Type and component certification of wind turbines according to IEC 61400-22
FOREWORD

DNV GL service specifications contain procedural requirements for obtaining and retaining certificates and other conformity statements to the objects, personnel, organisations and/or operations in question.

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Any comments may be sent by e-mail to rules@dnvgl.com

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Changes – Current

This service specification supersedes and replaces the December 2014 edition of DNVGL-SE-0074. Changes in this document are highlighted in red colour. However, if the changes involve a whole chapter, section or sub-section, normally only the title will be in red colour.

Changes January 2018

Table Detailed list of changes

<table>
<thead>
<tr>
<th>Reference</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>[1.1.1]</td>
<td>Deviating certifications to IEC 61400-22 will not be covered in this document. Text deleted.</td>
</tr>
<tr>
<td>[1.3]</td>
<td>Update related to IECRE clarification sheets and operational documents.</td>
</tr>
<tr>
<td>[2.1.2]</td>
<td>General update removing old no longer applied certification schemes and including IECRE information.</td>
</tr>
<tr>
<td>[2.1.3]</td>
<td>Updates as all deliverables will now be DNV GL documents.</td>
</tr>
<tr>
<td>[2.1.3]</td>
<td>Updated to add relation to IECRE.</td>
</tr>
<tr>
<td>[2.1.4] and [2.1.5]</td>
<td>New sections describing additional relevant DNV GL services.</td>
</tr>
<tr>
<td>[2.2.1]</td>
<td>Updated to add relation to IECRE.</td>
</tr>
<tr>
<td>[2.2.2]</td>
<td>The provisional IEC WT01 and special level will no longer be deliverables and are therefore deleted.</td>
</tr>
<tr>
<td>[2.2.3]</td>
<td>Updated due to restructure of sections dealing with validity, maintenance and use of type/component certificates.</td>
</tr>
<tr>
<td>[3.1.1]</td>
<td>Updated to include relation to IECRE while keeping the option of DNV GL certificates based on IEC 61400-22.</td>
</tr>
<tr>
<td>[3.2.1], [3.3.3] and [3.3.9]</td>
<td>Update to include relation to IECRE and to introduce the possible use of DNV GL standards.</td>
</tr>
<tr>
<td>[3.2.1] and [3.3.12]</td>
<td>Included reference to EN 50308.</td>
</tr>
<tr>
<td>[3.3.4]</td>
<td>Deleted guidance note and align reporting requirements to IECRE OD 501-4.</td>
</tr>
<tr>
<td>[3.3.5]</td>
<td>Updated to include DNVGL-ST-0376 and redundant text deleted.</td>
</tr>
<tr>
<td>[3.3.8]</td>
<td>Updated to include DNVGL-ST-0076 and text modified to align with the other parts of [3.3].</td>
</tr>
<tr>
<td>[3.3.12]</td>
<td>Updated to include tower internals.</td>
</tr>
<tr>
<td>[3.3.13]</td>
<td>New section for service lifts and hoisting devices. Includes also guidance note moved from subsection [4.2].</td>
</tr>
<tr>
<td>[3.4]</td>
<td>Aligned with IECRE OD 501 and the whole section is generally simplified.</td>
</tr>
<tr>
<td>[3.6.2]</td>
<td>Witnessing of commissioning tests has been deleted.</td>
</tr>
<tr>
<td>Reference</td>
<td>Description</td>
</tr>
<tr>
<td>-----------</td>
<td>-------------</td>
</tr>
<tr>
<td>[3.8]</td>
<td>Change IEC CBC clarification sheet to IECRE. Remove requirement for publishing front page of certificate.</td>
</tr>
<tr>
<td>Sec.5</td>
<td>Previous [3.9] moved and merged to Sec.5. Major update to simplify language and align to revised clarification sheet.</td>
</tr>
<tr>
<td>Sec.4</td>
<td>Changed title to <em>Certification of rotor-nacelle assembly</em> as the special level is no longer included. The section is restructured and type certificate rotor-nacelle assembly (RNA) is introduced.</td>
</tr>
<tr>
<td>[4.2]</td>
<td>Bullet list has been modified. Second guidance note is moved to [3.3.13] and reference has been replaced by DNVGL-ST-0378.</td>
</tr>
<tr>
<td>Sec.5</td>
<td>The section is rewritten/restructured and does now include all relevant information for the certificate holder.</td>
</tr>
<tr>
<td>App.A</td>
<td>is reworked to reflect DNV GL accreditation status as well as now available DNV GL certification mark and DNV GL certificate/statement template. IECRE is also added.</td>
</tr>
<tr>
<td>Previous App.B</td>
<td>Has been deleted.</td>
</tr>
</tbody>
</table>

**Editorial corrections**

In addition to the above stated changes, editorial corrections may have been made.
Appendix A Accreditations, certification marks and sample certificate............... 39
A.1 Accreditation and recognitions............................................................... 39
A.2 Certification marks............................................................................... 39
A.3 Sample certificate and conformity statement...................................... 39

Changes – historic.......................................................................................... 42
SECTION 1  GENERAL

1.1 Introduction

1.1.1 Objective
This service specification describes the DNV GL interpretation of IEC 61400-22 and includes also additional information required for type and component certification according to IEC 61400-22 as elaborated and modified by IECRE operational documents and clarification sheets.

1.2 Scope
This specification applies to type certification of wind turbines and rotor-nacelle assembly (RNA) as well as for component certification of e.g. parts, components, systems or sub-assemblies - referred to in this specification as type certification or component certification.

1.3 Application
This DNV GL service specification details the services for type and component certification of wind turbines according to IEC 61400-22 as elaborated and modified by IECRE operational documents and clarification sheets. It serves for onshore as well as offshore wind energy applications.

The document provides:
— a common platform for describing the scope and extent of verification activities for type certification of wind turbines as well as for component certification of components or systems used in wind turbines
— a reference document for defining the scope of work in accordance with requirements of the applicable certification scheme.

This service specification refers to specifications in IEC 61400-22 as elaborated and modified by IECRE operational documents and clarification sheets and should be read together with IEC 61400-22 and the relevant IECRE documents in order to obtain a full overview of the services described in this document.

1.4 Definitions

1.4.1 Definition of verbal forms

<table>
<thead>
<tr>
<th>Verbal forms</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>shall</td>
<td>verbal form used to indicate requirements strictly to be followed in order to conform to the document</td>
</tr>
<tr>
<td>should</td>
<td>verbal form used to indicate that among several possibilities one is recommended as particularly suitable, without mentioning or excluding others, or that a certain course of action is preferred but not necessarily required</td>
</tr>
<tr>
<td>may</td>
<td>verbal form used to indicate a course of action permissible within the limits of the document</td>
</tr>
</tbody>
</table>
### 1.4.2 Definition of terms

**Table 1-2 Definitions of terms**

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
</table>
| **certification**         | action by a certifying body, providing written assurance that adequate confidence is provided that the subject of the certification, i.e. the wind turbine, is demonstrably in conformity with a specific standard or other normative document  
  The term designates all the activities associated with the process leading to the issue of a certificate. The scope of work is defined by the certifying body or by a regulatory body. |
| **certification scheme**  | sequence of phases or modules to be completed prior to the issue of a certificate                                                                                                                                 |
| **component certificate** | certificate issued by a certifying body, here DNV GL, when it has been demonstrated that a product type in question, here a wind turbine part, component, system or sub-assembly, complies with the applicable regulations  
  The component certificate will allow the customer to manufacture certified wind turbine components or systems during the period of validity of the certificate. |
| **component certification** | certification of specific wind turbine components such as rotor blade, generator, gearbox, brake, coupling main bearing, nacelle frame or tower, wind turbine systems such as pitch system, yaw system, fire protection or condition monitoring systems as well as parts such as bolts and tower internals  
  Component certification covers relevant modules of type certification with the extent depending on the component/system in question. |
| **conformity statement**  | IEC term for statement of compliance                                                                                                                                                                      |
| **customer**              | DNV GL’s contractual partner, usually the certificate applicant                                                                                                                                              |
| **final evaluation report** | final report, issued as reference document for the type or component certificate, and providing documentation of the evaluation of the elements and modules in the type or component certification  
  The report includes a reference list of all supporting product documentation, an evaluation of whether the detailed documentation is complete and all relevant requirements are confirmed by type test results, and a review of the final product documentation. |
| **foundation**            | the structure that transfers the loads from the tower to the ground                                                                                                                                            |
| **manufacturer**          | the manufacturer of the wind turbine or of any wind turbine component or system in question                                                                                                                                 |
| **provisional type certificate** | a type certificate (class B) with some outstanding matters without safety implications and with limited period of validity, maximum one year                                                                 |
| **recommendation**        | non-mandatory advice                                                                                                                                                                                        |
| **statement of compliance** | statement signed by a qualified party affirming that, at the time of assessment, a product or a service meets specified requirements  
  The IEC term is conformity statement. |
### Term and Definition

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
</table>
| type certificate          | certificate issued by a certifying body, here DNV GL, when it has been demonstrated that a product type in question, here a wind turbine or rotor-nacelle assembly type, complies with the applicable regulations  
The type certificate will allow the customer to manufacture certified wind turbines or RNA during the period of validity of the certificate. |
| verification              | confirmation, through the provision of objective evidence, that specified requirements have been fulfilled (ISO 9000)  
For certification/assessment according to this service specification, this implies an evaluation or assessment to confirm that an activity, a product or a service is in accordance with specified requirements. Upon confirmation according to an agreed scope of work for the verification service, DNV GL will issue a statement of compliance, which in IEC terminology is referred to as a conformity statement. |
| wind energy generation systems | IEC term recently established for wind turbines and wind farms (for definition see wind turbine)                                                                                                                                                  |
| wind turbine              | System which converts kinetic wind energy into electrical energy  
Whenever, in this service specification the term is used to describe the wind turbine in general, it describes the rotor-nacelle assembly including the tower (optionally also the foundation), as this is the power generating unit. |

### 1.4.3 Abbreviations and symbols

Abbreviations and symbols used in this service specification.

