THE NEW GUIDELINE FOR THE CERTIFICATION OF WIND TURBINES, EDITION 2010

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Abstract: *Certification of wind farms, turbines or components is state-of-the-art and a must in most places around the world. Furthermore assessment to harmonised regulations is an active support of export and eases market entries. Therefore it is important to know the different certification processes and guidelines as well as the keystones of their development for all parties involved in a project lifecycle.*

This paper puts focus on the latest guideline developments for GL 2010: Guideline for the Certification of Wind Turbines, Edition 2010 and describes the outcome and latest innovations of Germanischer Lloyd and its technical committee for certification of wind turbines and projects onshore.

Based on [12] it informs about some changes in detail.

1 The Introduction – get an overview

The procedures to obtain Type and Project Certificates are described on the basis of GL 2010: Guideline for the Certification of Wind Turbines, Edition 2010.

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 Witnessing of Commissioning and Periodic Monitoring. The individual modules are concluded with Statements of Compliance. Certificates are issued upon the successful completion of the relevant modules.

The most important part of the Type Certification is the assessment of the design documentation, a thorough design review with respect to the requirements defined in the a. m. guideline and other codes and standards. It is generally carried out in two sequential steps. The first part covers all aspects of the safety and control concept as well as the load assumptions and load calculations.

During the second part of the Design Assessment all components of the system are being examined. At the end of the Design Assessment manuals and procedures for transport, erection, start-up, commissioning, operation and maintenance are checked for suitability, completeness and compliance with the assumptions in the design documentation. Rotor blade testing as well as prototype testing of e.g. main gearbox and generator are an integral part of the Design Assessment. In addition to this the Implementation of the design requirements in Production and Erection (IPE) shall be observed. This is shown once to the certification body by the manufacturers of the components and the wind turbine. The evaluation of the manufacturer's quality management covers the whole range of activities necessary to confirm the quality of the product. In order to validate the design calculations, to optimise control, performance and (optional) noise behaviour and to verify the performance of the safety and control systems the Prototype Testing was made an integral part of the design and certification process. The measurements shall be based on the relevant standards and are to be performed by institutes accredited according to ISO 17025 [7]. Furthermore the prototype of the gearbox shall be tested on the wind turbine in addition to the test on the bench. Additional parts of certification such as personnel safety, fire

protection, condition monitoring systems, maintenance systems, hot and cold climate or grid code compliance may be covered, too, to support e.g. availability, safety or export of the turbines.

Project Certification comprises a complete third party assessment and certification of a wind farm from Site Design Conditions to (Site-specific) Design Assessment as well as surveillance of most important steps in the project and Periodic Monitoring.

After the completion of evaluations, monitoring and witnessing, the certification body issues Statements of Compliance for the relevant steps and components / units. Certificates are being issued upon finalisation of the Component, Type and Project Certification.

In the first months of 2010 GL is finalising the revision of its guideline which will be published as GL 2010 including the state-of-the-art in certification and the actual knowledge about turbine design requirements. This paper covers the latest developments for the new guideline which will be published this year and will have effect on forthcoming wind turbine developments worldwide. It focuses on load calculations, international markets and reporting needs. To learn more about Type and Project Certification in general, the international guideline history or for a complete list of all changes covered by the new edition see [12]. Find out all about the changes and developments to be one of the first knowing all about GL 2010.

2 The Project – a long way to go

Early 2008, the existing GL-Guideline of 2003/2004 [2] was an established and worldwide used document. At that time the first meetings were held to discuss the next edition of this onshore guideline for the certification of wind turbines and wind farms. After clarification of the main tasks and the overall time-frame for the update the detailed planning started.

The project covers:

- review and revision of all chapters and sections of the existing edition,
- clarification of new information with regard to concepts, developments and solutions of both technical and certification background,
- harmonization with existing guidelines and standards,
- preparation of draft chapters and sections including revisions and new items,
- discussion and clarification of all drafts in the Wind Energy Committee of GL,
- layout, editorial office, translation and – finally –
- print and publication.

