Technical University of Denmark

DeepWind Project

What is DeepWind?

DeepWind is a 4 year project running from 1st October 2010 to 30th September 2014. DeepWind has also been adopted as the acronym for a new floating offshore wind turbine concept with a vertical axis turbine - a Darrieus rotor with pultruded blades.

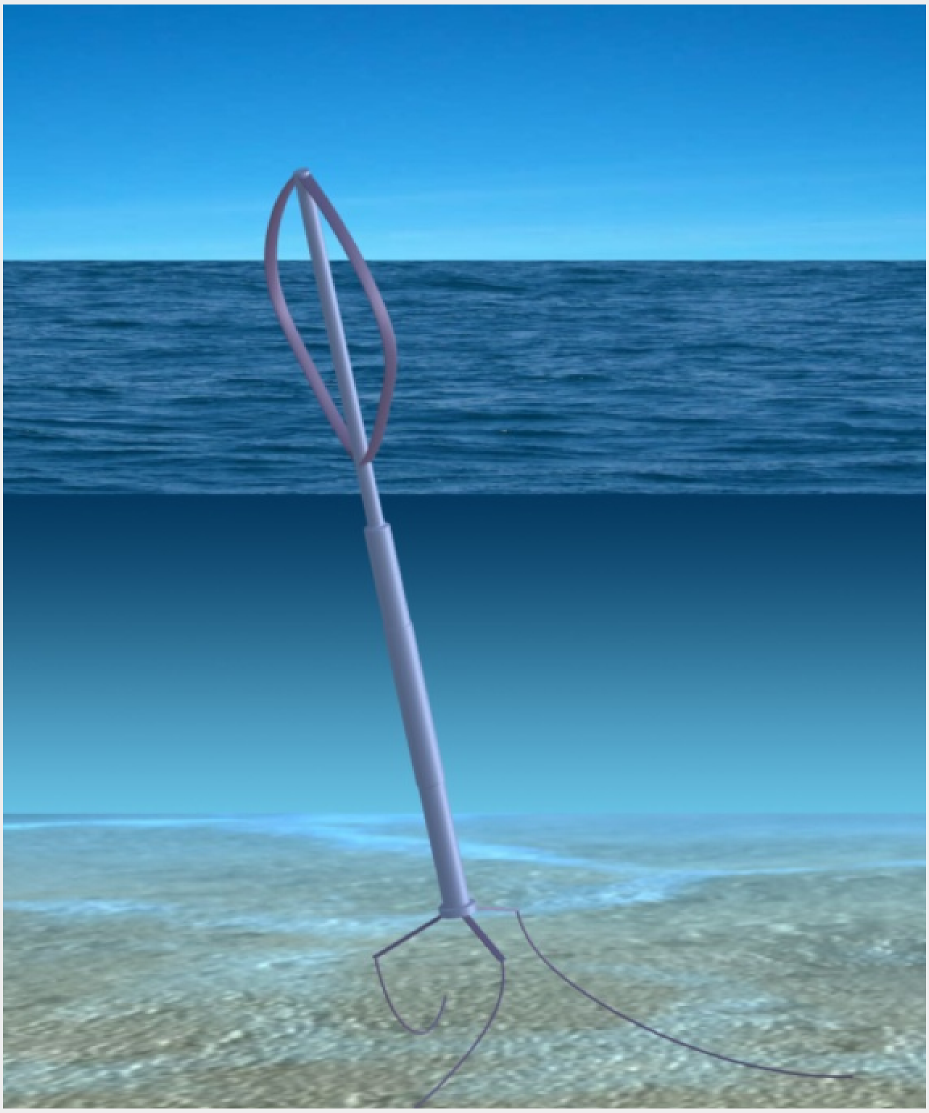
Existing vs dedicated technology

Next generation offshore wind energy needs dedicated technology rather than being based on onshore technology transported and adapted to sea environments.

The hypothesis behind DeepWind is that a new wind turbine concept developed specifically for offshore application has potentials for better cost efficiency than existing offshore technology. DeepWind explores the technologies needed for development of a new and simple floating offshore concept with a vertical axis rotor, and a floating and rotating foundation, which can:

- reduce the operation and maintenance costs
- increase its up-scaling potential.

To reach this, calculation and design tools for development and evaluation of very large wind turbines based on this concept are needed.



Artist's illustration of the DeepWind concept

What kind of work is involved?

The proposed concept consists of a vertical axis rotor mounted on a long spar buoy and anchored to the sea bed with a mooring system. The spar buoy and the rotor tower form a single body, which rotates in the water. The generator is placed at the bottom of the spar buoy and it is connected to the mooring lines with several torque absorption arms. However, the simple design presents extensive challenges needing explicit research on: dynamics of the system, pultruded blades with better material properties (to reduce the cost of large rotors), sub-sea generators, mooring and torque absorption systems, and hydrodynamic loads on the rotating shaft. In order to overcome these challenges, the project is focusing on:

1. Development of numerical tools for prediction of energy production, dynamics, loads and fatigue. The computational developments are implemented into one concept design tool.
2. Development of tools for design and production of blades. The feasibility of blade pultrusion manufacturing for MW-size VAWT is explored.
3. Tools for design of a very large, slow running direct-drive generator mounted at the bottom of the structure in deep sea conditions, and controls.
4. Design of mooring and torque absorption systems involving anchoring system, and exploration of dynamics of the rotating spar-buoy supporting structure.

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5. Knowledge of friction torque and lift and drag on rotating tube. In particular fluid interaction at high Reynolds numbers are unknown.
6. Proof-of principles testing of the concept with a 1 kW demonstrator at the DTU Risø Campus.
7. Integration of all technologies into a 5MW wind turbine, based on the concept, and an evaluation of the perspectives for the concept towards a 20 MW design.

Dissemination and exploitation of the results are important project steps in the strategy of knowledge diffusion and is handled by the partners.

What is pultrusion?

It is expected that the structural design of blades can be significantly improved and support the up-scaling potential of the DeepWind concept.

The blade cross section might be constant over the length of the blade. In order to manufacture such a composite blade with a constant profile having a long chord, pultrusion technology is one of the most efficient and suitable methods. Besides it is a continuous, automated closed-molding process, it is also cost effective for high volume production of constant cross section parts.

A key question: Does it work?

In order to answer this we will conduct proof-of principles testing with a 1 kW demonstrator in the fjord at the DTU Risø Campus starting summer 2012.

VESTAS provides the rotor tube and foundation, and NENUPHAR is responsible for the blade manufacture. DTU Risøs Campus is in charge of design, instrumentation, barge and measurements. AAU provides generator and controls. The design is based on current design tools. It will be used to demonstrate the principle under near to realistic operating conditions and to develop understanding of the concept. The wind turbine will be instrumented for monitoring displacements of the tube at sea level.

The rotor system, the power transmission system, the mooring and torque absorption system will be evaluated and analyzed for motions and loads for relevant environmental conditions, including wind, current and waves. A rotor configuration with 2 and 3 blades is planned.

Are you interested?

For participating the launching event in spring, please email us, see contact info, and we will return with details.

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