Power Curve Working Group Meeting Minutes

Impact of Outer Range Conditions on Wind Turbine Power Performance

11th Meeting Minutes, Friday 8th May 2015, University of Strathclyde, Glasgow, Scotland

Attending: Peter Stuart (RES), Alan Derrick (RES), Christoph Thiel (TB-Engineers), Malcolm Macdonald (Prevailing), Matthieu Boquet (Leosphere), Florin Pintilie (Sgurr), Elias Fernandez (EON), Petros Paterakis (EON), Brian Davison (Sgurr), Iñaki Lezaun Mas (Gamesaa), Daniel Marmander (Natural Power), Erik Brown (Oldbaum Services), Carlos Andre Niederbacher Silva (Nordex), Arlinda Huskey (NREL), Peter Clive (Sgurr), Axel Albers (WindGuard), Rodolphe Lebosq (Enercon), Rebeca Rivera Lamata (Dong), Erik Tuxen (DNV GL), Michael Pram Nielsen (Vestas), Peter Gregg (GE), Paula Gómez Arranz (DTU), Ioannis Antoniou (Siemens), Ignasi Simon (Alstom), Stathis Koutoulakos (Vattenfall), Hector Alonso (Barlovento), Jeremy Bass (RES) & Frank Ormel (Vestas).

Objective: to ensure the continued collaboration of IEC 61400-12-1, IEC 61400-15 and PCWG.

Presentations

01 Status of MT12-1 May 2015, Alan Derrick (RES)
02 Update on IEC 61400-15 activities for the PCWG, Malcolm MacDonald (Prevailing)
03 PCWG Update, Peter Stuart (RES)
04 Presentation on 61400-12-1 Uncertainty to the PCWG, Frank Ormel (Vestas)
05 PCWG Data Sharing Initiative, Peter Stuart (RES)

Discussion

Collaboration between IEC 61400-12-1, IEC 61400-15 and PCWG

The group discussed the issue of continued collaboration between IEC 61400-12-1, IEC 61400-15 and PCWG. A manufacturer member of the IEC 61400-12-1 maintenance team (MT12-1) commented that it would be very useful to continue to have at least one joint meeting per year. The same member added that it was most useful if the PCWG meeting occurred at the end of the week (the same week as the MT12-1 meeting) because this allowed the MT12-1 to give an overview of their progress during the week (c.f. presentation “01 Status of MT12-1 May 2015”).

An IEC 61400-15 member said that they also valued the opportunity to interact with both MT12-1 and PCWG members at the joint meeting. The same member added that the appointment of an official liaison between the PCWG working group and the IEC 61400-15 committee would help strengthen this interaction.

The issue of interaction of the PCWG with MEASNET was also briefly discussed. A MEASNET member present stated that MEASNET’s current focus is on issues distinct to those considered by the PCWG. The MEASNET member added that the situation could change in the future, but at present they did not see any reason for closer collaboration. The group agreed to continue to monitor the roles of the PCWG and MEASNET and initiate closer collaboration if a need arises.

The group co-ordinator posed the question to the MT12-1 members “What can the PCWG do for IEC 61400-12-1?” A manufacturer MT12-1 member stated that the PCWG Open Source Analysis Tool is

beneficial to IEC 61400-12-1 and very helpful to the industry in general. The same MT12-1 member added that even if people don't actually use the tool (as they favour their own existing tools) the PCWG Analysis Tool is still very useful as it provides a benchmark tool whose source code is available.

A different MT12-1 member commented on the benefit of the PCWG running multiple test cases to examine methods defined in the IEC 61400-12-1 standard. The member added that this should help prioritise future work of MT12-1 by identifying shortfalls in the current standard.

The group co-ordinator posed the question to the IEC 61400-15 members "What can the PCWG do for IEC 61400-15?" A member of -15 stated that their expectation was that the -15 standard would look to the PCWG for a recommendation on how to deal with the issue of turbine performance in non-standard atmospheric conditions. The group co-ordinator mentioned the issue of language harmonisation and suggested that the phrases "Generic Power Curve Adjustment" and "Site Specific Power Curve Adjustment" could be renamed "Inner Range Power Curve Adjustment" and "Outer Range Power Curve Adjustment" respectively to be more in step with the terminology used by the PCWG.

Potential for a Round Robin on the IEC 61400-12-1 Uncertainty Methodology

A developer who is a member of both MT12-1 and the PCWG stated that they supported the PCWG running a round robin on the IEC 61400-12-1 uncertainty methodology. The same member added that a round robin exercise forced users to try out the standard. The same member suggested that participants could evaluate the round robin with whatever tool they wanted (like previous round robins), including the PCWG Analysis Tool. A consultant member of both MT12-1 and the PCWG responded that the calculation of the IEC 61400-12-1 Uncertainty is an order of magnitude more complicated than the previous round robins. The same member added that it was likely to be very time consuming to follow up discrepancies identified in the round robin. A manufacturer member of MT12-1 commented that they believed that an open source analysis tool (PCWG Analysis Tool or similar) would need to be available to perform a round robin. The member who originally suggested the round robin (developer and MT12-1 and PCWG member) responded by saying that running a round robin "before and after" the analysis tool would provide an illustration of the convergence of results achieved by introducing the tool which would provide some useful insights into the benefit of the tool.

