

Low Frequency and Infrasound
Noise Immission from Wind
Farms and the potential for Vibro-
Acoustic disease

Malcolm Hayes
Hayes McKenzie Partnership Ltd
Machynlleth & Salisbury

www.hayesmckenzie.co.uk



Low Frequency Noise from Wind Farms

- Introduction
- The Issue
- VAD
- Measurements of infrasound and low frequency noise from wind farms
- Comparison of Levels between Wind Farm and VAD Levels
- Why might this link occur?
- Conclusions



What is Low Frequency Noise?

- Normal Hearing Range : 20 - 20 kHz
- Low Frequency Range : 20 - 160 (250) Hz
- Infrasound Range : < 20 Hz



Low Frequency Noise Study

- To look at three sites in UK which have been reported in National Newspapers to be subject to high levels of low frequency noise;
- To undertake measurements at these sites to determine the level of exposure;
- To reported collected data for public dissemination



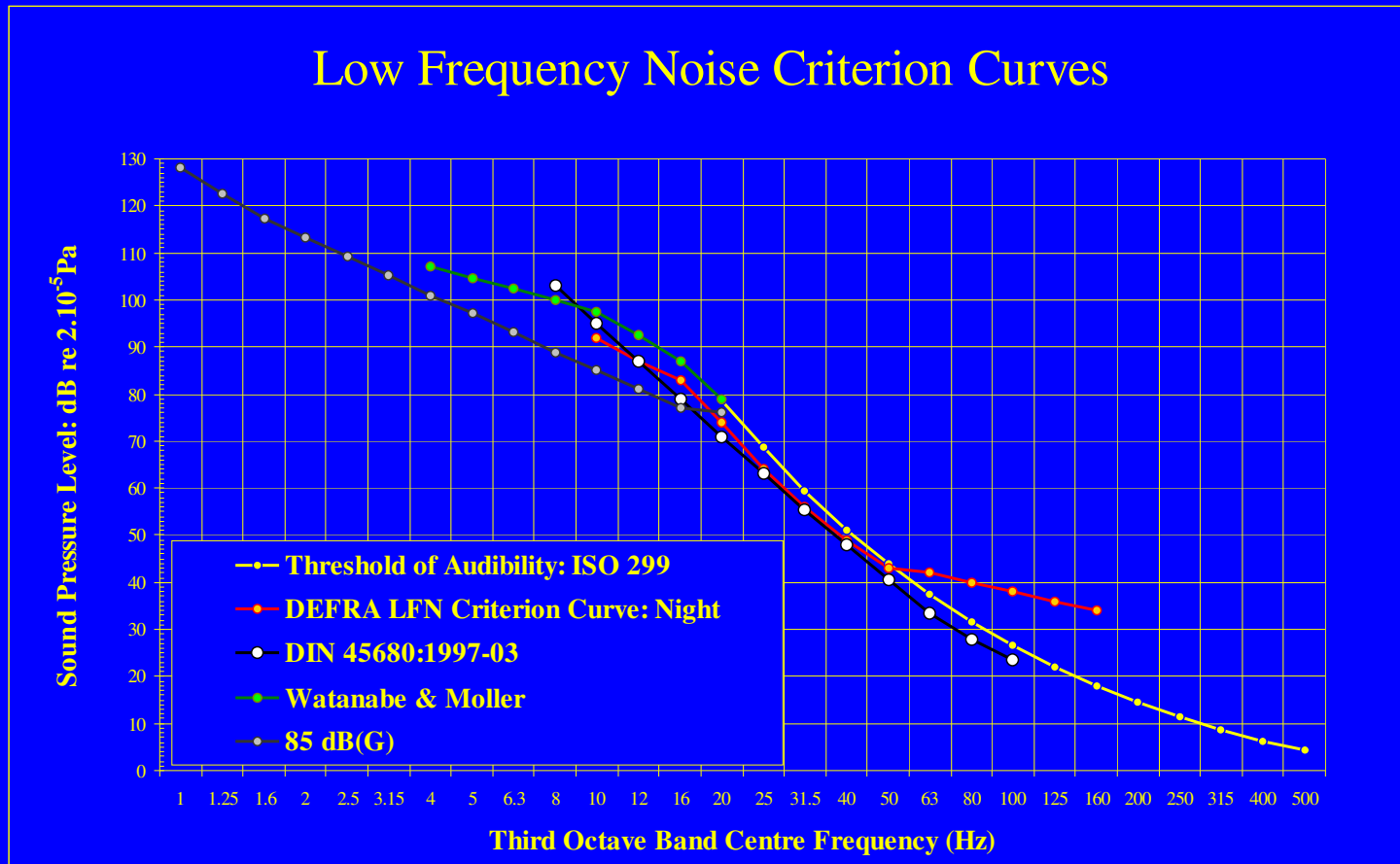
Assessment Methodology

- DEFRA Document: *Proposed criteria for assessment of low frequency noise disturbance*
- <http://www.defra.gov.uk/environment/noise/research/lowfrequency/index.htm>



