Certification of navigation and aviation aids of offshore wind farms
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 is a new document.
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SECTION 1 GENERAL

1.1 Introduction

Marking of offshore wind farms (by e.g. proper coating, navigation and aviation aids) is an important factor for ensuring safe nautical and aviation traffic, as well as safe operation of the assets of wind farms, thereby securing owner investments.

The marking of offshore wind farms is specified in international standards and regulations for the marking of wind turbines, offshore substations and other installations. The most important include:

— the Convention on International Civil Aviation (Annex 14) released by the International Civil Aviation Organisation (ICAO) for marking of wind turbines with regard to safety of aviation, see [2.3.1]
— IALA Recommendation O-139 On the Marking of Man-Made Offshore Structures released by the International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) for marking of wind turbines with regard to safety of nautical traffic, see [2.3.1].

In addition, national standards may define further specific requirements for the marking of offshore wind farms. For more information on national requirements see [2.3.2].

This service specification (SE) specifies DNV GL's services for certification of navigation and aviation aids of offshore wind farms. Furthermore, it provides a common communication platform for describing the scope and extent of activities performed during the assessment of navigation and aviation aids of an offshore wind farm. The SE focuses on the international standards, but national requirements may be included in the certification as well.

This SE is defined on basis of best practice from international standards listed in [1.5] as well as the experience gained by DNV GL in several projects, since no general international regulations for navigation and aviation aids of offshore wind farms exist.

The SE is divided into three main sections.

DNVGL-SE-0176 Sec.1 provides general information about this SE and general requirements regarding the certification of navigation and aviation aids of offshore wind farms.

Sec.2 provides a service overview for the various project phases and the deliverables of the assessment.

Sec.3 describes the different phases for the certification in detail.

In general, the DNV GL document system is organized according to a three-level document hierarchy, with these main features:

— principles and procedures related to DNV GL's certification and verification services are separated from technical requirements and are presented in DNV GL SEs, and present the scope and extent of DNV GL's services.
— technical requirements are issued as self-contained DNV GL standards (ST). STs are issued as neutral technical standards to enable their use by national authorities, as international codes and to be used by companies for project specifications.
— associated documents are issued as DNV GL recommended practices (RP). RPs provide DNV GL's interpretations of safe engineering practices for general use by the industry.

1.2 Scope

The certification of navigation and aviation aids of an offshore wind farm provides evidence to stakeholders (wind farm owners, financiers, partners, utility companies, insurer, the public, governmental and non-governmental organizations) that a set of requirements is met for fulfilling safe operation, navigation and aviation during design, commissioning and in-service of an offshore wind farm.

The services specified are based on the listed standards and regulations in the introduction (see [1.1]) in combination with the standards and regulations listed in [1.5] as well as broad experience gained by DNV GL in related wind energy projects.
1.3 Application

This SE applies to navigation and aviation aids and marking of offshore wind farms and related verification tasks during the design, commissioning and operation of offshore wind farms.

The following assets of offshore wind farms are covered by the services described herein:

— marking of the wind turbines including their support structure
— marking of substation(s) including topside(s) and support structure(s)
— additional navigation and aviation aids in offshore wind farms
— marking of meteorological masts
— navigation and aviation aids of other structures and platforms in offshore wind farms.

In addition to the services described in this SE there may be national requirements which shall be fulfilled for the navigation and aviation aids of an offshore wind farm and may not be included in this SE.

For a more detailed description of the assets of an offshore wind farm and the components of each asset see DNVGL-SE-0190 [1.4].

1.4 Definitions

1.4.1 Terminology and definitions

Table 1-1 lists verbal forms used in this SE.

Table 1-1 Definitions of verbal forms

<table>
<thead>
<tr>
<th>Verbal form</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>

Table 1-2 lists definitions of terms used in this SE.

Table 1-2 Definitions of terms

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>asset</td>
<td>term used in the context of wind farm projects to describe the project or object to be developed, manufactured and maintained. In this service specification the term refers either to “wind turbines with support structures”, the “offshore substation with topside and support structure” or “other structures and platforms in offshore wind farms”</td>
</tr>
<tr>
<td>certification</td>
<td>refers to third-party issue of a statement, based on a decision following review, that fulfilment of specified requirements has been demonstrated related to products, processes or systems (ISO 17000)</td>
</tr>
<tr>
<td>component</td>
<td>main part of an asset. In this SE, the term refers to rotor–nacelle-assembly, parts of the support structure of the wind turbine (tower, sub-structure and foundation), topside equipment, and parts of support structure for a substation (topside structure, sub-structure and foundation)</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>customer</td>
<td>DNV GL’s contractual partner (applicant)</td>
</tr>
<tr>
<td>foundation</td>
<td>the part of the support structure of a wind turbine or substation that transfers the loads acting on the structure into the soil</td>
</tr>
<tr>
<td>offshore wind farm project</td>
<td>assets of an offshore wind farm including the total number of offshore wind turbines, support structures, substations with topside and support structure and power cables</td>
</tr>
<tr>
<td>optional services</td>
<td>services which are not part of the scope which is required to obtain a statement of compliance and a project certificate</td>
</tr>
<tr>
<td>other installations</td>
<td>installations such as meteorological mast, secondary structures, power cables and other equipment</td>
</tr>
<tr>
<td>outstanding issue</td>
<td>the term outstanding issue is used to denote a deviation from standards and technical requirements specified in the certification agreement, and which needs to be completed for full compliance</td>
</tr>
<tr>
<td>project certificate</td>
<td>document signed by DNV GL affirming that, at the time of assessment and certification, the assets referred to in the certificate met the requirements stated in the normative documents</td>
</tr>
<tr>
<td>recommendation</td>
<td>non-mandatory advice</td>
</tr>
<tr>
<td>secondary structure</td>
<td>boat landings, access ladders and access platforms etc.</td>
</tr>
<tr>
<td>substation</td>
<td>transformer stations or converter stations or platforms, with or without accommodations. An onshore or offshore substation may be defined as an integral asset of the wind farm project or as a separate asset within DNV GL project certification. Whenever, in this SE the term is used in general, it describes the substation including the support structure, as this is the power transferring unit</td>
</tr>
<tr>
<td>substructure</td>
<td>part of the support structure of a wind turbine which extends upwards from the soil and connects the foundation and the tower. The term is also used to designate the part of the support structure of a substation which extends upwards from the soil and connects the foundation and the topside or platform</td>
</tr>
<tr>
<td>support structure</td>
<td>the structure below the yaw system of the rotor-nacelle-assembly and includes tower structure, substructure and foundation. The term is also used to designate the structure below of the topside structure and includes substructure and foundation of a substation</td>
</tr>
<tr>
<td>verification</td>
<td>confirmation, through the provision of objective evidence, that specified requirements have been fulfilled (ISO 9000)</td>
</tr>
<tr>
<td>wind turbine</td>
<td>system which converts kinetic wind energy into electrical energy. Whenever, in this SE the term is used to describe the wind turbine in general, it describes the rotor-nacelle-assembly including the support structure, as this is the power generating unit</td>
</tr>
</tbody>
</table>
1.4.2 Abbreviations and symbols

Table 1-3 lists abbreviations and symbols used in this SE.

