Review of the MOE Turbine Noise Compliance Test at the Libby Home

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Background

As a result of complaints of noise intrusion at the Libby home, measurements of sound pressure level at the home were made by Ministry of the Environment officials. The Libby home is 659 and 1060m respectively from the nearest two turbines of the Talbot Wind Farm. Noise modelling using the MOE protocol predicts a sound pressure level at the home of 38 dBA. The sound meter was placed 1.5 m above ground on the turbine side of the house, together with an anemometer at the same height. 10m wind speed measurements were provided by the developer. The measurements were made over 5 days in December 2011. The relevant measurements are collected in the following Table 1.

Date Dec. 2011	Time	V(1.5m) (m/s)	V(10m) (m/s)	SPL (dBA)	Power (MW)
16th	1:32 am	2.4	9.0	54.5	91
18th	5:32 pm	1.0	4.1	41.3	30
18th	8:10 pm	1.0	6.6	45.8	78
19th	9:11 pm	1.0	7.9	43.4	69
19th	9:56 pm	1.7	5.9	44.0	67
19th	11.55 pm	1.4	6.2	40.6	68
21st	4:50 pm	2.0	7.8	47.0	94
21st	5:51 pm	2.0	6.9	43.8	84
21st	9:13 pm	1.7	5.8	39.7	50

Table 1: Measurements Made at the Libby Residence

Columns 3 and 4 give the wind speeds at heights of 1.5 and 10 metres above the ground. Column 5 is the sound pressure level measured by the sound meter. The sound meter was fitted with a wind shield. The maximum contribution to the measured sound pressure level from wind noise in the microphone would have been 0.1 dBA. The power output of the nameplate 99MW wind farm is shown in the final column. These numbers were retrieved from the Independent Energy System Operator archive.

Figure 1 is a plot of the measured sound pressure level as a function of the 10 metre wind speed, V(10m). The solid line corresponds to the MOE noise limit for a class III

environment. It is 40 dBA up to a 10m wind speed of 6 m/s, rising to 51 dBA at 10 m/s. There are no qualifiers for humidity.

Clearly, the turbine noise is out of compliance for much of the time. Remember that the prediction was 38 dBA.

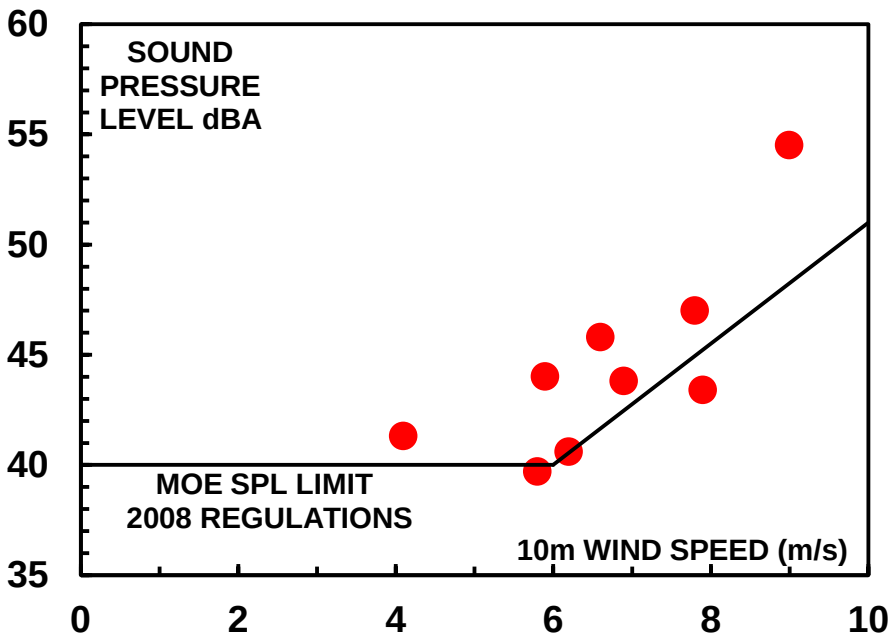

Figure 1: Measured sound pressure level (SPL) as a function of 10m wind speed.

