Future wind turbines go offshore -- deep and floating

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DeepWind was launched October 1st 2010, and Riso DTU is coordinating the consortium of 12 international members.

"Our objective is to develop more cost-effective MW wind turbines through dedicated technology rather than advancing existing concepts that are based on onshore technology being transported to the sea environment. Offshore wind energy today is twice as expensive as onshore technologies. That means that there is plenty of room for improvement," says DeepWind Project Manager Uwe Schmidt Paulsen, Riso DTU.

Studies show that for sea depths exceeding 30-60m, floating structures are economically more feasible than present offshore technology based on piled, jack-up or gravity foundations. The cost of material and logistics used in these constructions is simply too high. Furthermore, floating wind turbines will open up the possibility of placing offshore wind turbine plants with excellent wind potential near large cities with a deep-water coastline in e.g. Europe, Asia and North America.

Wind turbines in deep water

DeepWind is the acronym for this new power generation concept and project. As explained by the Risø DTU scientists behind the concept, it combines a vertical-axis wind turbine, new blade technology, full power transmission and control system, combined with a rotating and floating

offshore substructure (see picture).

The basis for the vertical-axis wind turbine is the well-explored Darrieus design. This provides a very simple MW turbine, but also contains challenges not least because of the long sub-sea support structure needed. The concept also includes a direct drive MW generator with its electronic control system at the bottom of the sub-sea shaft, together with the electrical power transmission cables. Combining the relevant technologies and designing the components properly, will positively re-address the issues of distribution of cost and the competitiveness of the concept compared to existing technology.

"The technology behind the proposed concept gives significant challenges and requires technological breakthroughs. We need explicit research in a wide area of different technology fields and materials. For example we foresee research in the dynamics of the system, pultruded blades with adequate material properties, sub-sea power generators and converters, turbine control and safety systems, wave and current loading on the rotating and floating shaft, and also the mooring and torque absorption system," explains Uwe Schmidt Paulsen.

One of the definite outcomes of this futuristic project will be the demonstration of a kW-sized wind turbine to be placed in open waters of Roskilde Fjord next to Risø DTU. In this phase, dedicated experiments will be carried out and simulation tools will be developed for design purposes. These will be used to design a 5 MW concept and evaluate the prospects of an up-scaled, future 20 MW turbine.

Collaboration between industry and research

Offshore wind energy has been identified by the European Union as a key power generation technology for renewable energy in the future, and Europe should lead the world technologically.

"DeepWind is a challenging and sound project. This project goes beyond a technology transfer from onshore vertical wind turbine generation and constitutes a radical upgrade of existing technologies and would constitute a real breakthrough in the energy sector", explains Risø DTU Director Henrik Bindslev.

DeepWind combines several research fields, in particular wind energy, the offshore environment and materials technology. In DeepWind these technologies are combined with recent deep sea offshore technologies and with advanced large-scale blade pultrusion technology in order to establish a new field of development. In this new field researchers and industry work in an international partnership between research institutions, industrial small and medium sized enterprises (SMEs), non-SME and end-users.

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