Table 1-3 Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>In full</th>
</tr>
</thead>
<tbody>
<tr>
<td>AIS</td>
<td>automatic identification system</td>
</tr>
<tr>
<td>ATON</td>
<td>aids to navigation</td>
</tr>
<tr>
<td>BSH</td>
<td>Bundesamt für Seeschifffahrt und Hydrographie (Federal Maritime and Hydrographic Agency)</td>
</tr>
<tr>
<td>BSI</td>
<td>Bundesamt für Sicherheit in der Informationstechnik (Federal Office for Information Security)</td>
</tr>
<tr>
<td>CAA</td>
<td>Civil Aviation Authority</td>
</tr>
<tr>
<td>CAP</td>
<td>Civil Aviation Authority publication</td>
</tr>
<tr>
<td>CIE</td>
<td>Commission Internationale de l’Eclairage (International Commission on Illumination)</td>
</tr>
<tr>
<td>GPS</td>
<td>global positioning system</td>
</tr>
<tr>
<td>IALA</td>
<td>International Association of Marine Aids to Navigation and Lighthouse Authorities</td>
</tr>
<tr>
<td>ICAO</td>
<td>International Civil Aviation Organisation</td>
</tr>
<tr>
<td>IEC</td>
<td>International Electrotechnical Commission</td>
</tr>
<tr>
<td>ISMS</td>
<td>information security management systems</td>
</tr>
<tr>
<td>ISO</td>
<td>International Organization for Standardization</td>
</tr>
<tr>
<td>IT</td>
<td>information technology</td>
</tr>
<tr>
<td>ITU</td>
<td>International Telecommunication Union</td>
</tr>
<tr>
<td>met</td>
<td>meteorological</td>
</tr>
<tr>
<td>MGN</td>
<td>marine guidance note</td>
</tr>
<tr>
<td>MMSI</td>
<td>maritime mobile service identity</td>
</tr>
<tr>
<td>OREIs</td>
<td>offshore renewables energy installations</td>
</tr>
<tr>
<td>OSS</td>
<td>offshore substation</td>
</tr>
<tr>
<td>RNA</td>
<td>rotor nacelle assembly</td>
</tr>
<tr>
<td>RP</td>
<td>DNV GL recommended practice</td>
</tr>
<tr>
<td>SDC</td>
<td>site design condition</td>
</tr>
<tr>
<td>SE</td>
<td>DNV GL service specification</td>
</tr>
<tr>
<td>SSDA</td>
<td>site specific design assessment</td>
</tr>
<tr>
<td>ST</td>
<td>DNV GL standard</td>
</tr>
<tr>
<td>WSV</td>
<td>Wasserstraßen- und Schifffahrtsverwaltung des Bundes (Administration of Waterways and Shipping)</td>
</tr>
<tr>
<td>WT</td>
<td>wind turbine</td>
</tr>
</tbody>
</table>
1.5 References

This document refers to relevant international documents and DNV GL documents. Unless otherwise specified in the certification agreement or in this SE, the latest valid revision of each referenced document applies.

Table 1-4 DNV GL documents

<table>
<thead>
<tr>
<th>Reference</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>DNVGL-SE-0073</td>
<td>Project certification of wind farms according to IEC 61400-22</td>
</tr>
<tr>
<td>DNVGL-SE-0190</td>
<td>Project certification of wind power plants</td>
</tr>
<tr>
<td>DNVGL-SE-0441</td>
<td>Type and component certification of wind turbines</td>
</tr>
<tr>
<td>DNVGL-ST-0145</td>
<td>Offshore substations</td>
</tr>
<tr>
<td>GL-IV-7-3</td>
<td>Rules for the Certification and Construction, Germanischer Lloyd Industrial Services, Part 7: Offshore Substations, 3 General Safety</td>
</tr>
</tbody>
</table>

Table 1-5 IALA documents

<table>
<thead>
<tr>
<th>Reference</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>IALA A-126</td>
<td>IALA Recommendation A-126, Use of the AIS in Marine Aids to Navigation Services</td>
</tr>
<tr>
<td>IALA E-108</td>
<td>IALA Recommendation E-108, On Surface Colours used as visual Signals on Aids to Navigation</td>
</tr>
<tr>
<td>IALA E-200</td>
<td>IALA Recommendation E-200-0, On Marine Signal Lights</td>
</tr>
<tr>
<td>IALA O-130</td>
<td>IALA Recommendation O-130, Categorisation and Availability Objectives for Short Range Aids to Navigation</td>
</tr>
<tr>
<td>IALA O-139</td>
<td>IALA Recommendation O-139, On The Marking of Man-Made Offshore Structures</td>
</tr>
<tr>
<td>IALA 1035</td>
<td>IALA Guideline No. 1035, On Availability and Reliability of Aids to Navigation</td>
</tr>
</tbody>
</table>

Table 1-6 ISO / IEC documents

<table>
<thead>
<tr>
<th>Reference</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISO 9000</td>
<td>Quality management systems - Fundamentals and vocabulary</td>
</tr>
<tr>
<td>ISO/IEC 17000</td>
<td>Conformity assessment - Vocabulary and general principles</td>
</tr>
<tr>
<td>ISO/IEC 17020</td>
<td>Conformity assessment - Requirements for the operation of various types of bodies performing inspection</td>
</tr>
<tr>
<td>ISO/IEC 17025</td>
<td>General requirements for the competence of calibration and testing laboratories</td>
</tr>
<tr>
<td>ISO/IEC 17065</td>
<td>Conformity assessment - Requirements for bodies certifying products, processes and services</td>
</tr>
<tr>
<td>ISO/IEC 27001</td>
<td>Information technology - Security techniques – Information security management systems – Requirements</td>
</tr>
<tr>
<td>IEC 61078</td>
<td>Analysis techniques for dependability - Reliability block diagram and boolean methods</td>
</tr>
<tr>
<td>IEC 61162</td>
<td>Maritime navigation and systems – Digital interfaces</td>
</tr>
</tbody>
</table>
### 1.6 Procedural requirements

#### 1.6.1 Customer - DNV GL interaction

The certification of the navigation and aviation aids of an offshore wind farm provides the customer with a third party verification for and compliance of their wind farm considering specific needs.

This SE has two main objectives. It serves as a publicly available description of DNV GL's services with regard to navigation and aviation aids of offshore wind farms and secondly it should be referred to as a contractual document in the certification agreement between the customer and DNV GL. The document specifies the obligations of the customer for navigation and aviation aids when his offshore wind farm is certified by DNV GL as well as DNV GL's service obligations to the customer.

