Wind Energ. Sci. Discuss., author comment AC4
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Reply on RC5

Alessandro Fontanella et al.

Author comment on "UNAFLOW: a holistic wind tunnel experiment about the aerodynamic response of floating wind turbines under imposed surge motion" by Alessandro Fontanella et al., Wind Energ. Sci. Discuss., https://doi.org/10.5194/wes-2021-12-AC4, 2021

Dear Refree, thank you for your comment. We understand the issue of tower flexibility is not clearly explained and deserves some further attention.

The tower of the LIFES50+ turbine was designed to match the 1st FA mode of the DTU 10MW (6.29 Hz at model scale), but turned out to be more compliant than desired (4.25 Hz), probably because the properties of the carbon fiber used in the production process were different than those considered in the design.

The UNAFLOW turbine adopted a new tower design based on aluminum instead of carbon fiber. The new tower is stiffer (1st FA mode at 6.75 Hz).

The flexible response of the LIFES50+ tower penalized force measurements. This is exemplified by the figure in the attached document, that compares the spectrum of the tower-top FA shear-force for the same surge-motion (A = 0.1m, f = 0.25Hz) and no wind measured in the LIFES50+ and UNAFLOW experiments. In no wind condition, the FA force is mostly due to RNA inertia and, as visible, the contribution due to the tower resonant response was larger in LIFES50+ than in UNAFLOW.

As we discussed in the previous answer, it is desirable to increase the frequency of the 1st FA mode, to avoid resonant excitation (the amplitude of the higher harmonics of the imposed surge-motion decrease with frequency) but this is in large part prevented by the RNA mass, which is fixed by commercial components.

Let us know if this made some clarity and if you have any further comment.

Please also note the supplement to this comment:
https://wes.copernicus.org/preprints/wes-2021-12/wes-2021-12-AC4-supplement.pdf