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Wind Energy Ball V200

Sound Power Level measurements

Client	:	Home Energy BV
Number	:	R068304aaA0.md
Date	:	26 october 2009

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1 Introduction

By order of Home Energy International Terneuzen in the Netherlands, noise measurements have been carried out at a Wind Energy Ball V200 located at Braakmanweg 1 Biervliet in the Netherlands. The measurements have been performed to determine the sound power level in compliance with the IEC 61400-11 December 2002 ‘Windturbine generator systems – Part 11: Acoustic noise measurement techniques’.

2 Site

The turbine is located at Braakmanweg 1 Biervliet. The surroundings are presented in figure 2.1. The terrain is flat with upwind a rougness length of approximately 0.15 (high grass, shrubbery, small trees). The turbine is located about 42 m north of a dwelling and about 24 m north of a shed. There are no relevant reflecting surfaces nearby. Background noises are affected birds, local traffic and by wind induced noise of vegetation.

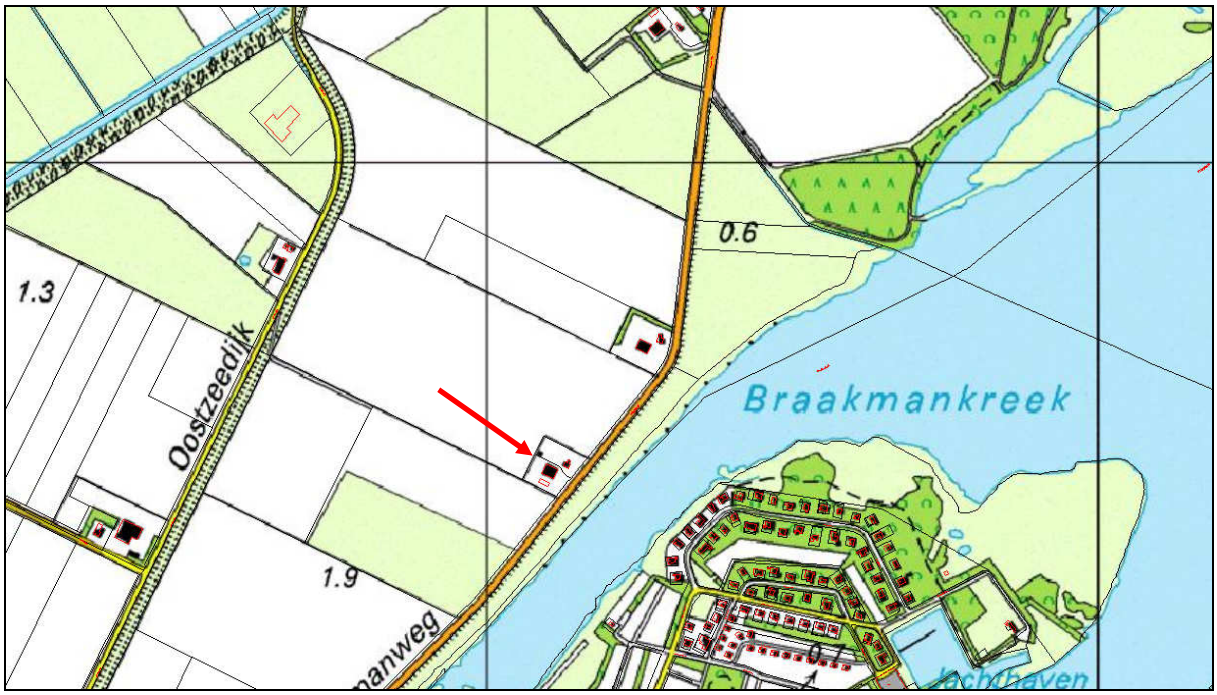


Figure 2.1
Site of the turbine (grid of 1 km).

3 Wind turbine

The Wind Energy Ball V200 is a spherical wind turbine with 5 rotor blades on a horizontal axis and a diameter of 1.98 m. The maximum power output is 2250 W. The hub height is 14 m (tube mast). The rotor is upwind with non-pitchable blades.

4 Measurements

Method
Measurements have been performed on October the 16th 2009 between 10.30 and 14.00 hours. With an operating turbine the sound pressure level is measured in the third octave bands of 25 Hz to 10.000 Hz at the reference point. The background noise level is measured with a stopped turbine.

Atmospheric conditions
In table 2.2 the atmospheric conditions are summarized.