Noise Criteria

Low Frequency Noise Criterion Curves



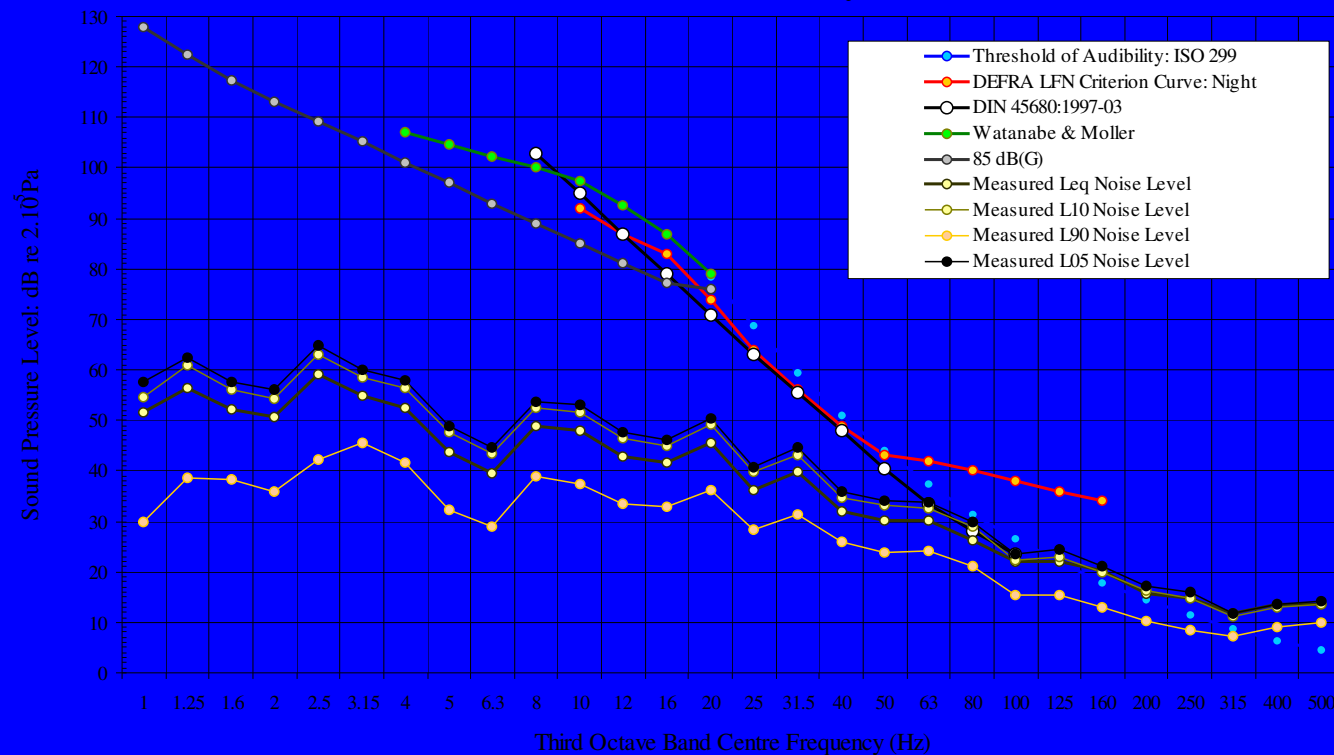
The measurement of low frequency noise at three UK wind farms

- Selection of measurement sites based upon reports in national press as giving rise to infrasound and low frequency noise
- Measurements performed at external and internal locations
- Measurements performed over extended periods: 2 – 4 weeks monitoring
- Analysis of periods when described by occupants as audible and “unacceptable”.



