CAB/235A/DV

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2000-09

INTERNATIONAL ELECTROTECHNICAL COMMISSION

CONFORMITY ASSESSMENT BOARD (CAB)

SUBJECT

IEC WT 01 - IEC system for conformity testing and certification of wind turbines – Rules and procedures

BACKGROUND

This document CAB/235A/DV replaces CAB/235/DV which did not include Figure 3, now given on page 18.

Following approval by the CAB at its meeting in May 2000, of the proposal to publish the draft on certification of wind turbine systems, prepared by TC 88: *Wind turbine systems,* under the authority of the CAB as IEC WT 01, the draft is now submitted for a four month vote by CAB members to approve its publication.

Reference: See CAB/232/RM, Report on the CAB meeting, item 7.2

ACTION

The CAB is invited to vote on the approval for publication of the draft IEC WT 01. Comments may be submitted with votes.

Comments and votes should be sent via the CAB technical server before **2000-11-15**

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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4 # IEC System for conformity testing and certification of wind turbines– Rules and Procedures

6

FOREWORD

8 This publication has been prepared by TC 88 WG 09 and has been approved by the Conformity Assessment Board (CAB). It defines a certification system for wind turbines. 10 It specifies rules of procedure and management for carrying out conformity evaluation with respect to standards and technical requirements for wind turbines. This document is intended 12 to be used with other technical standards and normative documents and, where necessary, technical requirements and test procedures are specified.

14 Compliance with this system does not relieve any person, organisation or corporation of the responsibility for observing other applicable regulations.

16 The text of this publication is based on the following documents:

Document	Report on voting
88/115/CDV	XX/XX/RVD

Full information on the voting of the approval of this publication can be found in the report on 18 voting indicated in the above table.

INTRODUCTION

NOTE - This INTRODUCTION provides an overview of the IEC WT System and is not part of the Rules.

The international scheme for recognition of results of testing to standards for wind turbines is operated by the IEC, and known as the IEC WT System. The IEC WT System is based on the principle of mutual recognition (reciprocal acceptance) by participants of test results and certificates issued by other participants for obtaining certification at national level, and operates within the scope of the IEC 61400 series of standards for wind turbines .

In addition to type testing, the IEC WT System provides for the recognition of or assessment for approval of the manufacturer's quality system, regular surveillance through inspection of the manufacturer's factory quality system and product quality plans, and audit testing of samples from the manufacturer's factory. The System is intended to result in significant benefit to the manufacturer by reducing the number of steps necessary to obtain certification or approval at national level.

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IEC System for conformity testing and certification of wind turbines – Rules and Procedures

1 Title

The title of the System is:
"IEC System for conformity testing and certification of wind turbines ", hereinafter referred to as "the IEC WT System".

2 Object

Taking into account the object of the International Electrotechnical Commission (IEC) as given in Article 2 of the Statutes, the particular object of the IEC WT System, operated under the authority of the IEC in conformity with the Statutes, is to facilitate international trade in wind turbines which comply with one or more of the IEC standards prepared by IEC TC 88. This compliance, should reduce the number of step necessary to obtain certification or approval at national level whilst preserving an appropriate level of safety.

3 Governing documents

The documents which state the Rules of the IEC WT System and which govern the organization of its work are as follows:

a) the Statutes of the IEC;

b) the Rules of Procedure of the IEC and the ISO/IEC Directives, unless otherwise specified in the Rules of Procedure of the IEC WT System;

c) the Rules and Procedures which define the principles of the IEC WT System and which are approved by the CAB;

4 Organization

The system shall be monitored by an overseeing group, comprising the IEC TC 88 officers. The overseeing group reports annually to the CAB on the use and development of the IEC WT System.

5 Scope

This publication defines a certification system for Wind Turbines (WT). It specifies rules for procedures and management to carry out conformity evaluation of WT, with respect to specific standards and other technical requirements, relating to safety, reliability, performance, testing and interaction with electrical power networks. It provides:

- definitions of the elements in a wind turbine certification process;
- procedures for the conformity evaluation in a wind turbine certification system;
- procedures for conformity surveillance;
- rules for the documentation that is to be supplied by an Applicant for the conformity evaluation; and
- requirements for certification and inspection bodies and testing laboratories.

The standard is not limited to WT of any particular size or type. It describes procedures relating to design, manufacture, erection and installation, operation and maintenance, and decommissioning. The procedures deal with the assessment of loads and safety, testing, characteristics measurements and surveillance of manufacturing, installation and operation. Some elements of certification are mandatory, whilst provision is specifically made for others to be optional. The purpose of the standard is to provide a common basis for certification of wind turbines, including a basis for acceptance of operating bodies(i.e., certification bodies, inspection bodies and testing laboratories) and mutual recognition of certificates.

The standard shall be used in conjunction with the appropriate IEC/ISO standards and Guides, see 6.

6 References

The following documents contain normative provisions, which, through reference in this text, constitute provisions of the International Standard. At the time of publication, the editions indicated were valid. All normative documents are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents referenced below. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 61400-1: (Ed. 2, 1999), *Wind turbine generator systems. Safety requirements*.

IEC 61400-2: (1996), *Wind turbine generator systems. Safety of small wind turbines*.

IEC 61400-11: (1998), *Wind turbine generator systems. Acoustic Noise Measurement Techniques*.

IEC 61400-12: (1998), *Wind turbine generator systems. Wind turbine power performance testing*.

IEC 61400-21: (xx), *Wind turbine generator systems. Power quality requirements for Grid Connected Wind Turbines*.

IEC/IEV 415: (xx), *International Electrotechnical Vocabulary, chapter 415 - Wind Turbine Systems*.

ISO/IEC Guide 2: 1986, *General terms and their definitions concerning standardization and related activities*.

IEC/ISO 17025:1999, *General requirements for the competence of calibration and testing laboratories*.

IEC/ISO Guide 39: 1988, *General requirements for the acceptance of inspection bodies.*

ISO/IEC Guide 62: 1996, *General requirements for bodies operating assessment and certification/registration of quality systems*.

ISO/IEC Guide 65: 1996, *General requirements for bodies operating product certification systems.*

ISO 8402: 1986, *Quality - Vocabulary*

ISO 9001: 1994, *Quality system - Model for quality assurance in design, development, production, installation and servicing.*

ISO 9002: 1994, *Quality system - Model for quality assurance in production, installation and servicing.*

7 Definitions

The relevant definitions contained in ISO/IEC Guide 2, ISO 8402 and IEC/IEV 415 are applicable.

For purposes of this International Standard, the following definitions also apply:

7.1
accreditation:
procedure by which an authoritative body gives formal recognition that a body is impartial and technically competent to carry out specific tasks such as certification, tests, specific types of tests etc.

Note - Accreditation is awarded following successful assessment and is followed by appropriate surveillance.

7.2
applicant:
entity applying for certification

7.3
certificate holder:
entity holding a certificate after the certificate is issued.

Note - This entity may not be the original applicant but nevertheless is responsible for maintenance of the certificate

7.4
certification:
procedure by which a third party gives written assurance that a product, process or service conforms to specified requirements, also known as conformity assessment

7.5
certification body:
body that conducts certification of conformity

7.6
certification system:
system that has specific rules for procedure and management to carry out certification of conformity

7.7
evaluation for conformity:
systematic examination of the extent to which a product, process or service fulfils specified requirements

7.8
final evaluation report:
report containing the results of conformity evaluations relating to Type Certification. It is the basis for the decision to issue the Type Certificate

7.9
inspection:
systematic examination of the extent to which a product, process or service fulfils specified requirements by means of measuring, observing, testing or gauging the relevant characteristics

7.10
installation:
process that encompasses on site fabrication, assembly, erection and commissioning

7.11
manufacture:
process that encompasses fabrication and assembly in a factory or workshop

7.12
manufacturer:
Entity manufacturing the wind turbine or, where relevant, main components of the wind turbine

7.13
operating body:
body that conducts certification of conformity, testing or inspection

7.14
surveillance:
continuing monitoring and verification of the status of procedures, products and services, and analysis of records in relation to referenced documents to ensure specified requirements are met

7.15
type certificate:
document issued upon the successful completion of type certification

7.16
type certification:
procedure by which a certification body gives written assurance that a wind turbine type conforms to specified requirements

7.17
type testing:
action of carrying out tests for a given wind turbine type according to specified procedures

7.18
project certificate:
document issued upon successful completion of project certification

7.19
project certification:
procedure by which a certification body gives written assurance that one or more specific wind turbines are in conformity with requirements for a specific site

7.20
wind turbine type:
wind turbines of a common design, materials and major components, subject to a common manufacturing process and uniquely described by specific values or ranges of machine parameters and design conditions

8 Symbols and abbreviations

8.1 Symbols

The relevant symbols contained in IEC 61400-1 (Ed.2, 1999) are applicable. For purposes of this International Standard, the following symbols also apply:

g	acceleration due to gravity (= 9.81 m/s^2)	[m/s^2]

8.2 Abbreviations

WT: Wind Turbine(s)

9 Acceptance of Operating Bodies

9.1 General

Operating bodies shall be capable and competent to operate their elements of the wind turbine certification system in an impartial manner and shall comply with the relevant IEC/ISO publications among the following:

ISO/IEC 17025: *General requirements for the competence of calibration and testing laboratories*;

ISO/IEC Guide 39: *General requirements for the acceptance of inspection bodies*;

ISO/IEC Guide 65: *General requirements for bodies operating product certification systems*.

9.2 Accreditation

Operating bodies shall be accredited by a national or international accreditation body that has been internationally evaluated. This is in order to facilitate recognition arrangements on an international level of certificates and test results and to increase public confidence in their competence and impartiality.

9.3 Recognition Arrangements

Operating bodies shall seek to obtain, preferably multilateral, recognition arrangements for the acceptance of each other's work, e.g. test results or quality system certificates. Such arrangements shall be established with reference to the requirements of this standard.

When the operating bodies have been accredited by a common accreditation body or where recognition arrangements exist between the corresponding accreditation bodies, the accreditation forms a sufficient basis for mutual recognition of work under the accreditation.

