IECRE OD-501

Edition 2.0 2018-05-24

IECRE OPERATIONAL DOCUMENT

IEC Systemfor Certification to Standards relating to Equipment for use in Renewable Energy applications (IECRE System)

Type and Component Certification Scheme

IECRE OD-501:2018

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

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

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigenda or an amendment might have been published.

Useful links:

IEC publications search - www.iec.ch/searchpub

The advanced search enables you to find IEC publications by a variety of criteria (reference number, text, technical committee,...).
It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished

Stay up to date on all new IEC publications. Just Published details all new publications released. Available on-line and also once a month by email.
Electropedia - www.electropedia.org

The world's leading online dictionary of electronic and electrical terms containing more than 30 000 terms and definitions in English and French, with equivalent terms in additional languages. Also known as the International Electrotechnical Vocabulary (IEV) on-line.

Customer Service Centre - webstore.iec.ch/csc

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre:csc@iec.ch.

IECRE OD-501

Edition 2.0 2018-05-24

IECRE OPERATIONAL DOCUMENT

IEC Systemfor Certification to Standards relating to Equipment for use in Renewable Energy applications (IECRE System)

Type and Component Certification Scheme

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

PRICE CODE ZZ

CONTENTS

Operational Document: OD-501, Type and Component Certification Scheme

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as “IEC Publication(s)”). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects, since each technical committee has representation from all interested IEC National Committees.
3) IEC Publications take the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
6) All users should ensure that they have the latest edition of this publication.
7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

This operational document replaces the type certification part of International Standard IEC61400-22 and has been prepared by WG501 under the IECRE scheme.

Further IECRE ODs are planned and are covering the same topics as OD-501 but in more detail. When such ODs are approved and published they will take precedence.

A list of all parts of the IEC61400 series, under the general title: *Wind turbines*, can be found on the IEC website (IECRE.ORG).

This document will be maintained according to the directive set out in the IEC CA 01 and IECRE 01-S, Basic Rules and IECRE 05, WE-OMC Rules of Procedure.

OD-501, Type and Component Certification Scheme

1 Scope

The type certification scheme constitutes a complete third party conformity assessment of a wind turbine type or a wind turbine component type. The type certification scheme applies for wind turbines intended for both onshore and offshore installation.

This Operational Document specifies procedures for the type certification scheme, 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 modules in the wind turbine type certification scheme;

– procedures for conformity assessment in the wind turbine type certification scheme;

– guidance for documentation that is to be supplied by an applicant for the conformity assessment;

The type certification scheme is not limited to wind turbines of any particular size or type. Some modules of the type certification scheme are mandatory, whilst provision is specifically made for others to be optional.

This type certification scheme also covers prototype certification including procedures related to evaluation of the safety of operating a prototype in order to enable testing of a new wind turbine type.

This OD describes procedures for conformity assessment relating to design, testing and manufacturing.

2 Normative references

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

IEC 61400 series standards as listed in the website IECRE.org

ISO/IEC 17000:2004, *Conformity assessment – Vocabulary and general principles*

ISO/IEC 17020:2012, *Conformity assessment – Requirements for the operation of various types of bodies performing inspection*

ISO/IEC 17021:2006, *Conformity assessment – Requirements for bodies providing audit and certification of management systems*

ISO/IEC 17025:2005, *General requirements for the competence of testing and calibration laboratories*

ISO/IEC 17065: 2012, *Conformity assessment – Requirements for bodies certifying products, processes and services*

ISO 9001:2015, *Quality management systems – Requirements*

Earlier or withdrawn editions of the referenced normative document may only be applied according to transition rules decided by IECRE WE-OMC e.g. through clarification sheets.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply, together with the relevant definitions contained in WE-OMC Rules of Procedure and ISO/IEC 17000.

3.1 applicant
entity applying for certification

3.2 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.

3.3 modification
a new installation or changes to an existing installation, which changes the original design/specification

3.4 rotor nacelle assembly RNA
part of a wind turbine carried by the support structure

3.5 support structure
part of a wind turbine consisting of the tower, sub-structure and foundation, see IEC61400-3

4 Symbols and abbreviations

4.1 Symbols

The relevant symbols contained in IEC 61400-1and IEC 61400-3 are applicable.

4.2 Abbreviations

RNA	rotor/nacelle assembly
WT	wind turbine(s)

5 Management of the type certification scheme

The type certification scheme shall be managed and operated in accordance with the, Basic Rules and IECRE 05, WE-OMC Rules of Procedure.

5.1 Certification Agreement

A certification body approved by REMC for operating as an RECB according to this OD shall upon request take on work for certification of wind turbines or wind turbine components according to this type certification scheme. 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 including a clear reference to the IECRE system and the OD-501 identifying the applicable certification modules.

5.2 Issue of certificates and conformity statements

The type certification scheme covers the issuance of certificates and conformity statements and is described in the Basic Rules, IECRE 02 Rules of Procedure and IECRE 05 Rules of Procedure for the Wind Energy sector.

In the case of outstanding issues of no importance to the primary safety of the certified object, a provisional certificate or provisional conformity statement may be issued for a limited period of validity, maximum 1 year, which permits evaluation and verification of the outstanding issues.

5.3 Security of relevant documentation

The certification body shall keep a file of all received material that is relevant to the certificate or conformity statement. This file shall be kept in a place with restricted access for at least 5 years plus the design lifetime of the object, starting from the issuing date. The material and any copies shall subsequently be returned to the applicant or destroyed with written notice thereof.

5.4 Validity, maintenance, expiration and renewal of certificates

5.4.1 Certificates

The period of validity of a prototype certificate shall not exceed 3 years.

A type or a component certificate allows the applicant to produce certified items. These certificates require maintenance and the period of validity shall not exceed 5 years.

In the case of a provisional certificate the period during which all outstanding issues shall be documented by the applicant and evaluated by the certification body shall not exceed 1 year.

5.4.2 Maintenance of type and component certificate

In order to maintain validity of the type certificate or component certificate, the following requirements shall be met by the applicant and the certification body:

– the applicant shall prepare an annual report for the certified wind turbine or the certified component to be sent to the certification body for review. The report shall include information on installed turbines and abnormal operating experience or failures known to the certificate holder and any minor modifications. The report format as well as an optional conformity statement is further specified in clarification sheet CS CBC-014C “Standard format maintenance report”. This clarification sheet will be replaced by a separate OD;

– the applicant shall report major modifications to the certified product to the certification body without delay and provide corresponding design documentation, procedures, specifications or processes. In case the certificate holder intends to maintain and/or extend the validity of the certificate, updated versions of all documents affected by such modifications shall be provided; and

– the certification body shall perform periodic inspection for the purpose of checking that the wind turbines or components produced correspond to the certificate. The period shall in general not exceed 2.5 years from the issue of the first type certificate (either provisional or final type certificate). Such inspection shall be on a recently installed wind turbine or in the workshop for component certificates. The scope of the inspection has to be significantly lower than for the manufacturing inspections as they were performed as a part of the type/component certificate. If the applicant does not operate a quality system that is certified according to ISO 9001, 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 7.5.2 and 7.5.3.

