Deutsche WindGuard – Basics

- Start of business: December 2000
- Number of employees: 170
- Highly qualified staff (physicists, engineers, technicians)
- Pure service provider
- Global player
- Offices in Varel, Berlin, Bremerhaven, Elsfleth, Gelnhausen, Alexandria (VA, USA), Beijing (China) and Chennai (India)
Deutsche WindGuard India

Indian Office @ Tek Meadows Campus, OMR, Chennai
Deutsche WindGuard India - Organogram

- Managing Director
  - DWG India

- Measurements Group
  - 2 Engineers

- WRA Group
  - 4 Engineers

- Windfarm Management
  - 1 Engineer

- Deutsche WindGuard
  - Germany
Our goal is to ensure that in the future, 80 to 90% of the global energy demand will be met by renewables.”

CEOs: Gerhard Gerdes, Axel Albers, Dr.-Ing. Knud Rehfeldt
The Wind Professionals

**WindGuard Expertise**
Our staff combines decades of experience in wind energy with a solid scientific background of highly educated physicists and engineers. This combination of theory and practice shapes our perspective.

**The Universe-Effect**
The extraordinary synergistic effects between departments combined with our world wide playing field provide us with a unique market sense and ample knowhow to support our customers along the whole value chain of wind energy projects.

**The WindGuard Way**
We want things to move forward. Working actively in all major harmonization and standardization bodies as well as international research projects, we don’t just work according to standards – we set them.
## Guaranteed Quality

### Deutsche WindGuard

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### WindGuard Certification

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<th>Testing Laboratory &amp; Certification Body acc. to DIN EN ISO/IEC 17025 DIN EN ISO/IEC 17065</th>
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All accreditations and certifications apply only for the scope which is shown in the attachment of each certificate.

www.windguard-certification.com  www.windguard.com
Our Services

The overall concept is based on an unique active structure and convincing efficiency – 50 services attended by 170 experts.

Discover our WindGuard Universe of services!
Over the years, we have build a comprehensive network of expertise. Success through Experience – Onshore. Offshore. Worldwide!
Measurements
Measurements

- **Power Curve Testing**
  - Active work on and compliance with IEC 61400-12-1, IEC 61400-12-2 and IEC 61400-50-3
  - Including ground-based LiDAR, scanning LiDAR and nacelle-LiDAR
  - Accredited by DAkkS (DIN EN ISO/IEC 17025:2005), FGW-seal, accepted by MEASNET and IECRE test laboratory

- **Prototype Testing**
  - Accredited measurements for type certification: Power curve, loads, grid and electrical characteristics, noise

- **Load Measurement**
  - Accredited by DAkkS (DIN EN ISO/IEC 17025:2005) and IECRE test laboratory
  - Active work on and compliance with IEC 61400-13
  - Rotor blades, main frame, shaft, tower or components

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**Power Curve Testing**
- More than 100 measurement campaigns conducted
- Power Curve Testing for more than 6.5 GW project capacity
• **Fault Ride Through (FRT)**
  - Test of dynamic voltage support
  - FRT, LVRT and OVRT-tests

• **Grid Protection**
  - Proof of compliance with all specifications for safety and grid stability

• **Noise Measurement**
  - Accredited by DAkkS (DIN EN ISO/IEC 17025:2005) and FGW-seal
  - Prototype testing and verification measurement
  - Notified body for government controlled emission and immission measurements for the determination of noise from WTG acc. to §29b BImSchG (Federal Immission Control Act)

**Noise Measurement**
- More than 270 measurement campaigns conducted
• Seven wind tunnels on more than 2,500 m²
• Four high-precision calibration wind tunnels
  – One used by PTB\(^1\) as a reference wind tunnel for the unit m/s
  – Very low turbulence intensity (< 0.2 %)
• One climatic wind tunnel with a temperature range from -25°C to 40°C and simulation of icing effects
• One variable density wind tunnel with an ambient air pressure-range from 0.7 to 1.3 bar and temperature range from -20°C to 40°C
• One acoustically optimised large-scale R&D wind tunnel with open and closes test sections, array of 80 microphones, wind speeds of up to 100 m/s and Reynolds-numbers up to 6,000,000

\(^1\) Physikalisch-Technische Bundesanstalt / National Metrologie Institute of Germany
Wind Tunnel Centre – Services

- **Anemometer Calibration**
  - DAkkS accredited (DIN EN ISO/IEC 17025:2005), accepted by MEASNET and IECRE test laboratory
  - Experience with more than 300 different types of sensors
  - Low uncertainties

