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

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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

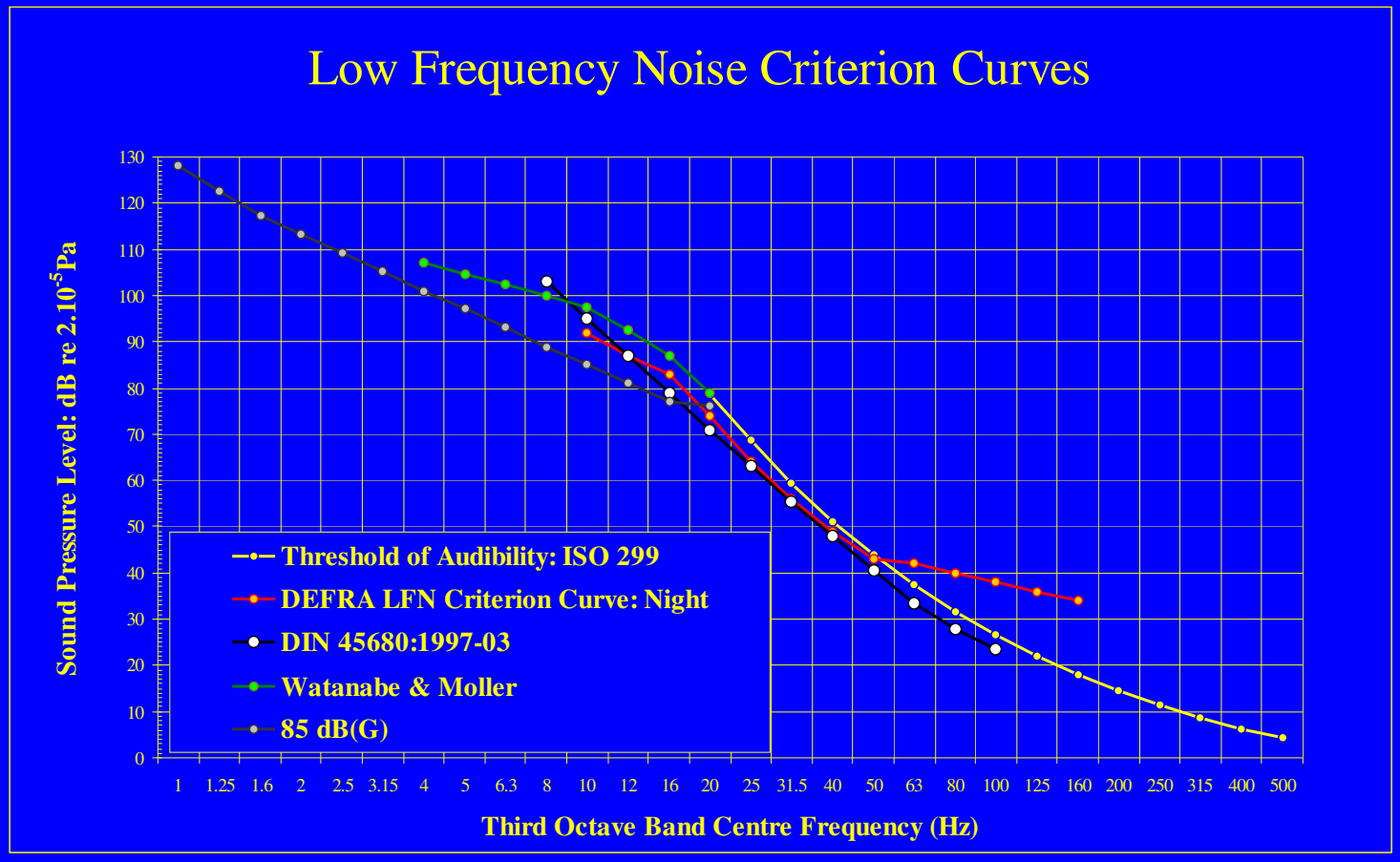
Low Frequency Noise Study

