Wind Energ. Sci. Discuss.,
https://doi.org/10.5194/wes-2020-27-RC2, 2020

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Interactive comment on "Demonstration of Offshore Wind Integration with an MMC Test Bench featuring Power-Hardware-in-the-Loop Simulation" *by* Fisnik Loku et al.

Anonymous Referee #2

Received and published: 13 April 2020

General comments:

I find that the focus and key contribution of the paper is not clear. Although HIL/PHIL results can be of great use, they are mainly for demonstration or validation purposes. PHIL results on their own are not of great interest – although I think the presented setup looks great and seems to behave reasonably, just making the HIL setup representative of a real system is not necessarily of significance (particularly for wind and HB-MMC systems which are now quite well understood). I would suggest that the focus of the paper should be more on the key outcome of the research – what is the thing that you are actually trying to validate using the PHIL setup – and then the PHIL results are

very nice to have but not the main focus. Otherwise, if the intention is to write a paper about how to design and configure a small scale demonstrator, then this could be of interest provided significant novel details are provided about the setup, the scaling of components, the other previously undocumented challenges when developing such a system. The title should then be adjusted accordingly so that it specifically reflects the key contribution.

I feel that you missed a key step in the design/demonstration process – I would expect that you also have a simulation only model of the low voltage system. Could it perhaps be of interest to discuss this model, and indicate if this model more closely matches the results from the full scale system or from the demonstrator? This could be an important step to identify where the differences in the results comes from. I suspect that you have already done this internally but I think it could be a useful addition to the paper (particularly when presenting the results for which the response of the full scale and the lab scale are not identical).

Detailed comments:

Page 2 Line 39 (P2 L39): The benefit of HIL/PHIL over pure simulation is critical to this paper. I think that the authors should provide more specific details here regarding the actual benefit of PHIL in this application.

P3 L75: Very little detail is provided here about the offshore wind farms, given that the paper claims to focus on the wind integration. I would expect more detail and more justification of the choice of wind farm – is the chosen case study typical and representative?

P5 L100: Although here there is some discussion of the implementation of the hardware, there are no details about the choices that were made when designing the system – e.g. how did you ensure that each component is representative of a full scale system? How are the MMC capacitors sized? How are the cable parameters chosen so that they are representative of a full scale cable? What phenomena is this system

representative for and what is it not representative for?

P9 L187: Here, and in other places in the paper, a start-up sequence is briefly mentioned but not detailed. Was this start-up sequence developed in this work? Or is it a standard sequence for which a reference should be provided?

Table 3: What is the basis for this wind speed case study – it looks like it would be reasonable to test a few power set points of the HVDC converter but this wind profile is surely not realistic for a real system. Might it be of interest to test a more realistic wind profile?

Fig8(right): The profile of the voltage is clearly very similar, but the magnitude is quite different. Could this be a problem with the scaling of the system? I suggest that the ('per unit') resistance of the cable is different between the full scale model and the lab scale demonstrator, and this causes the big difference in voltage for a given current. More discussion of the scaling would be useful to gain more insights into this point.

P10 L229: Following on from the point above I would certainly not say that the DC voltage is almost identical.

Fig10: I agree with "Anonymous Referee #1" that the 0.3pu power set point is perhaps not the most convincing one to demonstrate successful operation. I think that either a realistic case study should be presented (e.g. more detailed wind profile so that the full response of the controllers can be evaluated) or if you only wish to test the converters then you should demonstrate all points on the converter's PQ envelope to actually demonstrate that the converter can operate as specified. That said, I don't see too much added value in demonstrating the full PQ envelope of a converter that is perhaps not optimized (e.g. in terms of capacitance, current rating,. . .), and that for a converter topology which is well understood by academia and industry.

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