5.4.3 Renewal of certificates

Renewal requires a new assessment with focus on the technology developments including new standards and knowledge acquired since the previous issue. Related additional requirements as well as transition rules shall be addressed in IECRE WE-OMC ODs or certification schemes.

Generally, the aim will be to allow old standards to apply for renewal unless specified otherwise by the WE-OMC.

The annual reporting must be considered and it must be ensured that the wind turbines have been subject to periodic inspection. In connection with the renewal either a periodic inspection or a type inspection shall be carried out on a recently installed wind turbine which is representative of the type subject to renewal.

The manufacturing evaluation, including the manufacturing inspections, shall be repeated as part of the renewal of the certificate.

5.4.4 Dealing with outstanding matters

A provisional certificate or associated conformity statement can be issued to allow for 0-series manufacture as well as to allow for outstanding matters with no safety implication.

The outstanding matters should be limited to:

– matters with no safety implication within the period of validity (maximum 1 year); and
– matters related to the finalization of manuals and manufacturing and quality control procedures.

The owner of a wind turbine with a provisional certificate must ensure that the outstanding issues are sufficiently dealt with.

5.5 Corrective actions

The certification body shall be informed by the certificate holder in the event that a wind turbine or component is not functioning according to the design specifications and/or other criteria relevant to the certificate.

Incidents known to the certificate holder where the safety of a wind turbine, the surroundings or personnel is involved must be reported to the certification body without delay.

The certification body shall carry out an evaluation of the certificate holder’s incident reporting including root cause analysis and corrective actions.

If the incident is found to be related to a serial defect and the wind turbine/component manufacturer is not able to take appropriate action to prevent further incidents then the certificate shall be immediately suspended. Should it be concluded that further incidents cannot be avoided or the suspension period has expired, then the certificate shall be withdrawn. The suspension period shall not exceed 1 year.

6 The extent of certification

6.1 General

The certification process is concluded by one of the following certificates:

– a component certificate;
– a prototype certificate; or

– a type certificate

A type certificate covers a wind turbine type, 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 optionally include one or more foundations.

A component certificate covers a wind turbine component such as a blade or a gearbox.

A prototype certificate covers a wind turbine installed at a specific location which is typically not ready for serial production.

The approach given in 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, conformity with which shall be evaluated in the certification process, shall be IEC or ISO standards, when available.

6.2 Component certification

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

Component certification consists of the following modules:

– design basis evaluation[1)];
– design evaluation;
– type testing;
– manufacturing evaluation; and
– final evaluation.

These modules as well as their application for the type certification process are illustrated in Figure 1. The procedures for component certification should be in line with the type certification procedures described in Clause 7. The specific content of a module depends on the actual component. Where applicable, the evaluation elements described in Clause 7 should be applied.

---

1) The process begins with design basis evaluation of the component or design evaluation, if the design basis for the wind turbine type for which the component is intended is applicable and has already been evaluated.

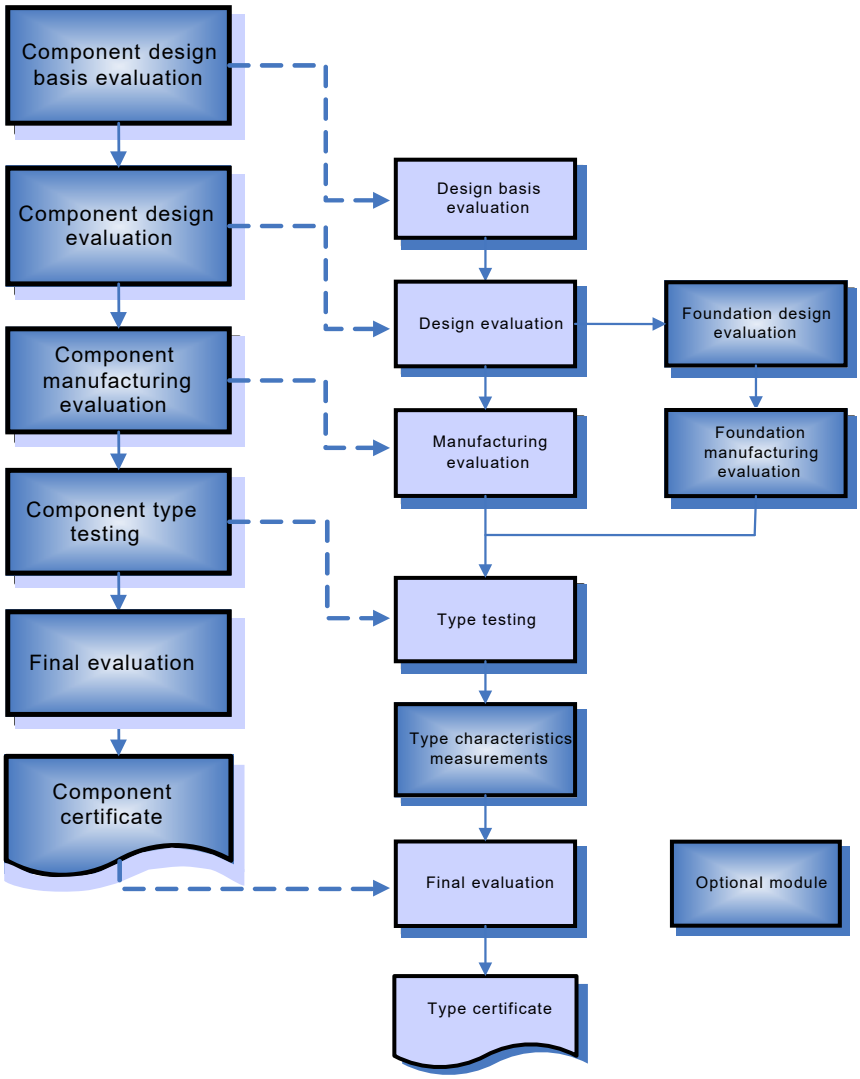

Figure 1 – Modules in component certification and their applications for type certification

IEC 1116/10

For components that are required to undergo specified type testing as part of the wind turbine type testing module, it is recommended that the type testing be included as part of any component certification. 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 may be issued for components designed and evaluated for conformance with the technical requirements of the applicable standards in the IEC 61400 series on the basis of completeness and correctness of final evaluation reports. A component certificate attests that conformity has been established for all modules of evaluation. Satisfactory evaluation of each module is concluded with an evaluation report and a conformity statement.

6.3 Prototype certification

The purpose of wind turbine prototype certification is to enable testing of a new wind turbine type in order to obtain type certification in accordance with this standard.

A prototype certificate is issued for a wind turbine that is not yet ready for serial production, at a specific location and for a limited period of maximum 3 years.

If a prototype is modified in any way that may affect the safety of the wind turbine, a new prototype certificate is required.

Prototype certification consists of the following modules:

– basic design evaluation;
– prototype test plan evaluation; and
– safety and function test.