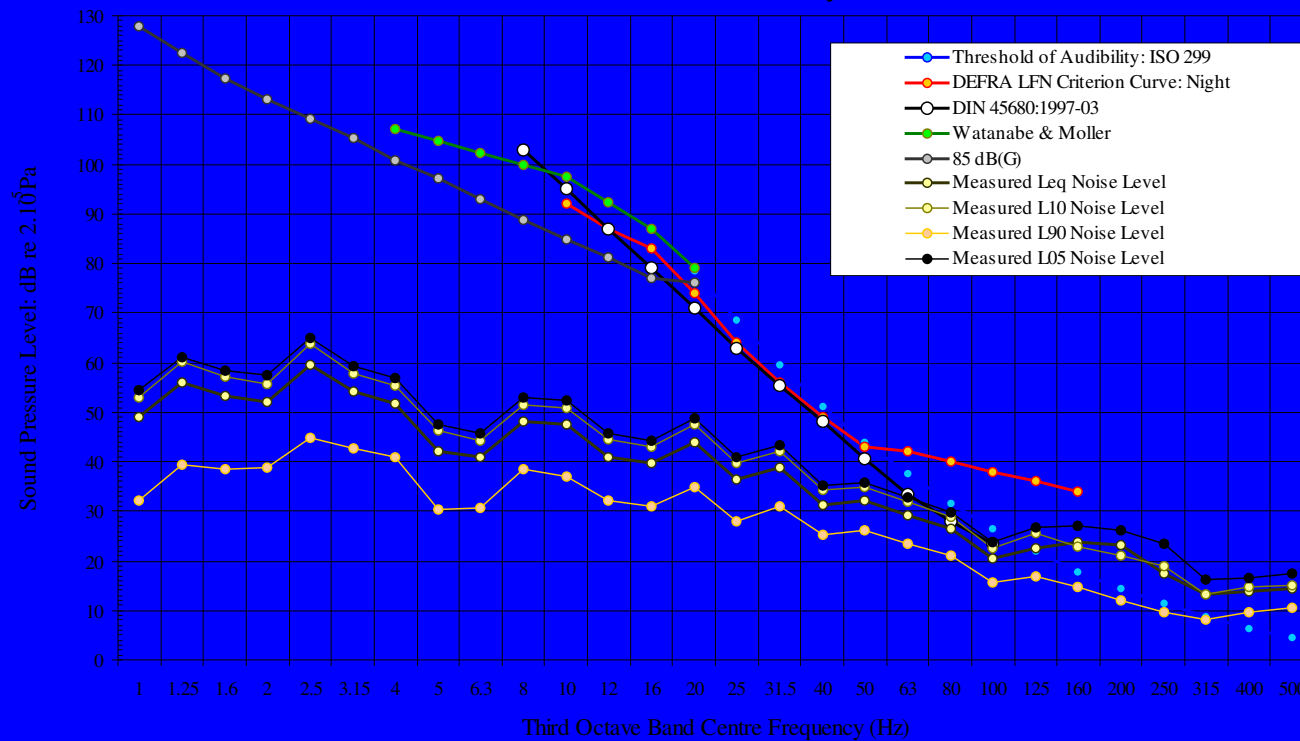
Site 1 Location 1

Low Frequency Noise Assessment
Location 1: 02:35 14th May 2005



Site1 Location 1

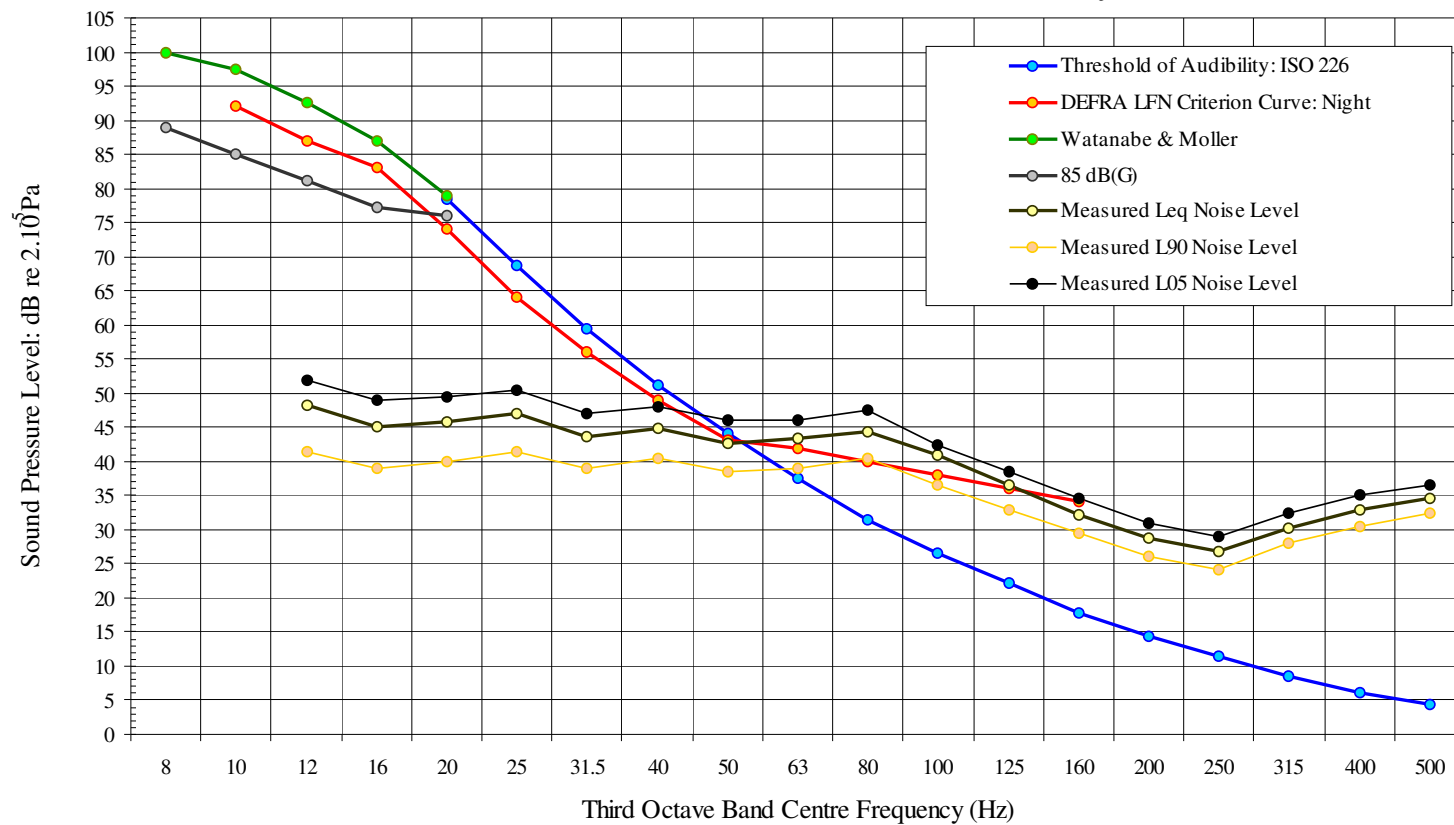
Low Frequency Noise Assessment
Location 1: 03:10 14th May 2005



