 to entry: An IED may have connections as a client, or as a server, or both, with other IEDs.

Note 2 to entry: This note only applies to the French language.

3.13
information
content of communication

Note 1 to entry: The basic element is raw data from the wind power plant components, which shall be processed into specified information according to IEC 61400-25 (all parts).

Note 2 to entry: Wind power plant information categories are: source information (analogue and state information), derived information (statistical and historical information). Information is defined as data (usually processed and derived data, and information describing other data).

3.14
information exchange
communication process between two systems, such as wind power component and actor, with the goal to provide and to get relevant information

Note 1 to entry: Information exchange requires specific communication functions, consisting of one or more services.

3.15
information model
model representing knowledge concerning functions and devices in which the functions are implemented

Note 1 to entry: This knowledge is made visible and accessible through the means of IEC 61400-25 (all parts). The model describes in an abstract way a communication oriented representation of a real function or device.

3.16
log
historical information

Note 1 to entry: Log is a chronological list of source information for a period of time.

3.17
logging
operational function

Note 1 to entry: Logging is the praxis of recording sequential data, often chronologically. The result of logging is a log.

3.18
logical device
entity that represents a set of typical wind power plant functions

3.19
management function
function required for the administration of the information exchange in a certain level

Note 1 to entry: Management functions are user/access management, time synchronization, diagnostics, and configuration.

3.20
mandatory
provided in compliance to IEC 61400-25 (all parts)

3.21
measured data
sampled value of a process quantity with associated data attributes such as time stamp and quality

3.22
meteorological system
component of a wind power plant responsible for the monitoring of the ambient conditions, for example the wind speed, wind direction, pressure, temperature

Note 1 to entry: It supplies data for various purposes for example to correlate the meteorological data to the electrical energy output by individual wind turbines to the potentially usable wind energy.

3.23
monitoring

operational function used for local or remote observation of a system or a process for any changes which may occur over time

Note 1 to entry: The term can also be used for observation of the behaviour of a data value or a group of data values.

3.24
operational function
function to obtain information and to send instructions for the normal daily operation of wind power plants

Note 1 to entry: Types of operational function are: monitoring, logging, reporting, data retrieval, control.

3.25
optional
optionally provided in compliance with IEC 61400-25 (all parts)

3.26
parameter
controllable information intended for obtaining or correcting a system behaviour

3.27
processed data
measured value, with the associated data attributes such as time stamp and quality, which has been processed according to the calculation method attribute

3.28
profile(s)
format(s) used by a particular protocol to transmit data objects or commands, etc.