Basic design evaluation includes the mandatory modules design basis evaluation and wind turbine design evaluation, described in 7.2 and 7.3. The evaluation can be limited to control and protection system, loads and load cases, rotor blades, main structural and electrical components and personnel safety issues.

The prototype certification does not include any site assessment. The site conditions must however be stated by the applicant as of a sufficient level to support the design evaluation. There will not be a mandatory requirement for assessment by the certification body of these conditions other than a general plausibility check and a check that the necessary conditions have been defined by the Applicant. However, authorities and other End Users may still request site assessment for prototypes.

A test plan for the prototype shall be submitted for evaluation. The test plan shall specify main components to be tested during the test period and loads to be documented during the tests.

A prototype test plan comprises as a minimum the elements described in 7.4. The safety and function test shall be part of prototype certification. The safety and functional test result is subject to the approval of the Certification Body.

NOTE: A provisional prototype certificate may thus be issued with a condition stating that the “safety and functional” testing should be carried out at a well-defined point in time such as “before unattended operation”.

6.4 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 consists of the mandatory modules:

– design basis evaluation;
– design evaluation;
– type testing;
– manufacturing evaluation; and
– final evaluation;

and the optional modules:

– foundation design evaluation;
– foundation manufacturing evaluation; and
– type characteristic measurements.

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

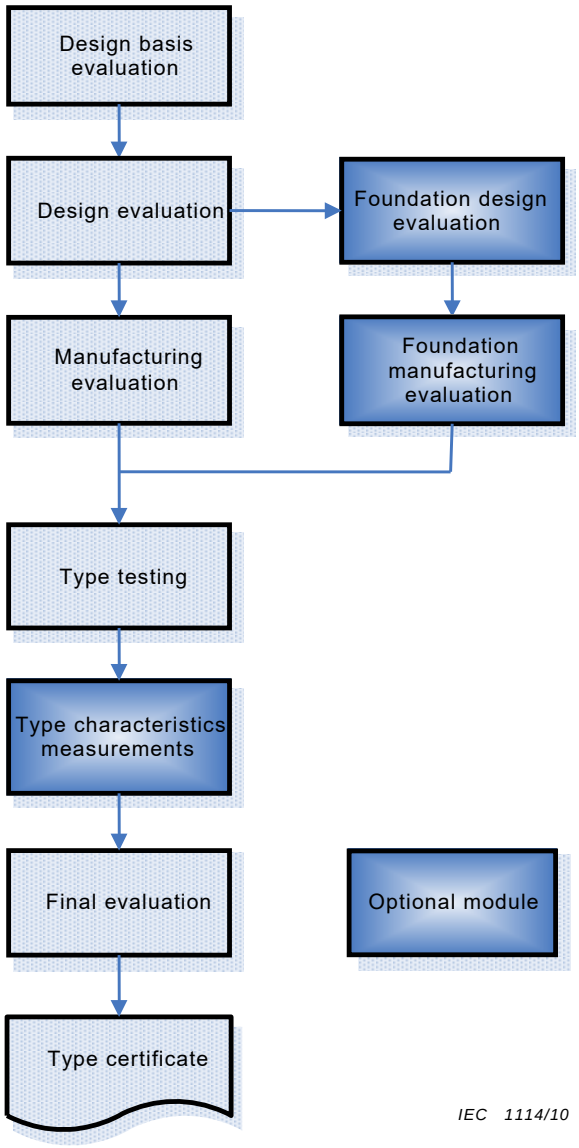

Figure 2– Modules of type certification

A type certificate is issued for a wind turbine designed and evaluated for conformance with the technical requirements of this OD and the applicable standards in the IEC61400 series, 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 optional modules.

The modules and their application are described in Clause 7.

7 Detailed type certification process

7.1 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 and that

the manufacturer operates an accepted quality system. Furthermore, it covers the type testing of the wind turbine.

The certification body shall require the 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 the applicable standards in the IEC61400 series and additional assumptions and requirements stated in the design basis by the designer and agreed with the certification body.

7.2 Design basis evaluation

The purpose of design basis evaluation is to examine whether the design basis is properly documented and sufficient for safe design of the wind turbine type.

The design basis shall identify all requirements, assumptions and methodologies, which are essential for the design and the design documentation, including:

– codes and standards;
– design parameters, assumptions, methodologies and principles, and
– other requirements, e.g. for manufacture, transportation, installation and commissioning as well as for operation and maintenance.

Such identification may be carried out through references to the applicable standards in the IEC61400 series and other applied codes and standards, or by listing specific design aspects and parameters. In particular, choices, supplementary information and deviations relating to the design issues shall be clearly stated in the design basis, e.g. for:

– external design parameters;
– design load cases;
– load factors and load reduction factors;
– partial safety factors applied on loads and materials;
– duration of simulation as well as number of simulations;
– methods for extreme and fatigue design loads/response analysis;
– environmental conditions relevant for installation;
– inspection scope and frequency;
– target lifetime of components, systems and structures, and
– requirements for condition monitoring systems.

7.3 Design evaluation

7.3.1 General

The purpose of design evaluation is to examine whether the wind turbine type is designed and documented in conformity with the design basis, i.e. the applicable standards in the IEC61400 series and other applied codes and standards. Normally, the design evaluation comprises all of the elements shown in Figure 3.

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.

