



IECRE OPERATIONAL DOCUMENT

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

Conformity assessment and certification of Tower by RECB





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1 Introduction and objectives

The objective of this OD is the definition of the evaluation method and procedure used for design basis, design and manufacturing evaluation of wind turbine towers in the frame of type certification. This includes small, onshore and offshore wind turbines. Furthermore this includes towers made of steel, concrete or hybrid (e.g. steel/concrete combination).

For the application in component certification the OD is general adaptive.

This OD covers the primary structure, which means that the lightning protection, earthing as well the tower internals are not part of this OD.

2 Norms and standards

The following referenced documents are normative 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 61400-1, Wind turbines – Part 1: Design requirements

IEC 61400-2, Wind turbines – Part 2: Design requirements for small wind turbines

IEC 61400-3: Wind turbines – Part 3: Design requirements for offshore wind turbines

CDV IEC 61400-6: Wind turbines – Part 6: Tower and foundation design requirements
Required documentation

The following documentation has to be delivered by the applicant. This list may be extended or reduced, depending on the wind turbine concept and complexity of the design.

2.1 Design Basis

- Design Basis documentation

2.2 Design Evaluation

- Design Basis (see above, usually already evaluated)
- General drawings, detailed drawings, bolted connections (if relevant), drawings of the formwork and reinforcement (if relevant), and others. (to be evaluated):

True-to-scale design drawings containing all the necessary information and technical requirements. These include in particular:

- representation of the tower geometry, including a general view ;
 - detailed presentation of the design details (e.g. bolted connections, dampers) ;
 - material specifications (alternatively specified in a separate document);
 - welding seam specifications and acceptance criteria ;
 - prestressing system and prestressing details if applicable ;
 - required execution class and the tolerance details (alternatively specified in a separate document);
 - specifications of the corrosion protection system (alternatively specified in a separate document)
- Design Calculations (to be evaluated)
 - Where applicable:
 - Approvals
 - Pretension procedures

- Specifications
- Test results
- Manufacturing Specification (for Manufacturing Processes) (to be evaluated)
- Foundation Interface Specification (to be evaluated) including:
 - design relevant loads at top of foundation,
 - dynamic and static stiffness,
 - mechanical interface,
 - horizontal stiffness (if relevant e.g. pile foundation),
 - mass of foundation, damping (if relevant e.g. offshore)
- Load report (usually already evaluated) (for consideration)
- drawings of machinery components which influence the evaluation of the top flange (for information)
- if already approved components are used (e.g. Stress-transfer functions of top flange), evaluation report is required

2.3 Manufacturing Evaluation

The following documentation shall be provided:

- General description
- Material certificates
- Drawings and work instructions
- Purchase specifications
- Acceptance criteria
- Personal qualification
- Calibration certificates
- Product specific documentation
- QM documents for the manufacturing process

3 Evaluation method and procedure

3.1 Design Basis Evaluation

The design basis shall determine all boundary conditions for the design and design evaluation and shall be assessed by a certification body for compliance with:

- Codes and standards including manufacturing requirements;
- Normal and extreme environmental conditions;
- Design parameters, assumptions, methodologies and principles;
- Other requirements, e.g. for manufacture, transportation, installation and commissioning as well as for operation and maintenance.

3.2 Design Evaluation

Verification of tower design is based on turbine specific design loads or non-turbine specific design loads for component certification. Recognized standards are given in section 2. Deviations from these standards or application of other standards shall be addressed in the design basis. A comparable safety level shall be reached.

The wind turbine tower shall be subjected to different types of verifications as per IEC 61400-6. The tower strength calculations provided by the designer shall be evaluated by the certification body through documentation review supported by the results from certification body's independent strength calculations in regard to:

- Ultimate Limit State ;
- Fatigue Limit State ;
- Serviceability Limit State.