External Noise Levels

Low Frequency Noise Assessment

External ETSU-R-97: Location 1: 03:00 14th May 2005



Infrasound Measurements

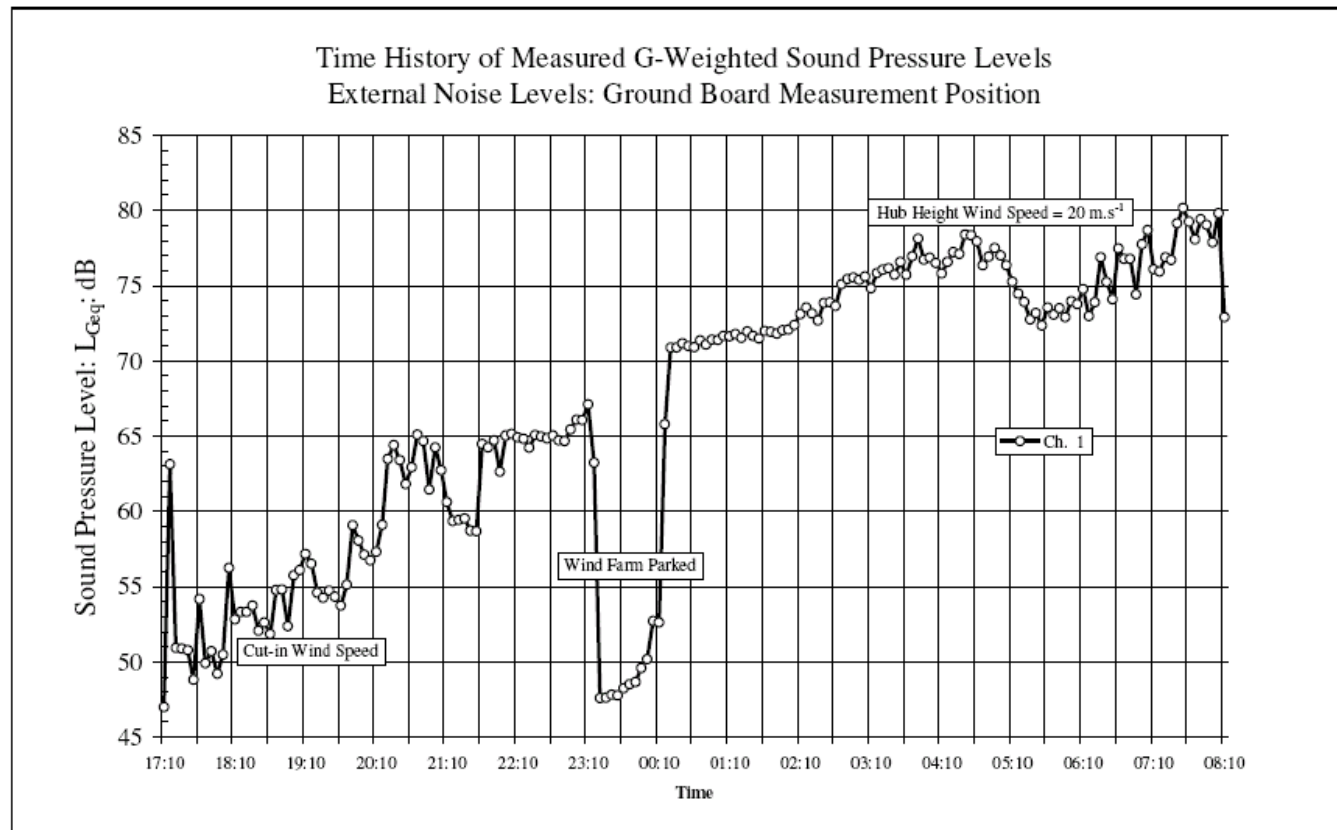


Figure 12: Time History Figure of G-Weighted Sound Pressure Levels for a Wind Farm

Infrasound Measurements

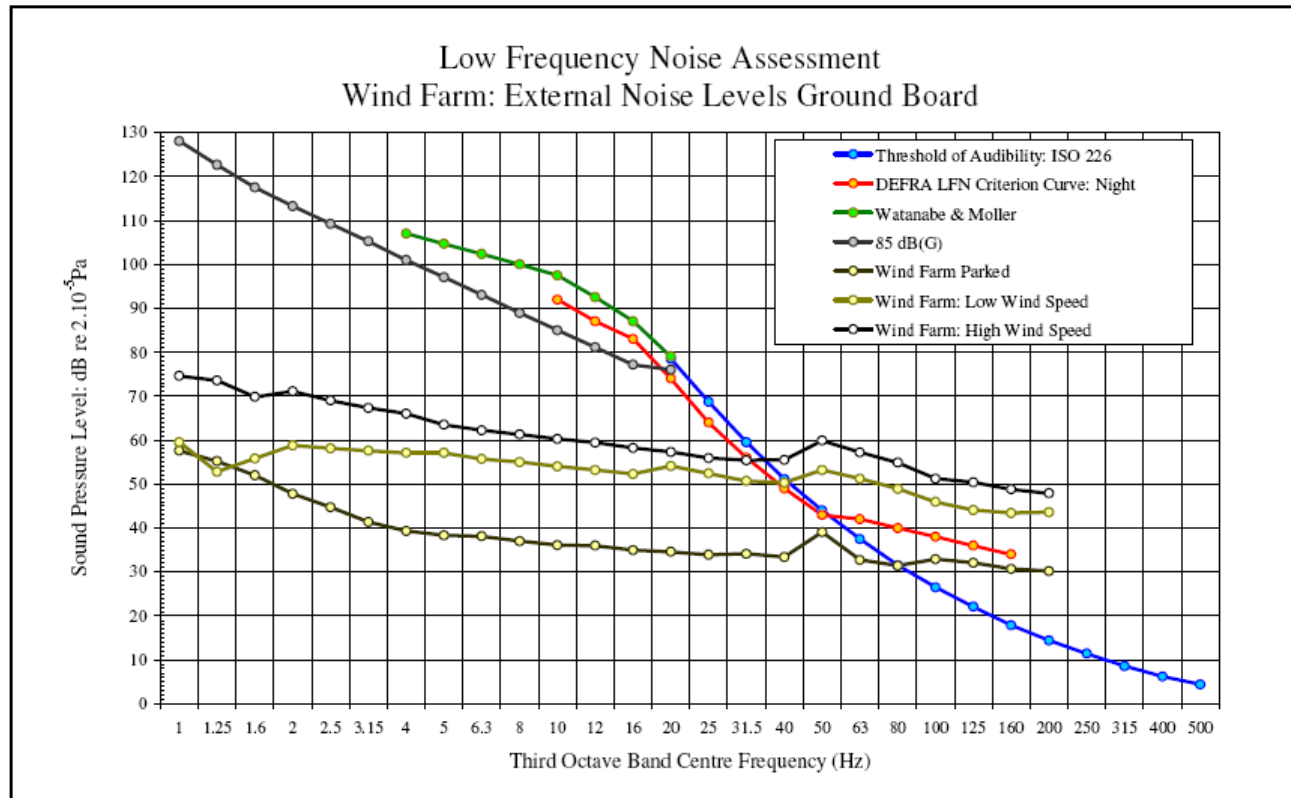


Figure 11: Measured Infrasound and Low Frequency Noise Levels: External Location on Ground Board