Thus three phases were identified. Phase one, starting in the middle of 2008 to prepare the new guideline on basis of drafts. Phase two, starting early 2009 to initiate the meetings of the Wind Energy Committee. Phase three, coming to an end now in the first months of 2010 to get to the final text and publish the new guideline in 2010.

All parts of GL 2003/2004 have been subject to review, discussions and improvements. The procedures for Type and Project Certification have been updated and component certification was stated explicitly; modules and elements have been revised and explained in more detail or deleted if no more necessary. Experience of several hundred certification projects on basis of the 2003/2004-edition resulted in optimised text, new information or additional annexes and notes. All references have been evaluated and updated in case new information is available. Additionally all Notes on Engineering Details issued by GL in the past years have been included. Thus the forthcoming edition represents the state-of-the-art with regard to the whole wind turbine or complete project.

The edition of this guideline called “GL 2010” covering onshore wind turbines and wind farms as well as components will come into force in 2010. Once published GL 2010 replaces GL 2003/2004 and forms a new and trend-setting basis for certification activities to ensure safety and reliability of wind turbines and wind farms worldwide. GL 2010 will become a worthy successor of the existing guideline – thanks to all the effort of GL- and external experts and especially the Wind Energy Committee with several unnamed experts of members’ companies in the background.

3 The Update – in detail

3.1 The Update – in general

Reading and using GL 2010 you may expect updates on almost all sections and chapters. In the following find some selected topics this paper will shed some light on. Expect more detailed information on all of the items in the months to come and feel free to visit our webpage (www.gl-group.com/GLRenewables) or contact us directly.

3.2 The Update – load calculations

In GL 2010 no load time series are required for C- and D-Design Assessments. These are assessments of prototypes or turbines under development not asking for thorough fatigue evaluations at this stage of testing and development. The Note on Engineering Details for D-Design Assessments is included in the guideline now. This enhances the options for different types of certification and makes it easier to benefit from certified products.

In general load calculations according to IEC 61400-1:2005 [5] and IEC 61400-1:1999 [4] are accepted as equivalent. An optional appendix can be used for detailed description on relevant parameters of control and safety system for load calculations. Doing this the options for the user of the guideline are maximised.

The procedure to evaluate loads for turbulent EWM (extreme wind speed model) load cases is modified; now it consists of an evaluation of 3 representative seeds of at least 15 seeds at I=11% instead of seeds with confirmed gust criteria at moving 3s-average. Furthermore the turbulence scale parameter $\Lambda 1$ for NTM (normal turbulence model) and EOG (extreme operating gust) is harmonized with IEC 61400-1:2005 ($\Lambda 1$=42m instead of $\Lambda 1$=21m as indicated in IEC 61400-1:1999). Therefore the equation for EOG is adapted. Last but not least positive and negative EWS (extreme wind shear) are to be considered for horizontal and vertical direction now.

The design load cases (DLC) are optimized as follows:

- DLCs are divided into two groups: mandatory DLCs (DLC 1.x to DLC 8.x) in one table and optional DLC 9.x in a separate table
- Both tables are restructured
- Non-relevant load cases DLC 1.8, 1.9, 3.3, 6.0, 6.5 removed
- Vortex induced transverse oscillations (old DLC 8.3) are moved from load chapter to tower chapter
- Transition of former DLC 1.4, 1.10, 1.11, 1.12, 1.13 into optional group DLC 9.x where manufacturer decides on scope of assessment.
- Merging of extreme load cases and fatigue load cases into combined extreme and fatigue load cases: e.g. DLC 1.1 + DLC 1.2 -> DLC 1.1; DLC 2.1 + DLC 2.2 + DLC 2.3 -> DLC 2.1 + DLC 2.2
- Mass eccentricity of rotor and all relevant components of the drive train is to be considered, e.g. eccentricity of direct drive generators

These measures will contribute to easier and faster load simulations and assessments.