If a recognition arrangement based on accreditation is not possible, a recognition arrangement between operating bodies should include:

- the scope of the agreement;
- specification of the parts of the wind turbine certification system with unrestricted acceptance;
- identification of the signatories and their legal status;
- agreement regarding surveillance of each other's work;
- a procedure for handling complaints and appeals;
- definition of the parties' responsibilities;
- details of lines of communication;

– undertakings regarding confidentiality and security; and

– a procedure for maintenance of a register of certificates, conformity statements and test reports issued by the bodies of the agreement.

10 Management of the Certification system

10.1 General

The certification system shall be managed and operated in accordance with IEC/ISO Guide 65: General requirements for bodies operating product certification systems.

10.2 Agreement on Certification

The Certification Body shall upon request be prepared to take on work for certification of wind turbines according to the rules of this standard. The services of the Certification Body shall be available to all applicants without undue financial or other conditions.

Prior to starting certification work an agreement between Applicant and Certification Body shall be made. In addition to financial and other usual contract conditions the agreement shall include:

– the scope of the certification;

– the identification of collaborating bodies (inspection or testing bodies), their accreditation and their responsibilities;

– the set of IEC 61400 standards and other technical requirements to which conformity shall be evaluated;

– a description of the scope of documentation to be supplied by the Applicant for evaluation, e.g. see Annex A: List of design documentation; and

– conditions for reporting and investigating incidents.

10.3 Issue of Certificates and Conformity Statements

The certification system covers the issue of certificates and conformity statements.

A certificate or conformity statement is based on evaluation of wind turbine documentation and the results of inspection, surveillance or testing, as applicable. The results of evaluation shall be documented in a final report. A certificate or a conformity statement shall be issued on the basis of an assessment of the completeness and correctness of an evaluation report or reports.

A certificate or conformity statement shall identify the scope of evaluation, the wind turbine, the supplier, the design assumptions and the set of normative documents, standards and other technical requirements. Examples, showing a suitable format and the minimum information, are given in Annex B.

10.4 Security of Relevant Documentation

The Certification Body shall keep a file of all received material that is relevant to the certificate or conformity statement. The files shall be kept in a place with restricted access for at least 5 years after the later date of receipt of the material or expiry of the last certificate issued. Subsequently the material and any copies shall be returned to the Applicant or destroyed with written notice thereof.

10.5 Maintenance and Expiration of Certificates

The period of validity and/or the period of review or monitoring of the certified object shall be clearly stated in the certificate and shall not exceed 5 years. To maintain validity, the object of the certificate shall be reviewed at periodic intervals not exceeding the period of validity.

10.6 Corrective Actions

The Certification Body shall be informed if, from log-book data or other information brought to the attention of the certificate holder, the wind turbine in question is shown not to function according to the design specifications and other criteria relevant to the certificate.

Incidents where the safety of a wind turbine or the surroundings are involved that are known to the certificate holder, shall be reported to the Certification Body without delay.

If after preliminary evaluation the Certification Body determines a serious defect affecting the safety of the wind turbine in question, the Certificate shall be immediately suspended. The Certification Body shall subsequently carry out a thorough evaluation of the defect. This evaluation shall result in either reaffirmation or withdrawal of the Certificate.

11 The Extent of Certification

11.1 General

The certification procedures specified in this standard constitute a complete third party conformity evaluation of a wind turbine type, a major component type or one or more wind turbines at a specific location, from design evaluation to monitoring of commissioning and operation. An evaluation results in one of the following:

- a Type Certificate;
- a Component Certificate; or
- a Project Certificate.

A Type Certificate covers a wind turbine, including the tower and the proposed type of connection between tower and foundation. It also covers the requirements governing the foundation, insofar as they arise from the wind turbine design and may include one or more foundation designs.

A Project Certificate covers one or more wind turbines, including the foundation(s), evaluated for the specific external conditions for an installation site. A Project Certificate presumes a Type Certificate and includes site assessment and foundation design evaluation as mandatory modules.

A Component Certificate covers a major wind turbine component such as a blade or gearbox.

This standard has a modular structure in order to account for requests for individual conformity statements, e.g. Design Evaluation.

The normative documents, i.e. standards and other specified technical requirements, to which conformity shall be evaluated in the certification process, shall be IEC or ISO standards when available.

11.2 Type Certification

The purpose of type certification is to confirm that the wind turbine type is designed, documented and manufactured in conformity with design assumptions, specific standards and other technical requirements. Demonstration that it is possible to install, operate and maintain the turbines in accordance with the design documentation is required. Type certification applies to a series of wind turbines of common design and manufacture. It consists of four mandatory modules:

- design evaluation;
- type testing;
- manufacturing evaluation; and
- final evaluation;

and the optional modules

- foundation design evaluation; and
- type characteristic measurements.

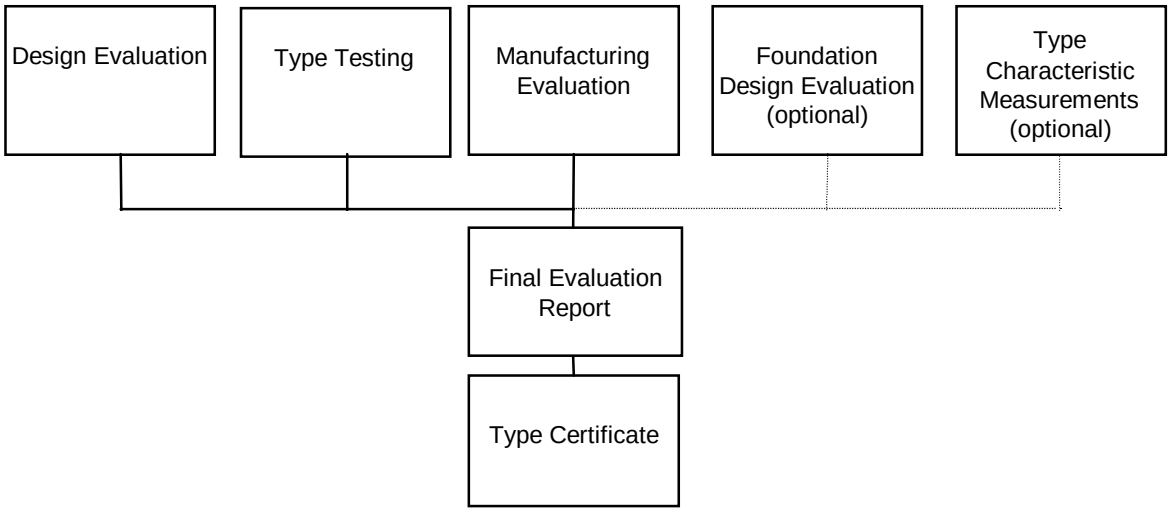

Figure 1 - Modules of type certification

The modules are illustrated in figure 1. Satisfactory evaluation of each module is concluded with an evaluation report and a conformity statement.

A Type Certificate is issued for a wind turbine designed and evaluated for conformance with the technical requirements of this part of IEC 61400 and IEC 61400-1 or IEC 61400-2, on the basis of the completeness and correctness of a Final Evaluation Report.

A Type Certificate documents conformity for all the mandatory modules and may additionally document conformity for one or both of the optional modules.

The elements comprising the modules and their application are listed in clause 12.

11.3 Project Certification

The purpose of Project Certification is to evaluate whether type-certified wind turbines and particular foundation designs are in conformity with the external conditions, applicable construction and electrical codes and other requirements relevant to a specific site. The Certification Body shall evaluate whether the wind conditions, other environmental conditions, electrical network conditions and soil properties at the site conform with those defined in the design documentation for the wind turbine type and foundation(s). The evaluation includes safety and quality.

Project Certification of type-certified wind turbines consists of the following mandatory modules:

– Site assessment; and

– Foundation design evaluation;

and the optional modules

– Installation evaluation; and

– Operation and maintenance surveillance.

The modules are illustrated in figure 2. Satisfactory evaluation of each module is concluded with an evaluation report and a conformity statement.

A Project Certificate documents conformity for all the mandatory modules and may additionally document conformity for one or both of the optional modules. The certificate is

issued on the basis of the completeness and correctness of the evaluation reports and conformity statements.

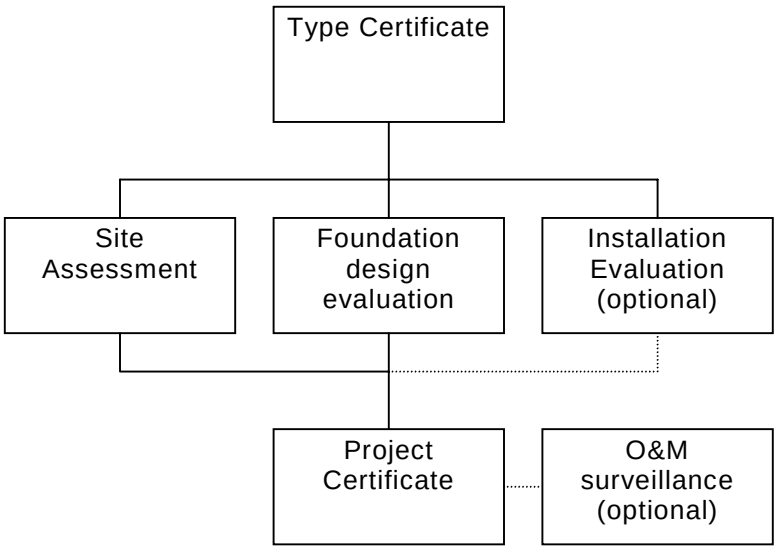

Figure 2 - Modules in Project Certification

11.4 Component Certification

The purpose of wind turbine component certification is to confirm that a major component of a specific type is designed, documented and manufactured in conformity with design assumptions, specific standards and other technical requirements.

Component certification consists of the following modules:

- design evaluation;
- type testing;
- manufacturing evaluation; and
- final evaluation.

These modules are equivalent to the mandatory modules of the type certification, illustrated in figure 1. The procedures for component certification shall be in line with the type certification procedures described in clause 8. The specific content of a module depends on the actual component. Where applicable, the evaluation elements described in clause 8 shall be applied.

Satisfactory evaluation of each module is concluded with a conformity statement.