The group co-ordinator asked if it would be possible to define a single simplified round robin exercise. A developer and MT12-1 member stated that they believed that a simplified case could be designed and would support the idea of a simplified round robin. A consultant and MT12-1 member added that the round robin should be limited to a subset of the IEC 61400-12-1 uncertainty methodology so that specific elements of the methodology can be examined in detail. The same consultant added that the design of the exercise would be crucial so that key insights are not missed. The consultant cited the example of the first PCWG round robin where ambiguity on how to deal with certain sub-tasks (e.g. annualisation) distracted from the core methodology which was being examined.

Proposed Data/Intelligence Sharing Initiative

Following the presentation “05 - PCWG - Data Sharing Initiative” the group discussed the relative merits of the proposed “Data Sharing” (Option 1) and “Intelligence Sharing” (Option 2) options. The group co-ordinator said that Option 2 was intended to address concerns raised by some members that non-disclosure agreements (NDAs) would be required in order to proceed with Option 1. The group co-ordinator said that Option 2 would involve sharing performance metrics on candidate correction methods (less commercially sensitive) rather than the data itself (more commercially sensitive). One consultant said that the performance metrics of Option 2 would need to be designed such that commercially sensitive data could not be reverse engineered, otherwise Options 1 and 2 would be equivalent. Another consultant said that in their view Option 2 was a good place to start and “safer bet” in terms of achieving progress over the next few months. One developer said that if Option 2 was progressed initially then members could in parallel progress the necessary NDAs to make Option 1 possible in due course. In conclusion the group agreed to focus initially on “Intelligence Sharing” (Option 2).

The group discussed the candidate methods that should be examined by the intelligence sharing initiative. It was agreed that the following methods should be examined:

- Rotor Equivalent Wind Speed (from IEC 61400-12-1 Draft CDV version 2)
- Turbulence Correction (from IEC 61400-12-1 Draft CDV version 2, Annex M)
- Wind Shear Normalisation (from IEC 61400-12-1 Draft CDV version 2, Annex P)
- Power Deviation Matrix
- Production by Height (as proposed by AWS True Power)

Group Engagement in Development of PCWG Analysis Tool

The group discussed the PCWG Open Source Tool. The group co-ordinator said that the open source project had been ‘seeded’ by RES, but that the vision was for a broad range of organisations to get involved in developing the code. An academic member of the PCWG suggested that a one-day meeting could be organised for those interested in getting involved in developing the code. The academic member added that the proposed meeting could take the form of a ‘hackathon’ whereby a group would get hands on experience of modifying the code during the course of the meeting. The group agreed that a one day meeting for the subset of PCWG members interested in developing the code would be a useful step in increasing the level of engagement in the open source project. Following a question the group co-ordinator confirmed that the PCWG Analysis Tool is written in the Python programming language. The group co-ordinator then asked the members present who was interested in becoming actively involved in the open source project to which 7 members present responded by saying they were.

Funding of Full Time Developer of the PCWG Analysis Tool

The group discussed the potential to fund a full time person for one year to drive forward the development of the PCWG Analysis Tool. The PCWG members were broadly receptive to the concept, but indicated a preference for the person to be hosted by an academic institution (as opposed to a commercial organisation). The PCWG members agreed that the hosting of the person at an academic institution did not preclude them being mentored by the group co-ordinator (belonging to a commercial organisation). The group co-ordinator suggested that if a person could be funded they could dedicate some of their time to helping organise the PCWG e.g. responding to

the emails received by the PCWG inbox, organising meetings etc. The group agreed that if such as person could be funded it would be of great help in driving forward to 2015 PCWG road map. The group agreed that if a person was funded then the PCWG Analysis Tool would remain fully open source in its entirety. The group agreed that those organisations providing the funding could receive priority software support from the funded person without compromising the 'openness principle' of either the software or the PCWG itself. One PCWG member made a firm commitment to contribute to funding while several others expressed that they would strongly consider supporting the funding.

Potential for Integration of the PCWG Analysis Tool with an Aero-Elastic Model

A manufacturer made the suggestion that the PCWG Analysis Tool could be integrated with an aero-elastic model. The manufacturer suggested that this could be used to examine the influence of turbulence and shear on power production. The group co-ordinator stated that a presentation was made by Richard Whiting of DNV GL at the December 2014 PCWG meeting on modelling power production in low turbulence using an aero-elastic model. The group co-ordinator said that this point had been discussed at previous meetings during which it was suggested that an academic partner could use an aero-elastic model in conjunction with an existing "open source rotor" to examine performance effects. The manufacturer who made the original suggestion said that they would be interested to support a MSc. student to investigate the use of aero-elastic models for this application and if this was to come to fruition would seek to involve the PCWG in providing feedback.

Open Source Datasets

A manufacturer suggested that datasets paid for by public money might be useful for the Data Sharing Initiative. The manufacturer said that certain datasets which have been publically funded become publically available after a certain period of time. The group co-ordinator said that one dataset (Dataset 1) was already publically shared via the PCWG website while 4 others (Datasets 2-5) were available via the group DropBox. The group co-ordinator said that ideally permission could be given from the dataset owners to share all datasets on the PCWG website.

Next Meeting

The group agreed to work towards the next meeting being held during the last week in June at Riso DTU, Roskilde. The group agreed to target completion of the following actions by the June meeting:

- Preparation of a definition document for the intelligence sharing initiative. The document should lay out exactly what will be involved in the initiative and should serve as a 'mini-roadmap'.
- Assemble initial feedback from prospective participants on their success in setting up their datasets in the PCWG Analysis Tool. Where necessary (and possible) improve the code and associated documentation to make this process easier.