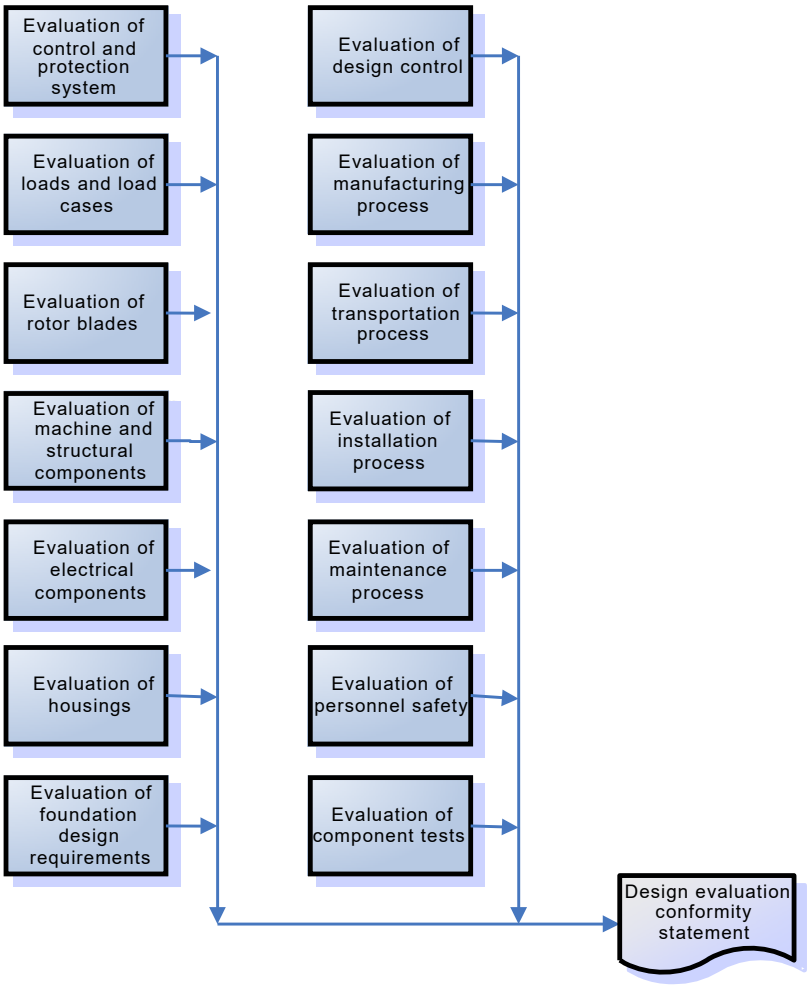

Figure 3 – Elements of design evaluation

7.3.2 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 applicable parts of ISO 9001 related to design and development; and
– include a control of documents so 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.

7.3.3 Control and protection system

The certification body shall evaluate the documentation of a control and protection system according to 61400-1, comprising e.g.:

– 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;
– braking system(s) analysis;
– condition monitoring, if applicable; and
– test plan for the verification of the control and protection system functions.

7.3.4 Loads and load cases

The certification body shall evaluate the loads and load cases for compliance with IEC 61400-1 or IEC 61400-3 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 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.

7.3.5 Rotor blades

The certification body shall evaluate the rotor blade design for compliance with the requirements of this OD and the applicable standards in the IEC 61400 series including IEC 61400-23 and the agreed additional codes and standards as defined in the design basis.

The design documentation shall contain sufficient information for the evaluation, such as

– codes, standards and references;
– design loads and relevant external conditions;
– static systems and boundary conditions;
– influence of adjacent structures and components;
– materials and permissible stresses;
– material and sub-component test program;
– full-scale blade test program;
– manufacturing processes;
– tolerances influencing the design; and
– quality control procedures and levels.

The full-scale test program for the rotor blade shall be verified based on IEC 61400-23. Requirements for full-scale tests are given in the type test certification module, see 7.4.6. Conformity between design requirements and the results of tests is evaluated in the final evaluation certification module, see 7.9.

7.3.6 Machinery structures and structural components

The structures and components shall be evaluated for compliance with the technical requirements of the applicable standards in the IEC 61400 series and additional assumptions and requirements stated in the design basis

The certification body shall evaluate the design of all load-bearing machinery structures and components of the wind turbine, such as:

– casted, forged or welded structures;

– nacelle frame;
– tower;
– pitch and yaw systems;
– bearings and elastomer bushings;
– gearboxes;
– brakes, couplings and locking devices;
– bolts for connecting these structures and components;
– cooling and heating systems; and
– hydraulic systems.

The gearbox shall be evaluated for compliance with the requirements of IEC 61400-4. The result of the workshop test for the prototype gearbox as well as the prototype gearbox field test program shall be part of the design evaluation.

Furthermore, requirements for testing of components during manufacturing and assembly shall be specified and evaluated.

The certification body shall require that the documentation clearly refers to the design basis and identifies the basis for the design. Additionally, the documentation shall contain sufficient information, for example on:

– codes, standards and references;
– design loads and relevant external conditions;
– static systems and boundary conditions;
– influence of adjacent structures and components;
– influence of drive train dynamics;
– materials and permissible stresses;
– type/data sheets (for mass-produced parts); and
– work instructions (for bolted connections).

7.3.7 Electrical components

The electrical components shall be evaluated for compliance with the technical requirements of the applicable standards in the IEC 61400 series and additional assumptions and requirements stated in the design basis. The certification body shall evaluate the design of all electrical components of the wind turbine such as:

– generators;
– transformers;
– converters;
– medium and high voltage components;
– electrical drives;
– charging equipment and storage batteries;
– switchgear and protection equipment;
– cables/bus bars and electrical installation equipment;
– slip ring; and
– lightning protection.

For evaluation of lightning protection, reference is made to IEC 61400-24.

Workshop tests for the generator according to the IEC 60034 series shall be carried out and documented. The result of the workshop test shall be considered during the design evaluation.

Furthermore, requirements for the testing of components during manufacturing and assembly shall be specified and evaluated.

The certification body shall require that the documentation clearly refers to the design basis and identifies the basis for the design. Additionally, the documentation shall contain sufficient information, for example on:

– codes, standards and references;
– design requirements and relevant external conditions;
– boundary conditions;
– influence of adjacent structures and components; and
– materials.

7.3.8 Housings

Housings shall be evaluated for compliance with the technical requirements of the applicable standards in the IEC61400 series and additional assumptions and requirements stated in the design basis.

The certification body shall evaluate the design of all housings such as:

– spinners; and
– nacelle covers.

The certification body shall require that the documentation clearly refers to the design basis and identifies the basis for the design. Additionally, the documentation shall contain sufficient information, for example on:

– codes, standards and references;
– design loads and relevant external conditions;
– static systems and boundary conditions;
– influence of adjacent structures and components; and
– materials and permissible stresses.

7.3.9 Evaluation of component tests

The strength and other functional requirements of some structural, mechanical or electrical components may be documented by measurements or test results only.

Should the relevant analysis for a component be 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 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.

7.3.10 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 the technical requirements of the applicable standards in the IEC 61400 series

and additional assumptions and requirements stated in the design basis. In addition, the evaluation shall establish that the foundation design(s) conform to interface geometry requirements (flatness, level, and bolt pattern tolerances) and the strength requirements defined in the wind turbine design documentation.

For offshore wind turbines, the foundation design requirements shall also include design requirements for the sub-structure connecting the tower to the foundation.

7.3.11 Manufacturing process

The certification body shall verify that the critical manufacturing processes are identified and the requirements for manufacturing are sufficiently described so that these can be implemented in the manufacturing.

The critical manufacturing processes may be documented in preliminary

– manufacturing specifications;
– work instructions;
– purchase specifications; and
– quality control procedures.

In addition, requirements for workshop tests shall be specified.

The evaluation of the final version of these documents shall, at the latest, be included in final evaluation certification module, see 7.9.

7.3.12 Transportation process

The certification body shall verify that the turbine can be transported according to any requirements identified in the design documentation.

This description of the transportation process shall, if applicable, include:

– technical specifications applicable for the transportation;
– limiting environmental conditions.
– transportation arrangement including required fixtures, tooling and equipment; and
– transportation loads and load conditions.

The transportation process may be documented in a preliminary transportation/installation manual. The final description of the transportation process shall be evaluated at the latest during final evaluation certification module, see 7.9.

7.3.13 Installation process

The installation process shall be sufficiently described to allow the certification body to verify the adequacy of the turbine design, taking into account specified installation processes, including commissioning. This description of the installation process shall, if applicable, include:

– identification of human resource requirements and skills;
– identification of interface points and any required technical specifications for civil and electrical construction works, including an earthing system;
– identification of specialised tooling and required lifting fixtures or equipment;
– 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
– quality recording and record keeping processes.