The deliverables by DNV GL shall be agreed in detail between the customer and DNV GL as part of the contract. In general, the DNV GL certificate is issued when all the required statements of compliance according to the certification scheme were issued and the final certification has been carried out successfully. The deliverables are listed in [2.4].

Each certification phase may be verified independently according to the DNV GL certification scheme and will be completed with the issue of a statement of compliance for the specific phase. Final time schedules of the verification and certification activities shall be discussed and agreed between the customer, DNV GL and suppliers (if involved) before commencement of the work.

#### 1.6.2 Certification procedure requirements

Subsequent phases shall not be initiated before previous or dependent phases are completed and approved (see [2.2] for the different phases). For example, prior to the verification of the commissioning, the design phase shall be completed and approved. Therefore, the commissioning of the project shall not be started before the design is approved and the commissioning is agreed, since the commissioning process is
dependent on the design. Alternative ways and the related risks shall be discussed and agreed with DNV GL in advance.

1.6.3 Integration of single work packages

Within the project certification of navigation and aviation aids according to this service specification, there may be occasions when it is intended to integrate a single work package. A single work package is defined as verification tasks for navigation and aviation aids as described in [3.1], for example the verification activities for IT-security.

It shall be considered that the integration of any work package shall be agreed with DNV GL in advance for each individual project as not all possible options can be foreseen nor are shown within this SE.

As a project certificate attests compliance to a certain standard, it shall be ensured that the statement or certificate to be integrated is based on the same standard. If this is not the case, additional items shall be assessed within the project certification procedure.

The integration of the single work packages in one of the phases of the project certification shall be reported in the final certification report and accordingly in the project certificate.

1.6.4 Documentation requirements

The documentation submitted for the certification process shall be complete and self-explanatory. The content shall meet the requirements of the applied standards. All relevant documentation shall be subject oriented and in a logical sequence to facilitate cross checking of the documents. Each document shall be named explicitly by e.g. title, report no., page no., date and a document revision number. Furthermore, the documents shall be signed officially at least by the author and/or approver to identify responsibilities. Alternatively, the documentation submitted shall bear unambiguous evidence of having been subject to the designer's and/or owner's quality management system.

The documentation, including standards and codes as well as other requirements and specifications, shall be prepared in English language unless otherwise agreed in writing between the customer and DNV GL. All documentation for verification should be forwarded to DNV GL in electronic form, preferably as pdf files. Other forms of documentation such as print-outs may be an alternative, if agreed.

1.6.5 Standards, codes and additional requirements

The standards, codes and requirements which form the basis for the certification of offshore wind farm navigation and aviation aids shall be listed and agreed in the design documentation at a very early stage. For the project in question, relevant statutory requirements shall also be listed. Such requirements may be e.g. national regulations for the marking of wind farm regarding sea and air traffic.

The standards, codes and additional requirements which are applicable for the project and site in question shall be verified for compliance with the design prerequisites of the project and for completeness and adequate suitability and applicability. The verification of the choice of standards, codes and requirements shall be conducted early in the project phase in order to avoid fundamental discussions on this basic aspect of the design.

For standards and codes, only the edition cited applies. For undated references, the latest edition of the referenced document including any amendments applies. In case of deviations from this rule, it shall be agreed in writing on an individual basis and in advance with DNV GL.

1.6.6 Inspection requirements

The customer or the entity having legal responsibility for the premises where DNV GL personnel shall work, shall inform DNV GL of any safety and health hazards related to the work and/or any safety measures required for the work, prior to starting the work, or if such information is not available at that time, during the performance of the work.
Whenever DNV GL executes work on site, the customer shall provide all adequate safety measures to ensure a working environment that is safe and in accordance with all relevant legislation. If at any time during the execution of the work on site a DNV GL employee judges that the work situation is unsafe, the work shall be suspended until such situation has been made safe.
SECTION 2 SERVICE OVERVIEW

2.1 Overview
Certification of navigation and aviation aids of offshore wind farms in accordance with this SE is carried out according to international standards, guidelines and regulations. An overview of applicable international standards, guidelines and regulations is given in [2.3].

Figure 2-1 Navigation and aviation aids in offshore wind farms
The DNV GL certification of navigation and aviation aids consists of three phases (see [2.2]).

2.2 Certification phases
The execution of the certification of navigation and aviation aids of offshore wind farms is split in three phases shown in Figure 2-2. The certification scheme contains the mandatory phases design and commissioning (dark blue arrows) to achieve a project certificate as well as the optional in-service phase (light blue arrow) to maintain the certificate.

Figure 2-2 Phases for the certification of navigation and aviation aids
— Phase I: Design covers the steps necessary to achieve final design verification. This verification includes a design approval of the concept of the navigation and aviation aids for the specific offshore wind farm including all planned components.
— Phase II: Commissioning involves all follow-up verifications and on-site inspections during the manufacturing, installation and start of operation of the offshore wind farm. This verification includes the on-/offshore inspections of the installations and checks if it is installed in compliance with the design.
— Phase III: In-service involves periodic on-site inspections as well as follow-up verifications after the start of operation and during the subsequent in-service period.

The verification activities associated with the different certification phases are presented in more detail in Sec.3 and the corresponding deliverables are defined in [2.4].

The verification of temporary aids is optional. Aids for temporary use (e.g. during construction phase) shall be designed as described in Sec.3 where possible.

### 2.3 Technical requirements

#### 2.3.1 International standards

This SE provides the key references to the technical requirements to be fulfilled for the offshore wind farm subject to certification, and it serves as DNV GL's aid to the interpretation of the international requirements for the navigation and aviation aids of offshore wind farms.

The international standards and requirements for the different navigational and aviation aids listed in [1.5] are assigned to the respective scope of the certification of navigation and aviation aids of offshore wind farms in Table 2-1.

