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Wind Turbine Testing

With the Barlovento Applus+ wind turbine testing laboratory, we can conduct a variety of tests on wind turbines in accordance with global standards. Our laboratory is accredited by ENAC / ILAC and is a member of IECRE (the IEC System for Certification to Standards Relating to Equipment for Use in Renewable Energy Applications) and Measnet (the International Network of Wind Energy Measurement Institutes).

Wind turbine testing aims to ensure reliability, efficiency, safety, and compliance with industry standards and regulatory requirements of wind turbine systems, helping mitigate risks of failures or underperformance.

THE Applus+ SOLUTION

Tests we can perform with our testing facilities and testing procedures include:

- **Wind turbine power performance testing** to verify the wind turbine performance in both onshore and offshore wind farms. We support our clients in the definition of the test configuration, the provision and commissioning of the measurement systems, including conventional met masts, ground LiDAR, and nacelle LiDAR, and the execution of the measurement campaign. We also carry out the reporting with a home-developed specific software that enables comprehensive data analysis, ensuring a fast response and problem-solving during the measurement campaign.
- **Acoustic noise tests and acoustic impact assessments** to determine the impact of wind farms both in the development and in the post-construction stages, according to international standards and local regulations. These tests are conducted based on the measurement of background noise levels and in-operation noise levels, as well as propagation models.
- **Mechanical load tests** to support the type certification of wind turbines or evaluate site-specific loads. Additionally, we conduct mechanical failure analysis lifetime

estimation based on site-specific conditions and loads, and we provide support for life-extension strategies.
- **Safety and function tests** to support the type certification of wind turbines under international schemes.
- **Electrical characteristics tests** aimed at the certification of wind turbines and also the verification of compliance of the local and international grid codes. We use modular acquisition equipment that can be configured for any test topology. Our in-house developed acquisition software can be adapted to the specific characteristics of each wind turbine and test campaign.

Barlovento Applus+ offers a turnkey and full-scope service, which covers the provision and commissioning of the complete measurement systems, including:

- Meteorological met mast. Remote measurement systems such as SoDAR and LiDAR (both ground and nacelle).
- Voltage dip generator mobile units.
- Different measurement sensors aimed at specific test purposes.

These services are provided in different regions, with local expert staff in our different offices, thus minimizing the reaction time in case the measuring system fails.

We also provide a full-scope service based on our extensive experience, which involves consultancy services during the different stages of the test, from the definition of contractual warranties and test configuration to the analysis of the result.

Barlovento Applus+ employs its own home-developed software packages that have been tested within the international forums (IECRE and/or MEASNET). This ensures the highest quality, reproducibility, the reduction of uncertainties, and prompt results delivery, making decision-making easier during the test's progress and analysis of the test results.

We provide a wide experience in wind turbine testing covering, among others:

- Most relevant stakeholders in the wind sector worldwide:
  - Developers and end-users
  - OEMs
- Different regions all around the world (Europe, LATAM, MENA, Australia...).
- More than 350 tested WTGs (for a total of over 1.300 MW), including different sizes of WTG, from SWT (self-consumption and isolated grids) to large-scale WTGs (15 MW).
- All kinds of climatic conditions, from cold climates to desert or tropical areas.
- Onshore (including complex and non-complex terrain) and offshore wind farms

Our Barlovento Applus+ wind turbine testing laboratory is accredited by ENAC / ILAC (accreditation n. 473/LE 1004 and 613/LE 1315) and also recognized as RETL under the international scheme applying to the wind sector IECRE. We also actively participate in

international working groups and forums aimed at the development of global standards and schemes, such as IEC and IECRE forums.

Target customers

Wind turbine tests and related services are performed during the different phases of the project, from the development stage (contractual warranties negotiations, test definition, or environmental assessment…) to the operational one (performance verification and/or analysis of site-specific performance and root failure analysis).

Key customer benefits

Wind consulting services during project development phases help mitigate risks by defining tests tailored to the wind project's site-specific conditions. Unlike generic specifications that may not accurately represent the project, adapting tests to a specific project ensures the turbines' performance is verified under real project conditions.

Carrying out the verification tests ensures the viability of the project as it provides evidence of:

- Performance of the wind project in the long term in comparison to the previous forecasts during the development stages.
- Identification of risks at an earlier stage.
- Compliance with local or international regulations.
- An independent statement and advice in case of a dispute.
- Deeper knowledge of the actual wind turbine performance to be extrapolated to future projects in earlier stages of the development.