The installation process may be documented in a preliminary installation/commissioning manual. The final description of the installation process shall be evaluated at the latest during final evaluation, certification module, see 7.9.

7.3.14 Maintenance process

The maintenance process shall be sufficiently described to allow the certification body to verify the adequacy of the turbine design, taking into account specified maintenance processes. This description of the maintenance process shall, if applicable, include:

– 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.

The maintenance process may be documented in a preliminary O&M manual. The final description of the maintenance process shall be evaluated at the latest during final evaluation, certification module, see 7.9.

7.3.15 Personnel safety

The certification body shall evaluate personnel safety aspects in the design documentation (drawings, specifications and instructions) for compliance with the requirements of the applicable standards in the IEC61400 series and additional assumptions and requirements stated in the design basis.

Personnel safety aspects may 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;
– emergency stop buttons;
– provision of alternative escape routes;
– provision for emergency stay in an offshore wind turbine for one week; and
– offshore-specific safety equipment for an offshore wind turbine.

The certification body shall require an applicant to identify elements in the design documentation that pertain to personnel safety.

7.3.16 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;
– reference to main codes and standards applied;
– specification of external conditions with reference to the wind turbine class and other principal data; and
– reference to evaluation report(s).

7.4 Type testing

7.4.1 General

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

The certification body shall evaluate that testing of these aspects, as applicable, has been carried out on a wind turbine or component of a wind turbine which is representative of the type being certified. Inspection records shall be completed, preferably prior to the tests, to demonstrate satisfactory conformity of the wind 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 following changes will normally require new testing for the relevant type test elements:

– a change in rotor diameter of more than 2%
– a change in rotor rotational speed of more than 2%
– a different design of the safety system
– a different way of limiting the power output
– modified blade profiles
– modifications which lead to a significant increase in the load spectrum
– increase of the power output by more than 5%
– major changes to the wind turbine design.

However, all changes within or outside the criteria in the above list require an updated Type Certificate stating the values of the changed parameters. The extent of additional documentation and evaluation will depend on the change(s).

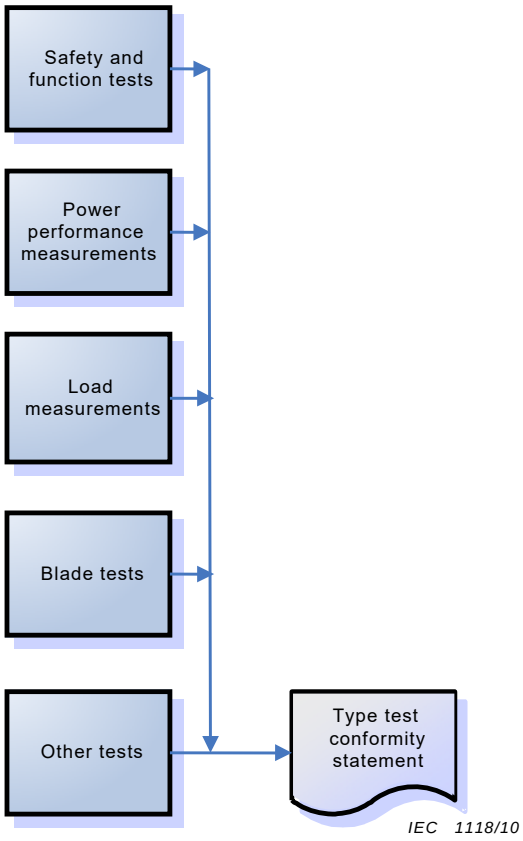

Figure 4– Type testing elements

In case of well-established competence area in IECRE, the type testing elements given in Figure 4 shall be carried out by a test laboratory approved by REMC for the subjected test scope, see also WE-OMC Rules of Procedure.

In case of no well-established competence area in IECRE, the type testing elements given in Figure 4 can be witnessed by an approved certification body by REMC for the subjected test scope, see also WE-OMC Rules of Procedure.

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. A satisfactory evaluation is concluded with a conformity statement.

7.4.2 Type inspection

The certification body shall evaluate that testing, as applicable, has been carried out on a wind turbine or component of a wind turbine representative of the type to be certified. Inspection records shall be completed, preferably prior to the tests, to demonstrate satisfactory conformity of the wind turbine or component with the design documentation.

The certification body shall verify through inspection that critical personnel safety features have been satisfactorily implemented in the installed wind turbine to be tested, see Annex C.6.

7.4.3 Safety and function tests

The purpose of safety and function testing is to verify that, under testing, the wind turbine displays the behaviour predicted in the design.

The certification body shall verify satisfactory demonstration of the control and protection system functions with reference to the approved test plan, see 7.3.3.

The detailed requirements for testing are given in OD-501-5.

7.4.4 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 61400-12-1.

The certification body shall verify that the measurement procedures conform with IEC61400-12-1 and that the measurement conditions, instrumentation, calibrations, and analyses are described in a test report, also in accordance with IEC 61400-12-1.

7.4.5 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.

The test procedures and evaluation of tests shall comply with IEC 61400-13.

7.4.6 Blade tests

The purpose of the 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 blade type is described not only in terms of its size and shape but also in terms of its internal construction and structure. Fatigue tests as well as static tests are required. The test procedures and the evaluation of the tests shall comply with IEC 61400-23 for full-scale structural testing and IEC 61400-24 for lightning test.

Test blades shall be representative for the blade design being 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
– transition zones in the blade root.

7.4.7 Other tests

The certification body may, as a result of the design basis evaluation or the design evaluation, require other tests and/or measurements to be carried out. Other tests may also be requested by the applicant for inclusion in type testing. Such tests may include:

– thermal conditions of main mechanical and electrical components;
– mechanical conditions (vibrations, clearances, response) of main mechanical and electrical components;

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

Additionally, the type test for a wind turbine equipped with main gearbox(es) shall include a field test, including robustness test, for main gearboxes as required in IEC 61400-4.

7.4.8 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.

7.5 Manufacturing evaluation

7.5.1 General

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

– quality system evaluation; and
– manufacturing inspection.

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

7.5.2 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. This system certification shall be carried out by an accredited body that operates according to ISO/IEC 17021.

If the quality system is not certified, the certification body shall evaluate the system of the applicant. The following aspects of ISO 9001 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.

7.5.3 Manufacturing inspection

It shall be ensured that the requirements identified during the design evaluation with regard to critical manufacturing processes are observed and implemented in production and assembly. The certification body shall verify by inspection that at least one representative specimen is manufactured according to the design under certification.

The following aspects shall be evaluated as part of the inspection:

– verification that design specifications are properly implemented in workshop;
– 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.

