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1. GL Introduction
2. Definition of Certification
3. Certification according to IEC 61400-2
4. Electro Magnetic Compatibility (EMC)
5. Advantages of certification
GL’s History in Renewables (Wind)

1977  First activities in Wind Energy
1980  Examination GROWIAN and small wind turbines
1984  Test Fields Pellworm / Kaiser-Wilhelm-Koog
1986  1st Guideline (onshore)
1994  European Offshore Study  
       1st Offshore-Wind Guideline
2001  start of FINO I research project
2007  Expansion of services with Helimax
2009  Garrad Hassan joins GL
2010  GL Onshore Guideline 2010 containing SWT
2012  GL Offshore Guideline 2012
Our geographical reach – Experts in Renewables

- ~800 staff
- ~40 locations
- ~20 countries

GL Garrad Hassan + GL Renewables Certification
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Definition of Certification (ISO / IEC 17000)

Certification means in short:

- Confirmation for compliance of a product (e.g. wind turbine) with defined requirements (e.g. standard)
Certification – Applicable International Requirements

- IEC 61400-2:2006, Ed.2
  “Design requirements for small wind turbines”

- IEC 61400-2, Ed.3 expected in 2013

- International Standard IEC 61400-series

- other national standards, e.g. DIBT, Renewables UK (BWEA), MCS, AWEA, DEO, etc.
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Scope and extent of Application

- Swept rotor area smaller than 200m², acc. to IEC 61400-2:2006, Ed.2 and
- AC voltage <1000V or DC voltage <1500V.
- IEC 61400-2 deals with safety philosophy, quality assurance and engineering integrity
- Requirements for the safety of SWT including design, installation, maintenance and operation under specified external conditions
- Appropriate level of protection against damage from hazards from these systems during their planned life-time

Source: Picture courtesy of Gaia-Wind.com, copyrights apply
General scope according IEC 61400-2

• **Recommendation ISO 9001:2008**
  regarding design, procurement, manufacture, installation, operation and maintenance of the SWT and their components

• **External Conditions**
  • Environmental (wind and others)
  • Electrical (network and local)
  • Soil conditions (foundation)
**IEC 61400-2 evaluation path**

1. **SWT**
   - Voltage $< 1000$ V AC or $< 1500$ V DC

2. **Area** $< 200$ m²?
   - **No** → IEC 61400-1
   - **Yes** →

   Determination of design loads, design data testing

3. →
   - Component test / analysis, static blade test

4. →
   - Electrical and protection system design

5. →
   - Duration test, system safety and function test

6. → **Certificate**
Design methodology and loads

- Simplified load equations (horizontal axis, 2 or more blades, cantiliver blades, rigid hub)
- Aeroelastic modelling
- Mechanical loads testing

![Diagram showing mass of nacelle, mass of tower, mass of foundation, spring, axial, spring, rotational](image)

Source: Helix Wind
Load calculations

- SWT classes
- Wind conditions (normal and extreme)
- Aerodynamic loads (static and dynamic)
- Inertial and gravitational loads (gyroscopic, vibration, rotation, gravity, natural frequencies)
Component test / analysis

- Ultimate and fatigue strength of structural item parts shall be verified by calculations
- and / or tests to determine the structural integrity of a SWT with the appropriate safety level (e.g. rotor, nacelle, tower, foundation, etc.)
- Rotor blade analysis and static blade test is required

Source: Aerogenesis Australia Pty. Ltd.
Protection System

- Protection System shall be designed to be fail-safe.

- Protect the SWT from any single failure or fault in a power source, or in any non-safe-life component within the control- and protection system.

- A failure shall not allow the turbine either exceed the maximum rotational speed or go into an unsafe state of operation.

- Testing and / or analysis shall verify the fail-safe behaviour of the system.
Electrical System

- The electrical system of a SWT and every electrical component used in it shall comply with the applicable portions of clauses of the IEC-series, the national standards and any local codes.

