



# 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 Main Electrical Components 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 main electrical components in the frame of type certification.

OD-501 Clause 7.3.7 specifies the main electrical components 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 rings and
- lightning protection

This OD covers the main electrical components comprising generator, power converter, transformer and switchgear only. Other electrical components and systems are not part of this OD. Corresponding technical requirements are outlined in the applicable part of series IEC 61400.

For novel turbine designs, additional components may be identified as a main electrical component depending on technology or system used, and be subjected to detailed review by the Certification Body. Such requirements would be determined as part of the Design Basis Evaluation.

This OD is applicable to onshore and offshore wind turbines. For the application in component certification the OD is general adaptive.

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

## 3 Required documentation

### 3.1 Design Basis

The design basis documentation shall clearly identify all requirements, assumptions, and methodologies that are essential for the main electrical component design and the design documentation, including:

- codes and standards,
- design requirements and relevant external conditions,
- general turbine description,
- component requirements,
- electrical system overview, and
- any other requirements, e.g. for manufacture, transportation, installation and commissioning, and operation as maintenance.

### 3.2 Design Evaluation

The design documentation related to main electrical components shall comprise as applicable:

- design basis (according to 3.1),
- functional descriptions,
- technical data of each component, including data sheets and declarations of conformity,
- schematics,
- drawings and part lists,
- design calculations, and
- test reports (according to 4.2).

The Certification Body may require additional documentation for the electrical components for the type certification of the wind turbine system. Such additional documentation would be determined in the Design Basis Evaluation.

Specific standards that are relevant for design and testing of the main electrical components are listed below:

Generator: IEC 60034

Power converter: IEC 62477-1 or IEC 61800-4 if  $U_r > 1\text{kV a.c.}$ )

Power Transformers ( $S_r > 100\text{ kVA}$ ): IEC 60076

Switchgear (high-voltage): IEC 62271

### 3.3 Manufacturing Evaluation

The following documentation shall be provided as appropriate and preferably in advance for the main components subjected to manufacturing inspection according to OD 501:

- general process description,
- material certificates,
- manufacturing specifications,
- manufacturing process plan or equivalent
- drawings and work instructions,
- purchase specifications,
- quality manual for the manufacturing process,
- quality control procedures and acceptance criteria,
- type/prototype tests, inspection and test plan and associated test equipment and calibration certificates, and
- personnel qualifications

## 4 Evaluation method and procedure

### 4.1 Design Basis Evaluation

The purpose of the Design Basis Evaluation is to examine whether the main electrical components' design basis is properly documented and sufficient for safe design and operation of the wind turbine type. The design assumptions, boundary conditions, but also general component qualification procedures shall be verified herein. Such verification may be carried out through reference to the applicable standards in the IEC 61400 series and other applicable codes and standards. These standards, as defined during the Design Basis Evaluation, form the basis of the design requirements to be evaluated as part of the Design Evaluation later on.

## 4.2 Design Evaluation

The purpose of the design evaluation is to examine whether the main electrical components are designed and documented in conformity with the design basis, i.e. the applicable codes and standards. There are two stages of the evaluation of main electrical components:

- A. Design documentation evaluation, including technical data and type testing results for compliance with normative references and design criteria identified in the Design Basis Evaluation, and
- B. General electrical and functional safety evaluation of the wind turbine electrical system, which is not covered by this OD.

The Certification Body shall evaluate the main electrical components' design documentation as defined and outlined in the Design Basis Evaluation. The scope for some selected main components is outlined below. The evaluation of other electrical main components should follow a similar scope.

### 4.2.1 Generator:

Generator documentation shall be subject to evaluation regarding:

- heat-run test results (converter operated, if applicable),
- other type/prototype test results,
- vibration test results as applicable,
- routine test plan,
- bearing rating life calculation (ISO 281),
- cooling system,
- cable connection and interfaces,
- installation and environment,
- protection and earthing and

Direct drive generators shall be documented according to an agreed design basis as IEC 60034 does not account for the special issues related to direct drives systems.

### 4.2.2 Converter:

Converter assemblies shall be subject to a detailed review. Test documentation and corresponding results are in main focus. This includes:

- EMC according to IEC 61800-3 or equivalent,
- IEC type and routine tests such as protective bonding impedance test, impulse withstand voltage test, touch current measurement, thermal performance test, etc.,
- insulation design (including environmental categories according to IEC 60721, overvoltage categories, clearance and creepage distance, etc.).

### 4.2.3 Switchgear:

The switchgear arrangement for the main power line between generator and grid and its ratings shall be compared with assumptions made in the design basis. For high-voltage switchgear internal faults testing, pressure relief measures and their possible influence on the installation environment shall be checked in addition.

### 4.2.4 Transformer:

Main power line transformer installation environment and heating caused by maximum operational currents shall be verified. Scope of evaluation includes:

- type and routine tests,
- vibration test,
- environmental testing,
- cooling system,

- installation and earthing and
- protection and monitoring equipment

### 4.3 Manufacturing evaluation

The purpose of manufacturing evaluation is to assess if the main electrical components subjected to manufacturing inspection according to OD 501 are 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 of main electrical components.

The manufacturing evaluation presupposes that the manufacturer of the respective electrical main component 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 planning and control,
- resources (infrastructure, environment for the operation of process)
- inspection and testing,
- corrective measures,
- quality recordings,
- training / qualification of personnel,
- product identification and traceability.

The manufacturing procedure shall be documented in suitable work instructions and process descriptions. The documentation shall be assessed for suitability for the production of the main electrical components under consideration.

It shall be ensured that the requirements identified during the design evaluation with regard to critical components (e.g. insulation) 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,

- random checks on the effectiveness of acceptance procedures for purchased components, and
- random checks of fabrication processes.

## **5 Reporting**

The report structure in this section is an example. The content/extent of the report shall be in line with the below.

### **5.1 Design Basis Evaluation**

1. Documents
  - Evaluated documents,
  - Noted documents.
2. Standards to apply
3. Technical outline of electrical system
4. Component requirements
5. Evaluation results, incl. conditions of validity, deviations, interfaces, requirements

### **5.2 Design Evaluation**

The following items shall be part of the evaluation report of the CB:

1. Documents
  - Evaluated documentation,
  - Noted documentation.
2. Applied standards
3. Technical description of electrical system
  - Detailed Interfaces and limits of the scope,
  - Technical data,
  - Evaluation remarks,
  - Evaluation results, incl. conditions of validity, deviations, interfaces, requirements.

### **5.3 Manufacturing Evaluation**

The following items shall be part of the evaluation report of the CB:

1. Scope of review
2. Documentations
  - Certificates,
  - Drawings,
  - Working instructions,
  - Specifications,
  - Related Design Evaluation reports/SoCs.
3. Applied standards
4. Critical components and critical manufacturing processes
5. Evaluation results
6. Conclusion

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