- 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

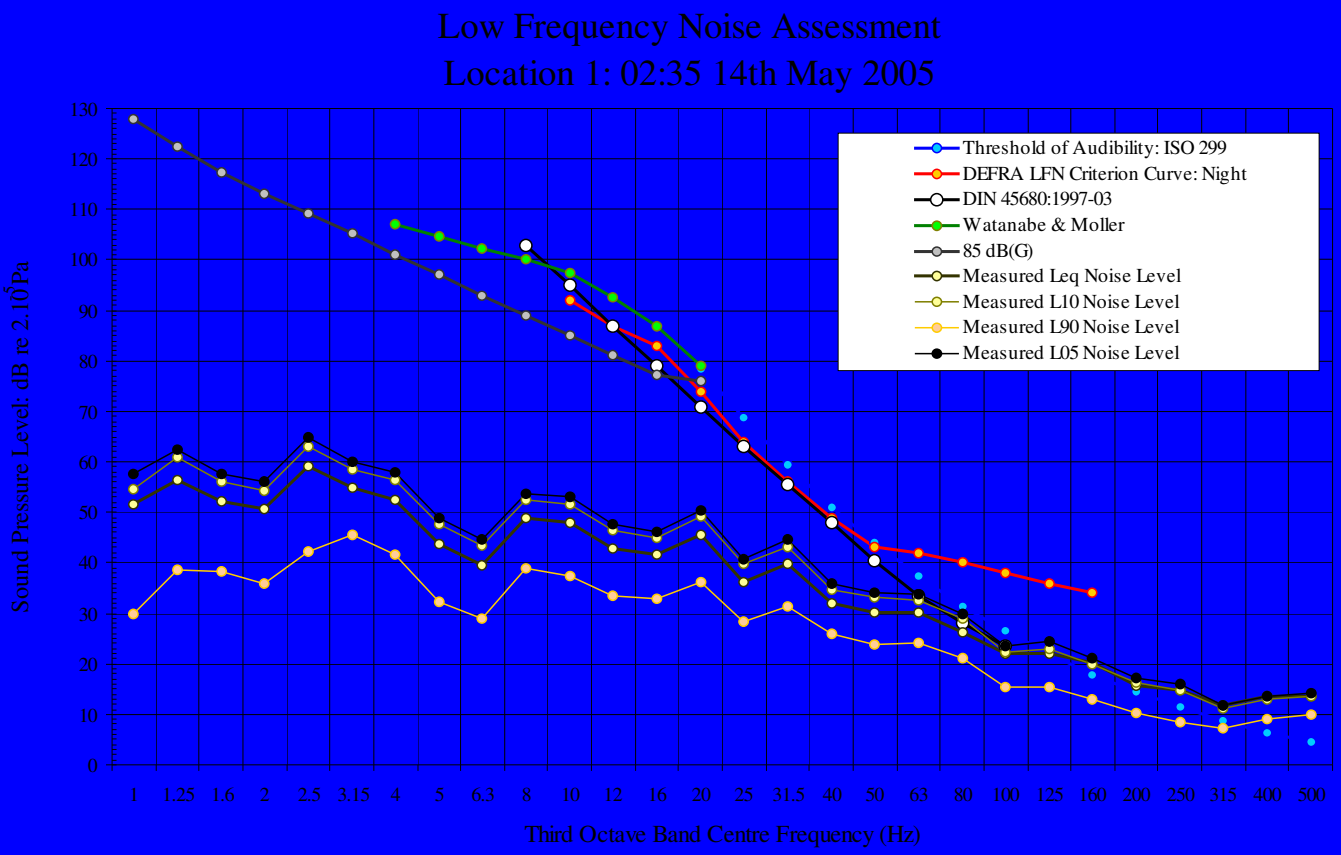
Noise Criteria



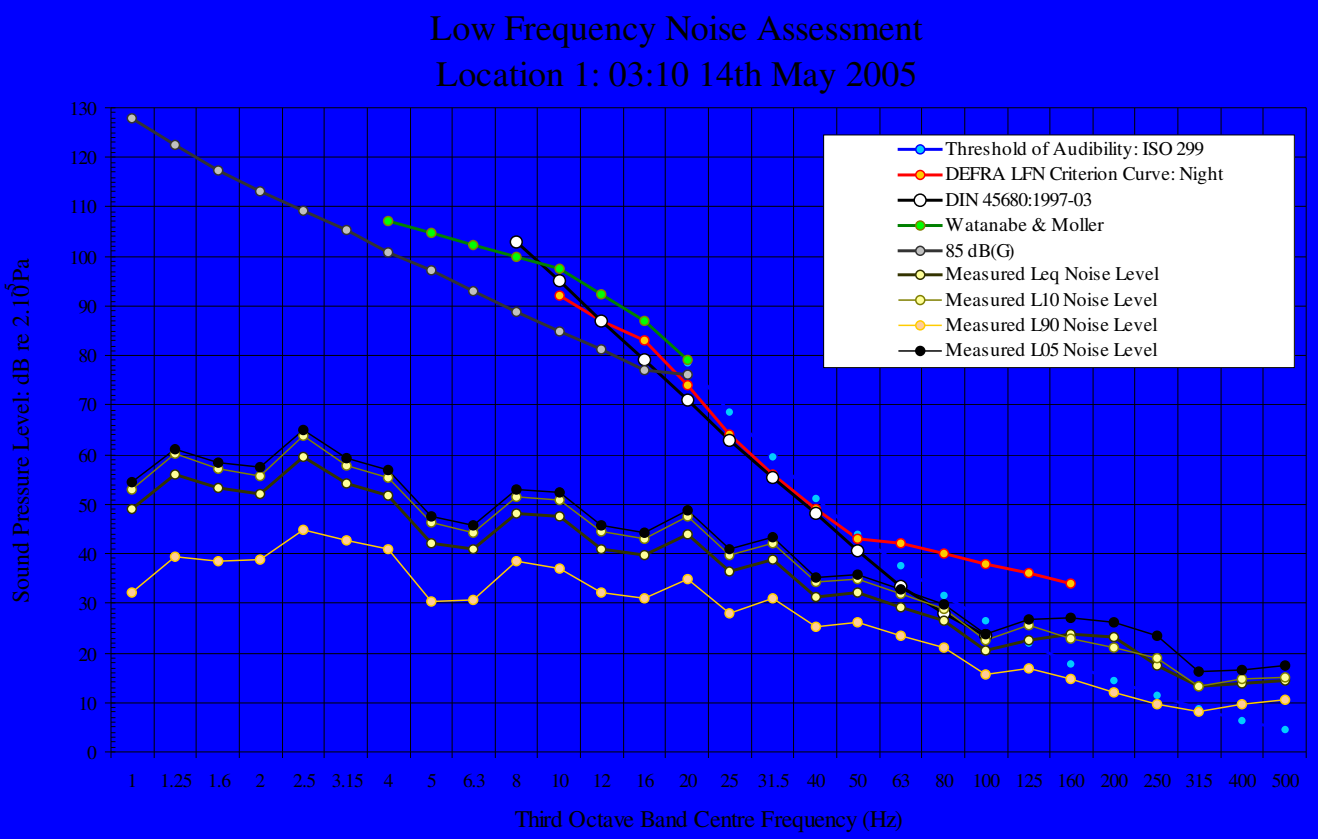
The measurement of low frequency noise at three UK wind farms