Correction for the 4.5m Regulation Height

The 2008 MOE noise regulations specify that the prediction is to be made for a location at the centre of the residence at a height of 4.5m. The sound pressure level at this location is typically 2 dBA higher than at a location 1.5m above ground outside the home[1]. Therefore the measurements made by MOE at a height of 1.5m have been corrected by adding 2 dBA. The corrected sound pressure levels, to be compared with the Ontario regulation, are shown in Figure 2 below. The sound pressure levels at the Libby home were up to 8 dBA above the regulation and clearly out of compliance. Furthermore, the measured sound pressure levels were up to 10 dBA above the predicted sound pressure levels at the residence.

[1] The Hatch environmental noise impact assessment for the Windlectric proposed project on Amherst Island was used for this comparison. The assessment provided the prediction for the two locations for all residences within the study area. For the first 30 residences on the list the average difference was 2.11 ± 0.25 dBA

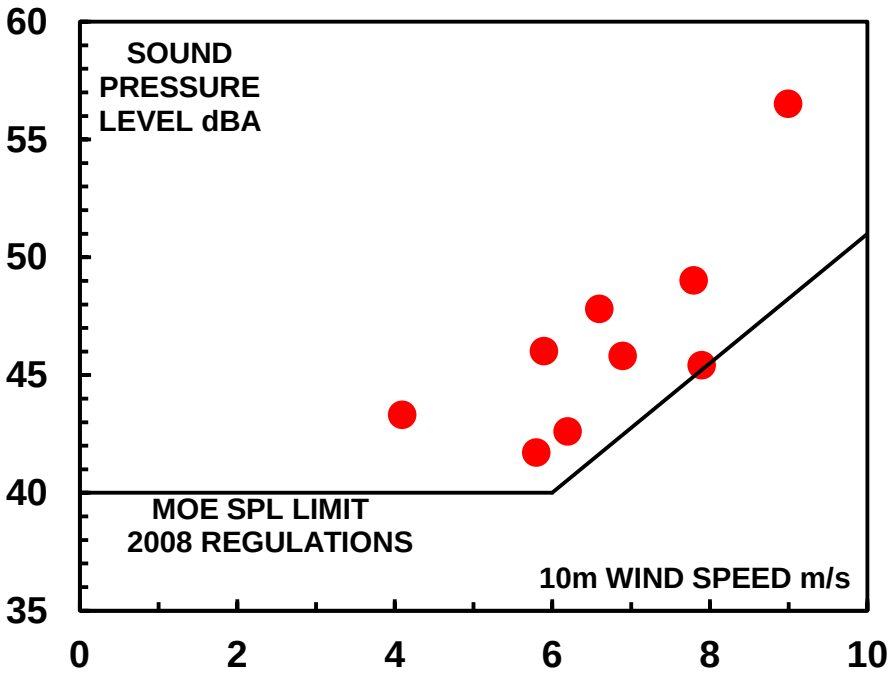

Figure 2: Corrected sound pressure level for a height of 4.5m

Errors in the MOE Analysis

Whoever provided the analysis of the MOE measurements at the Libby residence has no idea of what they were doing. This is serious because the analysis purports to show that the measured sound pressure levels are not so bad. What was done was to take the measured sound pressure level, subtract the regulation sound pressure level at the same wind speed and compare the difference with the regulation sound pressure level. This is nonsense.[2]

The erroneous MOE analysis is demonstrated in Table 2 below, extracted from the MOE report. The first column shows the measured sound pressure levels. The order is the same as that given in Table 1, which includes the dates, times and wind speeds.

The second column was labelled ambient but that is wrong. The numbers are in fact the sound pressure level limits under the MOE 2008 Noise Guidelines for Wind Farms. The MOE reference ambient sound pressure level in fact varies from 30 dBA at 4 m/s to

[2] For those unfamiliar with sound pressure level and the dBA scale, consider the following analogy: It is required to put a round peg into a round hole. The peg diameter is 5 cm and the hole diameter is 3 cm. Clearly it will not go. The MOE approach was to subtract the hole diameter from the peg diameter: 5 cm – 3 cm = 2 cm. Well, now the peg will fit!

