Type and Project Certification (Update 2012)

Mike Woebbeking et al
Germanischer Lloyd Industrial Services GmbH, Renewables Certification (GL RC)
Brooktorkai 18, 20457 Hamburg, Germany
Phone: + 49 40 – 3 61 49 – 33 07
Fax: + 49 40 – 3 61 49 – 17 20
Mike.Woebbeking@gl-group.com

Abstract: *Certification of wind farms, wind turbines and their components is state-of-the-art and a must in most places around the world. Furthermore certification to harmonised requirements is an active support of export. The benefit of Type and Project Certification for manufacturers, banks and insurances is described making use of the different certification processes as well as guidelines. The modules to obtain Type and Project Certificates are shown in detail according to the Guideline for the Certification of Wind Turbines, Edition 2010 [2]. Offshore Aspects are mentioned based on the Guideline for the Certification of Offshore Wind Turbines, Edition 2005 [3]. Type Certification comprises Design Assessment, Implementation of the design-related requirements in Production and Erection, Evaluation of Quality Management and Prototype Testing. Project Certification is based on Type Certification and covers the aspects of Site Design Conditions, Site Specific Design Assessment, Surveillance during Production, Transport and Erection as well as Commissioning and Periodic Monitoring. Each individual module is concluded with a Statement of Compliance. Certificates are issued upon the successful completion of the relevant modules leading to safe, reliable and successful projects and wind turbines.*

1 Introduction

Certification of wind turbines has a history of thirty years. It has been applied differently in scope, requirements and depth in e.g. Denmark, Germany and India each on the basis of their own rules. These countries are still leading in the development and application of certification rules but during recent years a number of other countries such as China, USA or Japan as well as many banks and insurance companies realised the necessity of a thorough evaluation and certification of wind turbines and wind farms. Assessment by certification standards builds confidence and differentiates between products, ensures safety, promotes exports and can create a global market for the technology. Therefore, it is important for all the parties involved throughout the lifecycle of a project to know the different certification processes, standards and guidelines as well as the keystones of their development.

In general, assessment, expertise and certification of wind turbines with respect to technical integrity and safety requirements become more apparent with view to demonstrate functionality and structural reliability. In particular Project Certification gives the possibility to assess technical integrity of the wind turbine due to site specific demands (e.g. higher grid outages, icing, hot or cold climate as well as e.g. wake effects in wind park configuration) to ensure reliability of the wind turbines on site. Minimising of risks and building up confidence to investors, insurances, operators and authorities are the main aspects of a third party assessment within the Project Certification, onshore and offshore.

2 Certification

According to the international standard ISO/IEC 17000, certification is the confirmation of compliance of a product or a service with defined requirements (e.g. guidelines, codes and standards). International standards and guidelines are used to carry out Type Certification and Project Certification in the wind turbine branch.

It is common practice to perform Type Certification (see chapter 4) for the complete wind turbine and Project Certification (see chapter 5) for the complete wind farm. Furthermore components and systems can be certified to enable sub-suppliers entering the market.

3 Guidelines

In 1986 GL created a first comprehensive certification procedure for international Type Certification and Project Certification which in its roots still applies today, but was enhanced in order to cover the practical aspects and the experiences and developments in the field.

International standardisation efforts on wind turbine certification procedures started in 1995 within IEC and resulted in the first issue of IEC WT01 [1] published by the IEC in April 2001 and substituted by IEC 61400-22 [6]. The certification procedure according to [1,6] as well as the procedure according to GL [2,3] have been introduced internationally and are the most important guidelines for certification of onshore and offshore wind turbines and wind farms.

4 Type Certification

Type Certification applies in general for a generic design of a wind turbine. To attain a Type Certificate the modules as shown in figure 1 are to be carried out.