- 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

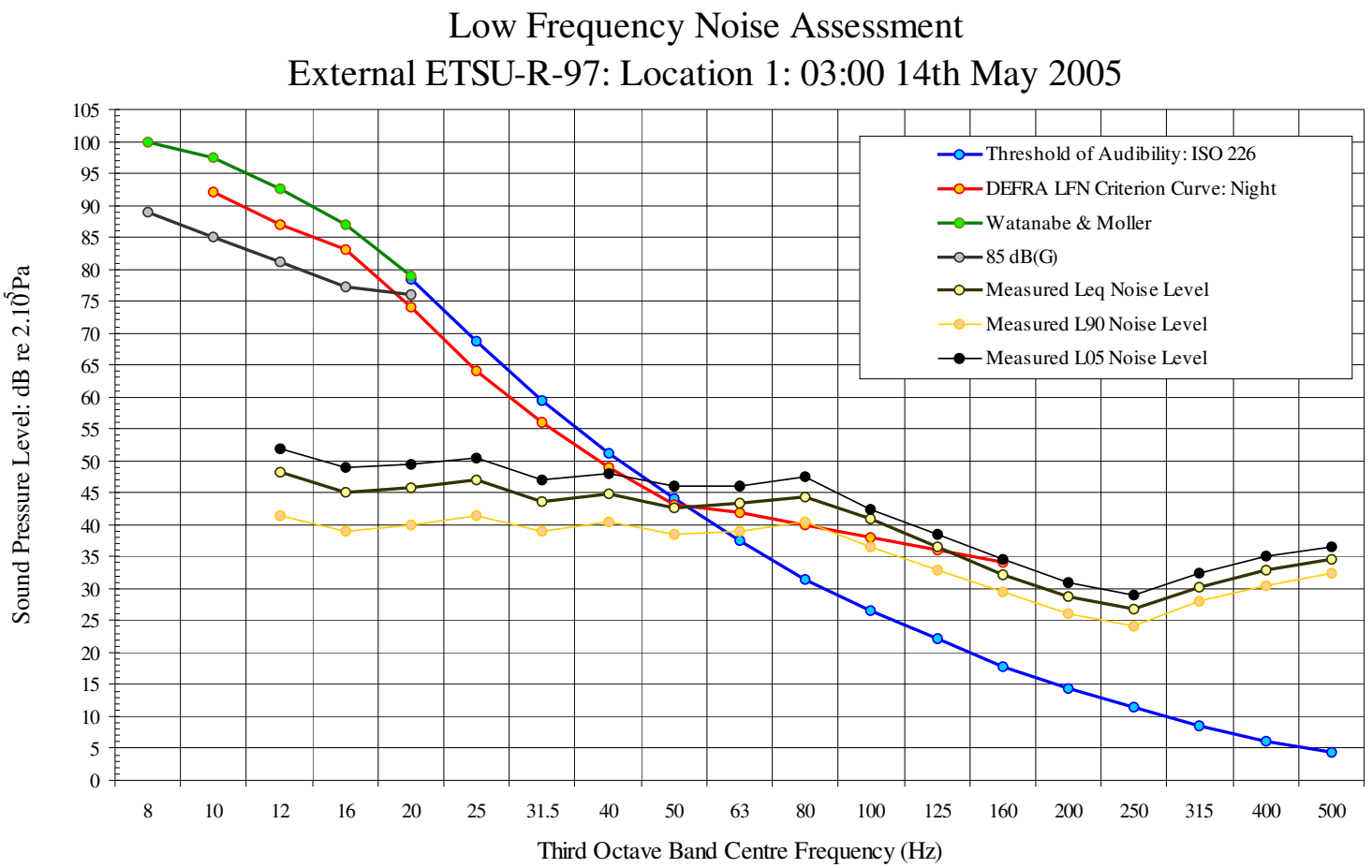


Site1 Location 1



Wind Farm Noise: Armagh 2008

External Noise Levels



Follow-up on LFN Report

- DTI NWG Reform to Peer Review Report
- Agree With Conclusions and suggest additional work
- Work completed by Salford University July 2007
- http://www.berr.gov.uk/files/file40570.pdf
- Indicated that out of 133 operating wind farms in UK only 4 have been identified to exhibit AM.
- http://www.berr.gov.uk/files/file40571.pdf

Infrasound Measurements

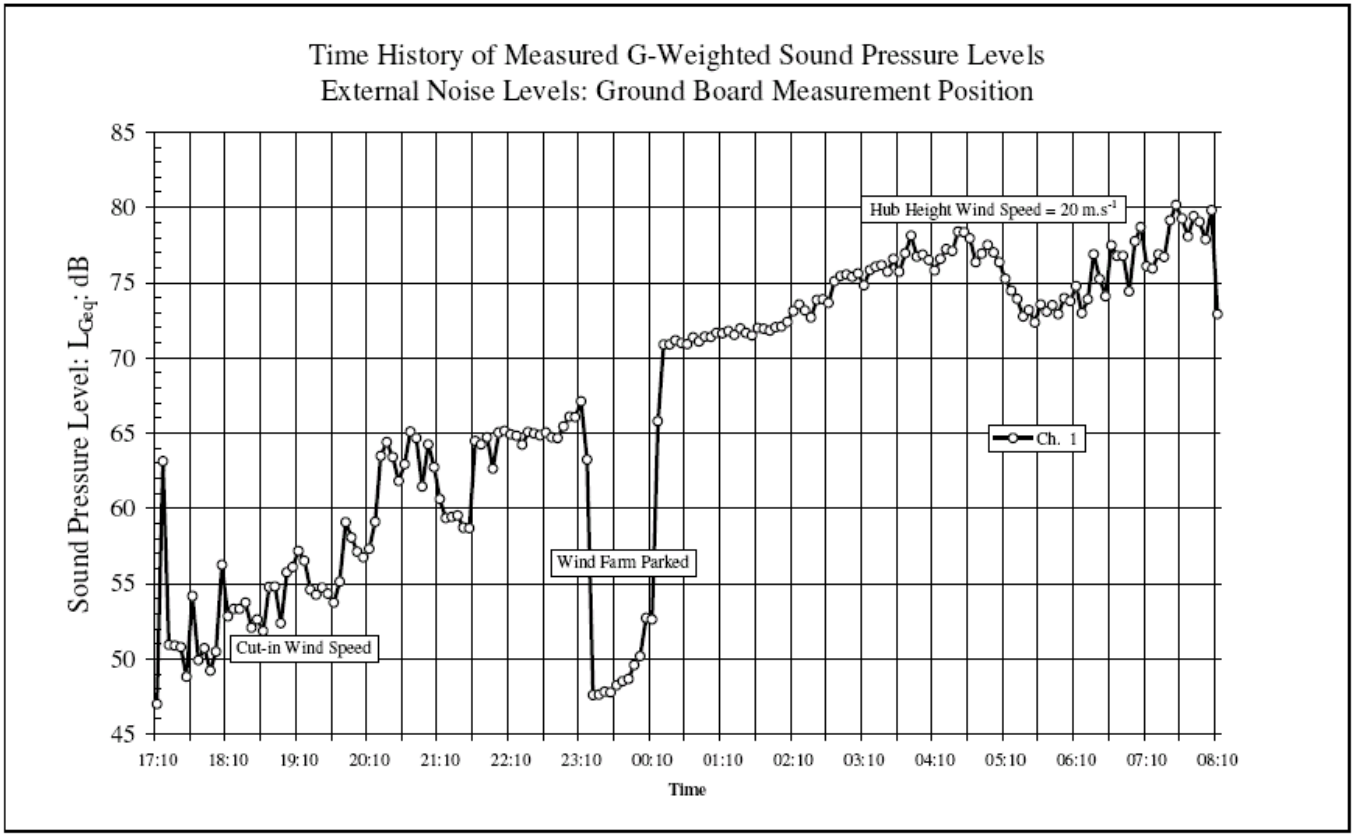


Figure 12: Time History Figure of G-Weighted Sound Pressure Levels for a Wind Farm