Special attention shall be given in design documentation to the specification of the interface between components and the rest of the wind turbine system and to the specification of critical conditions, such as operating conditions, loads and dynamic properties.

Component certificates are issued in accordance with this standard for components designed and evaluated for conformance with the technical requirements of this part of IEC 61400 and IEC 61400-1 or IEC 61400-2. They shall be issued on the basis of completeness and correctness of Final Evaluation Reports. A Component Certificate attests that conformity has been established for all the mandatory modules of evaluation.

12 Type Certification

12.1 General

Type Certification shall confirm that the wind turbine type is designed in conformity with the design assumptions, specific standards and other technical requirements. It shall also confirm that the manufacturing process, component specifications, inspection and test procedures, and corresponding documentation are in conformity with the design documentation.

The Certification Body shall require an Applicant to provide documentation that meets all the requirements detailed in this clause. The wind turbine type shall be evaluated for compliance with the technical requirements of this part of IEC 61400, IEC 61400-1 or IEC 61400-2 and additional codes or standards chosen by the designer, with the agreement of the Certification Body.

12.2 Design Evaluation

The purpose of design evaluation is to examine whether the wind turbine type is designed and documented in conformity with the design assumptions, specific standards and other technical requirements. Normally the design evaluation comprises all of the elements shown in figure 3, whilst for small wind turbines designed according to IEC 61400-2, the following elements shall as a minimum be evaluated:

– control and protection system;
– loads and load cases;
– structural components; and
– mechanical and electrical components.

The Certification Body shall require an Applicant to supply all documentation necessary for design evaluation. A list of design documentation is provided in Annex A. This list may be extended or reduced, depending on the wind turbine concept and complexity of the design.

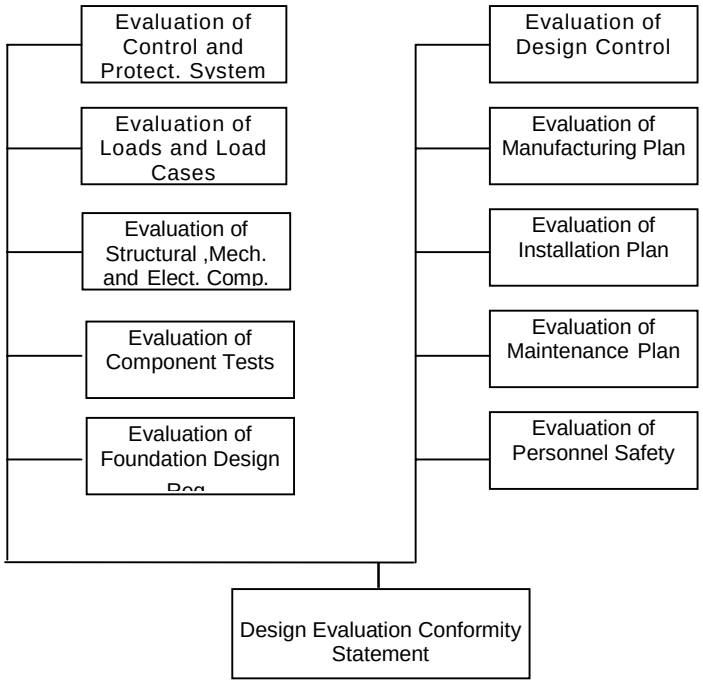

Figure 3 - Elements of design evaluation

12.2.1 Design Control

The Certification Body shall evaluate the quality procedures used to control the design process. Design control procedures shall be required to:

- comply with ISO 9001 sub-clause 4.4 , Design Control; and
- include control of documents such that the revision status of every document is clear to all parties.

The requirement for evaluation is satisfied if the quality system of the applicant has been certified according to ISO 9001.

12.2.2 Control and Protection System

The Certification Body shall evaluate the documentation of a control and protection system, comprising:

- Description of wind turbine modes of operation;
- design and functionality of all elements;
- fail-safe design of the protection system;
- system logic and hardware implementation;
- authentication of reliability of all safety critical sensors; and
- braking system(s) analysis.

12.2.3 Loads and Load Cases

The Certification Body shall evaluate the loads and load cases for compliance with IEC 61400-1 or IEC 61400-2 by independent analysis.

Description of loads shall be provided in a format that enables the Certification Body to carry out independent analysis.

The load values to be submitted shall be accompanied by the load case description, description of calculation models and input data such as:

- parameter values relating to aerodynamics;
- structural characteristics; and
- parameter values relating to the control system.

12.2.4 Structural, Mechanical and Electrical Components

The Certification Body shall evaluate the designs of structural, mechanical and electrical components for compliance with the requirements of this part of IEC 61400, IEC 61400-1 or IEC 61400-2 and the agreed additional codes and standards.

The design documentation relating to components will normally consist of specifications, descriptions, schematics and design calculations, which may be combined with measurement/test reports, drawings and part lists. The Certification Body shall require that the documentation clearly identifies the basis for the design, i.e. codes and standards, as well as loads and relevant external conditions.

12.2.5 Component Tests

IEC or other applicable standards may require that components be tested in addition to requiring design analysis. The strength and other functional requirements of some structural, mechanical or electrical components may be documented by measurements or test results only.

When the relevant analysis for a component is found to be inadequate, the Certification Body may require additional component tests and/or measurements to be carried out, as an alternative to further analysis. The Certification Body shall evaluate the design of such a component on the basis of the measurements and test reports and establish that test results are properly implemented in the design.

The Certification Body shall require that measurement and test reports clearly identify the component, the test standards or procedures, as well as the conditions for which the tests have been carried out.

12.2.6 Foundation Design Requirements

The Certification Body shall evaluate the foundation design requirements detailed in the design documentation for a turbine with respect to compliance of one or more foundation design(s) with IEC 61400-1 or IEC 61400-2 and relevant agreed structural codes. In addition, the evaluation shall establish that the foundation design conforms to interface geometry requirements (flatness, level, and bolt pattern tolerances) and the strength requirements defined in the turbine design documentation.

The characteristic and design loads at the interface of tower and foundation stated in the design documentation shall be used as a basis for this evaluation. These loads shall include both horizontal and vertical forces as well as any moments about horizontal and vertical axes at the interface. The extreme dynamic loads as well as fatigue loads resulting from the combination of all relevant load cases shall be considered in the design evaluation. Because overall turbine and tower system natural vibration frequencies and modes can be affected by foundation flexibility, a permissible range for horizontal, vertical and rotational foundation flexibility at the interface shall be stated.

The resistance and flexibility of the foundation shall be evaluated in terms of representative soil conditions at sites suitable for installation of the foundation. These soil conditions shall be described in the foundation design documentation.

12.2.7 Manufacturing Plan

The purpose of the manufacturing plan is to define the critical manufacturing processes. The plan must be sufficiently detailed to allow the Certification Body to verify that the turbine design can be manufactured according to any quality requirements identified in the design documentation. This plan may include:

- description of the manufacture and assembly processes;
- identification of required fixtures, tooling and equipment;
- identification of human resource requirements and skills;
- identification of quality check points and measurement or test equipment;
- description of procedures for component purchasing, including quality evaluation; and
- description of quality recording and record keeping processes.

12.2.8 Installation Plan

The purpose of the installation plan for a typical site is to document the design assumptions regarding the necessary quality requirements during the installation process. The plan must be in sufficient detail to allow the Certification Body to verify the adequacy of the turbine design, taking into account specified installation processes, including commissioning. This plan may include:

- description of typical installation processes.
- identification of human resource requirements and skills;

– identification of interface points and any required technical specifications for civil and electrical construction works including earthing system;
– identification of specialised tooling and required lifting fixtures or equipment;
– identification of quality control check points, measurements and inspections, required by the design;
– description of personnel safety and planned environmental protection measures;
– outline of planned installation manual;
– commissioning procedures and check-list; and
– description of quality recording and record keeping processes.

12.2.9 Maintenance Plan

The purpose of the maintenance plan is to define the requirements needed to maintain the design integrity of the turbine type over time. The plan must be in sufficient detail to allow verification by the Certification Body that this purpose is fulfilled. The plan may include;

– description of scheduled maintenance actions including inspection intervals and routine actions;
– identification of all safety related operational procedures or maintenance activities;
– description of planned environmental protection measures;
– identification of required specialised tooling and maintenance equipment;
– identification of human resource requirements and skills;
– outline of planned operating instructions and maintenance manual; and
– description of quality recording and record keeping processes.

12.2.10 Personnel Safety

The Certification Body shall evaluate personnel safety aspects in the design documentation (drawings, specifications and instructions) for compliance with IEC 61400-1or IEC 61400-2 and the agreed additional codes and standards, see sub-clause 10.2.

Personnel safety aspects to be considered include:

– safety instructions;
– climbing facilities;
– access ways and passages;
– standing places, platforms and floors;
– hand rails and fixing points;
– lighting;
– electrical and earthing system;
– fire resistance; and
– emergency stop buttons.

The Certification Body shall require an Applicant to identify elements in the design documentation that pertain to personnel safety.

12.2.11 Design Evaluation Conformity Statement

The Certification Body shall issue a conformity statement based on satisfactory evaluation of a design evaluation report(s). The conformity statement shall include:

– identification of the wind turbine type;

– identification of the Applicant;

– list of IEC 61400 series standards used;

– specification of external conditions with reference to the WT class and other principal data; and

– specific reference to evaluation report(s).

An example of a design evaluation conformity statement is given in Annex B.2.

12.3 Type Testing

The purpose of type testing is to provide data needed to verify power performance and aspects that are vital to safety and need additional experimental verification, and aspects that cannot be reliably evaluated by analysis. Type testing comprises the elements shown in figure 4.