VAD Symptoms

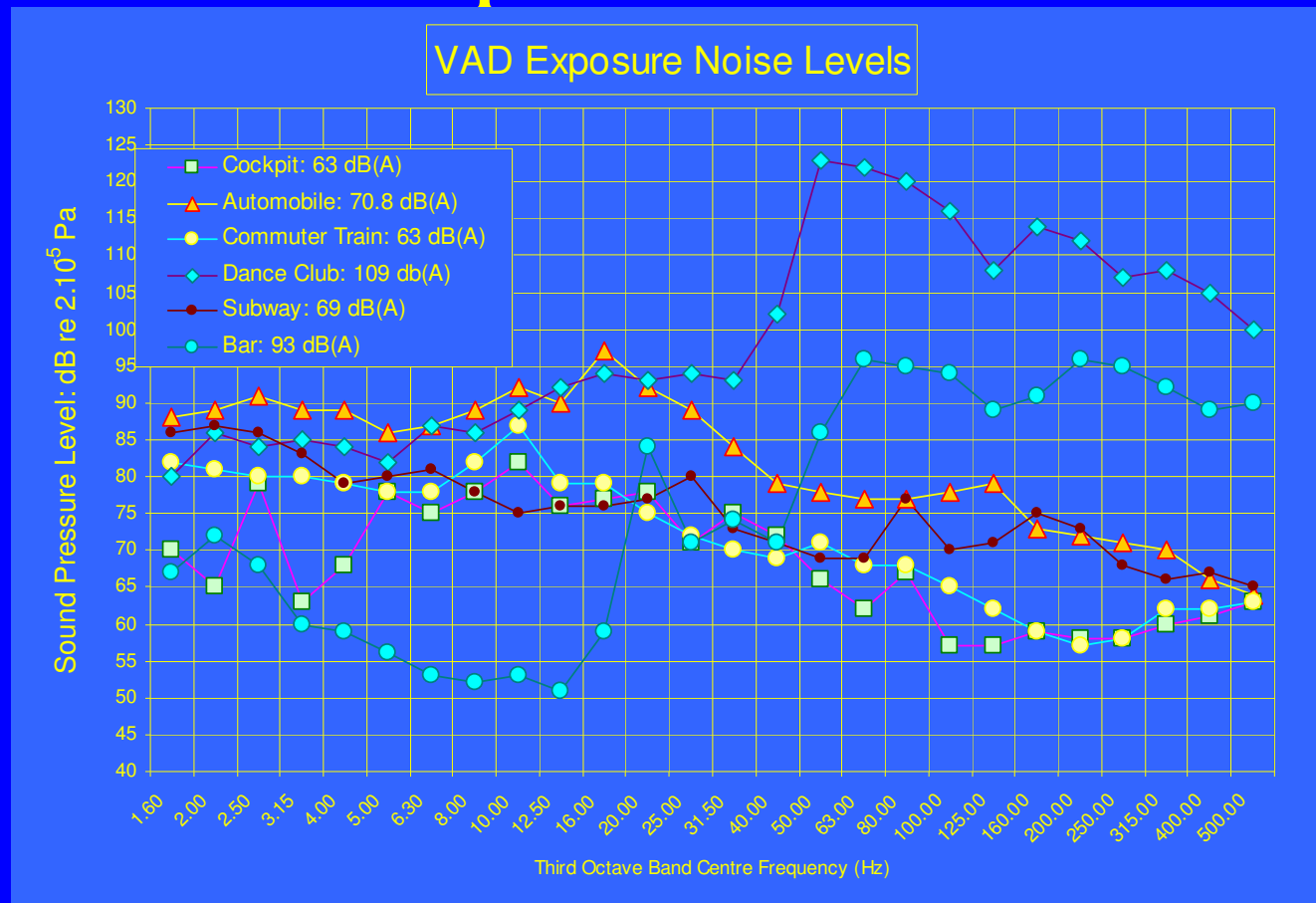
Table 1. Data from a group of 140 aircraft technicians (selected from an initial group of 306 workers), occupationally exposed to LFN (8 hrs/day, 5 days/week). Exposure time (in years) refers to the amount of time it took for 70 individuals (50%) to develop the corresponding sign or symptom (Castelo Branco, 1999b).

Clinical Stage	Sign/Symptom
<i>Stage I-Mild</i> (1-4 years)	Slight mood swings, Indigestion and heart -burn, Mouth/throat infections, Bronchitis
<i>Stage II-Moderate</i> (4-10 years)	Chest pain, Definite mood swings, Back pain, Fatigue, Fungal, viral and parasitic skin infections, Inflammation of stomach lining, Pain and blood in urine, Conjunctivitis, Allergies
<i>Stage III-Severe</i> (> 10 years)	Psychiatric disturbances, Haemorrhages of nasal, digestive and conjunctive mucosa, Varicose veins and haemorrhoids, Duodenal ulcers, Spastic colitis, Decrease in visual acuity, Headaches, Severe joint pain, Intense muscular pain, Neurological disturbances

Castelo Branco NAA, Rodriguez Lopez E, Alves-Pereira M, and Jones DR. (1999b) Vibroacoustic disease: some forensic aspects. *Aviation, Space and Environmental Medicine*, 70 (3, Suppl): A145-51.



VAD Exposure Noise Levels



Vibroacoustic disease: N.A.A. Castelo Branco and M. Alves-Pereira: : Noise & Health 2004, 6:23, 3-20


Wind Turbine Noise Conference: Lyon 2007



UK References

- UKNA Report: Location, Location, Location

Location, Location, Location
An investigation into wind farms and noise by The Noise Association