Infrasound Measurements

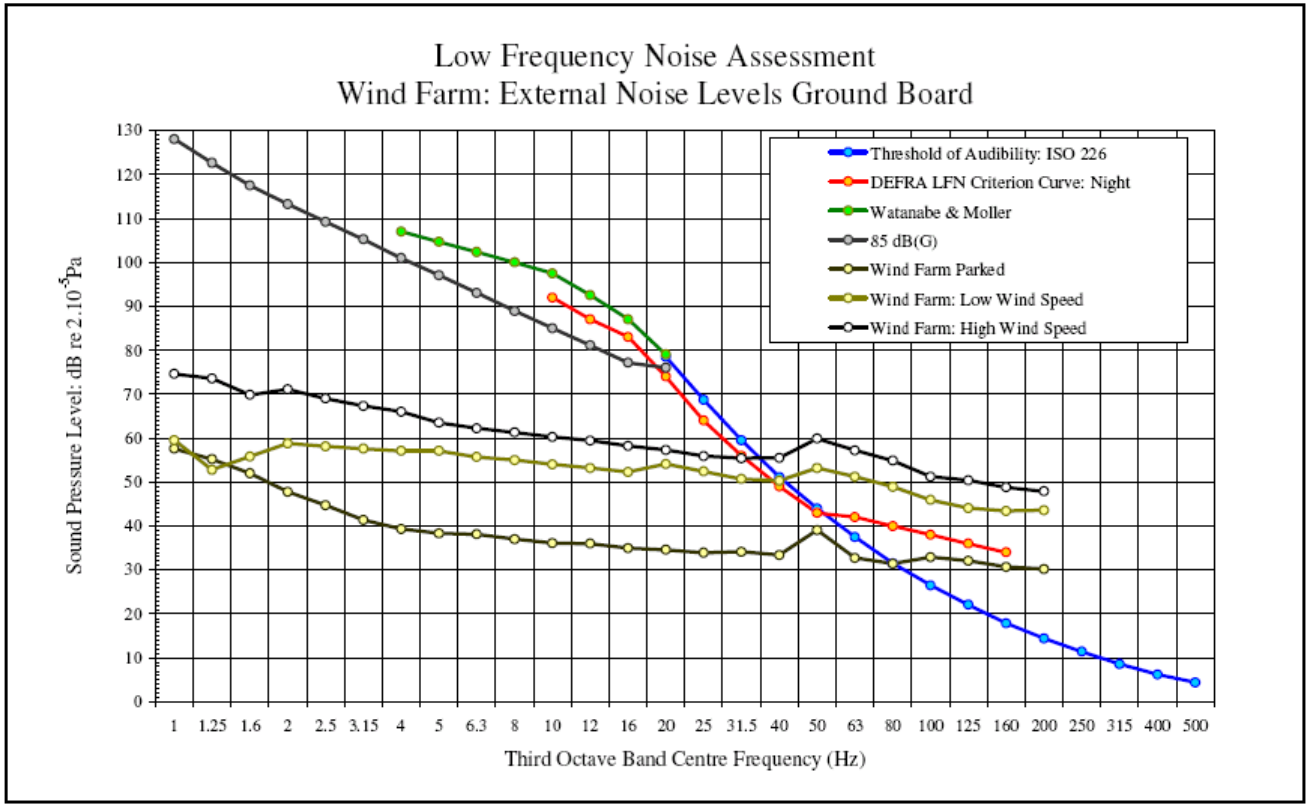


Figure 11: Measured Infrasound and Low Frequency Noise Levels: External Location on Ground Board

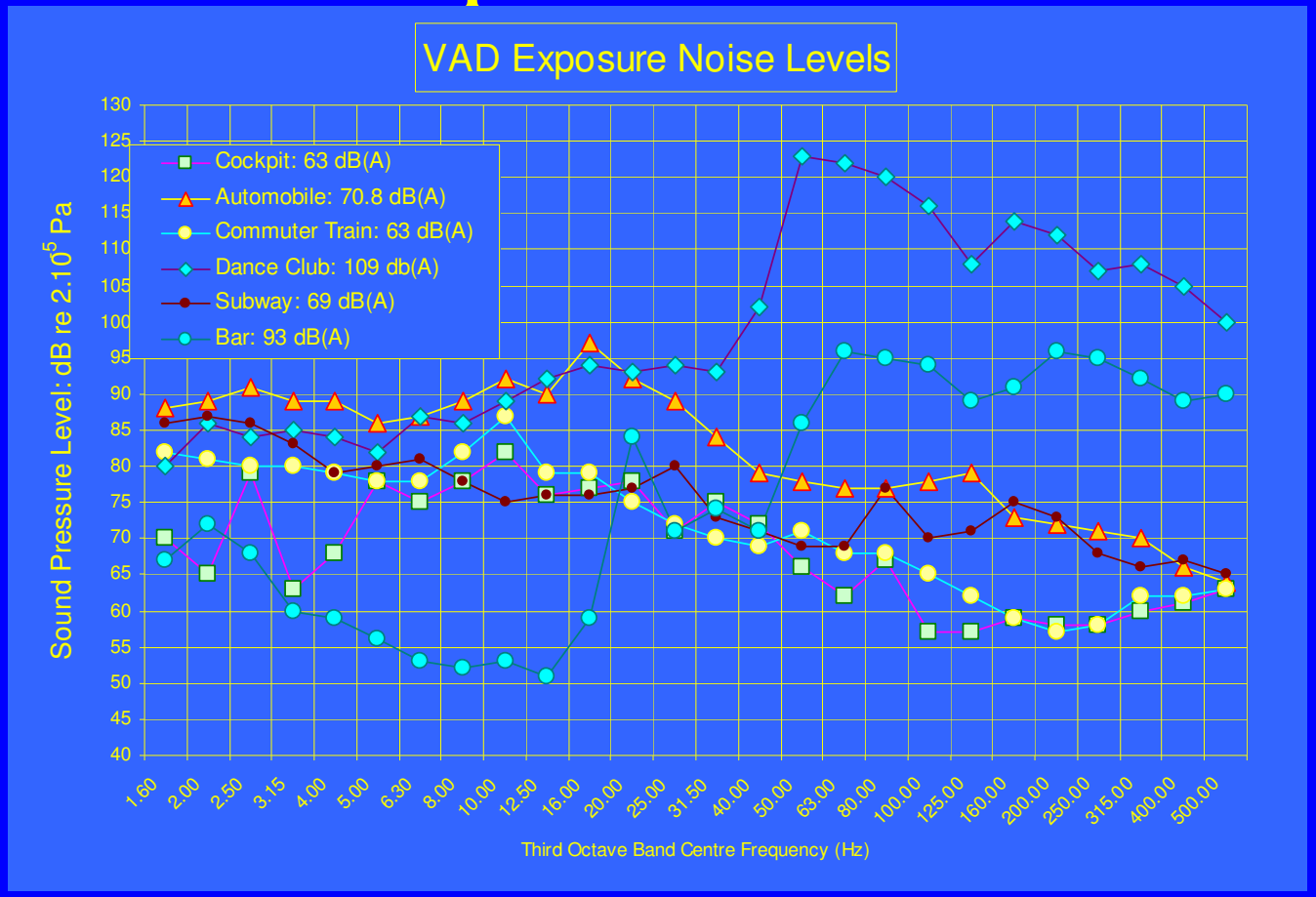
VAD Symptoms

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
Stage I-Mild (1-4 years)	Slight mood swings, Indigestion and heart -burn, Mouth/throat infections, Bronchitis
Stage II-Moderate (4-10 years)	Chest pain, Definite mood swings, Back pain, Fatigue, Fungal, viral and parasitic sk in infections, Inflammation of stomach lining, Pain and blood in urine, Conjunctivitis, Allergies
Stage III–Severe (> 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.

