FLOATECH

D4.3 Final design report: integrated design optimization

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AUTHOR(S) – Daniel van den Berg, Jan-Willem van Wingerden

DELFT UNIVERSITY OF TECHNOLOGY

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FLOATECH
THE FUTURE OF FLOATING WIND TURBINES

PUBLISHABLE SUMMARY

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Wind farms can produce significantly more energy when the negative effects of the turbine-to-turbine interaction can be mitigated. Several promising solutions that have gained traction in literature are the so-called 'wake mixing techniques'. These techniques make use of the blade pitch degree of freedom to destabilize the wake, promoting a re-energization process in the wake. If this does come along with a small or negligible decrease in the performance of the actuated turbine, the re-energization of the wake increases the wind speed downstream, resulting in higher power production for any downwind turbines. Work Package 4 investigates how these wake mixing techniques and floater design can be synergized to achieve a higher level of wake mixing, i.e., further promoting this re-energization process. Deliverable 4.1 of this work package investigated the working principle behind wake mixing techniques and looked into how wake mixing techniques work on floating turbines. Deliverable 4.2 investigates the tools that are used in the project to optimize floater design and wake mixing techniques. Within deliverable 4.2 the TripleSpar [35] is optimized to have enhanced yaw motion. For this deliverable, the Softwind [3] platform is also included in the analysis, and it is also optimized for yaw motion. In the same deliverable, it is found that the Helix method excites the yaw motion of these turbines. This deliverable investigates in more details this interaction between the optimized platform and control system evaluating the impact on downstream wind speed and power production. Aside from analysing the optimized platforms in combination with the Helix, this deliverable will also cover two examples of co-design of floating turbines and control systems. The first example covers a controller that is designed to promote wake mixing by synchronizing the wake mixing controller to the surge motion which is present due to the second-order wave forces. The 'second order' surge motion is at a frequency that is similar to the wake mixing frequency. By synchronizing a pitch controller to that motion less pitch input can be used to create wake mixing. The second example of co-design covers finding an optimal wake mixing signal for a floating turbine by means of an adjoint optimization process. This optimization process uses the thrust coefficient of the first floating turbine, in a hypothetical case study made of two floating turbines, to maximize the power production of the wind farm. The dynamics of the floating turbines are modelled as massspring-damper systems.