#### Table 1-3 Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AM</td>
<td>additive manufacturing</td>
</tr>
<tr>
<td>BEK</td>
<td>bekendtgørelse (executive order, in Danish)</td>
</tr>
<tr>
<td>CSH</td>
<td>clarification sheet</td>
</tr>
<tr>
<td>DAKkS</td>
<td>Deutsche Akkreditierungsstelle GmbH (the German accreditation body)</td>
</tr>
<tr>
<td>EMC</td>
<td>electromagnetic compatibility</td>
</tr>
<tr>
<td>EN</td>
<td>European Norm</td>
</tr>
<tr>
<td>FRT</td>
<td>fault ride-through</td>
</tr>
<tr>
<td>IEC</td>
<td>International Electrotechnical Commission</td>
</tr>
<tr>
<td>IECRE</td>
<td>IEC Renewable Energy certification system: IEC System for Certification to Standards Relating to Equipment for Use in Renewable Energy Applications</td>
</tr>
<tr>
<td>ISO</td>
<td>International Organization for Standardization</td>
</tr>
<tr>
<td>OD</td>
<td>operational document</td>
</tr>
<tr>
<td>RECB</td>
<td>renewable energy certification body</td>
</tr>
<tr>
<td>RNA</td>
<td>rotor-nacelle assembly</td>
</tr>
</tbody>
</table>
### Abbreviation

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>TS</td>
<td>technical specification</td>
</tr>
</tbody>
</table>

### 1.5 References

#### 1.5.1 General

This document refers to relevant DNV GL service specifications, standards and recommended practices and to international codes and standards and other international publications. Unless otherwise specified in the certification agreement, design basis or in this service specification, the latest valid revision of each referenced document applies.

#### 1.5.2 DNV GL documents

The following DNV GL documents are referenced in this service specification:

**Table 1-4 DNV GL documents**

<table>
<thead>
<tr>
<th>Document code</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>DNVGL-CG-0197</td>
<td>Additive manufacturing - qualification and certification process for materials and components</td>
</tr>
<tr>
<td>DNVGL-RP-0175</td>
<td>Icing of wind turbines</td>
</tr>
<tr>
<td>DNVGL-RP-0363</td>
<td>Extreme temperature conditions for wind turbines</td>
</tr>
<tr>
<td>DNVGL-RP-0440</td>
<td>Electromagnetic Compatibility (EMC) of wind turbines</td>
</tr>
<tr>
<td>DNVGL-RP-A203</td>
<td>Technology qualification</td>
</tr>
<tr>
<td>DNVGL-SE-0073</td>
<td>Project certification of wind farm according to IEC 61400-22</td>
</tr>
<tr>
<td>DNVGL-SE-0077</td>
<td>Certification of fire protection systems for wind turbines</td>
</tr>
<tr>
<td>DNVGL-SE-0124</td>
<td>Certification of grid code compliance</td>
</tr>
<tr>
<td>DNVGL-SE-0190</td>
<td>Project certification of wind power plants</td>
</tr>
<tr>
<td>DNVGL-SE-0263</td>
<td>Certification of life extension of wind turbines</td>
</tr>
<tr>
<td>DNVGL-SE-0436</td>
<td>Shop approval in renewable energy</td>
</tr>
<tr>
<td>DNVGL-SE-0439</td>
<td>Certification of condition monitoring</td>
</tr>
<tr>
<td>DNVGL-SE-0441</td>
<td>Type and component certification of wind turbines</td>
</tr>
<tr>
<td>DNVGL-SE-0448</td>
<td>Certification of service and maintenance activities in the wind energy industry</td>
</tr>
<tr>
<td>DNVGL-ST-0076</td>
<td>Design of electrical installations for wind turbines</td>
</tr>
<tr>
<td>DNVGL-ST-0126</td>
<td>Support structures for wind turbines</td>
</tr>
<tr>
<td>DNVGL-ST-0262</td>
<td>Lifetime extension of wind turbines</td>
</tr>
<tr>
<td>DNVGL-ST-0361</td>
<td>Machinery for wind turbines</td>
</tr>
<tr>
<td>DNVGL-ST-0376</td>
<td>Rotor blades for wind turbines</td>
</tr>
<tr>
<td>DNVGL-ST-0378</td>
<td>Standard for offshore and platform lifting appliances</td>
</tr>
</tbody>
</table>
The recommended practices may be applied optionally and in supplement as a basis for the type and component certification of wind turbines.

### 1.5.3 External documents

The following international standards and other relevant publications are referenced in this service specification:

**Table 1-5 External documents**

<table>
<thead>
<tr>
<th>Document code</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>EN 50308</td>
<td>Wind Turbines – Protective Measures – Requirements for Design, Operation and Maintenance</td>
</tr>
<tr>
<td>IEC 61400-1</td>
<td>Wind turbines - Part 1: Design requirements for wind turbines</td>
</tr>
<tr>
<td>IEC 61400-2</td>
<td>Wind turbines - Part 2: Design requirements for small wind turbines</td>
</tr>
<tr>
<td>IEC 61400-3</td>
<td>Wind turbines - Part 3: Design requirements for offshore wind turbines</td>
</tr>
<tr>
<td>IEC 61400-4</td>
<td>Wind turbines - Part 4: Design requirements for wind turbine gearboxes</td>
</tr>
<tr>
<td>IEC 61400-11</td>
<td>Wind turbines - Part 11: Acoustic noise measurements techniques</td>
</tr>
<tr>
<td>IEC 61400-12-1</td>
<td>Wind turbines - Part 12-1: Power performance measurements of electricity producing wind turbines</td>
</tr>
<tr>
<td>IEC 61400-12-2</td>
<td>Wind turbines - Part 12-2: Power performance measurements of electricity producing wind turbines based on nacelle anemometry</td>
</tr>
<tr>
<td>IEC 61400-13</td>
<td>Wind turbines - Part 13: Measurement of mechanical loads</td>
</tr>
<tr>
<td>IEC 61400-14</td>
<td>Wind turbines - Part 14: Declaration of apparent sound power level and tonality values</td>
</tr>
<tr>
<td>IEC 61400-21</td>
<td>Wind turbines - Part 21: Measurement and assessment of power quality characteristics of grid connected wind turbines</td>
</tr>
<tr>
<td>IEC 61400-22</td>
<td>Wind turbines - Part 22: Conformity testing and certification of wind turbines</td>
</tr>
<tr>
<td>IEC 61400-23</td>
<td>Wind turbines - Part 23: Full-scale structural testing of rotor blades</td>
</tr>
<tr>
<td>IEC 61400-24</td>
<td>Wind turbines - Part 24: Lightning protection</td>
</tr>
<tr>
<td>IEC 61400-25-1</td>
<td>Wind turbines - Part 25-1: Communications for monitoring and control of wind power plants - Overall description of principles and models</td>
</tr>
<tr>
<td>IEC 61400-25-2</td>
<td>Wind turbines - Part 25-2: Communications for monitoring and control of wind power plants - Information models</td>
</tr>
<tr>
<td>Document code</td>
<td>Title</td>
</tr>
<tr>
<td>---------------</td>
<td>----------------------------------------------------------------------</td>
</tr>
<tr>
<td>IEC 61400-25-3</td>
<td>Wind turbines - Part 25-3: Communications for monitoring and control of wind power plants - Information exchange models</td>
</tr>
<tr>
<td>IEC 61400-25-4</td>
<td>Wind turbines - Part 25-4: Communications for monitoring and control of wind power plants - Mapping to communication profile</td>
</tr>
<tr>
<td>IEC 61400-25-5</td>
<td>Wind turbines - Part 25-5: Communications for monitoring and control of wind power plants – Conformance testing</td>
</tr>
<tr>
<td>IEC 61400-25-6</td>
<td>Wind turbines - Part 25-6: Communications for monitoring and control of wind power plants – Logical node classes and data classes for condition monitoring</td>
</tr>
<tr>
<td>IEC TS 61400-26-1</td>
<td>Wind turbines - Part 26-1: Time-based availability for wind turbine generating systems</td>
</tr>
<tr>
<td>IEC TS 61400-26-2</td>
<td>Wind turbines - Part 26-2: Production-based availability for wind turbines</td>
</tr>
<tr>
<td>IEC TS 61400-26-3</td>
<td>Wind turbines - Part 26-3: Availability for wind power stations</td>
</tr>
<tr>
<td>IEC 61400-27-1</td>
<td>Wind turbines - Part 27-1: Electrical simulation models - Wind turbines</td>
</tr>
<tr>
<td>IECRE</td>
<td>Operational documents, clarification sheets and decisions as published on <a href="http://www.iecre.org">www.iecre.org</a></td>
</tr>
<tr>
<td>ISO 9001</td>
<td>Quality Management Systems - requirements</td>
</tr>
<tr>
<td>ISO/IEC 17020</td>
<td>General Criteria for the Operation of Various Types of Bodies Performing Inspection</td>
</tr>
<tr>
<td>ISO/IEC 17025</td>
<td>Competence of Testing and Calibration Laboratories</td>
</tr>
<tr>
<td>ISO/IEC 17065</td>
<td>Conformity assessment - Requirements for bodies certifying products, processes and services</td>
</tr>
</tbody>
</table>
SECTION 2 SERVICE OVERVIEW