Tabel 2.2
Atmospheric conditions

Date	October 16th 2009
Temperature	11 °C
Cloud cover	7/8
Wind direction	N
Wind velocity	4-10 m/s

Reference point
The reference distance R_0 downwind of the turbine is:
$R_0 = H + D/2 = 15$ m.
The measurement position is located at this distance, but not exactly downwind as this position was not possible due to a hedge. The chosen measurement position is located at approximately 45 degrees to the downwind position. Reflection of the hedge is neglegible. The microphone is placed on a ground board on the ground. An extra wind screen is applied with negligible influence on the sound measurement.

Wind measurements
The wind anemometer is located at a distance of app. 15 m upwind on a mast of 10 m height.

Instrumentation
- Portable real time analyser: Rion, type NA27, sn 501218
- Acoustic calibrator: B&K, type 4230, sn 930051
- Microphone: Rion, type UC-53A, sn 89751
- Cupanemometer: Wilh. Lambrecht Gmbh type 1457 S2
- Ground board 3 mm thick aluminium, circle shaped diameter app. 1.2 m
- Extra wind screen loudspeaker cloth upright in a frame of 0.8 by 0.5 m

5 Results

In figure 3.1 the measured sound pressure levels are presented. The sound power level is calculated from the levels according to the IEC-61400. The correction for background noise is limited to 1.3 dB(A). The measured wind velocities are corrected for a reference roughness of 0.05 m. In figure 3.2 the calculated values for the sound power level are presented together with the second order regression curve.

In table 3.1 the spectra of the sound power level are given for the different wind classes. The italic printed values are only informative due to shortage of measurement time in these wind classes. In table 3.2 the sound power level calculated with a 2nd order regression analysis is given.

Table 3.1
Measured sound power level for a roughness lengte of 0.05m

SPL L_w in dB(A)		Octave band [Hz]							
		63	125	250	500	1k	2k	4k	8k
Wind 5 m/s	*79.7*	*59.0*	*64.7*	*68.3*	*74.9*	*75.1*	*70.7*	*68.2*	*61.0*
Wind 6 m/s	81.8	59.6	66.2	70.0	75.9	78.3	72.7	70.1	63.0
Wind 7 m/s	84.5	60.6	66.7	71.2	77.2	81.8	75.5	72.7	65.6
Wind 8 m/s	87.3	61.7	68.1	73.0	78.6	85.2	78.3	75.2	68.2
Wind 9 m/s	89.2	62.8	69.3	74.5	79.5	87.2	80.8	77.1	70.1
Wind 10 m/s	*91.4*	*63.7*	*70.6*	*76.2*	*80.6*	*89.7*	*82.7*	*79.3*	*72.2*

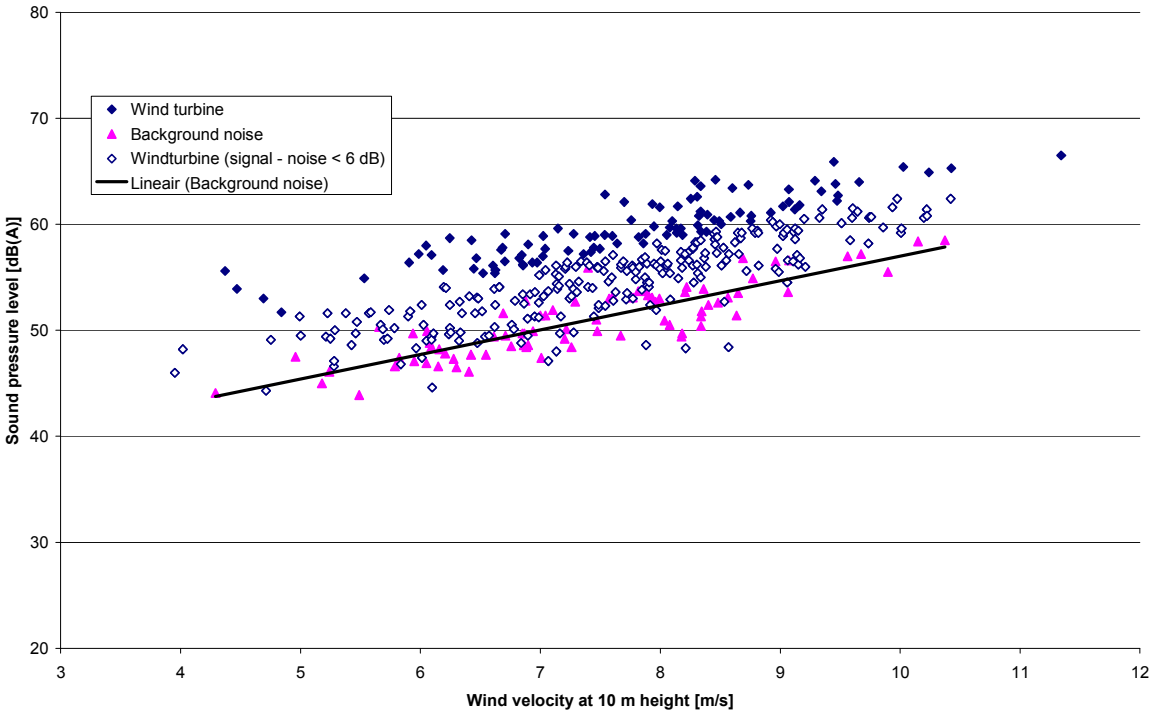
Table 3.2
Sound power level for a roughness length of 0.05m

