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[Invited Speaker]

Full test of grid connected floating wind turbine : The European Project Floatgen

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Abstract:

Floatgen is the first wind turbine to be installed off the French coast. Equipped with a floating foundation designed by the French expert, Ideol, and built by Bouygues Travaux Publics in SaintNazaire Port, it will be installed on the Centrale Nantes offshore test site, SEM-REV, off the coast from Le Croisic. The construction was officially launched on September 2016 but the project starts 3 years ago

There are over 3000 offshore wind turbines around the world – the overwhelming majority of which are “fixed” i.e. attached to the seabed, but none as yet in France. Backed by a European consortium of seven companies and research bodies, Floatgen is leading the way with several firsts. The first offshore wind turbine in France – the blades of this 2MW turbine are set to rotate for the first time in 2017, much earlier than for a fixed turbine – but, also the first fullscale demonstrator of the ring-shaped floating foundation developed and patented by Ideol.

The aim of this project is show the tremendous commercial potential of offshore floating wind turbines. They will produce electricity from a renewable source at a significant distance from the coast, thus preserving the visual integrity of the coastline, at a reduced cost thanks to the stronger winds further offshore. It will also underscore the industrial potential of this new sector which will lead to job creation on both a local level near the installation sites, where concrete is the main foundation construction material, as well as with the main suppliers, as illustrated by the contract signed for the supply of the anchoring system.

Construction will get off the ground in September in Saint-Nazaire Port in the west Atlantic coast of France, where Bouygues will build the floating foundation, mobilizing 80 workers on site. At the conclusion of the six month construction phase, the wind turbine will be fixed into position, quayside, on its foundation. The whole assembly will be subsequently towed out from the Le Croisic coast to the installation site, SEM-REV, the world’s first multi-technology offshore test site connected to the grid, owned by Centrale Nantes and run jointly with the French National Center for Scientific Research (CNRS).

Once on site, the wind turbine will be connected to the anchoring system and the electricity export cable. Floatgen, a project with backing from seven European partners The project began in 2013 bringing together seven partners each with a specific role to play: Ideol: design and provision of the entire floating system (foundation, anchoring system and electricity export cable) as well as the wind turbine; Centrale Nantes: ocean engineering expertise and access to its offshore test site; Bouygues Travaux Publics: floating foundation construction; the University of Stuttgart: participation in the study phase simulations, RSK GROUP: environmental impact analysis; ZABALA project management; and finally, FRAUNHOFER-IWES: comparative analysis of the different floating solutions.

It is supported by the European Union as part of the FP7 programme, by the French Environment and Energy Management Agency as part of the national Investments for the Future Programme, and by the Pays de la Loire region. This project is a precursor to the installation in coming years of first pilot, then commercial, offshore wind farms. More information on www.floatgen.eu

Dynamic response characteristic of a spar type offshore wind turbine secured on seabed

Eiji Hirokawa, Hideyuki Suzuki and Shinichiro Hirabayashi

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Abstract:

Offshore wind turbine can be categorized into two types. One is bottom-mounted offshore wind turbine and the other is floating offshore wind turbine. A bottom-mounted offshore wind turbine has a foundation structure on seabed and a floating wind turbine has moorings to keep its position. The deeper the sea is, the more difficult to use bottom-mounted offshore wind turbine because overturning moment due to wind and wave is enlarged on its foundation. The shallower the sea is, the more difficult to use floating offshore wind turbine because the dynamic fluctuation of tension on the moorings are enlarged. Due to these reasons, there exists sea area where neither the bottom-mounted nor the floating concepts are systematically deployed. From the past record, the shallow sea area with water depth of 30-100m has not been utilized. In this research, a new type of support structure of offshore wind turbine similar to a spar grounded on seabed is investigated to solve the problem.

To utilize offshore wind turbine in such area, it has been suggested to use jacket structure for bottom-mounted offshore wind turbine or to use buoy on a mooring line for floating offshore wind turbine, but it is difficult to install for business. In this research, a spar type wind turbine secured on the seabed by its own weight without mooring is considered. The spar type wind turbine has a platform that is shaped vertically long and typically the length is about 100m. The dynamic response characteristic of the offshore wind turbine with spar-like platform at the water depth less than 100m is investigated with a numerical calculation and water tank experiment.

It is important for this tower to balance with the moment of buoyancy and weight because of following constraints.

- Weight is needed to make the tower secured on seabed.
- Weight works as a moment to tilt the tower.
- To avoid the tilting of the tower, floating body is needed.
- Wave force largely affects floating body near sea surface.

Additionally, important characteristic of the tower is that the submerged volume changes with the change of sea level or the angle of the tower. It causes change of resonance frequency and parametric excitation. Given these phenomena, dynamic response characteristics of the secured type of offshore wind turbine is introduced.

Hydrodynamic response of a semi-submersible floating offshore wind turbine: Numerical modelling and validation

Shining Zhang and Takeshi Ishihara

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Abstract:

A fully coupled nonlinear simulation tool using improved Morison’s equation is developed to predict dynamic response of Floating Offshore Wind Turbine System (FOWT). Water tank tests are conducted to validate the hydrodynamic coefficients obtained from previous studies and to investigate the performance of simulation tool in prediction of dynamic response of floating offshore wind turbine to sea states. Three hydrodynamic models are discussed in this paper. Firstly, effect of radiation damping force is investigated and evaluated by a free decay test. Then, the axial Froude-Krylov force on slender members is included in Morison’s equation and is clarified by the water tank tests with regular and irregular waves. Finally, dynamic behavior of mooring system on fairlead tension is investigated by using quasi-static and dynamic model respectively. With the improved hydrodynamic models, the dynamic response of floating offshore wind turbine from the full coupling analysis shows a good agreement with measured water tank experimental response.