2.1 General

2.1.1 Objective
The objective of this section is to provide an overview of the verification activities relating to type and component certification of wind turbines.

2.1.2 Certification scheme
This service specification covers type and component certification according to IEC 61400-22 (identical to EN 61400-22) as elaborated and modified by IECRE operational documents and clarification sheets.

The requirements of the certification scheme in IEC 61400-22 are transferred to the IECRE operational document OD 501. The IECRE OD 501 (IEC 61400-22) is supplemented by further detailed IECRE operational documents IECRE OD 501-1 to IECRE OD 501-5 covering certification of rotor blades, gearboxes, towers, loads as well as control and protection systems.

Further IECRE operational documents are being developed covering electrical components, personnel safety and components in general.

Details of the type certification schemes based on IEC 61400-22 as elaborated and modified by IECRE operational documents and clarification sheets are given in Sec.3 and Sec.4.

In addition, there are national certification schemes using IEC 61400-22 as basis like in Denmark. The Danish scheme is defined in Executive Order BEK no. 73; 2013 Bekendtgørelse om teknisk certificeringsordning for vindmøller.

For small wind turbines according the definition in IEC 61400-2, a reduced scope relative to this service specification may be applied. The exact scope depends on the design of the small wind turbine and should be agreed with DNV GL before the start of the certification activities.

2.1.3 Old certification schemes
Type and component certification according to IEC 61400-22/IEC WT 01 issued based on DNV-DSS-904 or based on GL Renewables Certification (GL RC) procedures are all subject to maintenance according to IEC 61400-22, see also [2.2.4] and [3.9].

Type and component certificates as well as conformity statements will remain valid according to limitations stated on the certificate/statement and related contractual documents.

Modifications as well as new components/systems introduced during the validity period of the certificate/statement will be evaluated according to the selected certification scheme and as described in this service specification.

There may be further limitations related to IECRE certification which are governed by IECRE decisions, clarification sheets and other IECRE regulations such as transition rules. Such limitations may in some cases prevent DNV GL to issue an IECRE certificate although a DNV GL certificate referencing this service specification may be issued.

2.1.4 Optional type and component certification services

2.1.4.1 General
DNV GL offers several optional certification services relevant for wind turbine type and component certification.
2.1.4.2 Altitude, icing and extreme temperature conditions
For site conditions including altitude outside the standard site conditions as defined in IEC 61400-1, there shall be additional considerations for design and operation of wind turbines.
DNVGL-RP-0175 covers wind turbines subject to icing climate and provides recommendations related to external conditions including design requirements for load assessment and control and protection system.
DNVGL-RP-0363 covers the main aspects influenced by extreme temperatures including air density, material properties and lubrication. It may be used to extend the normal temperature range of a component or wind turbine to very low and/or very high temperatures.

2.1.4.3 Condition monitoring systems
The certification of condition monitoring systems may be included in the type or component certification or it may be delivered as an independent service. The DNV GL certification service is described in DNVGL-SE-0439.

2.1.4.4 Fire protection systems
The certification of fire protection systems may be included as part of the type certification for a wind turbine or it may be offered as an independent service, i.e. certification of the fire protection system. The service is described in detail in DNVGL-SE-0077.

2.1.4.5 Electromagnetic compatibility
The wind turbine control and protection system shall in general be immune against the electromagnetic emission levels within the wind turbine, see also DNVGL-ST-0438.
The certification of electromagnetic compatibility (EMC), i.e. immunity and emission may be included in the type certification of a wind turbine or delivered as a separate certification service. The DNVGL-RP-0440 may be used as reference.

2.1.4.6 Grid code compliance
The certification of grid code compliance for a wind turbine shall be based on measurements of electrical characteristics including fault ride-through (FRT) as well as verification of the wind turbine model for use in grid simulations by validation against test results. The outcome shall be a type certificate for the wind turbine or an additional component or equipment certificate.
The DNV GL service for grid code compliance certification is delivered independently of the wind turbine type or component certification as described in this service specification. Further information about grid code compliance (GCC) is given in DNVGL-SE-0124.

2.1.4.7 Additive manufacturing
Additive manufacturing (AM) technologies as an alternative method to produce materials, parts or components that are subjected to verification may be introduced by class guideline DNVGL-CG-0197 which provides a qualification and certification process for materials and components.

Guidance note:
AM is a term used to cover a broad range of new and emerging manufacturing processes (also known as 3D printing) that involve sequential-layer material addition throughout a 3D work envelope under automated control.

---e-n-d---o-f---g-u-i-d-a-n-c-e---n-o-t-e---

This certification may be relevant to:
— all stakeholders who want to adopt additive manufacturing technologies;
— manufacturers and sub-suppliers to seek and obtain approval of pre-materials, materials and components made by additive manufacturing;
— service suppliers to seek and obtain approval for their AM related services;
— end-users to specify part-building requirements to give purchasers and suppliers a common set of parameters with which to work.
2.1.4.8 Laboratory approvals
The DNV GL laboratory approval is providing third party verification of a laboratory and/or single testing procedure. It may be applied for testing of materials, components and single test procedures. Desired target is time and cost reduction during the certification process. The service is described in GL-II-2:2006 and DNVGL-SE-0436 may be applied.

2.1.4.9 Shop approvals
The DNV GL shop approval is providing third party verification of a workshop and/or single fabrication procedure. It may be applied for manufacturing of components, repair procedures and single manufacturing procedures. Desired target is time and cost reduction during the certification process. The service is described in DNVGL-SE-0436.

2.1.5 Other optional services

2.1.5.1 General
This service specification focuses on certification of the wind turbine and its components, however, DNV GL also offers project specific services as part of a project certification. These are described in DNVGL-SE-0190 or DNVGL-SE-0073. The DNVGL-SE-0441 type and component certification scheme does also include a site specific type certificate which is tailored to suite project certification.
Also in the early phase, even before prototype certification, DNV GL may carry out conceptual certification based on DNVGL-SE-0441 type or component certification scheme. This service will utilize technology qualification methods and it is concluded by a statement of feasibility together with a certification plan.
DNV GL also offers separate certification services relevant to the operation and maintenance of the wind turbine as described in the following sections.

2.1.5.2 Lifetime extension
Wind turbines are designed for a finite service life. Usually a design lifetime of 20, 25 or 30 years is taken as a basis for the design.
If a wind turbine or wind farm shall be operated beyond its design lifetime, the wind turbine shall be assessed regarding its potential for lifetime extension for the specific site conditions.
Different approaches may be taken to provide the necessary verification and shall preferably utilise the existence of a type certificate. Further information is available in DNVGL-SE-0263.
2.1.5.3 Service and maintenance activities
DNV GL provides certification services for service and maintenance activities for the wind energy industry. The service is delivered independently of other services and is described in DNVGL-SE-0448.

2.1.5.4 Training systems
DNV GL provides certification of training system established within the renewable energy sector e.g. covering rescue training programs. The service is described in the GL Technical Note for Certification of Training Programs and Training Systems in the Renewable Energy Industry.

2.1.5.5 Tower internals
DNV GL provides certification services for structurally relevant parts of the tower internals, like platforms, supports for ladders and service lifts and guard rails.

2.2 Type and component certification

2.2.1 Type certification of wind turbines
The DNV GL certification scheme described in this service specification is based on the IEC certification scheme as specified in IEC 61400-22 as elaborated and modified by IECRE operational documents and clarification sheets.