- Electrical systems are
  - Protective Devices
  - Disconnect Devices
  - Earthing Systems
  - Lightening Protection
  - Electrical Conductors and Cables
Testing

- Loads
  - Tests to verify design data 
    (for simplified load analysis or to verify aeroelastic model)
  - Technical load testing 
    (determine design loads)
- Duration testing 
  (verify structural integrity, quality protection, dynamic behaviour)
- Mechanical component testing 
  (e.g. static blade testing)
- Safety and function 
  (behaviour and personal safety)
Measurements and Analysis

Measurements

- Loads
- Power curve and control behaviour
- Noise emissions
- Electrical behaviour (grid compatibility)
- Duration testing
- and others

Expertise

- Wind conditions
- Energy production
- Noise propagation
- Shadow cast

GL Garrad Hassan
Accredited according to ISO/IEC 17025 and other relevant standards
Documentation Requirements

The manufacturer of the SWT shall provide a clear description of

- Assembly
- Installation
- Operation
- Erection
- Maintenance

The documentation shall be provided in manuals for the installer, owner and service personnel.
Documentation Requirements (2)

• Apart from the before mentioned manuals, the following documentation will be required within the certification process:
  • Assembly drawings
  • Single part drawings
  • Specifications
  • Analyses
  • Datasheets
  • etc.

• These documents shall prove a safe design in respect to the applicable standards.
GL Applicable Requirements

GL Guidelines

• Guideline for the Certification of Wind Turbines, Edition 2010

• Technical Note for Extreme Temperatures (here: Cold Climate)

• Grid Connection Compatibility of wind turbines according to Grid Codes

http://www.gl-group.com/GLRenewables
German Application Requirements

German (DIBt-) Regulations

- "Richtlinie für Windenergieanlagen, Einwirkungen und Standsicherheitsnachweise für Turm und Gründung", Fassung Oktober 2012, Deutsches Institut für Bautechnik (DIBt), Berlin

- Scope of application swept area <200m²

- Technical Note for German Type Approval, GL
Further Applicable Requirements

**United Kingdom**
- DECC Microgeneration Certification Scheme (MCS), 2008.
  - Scope of application 50kW@11m/s

**Denmark**
- Executive Order from the Danish Ministry for Climate, Energy and Buildings No. 73 dated 2013-01-25: "Bekendtgørelse om teknisk certificeringsordning for vindmøller" ("Executive order on the technical certification scheme for wind turbines"). Incorporates the IEC 61400-22
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Electro Magnetic Compatibility (EMC) - Basics
Basics: Electric voltage and current
Basics: Magnetic field
Basics: Electromagnetic field
Basics: EMC quantities

- **Conducted quantities:**
  - Electrical voltage and electrical current

- **Radiated quantities:**
  - Magnetic fields
  - Electromagnetic fields
Basics: Radiated emission
Basics: Radiated immunity
Basics: Conducted emission

Low voltage grid
Basics: Conducted immunity

Low voltage grid
The idea of EMC:

Emission

Immunity

- Emission level vs. frequency
- Immunity level vs. frequency
- Safety distance
- Maximum vs. Minimum
European DIRECTIVES in general

Products that „were placed on the marked and put into service“ in the European Union must apply all relevant European DIRECTIVES. Examples for wind turbines:

• DIRECTIVE 2006/42/EC (on machinery)
• DIRECTIVE 2004/108/EC (on EMC)
• DIRECTIVE 2004/40/EC (workers directive)

Annex within upcoming IEC 61400-2, Ed. 3

Specifies test setup for

• Measurements for radiated emissions
• Measurements of conducted emissions
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Why certify small wind turbines?

• Safe product design – especially in residential areas
• Conformity to state-of-the-art
• Ensuring Small Wind Turbine to be fit-for-purpose
• Trustable quality – important for the strong growing SWT market
• Reliable prediction of turbine lifetime
• Increasing client’s confidence
• Avoiding damages and financial risks
Advantages of Certification

An independent assessment of your products will ease

- Approvals from Regulation Authorities worldwide
- Acceptance and favourable business conditions from financiers, insurers
- Positively influence on buying decisions of your customer
- Successful market entry and market growth through increased competitive advantage by an accredited and internationally acknowledged certification body.
Thank you very much for your attention!
Further Information

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GL GH (Tests site)