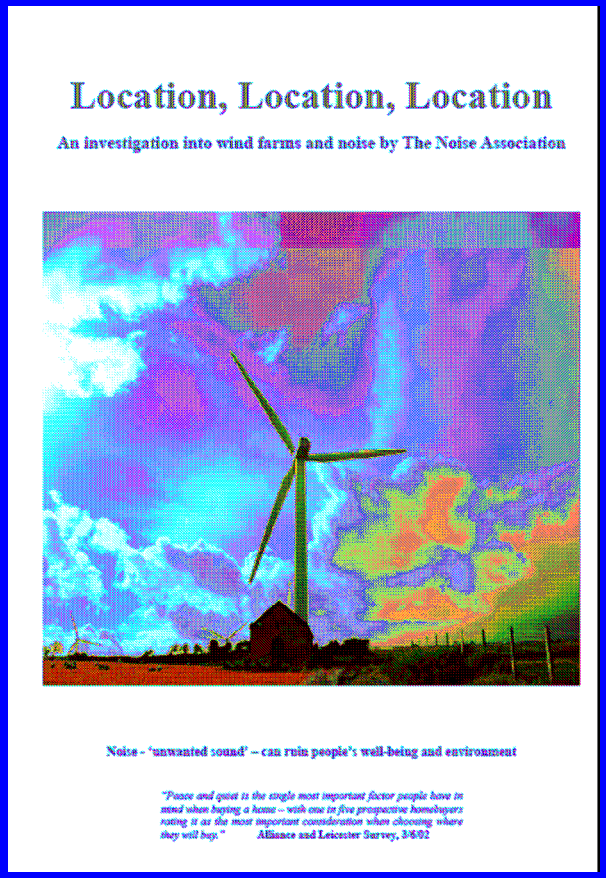
VAD Exposure Noise Levels



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

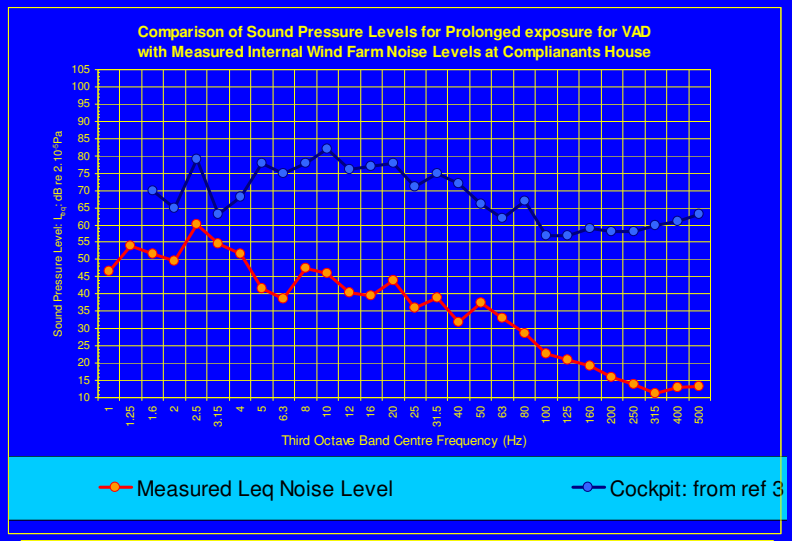
UK References

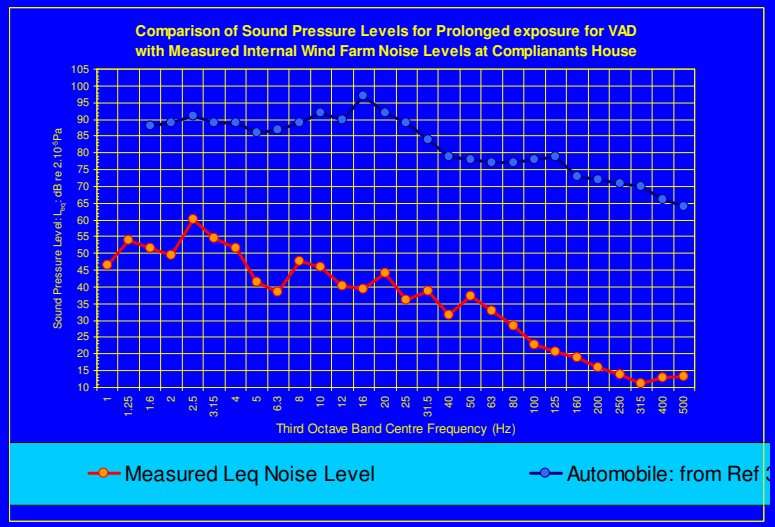
- UKNA Report: Location, Location, Location

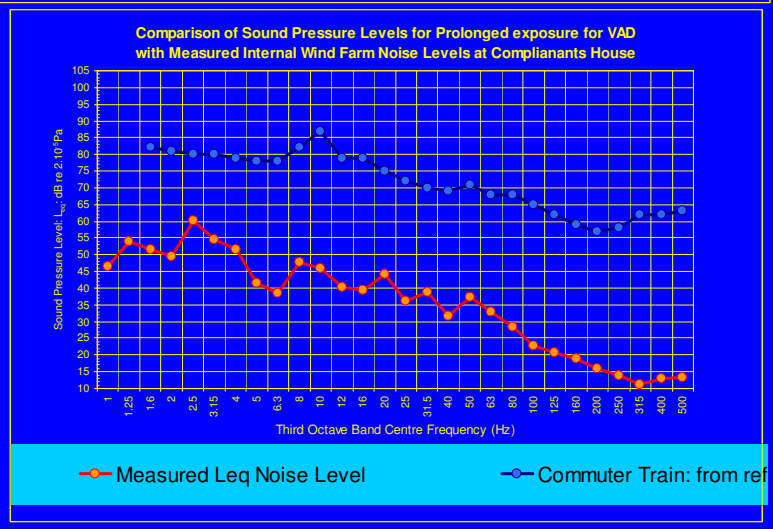


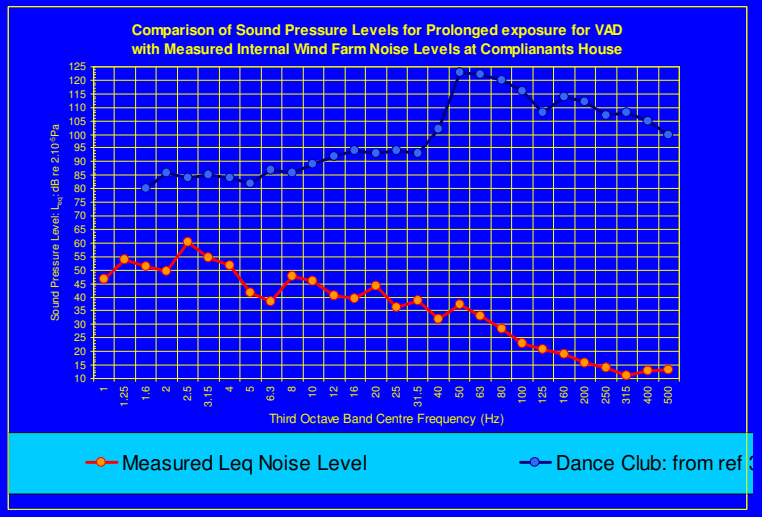
In Portugal, where low frequency noise has been researched extensively, a link has been found with a complex illness known as vibroacoustic disease. Although this research has been mainly concerned with high levels of low frequency noise, it is felt that prolonged exposure to lower levels of low frequency 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