The DNV GL type certification scheme according to IEC 61400-22 consists of five mandatory modules and three optional modules. The five mandatory modules refer to five major tasks during the design, manufacturing and testing of the wind turbine. The three optional modules refer to design and manufacturing of the foundation for the wind turbine and to type characteristics measurements, see Figure 2-2.
The certification modules design basis evaluation and design evaluation cover the steps necessary to achieve final design verification of the wind turbine. This verification includes an evaluation of the design basis and an evaluation of the design itself. The two modules are mandatory, however, although not recommended, the design basis module may be integrated in the design evaluation module. The design evaluation module
does not cover the foundation and may therefore be supplemented by an optional module “foundation design evaluation”, see Figure 2-2.

The certification module manufacturing evaluation is mandatory. The manufacturing evaluation module does not cover the foundation and may therefore be supplemented by an optional module foundation manufacturing evaluation, see Figure 2-2.

The certification module type testing is mandatory. The type testing module may be supplemented by an optional module for type characteristics measurements, see Figure 2-2.

The certification module final evaluation is mandatory.

2.2.2 Component certification

Component certificates may be issued for specific components, such as rotor blades, generators, gearboxes, electrical components, brakes, couplings, nacelle frames, towers, main bearings or systems such as pitch systems, yaw systems, fire protection systems, condition monitoring systems or parts such as bolts and tower internals.

Component certification covers relevant modules of type certification with the extent depending on the component in question, see Figure 2-3. For component certification, it is required that the interface including the design load envelope is clearly defined.

For rotor-nacelle assemblies intended for use in projects with site specific tower and foundation certificates may be issued as a type certificate RNA; see Sec.4.
2.2.3 Deliverables

Upon successful completion of each certification module, a conformity statement together with an evaluation report is issued.

Following the successful completion of all mandatory certification modules in the certification scheme, a DNV GL type/component certificate will be issued for the wind turbine type/component subject to certification. A final evaluation report will be issued to the customer as a reference document for the DNV GL certificate.

The following DNV GL certificates are available:
- type certificate
— component certificate
— provisional type/component certificate
— prototype certificate

In addition to this also IECRE certificates may be issued by DNV GL as an IECRE RECB, however, this is conditioned on compliance with the relevant IECRE requirements.

This service specification should enable both DNV GL certification and IECRE certification. However, IECRE decisions, Rules of Procedures, transition rules as well as new operational documents and clarification sheets may prevent DNV GL from issuing IECRE certificates.

### 2.2.4 Validity of certificate

The certificate refers to conformity statements issued for the completed modules. The type or component certificate is valid for 5 years after date of first issuance, except for the IEC 61400-22 provisional (class B) type certificate whose validity is limited to maximum one year. Moreover, the IEC 61400-22 prototype certificate is usually valid for a period of between 6 months and 3 years; however, 3 years is the maximum period of validity.

The type or component certificate validity is conditioned on the following:

— Annual reporting by the certificate holder
— Reporting by certificate holder of planned major modifications without delay and in sufficient time to allow for evaluation by DNV GL before implementation and to enable update of the certificate
— Periodic inspections by DNV GL during the validity period of the certificate, at least once every 2½ years

Optionally, DNV GL may issue a conformity statement confirming acceptance of the annual reporting by the manufacturer, see also IECRE clarification sheet CBC 14C.

Further details for the maintenance, recertification/renewal and validity of the certificates are given in Sec.5.

### 2.2.5 Outline of type and component certification schemes

The DNV GL type and component certification schemes based on IEC 61400-22 are outlined in Figure 2-4 and Figure 2-5.

![Figure 2-4 Type certification scheme](image-url)
Figure 2-5 Component certification scheme
SECTION 3 DETAILED SERVICE DESCRIPTION

3.1 Introduction

3.1.1 General

This section provides details of DNV GL's verification activities for each of the modules covered by IEC 61400-22 for wind turbines as elaborated and modified by IECRE operational documents and clarification sheets.

The requirements of the certification scheme in IEC 61400-22 are transferred to the IECRE operational document IECRE OD 501. The IECRE OD 501 (IEC 61400-22) is supplemented by further detailed IECRE operational documents:

— IECRE OD 501-1 Conformity assessment and certification of Blade by RECB
— IECRE OD 501-2 Conformity assessment and certification of Gearbox by RECB
— IECRE OD 501-3 Conformity assessment and certification of Tower by RECB
— IECRE OD 501-4 Conformity assessment and certification of Loads by RECB's
— IECRE OD 501-5 Conformity assessment and certification of Control and Protection System by RECB

Further IECRE operational documents are being developed covering electrical components, personnel safety and components in general.

For each verification activity, verification of compliance will be made against standards specified in IEC 61400-22. For verification activities, for which no particular standard is specified in IEC 61400-22 as elaborated and modified by IECRE operational documents and clarification sheets, verification of compliance will be made against standards agreed in the design basis, specifications or guidelines that meet or exceed the intended safety level.

DNV GL standards and recommended practices are available for all relevant technical areas and they are intended to cover the requirements implied when using the certification scheme described in this service specification.

The operational management committee for the wind energy sector IECRE WE-OMC is responsible for the further development of conformity assessment aspects of IEC 61400-22 i.e. transfer, clarifications, amendments and revisions. To accomplish this and to align with all other IEC certification schemes the IEC 61400-22 is split as follows:

— IECRE Basic Rules, Rules of Procedures, Meeting Decisions and Administrative Documents
— IECRE Operational Documents (IECRE OD 501, IECRE OD 501-1, ...)
— IECRE Clarification Sheets

DNV GL will apply relevant parts of these documents which amend, revise or clarify the IEC 61400-22 with the aim to issue an IECRE type or component certificate.

However, there may be further limitations related to IECRE certification such as WE-OMC decisions such as transition rules e.g. related to the validity of test reports and other type of documentation. In some cases, this may prevent DNV GL from issuing an IECRE certificate although a DNV GL certificate according to this services specification is issued.

In any case application of this service specification covers IEC 61400-22 and allows for issuance of component and type certificates by DNV GL based on IEC 61400-22 as well as related national certification schemes after successful verification.
3.2 Design basis evaluation

3.2.1 General

The design basis submitted to DNV GL for evaluation shall identify all requirements, assumptions and methodologies which are essential for the design and for the documentation of the design. Hence, the design basis shall include codes and standards, design parameters, assumptions, methodologies and principles as well as other requirements related to manufacturing, transportation, installation, commissioning and operation and maintenance.

The design basis shall refer to IEC or ISO standards when available for the detail, component or system in question.

DNV GL standards and recommended practices may be applied for the design basis and are available for all relevant technical areas. The DNV GL standards and recommended practices are intended to cover and supplement the requirements implied when using the certification scheme described in this service specification.

For the mandatory certification of personnel safety including tower internals there is no detailed IEC, ISO or DNV GL standard or guideline. Until such standards or guidelines are available, it is recommended to apply EN 50308.

DNV GL will verify that the design basis is properly documented and sufficient for safe design of the wind turbine type according to IEC 61400-22 as elaborated and modified by IECRE operational documents and clarification sheets. DNV GL will thus verify that the selected codes, standards and guidelines together with parameters, assumptions, methods and other requirements are appropriate and in line with the certification requirements.

3.3 Design evaluation

3.3.1 General

The purpose of the design evaluation is to verify that the wind turbine or component design complies with the approved design basis.

The manufacturer shall supply all necessary documentation of the design. Guidance on the list of documentation is given in IEC 61400-22, Annex A.

DNV GL will verify the final design for compliance with design assumptions, standards and other requirements specified in the DNV GL verified and approved design basis. Following a successful completion of the verification of the final design, DNV GL will issue a conformity statement.

The design evaluation shall address the following topics:

— design control
— control and protection system
— loads and load cases
— rotor blades
— mechanical components
— structural components
— electrical components and systems
— housings (nacelle cover and spinner)
— component tests
— foundation design requirements
— manufacturing process
— transportation process
— installation process
— maintenance process
— personnel safety.
Details of the evaluation of each topic are given in the following subsections.

### 3.3.2 Design control

The design control procedures shall comply with ISO 9001 [7.3] *Design and development*. The design control procedures shall include control of documents such that the revision status of every document is clear to all parties.

The requirements for the design control procedures are satisfied when the quality system of the wind turbine manufacturer has been certified according to ISO 9001 with design included in the scope. When this certification is not available, DNV GL will evaluate the quality procedures used by the wind turbine manufacturer to control the design processes.

### 3.3.3 Control and protection system

DNV GL will evaluate the control and protection system for compliance with the requirements of IEC 61400-22, IEC 61400-1, IEC 61400-3 as applicable, and the agreed additional codes and standards, such as DNVGL-ST-0438. The DNV GL standard DNVGL-ST-0438 is intended to cover the requirements implied when using the certification scheme described in this service specification.