#### Table 2-1 Applicable scope of standards and requirements

<table>
<thead>
<tr>
<th>Scope</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day marking</td>
<td>CIE 039.2-1983, Recommendations for Surface Colours for Visual Signalling</td>
</tr>
<tr>
<td>Day marking</td>
<td>IALA-Recommendation E-108 On Surface Colours used as Visual Signals on Aids to Navigation</td>
</tr>
<tr>
<td>Day marking</td>
<td>IALA Recommendation O-139 On The Marking of Man-Made Offshore Structures</td>
</tr>
<tr>
<td>Day marking</td>
<td>GL-IV-7-3: Rules for the Certification and Construction, Germanischer Lloyd Industrial Services, Part 7: Offshore Substations, 3 General Safety</td>
</tr>
<tr>
<td>Night marking</td>
<td>IALA Recommendation E-200-0 On Marine Signal Lights</td>
</tr>
<tr>
<td>Night marking</td>
<td>IALA Recommendation O-139 On The Marking of Man-Made Offshore Structures</td>
</tr>
<tr>
<td>Aviation</td>
<td>Annex 14 to the Convention on International Civil Aviation (Annex 14) released by the International Civil Aviation Organisation (ICAO) for marking of wind turbines with regard to safety of aviation</td>
</tr>
<tr>
<td>Aviation</td>
<td>IALA-Recommendation E-200 On Marine Signal Lights, Part 3; Measurement</td>
</tr>
<tr>
<td>AIS</td>
<td>IALA-Recommendation A-126 On the Use of the Automatic Identification System (AIS) in Marine Aids to Navigation Service</td>
</tr>
<tr>
<td>AIS</td>
<td>IEC 62320-2 Maritime navigation and radiocommunication equipment and systems - Automatic identification system (AIS) - Part 2: AIS AtOn Stations – Operational and performance requirements, methods of testing and required test results</td>
</tr>
<tr>
<td>AIS</td>
<td>IEC 61162 series of standards on Maritime navigation radiocommunication equipment and systems – Digital interfaces</td>
</tr>
<tr>
<td>AIS</td>
<td>International Telecommunication Union (ITU) Recommendation M.585 Assignment and use of identities in the maritime mobile service</td>
</tr>
<tr>
<td>Radar</td>
<td>IALA-Recommendation A-126 On the Use of the AIS in Marine Aids to Navigation Service</td>
</tr>
</tbody>
</table>
These regulations and requirements build the basis for the design and determine the set-up of the nautical and aviation aids of the offshore wind farm.

### 2.3.2 National regulations

National regulations and requirements may need to be considered. Examples for national regulations and requirements for the different navigational and aviation aids for Germany, North America and the United Kingdom are given in Table 2-2, Table 2-3 and Table 2-4.

#### Table 2-2 National regulations: Germany

<table>
<thead>
<tr>
<th>Scope</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>All components</td>
<td>Rahmenvorgaben zur Gewährleistung der fachgerechten Umsetzung verkehrstechnischer Auflagen im Umfeld von Offshore-Anlagen, hier: Kennzeichnung, Generaldirektion Wasserstraßen und Schifffahrt - Außenstelle Nordwest</td>
</tr>
<tr>
<td>IT-security</td>
<td>BSI-Standard 100-1: Information Security Management Systems (ISMS)</td>
</tr>
<tr>
<td>IT-security</td>
<td>BSI-Standard 100-2: IT-Grundschutz-Methodology</td>
</tr>
<tr>
<td>IT-security</td>
<td>BSI-Standard 100-3: Risk Analysis based on IT-Grundschutz</td>
</tr>
<tr>
<td>IT-security</td>
<td>IT-Grundschutz-Catalogues, BSI</td>
</tr>
<tr>
<td>Day marking</td>
<td>Richtlinie Offshore-Anlagen zur Gewährleistung der Sicherheit und Leichtigkeit des Schiffsverkehrs* der Generaldirektion Wasserstraßen und Schifffahrt - Außenstelle Nordwest</td>
</tr>
<tr>
<td>Day marking</td>
<td>DIN 5033-7 Colorimetry Part 7, measuring conditions for object colours (Messbedingungen für Körperfarben)</td>
</tr>
<tr>
<td>Day marking</td>
<td>DIN 5036-1 Radiometric and photometric properties of materials; definitions characteristics (Strahlungsphysikalische und lichttechnische Eigenschaften von Materialien; Begriffe, Kennzahlen)</td>
</tr>
<tr>
<td>Day marking</td>
<td>Mindestanforderungen für den Korrosionsschutz an Offshore-Anlagen in der ausschließlichen Wirtschaftszone (AWZ) von Nord- und Ostsee* des Bundesamtes für Seeschifffahrt und Hydrographie (BSH) vom 09.08.2013</td>
</tr>
</tbody>
</table>
2.4 Deliverables

A DNV GL project certificate can be issued for the navigation and aviation aids of an offshore wind farm. The certificate is supported by at least the following certification deliverables:

— statement of compliance: design
— statement of compliance: commissioning
— final certification report.

For the maintenance of the certificate, the following is necessary:

— statement of compliance: in-service.

A statement of compliance shall be issued after successful completion of a certification phase. Each statement of compliance is supported by a subject related certification report.

After completion of the phases design and commissioning and prior to the issue of the project certificate, a final evaluation shall be performed. During the final evaluation DNV GL shall check all parts of the certification for consistency and completeness with regard to the phases described in this SE. A DNV GL project certificate for the navigation and aviation aids of the offshore plant shall be issued after successful completion of the design and commissioning phases and successful completion of the final evaluation.

For inspections during commissioning as well as in-service, DNV GL shall report critical findings to the customer immediately after the inspections. DNV GL shall issue inspection reports to the customer and the frequency of these shall be agreed upon with the customer. The reports shall describe the extent of the inspections including findings, non-conformities and possible recommendations. The inspection reports shall be summarized in the relevant certification report at the end of the commissioning phase.

<table>
<thead>
<tr>
<th>Scope</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aviation</td>
<td>Allgemeine Verwaltungsvorschrift zur Kennzeichnung von Luftfahrthindernissen, vom 26.08.2015, Federal Ministry of Transport and Digital Infrastructure</td>
</tr>
</tbody>
</table>

Table 2-3 National regulations: North America

<table>
<thead>
<tr>
<th>Scope</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aviation lighting</td>
<td>U.S Department of Transportation, Federal Aviation Administration (FAA), AC No: 70/7460-1L, Obstruction Marking and Lighting</td>
</tr>
<tr>
<td>Aviation lighting</td>
<td>Canadian Aviation Regulations (CARs) 2016-1, Standard 621 - Obstruction Marking and Lighting</td>
</tr>
<tr>
<td>Availability</td>
<td>MIL-STD 785B, Military Standard: Reliability program for systems and equipment development and production, U.S. Ministry of Defense</td>
</tr>
</tbody>
</table>

Table 2-4 National regulations: United Kingdom

<table>
<thead>
<tr>
<th>Scope</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aviation lighting</td>
<td>CAP 764, Policy and Guidelines on Wind Turbines, Civil Aviation Authority</td>
</tr>
<tr>
<td>Day marking</td>
<td>Offshore Renewable Energy Installations (OREIs): Guidance to Mariners Operating in the Vicinity of UK OREIs, Maritime and Coast Guard Agency, Marine Guidance Note MGN 372 (M+F)</td>
</tr>
</tbody>
</table>
In the event that full compliance is not obtained during the verification, the deliverables shall depend on the nature of the lack of compliance. Three deliverable outcomes are available depending on the lack of compliance and are described in the following:

— No outstanding issue. Statement(s) of compliance with the accompanying DNV GL certification reports shall be issued. A DNV GL certificate shall be issued based on the statement(s) of compliance for the navigation and aviation aids of the offshore wind farm verified.

