Wind Energ. Sci. Discuss.,
https://doi.org/10.5194/wes-2019-102-RC1, 2020

WIND ENERGY SCIENCE DISCUSSIONS

Interactive comment on "Re-design of an upwind rotor for a downwind configuration: design changes and cost evaluation" *by* Gesine Wanke et al.

Pietro Bortolotti (Referee)

ptrbortolotti@gmail.com

Received and published: 2 June 2020

The paper runs a comparison between upwind and downwind configurations of a commercial 2MW wind turbine. Design optimization studies are run and the results are compared. The conclusions indicate an advantage of upwind in terms of COE and a possible minor advantage of downwind in CAPEX. The paper reads well and I recommend it for publication subject to minor revisions.

The design methods combine lower and higher fidelity approaches in a sequential approach that does not guarantee the true optimality of the design solutions. The choice of the objective functions is also confusing, with AEP in some steps treated as a con-

straint. It has been shown in https://doi.org/10.1115/1.4027693 that this can lead to suboptimal results. This, combined with the non dimensional presentation of the results, forces the reader to several acts of faith in your claims. This is a common problem of studies in the area of wind turbine design optimization, but I would prefer to see some disclaimers about this, highlighting a little better where some of the limitations of the present approach may be hiding. In my view, the biggest uncertainty is about rotor diameter and whether adding it among the design variables has the potential to reduce LCOE more for the downwind configuration than for the upwind. In lines 460-465 you let the reader understand that the outlook is pessimistic. However lines 465-466 say exactly the opposite. Please elaborate more about this aspect. Do you expect that your conclusions may change drastically? Do the downwind designs have some margins in the loads to support such increase in rotor diameter compared to the equivalent downwind? Table 3 suggests to me that no real margin is available. Another aspect where I'm not totally convinced consists of the analysis of the design drivers. At line 325 we read that the spar caps are strain constrained. Why doesn't then the optimizer reduce relative (and therefore absolute) thickness? If I understand right, Figure 4 shows the same absolute thickness between S111uw PF and S111dwPF. What are the design drivers at convergence? And if tip deflection is not an active design driver, why not reducing cone and tilt angles for the downwind? This would certainly help reducing the losses in AEP. Overall, a cleaner discussion on the different design drivers between upwind and downwind is needed in my opinion. Load analysis is great, but it's often somewhat nebulous.

Some smaller suggestions for improvements are listed below: 1) I suggest to reformulate the logical connection on lines 23-25 "Upwind rotor configurations, on the other hand, were found to be significantly less noisy. Upwind rotor configurations therefore dominated industrial applications as well as the focus in research efforts during the 1990s and 2000s.". As it is posed, it sounds like that it was only a noise problem. I think that the overall combination of the problems that you listed between lines 1-23 contributed to upwind dominating over downwind. 2) I suggest to reformulate the sentence “Since the blade tip deflection constraint could be eliminated in modern sized wind turbines, the downwind configuration is currently coming into research focus again, especially for future even larger rotors.”. The tip deflection constraint cannot be eliminated in modern wind turbines, even in downwind ones. . . We all know this, but I still find the sentence potentially confusing. 3) Line 80: define cp, which later becomes Cp 4) Line 84: check the sentence “This paper evaluates the specific example of the Suzlon S111 2.1MW turbine the potential of a downwind turbine configuration compared to the original upwind turbine configuration regarding mass and cost reduction.” 5) Please improve the introduction by better defining the motivation behind this work. What are the gaps existing in literature? How do you plan to address them? How do you structure the analysis? Currently, the introduction consists of a long list of little summaries of relevant work, without however highlighting what is missing and how the paper contributes in terms of novelty. Why is this work important? The introduction should answer this question leaving no doubt to the reader. Also, lines 84-89 describe the conclusions. These should be in the abstract and in the conclusions, not in the introduction. 6) Line 131: “For the downwind configuration the load simulations are conducted with an inflow inclination angle of 0.”. What about the upwind? Why not keeping the same angle as prescribed by the standards? If it gives an unfair advantage to downwind, why not sticking to 0 deg for both designs? Does it actually give an unfair advantage to downwind? 7) Line 147-149: “Start-up routines, especially at high wind speeds, need to have a lower pitch speed in downwind configurations than the comparable upwind configurations. Shut-down routines, especially during gusts, have to be of faster pitch speed in the downwind configuration.” . Please explain these effects and how you address them in more detail. What are the limitations of the downwind configurations? How did you solve them? 8) Line 326: where do the highest blade deflection of the downwind designs occur? Is shutdown a problem as pointed out in several works? What about high wind speeds? And start ups? Please discuss the design drivers of both upwind and downwind better, so that the reader can gain confidence in these results. 9) Line 328: please revise the sentence “For all redesigns of the

rotor blade, significant savings could be achieved of at least 12%.” Savings in what? 10) For some reason all figures were generated b/w. Some color would be great. . . 11) Line 364: I would move Table 3 to percentage values. Right now it is somewhat hard to interpret. Plots could also help. Same for Figure 5, % values would be more immediate to interpret. And please add some colors.

Interactive comment on Wind Energ. Sci. Discuss., https://doi.org/10.5194/wes-2019-102, 2020.