- **Anemometer Classification**
  - Classification acc. to IEC 61400-12-1:2017
  - Test of startup behaviour, dynamic behaviour, measurement regarding the influence of temperature and air density, response to inclined flow, dependency on wind direction

- **Wind Vane Calibration**
  - For wind vanes and ultra sonic anemometers

- **Sensor Testing under Icing Conditions**
  - Testing sensors under extreme conditions in our climatic wind tunnel (-25°C to +40°C)
  - Icing simulation by water injection

- **Density Testing**
  - Sensor-tests under extrem conditions in our density wind tunnel (-20°C to +40°C | 0.7 to 1.3 bar)

- **Large-Scale Wind Tunnel Testing**
  - Aeroacoustics airfoil measurement
  - Aerodynamic airfoil measurement
  - Tests with scaled models
  - Wind speed

- **Anemometer Calibrations**
  - 200,000 calibrations since 2003
Technical Inspections & Management

- **Technical Inspections & Condition-Based Assessment**
  - DAkkS accredited inspection body acc. to DIN EN ISO/IEC 17020
  - Early detection of damages by condition-based inspections, incl. gearbox endoscopy and vibration analyses of drive train

- **Thermographic Survey**
  - Early detection of damages on rotor blades via thermographic pictures
  - Ground-based, no rope access, while turbine is in operation

- **Commissioning Inspection**
  - DAkkS accredited inspection body acc. to DIN EN ISO/IEC 17020
  - Technical inspection in case of change of owner
  - Technical reports as basis for potential indemnity claims

- **Periodic Inspections of WTG**
  - Guarantee for safe operations of the WTG, obligatory every four or two years
  - Accredited inspection, member of expert advisory board of the German Wind Energy Association (BWE)

- **End of Warranty Inspection**
  - Independent end of warranty inspection including damage report

**Technical Inspection of WTG**
- More than 4,000 inspections
- 84 different WTG types
Technical Inspections & Management

- **Technical Management**
  - Onshore. Offshore. 24 hour remote monitoring, regular inspections & condition-based maintenance planning
  - Maximum energy yield due to high availability
  - Acceptance of turbine responsibility acc. to DIN/VDE 0105-100

- **Commercial Management**
  - Preparation of day-to-day financial accounting, liquidity monitoring and management, execution of payment transactions, target/actual comparison of costs, income and liquidity
  - Taking over the management responsibility and holistic reporting

**Technical Management**
- 233 WTG
- 53 windfarms
- Total capacity 556 MW

www.windguard.com
Technical Inspections & Management

- **Wind Farm Management Software (WONDER)**
  - Real-time data (control panel functionality)
  - SCADA-Management (Storage and analysis of operational data, life cycle documentation, support of RDS-PP)
  - Watchdog and Logbook
  - System solutions (integration in system infrastructure, open data interfaces, direct marketing, ERP-systems, reporting solutions)

- **Manufacturing Supervision**
  - Certified visual inspectors monitor the production process
  - Verification of compliance with specification for all components

- **Installation Survey**
  - Monitoring of loading and transport to end of installation
  - Impartial report in case of damage

- **Operations Evaluation**
  - Assessment of technical condition of the WTG, analysis of operational data, contract review, audit of funding

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**WONDER**
- In use on 2 500 WTG in 700 wind farms with 5 000 MW
- In application for more than 10 years
Offshore

- **Wind & Marine Engineering**
  - Integral load assessments
  - Structural design and analysis
  - Technical specification of the WTG
  - Simulation of logistics and installations processes in the large-scale wind tunnel
  - Availability & loss calculations
- **Technical Rating & Verification**
  - Due diligence & contract specification
  - Offshore power curve measurements
  - Risk assessments
- **Project Support**
  - Technical & interface managements
  - Safety at work and O&M concepts
  - Support with certification & permission
- **Inspections & Quality Assurance**
  - Commissioning & warranty inspections
  - Gearbox endoscopy
  - Manufacturing & installation supervision

Wind & Marine Engineering
- 15,600 MW of offshore energy yield assessments
- Involved in 75% of the German OWPs in operation and under construction

www.windguard.com
Offshore

- Certified by DNV GL and accepted training provider by GWO
- Certified management system acc. to ISO 9001
- GWO basic safety trainings & basic safety training refresher all modules
  - Working at Heights
  - Sea Survival
  - First Aid
  - Fire Awareness
  - Manual Handling
- HUET – Helicopter Underwater Escape Training using EBS or STASS
- All modules comply with DGUV
- First aid offshore wind farms acc. to DGUV
Site Assessment
Site Assessment