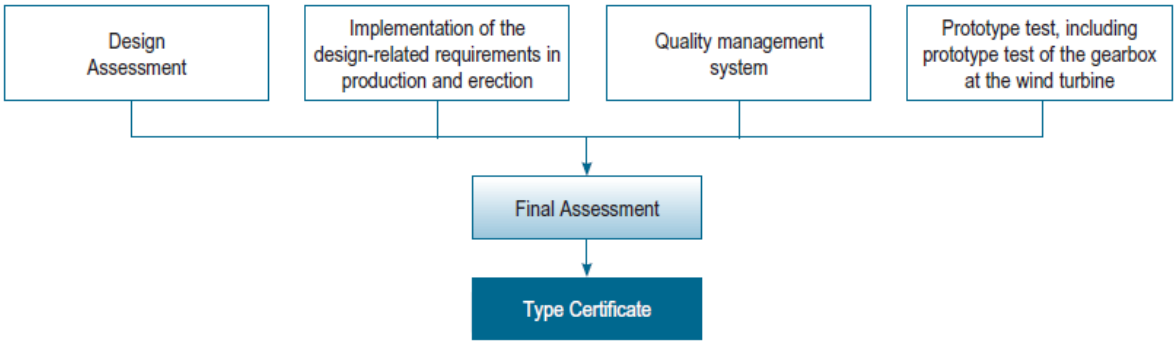


Figure 1: Modules of Type Certification

For each module a Statement of Compliance will attest the conformity with the guideline. The Type Certificate will list these statements and finalise the certification of the wind turbine type. Examples for both documents are shown in figure 2. A re-certification is possible to renew the certificate. Furthermore alternative components can be included step by step.

Figure 2: Examples for Statement of Compliance (left) and Type Certificate (right)

4.1 Design Assessment

Design Assessment acc. to [2] can be divided into four parts: A-, B-, C- and D-Design Assessment. The C-Design Assessment can be used to erect the prototype of a wind turbine. Within this C-Design Assessment, a plausibility check of the design documentation for the prototype will be performed. The scope for a D-Design Assessment is similar to a C-Design Assessment, but has no correlation with a site (foundation and site data).

A- and B-Design Assessment consist of a complete examination of the design analyses with all required material and component tests. It will be completed with the commissioning witnessing of one of the first wind turbines of the assessed type. Compared to the A-Design Assessment, the B-Design Assessment may contain outstanding items, if these are not directly safety-relevant. Furthermore the validity period is limited to one year. This period can be used to fulfil all requirements for the A-Design Assessment which contains no outstanding items and does not expire unless the design is modified.

According to [2] the following documents in the form of specifications, calculations, drawings, descriptions and / or parts lists are to be assessed:

- control and safety concept
- load case definitions / load assumptions
- safety system
- rotor blades and blade test reports
- nacelle housing and spinner
- machinery components (including prototype test of the gearbox on an adequate test bench)
- structural components
- electrical installations, including lightning protection and tests
- tower and, optionally, foundation or support structure
- manuals and procedures for transport, erection, start-up, commissioning, operating and maintenance
- other optional items like personnel safety, fire protection system, condition monitoring systems (mandatory offshore)

The load case definitions and the load assumptions / load calculations can optional be performed according to the International Standards IEC 61 400 – 1, 2nd edition [4] or IEC 61 400 – 1, 3rd edition [5] instead of the GL Guideline [2]. If this is done all requirements specified in the respective IEC standard will be used for design and certification. Topics not specified in the IEC standard will be dealt with according to the GL Guideline [2]. It is recommended using IEC 61 400 – 1, 3rd edition since the 2nd edition is about to be withdrawn in several countries and the 4th edition is under preparation already.

4.2 Implementation of the design-related requirements in Production and Erection (IPE)

IPE shall ensure that the requirements in the technical documentation of the components are observed and implemented in production and erection of the wind turbine. This will be shown by the manufacturer of the components and the manufacturer of the wind turbine to the certification body.