DNV GL evaluation should be carried out according to the IECRE OD501-5 which amends the IEC 61400-22 and IECRE OD501 with respect to requirements for the certification process including required design documentation and reporting. For IECRE certification all relevant approved IECRE ODs shall be applied unless allowed through other IECRE decisions, transition rules or equivalent.

DNV GL will evaluate the documentation of the control and protection system. The evaluation for a basic control and protection system shall comprise the following documentation:

— description of the applied system version control
— description of wind turbine modes of operation
— design of functionality of all elements
— fail-safe/safe-life design of the control and protection system
— system logic and hardware implementation incl. supervision and parameter values
— authentication of reliability of all safety critical sensors
— braking system(s) analysis
— quality control procedures for the controller development process
— detailed test program for safety and function test.

Documentation shall also be provided demonstrating that the model of the controller used in the load calculations resembles the same functionality and algorithms as for the real wind turbine.

Advanced control features such as resonance speed avoidance, active tower damping, individual pitch control, drive train damper may require additional documentation and/or testing.

The DNV GL evaluation methods for the advanced control features may include independent/parallel modelling, theoretical analysis and/or testing.

A failure analysis such as failure mode and effect analysis for the control and protection system shall be executed and documented by the manufacturer for a new wind turbine type or when deemed necessary by DNV GL.

There may be additional requirements for the documentation of the control and protection system related to the marine environment and the need for remote operation/monitoring as well as back-up supply.
3.3.4 Loads and load cases

DNV GL will evaluate the load analysis for compliance with the requirements of IEC 61400-22, IEC 61400-1, IEC 61400-3 as applicable, and the agreed additional codes and standards, such as DNVGL-ST-0437. DNVGL-ST-0437 is intended to cover the requirements implied when using the certification scheme described in this service specification.

The DNV GL evaluation should be carried out according to the IECRE OD501-4 which amends IEC 61400-22 and IECRE OD501 with respect to requirements for the certification process including required design documentation and reporting. For IECRE certification all relevant approved IECRE ODs shall be applied unless allowed through other IECRE decisions, transition rules or equivalent.

The manufacturer shall document the load analysis and also provide a summary of the loads used for design. The documentation shall include a load case description and a description of calculation models and input data such as

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

Furthermore, the result from the load analysis shall be reported:

- description of load analysis software including post processing tools as well as version control/validation of the applied software
- description of sensors and corresponding co-ordinate systems used by the load analysis software
- full input and output data including time series. The output data should include FFT spectra, statistics, RFC spectra, load duration distribution (LDD), Markov matrices, extreme loads, equivalent fatigue loads
- load analysis result summary for key locations and individual components such as blade, hub, shaft, gearbox, yaw system, tower, locks.

The required load cases are defined in IEC 61400-1 and/or IEC 61400-3. The design of the control and protection system shall be considered in the detailed set-up of load cases. The following design situations are covered by the load cases defined in IEC 61400-1 and/or IEC 61400-3:

- power production
- power production plus occurrence of fault (results from the failure analysis to be considered)
- start up
- normal shutdown
- emergency shutdown
- parked (standing still or idling)
- parked or fault conditions
- transport, assembly, maintenance and repair.

DNV GL will verify the loads and the load cases. The extent of the verification will depend on the wind turbine concept and on the size of the wind turbine e.g. small/medium stall/pitch regulated wind turbines may be verified by DNV GL using simplified well proven methods.

As part of the verification of loads and load cases, DNV GL will carry out independent load analyses, preferably using another analysis program than the one used by the manufacturer. The focus of the independent analyses will be on governing fatigue loads and selected critical extreme load cases.

The DNV GL independent load analysis will include a time domain load simulation using a special-purpose aero-elastic code.

The independent load analysis will serve as an independent check of applied input and will be used for the verification of the manufacturer’s load analysis report with respect to load level, dynamic behaviour and instabilities.

The main conclusions from the DNV GL independent load analysis will be reported to the manufacturer. Optionally, the full report may be provided as well.
In case of component certification a full load and load case verification may be included or the load set is checked for plausibility and applied for the design in question. In the latter case a load comparison and – in case of higher loads - reserve calculation are necessary during type certification to integrate the component or system in a wind turbine.

### 3.3.5 Rotor blades

DNV GL will evaluate the rotor blades for compliance with the requirements of IEC 61400-22, IEC 61400-1, IEC 61400-3, and the agreed additional codes and standards, such as DNVGL-ST-0376. DNVGL-ST-0376 is intended to cover the requirements implied when using the certification scheme described in this service specification.

The DNV GL evaluation should be carried out according to the IECRE OD501-1 which amends IEC 61400-22 and IECRE OD501 with respect to requirements for the certification process including required design documentation and reporting. For IECRE certification all relevant approved IECRE ODs shall be applied unless allowed through other IECRE decisions, transition rules or equivalent.

The design documentation shall normally comprise:

- design calculations
- drawings and specifications including layup and tolerances
- material data: material properties shall be verified by testing at latest for the final component/type certificate. If the material properties are taken very conservatively and not based on any testing, this may be acceptable for design evaluation
- manufacturing instructions: if possible, the manufacturing instructions should be reviewed as part of the design evaluation. Otherwise the correspondence of design and manufacturing shall be reviewed during the manufacturing evaluation.

The DNV GL evaluation consists of documentation reviews and/or independent analyses.

For new rotor blade designs or if the rotor blade design documentation includes advanced analyses, such as FEM analyses of highly utilized parts, DNV GL may carry out independent analyses for verification of the design.

The detailed blade test specification for testing of the blade shall be according to IEC 61400-23.

### 3.3.6 Mechanical components

DNV GL will evaluate the designs of mechanical components for compliance with the requirements of IEC 61400-22, IEC 61400-1, IEC 61400-3 and IEC 61400-4 as applicable, and the agreed additional codes and standards, such as DNVGL-ST-0361. The DNV GL standard DNVGL-ST-0361 is intended to cover the requirements implied when using the certification scheme described in this service specification.

The gearbox standard IEC 61400-4 shall be applied for new wind turbine gearbox designs included in type and/or component certification. ISO 81400-4, may still be applied for old and new gearbox versions of a gearbox, which was evaluated before 2013. New gearbox versions typically differ in gear ratio including changed high speed stage.

DNV GL evaluation for gearboxes should be carried out according to the IECRE OD501-2 which amends IEC 61400-22 and IECRE OD501 with respect to requirements for the certification process including required design documentation and reporting. For IECRE certification all relevant approved IECRE ODs shall be applied unless allowed through other IECRE decisions, transition rules or equivalent.

The design documentation relating to mechanical components normally consists of descriptions, specifications, drawings, part lists and schematics together with design calculations, which may be combined with measurement reports, test reports, FE models, drawings and part lists. DNV GL requires that the documentation clearly identifies the basis for the design, i.e. codes and standards, as well as loads and relevant external conditions.

The DNV GL assessment consists of documentation reviews and independent analyses.

For mechanical components with complex design details and/or an expected high utilisation DNV GL may carry out independent analyses for verification of the design.
For mechanical components subject to component tests, the results of the component tests may be used as full or partial documentation of the structural capacity. In this case, the test plan is subject to approval by DNV GL.

3.3.7 Structural components

DNV GL will evaluate the structural components for compliance with the requirements of IEC 61400-22, IEC 61400-1, IEC 61400-3 as applicable, and the agreed additional codes and standards, such as DNVGL-ST-0126. DNVGL-ST-0126 is intended to cover the requirements implied when using the certification scheme described in this service specification.

DNV GL evaluation for tubular steel towers should be carried out according to the IECRE OD501-3 which amends IEC 61400-22 and IECRE OD501 with respect to requirements for the certification process including required design documentation and reporting.

The design documentation relating to structural components normally consists of descriptions, specifications, drawings and part lists together with design calculations and if applicable also test reports and FE models. DNV GL requires that the documentation clearly identifies the basis for the design, i.e. codes and standards, calculation assumptions as well as loads and relevant external conditions.

The DNV GL assessment consists of documentation reviews and independent analyses.

For non-standardised structural components with complex design details and/or an expected high utilisation, DNV GL may carry out independent analyses for verification of the design.

For structural components subject to component tests, the results of the component tests may be used as full or partial documentation of the structural capacity. In this case, the test plan is subject to approval by DNV GL.

3.3.8 Electrical components and systems

DNV GL will evaluate the designs of electrical components and systems for compliance with the requirements of IEC 61400-22, IEC 61400-1, IEC 61400-3 and IEC 61400-24 as applicable, and the agreed additional codes and standards, such as DNVGL-ST-0076. DNVGL-ST-0076 is intended to cover the requirements implied when using the certification scheme described in this service specification.

The design documentation related to electrical components and systems normally consists of descriptions, specifications, diagrams, schematics, drawings and part lists together with design calculations and if applicable also test reports. DNV GL requires that the documentation clearly identifies the basis for the design, i.e. codes and standards, as well as relevant external conditions.

