




Onshore Services for
Manufacturers
of Wind Turbines &
Components

The image shows two large, white, three-bladed wind turbines standing on a grassy, slightly elevated terrain. The turbines are positioned on the left and right sides of the frame. In the background, a vast, blue ocean stretches to the horizon under a clear sky. The ground around the turbines is a mix of green grass and brownish soil. A white pickup truck is parked near the base of the turbine on the right. The overall scene is bright and clear, suggesting a sunny day.

Research & Studies

Customers benefit from our in-depth knowledge based on UL's participation in a number of state-of-the-art research projects, most notably FINO1 and RAVE – Research at Alpha VEntus, as well as our research into on-/offshore noise immission and acceptance. Visit ul.com/wind for a complete research reference list.

Professional Training

UL offers educational training in the form of in-house or public seminars to bring newly hired or existing staff up to speed on the fundamentals of wind power technology.

DEWI Magazine

Readers from over 70 countries look to the biannual DEWI Magazine for insight into the state of the wind industry. The publication includes findings from UL's own research, as well as external articles on research and technology. All articles are available for download at ul.com/wind.

DEWEK Conference

Since 1992, DEWEK has been world's leading wind energy technology and research conference. All conference sessions are conducted in English and German, with simultaneous translation.

Onshore Services for Manufacturers of Wind Turbines & Components

UL offers one-stop safety and performance testing services for wind turbines and their components based on international and national standards and regulations (IEC 61400 series, MEASNET, FGW). We always work with each customer's individual needs, and flexibly assist in solutions that speed products to market.

National & International Committees

UL is recognized by national and international committees as a key participant in defining wind energy standards, such as:

- **IEC** – International Electrotechnical Commission
- **IEA** – International Energy Agency
- **CENELEC** – Comité Européen de Normalisation Electrotechnique
- **MEASNET**
- **DKE** – Deutsche Kommission Elektrotechnik Elektronik-Informationstechnik in DIN und VDE
- **Technical Guidelines for Wind Turbines** (guidelines published by FGW, Germany)
- **UL-AWEA** – US National Standards Development

Validation & Type Testing

Validation testing is the process in the overall product development process that helps verifying that the wind turbine (component) is implemented in reality as designed. Type testing in the context of wind turbine type certification, however, helps verifying that the wind turbine (component) is in compliance with relevant and defined standards and rules.

UL provides field and laboratory testing to acquire the data needed to verify wind turbine function, safety, structural integrity, power performance, power quality, and acoustic noise emission characteristics. Beside worldwide testing activities in customer prototypes UL operates two wind turbine test facilities offering favorable year-round wind conditions for the testing of small and large wind turbines for extended periods.

UL wind turbine test site near Wilhelmshaven, Germany.

Another test site is located at West Texas A&M University near Amarillo, Texas.



MECHANICAL LOADS

When developing new wind turbines, extensive measurements of the mechanical loads acting on the prototypes during operation are indispensable. The results of these load measurements carried out by UL are used in the design validation and certification of wind turbine prototypes. UL offers load assessments according to IEC61400-13 or any customer specific scope on wind turbines and their components.

Guidelines:

- IEC61400-13

ACOUSTIC

Noise emissions are an important limiting factor in the layout of a wind farm. Qualified noise predictions are therefore essential for the planning of a wind farm. UL has been carrying out noise measurements and noise emission predictions for many years in line with the relevant standards and guidelines and is also participating in national and international research projects for the noise reduction of wind turbines, sound propagation and the further development of measuring methods.

Guidelines:

