Appendix 11.4: Candidate turbine manufacturer's noise emission data

Third octave sound power levels

Nordex N149/5.X

Mode 0

hub height 105 m – 105.6 dB(A)

third octave sound power levels [dB(A)] at standardized wind speeds v_s										
Frequency	**3 m/s**	**4 m/s**	**5 m/s**	**6 m/s**	**7 m/s**	**8 m/s**	**9 m/s**	**10 m/s**	**11 m/s**	**12 m/s**
10 Hz	37.6	38.8	42.3	46.7	48.1	48.5	48.5	48.5	48.5	48.4
12.5 Hz	42.4	43.6	47.2	51.6	53.0	53.3	53.3	53.3	53.3	53.3
16 Hz	47.0	48.2	51.8	56.2	57.6	57.9	57.9	57.9	57.9	57.9
20 Hz	51.4	52.6	56.1	60.5	61.9	62.3	62.3	62.3	62.3	62.3
25 Hz	55.8	57.0	60.5	64.9	66.3	66.2	66.2	66.2	66.2	66.2
31.5 Hz	59.9	61.1	65.0	69.4	70.8	71.7	71.7	71.7	71.7	71.7
40 Hz	65.8	67.0	69.4	73.8	75.2	75.3	75.3	75.3	75.3	75.3
50 Hz	67.0	68.2	72.7	77.1	78.5	80.4	80.4	80.4	80.4	80.4
63 Hz	71.9	73.1	75.2	79.6	81.0	81.7	81.7	81.7	81.7	81.7
80 Hz	74.8	76.0	78.9	83.3	84.7	84.5	84.5	84.5	84.5	84.5
100 Hz	75.8	77.0	80.9	85.3	86.7	89.2	89.2	89.2	89.2	89.2
125 Hz	78.0	79.2	81.9	86.3	87.7	87.7	87.7	87.7	87.7	87.7
160 Hz	81.3	82.5	84.9	89.3	90.7	89.0	89.0	89.0	89.0	89.0
200 Hz	80.4	81.6	84.9	89.3	90.7	90.3	90.3	90.3	90.3	90.3
250 Hz	81.7	82.9	86.4	90.8	92.2	91.2	91.2	91.2	91.2	91.2
315 Hz	82.9	84.1	88.0	92.4	93.8	94.5	94.5	94.5	94.5	94.5
400 Hz	83.3	84.5	88.3	92.7	94.1	94.1	94.1	94.1	94.1	94.1
500 Hz	82.0	83.2	88.0	92.4	93.8	94.3	94.3	94.3	94.3	94.3
630 Hz	83.2	84.4	89.6	94.0	95.4	96.3	96.3	96.3	96.3	96.3
800 Hz	82.5	83.7	89.2	93.6	95.0	95.4	95.4	95.4	95.4	95.4
1000 Hz	83.8	85.0	90.6	95.0	96.4	96.2	96.2	96.2	96.2	96.2
1250 Hz	83.4	84.6	90.1	94.5	95.9	95.5	95.5	95.5	95.5	95.5
1600 Hz	82.9	84.1	89.8	94.2	95.6	94.5	94.5	94.5	94.5	94.5
2000 Hz	81.4	82.6	88.1	92.5	93.9	93.3	93.3	93.3	93.3	93.3
2500 Hz	79.1	80.3	85.7	90.1	91.5	91.3	91.3	91.3	91.3	91.3
3150 Hz	76.9	78.1	81.5	85.9	87.3	88.6	88.6	88.6	88.6	88.6
4000 Hz	76.8	78.0	76.7	81.1	82.5	84.6	84.6	84.6	84.6	84.6
5000 Hz	72.2	73.4	74.3	78.7	80.1	79.8	79.8	79.8	79.8	79.8
6300 Hz	68.5	69.7	72.7	77.1	78.5	79.6	79.6	79.6	79.6	79.6
8000 Hz	66.6	67.8	70.6	75.0	76.4	77.7	77.7	77.7	77.7	77.7
10000 Hz	62.7	63.9	66.7	71.1	72.5	73.5	73.5	73.5	73.5	73.5
Total sound power level	**94.0**	**95.2**	**99.8**	**104.2**	**105.6**	**105.6**	**105.6**	**105.6**	**105.6**	**105.6**

hub height 120 m – 105.6 dB(A)