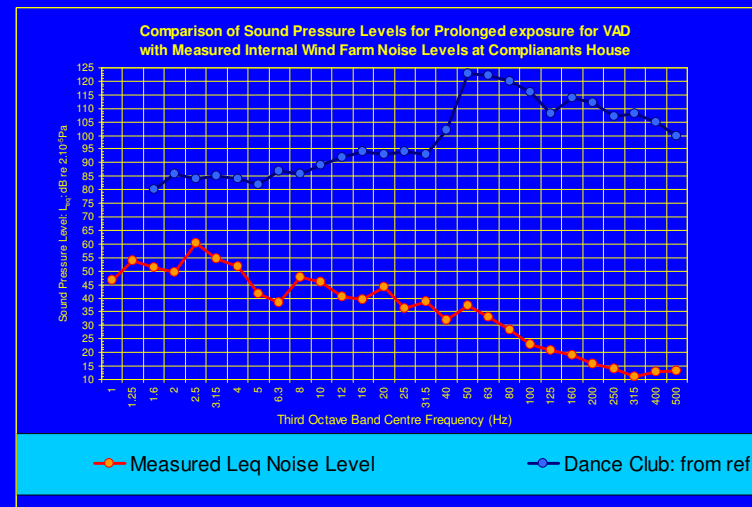
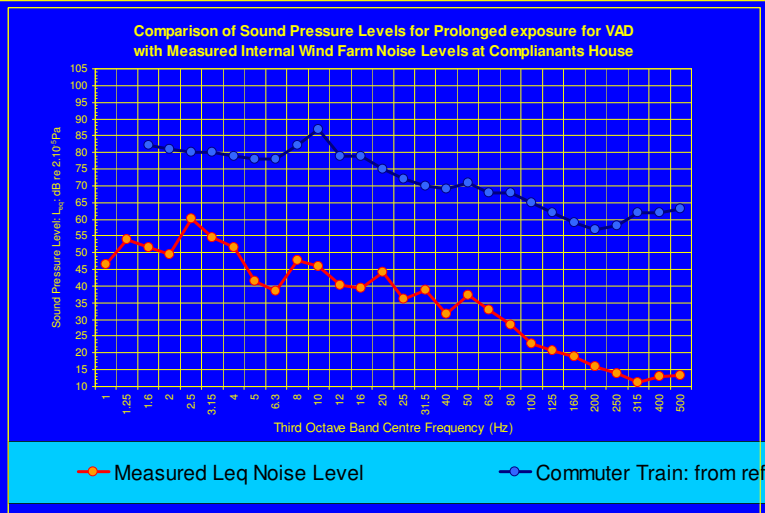
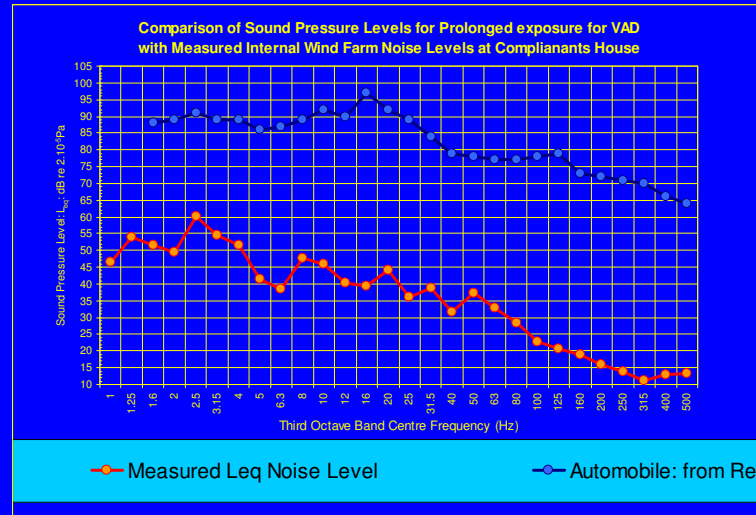
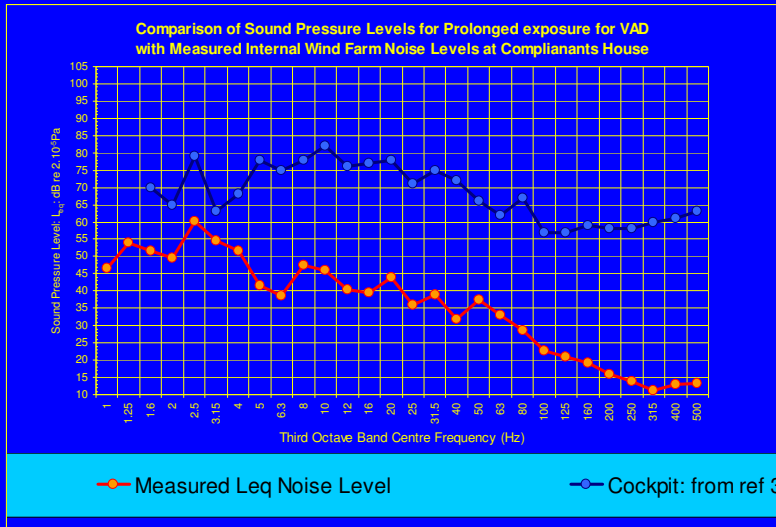
Noise - 'unwanted sound' -- can ruin people's well-being and environment

"Peace and quiet is the single most important factor people have in mind when buying a home -- with one in five prospective homebuyers rating it as the most important consideration when choosing where they will buy." Alliance and Leicester Survey, 3/8/02

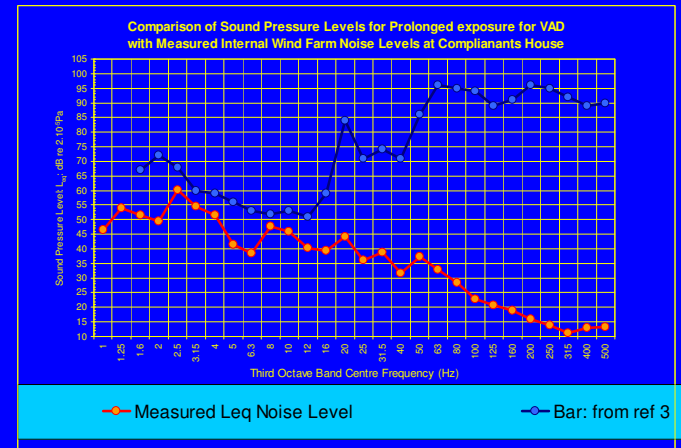
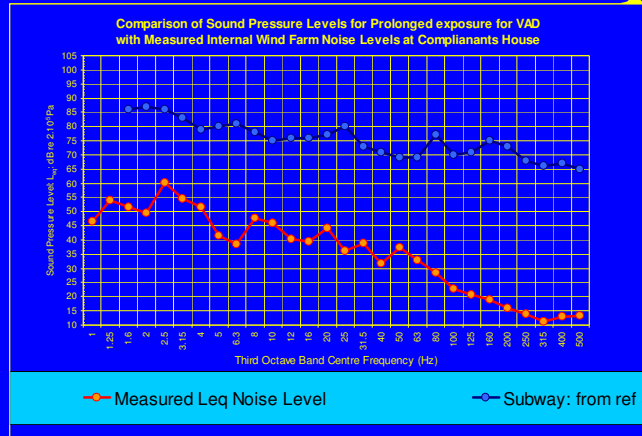
In Portugal, where low frequency noise has been researched extensively, a link has been found with a complex illness known as vibroacoustic disease. Although this research has been mainly concerned with high levels of low frequency noise, it is felt that prolonged exposure to lower levels of low frequency noise may cause similar problems. Certainly the symptoms which some people living around wind turbines complain of are very similar to those of vibroacoustic disease.



