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Title: Critique on Kamperman and James Paper on Wind Turbine Noise

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Summary

A review of a paper authored by George Kamperman and Richard James1 was conducted by Epsilon Associates Inc. (Epsilon). It is Epsilon's position that the low frequency sound from wind turbines at distances greater than 1000 feet are not of sufficient magnitude to cause adverse effects; therefore, permissible A-weighted levels do not need an "adjustment" to account for low frequency noise. The examples of wind turbine noise given by Kamperman and James meet all ANSI criteria for low frequency noise and UK criteria for guidance on disturbances.

Discussion Points

1. Kamperman and James (K/J) recommendation for an external Leq of 35 dBA relies on their assumption that there is significant low frequency sound from wind turbines; this assumption is false. K/J state, "It is not apparent to these authors whether the complaints that refer to "low frequency" noise are about the audible low frequency part of the swoosh-boom sound, the one hertz amplitude modulation of the swoosh-boom sound, or some combination of both acoustic phenomena." (p. 13)

2. K/J refer to numerous European country A-weighted sound level criteria on wind turbine noise, but failed to mention the numerous European country criteria that have been developed to address problems arising from low frequency noise directly by establishing criteria on the actual low frequency noise instead of indirectly by lowering A-weighted levels.

The UK Department of Environment, Food, and Rural Affairs (DEFRA) report2 discusses and evaluates each of the European country low frequency noise

1 Kamperman, George, and James, Richard, "The 'How to' Guide to Criteria for Siting Wind Turbines to Prevent Health Risks from Sound", July 30, 2008.available at http://www.wind-watch.org/documents/simple-guidelines-for-siting-wind-turbines-to-prevent-health-risks/
2 DEFRA, "Proposed criteria for the assessment of low frequency noise disturbance", University of Salford report, UK Department for Environment, Food, and Rural Affairs, DEFRA NANR45 Project Report, 2005.

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criteria. DEFRA 45 proposes LFN criteria for use by English Environmental Health Officers when investigating complaints of low frequency noise “to help determine whether a sound exists that might be expected to cause disturbance” instead of “a prescriptive indicator of nuisance.” (p63)

Therefore, there is no need to have a LAeq value lower than the WHO recommendation [WHO Community Noise Guidelines 1999] of Leq outside = 45 dBA during nighttime and 50 during daytime.

3. K/J failed to mention that there are studies of complaints due to low frequency noise from wind turbines that found the issue was not low frequency noise. K/J reference a Hayes report on “aerodynamic modulation” (that is a modulation or fluctuation of higher frequency swooshing sound) from only three of the 126 UK wind farms. K/J did not mention that the focus of this study was low frequency noise, not amplitude modulation. K/J fail to mention that Hayes investigated three of five wind farms (those three had been publicized in the press) with alleged low frequency noise problems, and found that there was no issue with low frequency noise; instead the issue was with amplitude modulation (or fluctuation) of the higher frequency swooshing sound.

Hayes McKenzie performed a study for the UK Department of Trade & Industry to investigate complaints of low frequency noise that came from three of the five farms with complaints out of 126 wind farms in the UK<sup>3</sup>. The study concluded that:

- Infrasound associated with modern wind turbines is not a source which will result in noise levels that are audible or which may be injurious to the health of a wind farm neighbor.
- Low frequency noise was measureable on a few occasions, but below DEFRA criteria. Wind turbine noise may result in indoor noise levels within a home that is just above the threshold of audibility; however, it was lower than that of local road traffic noise.
- The common cause of the complaints was not associated with low frequency noise but the occasional audible modulation of aerodynamic noise (“aerodynamic modulation”), especially at night. Data collected

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<sup>3</sup> Hayes McKenzie Partnership Ltd., “The Measurement of Low Frequency Noise at Three UK Wind Farms,” UK Department of Trade and Industry (DTI) contract number: W/45/00656/00/00, 2006.  
<http://www.berr.gov.uk/files/file31270.pdf>

indoors showed that the higher frequency modulated noise levels were insufficient to awaken the residents at the three sights; however, once awake, this noise could result in difficulties in returning to sleep.

K/J fail to mention the Howe reports on alleged problems from infrasound from wind turbines. Howe found no infrasound from wind turbines<sup>4</sup>.