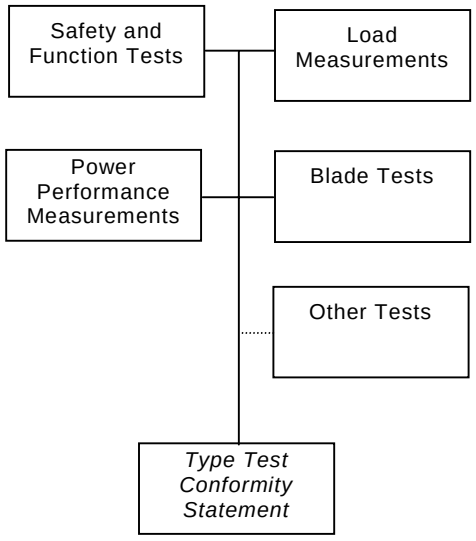

Figure 4 - Type testing elements

The Certification Body shall evaluate that testing of these aspects, as applicable, has been carried out on a turbine or component of a turbine representative of the type to be certified. Inspection records shall be completed prior to the tests in order to be able to demonstrate satisfactory conformity of the turbine or component with the design documentation.

The detailed test program shall be defined by the Applicant and be subject to approval by the Certification Body on a case by case basis.

The type testing elements given in figure 4 and the duration test specified in Annex E shall be carried out by an accredited testing laboratory or the Certification Body shall verify that the party conducting the testing complies with at least the criteria of ISO/IEC 17025or ISO/IEC Guide 39, as applicable.

The Certification Body shall require that the testing and the test results be documented in a test report. This test report shall be evaluated by the Certification Body to ensure that the tests have been carried out in accordance with the approved detailed test program and that the test report properly documents the aspects required for certification. The Certification Body shall verify by inspection that critical personnel safety features have been satisfactorily implemented in the installed wind turbine to be tested.

A satisfactory evaluation is concluded with a conformity statement. The signatories of the conformity statement shall be different from the persons responsible for the test reports, attestation of the tests and accreditation of the test laboratories.

For small wind turbines the load measurements (sub-clause 12.3.3) and the blade tests (sub-clause 12.3.4) may be replaced by the duration test described in Annex E.

12.3.1 Safety and Function Tests

The purpose of safety and function testing is to verify that the wind turbine under test displays the behaviour predicted in the design and that provisions relating to personnel safety are properly implemented.

The Certification Body shall verify satisfactory demonstration of the control and protection system functions. In addition, the dynamic behaviour of the wind turbine at rated wind speed or above shall be verified by testing if this has not been verified within the scope of the load measurements (see 12.3.3).

The requirements for testing are given in Annex D.

12.3.2 Power Performance Measurements

The purpose of power performance measurements is to document a measured power curve and predicted annual energy production for the wind turbine type, in accordance with IEC 61400-12.

The Certification Body shall verify that the measurement procedures conform with IEC 61400-12 and that the measurement conditions, instrumentation, calibrations, and analyses are described in a test report, also in accordance with IEC 61400-12.

12.3.3 Load Measurements

The purpose of load measurements is to validate design calculations and to determine the magnitude of loads under specific conditions.

The Certification Body shall evaluate load measurements carried out for type certification and review the analysis of measured data, supplied by the Applicant.

Measurements and analysis shall be conducted on the basis of the minimum requirements detailed in Annex C.

Measurements shall be made on a wind turbine that is dynamically and structurally similar to, but may differ in detail from, the turbine submitted for certification. In case of differences, load and dynamic behaviour predictions for the wind turbine under test shall be provided by the Applicant.

Guidance for test procedures and evaluation of tests may be found in IEC 61400-13 TS Ed1.

12.3.4 Blade Tests

The purpose of blade tests is to verify blade structural design and to assess the suitability of manufacturing processes. Full-scale structural testing is required for every new type of blade. A type of blade is described not only in terms of its size and shape but also in terms of its internal construction and structure. In general, fatigue tests as well as static tests are required. Guidance for test procedures and evaluation of the tests may be found in IEC 61400-23 TS Ed1.

Test blades shall be representative for the blade design considered for Design Evaluation. Deviations shall be subject to approval by the Certification Body. If the blade design is changed, the Certification Body shall determine the need and requirements for any new tests, through consultation with the manufacturer. New tests shall be required following any significant changes in blade design. Changes in the following, for example, may be significant:

- the structural system, including the internal stiffening arrangement;
- the aerodynamic profile;
- material for critical load carrying parts; and
- the transition zones in the blade root.

12.3.5 Other Tests

The Certification Body may require other tests and/or measurements to be carried out. Other tests may also be requested by an Applicant for inclusion in type testing. Such tests may include:

- environmental testing of electronic assemblies; and
- electromagnetic compatibility testing.

12.3.6 Test Reports

Type test reports shall conform with the requirements of ISO/IEC 17025 and relevant standards used to define the test requirements. In addition, test reports shall include a description of:

- the wind turbine or component, with identification by means of serial number (and control system software revision number(s), where applicable);
- any differences between the wind turbine or component under test with the corresponding part included in the certification; and
- any significant unexpected behaviour.

Attestation by the certification body shall be clearly marked on the final type test report(s).

12.3.7 Type Test Conformity Statement

The Certification Body shall issue a conformity statement based on satisfactory evaluation of the test reports. The conformity statement shall specify:

- the tests carried out;
- the test standards applied; and
- identification of the test reports.

An example of a type test conformity statement is given in Annex B.3.

12.4 Manufacturing Evaluation

The purpose of manufacturing evaluation is to assess if a specific wind turbine type is manufactured in conformity with the design documentation. This evaluation shall include the following elements:

- quality system evaluation; and
- manufacturing inspection.

The manufacturing evaluation presupposes that the manufacturer operates a quality system. It requires manufacturing of at least one specimen representative of the type under certification.

12.4.1 Quality System Evaluation

The requirement for evaluation of the quality system is satisfied if the quality system is certified to be in conformance with ISO 9001 or ISO 9002. This system certification shall be carried out by an accredited body that operates according to ISO/IEC Guide 62.

If the quality system is not certified, the Certification Body shall evaluate the system of the Applicant. The following aspects shall be evaluated:

- responsibilities;
- control of documents;
- sub-contracting;
- purchasing;
- process control;
- inspection and testing;
- corrective measures;
- quality recordings;
- training; and
- product identification and traceability.

This evaluation shall be based on documentation of the quality system, submitted by the Applicant.

12.4.2 Manufacturing Inspection

The Certification Body shall verify by inspection that at least one specimen is manufactured according to the design under certification. The inspection shall comprise:

- verification that design specifications are properly implemented in workshop drawings, workshop instructions, purchase specifications and installation instructions;
- evaluation of manufacturer's workshop, if relevant;
- verification of fabrication methods, procedures and qualifications of personnel;
- review of material certificates;
- random checks on effectiveness of procedures for acceptance of purchased components; and
- random checks of fabrication processes.

12.4.3 Manufacturing Conformity Statement

A satisfactory manufacturing conformity evaluation is concluded with a manufacturing conformity statement.

An example of a Manufacturing Conformity Statement can be found in Annex B.4.

12.5 Foundation Design Evaluation

The purpose of the optional foundation design evaluation is to enable the inclusion of one or more foundation designs in the Type Certificate, as selected by the Applicant. The Certification Body shall evaluate whether any turbine foundation included in type certification is designed in accordance with the foundation specifications detailed in the design documentation used in the turbine design evaluation (see sub-clause 12.2.6) and in accordance with the agreed applicable standards and codes.

The Certification Body shall require that reinforcement, concrete layout and construction sequence plans be part of the foundation design documentation. These plans shall be in sufficient detail to allow the Certification Body to verify the adequacy of the foundation design, taking into account the specified construction processes.

The Certification Body shall issue a conformity statement based on satisfactory evaluation of the foundation design evaluation report. The conformity statement shall include:

- identification of the wind turbine type and foundation;
- description of assumed soil and other external conditions;
- identification of tower configuration.

An example of a foundation design evaluation conformity statement is given in Annex B.5.

12.6 Type Characteristics Measurements

The purpose of type characteristic measurements is to establish performance-related characteristics of the wind turbine type, other than measurement of power performance, which is a mandatory element of type testing (sub-clause 12.3.2). These optional measurements may be selected by the Applicant and shall conform with the relevant IEC 61400 standards listed in the following sub-clauses. The type characteristics measurements comprise one or more of the elements:

- power quality tests; and
- acoustic noise measurements.

In cases where applicable IEC standards are not available, the measurement procedure shall be agreed between the Applicant and the Certification Body.

The Certification Body shall evaluate that measurement of characteristics has been carried out on a turbine representative of the type to be certified. Inspection records shall be completed prior to measurement in order to demonstrate satisfactory conformity of the turbine with design documentation.

The measurements shall be carried out by an accredited test laboratory or the Certification Body shall verify that the party conducting the testing complies with at least the criteria of ISO/IEC 17025: 1999 or ISO/IEC Guide 39, as applicable.

Measurements and test results shall be documented in a test report evaluated by the Certification Body. The Certification Body shall evaluate that the measurements have been carried out in accordance with an approved detailed program and that the report properly documents the characteristics required for certification.

A satisfactory evaluation is concluded with a conformity statement issued by the Certification Body, attesting that the measurements have been carried out in accordance with the appropriate test procedures and relevant IEC 61400 standards. An example of the Type Characteristics Conformity Statement is given in Annex B.6.

12.6.1 Power Quality Measurements

For type certification in which power quality measurements are included, the Certification Body shall verify that the measurement procedures conform with IEC 61400-21, and that the measurement conditions, instrumentation, calibrations and analyses are described in a test report, also in accordance with IEC 61400-21. The purpose of these measurements is to document the characteristic quality of the power generated by the wind turbine type.

12.6.2 Acoustic Noise Measurements

For type certification in which acoustic emission measurements are included, the Certification Body shall verify that the measurements conform with IEC 61400-11. The purpose of these measurements is to document the acoustic emission characteristics of the wind turbine type. If acoustic emission measurements are included, the Certification Body shall verify that they, at least, include the:

- apparent sound power level at a wind speed of 8 m/s,
- sound directivity index at the three required positions, and
- tonality of any tones above the minimum threshold,

as defined in IEC 61400-11.

The Certification Body shall also verify that the measurement conditions, instrumentation, calibrations and analyses are described in a test report in accordance with IEC 61400-11.

12.6.3 Test Reports

The Certification Body shall require that type characteristics measurement reports conform with the requirements of ISO/IEC 17025: 1999 and relevant standards used to define the test requirements. In addition, descriptions of:

- the test turbine, including serial number and control system software revision number(s);
- any differences between the test turbine and the wind turbine type under certification; and
- any significant unexpected behaviour,

shall be required.