— Non-safety critical outstanding issues. One or more provisional statement(s) of compliance may be issued with the outstanding issue(s) listed in the statement(s) of compliance. A provisional certificate may be issued on request, which points out the outstanding issues. The outstanding issues listed on the statement(s) of compliance shall be repeated in the certificate. Specific descriptions of the outstanding issues shall be given in the accompanying DNV GL certification reports. Upon closing the outstanding issues an updated statement of compliance and finally a certificate with no outstanding issues shall be issued.

— Safety critical outstanding issues. Statement(s) of compliance and a certificate shall not be issued. DNV GL shall deliver the DNV GL certification report(s) that list the outstanding issues which rectification is required before the statement of compliance may be issued.

On request, complementary services to the certification of nautical and aviation marking of wind farms may be performed and shall be documented separately (see Sec.4).

2.5 Certificate validity and maintenance

The DNV GL project certificate refers to statements of compliance issued for the completed certification phases (see Figure 2-2).

The validity of the certificate is limited to the design lifetime of the navigation and aviation aids installation stated in the certificate.

The maintenance of the certificate is optional, but if applied it is based on periodic in-service evaluations by DNV GL and requires the following information:

— annual reporting by the customer covering the certified navigation and aviation aids including information about:
  — abnormal or deviant operating experience or operating failures as well as minor modifications
  — statistics on availability of the navigation and aviation aids

— reporting by the customer of planned major modifications of the navigation and aviation aids without delay and in sufficient time to allow for evaluation by DNV GL before implementation and to enable updating of the design verification and others, if relevant

— a statement, that the navigation and aviation aids of the offshore wind farm is maintained to a standard complying with the requirements of applicable codes and relevant manuals

— periodic inspections by DNV GL during the validity period of the certificate to check that the offshore wind farm corresponds to the certified design.

The maintenance of the certificate validity should be confirmed by a statement of compliance: in-service no later than four years from the date of issue. The period for in-service inspections may also be defined by national standards, which shall be considered accordingly.

Following a successful completion of an in-service evaluation, a statement of compliance in-service validating the certificate shall be issued.

Re-certification may be necessary, if additional requirements for maintenance of the certificate are set by national authorities or by the applicable design code(s) or standard(s) during the validity period of the certificate.

Safety relevant incidents shall be reported to DNV GL without delay. DNV GL shall evaluate the incidents. In case of a serious defect of the navigation and aviation aids of the offshore wind farm in question, DNV GL shall suspend the certificate until elimination of the cause. The certificate shall be reaffirmed after successful evaluation of the rectifying measure(s).
Provisional statements or provisional certificates have a maximum validity of one year. During this period the customer shall document the closing of the outstanding issues and these shall be evaluated by DNV GL.
SECTION 3 SERVICE DESCRIPTION

3.1 Phase I: Design

3.1.1 General
This subsection provides the details of DNV GL verification activities for the first phase of the DNV GL certification scheme for the navigation and aviation aids for offshore wind farms.

The purpose of the evaluation of the design is to evaluate if the owner’s requirements and international and national regulations are properly applied and documented. This includes general specifications, criteria, parameters, design approach, installation and other assumptions relevant for the use of the aids in the project. The design shall document a safe design and adequate application of the navigational and aviation aids in the specific offshore wind farm. The standards, codes and additional requirements shall be agreed within the design (see [2.3]). The documentation for the design shall be submitted to DNV GL.

Once the evaluation of the design has been successfully completed, DNV GL shall issue a statement of compliance for Phase I: Design.

3.1.2 Description of design and introduction to assets of the offshore wind farm
An overview of the different assets (wind turbine/substation/met mast/accommodation platform) installed in the offshore wind farm shall be given in order to get a general picture of the offshore wind farm and deduce the right marking system installation for the assets.

This overview shall at least include:
— description of all relevant components of the offshore wind farm (on e.g. the WT, OSS or other assets)
— location of the offshore wind farm and possible adjacent structures or offshore wind farms
— offshore wind farm layout with an overview of assets and navigation and aviation aids in the offshore wind farm
— brief description of each aid (day marking, night marking, navigation lights etc.)
— environmental conditions relevant for the navigation and aviation aids.

Additional information may be required depending on the different assets and aids to be installed.

The visual marking of offshore wind farms may be split into day marking and night marking.

3.1.3 Day marking
The nautical navigation day marking is mainly a coloured coating and labelling on defined structure areas as foundation or tower structure above sea level; the aviation day marking requirements are being met by specific coloured areas as tower, nacelle and/or rotor blades and may additionally require specific lighting.

The design documentation shall include requirements, assumptions and specifications for the day marking for both nautical and aviation traffic.

Assumptions, specifications and requirements may include, but are not necessarily limited to:
— standards, codes and additional requirements
— description of components (coating system and labelling, aviation lighting etc.)
— aviation lighting configuration of the wind turbines
— spatial arrangement of aviation lights in the offshore wind farm
— specifications and documentation of components (detailed data sheets)
— evidence for usability of the coating system and of lights as day marking for offshore wind farms
— mounting devices for specific lights designed for offshore conditions
— assembly drawings of aids
— requirements for transportation, installation and commissioning of assets and aids
— installation and commissioning manual for devices
— automatic switch on/off function of devices
— requirements for in-service and maintenance
— test programme for in-service.

The assumptions, specifications and requirements are expected to depend on owner’s requirements as well as on international and national regulations.

DNV GL shall evaluate assumptions, specification and requirements stated in the design for the day marking.

### 3.1.4 Night marking

The design of the night marking shall include requirements, assumptions and specifications for both nautical and aviation traffic such as navigation lights, aviation lighting, identification panels and illuminated signboards.

Assumptions, specifications and requirements may include, but are not necessarily limited to:

— standards, codes and additional requirements
— description of components (navigation lights, aviation lighting, signboards etc.)
— aviation lighting configuration of the wind turbines
— spatial arrangement of navigation lights in the offshore wind farm
— overview of identification panels and / or illuminated signboards
— specifications and documentation of components (detailed data sheets)
— evidence for usability of lights as night marking for offshore wind farms
— mounting devices for specific lights designed for offshore conditions
— requirements for transportation, installation and commissioning of assets and aids
— installation and commissioning manual for devices
— automatic switch on/off function of devices
— test programme for in-service.

The assumptions, specifications and requirements are expected to depend on owner’s requirements as well as on international and national regulations.

DNV GL shall evaluate assumptions, specification and requirements stated in the design for the night marking.

### 3.1.5 Automatic identification system

In addition to the visual day and night marking, the automatic identification system (AIS), a radio-based system, represents another important pillar of at least the nautical marking system of an offshore wind farm.

Located at one position in the offshore wind farm, the AIS transceiver marks the coordinates of the corner structures of the offshore wind farm ("Synthetic AIS").