Wind class	Sound power level [dB(A)]
Wind 5 m/s	80.2
Wind 6 m/s	82.4
Wind 7 m/s	84.7
Wind 8 m/s	87.2
Wind 9 m/s	89.8
Wind 10 m/s	92.6

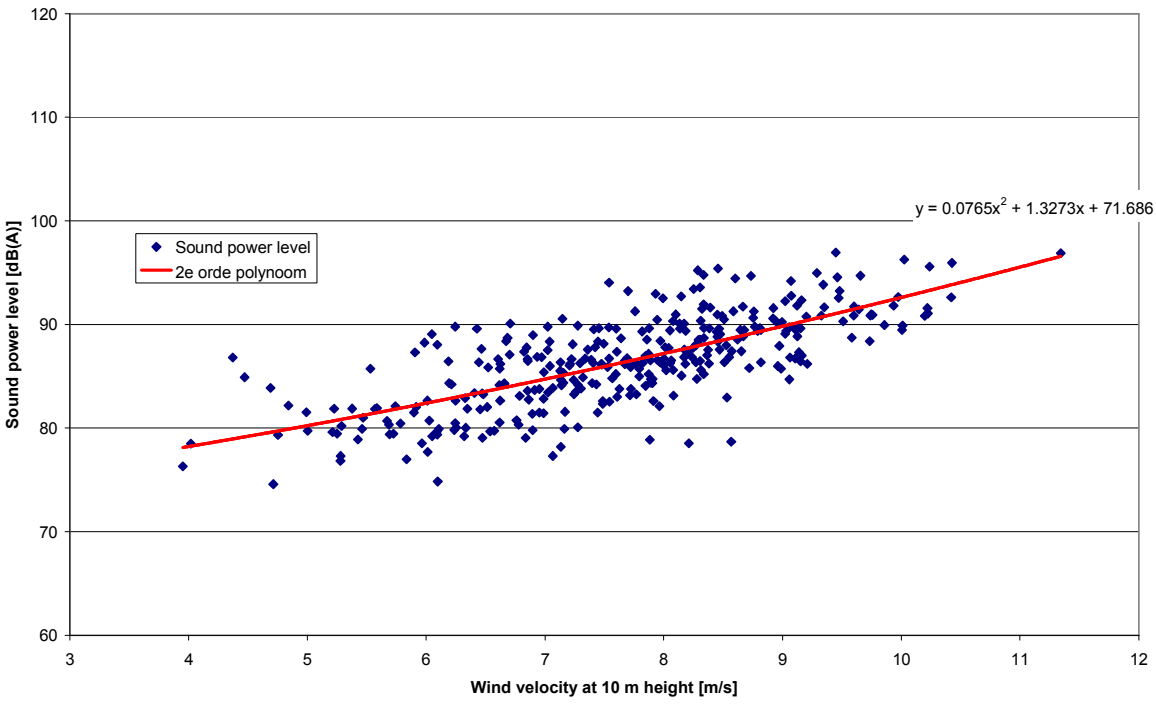
The uncertainty of the measurements and calculations is estimated at :

- Regression analysis U_A 3,0 dB
- Instrumentation sound 0,3 dB
- Measurement wind 0,7 dB
- Distance 0,2 dB
- Correction background noise 0,8 dB

The total combined uncertainty is **3,2 dB** and is relative high due tot the high background noise.



Figuur 3.1
Measurement pairs (30 s equivalent)



Figuur 3.2
Sound power level pairs (30 s equivalent)

6 Extract of test report - fact sheet

Measurement according to 'Wind turbine generator systems – part 11' IEC61400-11 december 2002.

