COMPARISON OF INTERNATIONAL ENVIRONMENTAL NOISE GUIDELINES FOR WIND FARMS

Sam Du, A. D. Lightstone [*1] and Joseph Doran [*1]
[1]Valcoustics Canada Ltd., Richmond Hill, Ontario, Canada.

1 Introduction

Many jurisdictions treat wind farms as they do any other industrial noise source, while some jurisdictions have noise regulations/guidelines/criteria specific to wind farms.

2 Canada

The sound propagation model, ISO 9613-2, is widely used across Canada. However, guidelines and criteria vary from province to province. The Canadian Wind Energy Association recommends setback distances for wind turbines based on issues regarding turbine and blade failure, ice shedding, noise, environmental impacts and interruption of communication systems [1].

2.1 Ontario

In Ontario, the sound level limits for wind turbine noise are in the Ministry of Environment and Climate Change Publication "NPC-232" [2] as well as "Noise Guidelines for Wind Farms" [3] which explains how the limits identified in NPC-232 are applied to wind farms

In rural areas, sound level limits in terms of $L_{eq,1hr}$ at noise sensitive receptors range from 40 to 51 dBA as wind speeds increase from 4 to 11 m/s. In other zones (suburban and urban) the range is to 45 to 51 dBA.

2.2 New Brunswick, Manitoba, Nova Scotia

In New Brunswick, Manitoba and Nova Scotia, the sound level limits are the same as in Ontario.

2.3 British Columbia

The "Best Practice for Wind Power Project Acoustic Assessment document", dated 2012, [4] makes recommendations for interpretation of the Land-Use Operational Policy criteria; requirements of assessment reports; and predictive modelling techniques.

The Land-Use Operational Policy requires that sound from wind turbines should not to exceed 40 dBA in terms of $L_{eq,Night\ (2200\text{-}0700)}$ and $L_{eq,Day\ (0700\text{-}2200)}$ on the outside of a permanently-occupied residence or the nearest property line of undeveloped land parcels zoned for residential uses at the time of application to construct a wind farm, where ambient is 35 dBA or less.

Where ambient is greater than 35 dBA, day or night (except where another wind power project is present), a 5 dBA increment may be applied to a measured background sound level, to a maximum criterion of 50 dBA.

The BC guidelines recommend ISO 9613-2 as the sound propagation model. However, CONCAWE, Harmonoise and Nord2000 models may be used with explanations of particular effects being modelled.

2.4 Alberta

Rule 12, of the Alberta Utilities Commission, concerns noise control for all energy facilities including wind farms [5].

The CONCAWE model is recommended alongside ISO 9613-2 with additional adjustments specifically for wind facilities. The turbine sound power level must be the maximum emitted when the turbine operates under planned maximum operating conditions for both day and night. The model must include the cumulative effects of adjacent wind farms and other energy-related facilities that may impact a dwelling. Where no dwelling exists within a 1.5 km radius of the wind farm, and the proposed facility is adjacent to an existing facility, which also has no dwellings with a 1.5 km radius, then the sound level may exceed the permissible limit where the two radii overlap.

Criteria at receptors are determined on a case by case basis based on proximity to heavily travelled transportation noise sources and density of settlement. The criteria range from L_{eq} (8hr) 40 dBA to 56 dBA.

3 Europe

Many countries in Europe use the World Health Organization Guidelines for Night Noise as the base criterion, where L_{eq} over 8 hours (23:00 – 07:00) outdoors should not exceed 40 dBA [6].

3.1 Denmark

Denmark previously used their own sound propagation model with criteria ranging from 37 dBA at wind speeds of 6 m/s in noise sensitive areas up to 44 dBA at wind speeds of 8 m/s in open country. Now the Nord2000 propagation model is recommended. A correction of +1.5 dB for ground effect is used for land based wind farms. For offshore wind farms, the correction is +3 dB.

3.2 Sweden

The Swedish Environmental Protection Agency has guideline limit of $L_{eq,24hr}$ of 35 dBA for Natura 2000 (environmental protection) areas. The commonly used

[*] solutions@valcoustics.com

model is ISO 9613-2 with additional considerations for cylindrical spreading over water for offshore wind farms.

3.3 United Kingdom

In the UK, both the Marine Management Office and Department of Energy and Climate Change are responsible for assessing offshore wind farms. Both agencies require projects to be assessed using the ISO 9613-2 and/or CONCAWE models.