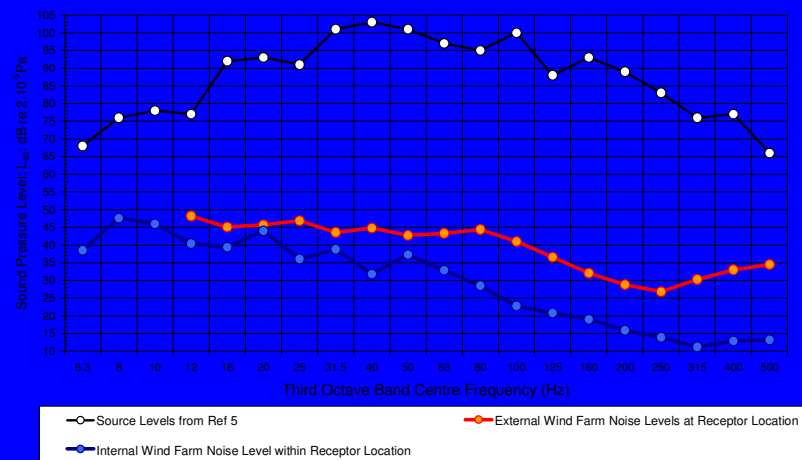
Comparison of Levels



Comparison of Levels



Comparison of Sound Pressure Levels for Prolonged exposure for VAD with Measured Wind Farm Noise Levels at Complainants House Internal and External

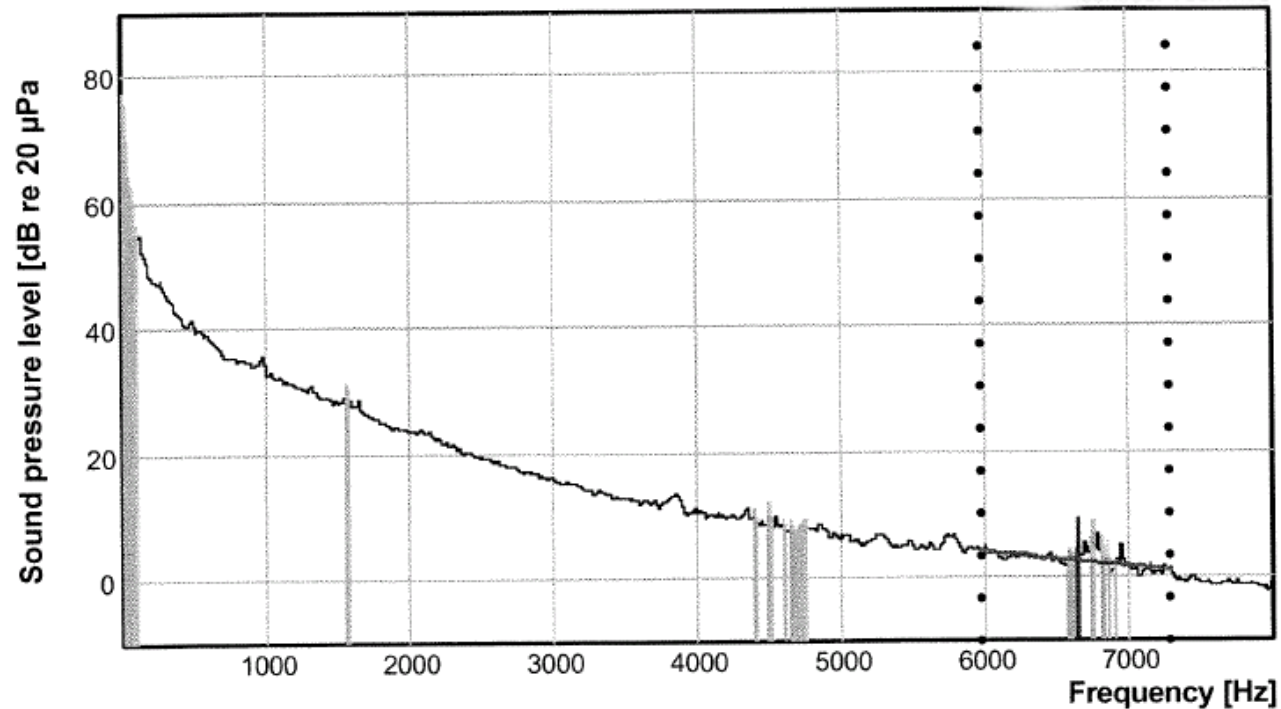


Why might this link occur?

