A REVIEW OF THE BRITISH COLUMBIA WIND POWER PROJECT ACOUSTIC ASSESSMENT GUIDELINES

B. Martin[*], EIT and M. Bliss[†], P.Eng.
BKL Consultants Ltd., #308-1200 Lynn Valley Road, North Vancouver, BC V7J 2A2

1 Introduction

The BC Ministry of Forests, Lands and Natural Resource Operations (FLNRO), Ministry of Energy and Mines and the Environmental Assessment Office (EAO) jointly published the guideline Best Practice for Wind Power Project Acoustic Assessment (BC Guideline) in 2012 [1]. This document makes recommendations in three areas: interpretation of the Wind Policy criteria, requirements of assessment reports and predictive modelling techniques.

As it would be difficult to compare the BC Guideline to every published windfarm noise assessment guideline worldwide, this paper provides a discussion and critique of the requirements presented in this guideline when contrasted to the Institute of Acoustics (IOA) document *A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise* (IOA Guideline) published in 2013 [2]. The IOA Guideline has been referenced as an industry best practice guideline. A case study has been used to illustrate how predicted noise levels could vary when following the BC Guideline recommendations compared to the IOA Guideline.

2 Method

2.1 Literature Review

The purpose of the literature review is to compare the recommendations of the BC Guideline with other assessment frameworks that are used in other areas of the world.

The IOA Guideline has been used as a contrasting framework, as this document aims to summarize the findings of past research undertaken to present a current good practice in the application of the ETSU-R-97 assessment methodology for all wind turbine developments above 50 kW.

2.2 Case Study

To demonstrate the impact that different assessment methodologies can have on the predicted noise levels for a project, the requirements of these two different assessment methodologies have been applied to the same case study project.

[*] martin@bkl.ca
[†] bliss@bkl.ca

3 Results

3.1 Literature review

Some key differences between the BC Guideline and the IOA Guideline can be summarized as follows:

Correction Factors to Address the Limitations of Using the ISO 9613-2 Noise Prediction Methodology for Wind Farm Noise Predictions

The ISO 9613-2 [3] prediction methodology sets out the standard's limitations. Of relevance for wind farm projects is that ISO 9613-2 is designed for noise sources that are no higher than 30 metres above the ground and that receiver locations are no more than 1,000 metres from the noise source. Given the height of modern wind turbines is typically much greater than 30 metres (the turbine hub height used for the case study was 135 metres), this scenario rarely occurs for wind farm projects. While the BC Guideline recognizes that wind turbine projects do not fall within the stated limitations of the ISO 9613-2 prediction methodology, it does not specifically address how the ISO9613-2 standard should be applied to address these limitations.

The IOA Guideline addresses the ISO 9613-2 limitations by recommending appropriate maximum attenuation values for screening due to intervening terrain. According the IOA Guideline, attenuation due to screening should be limited to 2 dBA. In addition, the screening calculation must consider screening that would occur if the noise source was at rotor tip height rather than the hub height which would typically be used to determine the screening attenuation for a noise source.

Recommended Ground Absorption Coefficients

The BC Guideline and the IOA Guideline both discuss the risks of using soft ground for wind farm projects, given the limitation of ISO 9613-2 (discussed above), however the guidelines specify different maximum ground absorption coefficients. The BC Guideline specifies a maximum value of G=0.7 in contrast to the IOA Guideline maximum value of G=0.5. IOA Guideline recommendations appear to be based on the findings of studies which compared the measured noise level to predicted noise levels for as-built wind farms.

Wind Turbine Sound Power Levels

The BC Guideline states that the sound power level of the turbines is to be supplied by the turbine manufacturer and that uncertainty factors should be discussed.