Therefore the following input interfaces from other sections are defined as:

- Load report (usually already evaluated);
- Tower top: assembly drawings (e.g. yaw bearing, brake disc)

and the following output interface to other sections have to be checked:

- Foundation: foundation specification (e.g. foundation type, valid stiffness requirements)
- Tower internals: allowed detail category, weight assumptions
The certification body shall perform all verifications by independent comparing calculations based on submitted drawings and specifications.

The analyses shall be performed at the different parts of the tower: tower shell, bolted connections (when applicable), openings, interface between tower and foundation, interface between tower and nacelle and any other structural part.

The eigenfrequencies shall be calculated and compared to the allowable range stated in the load report. For special tower constructions additional influences need to be taken into consideration, e.g. lattice towers, the torsional eigenfrequency or e.g. concrete hybrid towers the E-Modulus of concrete. Furthermore the assumed structural damping has to be checked.

Prestressing manuals (for prestressing tendons if relevant), Prestressing forces and corresponding torque moments, for installation and maintenance have to be evaluated by the certification body. Followed up by comparing the results with values in the installation and maintenance manuals.

The design corresponding drawings shall be checked for compliance with the design assumptions and with respect to strength and stability.

The work instructions and manuals (e.g. for bolted connections) shall be evaluated, if this is not part of the other manuals.

3.3 Manufacturing evaluation

The purpose of manufacturing evaluation is to assess if the tower is manufactured in conformity with the design documentation verified during the design evaluation and if the production procedure is suitable to maintain the intended quality in practice.

This evaluation will include the following elements:

- Quality system evaluation,
- Manufacturing inspection.

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

The requirement for evaluation of the quality system is satisfied if the quality system is certified in conformance with ISO 9001. This system certification shall be carried out by an accredited body that operates according to ISO/IEC 17021.

In case of type certification, the manufacturer (sub supplier) do not need an ISO 9001 certificate and it is not needed to evaluate the quality system. The applicant needs to maintain an ISO 9001 certificate and to track the manufacturing (sub suppliers) process.

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 / qualification of personnel
- product identification and traceability.

The manufacturing procedure shall be documented in suitable specifications and work instructions. The documentation shall be assessed for suitability for the production of the tower under consideration.

It shall be ensured that the requirements identified during the design evaluation with regard to critical components (e.g. post weld treatment, components which need to be normalized like door frame) and 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 inspection shall comprise:

- verification that design specification are properly documented in workshop;
- workshop instructions and purchase specifications;
- evaluation of manufacturer's workshop;
- verification of fabrication methods, procedures and qualification of personnel;
- review of material certificates;
- random checks on the effectiveness of acceptance procedures for purchased components, and
- random checks of fabrication processes.

4 Reporting

4.1 Design Evaluation

The following items shall be part of the evaluation report:

1. Documents
 - a. Evaluated docs
 - b. Noted docs
2. Applied standards
3. Technical description
 - a. Geometry
 - b. Eigenfrequencies incl. required stiffness

- c. Detailed Interfaces and limits of the scope (e.g. approved top flange incl./excl bolts)
 - d. Design loads incl. scope of application (if different from load report)
 - e. Used materials
 - f. applied damper (e.g. connection to tower, relevant masses) if relevant
4. Evaluation
- a. Methodology
 - b. Evaluation remarks
 - c. Evaluation results
 - Incl. Conditions of validity, deviations, interfaces, requirements
 - Requirements on notch details for internals (if not on drawings)
 - min. required distance for weldings (e.g. bushings for internals) in areas of openings (if not on drawings)
 - Work instructions for bolted connections (if not included in manuals)

4.2 Manufacturing Evaluation

The following items shall be part of the evaluation report:

1. Scope of review
2. Documents
 - 2.1 Submitted Documents
 - 2.1.1 Certificates
 - 2.1.2 Drawings
 - 2.1.3 Working instructions
 - 2.1.4 Specifications
 - 2.1.5 If applicable measurements after findings of inspection with all related documents
 - 2.2 Related Design Evaluation reports/SoCs
3. Applied standards
4. Critical components (e.g. post weld treatment, components which need to be normalized like door frame) and critical manufacturing processes
5. Evaluation results
6. Conclusion

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