Inspection of critical manufacturing processes should preferably take place at the wind turbine manufacturer to ensure that the requirements identified during the design evaluation are met. If this is not possible due to the lack of manufacturing records for the critical manufacturing processes, an inspection at the sub-supplier will be required. Any stipulations such as conditions/remarks in the design evaluation statement regarding critical manufacturing processes must be addressed in the manufacturing evaluation or in the final evaluation.

In general, the following components shall be considered for inspection:

– rotor blades;
– rotor hub;
– rotor shaft;
– main, pitch and yaw bearings (pitch and yaw drives);
– main bearing housings;
– gear box;
– locking devices and mechanical brake;
– generator, transformer;
– main frame, generator frame;
– tower;
– sub-structure (optional);
– foundation (optional);
– bolted connections; and
– hub and nacelle assembly (in workshop).

If a component subjected to inspection is produced by more than one component manufacturer or parts of the component is sub-supplied and the components differ significantly in specifications and/or manufacturing processes, all differing components shall be considered for inspection.

Changes in manufacturing processes that influence the component quality or component properties shall be reported to the certification body. In the event of major process changes documentation shall be submitted for renewed evaluation and, if necessary, the inspection shall be repeated.

7.5.4 Manufacturing conformity statement

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

7.6 Foundation design evaluation (optional)

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 7.3.10) and is in accordance with the agreed applicable standards and codes.

For an offshore wind turbine the scope of foundation design evaluation shall include the sub-structure connecting the foundation to the tower.

The certification body shall, if applicable, require that reinforcement, concrete layout and construction sequence plans be included in 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;
– description of assumed soil and other external conditions;
– identification of tower configuration;
– identification of the sub-structure configuration; and
– identification of the foundation type.

7.7 Foundation manufacturing evaluation (optional)

7.7.1 General

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

– quality system evaluation; and
– manufacturing inspection.

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

For an offshore wind turbine, the foundation manufacturing evaluation shall include manufacturing evaluation of the sub-structure connecting the foundation to the tower.

7.7.2 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. This system certification shall be carried out by an accredited body that operates according to ISO/IEC 17021.

If the quality system is not certified, the certification body shall evaluate the quality 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.

7.7.3 Foundation manufacturing inspection

It shall be ensured that the requirements identified during the design evaluation with regard to critical manufacturing processes are observed and implemented in production. The certification body shall verify by inspection that at least one representative specimen is manufactured according to the design under certification.

The inspection shall comprise:

– verification that design specifications (e.g. reinforcement, concrete layout and construction sequence plans) are properly implemented on site;
– manufacturing instructions, purchase specifications and installation instructions;
– 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.

If a foundation is produced by more than one manufacturer and the foundations differ significantly in specifications and/or manufacturing processes, all differing foundations shall be considered for inspection.

Changes in manufacturing processes, which influence the foundation quality or properties, shall be reported to the certification body. In the event of major process changes, documentation shall be submitted for renewed evaluation and, if necessary, the inspection shall be repeated.

The manufacturing inspections shall be repeated as part of the renewal of the certificate.

7.7.4 Foundation manufacturing conformity statement

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

7.8 Type characteristics measurements (optional)

7.8.1 General

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 (Subclause 7.4.4). These optional measurements may be selected by the applicant and shall conform with the relevant IEC61400 standards listed in the following subclauses. The type characteristics measurements comprise one or more of the following elements:

– power quality tests;
– low voltage ride through tests; and
– acoustic noise measurements

as shown in Figure 5.

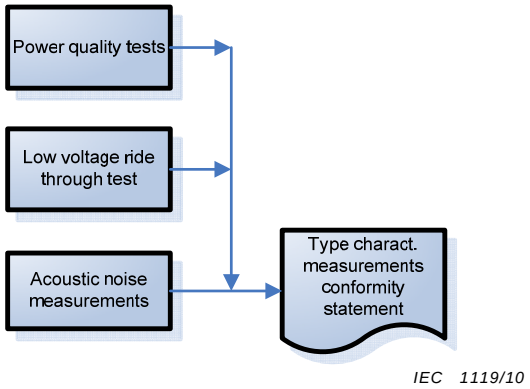

Figure 5– Type characteristics measurements elements

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, see also 7.4.2.

The measurements shall be carried out by a test laboratory approved by REMC for the relevant test scope, see also WE-OMC Rules of Procedure.

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.

7.8.2 Electrical characteristics- 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.

7.8.3 Electrical characteristics- Low voltage ride through measurement

For type certification in which low voltage ride through (LVRT) measurements are included, the certification body shall verify that the measurement procedures conform with the relevant standards and that the measurement conditions, instrumentation and equipment, calibrations and analyses are described in a test report which is also in accordance with the relevant standards.

The relevant standards shall comprise:

– IEC 61400-21; and

– other standards agreed between the certification body and the applicant.

The purpose of these measurements is to document the low voltage ride through capabilities of the wind turbine type.

7.8.4 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,
– 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.

7.8.5 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).

7.9 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:

– a reference list of all supporting product documentation for the type certificate;
– a report of whether the detailed documentation is complete and whether the type test results confirm that all relevant requirements are set out in the design documentation; and
– a review of the final product documentation, including drawings, component lists, procurement specifications and manuals (see following paragraph), to confirm that this is consistent with the manufacturing evaluation report and with the supporting design calculations and relevant design assumptions.

The certification body shall verify that the operation, installation, transport and maintenance manuals comply with the relevant requirements in the applicable standards in the IEC61400 series. The manuals shall be reviewed against the corresponding approved processes, see 7.3.11 - 7.3.147.3.15.

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 so that they appear before the operation in question; and these notes are 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.

7.10 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 and manufacturing evaluation (see 7.6 and 7.7) and type characteristic measurements (see 7.8).

The type certificate is valid for the wind turbine type specified in the certificate. The specifications may include alternative components and configurations. The different combinations of alternatives which are permitted shall be clearly identified.

The type certificate shall reference the standards and normative documents used in an appropriate way. The type certificate shall include the information given in the approved templates.

The certification body shall include requirements in the agreement governing the validity of the certificate, see 5.4.1

Annex A

Design documentation (if applicable)

Table A.1 – Design documentation (if applicable)

	Item	Drawings geometric data	Analysis calculations	Description	Specifications	Data sheet	Schematics	Test data
1	**General turbine description**							
	General turbine characteristics, configurations and layout			√			√	
	Turbine description and general specifications	√		√	√			
	Major component weights and centres of gravity				√			
	Operational limits				√			
	Electrical power system			√			√	
	External conditions and design class			√				
	Codes and standards			√				
	Co-ordinate Systems	√		√				
2	**Design control procedure**							
	Document description and Organisation in compliance with ISO 9001			√				
3	**Control and protection system**							
	Detailed control logic flow chart						√	
	Control and protection philosophy			√				
	Modes of operation			√				
	Control system software			√	√		√	
	Software release and version control			√				
	Set point list				√			
	Remote control/monitoring			√	√		√	
	Protection system logic			√			√	
	Electrical control system (structure, starting and stopping procedures…)			√			√	
	Fault analysis		√	√				
	Structure of protection system	√		√			√	
	Description of safety concept and component specifications including transducers and sensors (settings, time constants…)			√	√			
	Braking system (structure, time constants, characteristics, braking torque curve…)	√	√	√	√		√	
	Electrical and hydraulic circuit diagrams			√			√	
	Condition monitoring			√	√	√	√	
	Safety instructions			√				
	Overspeed sensing				√		√	
	Overpower/current sensing				√		√	
	Vibration sensing				√		√	
	Emergency stop button			√			√	
	Supervisory wind farm control system (remote control of power output, pitch/yaw control parameters…)			√				
	Test plan			√				