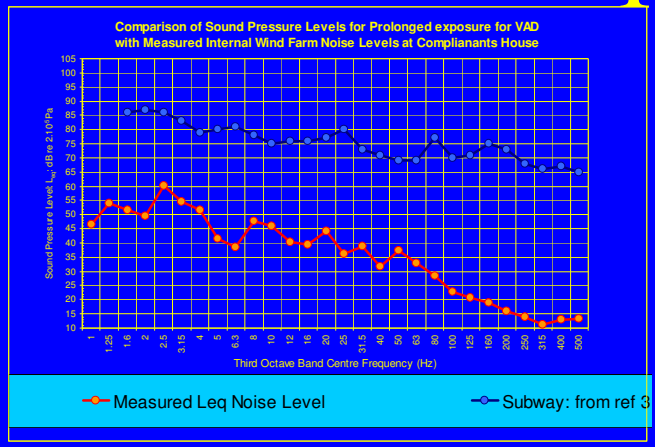


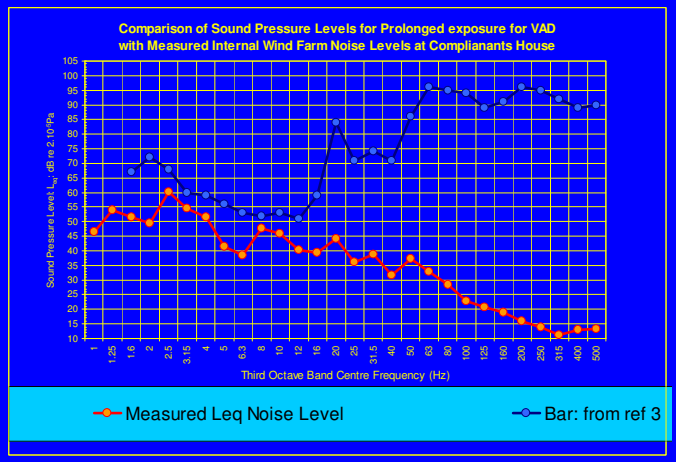


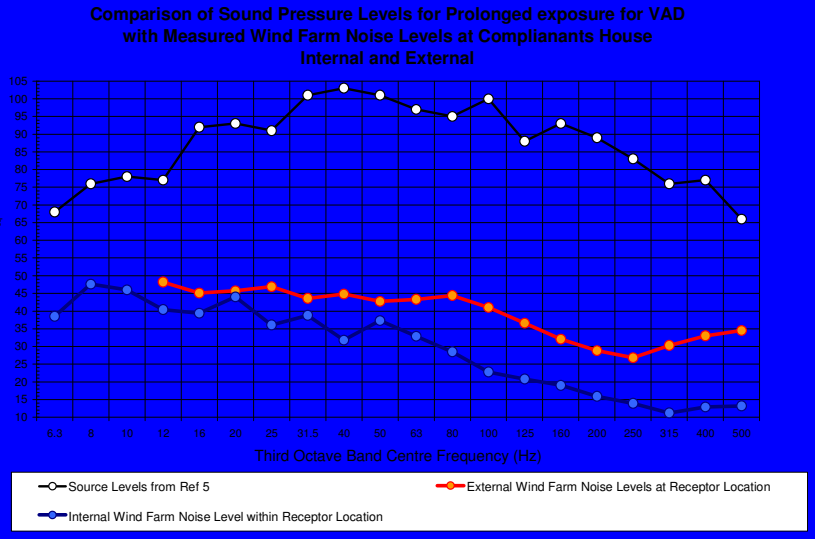


Wind Farm Noise: Armagh 2008

Comparison of Levels







Wind Farm Noise: Armagh 2008

In-Home Wind Turbine Noise is Conducive to Vibroacoustic Disease

Mariana Alves-Pereira: 2nd Internal Conference on Wind Turbine Noise: Lyon 2007

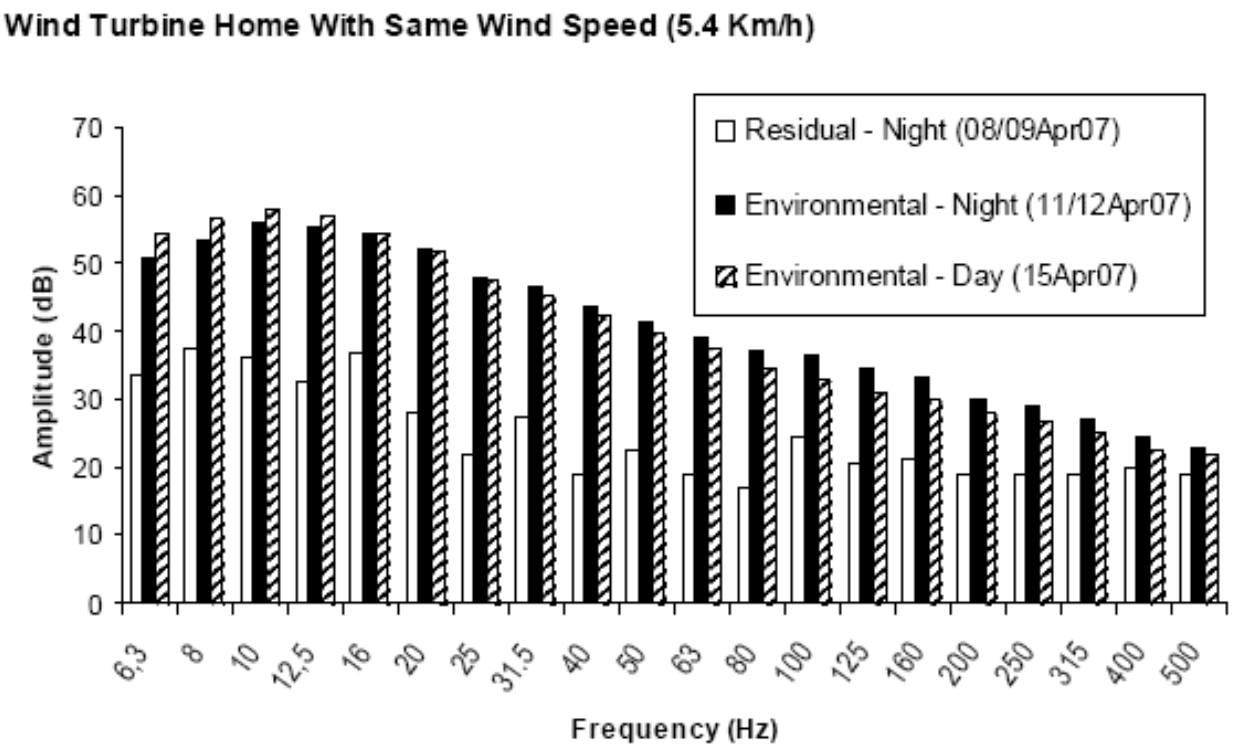
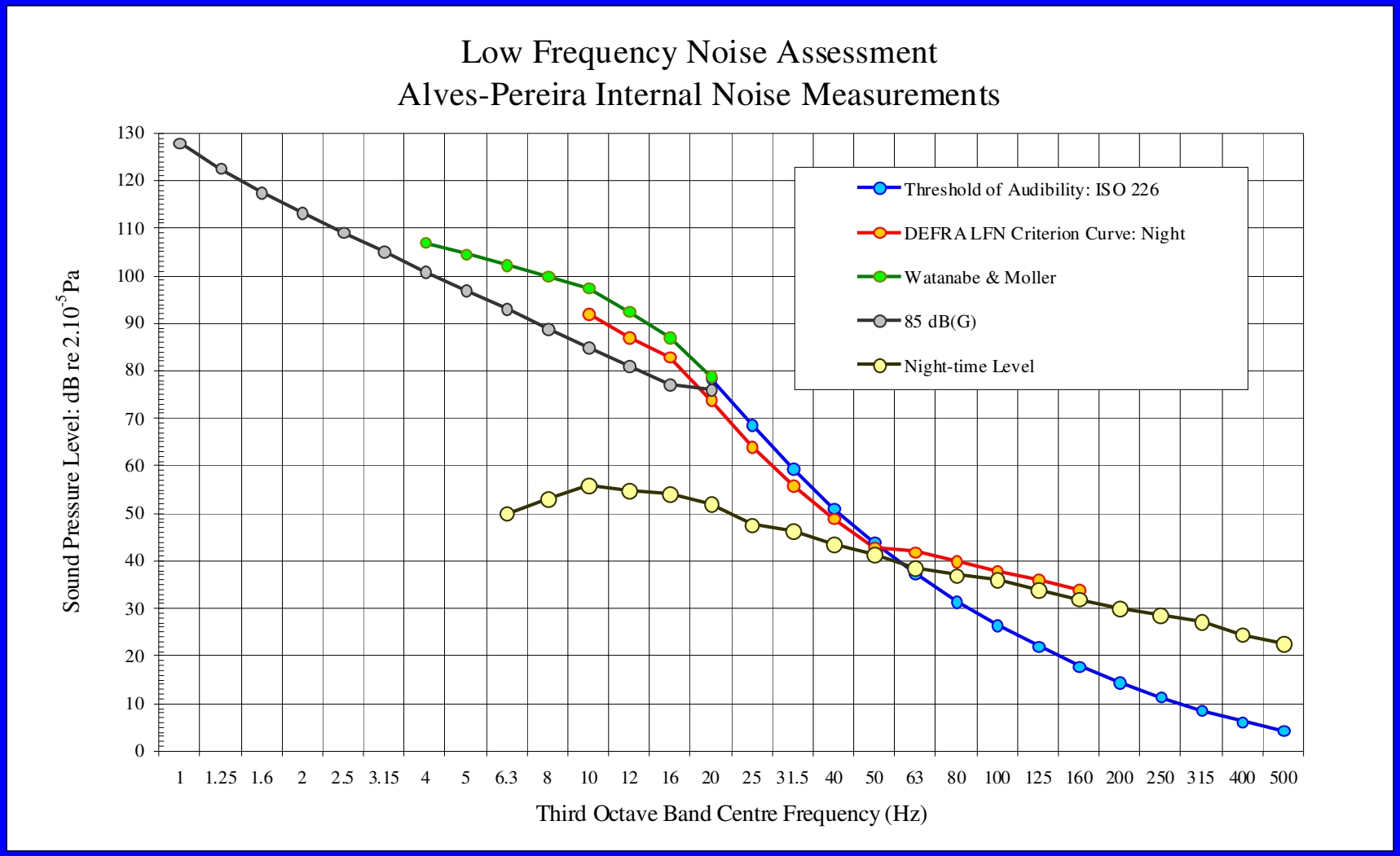


Figure 3. Comparison of 1/3 octave ILFN levels, in dBL, of the *Residual* (no WT blade movement) measurement and the *Environmental* (with rotating WT blades) measurement in the WT home Master Bedroom, with the same recorded wind speed.

Wind Farm Noise: Armagh 2008


Low Frequency Noise Assessment
Alves-Pereira Internal Noise Measurements
Sound Pressure Level: dB re 2.10-5Pa
130
120
110
100
90
80
70
60
50
40
30
20
10
0
1
1.25
1.6
2
2.5
3.15
4
5
6.3
8
10
12
16
20
25
31.5
40
50
63
80
100
125
160
200
250
315
400
500
Third Octave Band Centre Frequency (Hz)
Threshold of Audibility: ISO 226
DEFRA LFN Criterion Curve: Night
Watanabe & Moller
85 dB(G)
Night-time Level

