nabla
wind hub

TECHNOLOGY ACQUISITION

more info at www.nablawindhub.com

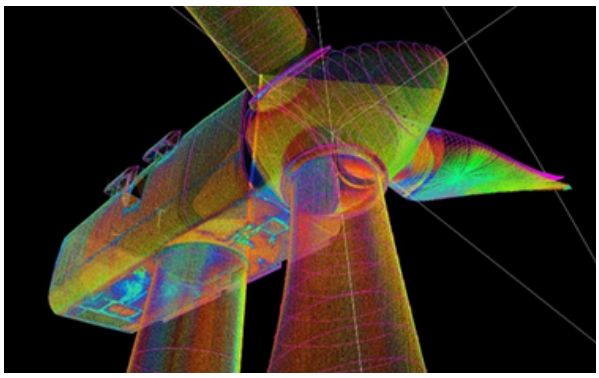
INTRODUCTION

The Technology Acquisition of nabla enables to obtain the aeroelastic model of any wind turbine model in the market. Nabla wind hub has more than 50 wind turbine aeroelastic models already developed and validated.

CONCEPT

The **Independently developed Aeroelastic Models** created by nabla are part of the core technology of nabla, enabling to calculate in detail the loads/fatigue of an asset, among other utilities.

Nabla wind hub build its own Aeroelastic Models in 2 phases consisting on the Measurement Campaign and the Post Process of the Model.



METHODOLOGY

The Aeroelastic Model Build-Up, begins with:

- **3D Laserscan of turbine External Surface:** to acquire the 3D point cloud of the turbine geometry.
- **UTs - Ultrasonic Measurements:** measuring the thickness of different structural components.
- **SCADAs:** minimum 1 year of SCADA data to postprocess.

According to the information gathered on site, the engineering develops the models that make up the whole Aeroelastic Model:

- **Geometrical Model Build-Up:** nabla wind hub will assembles the 3D Laser and Ultrasonic measuring measurements of the specific turbine model leading to the creation of the geometrical and aerodynamic model.
- **Aerodynamic Model Build-Up:** based on geometries identification, extensive nabla wind hub database of wind tunnel measurements of airfoils and aerodynamic analysis of each blade airfoil and the different components, every aerodynamic performance parameter will be built. 3D Rotational, Mach number and Reynolds number corrections are implemented.

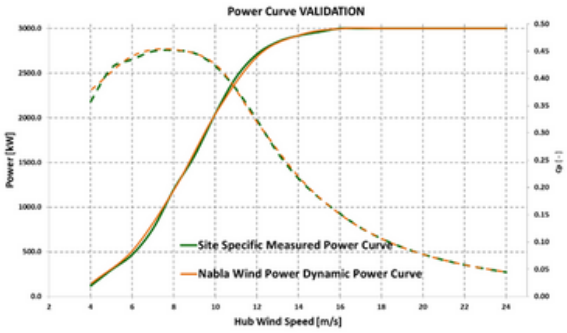
- **Structural and Mass Models Build-Up:** all design loads-structural analysis cycles are carried out up to achieving an structural sizing of the components which reproduce the technical specifications in terms of linear mass distributions, stiffness and eigenfrequencies of the turbines to be implemented in the aeroelastic model.

  In addition, the model is adapted to reality of supplied components at the wind farm (e.g. modeling blades with overweight or different mass moments) in order to obtain most detail realistic model of the wind farm.

- **Functional Models and Controller Programming:** the turbine control system will be programmed according to:

  - Type of Turbine
  - Aerodynamic Model
  - Modal responses of the Structures
  - The controller statistics extracted from the SCADA system and from the functional parameters
  - And the technical specifications of the turbine, completing the aeroelastic model
  - Following the same logical process that the Designer followed for optimizing turbine performance

Finally, the aeroelastic model is Validated in 3 aspects:



- **Structural responses:** all turbine elements Eigenfrequencies predicted by the model will be compared with the certification model technical data.

- **Controller Statistics:** the statistics of the control system extracted from the calculations and which are the result of all dynamic responses of the turbines according to real wind conditions, blades deflections, rotor area loss, yaw misalignments will be compared to the measured statistics extracted from SCADA System.

- **Dynamic power curve:** the dynamic power curve extracted from the calculations and which is the result of all dynamic responses of the turbines according to real wind conditions, blades deflections, rotor area loss, yaw misalignments and real controller setting will be compared to the measured power curves at the wind farm.

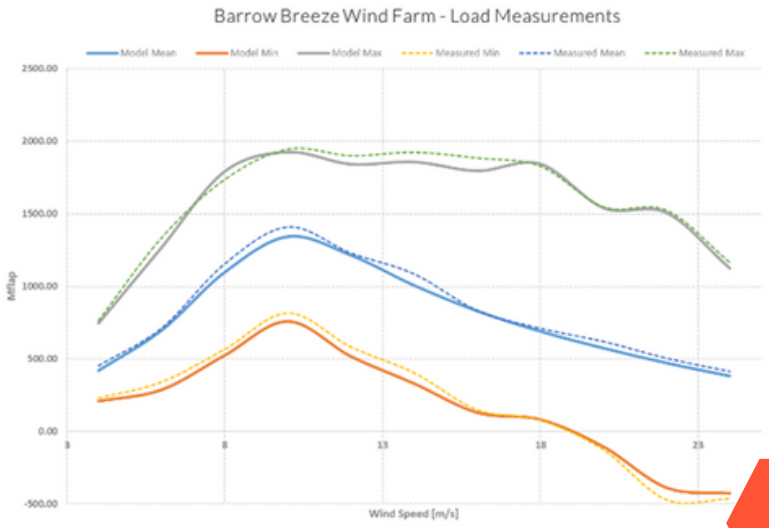
And optionally for uncertainties minimization measurements can be carried out:

- **Eigenfrequencies Measurement**

  When eigenfrequencies tests have been done by nabla wind hub, the deviation between the model and the measurement were 3%, below the acceptance margin of maximum 5% required by Type Certification for OEMs.

- **Loads Measurement Campaign**

  When loads measurements have been done by nabla wind hub, the deviation between the model and the measurement were 9%, below the acceptance margin of maximum 10% required by Type Certification for OEMs (thus P90 nomenclarure).



EXAMPLE: Load comparison between Measurements vs Model – Mflap+

OUTCOMES

Nabla wind hub can deliver a report with the basic parameters for structural calculations or the full file of the aeroelastic model always provided that the terms of the Model delivery are meet.

REFERENCES

nabla wind hub is an independent technology platform that delivers asset redevelopment projects for the wind industry worldwide. End-to-end & one-stop-shop partner for SPVs and Porftolios revaluation, through Life Extension, Performance Improvement and Maintenance Optimisation; based on state of the art technologies, such as top-accuracy aeroelastic models, in-house rerotoring components, and advanced monitoring solutions.

600 wind farms assessed

1200 sensors installed

2000 blades installed

+250 Wind Turbines monitored

For more information contact us at:

nabla wind hub sales department
M: +34 945 023 674
info@nablawindhub.com