- IEC 61400-11, 2nd and 3rd edition
- FGW Technische Richtlinie 1

POWER PERFORMANCE

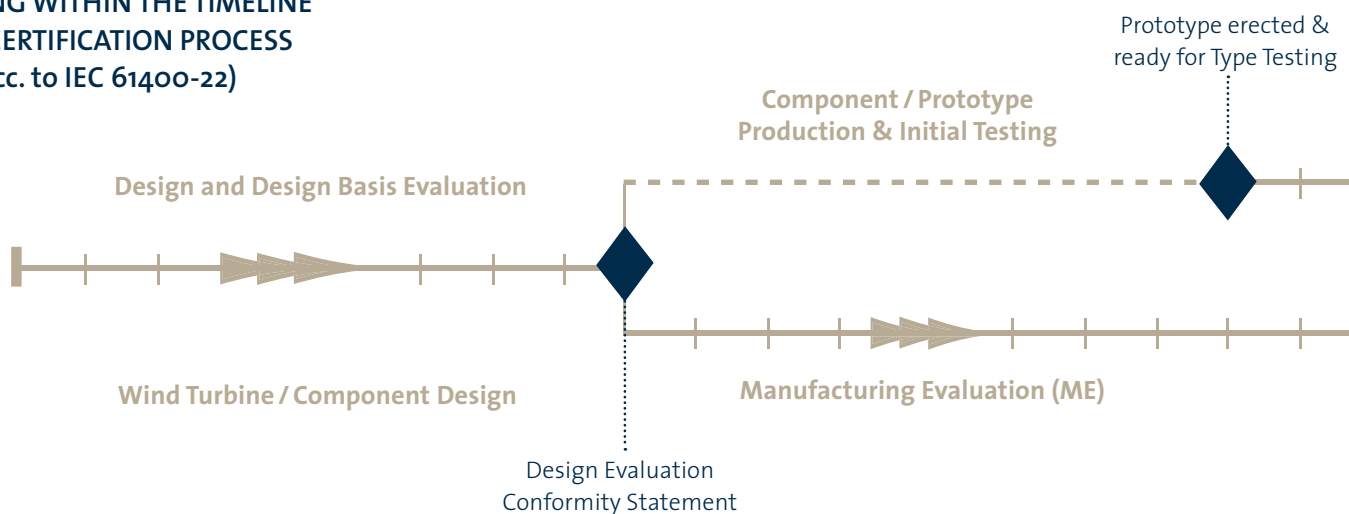
The measurement of wind turbine power curves is one of the key activities in the range of services of UL. The power curve summarizes the effort that went into the design of a wind turbine and as such the power curve report is an integral part of every type testing campaign. Next to the classic setting of measuring a power curve using met tower based cup anemometry UL is active in the development of the methodology utilizing ground based LiDARs to operate with the new wind speed definition of rotor equivalent wind speed.

UL also offers nacelle based measurement approaches taking their data from cup anemometers, LiDAR or spinner anemometry. These are useful alternatives in offshore environments as well as for turbines with large hub heights and when it comes to detect yaw misalignment.

Guidelines:

- IEC 61400-12-1
- IEC 61400-12-2
- Measnet Power Performance Measurement Procedure Version 5
- FGW Technische Richtlinie 2, Rev 6 and FGW Technische Richtlinie 5, Rev 5
- IEA wind, 15. Ground-based vertically profiling remote sensing for wind resource assessment
- DTU E-0019, Procedure for wind turbine power performance measurement with a two-beam nacelle lidar

TYPE TESTING WITHIN THE TIMELINE OF A TYPE CERTIFICATION PROCESS (onshore, acc. to IEC 61400-22)



ELECTRICAL CHARACTERISTICS

In the field of grid integration UL carries out measurements and evaluations to determine the electrical characteristics and grid compatibility of wind turbines, solar inverters, combined heat and power plants (CHP) and of other generation units/systems. The measurements are required for planning grid connections and verifying applicable limits, but they also allow an exact analysis of the electrical behavior of the generation units and systems, which is important for their design, development and optimization. In this connection UL also carries out calculations of required grid capacities as well as power quality and background interference measurements.

Guidelines:

- IEC 61400-21: Wind turbines – Part 21: Measurement and assessment of power quality characteristics of grid connected wind turbines; Edition 2.0 2008-08.

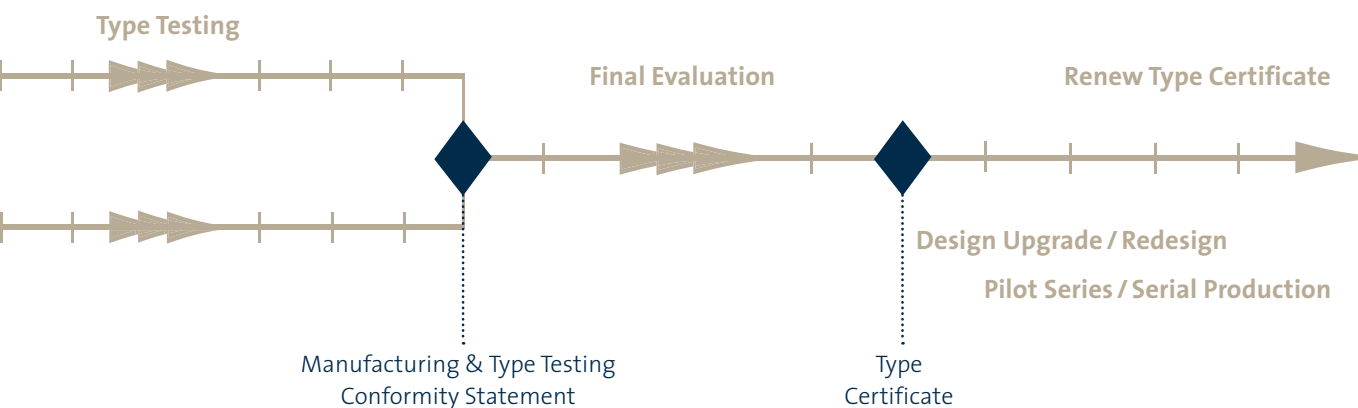
LVRT TESTING

Before any generating plant can be connected to the grid, the system operator normally requires a certificate, which in turn requires the measurement of electrical characteristics and increasingly also verification of the plant's Low Voltage Ride Through (LVRT) capability. UL offers LVRT testing and measuring services to determine the electrical characteristics and grid compatibility of wind turbines, solar inverters, combined heat and power plants (CHP) and other generation systems.