4.3 Quality Management system of the manufacturer and designer

It will be shown that the manufacturer and designer meet the requirements of ISO 9001:2008 with regard to the design and manufacturing process. In general the QM system is certified by an accredited certification body.

4.4 Prototype Test

Within the scope of Prototype Testing measurements of the power curve, noise emission (optional) and electrical properties as well as a test of wind turbine behaviour and load measurements are carried out by an accredited measurement institute in order to validate the design calculations and to verify the performance of the safety control systems The institute should be accredited according to ISO 17025 otherwise witnessing of the tests is performed. Furthermore the prototype of the gearbox is to be tested on the wind turbine in addition to the bench test. Additional tests and certification for e.g. grid code compliance may also be covered to support the availability, safety and export of the turbines. All resulting test reports will be checked for plausibility of the measured results and compared to the assumptions in the design documentation.

5 Project Certification

Project Certification covers the aspects of assessing site design conditions and suitability of the wind turbine for a given site. The individual modules are given in figure 3.

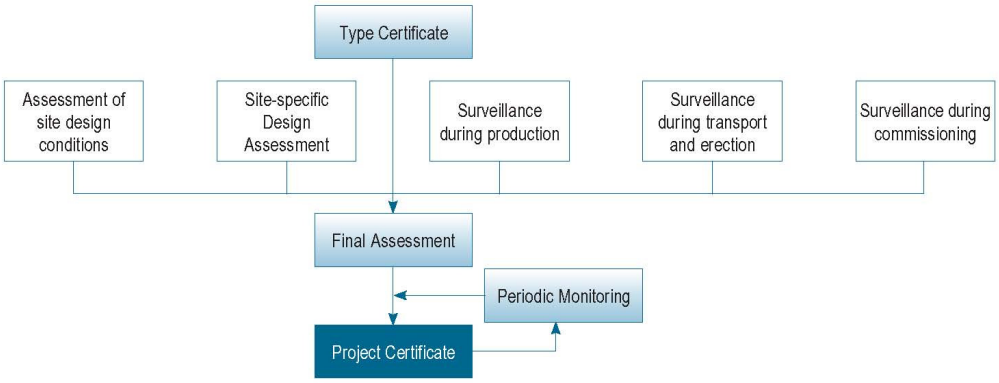
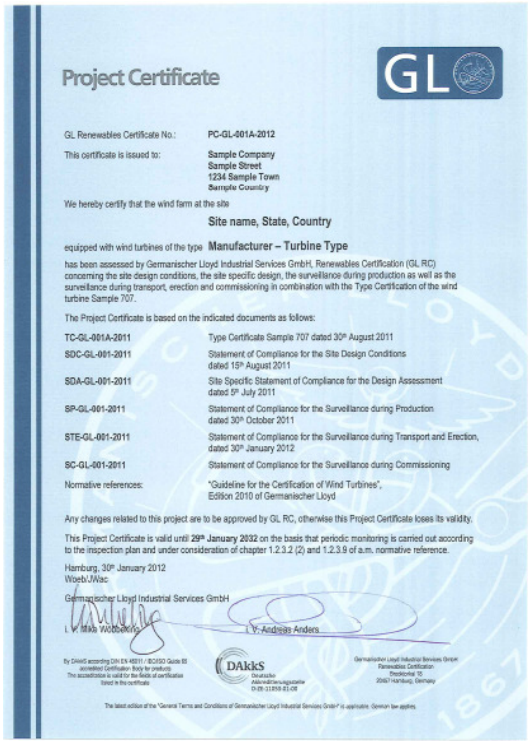


Figure 3: Modules of Project Certification

Upon successful assessment of the different modules shown in figure 3, the Project Certificate as shown in figure 4 will be issued remaining valid as long as the Periodic Monitoring is carried out.