Turbine: Wind Energy Ball V200
Rotor diameter: 1.98 m
Hub height: 14 m (tube mast)
Rated power: 2200 W
Date of measurement: 16th October2009
Location: Braakmanweg 1, Biervliet, the Netherlands

Sound power level for standardized wind speed

Wind class	Sound power level [dB(A)]
Wind 5 m/s	80.2
Wind 6 m/s	82.4
Wind 7 m/s	84.7
Wind 8 m/s	87.2
Wind 9 m/s	89.8
Wind 10 m/s	92.6

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Annex I Figures

Figure 0.1
Turbine and microphone

Figure 0.2
Anemometer and turbine (photographed on the day before the measurements)

Figure 0.3
Anemometer taken from wind turbine (photographed on the day before the measurements)

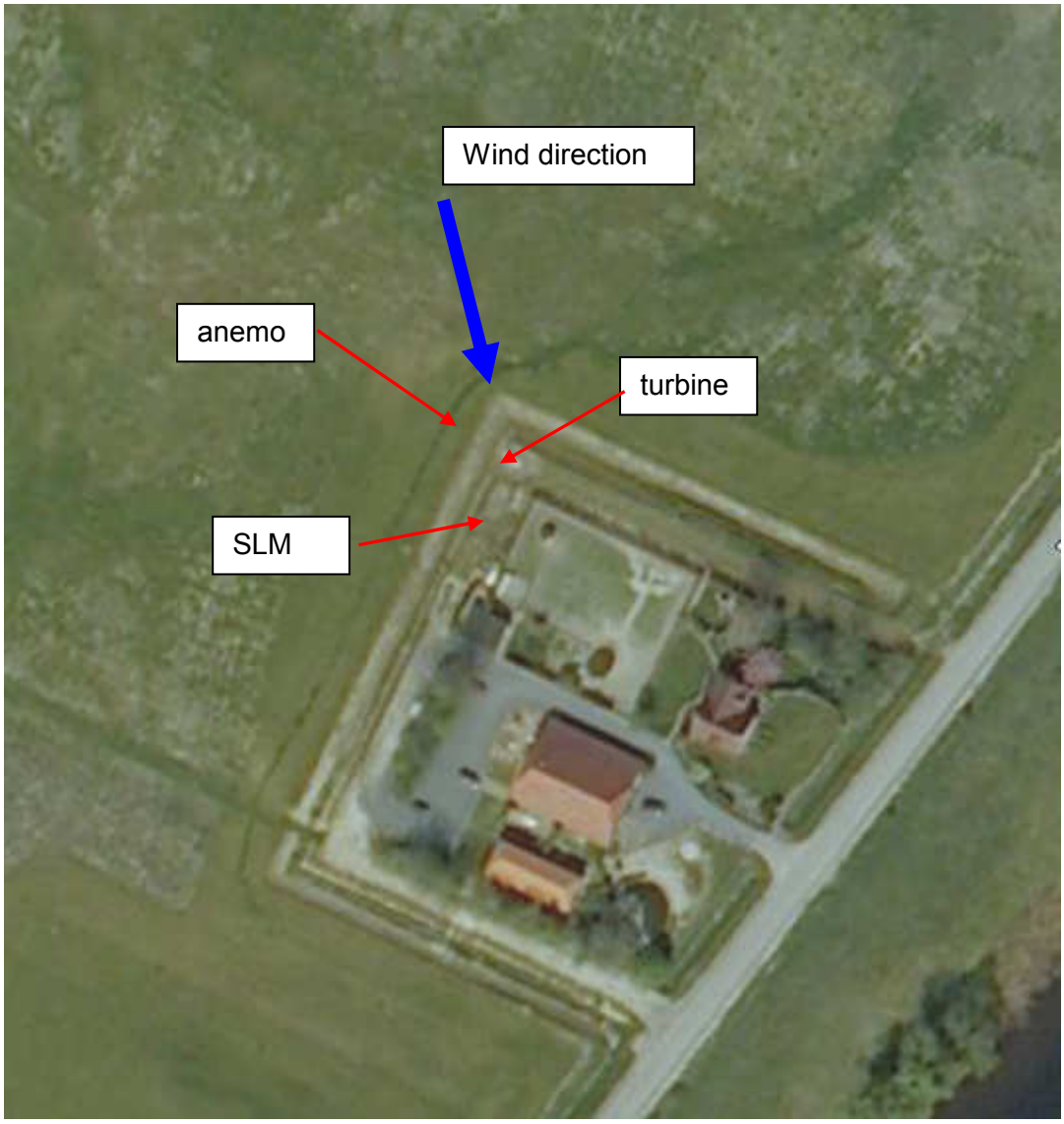

Figure 0.4
Measurement positions