The IOA Guideline provides more details on how sound power level data should be considered. Specifically, where G=0.5 is used for the model, the IOA states the following:

- Sound power levels that are determined based on considering the average of several individual IEC 61400-11 test results **(Declared sound power levels)** can be used directly.
- Sound power levels that are **warranted or specified manufacturer sound power level data** can be used provided a margin to account for uncertainty has been included. Where uncertainty has not been incorporated into the specified level, an uncertainty factor of +2 dBA should be added.
- Sound power levels that are determined based on an individual IEC 61400-11 test results **(Tested sound power level)** can be used when a correction reflecting the reported test uncertainty is incorporated. Where no data on uncertainty or test reports are available, a factor of +2 dBA should be added.

The benefits of the IOA approach mean that a clear view of the uncertainty can be presented. By applying the uncertainty value to the sound power level of the wind turbines, the risk of exceeding the criteria is reduced.

Consideration of Concave Ground Profiles for IOA Guideline

The IOA Guideline recommends that an additional correction factor of +3 dBA should be added for noise propagation "across a valley" i.e. a concave ground profile where the ground falls away significantly between the turbine and receiver when G=0.5 is used for the model (a correction of +1.5 dBA is recommended for G=0.0 models). A suggested criterion as to when to apply this correction is:
$h_m \geq 1.5 \times (\text{abs}\ (h_s - h_r)\ /2)$

This correction is recommended to account for the reduced ground effect expected and potential for additional reflection path that may exist when this specific topography occurs on site. This scenario is not specifically discussed in the BC Guideline.

3.2 Case Study

Based on the literature review, the key modelling differences between the BC Guideline and the IOA Guideline identified are summarized in Table 1.

Table 1: Key Differences in Recommended Prediction Methodology

Parameter	BC Guideline	IOA Guideline
Maximum ground absorption coefficient	0.7	0.5
Maximum attenuation due to intervening terrain	25 dBA	2 dBA

These two prediction methodologies were applied to a wind farm project to illustrate how predicted noise level could vary. The wind farm project consisted of 8 wind turbines, with the closest residential receivers approximately one kilometre from the nearest turbine. The wind turbines were proposed to be sited at an elevated level, with the residential receivers approximately 50 metres lower in elevation. The results for the receiver with the highest predicted noise level is shown in Table 2 below.

Table 2: Noise Levels for Case Study using the BC Guideline and IOA Guideline Prediction Methodologies

	BC Guideline	IOA Guideline
Highest predicted level	31.9 dBA	35.5 dBA

The average difference in noise level for receivers was an increase of +3.5 dBA when using the IOA Guideline compared to the BC Guideline. The differences ranged from 2.6 dBA to 6.4 dBA.

4 Conclusion

Reviewing and contrasting the BC Guideline and IOA Guideline for the wind farm noise assessment illustrate some differences in assessment methodologies. Some of these differences have to potential to result in significant variations in the noise prediction results for the same project. Further work should be undertaken to compare the predicted noise levels using the BC Guideline prediction methodology to noise levels experienced on site. In absence of this data, it is important to consider the risk that following the BC Guidelines may unknowingly result in noise that exceeds the BC Wind Policy noise criteria. The uncertainty of the noise predictions and possibility that turbines may have to be shut-down or operated in low-noise modes to enable compliance with the noise criteria should be considered as part the risk assessment procedure for wind farm projects in BC.

References

[1] Ministry of Forests, Lands and Natural Resource Operations the Ministry of Energy, Mines and Natural Gas and the Environmental Assessment Office. 2012. Best Practice for Wind Power Project Acoustic Assessment British Columbia. Victoria, Ministry of Forests, Lands and Natural Resource Operations the Ministry of Energy, Mines and Natural Gas and the Environmental Assessment Office.

[2] Institute of Acoustics. 2013. A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise. Hertfordshire, Institute of Acoustics

[3] International Organisation for Standardization (ISO). 1996. Acoustics - Attenuation of Sound During Propagation Outdoors - Part 2: General Method of Calculation. Reference No. ISO 9613-2:1996. Geneva, International Organisation for Standardization.