Attestation by the Operating Body shall be clearly marked on the final type characteristics measurement report(s).

12.6.4 Type Characteristics Measurements Conformity Statement

The Certification Body shall issue a conformity statement based on satisfactory evaluation of the test reports. The conformity statement shall specify:

- the measurements carried out;
- the measurement standards applied; and
- identification of the test report(s).

An example of a type characteristics measurements conformity statement is given in Annex B.6.

12.7 Final Evaluation

The purpose of final evaluation is to provide documentation of the findings of all operating bodies involved in the evaluation of the elements of the type certificate.

The final evaluation report shall consist of:

- reference list of all supporting product documentation for the type certificate;
- evaluation of whether the detailed documentation is complete and whether the type test results confirm all relevant requirements set out in the design documentation; and

– review of the final product documentation, including drawings, component lists, procurement specifications, and manuals (see following paragraph) to confirm that they are consistent with the manufacturing evaluation report and with the supporting design calculations and relevant design assumptions.

The Certification Body shall attest that the installation, operator's instructions and maintenance manuals are based on the relevant requirements in IEC 61400-1, chapters 9 and 10. The manuals shall be reviewed against the corresponding approved plans. The Certification Body shall establish that

– format and detail are such that a skilled worker with technical training can understand the documentation;

– notes regarding safety and regulations for the prevention of accidents are arranged in the text such that they appear before the operation in question; and

– these notes shall be clearly identified as safety related items.

The final evaluation report shall be delivered to the Applicant, and a copy retained in the confidential files of the Certification Body.

12.8 Type Certificate

The Certification Body shall issue a Type Certificate based on satisfactory evaluation for completeness and correctness of the Final Evaluation Report. The Type Certificate shall include the results of the mandatory modules and , when applicable, document the optional Foundation Design Evaluation (see sub-clause 12.5) and Type Characteristic Measurements (see sub-clause 12.6).

The Type Certificate is valid for the wind turbine type specified in the certificate. The specifications may include alternative components and configurations. The allowable combinations of alternatives shall be clearly identified.

The Type Certificate shall reference in an appropriate way the standards and normative documents used. The Type Certificate shall include the information given in Annex B.1.

The Certification Body shall include the following requirements in the agreement governing the validity of the certificate:

– An annual report for the certified wind turbine shall be prepared and sent to the Certification Body for review. The report shall include information on deviant operating experience known to the certificate holder and minor modifications.

– Major modifications to the certified product, the design documentation, procedures, specifications or processes shall be reported to the Certification Body without delay. In case the certificate holder intends to maintain and/or extend the validity of the Certificate, the update of all documents affected by the modification shall be provided.

If the applicant does not operate a quality system that is certified according to ISO 9001 or ISO 9002, the Certification Body shall verify at least once a year that manufactured wind turbines continue to be in conformance with the certified design. This verification shall follow the elements of sub-clauses 12.4.1and 12.4.2.

An example of a Type Certificate is given in Annex B.1.

13 Project Certification

13.1 General

Project Certification shall confirm for a specific site that type-certified wind turbines and particular foundation designs meet requirements governed by site-specific external conditions and are in conformity with applicable local codes and other requirements relevant to the site. This certification shall confirm that the wind conditions, other environmental and electrical network conditions, and soil properties at the site conform with those defined in the design documentation for the wind turbine type and foundation(s).

Project Certification may also confirm that installation and commissioning are in conformity with specific standards and other technical requirements, and that the wind turbines are operated and maintained in conformity with relevant manuals.

Under this standard, the Certificate and Conformity Statements for Project Certification shall be issued only for wind turbines that are type-certified according to the criteria detailed in clause 8.

The Certification Body shall require an Applicant to provide documentation that covers all the aspects detailed in this clause. The documentation shall be evaluated for compliance with the technical requirements of this part of IEC 61400, IEC 61400-1 or IEC 61400-2 and additional codes or standards chosen by the designer and agreed with the Certification Body.

13.2 Site Assessment

The purpose of Site Assessment is to examine whether the environmental, electrical and soil properties at a site conform with the parameter values defined in the design documentation.

The Certification Body shall evaluate site conditions on the basis of measurements and/or applicable standards or methods valid for the installation site. The evaluation shall consider the external conditions detailed in IEC 61400-1 which are classified in the following four categories:

- wind conditions;
- other environmental conditions;
- electrical network conditions; and
- soil conditions.

Measurements of the external conditions of the site shall be carried out by a testing laboratory accredited to ISO/IEC 17025: 1999, or the Certification Body shall verify the satisfactory quality and reliability of the measurements. The verification shall include evaluation of:

- test and calibration methods;
- equipment;
- measurement traceability;
- assurance of the quality of test and calibration results; and
- reporting of the results.

The Certification Body shall require that qualified personnel (meteorologists, engineers or geologists) carry out the evaluation and reporting of the external conditions at the site.

The certification body shall evaluate that relevant reports properly document the external conditions .

A satisfactory evaluation of the Site Assessment is concluded with a Site Assessment Conformity Statement. The conformity statement shall include identification of the evaluated reports. An example of a Site Assessment Conformity Statement is given in Annex B.8.

13.3 Foundation Design Evaluation

The purpose of foundation design evaluation is to examine whether a foundation design is in conformity with specific standards and other technical requirements.

Normative design codes and other criteria shall be identified in a list agreed between the Certification Body and the Applicant. These codes and criteria shall include all requirements of the local jurisdiction applicable to the installation site and shall be IEC or ISO codes where applicable. The Certification Body shall evaluate the turbine foundation design with respect to the foundation design requirements defined in the design documentation for the type-certified turbine, the local soil/ground conditions and applicable standards and codes. The reinforcement, concrete layout and construction sequence plans shall be part of the foundation design documents. These plans shall be in sufficient detail to allow the Certification Body to verify the adequacy of the foundation design with respect to specified construction processes.

If a Conformity Statement has already been issued for the foundation design, (see sub-clause 12.5), the evaluation may be limited to the local soil/ground conditions and applicable local standards and codes.

A satisfactory evaluation of the wind turbine foundation design is concluded with a conformity statement. The conformity statement shall detail:

- reference to Type Certificate for the wind turbine(s);
- reference to the soil condition report;
- applied codes and standards; and
- identification of the evaluated foundation design documentation.

An example of a Foundation Design Conformity Statement is given in Annex B.9.

13.4 Installation Evaluation

The purpose of installation evaluation is to verify that one or more wind turbines have been installed and commissioned in conformity with specific standards and other technical requirements.

The Certification Body shall evaluate whether the installation of the wind turbine(s) is in conformance with the design documentation and the requirements in clause 9 and 10 of IEC 61400-1. The Certification Body shall also evaluate whether the foundation is in compliance with the design requirements stated in the turbine design documentation. This requires evaluation of the quality system[1] governing installation and commissioning, and systematic third-party surveillance, including inspection at regular intervals during installation and commissioning.

13.4.1 Installation Quality System

The installation quality system shall be evaluated on the basis of documentation, submitted by the Applicant to the Certification Body. The documentation shall comprise:

- identification and information on the wind turbine type to be installed under the certificate, including copies of the type certificate;

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1 Note: the requirement for examination of the quality system is in general satisfied by certification that the quality system is in conformance with ISO 9001 or ISO 9002.

– a quality manual that makes reference to the quality system procedures and outlines the structure of the documentation used in the quality system;

– certified manuals (see sub-clause 12.7) and installation/construction plans; and

– detailed procedures and instructions.

The Certification Body shall evaluate whether the installation quality system is in agreement with the installation plan (see sub-clause 12.2.8), the installation manual (see sub-clause 12.7), and other installation/construction plans for civil and electrical works. The installation manuals are to be issued in a language that can be understood by relevant personnel.

The party responsible for installation may elect to operate a quality system that meets the requirements specified in ISO 9001 or ISO 9002. Alternatively, evaluation of the effectiveness of the installation quality system by the Certification Body through systematic surveillance will be required.

The Certification Body shall prepare a report on the evaluation of the Applicant's quality system. This report shall also identify the surveillance or audits for evaluation of the implementation of the quality system.

13.4.2 Surveillance/Audits

Following evaluation of the installation quality system the Certification Body shall evaluate implementation of the system to verify that the site works involving assembly and erection, and commissioning are performed according to the approved wind turbine design and installation plan.

The Certification Body shall witness commissioning of at least one wind turbine at the site.

The surveillance/audit activities shall be concluded with reports that describe the activities carried out and detail the observations made during the course of the audit.

13.4.3 Installation Conformity Statement

The Certification Body shall issue a conformity statement based on a satisfactory evaluation of verification and surveillance/audit reports. The conformity statement shall specify:

– reference to a Type Certificate for the wind turbine(s);

– reference to Foundation Design and Site Assessment Conformity Statements; and

– identification of verification, surveillance and/or audit reports.

The signatories of the conformity statement shall be different from the persons responsible for the verification, surveillance and/or audit reports.

An example of an Installation Conformity Statement is given in Annex B.10.

13.5 Project Certificate

The Certification Body shall issue a Project Certificate based on a final evaluation for completeness and correctness of the evaluation reports and Conformity Statements. The Project Certificate shall include the results of the mandatory modules and may additionally document the optional Installation Evaluation (see sub-clause 13.4).

Following evaluation of the mandatory and, if applicable, the optional evaluation report and conformity statements, final evaluation shall include:

– preparation of a reference list of all supporting documentation for the Project Certificate;

– confirmation that the results of the site assessment are compatible with the wind turbine design and implemented in the foundation design: and

– where applicable, confirmation that the results of the site assessment are implemented in the installation.

The Project Certificate is valid for wind turbine(s) at the site specified in the certificate. Major modifications to the site or the wind turbines shall be reported to the Certification Body without delay for renewal of validity or extension of the certificate.

The Project Certificate shall reference in an appropriate way the standards and normative documents used. An example of a Project Certificate is given in Annex B.7.

The Certification Body and the Applicant may agree to include Operation and Maintenance Surveillance as a condition in the contract that governs the validity of the certificate. The surveillance shall be carried out according to sub-clause 13.6.

