Acoustic Noise Generated by Wind Turbines

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Oguz A. Soysal, Ph.D.
Frostburg State University
Department of Physics and Engineering
Frostburg, MD 21532
osoysal@frostburg.edu
Overview

• Measurements at distance of 0.55 miles from wind farm in Meyersdale, PA
  – Sound level measurements
  – Sound recordings
• Analysis of the frequency composition of the noise generated by wind turbines
• Analysis of the ambient noise level as a function of wind speed
• Discussion of the wind turbine noise characteristics
Meyersdale Wind Generation Facility

- Located in Somerset County near Meyersdale, in southwestern Pennsylvania
- Consists of 20 wind turbines,
- Rated power of turbines: 1.5-MW
- Tower height: 375’
Test Equipment

- Extech Datalogging sound level meter (Model#407764)
- Marantz Professional portable solid state recorder (Model PMD670)
- Omni-Directional microphone with frequency response 60Hz – 12kHz and sensitivity – 70 dB
Meyersdale, PA
Sound recordings

Distance to windmills: 0.55 miles
Recording date: October 29, 2005
Time: 11:16
Meyersdale, PA

Frostburg, MD

1011

1023

Magnitude vs. Time (s)

Magnitude vs. Frequency (Hz)
Sound recording and sound level measurements at Meyersdale, PA
Recording date: November 2, 2005
Time: 4:02PM
Ambient Noise versus Wind Speed

Wind speed measured in ground level, at the same location as the sound level measurement
Lycoming County Zoning Ordinance
Noise Protection Levels

<table>
<thead>
<tr>
<th>Frequency Band (Cycles/second)</th>
<th>Maximum Permitted Sound-Pressure Level (dB)</th>
<th>Corrected max. level as per Table 5130.B due to periodic character of noise (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 – 150</td>
<td>67</td>
<td>62</td>
</tr>
<tr>
<td>150 – 300</td>
<td>59</td>
<td>54</td>
</tr>
<tr>
<td>300 – 600</td>
<td>52</td>
<td>47</td>
</tr>
<tr>
<td>600 – 1,200</td>
<td>46</td>
<td>41</td>
</tr>
<tr>
<td>1,200 – 2,400</td>
<td>40</td>
<td>35</td>
</tr>
<tr>
<td>2,400 – 4,800</td>
<td>34</td>
<td>29</td>
</tr>
<tr>
<td>Above 4,800</td>
<td>32</td>
<td>27</td>
</tr>
</tbody>
</table>
Annex A – Other possible characteristics of wind turbine noise emission and their quantification (page 35)

A disturbance can be caused by low-frequency noise with frequencies in the range from 20 to 100 Hz. The annoyance caused by noise dominated by low frequencies is often not adequately described by the A-weighted sound pressure level, with the result that nuisance of such a noise may be underestimated if assessed using only an $L_{A_{eq}}$ value.

It may be possible to decide whether the noise emission can be characterised as having a low-frequency component. This is likely to be the case if the difference between the A and C-weighted sound pressure levels exceeds approximately 20 dB.

In these circumstances, low-frequency noise may be quantified by extending the one-third octave band measurements described in the main body of the text, down to 20 Hz. For one-third octave bands, the 20, 25, 31.5 and 40 Hz bands should additionally be determined.
dB Weighing
Sound Level Measurements in Meyersdale, PA; Distance to wind farm: 0.55 miles
One-day Noise Measurements

11/27/2005 - Meyersdale PA

Sound Level (dBC)

Hours

11/27/2005 - Ground level wind speed

Wind speed (miles/hr)

Hours
Subjective Issues

• A listener’s ability to hear noises depend on many subjective factors
• The turbine noise is distinguished from the random background noise because of its periodic characteristic
• Wind speed in the ground level usually do not correlate to the wind speed at the height of the turbine
• A lower level masking noise in the ground level affect the listener’s ability to hear the turbine noise
Conclusions

- Recorded wind mill noise contains dominant low frequency components below 100 Hz
- Recordings clearly show the noise is distinguished from the background noise due to its periodic characteristic
- The noise level difference between A and C weighing is approximately 20 dB
- A weighing does not represent adequately the wind turbine noise
- C weighing noise level measurements indicate that the noise level at 0.55 mile distance exceeds the Lycoming County Zoning ordinance