For the DNV GL evaluation of the electrical component and system design the following shall be documented by the manufacturer/designer:

— assumptions made for dimensioning and installation layout
— major electrical components including generator, main frequency converter, high-voltage switchgear, transformer and cables
— safety relevant electrical systems and components such as low-voltage switchgear, controlgear, back-up power supply system, safety system (overspeed, short-circuit, overpower, vibration/shock, cable-twist, emergency stop)
— protection against electrical hazards (direct and indirect contact; arcing)
— electrical interfaces to mechanical appliances like e.g. hydraulics and brakes
— lightning protection, earthing and equipotential bonding (limitation of step and touch voltages; over voltage protection).

Specific requirements and issues that are relevant for design and testing of the major electrical components including generators, main frequency converters, high-voltage switchgears, transformers and cables are listed in the relevant IEC standards as well as in DNVGL-ST-0076.
3.3.9 Housings (nacelle cover and spinner)

DNV GL will evaluate the nacelle cover and spinner for compliance with the requirements of IEC 61400-22, IEC 61400-1, IEC 61400-3, and the agreed additional codes and standards, such as DNVGL-ST-0361, Sec.11. DNVGL-ST-0361, Sec.11 is intended to cover the requirements implied when using the certification scheme described in this service specification.

For nacelle cover and spinner, the review of the design documentation will focus on the strength of connection points between cover/spinner and main structure/hub as well as items related to personnel safety; see section [3.3.12]. Structures integrated in the nacelle cover/spinner e.g. for crane support, hook-up points and helicopter platforms will be reviewed as well together with the crane structure, hook-up point structure and helicopter deck structure.

3.3.10 Foundation design requirements

Evaluation of the foundation design is not a mandatory module for type certification. DNV GL will, however, assess at least the design requirements for the foundation. The characteristic loads and the design loads will be assessed, and the permissible range for foundation flexibility at the foundation–tower interface will be assessed. The assessment will be carried out by a review of documentation. Full integration of a foundation is an optional part of the type certification process or may be handled via component certification separately.

3.3.11 Manufacturing, transportation, installation and maintenance

The purpose of this part of the design verification is to verify that the wind turbine can be manufactured, transported, installed and maintained according to any requirements identified in the design documentation. The DNV GL assessment consists of a documentation review. The documentation to be reviewed consists of specifications, instructions, manuals and other documents that DNV GL may require. Final manuals will be reviewed as part of the final evaluation.

3.3.12 Personnel safety

For personnel safety aspects, EN 50308 is recommended. DNV GL will evaluate personnel safety aspects in the design documentation. The evaluation shall comprise documentation of the following aspects according to the design basis:

- safety instructions
- climbing facilities
- access ways and passages
- standing places, platforms and floors
- hand rails and fixing points
- lighting
- electrical system and earthing system
- fire resistance
- emergency stop buttons
- alternative escape routes
- provisions for one week emergency stay (offshore wind turbine)
- specific safety equipment for offshore (offshore wind turbine).

The DNV GL assessment consists of a documentation review. The documentation to be reviewed normally consists of specifications, instructions, drawings, calculations and manuals. For review of structural design related to tower internals, see also [3.3.7]. Final manuals will be reviewed as part of the final evaluation.
3.3.13 Service lifts and hoisting devices

3.3.13.1 General
Service lifts and hoisting devices such as cranes may be included in the type certification or covered by component certification.

For wind turbines installed in Europe, service lifts and hoisting devices shall comply with relevant directive i.e. the Machinery Directive or the Lifts Directive. The wind turbine manufacturer shall be responsible for compliance with these directives and the manufacturer shall mark the wind turbine as required.

For wind turbines installed outside Europe, the required documentation for certification will be agreed with the manufacturer case by case. Normally, the same approach as for Europe will be acceptable.

3.3.13.2 Service lifts and standard hoisting devices
Service lifts and standard hoisting devices including integrated safety devices shall have the appropriate conformity statement (CE conformity statement) and the required manuals and instructions. The manuals shall describe the installation in the wind turbine including all required arrangements. The design loads for the support structure shall be clearly stated.

The strength of the support structure shall be documented clearly showing that the design loads can be safely transferred to the wind turbine main structure. The design loads include load safety factors accounting for uncertainties of the loads.

Alternatively, full documentation shall be submitted for approval covering the installation arrangement, user manuals and maintenance and service manuals. In this case, the elevator/service lift/hoisting device arrangement shall be subject to type inspection by DNV GL.

3.3.13.3 Non-standard hoisting devices and cranes
Documentation shall be submitted for approval covering the design of the hoist arrangement, test procedures, user manuals, maintenance and service manuals. The hoisting device including its arrangement shall be subject to type inspection by DNV GL and at least one load test shall be witnessed by DNV GL.

The strength of the support structure shall be documented clearly showing that the design loads can be safely transferred to the wind turbine's main structure.

Guidance note:
The design verification of a non-standard lifting appliance and its arrangement may be based on DNVGL-ST-0378 Standard for offshore and platform lifting appliances. The following reference documents for the certification should be submitted:

— detailed design drawings and manufacturing specifications for the complete arrangement
— detailed design calculations for the complete arrangement including the support structure
— risk assessment
— user manual including instructions regarding lifting from floating vessel offshore as well as limitations in operation for environmental conditions such as wind, waves and temperature
— CE declaration of conformity, technical construction file and user manuals for standard sub-parts of the arrangement such as hoisting/lifting devices, chains and other accessories
— work instructions on factory acceptance test of hoisting device/crane (support of nacelle, vertical loading, horizontal loading, displacement of load)
— work instructions on testing of loose lifting gear.

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3.4 Manufacturing evaluation

3.4.1 General

The purpose of the manufacturing evaluation is to verify that the requirements identified and specified during the design evaluation with regard to critical manufacturing processes are observed and implemented in production and assembly.

The manufacturing evaluation consists of the following two elements:

— quality system evaluation
— manufacturing inspection.

The requirement for evaluation of the quality system is considered satisfied if the manufacturer’s quality system is certified by an accredited certification body to be in conformance with ISO 9001 with scope including design. When the manufacturer’s quality system is not certified to ISO 9001 as specified, DNV GL will carry out an audit for verification of compliance with ISO 9001 or alternatively according to IEC 61400-22 [8.5.2] Quality system evaluation.

3.4.2 Manufacturing inspection

DNV GL will verify by inspection that at least one representative wind turbine is manufactured according to the design subject to certification, i.e. in compliance with verified design drawings and design specifications. DNV GL will verify that the requirements identified during the design evaluation with respect to critical manufacturing processes are observed and implemented in production and assembly.

The manufacturing inspection shall comprise:

— a survey of the manufacturing of at least one wind turbine of the type
— verification that design specifications are properly implemented in workshop drawings, workshop instructions, purchase specifications and installation instructions
— evaluation of manufacturer's workshop, if relevant
— verification of fabrication methods, procedures and qualifications of personnel
— review of material certificates
— random checks on effectiveness of procedures for acceptance of purchased components
— random checks of fabrication processes.

The following components of a standard wind turbine shall be considered for manufacturing inspection.

— rotor blades
— rotor hub
— rotor shaft
— main, yaw and pitch bearing(s)
— main bearing housing(s)
— gearbox
— locking devices and mechanical brakes
— generator and transformer
— main and generator frame
— tower
— foundation and sub-structure (if part of certification process)
— hub assembly
— nacelle assembly.

This list shall be evaluated for each project under consideration of the wind turbine specific design, e.g. direct drive wind turbine design.
If there is more than one type/manufacturer of a component and the components differ significantly in specifications and/or manufacturing processes, all differing components shall be considered for inspection.

When an inspection in the workshop is required, the inspection will as a minimum be performed for one workshop for each component type. If several workshops of one manufacturer are in operation for a component of the same type the workshop(s) to be inspected will be selected by DNV GL based on experience.

**Guidance note:**

As an alternative, DNV GL may offer workshop approval. Workshops which have a valid workshop approval may be included in the type or component certificate at any time based on evidence that the workshop actually manufactures the respective components with identical equipment and materials and that the approved design documents are implemented in his workshop. The evidence will be reviewed during the inspection at the wind turbine manufacturer.

The detailed requirements for the workshop approval will be specified by DNV GL. The workshop approval will be valid for 2 years.

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The inspection shall preferably be performed during serial production such that all (or most) design requirements are implemented in the workshop instructions, drawings, etc.

The evaluation report for the manufacturing evaluation as well as the manufacturing evaluation conformity statement will list the workshops inspected together with the date of inspection.

### 3.5 Optional modules for foundation design and manufacturing

#### 3.5.1 Foundation design evaluation

The foundation design evaluation module, when included in the type certification or handled as component certification, will be carried out according to the section [3.3.7] for design evaluation of structural components.

