Low Frequency Noise

BWEA Briefing Sheet

Low Frequency Noise and Wind Turbines

Summary

Concerns have been raised in the UK that noise radiated from wind turbines contains sufficiently high levels of low frequency energy that may pose a threat to human health. It was suggested that symptoms included nausea, headaches and anxiety. This document, issued by the British Wind Energy Association (BWEA), provides information on the issue of low frequency noise and wind turbines, based on current knowledge.

Low Frequency Noise Explained

The frequency, or 'pitch', of a sound is measured in cycles per second (or 'Hertz' (Hz)) although most noise in the environment contains energy at many different frequencies combining together to give it its overall character. For a healthy young adult the range of hearing is often quoted as extending from 20Hz to 20,000Hz although the sensitivity of the ear varies significantly with frequency and is most sensitive to sounds with frequencies between around 500Hz and 4000Hz where the majority of information in speech signals is contained. Above and below this, the ear becomes decreasingly sensitive and is very in-sensitive at very low frequencies, meaning that sound levels have to be very high for such sounds to be perceived.

'Low frequency noise' is the term used to describe sound energy in the region below about 200Hz. The rumble of thunder and the throb of a diesel engine are both examples of sounds with most of their energy in this low frequency range.

Infrasound Explained

The additional term 'infrasound' is also often used to describe sound energy in the region below 20Hz. Almost all noise in the environment has components in this region although they are of such a low level that they are not significant. Noise which has most of its energy in the 'infrasound' range is only significant if it is at a very high level, far above normal environmental levels.

Noise Associated with Wind Turbines

The noise output from a modern wind turbine contains energy spread across the audible frequency range and, like most sounds in the environment, has some (inaudible) energy in the infrasound range.

Early wind turbines installed in the USA in the 1980s, however, were designed with the blades located downwind of the turbine tower such that the wind had to travel past the tower before it struck the blades. This caused the sound output from this type of turbine to generate a strong low frequency pulse, which also had significant levels of energy in the infrasound range. Largely as a consequence of this, wind turbine design was subsequently changed such that the blades were moved upwind of the tower. Coupled with this, the stand-off distance between the blades and the tower was increased in order to minimise any residual possibility that the blades may interact with disturbed air flow upwind of the tower. The consequence of these developments was to dramatically reduce tower interaction effects, and the generation of high levels of low frequency noise by wind turbines.

Low Frequency Noise

Noise from modern wind turbines is normally clearly audible on a wind farm site and a listener may readily perceive that the sound does not contain any of the strong low frequency pulsing described above, although the sound does change slightly close to an individual wind turbine as the blades pass through the air and change their distance from the listener. As the listener moves away from the site, the noise level decreases due to the increasing distance.

The noise character is also likely to change due to air absorption, which increases with increasing frequency, meaning that although the energy across the frequency range is reduced, higher frequencies are reduced more than lower frequencies. This effect may also be observed with road traffic noise or natural sources, such as the sea, where higher frequency components are diminished relative to lower frequency components at long distances. Wind turbines are not, therefore, a significant source of low frequency or infrasonic noise but, as with noise from any other sound source, the high frequency components are reduced when heard from a distance and overall levels are very low.

Conclusion

With regard to effects of noise from wind turbines, the main effect depends on the listener's reaction to what they may hear. There are no direct health effects from noise at the level of noise generated by wind turbines. It has been repeatedly shown by measurements of wind turbine noise undertaken in the UK, Denmark, Germany and the USA over the past decade, and accepted by experienced noise professionals, that the levels of infrasonic noise and vibration radiated from modern, upwind configuration wind turbines are at a very low level; so low that they lie below the threshold of perception, even for those people who are particularly sensitive to such noise, and even on an actual wind turbine site.

In response to concerns that wind turbines emit infrasound and cause associated health problems, Dr Geoff Leventhall, Consultant in Noise Vibration and Acoustics and author of the Defra Report on Low Frequency Noise and its Effects, says:

"*I can state quite categorically that there is no significant infrasound from current designs of wind turbines.*"

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Further references

1 Accompanying Technical Annex is available from BWEA, www.bwea.com/pdf/lfn-annex.pdf
2 BWEA Best Practice Guidelines for Wind Energy Development is available online at www.bwea.com/ref/bpg.html.

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