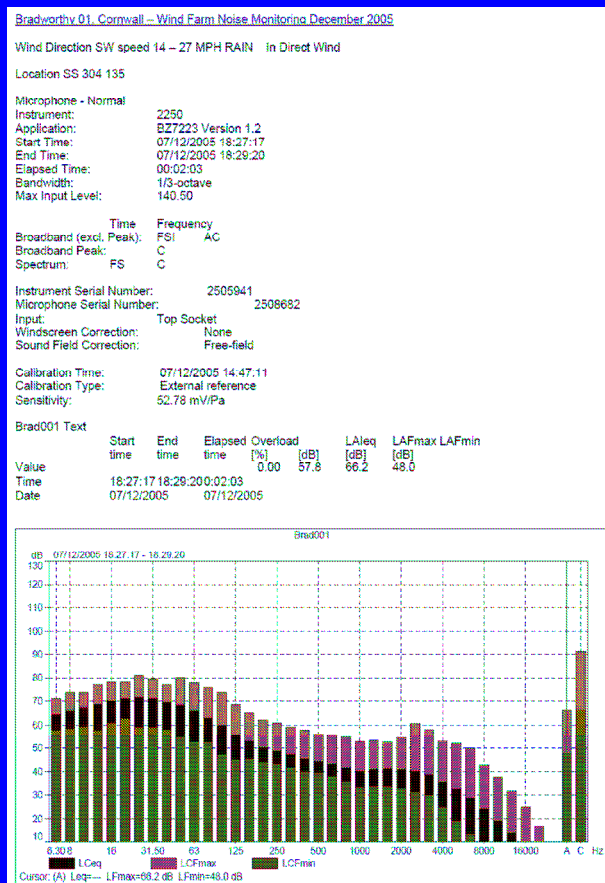
9.2 Narrow band analysis

An FFT analysis of noise on the metal sheet at approx 8 m/s has been performed in order to determine tonal audibility of turbine noise.

Spectrum: —
Tone(s): ■
Noise pauses: ▨



Why might this link occur?



Body Surface Induced Vibration from Low Frequency Noise

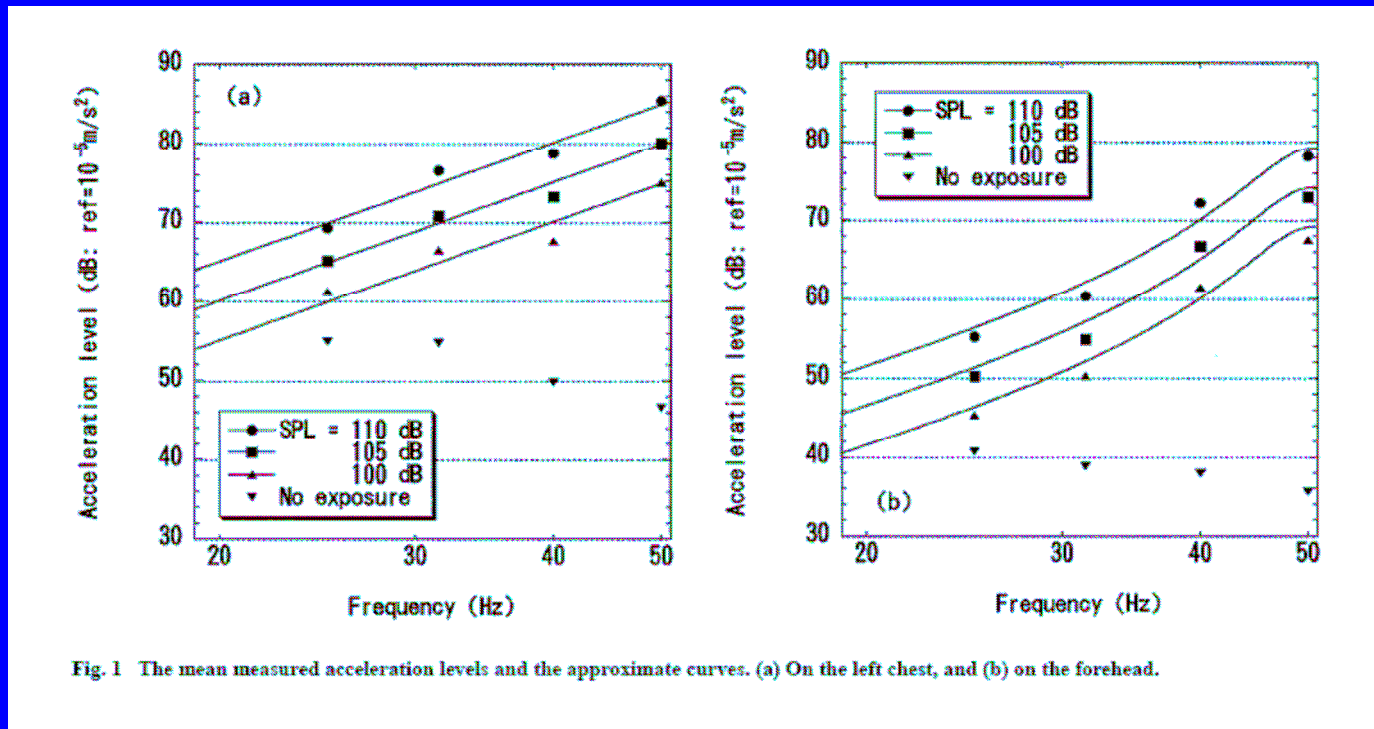


Fig. 1 The mean measured acceleration levels and the approximate curves. (a) On the left chest, and (b) on the forehead.

- Measurement of Human Body Surface Vibrations Induced by Complex Low-Frequency Noise Composed of Two Pure Tones: Y. Takahashi, S Maeda: Journal of Low Frequency Noise, Vibration and Active Control: Vol. 22 No. 4 2003
- A New Approach to Assess Low Frequency Noise in the Working Environment: Y. Takahashi, Y Yonekawa, K. Kanada: Industrial Health 2001, 39, 281 - 286



Conclusions

- Internal/External Infrasound and Low Frequency Data now available for operational wind farms in the UK
- The measurements are downloadable from the DTI Web Site
- Infrasound and Low Frequency Noise are unlikely to be the source of complaints, audible aerodynamic sound within dwellings is source of complaints
- Measured Levels compared to published measurements of Infrasound and LFN for alleged VAD occurrence
- Unlikely that symptoms will result through induced internal body vibration from incident wind farm noise