Project Certificate

GL Renewables Certificate No.: PC-GL-001A-2012

This certificate is issued to: Sample Company, Sample Street, 1234 Sample Town, Sample Country

We hereby certify that the wind farm at the site

Site name, State, Country

equipped with wind turbines of the type Manufacturer – Turbine Type

has been assessed by Germanischer Lloyd Industrial Services GmbH, Renewables Certification (GL RC) concerning the site design conditions, the site specific design, the surveillance during production as well as the surveillance during transport, erection and commissioning in combination with the Type Certification of the wind turbine Sample 707.

The Project Certificate is based on the indicated documents as follows:

TC-GL-001A-2011	Type Certificate Sample 707 dated 30th August 2011
SDC-GL-001-2011	Statement of Compliance for the Site Design Conditions dated 15th August 2011
SDA-GL-001-2011	Site Specific Statement of Compliance for the Design Assessment dated 5th July 2011
SP-GL-001-2011	Statement of Compliance for the Surveillance during Production dated 30th October 2011
STE-GL-001-2011	Statement of Compliance for the Surveillance during Transport and Erection, dated 30th January 2012
SC-GL-001-2011	Statement of Compliance for the Surveillance during Commissioning
Normative references:	"Guideline for the Certification of Wind Turbines", Edition 2010 of Germanischer Lloyd

Any changes related to this project are to be approved by GL RC, otherwise this Project Certificate loses its validity.

This Project Certificate is valid until 29th January 2032 on the basis that periodic monitoring is carried out according to the inspection plan and under consideration of chapter 1.2.3.2 (2) and 1.2.3.9 of a.m. normative reference.

Hamburg, 30th January 2012
WoebJWac

Germanischer Lloyd Industrial Services GmbH

i. V. Mike Wobbeking i. V. Andreas Anders

Figure 4: Example for Project Certificate

5.1 Site Design Conditions

Within an Assessment of Site Design Conditions, the site conditions will be checked and compared to the parameters used for the generic design assessment of the wind turbine (part of the Type Certification). Documentation to the following categories will be assessed:

- Wind conditions
- Soil conditions
- Influence of the wind farm configuration
- Electrical grid conditions
- Other environmental conditions such as salt content of the air, temperatures, ice and snow, humidity, lightning strike and solar radiation

The Site Assessment will be concluded with a Statement of Compliance for Site Design Conditions.

In case conditions at the site are not covered by design parameters, a design assessment shall be performed applying the site-specific conditions. The generic Design Assessment will be enhanced to a Site Specific Design Assessment (see chapter 5.2).

5.2 Site Specific Design Assessment

The Site Specific Design Assessment extends the Design Assessment as part of the Type Certification to the site specific conditions. Due to the following reasons a Site Specific Design Assessment has to be performed:

- Site conditions are not covered by design parameters or
- Design of the wind turbine to be installed deviates from the design assessed as part of the Type Certification (e.g. tower developed for the wind farm only or change in rotor diameter)

In case of offshore wind farms anyway a Site Specific Design Assessment of the support structure (primary steel) will be performed:

- Tower
- Transition piece (if any)
- Monopile (or other) substructure
- Assessment of the complete system
- Eigenfrequencies machinery / support structure / soil

5.3 Manufacturing Surveillance

Before manufacturing surveillance may begin, certain Quality Management (QM) requirements shall be met by the manufacturer. As a rule, the QM system should be certified to comply with ISO 9001:2008; otherwise the QM measures can be assessed by the certification body within the Project Certification. The extent of the surveillance during production depends on the level of the QM measures. In general, actions and approvals like inspection and testing of materials and components, scrutiny of QM records (test certificates, reports), surveillance of production, inspection of the corrosion protection and of the electrical power system will take place.

The manufacturing surveillance is a continuation of the IPE for selected components. Instead of one approval of the manufacturer's competence as per IPE, the manufacturing surveillance is a continuous inspection on spot basis and performed randomly.

5.4 Transport and Installation Surveillance

At the wind farm site the important steps during installation shall be monitored. Prior to this monitoring, the transportation of the components from the manufacturer's works to the relevant site will be surveyed.

