

# **Certification strategies for modular wind turbine designs**

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### Introduction and background

Development of new offshore wind turbines is a process lasting on average three to five years. In contrast, Type Certification of the new turbine model occupies normally the last two to three years of the wind turbine development, in parallel with the deployment of the first turbine prototypes.

The long time span between the conceptual design phase and the conclusion of the design validation phase constitutes a large risk for all the industry's actors, among other reasons also for the complexity of managing the design of all turbine components at the same time, along with the necessary prototype manufacturing and testing campaign. A delay in any of these phases might cause a delay in the introduction to market of the turbine and possibly also in the financing and execution of the offshore wind park projects.

An effective mitigation measure would decouple design, validation and certification of the main wind turbine components from the design, validation and certification of the wind turbine and the specific offshore wind park project.

The wind turbine may be considered a combination of modules which are designed and certified separately and at an earlier stage of the turbine development process. The risk is now shared among several stakeholders and can be managed more easily.

On top of that, the same certified component can be easily incorporated in several wind turbine models. This allows turbine manufacturers, or even wind park developers, to use already developed and certified components with different wind turbine models, thereby promoting truly modular wind turbine designs.



#### Wind turbine components

1. ROTOR: The rotor is made up of blades affixed to a hub. The blades are shaped like airplane wings and use the principle of lift to turn wind energy into mechanical energy. Blades can be as long as 150 feet — half the length of a football field.

2. PITCH DRIVE: Blades can be rotated to reduce the amount of lift when wind speeds become too great.

NACELLE: The rotor attaches to the nacelle. which sits atop the tower and encloses the various components.

BRAKE: A mechanical brake acts as a backup to the braking effects of the blade pitch drives or as a parking brake for maintenance.

LOW-SPEED SHAFT: Attaches to the rotor.

6. GEAR BOX: The rotor turns the low-speed shaft at speeds ranging from 20 revolutions per minute (rpm) on large turbines to 400 rpm on residential units. Transmission gears increase the speed to the 1,200-1,800 rpm required by most generators to produce electricity. Some small-scale turbines use a direct-drive system, eliminating the need for a gear box.

7. HIGH-SPEED SHAFT: Attaches to the generator. 8. GENERATOR: Converts the mechanical energy produced by the rotor into electricity. Different designs produce either direct current or alternating current. The electricity may be used by nearby appliances, stored in batteries or transferred to the power grid. 9. HEAT EXCHANGER: Keeps the generator

COOL 10. CONTROLLER: A computer system runs self-diagnostic tests, starts and stops the turbine, and makes adjustments as wind speeds vary. A remote operator can run system checks and enter new parameters via modem.

11. ANEMOMETER: Measures wind speed and passes it along to the controller.

> 12. WIND VANE: Detects wind direction and passes it along to the controller, which adjusts the "yaw," or heading, of the rotor and nacelle.

> > 13. YAW DRIVE: Keeps the rotor facing into the wind.

14. TOWER: Because wind speed increases with height, taller towers allow turbines Typical phases of a Component Certification project – www.dnvgl.com

## Interfaces to the wind turbine

To consider when integrating a certified components:

- Geometrical dimensions, specification of connection, tolerances
- Mass, inertia and dynamic properties
- Design loads, actuator capacity
- Control system interface, I & O communication protocol
- Electrical interfaces, name plate
- Transportation, installation, operation and maintenance provisions

Tests and assessments upon integration in a wind turbine

Integrating certified components in a wind turbine might require:

- New load calculations
- New analysis of the drivetrain dynamics
- New load validation campaign
- New safety and function tests

to capture more energy.

New gearbox field tests

Wind turbine parts which typically undergo component certification – www.awewa.org

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### Conclusions

Wind park developers and owner may take advantage of Component Certification to assemble a turbine from components designed, tested and certified individually. The turbine configuration may be tailored to the specific project requirements.

This strategy might still require some assessments and tests to be executed during the commissioning phase on the turbines selected for the specific wind park.

The advantage is that the design of the offshore wind turbine is validated for the specific offshore project, reducing the technical and commercial risks considerably.



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