Body Surface Induced Vibration from Low Frequency Noise

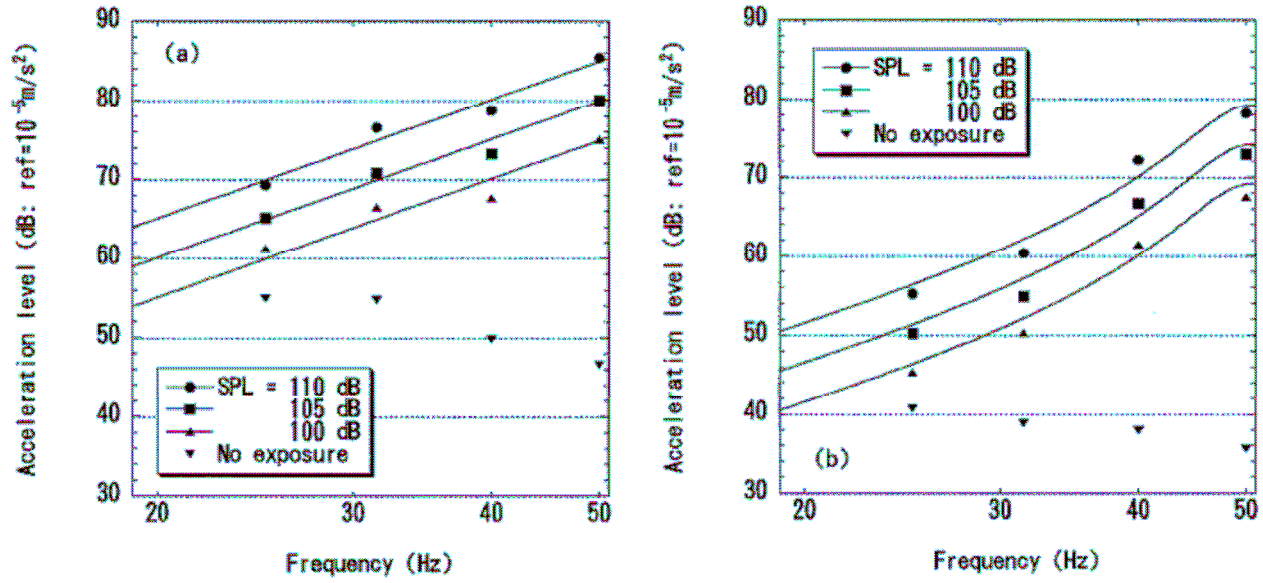


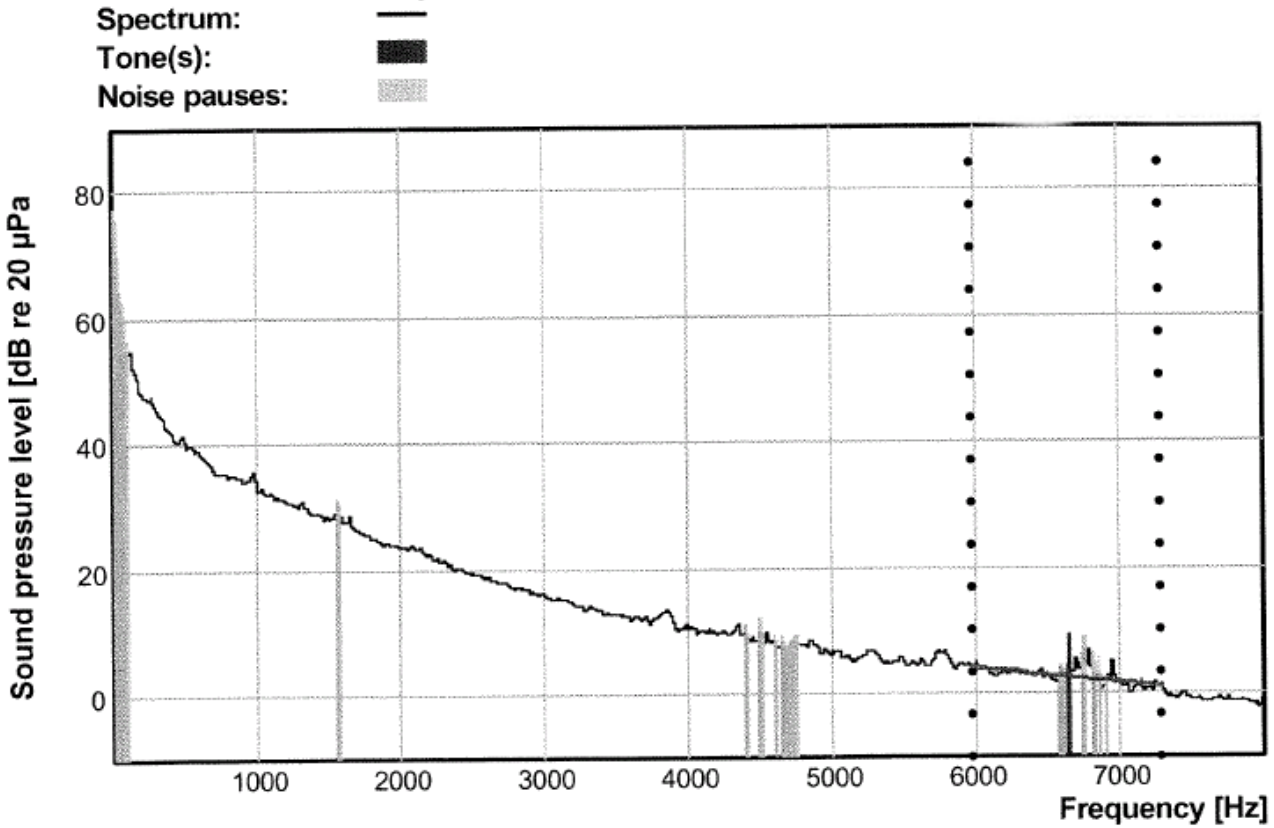
Fig. 1 The mean measured acceleration levels and the approximate curves. (a) On the left chest, and (b) on the forehead.

- 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

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.



Why might this link occur?

Bradworthy 01, Cornwall – Wind Farm Noise Monitoring December 2005

Wind Direction SW speed 14 – 27 MPH RAIN In Direct Wind

Location SS 304 135

Microphone - Normal

Instrument:	2250
Application:	BZ7223 Version 1.2
Start Time:	07/12/2005 18:27:17
End Time:	07/12/2005 18:29:20
Elapsed Time:	00:02:03
Bandwidth:	1/3-octave
Max Input Level:	140.50

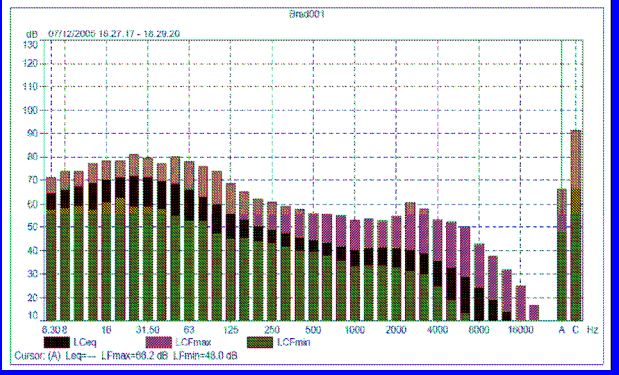
	Time	Frequency
Broadband (excl. Peak):	FSI	AC
Broadband Peak:	C	
Spectrum:	FS	C

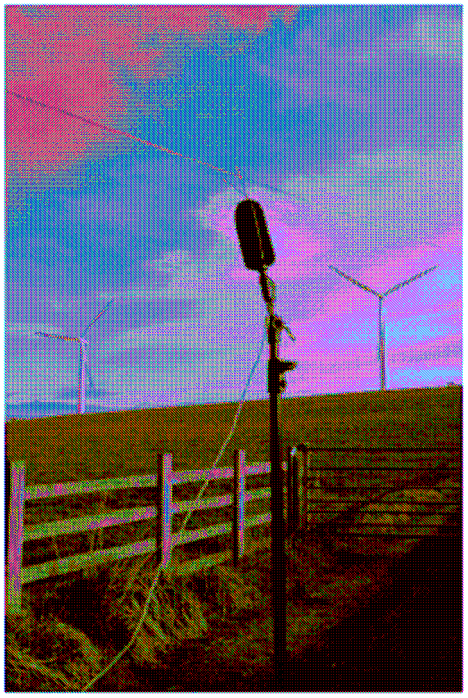
Instrument Serial Number:	2505941
Microphone Serial Number:	2508682
Input:	Top Socket
Windscreen Correction:	None
Sound Field Correction:	Free-field

Calibration Time:	07/12/2005 14:47:11
Calibration Type:	External reference
Sensitivity:	52.78 mV/Pa

Brad001 Text

	Start time	End time	Elapsed time	Overload [%]	LAeq [dB]	LAFmax [dB]	LAFmin [dB]
Value				0.00	57.8	66.2	48.0
Time	18:27:17	18:29:20	00:02:03				
Date	07/12/2005	07/12/2005					





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