13.6 Operation and Maintenance Surveillance

13.6.1 General

The purpose of operation and maintenance surveillance is to establish that a specific wind turbine or group of wind turbines at a specific site are operated and maintained in conformity with the relevant manuals included in the design documentation (see sub-clause 12.7).

This surveillance requires examination of operation and maintenance records and random inspection of turbines.

Operation and maintenance surveillance shall be carried out at regular intervals on the basis of an agreement between Applicant and Certification Body. An operation and maintenance surveillance conformity statement shall attest compliance under the terms of this agreement.

13.6.2 Operation and Maintenance Surveillance Requirements

The Certification Body shall as a minimum establish that:

– maintenance has been carried out by authorised and qualified personnel in accordance with and at the intervals specified in the maintenance manual; and

– the control settings have been checked with regard to conformance with the limiting values specified in the design documentation.

The operator’s instructions and maintenance manuals shall be issued in a language that is understood by relevant personnel. Particular attention shall be paid to repaired and/or modified components to assure that only repairs or modifications compatible with the type certificate are made.

13.6.3 Operation and Maintenance Surveillance Conformity Statement

A satisfactory operation and maintenance evaluation is concluded with a conformity statement.

An example of an Operation and Maintenance Surveillance Conformity Statement is given in Annex B.11.

Annex A
(Informative)

Design Documentation

			Drawings (Note 1 and 4)	Analysis (Note 2 and 4)	Description (D) Specifications (Sp) Schematics (Sch) (Note 3)
1.0		**General Turbine Description**			
	1.1	General Turbine Characteristics and Configuration Description			
		Turbine description and general specifications	✓		D, Sp
		Major component weights and centres of gravity			Sp
		Operational limits			Sp
		Electrical power system			D, Sch
		Electrical control system			D, Sch
		Hydraulics and pneumatics			D, Sch
	1.2	External conditions and design class			D
	1.3	Control and protection philosophy			D
	1.4	Codes and standards			D
	1.5	Co-ordinate Systems	✓		D, Sch
2.0		**Design Control Procedure**			
	2.1	Document Description and Organisation			D
3.0		**Control and Protection System**			
	3.1	Description and component specifications including transducers and sensors			D, Sp
	3.2	Detailed control logic flow chart			Sch
	3.3	Set point list			Sp
	3.4	Control system software			D, Sch, Sp
	3.5	Software release and version control			D
	3.6	Remote control/ monitoring			D, Sch, Sp
	3.7	Protection system logic		✓	D, Sch
	3.8	Fault analysis		✓	
	3.9	Overspeed sensing			Sp, Sch
	3.10	Overpower/current sensing			Sp, Sch
	3.11	Vibration sensing			Sp, Sch
	3.12	Emergency stop button			D, Sch
4.0		**Loads and Load Cases**			
	4.1	General analysis approach		✓	D
	4.2	System dynamics model description :			
		Degrees of freedom			D, Sch
		Mass and stiffness distributions			Sp
		Aerodynamic inputs (airfoil tables, blade geometry, etc.)		✓	Sch, Sp
	4.3	Partial safety factors		✓	Sp

			Drawings (Note 1 and 4)	Analysis (Note 2 and 4)	Description (D) Specifications (Sp) Schematics (Sch) (Note 3)
	4.4	Validation of calculation models:			
		Analytical		✓	
		Comparisons with test data		✓	
	4.5	Dynamic behaviour of the system and of individual major components:			
		Campbell diagrams,		✓	Sch
		Spectral / frequency plots		✓	
		Mode shapes & frequencies		✓	
		Comparisons between predictions and measurements		✓	
	4.6	Load cases (from IEC 61400-1 plus other identified cases):			
		Fatigue load cases		✓	
		Ultimate load cases		✓	
		Failure modes		✓	
	4.7	Loads for structural components:			
		Blade		✓	
		Hub		✓	
		Locking device(s)		✓	
		Low speed shaft and bearings		✓	
		Mainframe and gearbox structure		✓	
		Gearing and drive train (including gen., brake & couplings)		✓	
		Tower top/yaw bearing		✓	
		Tower		✓	
		Tower connection to foundation		✓	
		Foundation		✓	
		Other		✓	
	4.8	Critical deflection (blade/tower)		✓	
5.0		**Components**			
	5.1	System Level Descriptions:			
		Assembly drawings	✓		
		Material properties			Sp
		Rotor			
	5.2	Blade:			
		Structure	✓	✓	D, Sp
		Root	✓	✓	
		Blade/hub joint	✓	✓	
		Aerodynamic brake mechanism	✓	✓	Sp
	5.3	Hub:			

			Drawings (Note 1 and 4)	Analysis (Note 2 and 4)	Description (D) Specifications (Sp) Schematics (Sch) (Note 3)
		Structure	✓	✓	
		Teeter system	✓	✓	Sp
		Pitch system (including power supply)	✓	✓	Sp
		Pitch bearing	✓	✓	Sp
		Hub/low speed shaft joint	✓	✓	
	5.4	Low speed shaft:			
		Structure	✓	✓	
		Bearings	✓	✓	Sp
		Bearing mountings	✓	✓	Sp
Nacelle					
	5.5	Structure:			
		Main frame	✓	✓	
		Enclosure	✓	✓	
	5.6	Gearbox:			
		Housing structure	✓	✓	
		Gearbox/mainframe connection	✓	✓	
		Gearbox/generator coupling	✓	✓	Sp
		Gearing, bearings, cooling, lubrication, shafting & couplings	✓	✓	Sch, Sp
	5.6	Generator:			
		Structure of direct drive unit	✓	✓	
		Generator/nacelle connection	✓	✓	
	5.7	Yaw system:			
		Drive	✓	✓	Sp
		Bearing & connections	✓	✓	Sp
Tower and Foundation					
	5.8	Tower:			
		Structure	✓	✓	
		Connections	✓	✓	
		Openings	✓	✓	
		Cable twist			D, Sp
		Cable suspension	✓		Sp
		Ladders, platforms, elevators	✓	✓	Sp
	5.9	Foundation:			
		Structure	✓	✓	
		Connection to tower	✓	✓	
Other					
	5.10	Brake (maximum & minimum torque rating plus energy capacity)	✓	✓	Sp

			Drawings (Note 1 and 4)	Analysis (Note 2 and 4)	Description (D) Specifications (Sp) Schematics (Sch) (Note 3)
	5.11	Locking Devices (including power supply requirements)	✓	✓	Sch, Sp
	5.12	Auxiliary systems (hydraulic/pneumatic)	✓	✓	Sch, Sp
	5.13	Auxiliary equipment (cranes, lifts, etc.)	✓	✓	Sp
6.0		**Electrical**			
	6.1	One line diagram (basic power circuit with safety devices)			Sch
	6.2	Power circuit schematic			Sch
	6.3	Electrical systems schematics			Sch
	6.4	Power Converter	✓		Sp, Sch
	6.5	Generator electrical			Sch
	6.6	Disconnection devices			Sp, Sch
	6.7	Earthing			Sp, Sch
	6.8	Lightning Protection	✓		Sp, Sch
7.0		**Component Test Reports**			
	7.1	Component tests		✓	D
8.0		**Plans**			
	8.1	Manufacturing plan			D, Sch, Sp
	8.2	Installation plan			D, Sch, Sp
	8.3	Maintenance plan			D, Sch, Sp
9.0		**Personnel safety**			
	9.1	Workplace requirements			D
	9.2	Emergency stop			D, Sch
	9.3	Locking devices			Sch
	9.4	Safety instructions			D

Notes:

1. **Drawings** are typically engineering drawings that clearly define dimensions of components or electrical schematics. They can also include material specifications, fabrication instructions or finish specifications when referring to a specific component contained within the drawing.

2. **Analysis** usually refers to engineering calculations such as stress analysis or calculations of structural loads or of electrical loads as well as statistical analysis. Analysis is the basis of specifications for structural, material, electrical and mechanical component requirements. This also includes plots of results and comparisons with test results.3. **Specifications** (Sp) are written requirements for certain components of the wind turbine. These could include performance and dimensional specifications for a gear-box, finish requirements for gearing, bearing descriptions, electrical demands for electrical components, dimensional requirements for mechanical components, performance specifications for a hydraulic auxiliary power supply or quality documentation.

3. **Schematics** (Sch) are data plots, flow charts, diagrams and other illustrations (electric, pneumatics, and hydraulics).

4. **Descriptions** (D) consist of text describing relevant tasks, functions, components etc.

5. A check mark (✓) indicates that Drawings or Analysis are expected in the documentation for the element in the left-hand column.

Annex B.1
(Informative)

Type Certificate Example Format

TC - (Number)
Type Certificate

This certificate is issued to

XXXX
Street
City
Country

for the wind turbine

XXXX

The certificate attests compliance with IEC 61400-1 (ed. x), Class xx (or IEC 61400-2), concerning the design and manufacture. It is based on the following reference documents:

DE-(Number)	:	Design Evaluation Conformity Statement
dated	:	dd.mm.yy
TT-(Number)	:	Type Test Conformity Statement
dated	:	dd.mm.yy
MC-(Number)	:	Manufacturing Conformity Statement
dated	:	dd.mm.yy
FDE-(Number)	:	Foundation Design Eval. Conformity Statement
dated	:	dd.mm.yy
TC-(Number)	:	Type Characteristics Conformity Statement
dated	:	dd.mm.yy
ER-(Number)	:	Final Evaluation Report
dated	:	dd.mm.yy

The conformity evaluation was carried out according to IEC WT 01 - IEC system for conformity testing and certification of wind turbine – Rules and procedures.

The wind turbine type is specified on page 2 of this certificate.

Changes in the system design or the manufacturer's quality system are to be approved by (Certification Body). Without approval the Certificate loses its validity.

This Type Certificate is valid until: dd.mm.yy.