	Item	Drawings geometric data	Analysis calculations	Description	Specifications	Data sheet	Schematics	Test data
4	**Loads and load cases**							
	General:							
	Wind farm configuration chart	√					√	
	Site data (e.g. environmental and marine conditions, dynamic viscosity, air density, salinity, soil…)		√	√				
	Mass distribution, stiffness, natural frequencies and damping factors for all structural components (rotor, blade, drive train, support structure…)		√		√			
	Cut in/cut off/rated wind speed				√			
	Rotor-/generator speeds				√			
	Mechanical/electrical losses				√			
	Generator data (rated power, synchronous speed, nominal/ maximum slip, relevant time constants)					√		
	Nacelle/rotor data (mass, dimensions, centre of gravity, etc.)	√	√		√			
	General analysis approach (e.g. co-ordinate system used)	√	√	√				
	System dynamics model description:							
	Degrees of freedom			√			√	
	Mass and stiffness distributions				√			
	Aerodynamic inputs (airfoil tables, blade geometry, lift and drag coefficients…)		√		√		√	
	Partial safety factors		√		√			
	Validation of calculation models:							
	Analytical		√					
	Comparison with test data		√					√
	Dynamic behaviour of the system and of individual major components:							
	Campbell diagrams		√				√	
	Spectral/frequency plots		√					√
	Mode shapes and frequencies		√					
	Comparisons between predictions and measurements		√					√
	Load cases (from IEC 61400-1/3 plus other identified cases):							
	Fatigue loads for several turbine sections (tower sections, main shaft/hub, blade root, blade sections)		√					
	Ultimate loads for several turbine sections (tower sections, main shaft/hub, blade root, blade sections)		√					
	Markov matrices for drive train and blade section loads		√					
	Load duration distribution spectra (LDD) for drive train and pitch bearing loads		√					
	Tower bottom loads		√					
	Maximum blade deflection analysis		√					
	Critical deflection (blade/tower)		√					

	Item	Drawings geometric data	Analysis calculations	Description	Specifications	Data sheet	Schematics	Test data
	Failure modes		√					
	Turbine controller (e.g. block circuit diagram, input and output signals, etc.)			√			√	
5	**Rotor blades**							
	Structure	√		√	√			
	Blade connection		√		√			
	Data of materials used (fibres, resins, foam, etc.)				√			
	Geometric data	√			√			√
	Extreme stress analysis		√					
	Fatigue stress analysis		√					
	Modal analysis		√					
	Stability stress analysis		√					
	Production sequence	√			√			
	Root	√	√					
	Blade/hub connection	√	√					
	Aerodynamic brake mechanism	√	√		√			
	Material and blade tests		√					√
6	**Machine and structural components**							
	General:							
	Assembly drawings	√		√				
	Material data		√		√			√
	Gearing and drive train (including generator, brake and couplings, ratio, inertia)		√		√			
	Drive train dynamics	√	√	√	√	√		
	Hydraulic system		√	√	√	√	√	
	Pitch system:							
	Drive	√	√		√	√	√	
	Power supply	√	√		√			
	Bearings	√	√		√			
	Pitch lock	√	√		√			
	Connections	√	√		√			
	Hub:							
	Structure	√	√		√			
	Teeter system	√	√		√			
	Pitch system (including power supply)	√	√		√	√		
	Hub/low speed shaft connection	√	√		√			
	Low speed shaft:							
	Main shaft	√	√		√			
	Main bearing	√	√		√			
	Bearing housing	√	√		√			
	Rotor lock	√	√		√			
	Coupling		√		√			
	Bearing lubricants				√	√		
	Gear box:							
	Gear box	√	√		√			√
	Torsion support	√	√		√			
	Connections to main frame, bearings	√	√		√	√		
	Cooling and heating systems	√	√		√	√		√
	High speed shaft:							
	Mechanical brake	√	√		√			
	Coupling	√	√		√			
	Frame:							

	Item	Drawings geometric data	Analysis calculations	Description	Specifications	Data sheet	Schematics	Test data
	Main frame	√	√		√			
	Generator frame	√	√		√			
	Connections main frame and main frame to generator frame	√	√		√			
	Yaw system:							
	Drive	√	√		√	√	√	
	Bearings	√	√		√			
	Yaw lock	√	√		√			
	Connections	√	√		√			
	Tower:							
	Structure	√			√			
	Connections	√	√					
	Dynamic analysis of the tower (with turbine)		√					
	Earthquake analysis		√					
	Extreme and fatigue analysis for welded and bolted connections of the tower		√					
	Finite-element-analysis of door frame and other openings	√	√					
	Corrosion protection system				√			
	Cable twist			√	√		√	
	Cable suspension	√			√			
	Ladders, platforms, elevators	√	√		√			
7	**Electrical components**							
	Single line diagram (basic power circuit with safety devices)						√	
	Characteristic parameters of electrical components (positioning drives, generator…)			√	√			
	Functional descriptions and maintenance instructions			√				
	Power circuit schematic	√					√	
	Data of short-circuit and overcurrent protection gear						√	
	Electrical systems diagrams (incl. auxiliary circuits like cranes, lifts, etc.)	√		√	√		√	
	Part lists (incl. sensors, switches and all important electrical appliances)						√	
	Emergency power system and fire alarm system	√		√			√	
	Charging equipment and storage batteries			√	√	√	√	
	Summary of electrical measuring equipment	√		√			√	
	Records of routine test according to IEC 60034-1			√	√			√
	Power converter	√			√		√	
	High voltage cable	√		√		√		
	Generator			√	√		√	√
	Connections to generator frame	√	√		√			
	Generator bearings	√	√		√			
	Air flow concept, cooling system			√				
	Capacitors			√		√		
	High voltage disconnection device	√		√		√	√	
	Low voltage disconnection device	√		√		√	√	
	Medium voltage transformer	√		√	√		√	