- **Wind Resource Assessments**
  - Accredited by DAkkS (DIN EN ISO/IEC 17025:2005), accepted by MEASNET and active work on and compliance with IEC 61400-15
  - Strict independence from manufacturers and planners
  - High bankability
  - Including loss calculations

- **Site Suitability Studies**
  - Accredited by DAkkS (DIN EN ISO/IEC 17025:2005), accepted by MEASNET and compliance with IEC 61400-1
  - Assessment of turbulence intensity, suitability of wind farm layout, extreme wind speeds and wind shear
  - Onshore and offshore

- **Wind Measurements**
  - Accredited by DAkkS (DIN EN ISO/IEC 17025:2005), accepted by MEASNET and active work on and compliance with IEC 61400-15
  - Independence from manufacturers and planners increases bankability
  - Using met mast or LiDAR
  - Accredited calibration lab for LiDAR and SoDAR
  - Intelligent wind measurement concepts
  - Measurement systems fitted to your project site requirements

Wind Measurements
- More than 260 with met masts
Wind Resource Assessments
- 22,000 MW onshore

www.windguard.com
Site Assessment

• **Noise Propagation**
  - Notified body acc. to §29b BImSchG
  - Assessment for approval process acc. to TA-Lärm (German noise pollution prevention regulation)
  - Concepts for noise reduction considering economic aspects

• **Determination of Shadow Immission**
  - Determination of optical immissions for the approval process

• **Ice Throw Assessment**
  - For your approval process
  - Calculations on probability and throwing range for WTG in operation and in stand-still

• **Visibility Analysis**
  - Analysis of relative and absolute visibility
  - Evaluation of compensatory measures
• **Due Diligence**
  - Highlighting of flaws and potential problems
  - Assessment of overall projects or subprojects/expertise
  - Security for your investment decision

• **Tender and Contract Consulting**
  - Minimizing risks by correctly phrased tenders and contracts
  - Support on identifying the suitable WTG supplier

• **Operations Evaluation**
  - Assessment of technical condition of the WTG, analysis of operational data, contract review, audit of funding

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**Technical Due Diligence**
- 400 wind farms with more than 10,500 MW
Consulting

• **Grid Assessment**
  - Review of compliance to grid codes
  - Load flow calculation within the wind farm
  - Protection against outage or damage

• **Wind Turbine & Manufacturer Assessment**
  - Independent consulting regarding advantages and disadvantages of different WTG concepts
  - Expertise on all WTG types and manufacturers

• **Analysis of Operating Wind Farms**
  - Energy yield analysis, long term yield assessment, analysis of operational data
  - For performance problems, before acquisitions and preventive for profit maximisation

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Wind Turbine & Manufacturer Assessment
- Continuous consultation of national and international investors

www.windguard.com
Consulting

- **Market Analysis**
  - Market analysis from political frame works and market participants to market entry strategies

- **Government/NGO Consulting**
  - Think tank work for all stakeholders
  - Experience from 20 years supporting the EEG-development
  - For governments, NGOs, associations and corporations

- **Feasibility Studies**
  - Considering potential energy yields, political frame works, grid and infrastructure, logistics, resources and funding

- **M&A Technical & Commercial Expertise**
  - Successful investments based on science and experience
Safely navigating the certification process

- **Type certification**
  - Turbine and components
  - Acc. to IEC 61400-22, DNVGL and DIBt

- **Electrical certification of Power Generating Units and Power Generating Systems**
  - Determination of electrical PGU connected to low, medium and high voltage grids (FGW TR 3 and 4; IEC 61400)
  - Certification of PGUs acc. to FGW TR 8
  - Certification of PGS, components and product groups acc. to FGW TR 8

Amount of PGU certificates
- More than 280 PGU certificates
Certification

- **Grid Protection**
- **Offshore Project Certification**
  - Accepted by BSH
- **Certification of Continued Operation of Wind Turbines**
  - Extended operation of turbines beyond design lifetime
  - Combination of load estimation and inspection
Discover the WindGuard Universe!


ONSHORE. OFFSHORE. WORLDWIDE.
Projects and Offices

WindGuard has already successfully supported wind projects in these countries:

- Springfield (USA)
- Chennai (India)
- Beijing (China)
- Berlin
- Gelnhausen
- Bremerhaven
- Varel
- Elsfleth
- Germany

www.windguard.de
Our integrated services reliably support the complete project lifecycle and ensure optimum performance from the word go.


www.windguard.com
Thank you for your time!

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Discover the full spectrum of the WindGuard Universe on
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