The following components shall be considered and documented:

— transceiver, antennas, wiring
— design of the system
— backup system
— installation materials
— the required transmission range shall be provided.

Documentation describing the AIS shall include at least:

— MMSI numbers for AIS ATON: Request/ frequency allocation
— definition of AIS, see [2.3.1]
— availability of the system, analysis/evidence
— technical specifications, drawings, certificates
— description and drawings of mounting location of the system components on the structure (transceiver, antennas) and assembly drawing
— radio propagation forecast
— requirements for in-service and maintenance.

DNV GL shall review the documentation for the chosen AIS system within the design phase.

3.1.6 Radar
Offshore wind farms shall be equipped with a radar system in case it is required by national standards (see [2.3.2]) with regard to the safety of aviation traffic. This system shall be installed in compliance with the relevant national standards and with GL-IV-7-3, Sec. 2 *Marking Platform*. The detailed set-up of the radar system shall comply with national standards and be defined accordingly in the design.

3.1.7 Sonar
Offshore wind farms shall be equipped with a sonar system in case it is required by national standards (see [2.3.2]) with regard to the safety of submarines. This system shall be installed in compliance with the relevant national standards and with GL-IV-7-3, Sec.2 *Marking Platform*. The detailed set-up of the sonar system shall comply with national standards and be defined accordingly in the design.

3.1.8 Infrastructure
Offshore environments require special attention concerning the selection of materials, design and installation. This has significant influence on the infrastructure required to install the different components for the navigation and aviation aids.
Within the design it shall be assured that requirements regarding the installation of the components of the different marking systems, e.g. avoidance of contact corrosion, lightning protection, conformity and quality statements for installed components, fit for use in offshore environments are met. Requirements, materials, design and measurements shall be described in the design to assure proper installation for the designed lifetime of each component.

3.1.9 IT-security
IT-security is becoming an important issue for power plants. To secure the whole offshore wind farm as well as single assets of offshore wind farm it shall be investigated, if the necessary requirements according to ISO/IEC 27001 are being met.
In addition to the overview of international standards in [2.3] other national regulations may be considered during design and commissioning (see [2.3.2]). Especially for navigation and aviation aids of offshore plants in Germany the requirements according to WSV regulations (see [1.5]) shall be met.

3.1.10 Synchronization and harmonization of lighting
For the perception of the offshore wind farm as a cohesive structure the nautical lights as well as aviation lighting shall be synchronized and harmonized.
The different navigation lights shall be harmonized to give a complete picture for nautical traffic regarding the size and orientation of the offshore wind farm and to minimize the disturbing effect of unsynchronized flashing of lights.
Aviation lighting shall also be harmonized with the purpose to minimize disturbing effects on the aviation traffic.
National regulations may also demand a synchronization and harmonization of the lighting systems. This may include harmonization of switch on / off functions to the specific location of the offshore wind farm.

3.1.11 Availability assessment

In order to ensure the continuous operation of the navigation and aviation aids during the operational lifetime of the offshore wind farm, a detailed availability analysis of the systems shall be executed. The availability of the overall system is thereby dependent on each of its sub-systems (e.g. single or redundant systems) and the single components of each system. These systems may include some of the following components, but are not necessarily limited to:

- power supply unit
- emergency power supply (e.g. battery)
- navigation or aviation aid
- global positioning system (GPS) module
- visibility measuring device
- control unit
- antenna(s).

The availability of the overall system shall be analysed according to IALA Guideline No. 1035 with the support of the IEC 61078:2016.

The availability criteria for the systems are dependent on national standards (see [2.3.2]) and authorities. The IALA Recommendation O-130 may be applied for defining the criteria for the systems.

3.1.12 Commissioning requirements

The design shall state assumptions, specifications and requirements for the commissioning programs themselves. Requirements for the commissioning of the navigation and aviation aids shall be properly documented by the client or supplier of the component in the design.

Assumptions, specifications and requirements may include, but are not necessarily limited to:

- standards, codes and additional requirements
- specifications and tolerances
- limiting environmental conditions
- commissioning requirements
- requirements for commissioning manuals.

Based on the information above, a detailed plan for the commissioning shall be generated. The commissioning plan may include, but is not necessarily limited to:

- commissioning procedure of each system and component
- tools required and used.

The assumptions, specifications and requirements are expected to depend on the owner's requirements as well as on the actual contractual arrangements for the offshore wind farm.

DNV GL shall evaluate assumptions, specification and requirements stated in the design as well as the commissioning plan.

3.1.13 In-service requirements

The design shall state assumptions, specifications and requirements for the in-service operation and maintenance program. Requirements for the in-service phase of the navigation and aviation aids shall be properly documented by the client or supplier of the component in the design.

Assumptions, specifications and requirements may include, but are not necessarily limited to:

- standards, codes and additional requirements
— specifications and tolerances
— limiting environmental conditions
— operation requirements
— maintenance requirements
— requirements for operation and maintenance manuals.

The assumptions, specifications and requirements are expected to depend on the owner’s requirements as well as on the actual contractual arrangements for the offshore wind farm.

Based on the information above, a test plan for the periodic in-service inspections shall be generated. The test plan may include, but is not necessarily limited to:

— inspection intervals for each system and component
— inspection procedure for each system and component
— tools required and to be used.

DNV GL shall evaluate assumptions, specifications and requirements stated in the design as well as the test plans.

### 3.2 Phase II: Commissioning

#### 3.2.1 General

This subsection provides the details of DNV GL verification activities for the commissioning, the second phase of the DNV GL certification scheme for the navigation and aviation aids for offshore wind farms.

Within the commissioning DNV GL shall evaluate a safe and proper implementation of the navigation and aviation aids in the specific project by document assessment and inspections. The documentation includes general specifications, installation and commissioning protocols, and other assumptions relevant for the use of the aids in the project. The final documentation for the commissioning shall be submitted to DNV GL. The inspections shall be a reasonable combination of day and night inspections. Whenever possible general inspections may be done before transportation of the components to the offshore wind farm (e.g. at the fabrication yard).

The different commissioning inspections are defined in [3.2.2] to [3.2.9].

In general, each asset of the offshore wind farm (e.g. WT and OSS) shall be subject to inspections by DNV GL. The number of inspections and review of commissioning records of navigation and aviation aids shall cover at least 10% or two turbines (the larger of the two numbers shall be chosen) of the offshore wind farm as well as the offshore substation(s) (if existing) in order to obtain a representative picture of the assets of the offshore wind farm. The number may be increased in case of insufficient inspection results.

Once the evaluation of the commissioning has been successfully completed, DNV GL shall issue a statement of compliance for Phase II: Commissioning.

#### 3.2.2 Day marking

During the commissioning phase DNV GL shall check by witnessing and document assessment if all requirements, assumptions and specifications for the day marking have been correctly implemented in the specific project.

