Replies to editor comments, December 5, 2019.

The authors wish to thank the editor for the comments below. Each comment is addressed separately and the relevant text from the paper is copied where relevant to make review easier. Changes to the manuscripts are indicated in red text where applicable.

Please note that the submitted PDF may have figures placed at the end of the document. This is due to Latex restrictions on figure placement in a single column document and can be corrected in the final print version (2 column).

Dear Authors,
I like your work with testes on commercial wind turbines it gives a good knowledge and experience of the control of the turbine and can help the development of the frequency control by wind turbines.
I have seen your last update of the paper and it is good, although I still like to see some small updates.

1. Regarding the comments from the latest review. Figure 2. Have a figure of Type 3 and Type 4 wind turbine and saying they ae different, it give notthing to the reader. Skip this text.

Updated.

2. I like to see a motivation to your selection of AGC signals in figure 6. One is at rated power the other one around zero, wat what is good with the selection, what should the reader learn.

Added. To make review simpler, the text is copied below:

The Alberta Electric System Operator (AESO) provided both AGC signals used in this work. One was a 30 minute duration signal and the other was 4.5 hours long. These are identical to the signals used in Rebello et al. (2019) and Nasrolahpour et al. (2017). This is done to make direct comparison with earlier work easier. Both signals use a 4 s update interval which is 5 identical to PJM's Reg-D signal. Although we do not use PJM's regulation signals, the identical update intervals allows for a more straightforward comparison. The first step to signal preparation was scaling the raw AGC signals to fit within our chosen regulation ranges. The results of this scaling are shown by blue traces in Figure 5 (a) and (b). Note that the signal in Figure 5 (a) has a range from 720 to 800 kW (centred around 760 kW i.e. 800 � 40 kW) as these power targets are sent directly to the wind turbine. Power values in the range [720, 800] kW are within the operational range of the wind turbine and this test is 10 performed when prevailing wind speeds are above the turbine's rated wind speed i.e. rates power production is possible. The signal in Figure 5 (b) is centred around zero kW as this signal is a bias value. The bias values therefore in the range of [-40,40] kW and are added to an estimated power value as described in Section 2.3. The scaling process was followed by filtering, as described below. 3.

3. In the same way what are the motivations for perform the specific tests I table 1 ?

Added. To make review simpler, the text is copied below:

The experiments presented in this work are grouped into two tests as summarized in Table 1 with two being above rated wind speed and one below. The aim of both tests is to examine the ability of the wind turbine to vary its active power output in 20 response to an external target. In order to provide a complete picture, examining this ability across the full range of operational wind speeds is required. Test 3 is *performed below rated wind speed and therefore requires a varying power curtailment to provide up-regulation. As described in Section 2.3, this varying power curtailment is provided via a wind speed estimate and a power curve. In contrast, Test 2 is performed when prevailing wind speeds are above the turbine's rated wind speed and rated power production is therefore possible. No estimate of power production is required. We also present a variation of Test 2 where the regulation offer is 100 kW. This is denoted by Test 2* as it is functionally identical to Test 2, the only difference being a larger regulation region (100 kW versus 40 kW in Test 2). Test numbers are kept consistent with other project documentation. The two tests presented here are the only ones with the wind turbine operating independently.*

4. Page 9 line 3: some words missing?

Corrected

5. Page 9 line 5: Do not write about a future battery test in this paper, may be in a specific chapter: Future work

Removed mention of the battery. It is still included in the system description (Section 1.6) for completeness

6. Page 12 Figure 9: Nice if you could add an error signal in figure 9, as you have done in figure 10.

Done.

7. Page 13: Figure 10. Please improve the color for the regulation region, very hard to read. I also suggest that you have a separate scale for the Error, on the right side of the figure, maybe with a factor 4 to be able to read the Error. Alternative have a special figure for the Error. The Error is an important number and need to be readable.

Done**.**

And then a comment to the discussion of electrical torque/power: The electrical power output is set by the control system of the converter of the wind turbine and it can be very fast down to some ms. The pitch controller is used to limit the speed of the turbine by reducing the power input to the turbine. And there by also reducing the incoming loads of the turbine.

Included in Section 3.5 and copied below for reference:

Additionally, note that using a wind turbine to provide AGC in the manner described in this work will produce some level of tracking error. The electrical power output of a Type 4 wind turbine is set by the power converter and its response time can be in the order of milliseconds. Power, via torque, is ultimately produced aerodynamically and is controlled by the wind turbine's pitch system, a system that has a typical response time of a few seconds. Depending on the control methods implemented, the pitch system also works to reduce the loads experienced by the turbine in addition to limiting power which may increase *power tracking error. The question of wind turbine loads is an important aspect that requires further examination, particularly of field data during a demonstration such as presented here.*