4. K/J are incorrect to state that there are no “national or international or local community noise standards for siting wind turbines near dwellings [that] address the low frequency portion of the wind turbine’s sound immissions.”(P. 13). In fact, there are criteria available to objectively determine if low frequency sound from wind turbine noise could cause disturbances or problems. These criteria or recommendations have come from years of experience dealing with low frequency problems:

- ANSI S12.2 criteria for indoor levels for moderately perceptible vibrations in light-weight walls and ceilings
- ANSI S12.2 low frequency portions of recommended levels for bedrooms, classrooms and hospitals including spectral balance.
- ANSI S12.9 Part 4 guidance on levels which will cause no more than minimal annoyance or when rattles may begin.
- DEFRA (UK Department for Environment, Food, and Rural Affairs) interior guideline for use by Environmental Health Officers as guidance to determine if sound exists that may cause a disturbance.
- Illinois Pollution Control Board sound pressure limits for the octave bands centered at 31, 63 and 125 Hz.

5. The detailed examples from wind turbine noise shown by K/J in the figures on pages 8, 9 and 14 meet each of the previous criteria for low frequency sound:

- ANSI S12.9 Part 4 for outdoor noise: minimal annoyance and beginning of rattles
- ANSI S12.2 – room criteria for moderately perceptible vibration and rattle in lightweight wall and ceiling structures
- ANSI S12.2 – NC criteria for bedrooms and “spectrum balance”

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<sup>4</sup> Howe, Brian, “Wind Turbines and Infrasound”, prepared for the Canadian Wind Energy Association by Howe Gastmeier Chapnik Limited (HGC Engineering) (2006)

- DEFRA indoor criteria to be used as guidance by Environmental Health Officers

If the examples presented by K/J, and those measured by Epsilon at 1000 feet from wind turbines under maximum noise conditions, do not demonstrate significant low frequency noise, then there is no need to adjust A-weighted criteria due to account for low frequency noise.

6. K/J state that there is considerable low frequency content to the wind turbine sound, and K/J state incorrectly that “modern home construction techniques used for most wood frame homes result in walls and roofs that cannot block WT [wind turbine] low frequencies from penetrating into the interior.” Analysis of wind turbines from NextEra wind farms at 1000 feet indicate that the infrasound is inaudible and that the LFN is below ANSI criteria for external and internal bedroom noise and meets UK DEFRA guidance for Environmental Health Officers for determining if the low frequency sound might create a “disturbance”. In addition, the interior sound levels shown by K/J in the first two figures meet the interior ANSI S12.2 and DEFRA criteria. Therefore, we can conclude that although the wind turbine noise has low frequency content, it is not of sufficient level to be a problem in homes at distances greater than 1000 feet, and possibly less.

7. K/J are correct that WHO documents recommend an Leq of 30 dBA for sleep disturbance; however, K/J did not note that this is an interior noise level and not an exterior noise level; the WHO recommended exterior level is an LAeq of 45 dBA during nighttime hours. The WHO document suggests lower A-weighted levels if there is significant low frequency sound. The Guidelines for Community Noise report (WHO, 1999) mentions that if the difference between dBC and dBA is greater than 10 decibels, then a frequency analysis should be performed to determine if there is a low frequency issue. Even though the difference in dBC and dBA is greater than 10 dB, both Epsilon data and K/J figures indicate that low frequency noise meets ANSI and DEFRA criteria. Therefore, there is no need to lower the WHO recommendation of LAeq = 45 dBA.

8. K/J were “surprised” that the noise from 10 wind turbines at one mile is only 6.3 dBA lower than the noise from 1 wind turbine at 1000 feet. This is not surprising since they failed to take into account the effect of the noise from 1 turbine versus 10 turbines. The noise from 10 turbines at 1 mile is 16.3 dBA less than the noise from 10 turbines at 1000 feet.

9. K/J did not mention that ISO R 1996 (1971) levels are no longer an ISO standard and have been replaced by other metrics and other recommendations in the more recent versions. Furthermore they failed to mention that ISO R 1996 1971 state that the “basic value” has to be established for each country, and as a footnote ISO 1996 state a range for the basic value for outdoor for residential premises: (35 – 45); however, K/J used only the lower value in preparing their table on page 3. What other provisions in their paper have K/J selected the low end of ranges? Among other materials, ISO R1996 (1971) was considered by the Illinois Pollution Control Board in establishing limits for property line noise sources in 1973.

10. K/J make the claim, “Other research into computer modeling and other methods used for determining the layout of the industrial wind turbine developments and the distances from residents in the adjacent communities are showing that the output of the models should not be considered accurate enough to be used as the sole basis for the siting decisions.” (p. 11) K/J provide no references to support their claim. Their unsubstantiated claim is completely unrelated to proposed sound level limits. K/J provide no alternatives to modeling to predict compliance with their own limits.

### Conclusions

It is Epsilon’s position that the low frequency sound from wind turbines at distances greater than 1000 feet are not of sufficient magnitude to cause adverse effects; therefore, permissible A-weighted levels do not need an “adjustment” to account for low frequency noise. The examples of wind turbine noise given by Kamperman and James meet all ANSI criteria for low frequency noise and UK criteria for guidance on disturbances.

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