The following tasks are part of the commissioning inspections:

— visual overview inspection of the day marking systems
— detailed inspection of the installations and tests of correct functioning
— inspection of the condition of the coating and measurements of color values
— registration of failures, mechanical damages and corrosion
— recording of actual state of the day marking.
In addition, DNV GL shall assess test and commissioning records of the condition and functioning of the day marking systems.

### 3.2.3 Night marking

During the commissioning phase DNV GL shall check by witnessing and document assessment if all requirements, assumptions and specifications for the night marking have been correctly implemented in the specific project. The night marking usually consists of navigation lights, aviation lighting, identification panels and illuminated signboards.

The following tasks are part of the commissioning inspections:

- visual inspections of the overall condition of the navigation lights and aviation lighting
- installation of lights (type, orientation)
- visibility of lights
- inspections of the installations and tests of correct functioning
- inspections of the correct distribution of lighting
- inspections and measurements of light intensity values
- registration of failures, mechanical damages and corrosion
- recording of actual condition of the night marking
- check of correct harmonization of navigation light
- inspection of correct function of other night marking (identification panels, illuminated signboards etc.).

Commissioning protocols of all relevant components of the night marking shall be submitted to DNV GL.

### 3.2.4 Automatic identification system

Within the commissioning phase DNV GL shall inspect and check tests and records of the correct functioning of the AIS system. The following checks and function tests are part of the commissioning phase and shall be checked by DNV GL by witnessing and document assessment:

- system configuration as required
- installation of the components on the structure
- sending out message 21, content complete (according to relevant regulations), for all marked structures
- transmission range, measuring of transmitted power and voltage standing wave range (VSWR)
- behaviour in case of failure or power outage.

### 3.2.5 Radar

If the offshore wind farm is equipped with a radar system, the commissioning of the radar system may be subject to the commissioning inspections. It is dependent on the offshore wind farm specific design of the radar system as well as national standards.

The commissioning inspections shall be agreed between the owner and DNV GL during the commissioning planning with respect to required checks and functions tests during commissioning inspection and documents to be submitted to DNV GL.

The inspections may include, but are not necessarily limited to:

- general inspections of fixation of the components (e.g. screws, nuts, damages of corrosion protection, serviceability)
- inspections of electrical installation (e.g. cable routes, plugs, power supply)
- inspections of start-up procedures
- inspections of settings
- inspections of accurate operation after start-up.
3.2.6 Sonar

If the offshore wind farm is equipped with a sonar system, the commissioning of the radar system may be subject to the commissioning inspection. This is dependent on the offshore wind farm specific design of the sonar system as well as national standards (see [2.3.2]) and shall be aligned between the owner and DNV GL during the commissioning planning in terms of required checks and functions tests during commissioning inspection and documents to be provided to DNV GL. General inspections (e.g. fixation of components) shall be done at the fabrication yard, if possible.

The inspections may include, but are not necessarily limited to:

— general inspections of fixation of the components (e.g. screws, nuts, damages of corrosion protection, serviceability)
— inspections of electrical installation (e.g. cable routes, plugs, power supply)
— inspections of start-up procedures
— inspections of settings
— inspections of accurate operation after start-up.

3.2.7 Infrastructure

The installation of the components of the different marking systems shall be checked during the commissioning inspections by witnessing and document assessment.

The visual inspection focuses on all relevant mountings and installation systems required to fix the components on the structures. Main focus is on:

— avoidance of contact corrosion
— lightning protection
— components, fit for use in offshore environments
— installation is according to design
— installation protocols are correctly issued.

3.2.8 IT-Security

The implementation of the design shall be verified in the commissioning phase and the requirements according to ISO 27001 shall be followed and met.

3.2.9 Synchronization and harmonization of the marking

The synchronization and harmonization of the navigation lights and aviation lighting shall be checked during the commissioning inspections of the night marking by witnessing.

3.3 Phase III: In-service

3.3.1 General

This subsection provides the details of DNV GL’s verification activities for the optional third phase of the DNV GL certification system for the navigation and aviation aids for offshore wind farms.

The in-service inspections shall evaluate a safe and proper operation of the navigation and aviation aids in the specific project by document assessment and inspections throughout the whole lifetime of the specific offshore wind farm. The documentation includes general specifications, maintenance protocols, and other assumptions relevant for the use of the aids in the project.

If no international as well as national regulations exist the necessary intervals for inspections shall be agreed between owner and DNV GL and is dependent on the applied design.
The different in-service inspections are defined in [3.3.2] to [3.3.10].
Once the verification of the in-service inspections has been successfully completed, DNV GL will issue a statement of compliance for Phase III: In-Service.

3.3.2 Day marking
During the operation phase of the navigation and aviation day marking regular inspections have to be done to monitor the state and changes of the day marking systems. The following tasks are part of the in-service inspections:
— visual overall inspections
— inspection of the installations and tests of correct functioning
— inspection of the condition of the coating and measurements of colour values
— registration of failures, mechanical damages and corrosion
— recording of actual state of the day marking.

The day marking will be checked by DNV GL on the basis of measurement protocols, maintenance documentation and offshore inspection of the navigation and aviation aids.

3.3.3 Night marking
During the operation phase of the navigation and aviation night marking regular inspections have to be done to monitor the state and changes of the systems. The following tasks are part of the in-service inspections:
— visual inspections of the overall condition of the navigation lights and aviation lighting
— inspection of the installations and tests of correct functioning
— inspections of the correct distribution of lighting (section blends)
— inspection and measurements of light intensity values
— registration of failures, mechanical damages and corrosion
— recording of actual state of the night marking
— correct harmonization of navigation light shall be checked
— inspection of correct function of other night marking (identification panels, illuminated signboards etc.).

The night marking will be checked by DNV GL on the basis of measurement protocols, maintenance documentation and offshore inspection of the navigation lights and aviation lighting.

3.3.4 Automatic identification system
Regular inspections have to be executed during the in-service phase to monitor the state and changes of the AIS system. The following tasks are part of the in-service inspections and shall be checked by DNV GL by witnessing and document assessment:
— visual inspections
— inspection of the installations and tests of correct functioning
— registration of failures, mechanical damages and corrosion
— recording of breakdown statistics
— proof of availability.

3.3.5 Radar
If the offshore wind farm is equipped with a radar system, the in-service inspection of the radar system may be subject to the in-service inspections. This is dependent on the offshore wind farm specific design of the radar system as well as national standards and shall be aligned between the owner and DNV GL during the in-service inspection planning in terms of required checks and functions tests during in-service inspection and documents to be provided to DNV GL.
These inspections may include, but are not necessarily limited to:
- general inspection of fixation of the components (e.g. screws, nuts, damages of corrosion protection, serviceability)
- inspection of electrical installation (e.g. cable routes, plugs, power supply)
- inspection of settings
- inspection of accurate operation.