(Location), dd.mm.yy.

ee/ss

(Certification Body)

Signature(s)

TC - (Number)
Type Certificate, Page 2

Wind Turbine Type Specification:

Machine parameters:

Model	
WT manufacturer and country	
IEC WT class	
Rated power	[kW]
Rated wind speed V_r	[m/s]
Rotor diameter	[m]
Hub height(s)	[m]
Hub height operating wind speed range V_{in}-V_{out}	[m/s]
Design life time	[y]

Wind conditions:

Characteristic turbulence intensity I15 at V_{hub} = 15 m/s	[-]
Annual average wind speed at hub height V_{ave}	[m/s]
Reference wind speed V_{ref}	[m/s]
Mean flow inclination	[deg]
Hub height 50-year extreme wind speed V_{e50}	[m/s]

Electrical network conditions

Normal supply voltage and range	[V]
Normal supply frequency and range	[Hz]
Voltage imbalance	[V]
Maximum duration of electrical power network outages	[days]
Number of electrical network outages	[1/y]

Other environmental conditions (where taken into account):

Design conditions in case of offshore WT (water depth, wave conditions etc.)	
Normal and extreme temperature ranges	[°C]
Relative humidity of the air	[%]
Air density	[kg/m3]
Solar radiation	[W/m2]
Description of lightning protection system	
Earthquake model and parameters	
Salinity	[g/m3]

Major components:

Blade type	[-]
Gear box type	[-]
Generator type	[-]
Tower type	[-]

Annex B.2
(Informative)

Design Evaluation Conformity Statement Example Format

DE - (Number)
Design Evaluation Conformity Statement

This conformity statement is issued to

XXXX

Street

City

Country

for the wind turbine

XXXXXX

This conformity statement attests compliance with IEC 61400-1 (ed. x), Class xx (or IEC 61400-2), concerning the design. It is based on the following evaluation reports:

Evaluation Report	:	Control- and Protection System
dated	:	dd.mm.yy
prepared by	:	name(s)
Evaluation Report	:	Loads and Load Cases
dated	:	dd.mm.yy
prepared by	:	name(s)
Evaluation Report	:	Structural Components
dated	:	dd.mm.yy
prepared by	:	name(s)
Evaluation Report	:	Mechanical and Electrical Components
dated	:	dd.mm.yy.
prepared by	:	name(s)
…..		

The conformity evaluation was carried out according to IEC WT 01 - IEC system for conformity testing and certification of wind turbine – Rules and procedures.

Any change in the design is to be approved by (Certification Body). Without approval the Statement loses its validity.

The wind turbine type is specified on page 2 of this conformity statement. (See wind turbine specification in Annex B.1)

(Location), dd.mm.yy.

ee/ss

(Certification Body)

Signature(s)

Annex B.3
(Informative)

Type Test Conformity Statement Example Format

TT - (Number)
Type Test Conformity Statement

This conformity statement is issued to

XXXX
Street
City
Country

for the wind turbine

XXXXXX

The conformity statement attests that the wind turbine has been evaluated by (Certification Body) concerning Type Testing. It is based on the following reference documents:

Measurement Report	:	Safety and Function Test
dated	:	dd.mm.yy
issued by	:	test lab.
Measurement Report	:	Power Performance Measurements
dated	:	dd.mm.yy
issued by	:	test lab.
Measurement Report	:	Load Measurements
dated	:	dd.mm.yy
issued by	:	test lab.
Measurement Report	:	Blade Test
dated	:	dd.mm.yy
issued by	:	test lab.
(Measurement Report	:	Other component tests)
(dated	:	dd.mm.yy)
(issued by	:	test lab.)

The conformity evaluation was carried out according to IEC WT 01 - IEC system for conformity testing and certification of wind turbines – Rules and procedures.

The wind turbine type is specified on page 2 of this conformity statement (see specification in Annex B.1). Any change in the design is to be approved by (Certification Body). Without approval the Statement loses its validity.

(Location), dd.mm.yy.
ee/ss

(Certification Body)

Signature(s)

Annex B.4
(Informative)

Manufacturing Conformity Statement Example Format.

MC - (Number)

Manufacturing Conformity Statement

This conformity statement is issued to

XXXX
Street
City
Country

for the wind turbine

XXXXXX

The Conformity Statement attests compliance with IEC 61400-1 (ed. **x**), Class **xx** (or IEC 61400-2), concerning the manufacturer's quality system. It is based on the following reference documents:

Evaluation Report	:	Quality System
dated	:	dd.mm.yy
issued by	:	name
Evaluation Report	:	xxx
dated	:	dd.mm.yy
issued by	:	name

The conformity evaluation was carried out according to IEC WT 01 - IEC system for conformity testing and certification of wind turbines – Rules and procedures.

The wind turbine type is specified on page 2 of this statement (see specification in Annex B.1).

Any change in the manufacturer's quality system is to be approved by (Certification Body). Without approval the Statement loses its validity.

This Manufacturing Conformity Statement is valid until (validity of ISO 9001 or 9002 certificate or date of next audit ...).

(Location), dd.mm.yy.
ee/ss **(Certification Body)**

Signature(s)

Annex B.5
(Informative)

Foundation Design Evaluation Conformity Statement Example Format

FDE - (Number)
Foundation Design Evaluation Conformity Statement

This conformity statement is issued to

XXXX
Street
City
Country

for the wind turbine

XXXXXX

The Conformity Statement attests compliance with IEC 61400-1 (ed. **x**), Class **xx** (or IEC 61400-2), concerning the design of the foundation. It is based on the following reference documents:

Evaluation Report	:	Foundation
dated		: dd.mm.yy
issued by		: name

The conformity evaluation was carried out according to IEC WT 01 - IEC system for conformity testing and certification of wind turbines – Rules and procedures.

Any change in the design or the referenced soil conditions is to be approved by (Certification Body). Without approval the Statement loses its validity.

The wind turbine type is specified on page 2 of this conformity statement (see specification in Annex B.1).

(Location), dd.mm.yy.
ee/ss **(Certification Body)**

Signature(s)

Annex B.6
(Informative)

Type Characteristics Measurements Conformity Statement Example Format

TC - (Number)

Type Characteristics Measurements Conformity Statement

This conformity statement is issued to

XXXX
Street
City
Country

for the wind turbine

XXXXXX

The conformity statement attests that the wind turbine has been evaluated by (Certification Body) concerning Type Characteristics Measurements. it is based on the following reference documents:

Measurement Report	:	Power Quality Measurements
dated	:	dd.mm.yy
issued by	:	test lab.
Measurement Report	:	Acoustic Noise Measurements
dated	:	dd.mm.yy
issued by	:	test lab.

The conformity evaluation was carried out according to IEC WT 01 - IEC system for conformity testing and certification of wind turbines – Rules and procedures.

The wind turbine type is specified on page 2 of this statement (see specification in Annex B.1).

Any change in the design is to be approved by (Certification Body). Without approval the Statement loses its validity.

(Location), dd.mm.yy.

ee/ss **(Certification Body)**

Signature(s)

Annex B.7
(Informative)

Project Certificate Example Format

PC- (Number)
Project Certificate

This certificate is issued to

XXXX
Street
City
Country

for the wind turbine(s) at the site

XXXX
Address
Country

The certificate attests compliance with IEC 61400-1 (ed. **x**), Class **xx** (or IEC 61400-2). It is based on the following reference documents:

TC-(Number)	:	Type Certificate
Dated	:	dd.mm.yy
SA-(Number)	:	Site Assessment Conformity Statement
dated	:	dd.mm.yy
FD-(Number)	:	Foundation Design Conformity Statement
dated	:	dd.mm.yy
IN-(Number)	:	Installation Conformity Statement
dated	:	dd.mm.yy
OMS-(Number)	:	Operation and Maintenance Surveillance Conformity Statement

The conformity evaluation was carried out according to IEC WT 01 - IEC system for conformity testing and certification of wind turbines – Rules and procedures.

The wind turbine type is specified on page 2 of this certificate (see specification in Annex B.1).

Changes in the system design or the manufacturer's quality system are to be approved by (Certification Body). Without approval the Certificate loses its validity.

This Type Certificate is valid until dd.mm.yy.

(Location), dd.mm.yy.
ee/ss (Certification Body)

Signature(s)

Annex B.8
(Informative)

Site Assessment Conformity Statement Example Format

SA - (Number)

Site Assessment Conformity Statement

This conformity statement is issued to

XXXX
Street
City
Country

for the wind turbine(s) at the site

XXXX
Address
Country

This conformity statement attests compliance with IEC 61400-1 (ed. **x**), Class **xx** (or IEC 61400-2), concerning site assessment. It is based on the following evaluation reports:

Evaluation Report	:	Wind conditions	
dated	:	dd.mm.yy	
prepared by	:	name(s)	
Evaluation Report	:	Other environmental conditions	
dated	:	dd.mm.yy	
prepared by	:	name(s)	
Evaluation Report	:	Electrical conditions	
dated	:	dd.mm.yy	
prepared by	:	name(s)	
Evaluation Report	:	Soil conditions	
dated	:	dd.mm.yy.	
prepared by	:	name(s)	
…..			

The conformity evaluation was carried out according to IEC WT 01 - IEC system for conformity testing and certification of wind turbines – Rules and procedures. Any change in the site conditions is to be approved by (Certification Body). Without approval the Statement loses its validity.

The wind turbine type is specified on page 2 of this statement (see specification in Annex B.1).

(Location), dd.mm.yy.

ee/ss (Certification Body)

Signature(s)

Annex B.9
(Informative)

Foundation Design Conformity Statement Example Format

FD - (Number)
Foundation Design Conformity Statement

This conformity statement is issued to

XXXX
Street
City
Country

for the wind turbine(s) at the site

XXXX
Address
Country

The Conformity Statement attests compliance with IEC 61400-1 (ed. **x**), Class **xx** (or IEC 61400-2), concerning design of the foundation. It is based on the following reference documents:

TC-(Number)	:	Type Certificate
dated	: dd.mm.yy	
issued by	: name	
Evaluation Report	:	Foundation design
dated	: dd.mm.yy	
issued by	: name	
Evaluation Report	:	Soil conditions
dated	: dd.mm.yy	
issued by	: name	
.....		

The conformity evaluation was carried out according to IEC WT 01 - IEC system for conformity testing and certification of wind turbines – Rules and procedures.

Any change in the design or the referenced soil conditions is to be approved by (Certification Body). Without approval the Statement loses its validity.