#### 3.5.2 Foundation manufacturing evaluation

The foundation manufacturing evaluation module, when included in the type certification or handled as component certification, will cover a quality system evaluation and a manufacturing inspection; see also section [3.4] for further details.

### 3.6 Type testing

#### 3.6.1 General

The purpose of the type testing is to prove the wind turbine performance with respect to power production and to verify the load calculations as well as the blade design and manufacturing.

The type testing module comprises the following elements:

- safety and function tests and type inspection
- load measurements
- power performance measurements
- blade tests
- other tests including Gearbox Field Test.

The elements of the type testing should be carried out by accredited laboratories. Otherwise, DNV GL will verify that the testing is carried out according to ISO/IEC 17020 or ISO/IEC 17025, as applicable.
3.6.2 Safety and function test and type inspection

The safety and function test shall be carried out according to IEC 61400-22 Annex D and the detailed test plan approved by DNV GL. For load measurements during safety and function test, see section [3.6.3].

Unless an accredited laboratory carries out the safety and function tests, DNV GL will witness the safety and function tests.

DNV GL will carry out the type inspection at the prototype or one of the first serial wind turbines installed. The required DNV GL type inspection implies that the wind turbine is inspected for compliance with the documentation approved by DNV GL including also personnel safety aspects according to IEC 61400-22 Annex D.6.

3.6.3 Load measurements

Load measurements shall be carried out according to IEC 61400-13 and the DNV GL approved test plan.

For non-accredited test laboratories, DNV GL will witness the calibration, and the raw data from the measurements shall be available to DNV GL for independent processing.

The load measurements will be compared with the results from the design as part of the final evaluation, see section [3.8].

3.6.4 Power performance measurements

Power performance measurements shall be carried out by an accredited laboratory according to IEC 61400-12-1.

3.6.5 Blade tests

Blades shall be tested according to IEC 61400-23 and the by DNV GL approved detailed test plan.

In the case of testing performed at a non-accredited test laboratory all static tests (pre- and post-fatigue) shall be witnessed by DNV GL. The extent of witnessing the fatigue tests will be decided case by case, taking into account the experience and the quality measures of the test laboratory, and should include witnessing/inspection of both test directions, and at least one inspection of fatigue testing.

The test blade(s) shall be representative for the serial produced blade.

If it is not possible to randomly select a blade or if standard repairs shall be tested as well, the manufacturing of the test blade has to be evaluated regarding the representativeness of the type to be certified. The level of inspection has to be agreed with the manufacturer, and a complete and traceable production record for the test blade has to be reviewed prior to the testing. Any modifications on the test blade are to be documented and approved. Since the test blade shall be representative for the serial production, those repairs which are most probably used during production have to be present in the test blade. The repairs shall be performed at areas, which are loaded representatively with regard to the maximum blade loads.

The need for re-testing due to design changes on the blade or the possibility to make use of a blade test within a certification of variants of the blade design shall be decided case by case, considering the guidelines given in IEC 61400-23 (annex A). As a rule, the stress and/or strain level of the tested blade version may not be lower than that of the modified blade and design details critical to buckling shall not show lower safety margins than in the tested blade version.

Blades tested according IEC/TS 61400-23 before 2014 may be used for new wind turbine designs without retesting if the design load level is within the test load applied for the blade as per IEC/TS 61400-23.

The requirement in IEC 61400-24 for either testing of blades for verifying the lightning protection or verification based on documented experience will only be applied to new blade designs for which testing has not been concluded in 2010.
3.6.6 Gearbox field test

The Gearbox field test is specified in IEC 61400-22 and shall be part of the by DNV GL approved overall gearbox test plan according to IEC 61400-4. The gearbox field test is not required for IEC WT 01 based certifications.

The gearbox field test requirements for type testing are described in IEC 61400-4, section 8.4.3 *Type test of gearbox in wind turbine* and include as a minimum:

— measurements of vibration levels - compare with workshop test
— effectiveness of the lubrication system - temperature measurements.

In the case of non-accredited test laboratories, the DNV GL involvement shall be agreed case by case considering the test set-up and the type of tests included in the field test.

3.7 Type characteristics measurements

3.7.1 General

Type characteristics measurements form an optional module in the type certification scheme. The type characteristics measurements module, when included in the type certification, comprises one or more of the following elements:

— power quality tests – IEC 61400-21
— low-voltage ride-through (LVRT) tests – IEC 61400-21

Generally, the Type Characteristics Measurements shall be carried out by an accredited test laboratory. For non-accredited test laboratories, DNV GL will witness the measurements.

3.8 Final evaluation and issue of certificate

3.8.1 General

The purpose of the final evaluation is to provide documentation of the findings from the evaluation of the elements of the type or component certification.

The final evaluation module summarizes the mandatory modules and the selected optional modules. It will address whether the design documentation is complete and whether the type-test results confirm the relevant design assumptions. Furthermore the final wind turbine documentation including drawings, specifications and manuals is reviewed for compliance with the manufacturing evaluation and the design calculations and assumptions.

The final evaluation report is issued when a satisfactory result of the evaluation has been achieved. The final evaluation report will contain a reference list of all supporting product documentation. It will contain an evaluation of whether the detailed documentation is complete. It will also contain an evaluation of whether the type test results and the type inspection confirm that all relevant requirements set forth in the design documentation have been met.

*Guidance note:*

The results of the load measurements shall be compared with the results from the load analysis which is adjusted to the prototype design and the prototype site conditions.

---e-n-d---o-f---g-u-i-d-a-n-c-e---n-o-t-e---

The final evaluation report shall contain a review of the final product documentation, including:

— drawings
and shall confirm that it is consistent with the manufacturing evaluation, with the supporting design calculations and with relevant design assumptions.

The type certificate may also refer to one or more component certificates. The validity of the type certificate will in such cases be limited to the validity of the referenced component certificate. For component certificates issued by another certification body the IECRE clarification sheet CBC 8A shall apply.

The certificate for the wind turbine type or component subject to certification will be issued based on a satisfactory final evaluation. The certificate will be issued in accordance with the type/component certification scheme selected for the certification, see Sec.2. The certificate is valid for 5 years, unless otherwise stated, and refers to conformity statements for the completed modules:

- design basis evaluation
- design evaluation
- manufacturing evaluation
- type testing
- type characteristics measurements (optional)
- foundation design evaluation (optional)
- foundation manufacturing evaluation (optional).

The type certificate or component certificate shall be included in the list of valid certificates on the DNV GL internet site.
SECTION 4 CERTIFICATION OF ROTOR-NACELLE ASSEMBLY

4.1 General
To facilitate projects with site specific tower and foundation designs, a type certificate rotor-nacelle assembly (TC RNA) is defined. In the case of offshore projects the certification shall consider the aspects in [4.2].

4.2 Offshore wind turbines
Certification of offshore wind turbines shall be carried out according to IEC 61400-22, IEC 61400-3 and/or IEC 61400-1 as described in Sec.3.

Guidance note:
For an offshore wind turbine, IEC 61400-22 should preferably be applied together with IEC 61400-3. In some cases, such as for near-shore locations with shallow/sheltered water, IEC 61400-1 class "S" may be appropriate. In other cases e.g. for a wind turbine intended for both onshore and offshore locations, compliance with both IEC 61400-1 and IEC 61400-3 may be required.

Wind turbine standard classes according to IEC 61400-1 may only be applied if the wind turbine fulfils both IEC 61400-3 and IEC 61400-1 (Example: inclined mean flow with respect to a horizontal plane according to IEC 61400-1 shall be included). Otherwise, the wind turbine class shall be "S".
The offshore wind turbine has in most cases site specific towers and substructure. Hence, the generic certification of offshore wind turbines will typically only include the rotor-nacelle assembly (RNA). Hence, a type certificate RNA is defined, see [4.3].
The influence of the support structure dynamic behaviour and its interaction in the RNA design shall be considered.
The following aspects need to be considered for an offshore wind turbine:
— the corrosion protection requirements according to IEC 61400-3, Annex H should be applied
— atmospheric control of the nacelle is recommended. If this is not the case, the corrosion protection of all machinery components shall be carefully assessed
— the lubrication systems for wind turbine gearboxes shall be designed to avoid pollution due to leakage, see IEC 61400-4
— the electrical installation shall comply with the requirements of IEC 61400-3
— manuals shall be adapted to offshore operations. This includes transport, installation, maintenance and operation manuals
— hoisting etc. provisions shall comply with the offshore operations requirements. This applies especially for design of padeyes and non-standard lifting appliances, see [3.3.13].