### 3.3.6 Sonar

If the offshore wind farm is equipped with a sonar system, the in-service inspection of the sonar system may be subject to the in-service inspection. This is dependent on the offshore wind farm specific design of the sonar system as well as national standards (see [2.3.2]) and shall be aligned between the owner and DNV GL during the in-service inspection planning in terms of required checks and functions tests during in-service inspection and documents to be provided to DNV GL.

These checks and functions tests may include, but are not necessarily limited to:
- general inspection of fixation of the components (e.g. screws, nuts, damages of corrosion protection, serviceability)
- inspection of electrical installation (e.g. cable routes, plugs, power supply)
- inspection of settings
- inspection of accurate operation.

### 3.3.7 Infrastructure

The installation of the components of the different marking systems will be checked during the in-service inspections by witnessing and document assessment.

The visual inspection focuses on all relevant mountings and installation systems required to fix the components on the structures. Main focus is on:
- avoidance of contact corrosion
- lightning protection
- components, fit for use in offshore environments
- installation is according to design
- maintenance protocols are correctly issued.

### 3.3.8 IT-Security

The security of the IT has to be assured by in-service tests. Necessary updates to the IT have to be documented and assessed. Requirements according to ISO 27001 have to be fulfilled.

### 3.3.9 Synchronization and harmonization of the marking

The synchronization and harmonization of the navigation lights and aviation lighting shall be checked during the in-service inspections of the night marking system in regular intervals by witnessing.

### 3.3.10 Availability assessment

The availability of the navigation and aviation aids shall be tracked and recorded. These records shall be submitted to DNV GL on a yearly basis on a summarized level to verify the availability in comparison to the design calculations. Countermeasures may be necessary if the availability during operational lifetime is lower than in the design calculations.
SECTION 4 RELATED SERVICES

4.1 General

This section provides a description of typical related services and systems. These have close links to the scope described and may be certified on an optional basis as part of the above described asset related certification or as stand-alone. These optional services are available on request, based on the individual needs.

These items would not exclusively relate to one of the navigation or aviation aids, but can be relevant for the offshore wind farm operation and maintenance. Thus these items can be part of the above described certification process, if contractually agreed. The subjects require an early consideration in the offshore wind farm planning.

4.2 Site-specific type certification

The project certification or parts of it are always project related, thus for a specific project intention and therefore linked to a defined site.

In general the adaptation and implementation of an existing type of turbine into a project is part of the project certification and described in DNVGL-SE-0190. An existing type certificate is used as basis.

Guidance note:

This work is typically done in collaboration between the project developer and the wind turbine manufacturer.

Alternatively it is possible to perform a site level certification according to DNVGL-SE-0441. The site level certification is introduced to be prepared for project certification of offshore and onshore projects. The site level certification aims at minimizing the efforts in project certification for the turbine manufacturer. In this case the implementation of an existing type of turbine into the project is facilitated. The site-specific type should already consider the project specific needs the wind turbine shall comply with. In the project certification the implementation of such a site-specific type certification will then be limited to checking that all current requirements of the project are being met.

4.3 Project certification

Project certification shall ensure that the offshore wind farm will operate safely and cost efficiently, risks are mitigated and all technical, design and construction requirements are being met. DNVGL-SE-0190 provides a flexible certification scheme to address individual needs, reduce the costs over the lifetime while not compromising on quality. In addition, it details and clarifies the certification activities and facilitate achieving compliance. This DNV GL scheme is also intended to cover the requirements implied when applying IEC related certification schemes. In general, the following assets may be covered by the services of project certification described in this SE:

— wind turbines and their support structure
— substation(s) including topside(s) and support structure(s)
— power cables
— control station.

The following certification phases are defined in DNVGL-SE-0190:

— Concept: covers the concept development at the beginning of the wind power project.
— Design basis: covers the site conditions and the basis for design.
— Design: covers the steps necessary to achieve final design approval. This includes the site-specific design approval of the integrated structural system of the project related assets.
— Manufacturing: covers the inspection during manufacturing of the project related assets.
— Transport and installation: covers the inspection during transport and installation of the project related assets.
— Commissioning: involves all follow-up evaluation and on-site inspections during the implementation and start of operation of the power plant.
— In-service: involves follow-up evaluation and periodic on-site inspections after start of operation and during the subsequent in-service period.
— Lifetime extension: covers the subject to continue to operate a wind power plant over its initial design lifetime.
— Decommissioning: contains the planning and execution of a wind power plant decommissioning and removal.
— Repowering: covers the renewal and reinstallation (typically upgrading) of a wind power plant at a former power plant site.
APPENDIX A  EXAMPLE CERTIFICATE/STATEMENT

PROJECT CERTIFICATE

Certificate No.:  PC-DNVGL-SE-0176-(ID with 5 digits)-(rev.)
Issued: [YYYY]-[MM]-[DD]
Valid until: [YYYY]-[MM]-[DD]

Issued for:

<Offshore Wind Farm>

Comprising:

<Navigation and aviation aids for Wind Turbines, Substation, other installations>

Specified in Annex 1

Issued to:

<Offshore Wind Farm Developer>

< Address line >
< Address line >

According to:

DNVGL-SE-0176:2017-05 Certification of aviation and navigation aids of offshore wind farms

Based on the documents:

D-DNVGL-SE-0176-[ID]-[rev.] Design Statement of Compliance, dated yyyy-mm-dd
COM-DNVGL-SE-0176-[ID]-[rev.] Commissioning Statement of Compliance, dated yyyy-mm-dd
FCR-DNVGL-SE-0176-[ID]-[rev.] Final Certification Report, dated yyyy-mm-dd

The project certificate remains valid if maintenance of the project certificate is successfully carried out per Annex 2.

Changes of the certified aviation and navigation aids of the offshore wind farm are to be approved by DNV GL.

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

[Name of SS for "Cert. decision"]
[Function]

[Name of PM "doing it"]
[Function]

The accredited certification body is Germanischer Lloyd Industrial Services GmbH, Bremerstrasse 18, 20457 Hamburg.

DNV GL Renewables Certification is the trading name of DNV GL's certification business in the renewable energy industry.

Figure A-1 Project certificate
STATEMENT OF COMPLIANCE

Statement No.: [DNVGL-SE-0176-[ID with 5 digits]-[rev.]] [YYYY-MM-DD]

Issued for:
Design of
<Offshore Wind Farm>
Comprising:
<Navigation and aviation aids for Wind Turbines, Substation, other installation>
Specified in Annex 1

Issued to:
<Offshore Wind Farm Developer>
< Address line >
< Address line >

According to:
DNVGL-SE-0176:2017-05 Certification of aviation and navigation aids of offshore wind farms

Based on the documents:
CR-D-DNVGL-SE-0176-[ID]-[rev.] Certification Report, dated yyyy-mm-dd

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

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

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

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

Figure A-2 Statement of compliance
CHANGES – HISTORIC

There are currently no historical changes for this document.
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.