Summary of IEA RD&D Wind – 58th Topical Expert Meeting on

Sound Propagation Models and Validation

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Background

For the Wind Farms noise generation and emission, an important work has been performed in the last years, as the development of the existing IEC standards (61400-11: Acoustic noise measurement techniques). However, on the immission side, that is, the calculation of noise levels and measurement and assessment of noise at receptor locations, less has been done and no generally accepted procedures for estimating the noise immission exist.

The objective of this meeting was to report and discuss in this field, that can potentially be a barrier to the social acceptance of wind energy implementation.

Participants / Presentations

The meeting was attended by 17 participants representing 9 countries: Denmark, Finland, Germany, Italy, Japan, Norway, Spain, Sweden and the United Kingdom. The participants represented universities, research centres, public organizations and industries. Presentations covered the following topics:

- Long range sound propagation in the atmosphere
  - Modelling
  - Experimental investigations
  - Offshore Wind Farms
  - Meteorological data
- Background noise (wind driven)
- Masking of wind turbine noise

A total of 13 presentations were given:

1. Sabine Schulz, ENERCON GmbH, Germany (SSz)
2. Sigurs Solberg, Norway (SSg)
3. Seppe Hoogzaad, The Netherlands (SH)
4. Carlo di Napoli, Pöyry Energy Oy, Finland (CN)
5. Rob Shephard, UK, (RS)
6. Bo Søndergaard, Delta Akustik, Denmark (BO)
7. Ilkka Karasalo, FOI, Sweden (IK)
8. Dennis Siponen, VTT, Sweden (DS)
9. Roberto Ziliani, ISMES, Italy (RZ)
10. Martin Almgren, ÅF-Ingemansson, Sweden (MA)
11. Conny Larsson, Uppsala University, Sweden (CL)
12. Prof. Arakawa, Univ. of Tokyo, Japan (PA)
13. Karl Bolin, Royal inst. of Technology, Sweden (KB)
Discussion

Following the two days of presentations the floor was opened and a general discussion took place. A number of different topics were handled:

- Noise Country Limits
- Long Propagation noise on Offshore Installations.
- Procedure for Immission Noise measurement.
- Measured data for validation of Sound Propagation Models
- Background Noise (Masking the noise)
- Future actions under the umbrella of IEA Wind

Bellow is a summary of the discussion.

**Noise Country Limits**

Different type of noise limits already exist in several countries. A general feeling is that already existing limits are conservative and protect neighbours of wind installations. In on going IEA Task 28 “Social Acceptance of Wind Energy Projects”, this issue will be analysed.

**Long Propagation noise on Offshore Installations.**

In Sweden there is an important concern about sound propagation noise from offshore wind installations. The results obtained using already existing propagation models gives high levels of noise even for wind farms located far away from the shore. Values of 47 dB or higher are predicted.

In Denmark, there are not complains about noise in the offshore installations.

The conclusion is that models are predicting higher noise level that real values. Work should be done to modify already existing models for noise propagation on the sea.

**Procedure for Immission Noise measurement**

According with the information presented by the participants, at the present time it is not well defined the methodology to measure noise immission.

CL stated that is required more measurements of meteorological data during the measurement campaigns, due to the fact that meteorological conditions have an strong influence in the results measured. It is well known that sound propagation in the atmosphere, affected by temperature and wind speed gradients. Data required for validating the existing models, need to include extensive meteorological measured data.

The three most significant meteorological effects on sound propagation are: refraction, scattering by turbulence and atmospheric absorption. Meteorological effects were noticeable even at a distance of twenty five metres from the source and increased with decreasing receiver height. (CL).
SSz remarked the necessity of measure wind speed at hub height (near the WT) and at the same time the wind speed at 10 m high level near to the immission site. The wind speed measurement at hub height could be deduced from the WT power production.

General consensus about the necessity to have guidelines to make noise immission measurements, in the vicinity of wind farms and wind turbine installations.

Also it was discussed about the statistical treatment of the measured data. More data that mean values of the complete distributions should be presented. In particular high levels should be presented as well as high sound variations.

The noise descriptors are different for the different propagation models. The noise descriptor should be unified trying to give the best information to protect neighbours of the WT.

**Measured data for validation of Sound Propagation Models**

Various propagation models have been developed to estimate the level of noise near residential areas. The availability of validated prognosis models generally accepted by the governmental and local authorities, will allow being less conservative when planning new wind turbine installations.

It was expressed the need to have friendly used models public available, due to the fact that already existing models for sound propagation of noise from wind farms, are models usually existing at universities and research centres and not friendly used (BO).

More measured data available are required to verify the existing sound propagation models. The validation of the models will allow reducing the time of required immission measurements, just needed for comparison with the predictions (RS).

SSz informed that measured data from the new Alpha Ventus Offshore Wind Farm could be available in the future to validate sea propagation.

MA informed that measured data of noise of small wind turbines are available for the measured performed at Chalmers University

MA asked about the noise behaviour of Vertical Axis WT. (??) informed that the claimed reduction of VAWT is only 1 or 2 dB versus HAWT.

**Background Noise**

The existing noise environment at potential receiver locations (in the vicinity of a proposed wind farm site) must be properly determined for a representative range of conditions. This requires obtaining sufficient background noise measurements correlated with wind speed at the wind farm site.

Determination of background noise it is not an easy task. In Holland they use standardised values for the background noise, while in France they measure the background noise level on the site.
One important question is what should be included in background noise. If it is not just natural sound then the background noise in an area will increase as more and more sound sources (industries, roads, other wind turbines etc) are built.

One issue of relevance for judging the effect of a certain immission from wind turbines is the possibility to estimate masking from background noise. In some experiences the high background level noise masks the high level noise produced by the wind turbines, eliminating the problem.

**Future actions under the umbrella of IEA Wind**

Several options were discussed:

- New Topical Expert Meeting on this subject
- Elaboration of Recommended Practices for Noise Immission Measurement
- New Task on this subject

The participants decided that an additional meeting would be required on the noise immission issue within two years.

BO, convenor of the IEC 61400-11 WG, informed that for the time being there is not specific work inside the IEC to develop standards for noise immission measurement in wind farms. In general the IEC WG produce standards from already existing knowledge, but for immission measurements still is needed to develop new knowledge, that is outside the scope of IEC WG. On the other hand the average time required to produce an IEC standard is 2/3 years.

The participants agreed to elaborate a Recommended Practices document for “Noise Measurement Immission”. And Ad-hoc group will be created. Several of the participants expressed their interest to be included in the Ad-hoc group (their main problem is how to finance their participation).

The measurement of the low frequency noise indoors should be included in the scope of the future Recommended Practices.