4.3 Type certification of rotor-nacelle assembly
The Type Certificate RNA includes electrical installations in the tower, but excludes the tower structural design, tower internals, tower manufacturing and tower manuals. The type certificate RNA comprises certification according to IEC 61400-22 for the complete wind turbine including design basis, design evaluation, type testing, manufacturing evaluation and final evaluation except for the tower design, manufacturing and final evaluation. The tower and foundation shall be sufficiently documented to enable type testing and load calculations for the complete wind turbine.
SECTION 5  TYPE AND COMPONENT CERTIFICATE

5.1 General

During the validity period of the certificates, the certificate holder shall keep DNV GL informed about design changes, incidents and deviant operation. Major incidents and failures shall be immediately reported by the certificate holder to DNV GL whereas other issues are part of the certificate holder’s mandatory annual report.

The certificate validity is conditioned on a successful 2½-year inspection by DNV GL.

Major design changes shall be certified by DNV GL before implementation otherwise the certificate loses its validity.

Major revision of a referenced standard as well as other new industry learning during the validity period of a certificate shall be evaluated by DNV GL. If such a revision is judged to have implications on the integrity and safety of the certified wind turbine or component, it shall be modified and/or re-evaluated in order to retain the certificate. Transition periods and guidance for implementation of new revisions shall be established by DNV GL for each individual case.

Upon failure to conform to the conditions of the certificate, the certificate holder will be requested by DNV GL to correct the nonconforming situation within a specified time frame.

If no satisfactory corrective action is taken, the certificate in question shall be withdrawn and the accreditation authority, under whose authority the certificate was issued, will be informed accordingly. Certification documents issued by DNV GL shall upon withdrawal or suspension be returned to DNV GL.

5.2 Quality system

The certificate holder shall maintain a certified ISO 9001 quality system during the validity period of the certificate. This implies that the certificate holder shall take appropriate actions according to the requirements of the ISO 9001 certification scheme with respect to complaints and any deficiencies that affect compliance with the requirements for the certificate. The customer shall keep records of all complaints relating to the compliance of the wind turbine, components or systems with the standards and requirements applied for the certificate.

5.3 Annual reporting

The certificate validity is conditional on annual reporting by the certificate holder covering all installed turbines of the certified type and including information about:

— installed wind turbines including serial number, location and year
— abnormal or deviant operating experience or operating failures
— minor modifications.

A report template is available in IECRE clarification sheet CBC 14C.

Optionally, DNV GL may issue a conformity statement confirming acceptance of annual reporting by the manufacturer, see also IECRE clarification sheet CBC 14C.

5.4 Inspection

DNV GL shall inspect randomly chosen specimens for each type of wind turbine/component during the validity period of the certificate, at least once every 2½ years, to check that the wind turbines produced correspond with the type certified wind turbine.

The DNV GL inspection shall be carried out either on installed wind turbines in the field or in the workshops of the major components/assemblies during ongoing production.
The certificate holder is responsible for arranging the inspection and shall provide access to the wind turbine/component/workshops chosen by DNV GL for inspection.

5.5 Modifications
Changes of the wind turbine design may lead to issuance of a new revision of the certificate upon successful review. The new revision shall have the same expiry date as the original certificate. In case of major changes, a new certificate with a 5-year validity may be issued upon successful review.

Guidance note:
Examples of major modifications:

— change in number or quality of bolts
— change in geometry e.g. hub geometry
— change in type and quality of material
— change in manufacturing process for hub casting
— change in sub supplier e.g. bearing(s), gearbox, hydraulic unit and controller.

Examples of minor modifications:

— additional drilled holes in non-loaded areas of housing
— change of standard parts (screws, springs etc.)
— new corrosion protection according to specification
— change in assembly instruction for cooling system
— exchange of anemometer
— exchange of catalogue parts (circuit breakers, resistors, fittings, hoses, etc.).

Modified modifications of a type certified wind turbine are allowed without repeating type testing if these do not change or affect the principal characteristics at all, or if they change or affect the principal characteristics within the limits specified in the applicable design code or standard. The same applies in the case of components or systems subject to component certification.

In accordance with IECRE clarification sheet CSH 002, the following changes may require new testing for the relevant type test elements:

— a change in rotor diameter by more than 2%
— a change in rotor rotational speed by more than 2%
— a modified design of the safety system
— a modified way of limiting the power output
— modified blade profiles
— modifications which lead to a significant increase of loads in the load spectrum
— increase of the rated power output by more than 5%
— major changes of 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 shall depend on the kind of modification. The same applies in case of components or systems subject to component certification.

An updated certificate may also be required if additional requirements for maintenance of the certificate are set by national authorities or by the applicable design code or standard during the validity period of the certificate.

5.6 Incidents and failures
Once a safety-related incident or failure of the installed certified turbines or components comes to the certificate holder's knowledge, the certificate holder shall immediately report this incident or failure to DNV
GL. Such incidents or failures may result in a request by DNV GL for corrective actions to be taken by the customer in order to maintain the type/component certificate. Based on an evaluation of the incident or failure and, if relevant, an evaluation of the corrective actions, DNV GL shall decide if the type/component certificate shall be suspended until a satisfactory corrective action is implemented. A suspension implies that wind turbines or components may not be advertised, sold, manufactured or installed with reference to the suspended type or component certificate. The type or component certificate may be suspended up to a maximum of one year provided that a plan for corrective action by the customer is agreed with DNV GL. If no satisfactory corrective action is taken, the type or component certificate in question will be withdrawn and the accreditation authority, under whose authority the certificate was issued, shall be informed accordingly. Certification documents issued by DNV GL shall upon withdrawal or suspension be returned to DNV GL.

5.7 Recertification

To retain a type or component certificate after the 5-years validity period, a recertification shall be carried out. The recertification shall include a review of the existing and/or updated documentation for the wind turbine for compliance with the certification scheme i.e. IEC 61400-22 and/or IECRE system. This shall include new and/or additional manufacturing inspections as required according to IEC 61400-22 and/or the IECRE system.

5.8 Rules for use of the certificate

The certificate shall not be used in such a manner as to bring DNV GL into disrepute. Furthermore, misleading or unauthorized statements regarding the certificate are not allowed. The DNV GL issued certification documents such as certificates, statements, reports and final evaluation reports shall only be provided to others in their entirety. The certification mark, as shown in App.A, may only be used on or with a reference to the certified product. The certification mark shall not be used in such a way that it may mislead or give the impression that other products than the certified products are covered by the certificate or statement. When the certification mark is used in brochures, letters and other printed material, a distinct reference to the certified product shall be stated. Any claims regarding the certificate shall be promoted with reference to a specific item in the scope for the certification.
APPENDIX A ACCREDITATIONS, CERTIFICATION MARKS AND SAMPLE CERTIFICATE

A.1 Accreditation and recognitions
DNV GL is accredited by DAkkS for type and component certification of wind turbines according to IEC 61400-22 applying this service specification. The accreditation also covers related national schemes as follows:
— Danish type certification scheme
— Indian type certification scheme TAPS-2000.
DNV GL is also an IECRE renewable energy certification body (RECB) for type and component certification of wind turbines.

A.2 Certification marks
A certification mark as shown in Figure A-1 may be attached to type or component certified products. The certification mark shall not be used in such a way that it may mislead or give the impression that other products than the certified products are covered by the certificate or statement. If the certification mark is used in brochures, letters and other printed material, a distinct reference to the certified product shall be stated.
The certification mark shall be approved and provided by DNV GL before use.

Figure A-1 Certification mark

A.3 Sample certificate and conformity statement
A sample type certificate is shown in Figure A-2 and a sample conformity statement for manufacturing evaluation is shown in Figure A-3.
Figure A-2 Type certificate
CONFORMITY STATEMENT

Issued for:

Design Evaluation of

<Wind Turbine Type>
Specified in Annex 1

Issued to:

<Wind Turbine Manufacturer>

< Address line >
< Address line >

According to:

DNVGL-SE-0074:2018-01 Type and component certification of wind turbines according to IEC 61400-22

Based on the document:

ER-DNVGL-SE-0074-[ID]-[rev]. Evaluation Report, dated yyyy-mm-dd

Changes of the system design are to be approved by DNV GL.

Place, yyyy-mm-dd
For DNV GL Renewables Certification

DakkS
[Name of SLL for "Cert. decision"
[Function]

The accredited certification body is Germanischer Lloyd Industrial Services GmbH, Brohltor 18, 20457 Hamburg. DNV GL Renewables Certification is the trading name of DNV GL's certification business in the renewable energy industry.

Place, yyyy-mm-dd
For DNV GL Renewables Certification

[Name of PM "doing it"
[Function]

Figure A-3 Conformity statement
CHANGES – HISTORIC

December 2014 edition

General
This service specification supersedes and replaces the January 2014 edition of DNV-DSS-904.
About DNV GL
Driven by our purpose of safeguarding life, property and the environment, DNV GL enables organizations to advance the safety and sustainability of their business. We provide classification, technical assurance, software and independent expert advisory services to the maritime, oil & gas and energy industries. We also provide certification services to customers across a wide range of industries. Operating in more than 100 countries, our experts are dedicated to helping our customers make the world safer, smarter and greener.

SAFER, SMARTER, GREENER