	Item	Drawings geometric data	Analysis calculations	Description	Specifications	Data sheet	Schematics	Test data
	Type test records of the transformer as per IEC 60076-1			√				√
	Earthing and lightning protection (incl. lightning protection zones, lightning rods and conductors, earth electrodes, location of bonding bars, connection to separate buildings)	√		√	√		√	
8	**Housings**							
	Spinner and nacelle cover	√	√		√			
	Enclosure (materials, design details, general view, etc.)	√	√		√			√
	Extreme analysis (for steel parts, bolts and fibre reinforced plastics, etc.)		√					
9	**Component design evaluation tests**							
	Test report							√
10	**Foundation**							
	Structure	√			√			
	Design parameters			√	√			
	Materials			√	√			
	Detailed presentation of the reinforcement plan	√		√			√	
	Reinforcement (type of steel; diameter, shape, number and position of bars)	√	√	√	√			
	Analysis of tower to foundation joint (embedded steel or anchor bolts)	√	√					
	Extreme and fatigue analysis for all load bearing concrete parts		√					
	Determination of pile forces in case of pile foundations (monopile, tripod, jacket)		√					
	Geotechnical verifications (sliding, settlement, bearing capacity)		√					
	Construction, transport and installation			√				
11	**Manufacturing process**							
	Purchase specifications				√			
	Manufacturing specifications				√			
	Work instructions	√		√			√	
	Quality control procedures				√	√		
	Manufacturing manual	√		√	√	√	√	
12	**Transportation process**							
	Technical specifications				√			
	Limited environmental conditions			√	√			
	Work instructions	√		√			√	
	Quality control procedures				√	√		
	Transportation manual	√		√	√	√	√	
13	**Installation process**							
	Installation specifications				√			
	Work instructions	√		√			√	
	Quality control procedures				√	√		
	Installation manual	√		√	√	√	√	
14	**Maintenance process**							
	Work instructions	√		√			√	
	Quality control procedures				√	√		

	Item	Drawings geometric data	Analysis calculations	Description	Specifications	Data sheet	Schematics	Test data
	Maintenance manual	√		√	√	√	√	
15	**Personnel safety**							
	Safety instructions			√	√		√	
	Climbing facilities, access ways, passages, platforms, floors, hand rails, fixing points	√	√	√	√			
	Lighting			√	√	√		
	Fire resistance			√	√	√		
	Alternative escape routes			√	√		√	

NOTE 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.

NOTE 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.

NOTE 3 Descriptions consist of text describing relevant tasks, functions, components, etc.

NOTE 4 Specifications 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.

NOTE 5 Data sheets are listings of data relevant for the corresponding component, part, detail, etc.

NOTE 6 Schematics are data plots, flow charts, diagrams and other illustrations (electric, pneumatics and hydraulics).

NOTE 7 Test data usually refers to reports of tests and measurements.

NOTE 8 A check mark (√) indicates that corresponding documentation is expected for certification purposes.

Annex B (valid until an OD or standard is available)

Minimum requirements for load measurements

B.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:

Measurements shall be made on a wind turbine that is dynamically and structurally similar to, but may differ in detail (such as alternative tower designs) from, the turbine submitted for certification. In case of differences, the applicant shall evaluate the differences, e.g. perform load and dynamic behaviour predictions for the wind turbine under testing.

New measurements are necessary when introducing a different tower design. Examples for different tower designs are

- steel tubular tower,
- lattice tower,
- concrete tower,
- hybrid tower.

The wind turbine's natural frequencies shall be evaluated based on analyses for the subjected tower designs. The evaluation shall consider the risk of coupled rotor vibrations such as whirling i.e. higher modes than the lowest natural frequency. Based on this evaluation a limited load measurement program may be adopted and, if coupled vibrations are not likely to occur, RNA (Rotor and Nacelle Assembly) and/or tower measurements may be omitted. In case of a changed hub height with similar tower design no load measurements are generally deemed necessary.

Example of application:

In case of similar first tower natural frequencies (first and second order frequencies) of different tower designs, the following procedure is acceptable:

1) Load measurements of blade and shaft may be omitted provided it can be shown by simulation that loads acting at blade, shaft and tower top do not deviate significantly.

2) Load measurements of the tower are normally requested for different design variants at critical tower sections, for example at sections in a hybrid tower where the material(s) has/have been changed.

B.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 61400-3. The measurement load cases shall include all normal and critical operating and fault conditions (e.g. loss of grid, emergency shutdowns, protection system faults, etc.), braking performance 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 shall be collected.

B.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.

B.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 C
(valid until an OD or standard is available)

Requirements for safety and function tests

C.1 General

Covered by OD-501-5 chapter 5.1.1.

C.2 Definition of protection functions

Covered by OD-501-5 chapter 5.1.2.

C.3 Test plan

Covered by OD-501-5 chapter 5.1.3.

C.4 On-site test activities

Covered by OD-501-5 chapter 5.1.4.

C.5 Analysis and reporting

Covered by OD-501-5 chapter 5.1.5.

C.6 Inspection of personnel safety

The certification body shall inspect the aspects of the personnel safety described in the design documentation, see 7.3.15. In general, all safety facilities must be checked for compliance with the design documentation and proper assembling.

The certification body shall at minimum inspect the following personnel safety aspects;

- Safety instructions
  - Safety instructions shall be available for everybody working or operating on the site or in the wind turbine.
- Climbing facilities
  - Climbing facilities and fixing points shall be checked that they have been properly assembled and are fully functional.
- Access ways and passages
  - Access ways and passages shall ensure that it is possible to leave the wind turbine at any time.
  - Access ways and passages shall ensure an entry for rescue workers.
- Standing places, platforms and floors
  - Trip hazards shall be avoided or marked clearly.
  - Platforms, floors and walkways shall be equipped with non-slip surfaces.
  - Hatches in the platforms shall be lockable.

- Hand rails and fixing points
  - Hand rails and fixing points shall be properly fixed.
  - Hand rails shall be checked for sharp edges.
- Lighting
  - The existence of suitable lighting shall be checked.
  - The emergency lighting shall be checked that it functions.
- Electrical and earthing system
  - Electrical equipment shall be grounded, well insulated and conform with the design documentation.
  - Conductive components shall be marked clearly.
- Fire resistance
  - The fire prevention and control concept shall be checked.
- Emergency stop buttons
  - Emergency switching off buttons shall be clearly recognizable, visible and easily approachable.
  - The function of the emergency switching off buttons shall be checked.
- Provision of alternative escape routes
  - Provision of alternative escape routes shall be described and prepared for everyone working or operating on a wind farm if this is included in the design documentation.
- Provision for emergency stay on an offshore wind turbine for one week
  - Sufficient resources and provisions for an emergency stay of one week shall be available.
- Offshore-specific safety equipment for an offshore wind turbine
  - The existing of offshore-specific safety equipment shall be checked.

The basis for this inspection is the evaluated design documentation.

The certification body shall verify that the assembled safety facilities are in compliance with the design documentation.

INTERNATIONAL ELECTROTECHNICAL COMMISSION

3, rue de Varembé
PO Box 131
CH-1211 Geneva 20
Switzerland

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

IEC SYSTEM FOR CERTIFICATION TO STANDARDS RELATING TO EQUIPMENT FOR USE IN RENEWABLE ENERGY APPLICATIONS (IECRE SYSTEM)

IECRE Secretariat c/o IEC
3, rue de Varembé
PO Box 131
CH-1211 Geneva 20
Switzerland

Tel: + 41 22 919 02 11
secretariat@iecre.org
www.iecre.org