Before starting, an installation manual shall be prepared containing all actions under consideration of the special circumstances of the site. Furthermore, a site plan showing the locations of the wind turbines shall be prepared, together with plans of the electrical installation showing how the plant will be connected to the public mains supply.

The transport and installation inspector (TII) will secure quality during transport and installation in terms of the certification and on behalf of the client.

In case of offshore projects the marine warranty surveyor (MWS) is required by the insurer and comprises:

- Assessment of the selected ships/barges and equipment
- Marine operations / environmental conditions (in the sense of `loss of cargo`)

5.5 Commissioning Surveillance

Commissioning surveillance deals with the transition of the finalised installation to get the wind turbine into operation. Surveillance of commissioning is to be performed for the wind turbines of the wind farm and shall

finally confirm that the wind turbines are ready to operate and in compliance with the assumptions during the thorough assessment. Commissioning will be performed according to the previously approved procedures for all components related to operation and safety.

5.6 Periodic Monitoring

Periodic Monitoring is necessary to maintain the validity of the Project Certificate and is carried out in regular intervals of e.g. two years. Periodic Monitoring shall be carried out by authorized persons and shall contain at least the main components (e.g. rotor blades, gearbox, tower), the electrical installations, the hydraulic and pneumatic system and the safety and control system.

Scope of Periodic Monitoring:

- 25% of the wind turbines per year
- After 4 years all wind turbines shall have been inspected
- Annual inspection of transformer station offshore

6 The Certification Body

GL RC is an internationally operating certification body for wind turbines and related technology. GL RC carries out examinations, certifications and expertises and is actively involved in the development of national and international standards. GL RC offers the complete range of services for wind turbine and wind farm certifications and third party inspections as well as any kind of expertise reporting. Certification is among others carried out on the basis of the GL Guideline for the Certification of Wind Turbines (Edition 2010) [2] as shown in figure 5 and the Guideline for the Certification of Offshore Wind Turbines (Edition 2005) [3]. Both guidelines are regularly updated by Notes on Engineering Details and supplemented by Technical Notes - both available on GL RC´s homepage (www.gl-group.com/GLRenewables). Furthermore, GL RC is accredited to carry out certification in accordance with all relevant national and international standards in the field of wind and marine energy.

Figure 5: Guideline [2]

7 Conclusion

The rapid growth of the wind energy industry and the growing size of wind farms enforce financing banks and insurance companies as well as authorities to require reliability and safety assessments of these projects. The assessments are carried out within the certification of the types of components, turbines and the wind farms, onshore and offshore. Within the framework of the certification of wind turbines, reliability, safety, strength and fatigue are evaluated in order to guarantee safe operation. Minimising of risks and building up confidence to investors, insurances, operators and authorities are the main aspects of a third party assessment within the certification process.

8 References

[1] IEC WT 01: “IEC System for Conformity Testing and Certification of Wind Turbines, Rules and Procedures”, 2001-04

[2] Germanischer Lloyd, Hamburg, Germany: “Guideline for the Certification of Wind Turbines”, Edition 2010

[3] Germanischer Lloyd, Hamburg, Germany: “Guideline for the Certification of Offshore Wind Turbines”, Edition 2005

[4] IEC 61 400 -1 “Wind turbine generator systems – Part 1: Safety requirements”, second edition February 1999

[5] IEC 61 400 -1 “Wind turbine generator systems – Part 1: Design requirements”, third edition August 2005

[6] IEC 61 400 -22 “Wind turbines – Part 22: Conformity testing and certification”, first edition May 2010

For further information:

Author: Mike Woebbeking

Address: Germanischer Lloyd Industrial Services GmbH, Renewables Certification (GL RC)
Brooktorkai 18
20457 Hamburg
GERMANY

Phone: +49 (0) 40 - 3 61 49 - 33 07

Fax: +49 (0) 40 - 3 61 49 - 17 20

Email: Mike.Woebbeking@gl-group.com