44 dBA at 10 m/s (10m wind speeds). The sound pressure level limits have the reference ambient sound pressure level built in.

The author of the analysis has then subtracted[3] the numbers in column 2 from the measurements in column 1; these are shown in column 3. It is claimed in the report that that these numbers represent the measured sound pressure level corrected for the ambient sound pressure level. As noted above, this is nonsense; the third column has no meaning.

10 min Leq (dBA)	Ambient (dBA)	Turbines Sound Level (dBA)	Level criteria based on wind speed (dBA)
54.5	51	51.9	51
41.3	40	35.4	40
45.8	43	42.6	43
43.4	45	0.0	45
44.0	40	41.8	40
40.6	43	0.0	43
47.0	45	42.7	45
43.8	43	36.1	43
39.7	40	0.0	40

Table 2. Analysis Extracted from the MOE Report

Impact of Turbine Noise

The noise from a turbine has more impact when the wind speed gradient is high. There are two reasons:

- The wind speed at hub height is significantly higher than it is at 10m. Therefore there can be the full sound pressure level from the turbine with very little masking noise at the residence.
- When the blades are rotating in a large wind-speed gradient, the blades are continually moving from high wind speed to low wind speed. The blade pitch is therefore not optimized and the sound pressure level can be 5 dBA higher. Acousticians are well aware of this although do not acknowledge it when consulting for the wind-energy developers. This is discussed in the Richard James review of the Environmental Noise Impact Assessment for the Algonquin Power wind energy project on Amherst Island in Ontario.

[3] Subtracting, say, 4 dBA from 7 dBA proceeds as follows:
Difference = $10 \log(10^{7/10} - 10^{4/10}) = 3.98$ dBA

Figure 3 shows measurements of the wind-speed gradient parameter, measured by M. Schwartz and D. Elliott (NREL); these measurements are typical as will be well-known to the acousticians at MOE.

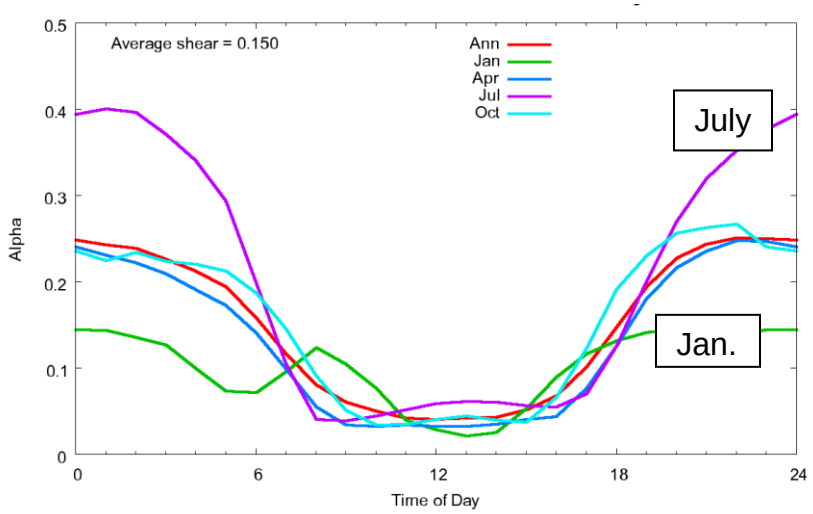

Figure 3: Diurnal wind shear exponent pattern at Lamar, CO, for 52-113-m levels.

Typically, at night during the summer month the turbine noise is going to be higher and more noticeable than during the winter months. Therefore the measurements made in December do not catch the full impact of the turbine noise at the Libby home.

Conclusion

I conclude that the turbines close to the Libby home are non-compliant and need to be shut down. I also conclude that there needs to be more supervision of those making turbine noise compliance measurements. Finally, these measurements highlight the inadequacy of the present prediction protocol.

Acknowledgements

I acknowledge the permission granted by Mr. David Libby to release these results to a wider audience and to my colleague Wayne Gulden for his comments on an earlier draft. The MOE Windsor Office had already written to David as follows: “Once it has been sent to you it becomes your property and you can do whatever you want with it"