Completely new chapter on controller assessment addressing Load Relevant control and safety system Functions (LRF) including controller assessment from GL 2003/2004, section 2.1.3 (now Alternative 1) plus new approach verifying the controller by a description of the controller development process, functional testing and an inspection of testing by GL (Alternative 2).

3.3 The Update – national requirements

3.3.1 Local markets

Local markets and their requirements and regulations are becoming more and more important. Whereas the existing guideline [2] covered the countries Germany, Denmark, France, The Netherlands and India, the forthcoming guideline GL 2010 will provide information on many more regions worldwide – e.g. Canada and China as listed below. Thanks to several editors worldwide this shall ease the entry to these markets and provide further information on relevant regulations and how to deal with them. Additionally most of the national requirements may be covered by one single certification project if known in advance. The individual scope of such certification projects should be defined between applicant and certification body as early as possible to fulfil the needs of all parties involved. Setting up such a “design basis” accelerates the whole process of certification and extends the usage of certificates.

3.3.2 National requirements in Canada

Section A of the Canadian guide [13] gives a general introduction, describes the scope of the document, and provides background information on the situation in Canada as well as on available and applicable standards.

The guide provides general information on codes and standards regarding the approval, design, installation, operation and maintenance of wind turbines for use in Canada.

Section B includes specific information on zoning, public hearings, power purchase agreements, building permits, electrical plan approval/permitting, site suitability, evaluation of impact on water, air, and wildlife, acoustic noise, electrical connections (off-grid and grid-connected) as well as technical information on foundations, towers, markings, electrical safety, environmental design considerations / external conditions, load cases, lightning protection, rotor blades, mechanical systems, performance measurement, power quality and worker safety.

3.3.3 National requirements in China

The approval of wind turbines within China by a third party or accredited certification body is not mandatory yet. However, due to the ongoing development of the wind energy industry in China, the responsible ministry is in hearing with the aim of promulgating the relevant rules in a statutory form.

At present, the competent Chinese authority – the Standardization Administration of the People's Republic of China (SAC) – assigns the standard SAC TC50 in correspondence with IEC TC88 in harmonizing the relevant technical standards for the wind energy industry. The accreditations of GL for the certification of wind turbines and for the certification of quality systems are recognized in China.

For some aspects there is no standard, and some of the existing national standards are based on earlier versions of IEC standards, which need to be updated. In addition, there is a lack of adequate observation data, analysis and research in the aspect of wind resources and wind conditions (wind model).

Therefore, wind power-related standards have been drafted and revised in the past few years, mainly including IEC WT01:2001 [1] combined with specific conditions, resulting in the Rules and Procedures for Conformity Testing and Certification of Wind Turbines.

With respect to further IEC standards, the other wind turbine-related national standards (including blade, tower, gearboxes, generators etc.) as well as wind turbine testing standards will be revised.

In addition, under the support of the Chinese government, the installation of hundreds of met masts in those regions with good wind resources has commenced, in order to carry out wind resource observations. The resulting data will be used to develop research on Chinese wind conditions (wind model).

Details on the different regulations and standards may be found in GL 2010.

3.4 The Update – reporting needs

For the annual update and in case of a re-certification, the following documents shall be submitted for evaluation:

- list of valid drawings and specifications (for re-certification only)
- list of current manufacturing facilities (for re-certification only)
- list of all modifications to the design of components forming a part of the design assessment or IPE and, if applicable, documents for evaluation of the modifications
- list of alterations to the QM system since the last audit (for re-certification only)
- list of all installed wind turbines of the type (at least a statement of the type with precise designation of the variant, serial number, hub height, location)
- list of all damages to components of the installed wind turbines forming a part of the design assessment or IPE
- declaration on possible changes or additions to workshops and / or store-houses (for annual update only)

Whereas the items are clearly described it was always difficult to figure out which modifications or damages are to be reported as indicated above. What is a "major" modification or which damage is severe enough to be included? To answer these questions two tables are included in GL 2010 giving a first indication. In case of further needs for clarification feel free to contact us.

