Small scale experimental study of the dynamic response of a tension leg platform wind turbine - DTU Orbit (26/01/2019)

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A floating Tension Leg Platform (TLP) wind turbine was constructed at scale 1/200 and its dynamic response was analysed experimentally in co-directional wind and waves. The wind turbine was Froude scaled and a new rotor was designed to yield maximum power and Froude scaled thrust at the low model Reynolds number. Physical limitations due to the large scaling ratio further meant that some structural adjustments were necessary. Nacelle and floater accelerations were measured by means of two accelerometers. The TLP was moored with four different tendon configurations and exposed to different constant wind speeds and irregular sea states as well as a range of regular waves. It was found that an increase in wind speed reduces the wave-induced floater motion but causes slightly larger nacelle displacements. Further, the orientation of the spokes relative to the direction of wind and waves influences the pitch stiffness and thereby the nacelle displacements. Inclining the tendons towards the wind turbine reduces the nacelle displacements significantly and reduces the occurrence of slack tendons, but increases the inline tilt-motion of the rotor. Application of a very stiff mooring configuration increases the occurrence of slack tendons and the magnitude of the pitch accelerations. In a robust commercial design, however, slack tendons must be avoided. The experiments demonstrate the ability of the wind turbine model and the experimental setup to give insight to the dynamic characteristics of floating TLP wind turbines.

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