The wind turbine type is specified on page 2 of this statement (see specification in Annex B.1).

(Location), dd.mm.yy.

ee/ss (Certification Body)

Signature(s)

Annex B.10
(Informative)

Installation Conformity Statement Example Format

IN - (Number)

Installation Conformity Statement

This conformity statement is issued to

XXXX
Street
City
Country

for the wind turbine(s) at the site

XXXX
Address
Country

The Conformity Statement attests compliance with IEC 61400-1 (ed. **x**), Class **xx** (or IEC 61400-2), concerning installation and commissioning. It is based on the following reference documents:

TC - (Number)	:	Type Certificate
dated	:	dd.mm.yy
issued by	:	name
FDC - (Number)	:	Foundation Design Conformity Statement
dated	:	dd.mm.yy
issued by	:	name
Evaluation Report	:	Verification, surveillance and/or audit
dated	:	dd.mm.yy
issued by	:	name

The conformity evaluation was carried out according to IEC WT 01 - IEC system for conformity testing and certification of wind turbines – Rules and procedures.

The wind turbine type is specified on page 2 of this statement (see specification in Annex B.1).

(Location), dd.mm.yy.

ee/ss **(Certification Body)**

Signature(s)

Annex B.11
(Informative)

Operation and Maintenance Surveillance Conformity Statement Example Format

OMS(Number)

Operation and Maintenance Surveillance Conformity Statement

This conformity statement is issued to

XXXX
Street
City
Country

for the wind turbine(s) at the site

XXXX
Address
Country

The Conformity Statement attests compliance with IEC 61400-1 (ed. **x**), Class **xx** (or IEC 61400-2), concerning Operation and Maintenance Surveillance. It is based on the following reference documents:

TC - (Number)	:	Type Certificate
dated	:	dd.mm.yy
issued by	:	name
Manual	:	Operation and Maintenance instructions
dated	:	dd.mm.yy
issued by	:	name
Evaluation Report	:	Verification, surveillance and/or audit
dated	:	dd.mm.yy
issued by	:	name

The conformity evaluation was carried out according to IEC WT 01 - IEC system for conformity testing and certification of wind turbines – Rules and procedures.

The wind turbine type is specified on page 2 of this statement (see specification in Annex B.1).

This Conformity Statement is valid until (date of next audit ...).

(Location), dd.mm.yy.

ee/ss **(**Certification Body)

Signature(s)

Annex B.12
(Informative)

Component Certificate Example Format

CC - (Number)
Component Certificate

This certificate is issued to

XXXX
Street
City
Country

for the wind turbine component

XXXX

The certificate attests compliance with IEC 61400-1 (ed. x), Class xx (or IEC 61400-2), concerning the design and manufacture. It is based on the following reference documents:

DE-(Number)	:	Design Evaluation Conformity Statement
dated	:	dd.mm.yy
TT-(Number)	:	Type Test Conformity Statement
dated	:	dd.mm.yy
MC-(Number)	:	Manufacturing Conformity Statement
dated	:	dd.mm.yy
ER-(Number)	:	Final Evaluation Report
dated	:	dd.mm.yy

The conformity evaluation was carried out according to IEC WT 01 - IEC system for conformity testing and certification of wind turbines – Rules and procedures.

The wind turbine component is specified on page 2 of this certificate.

Changes in the system design or the manufacturer's quality system are to be approved by (Certification Body). Without approval the Certificate loses its validity.

This Component Certificate is valid until: dd.mm.yy.

(Location), dd.mm.yy.

ee/ss (Certification Body)

Signature(s)

Annex C

Minimum Requirements for Load Measurements

C.1 General

The purpose of load measurements for Type Certification is to validate design calculations and to directly determine loads under specific conditions. The following minimum requirements for these measurements shall be met.

C.2 Load Measurement Program

The load measurement program shall be based on and consist of measurement load cases that are as close as practically possible to the design load cases defined in IEC 61400-1 or IEC 61400-2. The measurement load cases shall include all normal and critical operating and fault conditions, braking performance (e.g. loss of grid, emergency shutdowns, protection system faults, etc.) and yaw behaviour. Testing shall be sufficient to characterise typical operational behaviour throughout the design wind speed range. A statistically significant amount of data for relevant wind speeds and turbulence intensities, allowing extrapolation, shall be collected.

C.3 Measured Data

Measured data shall at least include loads, meteorological parameters and wind turbine operational data. Loads at critical load path locations in the structure, which will enable valid comparisons with predicted loads and characterise the dynamic behaviour of the WT, shall be measured. These loads may include blade root bending moments (flap-wise and lead-lag), shaft loads (bending and torque) and tower top and base loads (in two directions). Meteorological parameters shall include hub height wind speed, wind direction, and atmospheric pressure and temperature. Relevant wind turbine operational data including rotor speed, electrical power, pitch angle, rotor azimuth, yaw position and turbine status shall be measured.

C.4 Data analysis

The data shall be analysed in such a way that valid comparisons with calculated loads and frequencies are possible. As a minimum the mean, minimum and maximum values, standard deviation, cycles counted, power spectral densities and histograms of the appropriate load data shall be evaluated over the recorded wind speed and turbulence ranges and the relevant data included in the test report.

Annex D

Requirements for Safety and Function Testing

D.1 General

The purpose of the safety and function testing element of wind turbine type certification is described in sub-clause 12.3.1. This annex describes the general requirements for conducting these tests. The requirements are divided into the following three main sections:

D.2 Test Plan

The plan for the safety and function tests shall include the critical functions of the control and protection system that require test verification, as described in the design documentation. These critical functions shall at least include:

- emergency shutdown during operation;
- power and speed control;
- yaw control (including cable twist);
- operating vibration levels and excessive vibration protection ;
- grid loss behaviour;
- over speed protection at rated wind speed or above; and
- start-up and shutdown above rated wind speed.

Any additional protection system function that may be activated by component failure or other critical events or operational conditions shall also be tested. This testing may include simulation of the critical event or operational condition. Each test shall be described in the test plan. In many cases, several component failure modes or critical events will lead to similar behaviour of the control and protection system and may be covered by a single test. The Certification Body shall verify that the tests described in the test plan cover all identified critical control and protection system functions.

For each test the test plan shall detail the physical quantities to be measured, the instrumentation and data acquisition system and the calibration and operational settings for the control system, any required special actuators, solenoids, or electrical switches, and all external condition requirements associated with the test. Procedures for conducting each test, including appropriate safety measures, shall be described in the test plan. Also, as part of the test plan, the Operating Body shall identify the criteria for acceptable wind turbine system behaviour (including dynamic behaviour). Developed from the design documentation, these criteria shall be subject to approval by the Certification Body and the Applicant. The Certification Body shall further verify that the descriptions given in the test plan are adequate for successful implementation of the test.

D.3 On-site Test Activities

The test shall be carried out in accordance with the approved test plan. Any modifications to the test plan, which are found to be necessary during the test, shall be documented and subject to approval.

D.4 Analysis and Reporting

A test report conforming to the requirements of sub-clause 12.3.6 shall be prepared. The data analysis shall also minimally include time series plots of each critical physical quantity measured and either a table of computed values of statistical measures of the data variability (including maximum and minimum values) or suitable statistical graphs such as histograms, exceedance curves or power spectral densities. The analysis shall include identification of the

2 critical overall system natural frequencies displayed in the data. The reported information shall establish that the purpose of the test has been fulfilled and that the agreed acceptance criteria have been met.

Annex E

Duration Tests for Small Wind Turbines

For small wind turbines a duration test may replace load measurements and blade tests specified in 8.3.3 and 8.3.4. The purpose of the test is to investigate:

– structural integrity and material degradation (corrosion, cracks, deformations); and

– quality of environmental protection of the wind turbine.

Any degradation of the wind turbine conditions during the test period shall be recorded.

The tests and the report format shall meet the specifications defined in IEC 61400-2.

During the test period, which shall have a duration of at least 6 months, the wind turbine shall achieve at least 1500 hours of generation without major repair and achieve an availability[2] of at least 90 %. If the 90% availability is not achieved, the test shall be continued until 90% is reached, or a new test undertaken that will meet the stated criteria.

During the test period, the wind turbine shall be exposed to at least 250 hours of normal operation at 10-min average hub height wind speeds ≥ 10 m/s, of which at least 25 hours shall be at 10-min average wind speeds ≥ 15 m/s. The specified wind speeds refer to hub height.

For variable load systems, such as battery charging applications, the wind turbine shall operate at full and at less than 40 per cent battery bank charge, simulating a realistic range of turbine operating load. Each of the load levels shall be tested over the full range of possible wind conditions. A suitable means of maintaining consistent load conditions for each charge condition shall be provided.

The dynamic behaviour of the turbine shall be assessed experimentally in order to verify that system natural frequencies do not interfere with operational frequencies. The dynamic behaviour of the turbine shall be observed for at least 1 minute at wind speeds near and above 10, 15 and 20 m/s. The highest 3-sec wind speed and average turbulence intensity at 15 m/s wind speed during the test shall be recorded. These results shall be stated in the test report and the Type Certificate. The certificate shall also state that “The recorded wind speed may not reflect the design wind speed.”

Annex F
(Informative)

References

[2] For the purpose of this test, availability is defined as a measure of performance given by the ratio of time a wind turbine is available to the total time in any evaluation period, expressed as a percentage. When the status of the wind turbine is not known for some time periods, the availability, A, is given by the following equivalent definitions:

$$A = \frac{T_A}{T_T - T_U} \times 100\% = \frac{T_T - T_N - T_U}{T_T - T_U} \times 100\%$$

where:

T_T is the total time period under consideration,

T_A is the time during which the turbine is known to be available,

T_N is the time during which the turbine is known not to be available, and

T_U is the time during which the turbine status is unknown.

A wind turbine is considered to be available if it is either operating (generating power, starting up or shutting down) or on standby, that is capable of generating power if the external conditions return to the normal operating range.

2 IEC 61400-13 TS Ed 1: *Wind turbine generator systems. Mechanical Load Measurements*.

4 IEC 61400-23 TS Ed 1: *Wind turbine generator systems. Full-scale structural testing of rotor blades for WTGs*.