Table 1: Examples for modifications or damages to be reported

Rotor blade	*Cracks in the laminate and adhesive*	*- list of damages* *- root cause analysis*
Planet carrier of main gearbox	*Change of material*	*- list of modifications* *- changed documentation*
Bolted connection of hub/rotor shaft (multiple bolt connection)	*Change in number of bolts*	*- list of modifications* *- changed documentation*

Table 2: Examples for modifications or damages not necessarily to be reported

Cover of main shaft	*Change of material*	-
Fixture for control cabinet	*Broken once*	-
Bolted connection of tower platform	*Change in size of bolts*	*- depending on scope of certification (see Note in Section 1.1.1)*

4 The Certification Body – who we are

Germanischer Lloyd Industrial Services GmbH, Renewables Certification (GL) is an internationally operating certification body for wind turbines, wind farms and related technologies. GL carries out examinations, certifications and expertises and is actively involved in the development of national and international standards. GL offers the complete range of services for certifying wind energy products and projects. Certification of small, medium and large wind turbines is carried out e.g. on the basis of the GL Guideline for the Certification of Wind Turbines (Edition 2003 with Supplement 2004 to be subsituted by Edition 2010) and the GL Guideline for the Certification of Offshore Wind Turbines (Edition 2005). All GL-guidelines are regularly updated by Notes on Engineering Details and supplemented by Technical Notes which are available on GL´s webpage (www.gl-group.com/GLRenewables). Furthermore, GL is accredited to carry out certification in accordance with all relevant national and international standards in the field of wind energy.

5 The Conclusions – further information coming soon

The strong growth of the wind energy industry and the growing size of wind farms as well as turbines enforce financing banks and insurance companies as well as authorities to require reliability and safety assessments of these products and projects. Additionally the market for small and medium wind turbines becomes more and more important and a thorough technical review is required, too. The assessments are carried out within the certification of the types of components, turbines and the wind farms. 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, insurers, operators and authorities are the main

aspects of a third party assessment within the certification process. The forthcoming guideline GL 2010 will contribute to these objectives and thus support the whole industry.

Await further information on GL 2010 in the near future and contact us for a first draft document and information on the final release of GL 2010.

6 The References – and more information

[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 2003 with Supplement 2004

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

[4] IEC 61400-1: "Wind turbine generator systems – Part 1: Safety requirements", second edition February 1999

[5] IEC 61400-1: "Wind turbines – Part 1: Design requirements", third edition August 2005

[6] IEC 61400-22: "Conformity Testing and Certification of Wind Turbines", first edition, draft 2009

[7] ISO / IEC 17025: "General requirements for the competence of calibrating and testing laboratories", 2005

[8] Woebbeking, M. et al: "Wind Turbine Certification and Type Certification, IEC WT 01: IEC System for Conformity Testing and Certification of Wind Turbines", 2001-04, Proceedings, World Wind Energy Conference, Beijing, 2004

[9] Woebbeking, M.: "Type and Project Certification", Proceedings, Wind Power Shanghai, 2007

[10] Woebbeking, M.: "IEC WT 01 – Development of the Second Edition and Innovations in Certification of Wind Turbines", Proceedings, European Wind Energy Conference, Milano, 2007

[11] Woebbeking, M.: "IEC TS 61400-22 (First Revision of IEC WT 01) – The new standard for Wind Turbines and Wind Farms – Onshore and Offshore", Proceedings, WindPower Asia, Beijing, 2008

[12] Woebbeking, M.: "The forthcoming GL-Guideline for onshore wind energy – GL 2010", Proceedings, Windpower China, Beijing, 2009

[13] Canadian guide: "CSA Guide to Canadian wind turbine codes and standards – Draft version 1.2 – January 2008" (www.csa.ca)

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