Guidelines:

- IEC 61400-21: Wind turbines – Part 21: Measurement and assessment of power quality characteristics of grid connected wind turbines; Edition 2.0 2008-08.
- Particular Grid Code requirements which may vary from country to country.

Please note: All services are available as a complete package or individually.





What sets UL apart?

TECHNICAL EXPERTISE

We are globally recognized as leading experts within the wind energy industry, setting the benchmark that others aspire to.

FLEXIBILITY

Our extensive service portfolio covers all of your business needs, from research and development to installation and end use.

RESPONSIVENESS

Our long experience with manufacturers, project developers, owners, operators and government regulators means we can respond quickly to your specific needs.

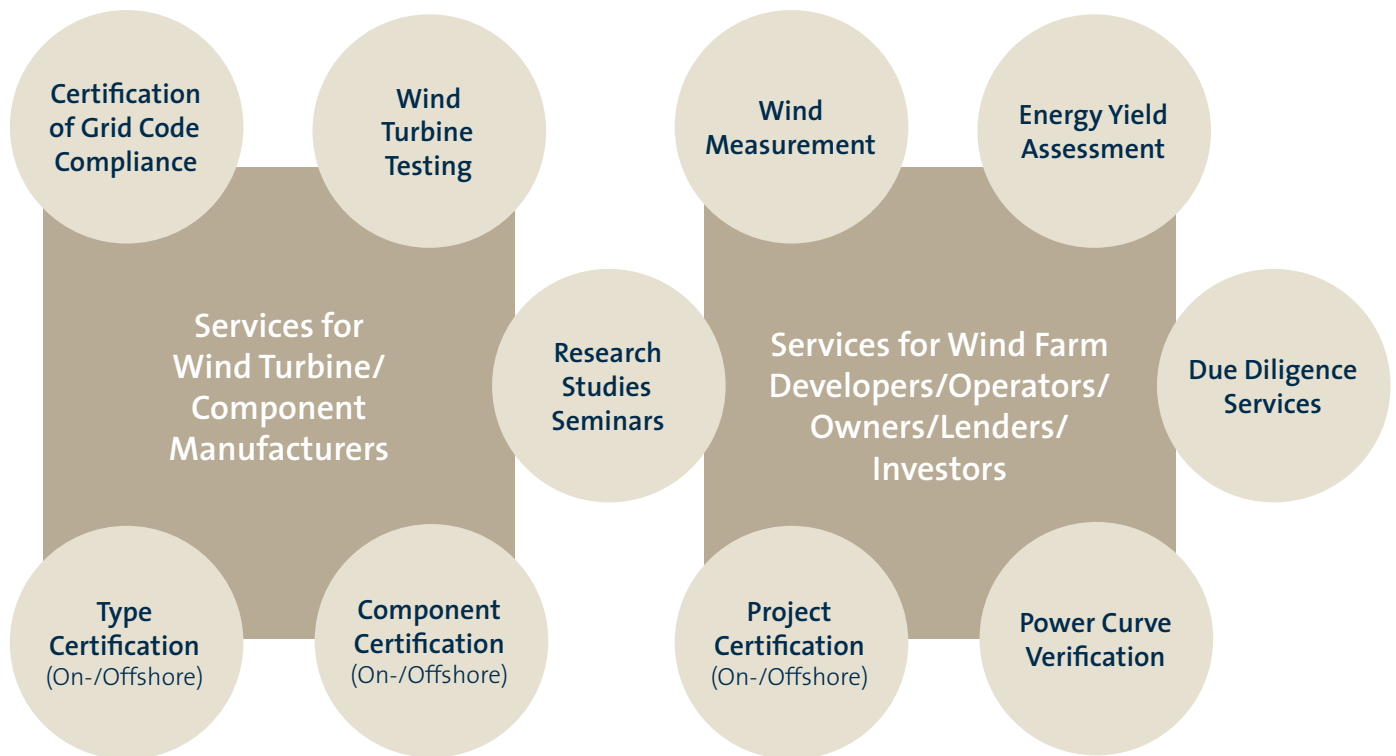
CUSTOMER FOCUS

Customers optimize opportunities for global access by leveraging our expertise and services to meet new regulatory or specific market demands.

Global Wind Energy Measurement Services

All-in-One Service Provider

UL is a premier global independent safety and performance science company, with 120 years of history. Combining technical expertise with years of in-depth industry experience, UL offers global one-stop wind energy service to turbine manufacturers, component manufacturers, project developers, utilities and other companies within the sector. UL currently operates two wind test sites at West Texas A&M University, near Amarillo, Texas and in Wilhelmshaven, Germany.



UL Accreditations / Quality Agreements

The accreditations are valid for the UL locations, test and calibration procedures mentioned in the certificates. The certificates are available on request or at www.dakks.de



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