For noise assessment, the ETSU-R-97 guidance developed by the Noise Working Group for the UK Department of Trade and Industry, was used to scope the impact of the wind turbines on onshore and near-shore sensitive receptors [7]. The day-time limits range from 35 to 40 dB in terms of $L_{90,\ 10\ minutes}$ when the prevailing background noise level is below 30 dBA L_{90}. The range allows for considerations of number of dwellings, the amount of energy generated and the duration and level of sound exposure). The nighttime limit is 43 dB.

4 Oceania

South Australia, Queensland, Western Australia and New South Wales use "South Australia Wind Farms Environmental Noise Guidelines" [8]. Both Victoria and Tasmania use the New Zealand Standard NZS 6808:2010, "Acoustics – Wind Farm Noise" [9] with the former including a minimum setback distance of 1 km.

4.1 New Zealand

NZS 6808:2010 provides guidelines for most of the processes involving noise from wind farms. The noise limit ($L_{90,\ 10\ minutes}$) at most receptors is 40 dBA or the background level plus 5 dBA if the background level is over 35 dBA. In special circumstances, a more stringent limit of 35 dBA or the background level plus 5 dBA, if the background level is over 30 dBA, is applied.

Sound modelling is acknowledged as not being standardized but the ISO 9613-2 model is mentioned as correlating well with measured data for wind farms. It indicates that whichever model is used, the predictions should take into account sound power levels; positions of wind turbines; directivity of propagation; meteorological conditions; attenuation due to geometric spreading, atmospheric absorption, ground effects and obstacles; and barrier/terrain screening. Penalties of up to 6 dBA are applied for a range of characteristics such as tonality, impulsiveness and amplitude modulation.

4.2 South Australia

The South Australia guidelines state that a suitable model must be selected (or developed) to predict the worst-case sound level at all relevant receivers. While recognizing that there is no standard procedure directly applicable to sound propagation from wind farms, the guidelines recommend that noise prediction methods in ISO 9613−2 or CONCAWE be used, with atmospheric conditions at 10ºC and 80% humidity, weather category 6 (if CONCAWE), and hard ground (zero ground absorption factor).

The sound level ($L_{eq,\ 10\ minutes}$) in outdoor living areas, due to the new wind farm developments, shall not exceed 35 dBA in rural areas; 40 dBA in other areas; or the background ambient sound level plus 5 dBA, whichever is greater. There is a +5 dBA penalty for tonal components.

5 U.S.A. (Oregon)

Most states do not have noise criteria specific to wind farms. In Oregon, Industrial and Commercial Noise Source Standards for a wind energy facility allow the wind energy facility to increase the ambient statistical noise levels L_{10} and L_{50} over 1 hour by 10 dBA using either an assumed L_{50} of 26 dBA or the actual ambient background level measured at an appropriate measurement point (i.e., the further of a point 25 feet in front of the receptor or the point on the property line nearest the noise source.). The sound level limits are 50 dBA (L_{50} over 1 hour) or 55 dBA (L_{10} over 1 hour) at night (2200 to 0700). During daytime, the sound level limits are 5 dB higher.

6 Conclusions

The strictest noise requirements are found in Sweden, Germany, Finland, New Zealand, the United Kingdom and parts of Australia. Several countries have penalties for tonal, impulsive, low frequency noise or amplitude modulation of wind turbine sound. Some jurisdictions indicate a particular acoustical modelling method should be used for wind farm noise assessment. Many do not specify nor require a particular modelling method.

The sound limits variously range from 35 to 60 dBA, subject to time of day and other factors such as ambient sound level, typically with the starting point being 35-40 dBA.

References

[1] Canadian Wind Energy Association Position on Setbacks for Large-Scale Wind Turbines in Rural Areas (MOE Class 3) in Ontario.

[2] NPC-232, Sound Level Limits for Stationary Sources in Class 3 Areas (Rural) – Ontario Ministry of the Environment 1995.

[3], Noise Guidelines for Wind Farms, Ontario Ministry of the Environment and Climate Change, PIBS 9900e, May, 2016.

[4] Best Practice for Wind Power Project Acoustic Assessment - British Columbia, 2012.

[5] Alberta Utilities Commission, Rule 012 – Noise Control, March 2013

[6] Night Noise Guidelines for Europe, WHO, 2009.

[7] The Assessment and Rating of Noise from Wind Farms, The Working Group on Noise from Wind Turbines, ETSU-R-97, September 1996.

[8] Environment Protection Authority (South Australia), Wind Farms Environmental Noise Guidelines, Environment Protection Authority, ISBN 978-1-876562-43-9, July 2009.

[9], Acoustics – Wind Farm Noise, New Zealand Standard NZS 6808:2010, ISBN 978-1-86975-130-2, March 2010.