third octave sound power levels [dB(A)] at standardized wind speeds v_s										
Frequency	**3 m/s**	**4 m/s**	**5 m/s**	**6 m/s**	**7 m/s**	**8 m/s**	**9 m/s**	**10 m/s**	**11 m/s**	**12 m/s**
10 Hz	37.6	39.1	42.6	47.1	48.1	48.5	48.5	48.5	48.5	48.4
12.5 Hz	42.4	43.9	47.5	52.0	53.0	53.3	53.3	53.3	53.3	53.3
16 Hz	47.0	48.5	52.1	56.6	57.6	57.9	57.9	57.9	57.9	57.9
20 Hz	51.4	52.9	56.4	60.9	61.9	62.3	62.3	62.3	62.3	62.3
25 Hz	55.8	57.3	60.8	65.3	66.3	66.2	66.2	66.2	66.2	66.2
31.5 Hz	59.9	61.4	65.3	69.8	70.8	71.7	71.7	71.7	71.7	71.7
40 Hz	65.8	67.3	69.7	74.2	75.2	75.3	75.3	75.3	75.3	75.3
50 Hz	67.0	68.5	73.0	77.5	78.5	80.4	80.4	80.4	80.4	80.4
63 Hz	71.9	73.4	75.5	80.0	81.0	81.7	81.7	81.7	81.7	81.7
80 Hz	74.8	76.3	79.2	83.7	84.7	84.5	84.5	84.5	84.5	84.5
100 Hz	75.8	77.3	81.2	85.7	86.7	89.2	89.2	89.2	89.2	89.2
125 Hz	78.0	79.5	82.2	86.7	87.7	87.7	87.7	87.7	87.7	87.7
160 Hz	81.3	82.8	85.2	89.7	90.7	89.0	89.0	89.0	89.0	89.0
200 Hz	80.4	81.9	85.2	89.7	90.7	90.3	90.3	90.3	90.3	90.3
250 Hz	81.7	83.2	86.7	91.2	92.2	91.2	91.2	91.2	91.2	91.2
315 Hz	82.9	84.4	88.3	92.8	93.8	94.5	94.5	94.5	94.5	94.5
400 Hz	83.3	84.8	88.6	93.1	94.1	94.1	94.1	94.1	94.1	94.1
500 Hz	82.0	83.5	88.3	92.8	93.8	94.3	94.3	94.3	94.3	94.3
630 Hz	83.2	84.7	89.9	94.4	95.4	96.3	96.3	96.3	96.3	96.3
800 Hz	82.5	84.0	89.5	94.0	95.0	95.4	95.4	95.4	95.4	95.4
1000 Hz	83.8	85.3	90.9	95.4	96.4	96.2	96.2	96.2	96.2	96.2
1250 Hz	83.4	84.9	90.4	94.9	95.9	95.5	95.5	95.5	95.5	95.5
1600 Hz	82.9	84.4	90.1	94.6	95.6	94.5	94.5	94.5	94.5	94.5
2000 Hz	81.4	82.9	88.4	92.9	93.9	93.3	93.3	93.3	93.3	93.3
2500 Hz	79.1	80.6	86.0	90.5	91.5	91.3	91.3	91.3	91.3	91.3
3150 Hz	76.9	78.4	81.8	86.3	87.3	88.6	88.6	88.6	88.6	88.6
4000 Hz	76.8	78.3	77.0	81.5	82.5	84.6	84.6	84.6	84.6	84.6
5000 Hz	72.2	73.7	74.6	79.1	80.1	79.8	79.8	79.8	79.8	79.8
6300 Hz	68.5	70.0	73.0	77.5	78.5	79.6	79.6	79.6	79.6	79.6
8000 Hz	66.6	68.1	70.9	75.4	76.4	77.7	77.7	77.7	77.7	77.7
10000 Hz	62.7	64.2	67.0	71.5	72.5	73.5	73.5	73.5	73.5	73.5
Total sound power level	**94.0**	**95.5**	**100.1**	**104.6**	**105.6**	**105.6**	**105.6**	**105.6**	**105.6**	**105.6**

Blacklough Wind Farm and Stokane Permitted Single Turbine, Enercon, E92's 2.35MW Octaves at Maximum Sound Power Level

Excerpt from Test Report

According to "Technischen Richtlinien für Windenergieanlagen, Teil 1: Bestimmung der Schallemissionswerte"

Revision 18, 2008/02/01 (Publisher: Fördergesellschaft Windenergie e.V., Stresemannplatz 4, D-24103 Kiel, Germany)

Excerpt from Test Report MN15002

Acoustic Noise Emission of Wind Turbine Generator Enercon E-92 Operation Mode OM0s

General Information		Technical Specifications (Manufacturer)	
Turbine Manufacturer:	Enercon GmbH	Rated Power:	2350 kW
	Dreekamp 5	Rotor Diameter:	92 m
	26605 Aurich/Germany	Hub Height Above Ground:	98.4 m
Serial Number:	920340	Tower Design/Material:	Conical, Concrete
WTG Location:	E 3401163 N 5943704	Power Control:	Variabel, Pitch
Additional Specifications Rotor (Manufacturer)		**Add. Specifications Gear Box and Generator (Manufacturer)**	
Manufacturer of Rotor Blades:	Enercon GmbH	Manufacturer of Gear Box:	n/a
Type of Rotor Blades:	E92-1	Type of Gear Box:	n/a
Tilt Angle:	5°	Manufacturer of Generator:	Enercon GmbH
Number of Blades:	3	Type of Generator:	G-92 / 23-G1
Rotor Speed Range:	5 - 17 min^{-1}	Generator Speed Range:	5 - 17 min^{-1}
Report No. Power Performance:	LK_E-92_2350kW_BM0s_berechnet_V1.0		

	Reference Position		Acoustic Noise Emission	Remarks
	Standardized Wind Speed at a Height of 10m	Electrical Power		
Sound Power Level $L_{WA,P}$	6 m/s	1226 kW	102.6 dB(A)	
	7 m/s	1822 kW	103.7 dB(A)	
	8 m/s	2155 kW	104.3 dB(A)	
	9 m/s	> 95% P rated	104.7 dB(A)	
	10 m/s	-	-	1)
Addition to Tonality Near Range K_{TN}	6 m/s	1226 kW	0 dB at 115 Hz	
	7 m/s	1822 kW	0 dB at 116 Hz	
	8 m/s	2155 kW	0 dB at 119 Hz	
	9 m/s	> 95% P rated	0 dB at 123 Hz	
	10 m/s	-	- at -	1)
Addition to Impulsivity Near Range K_{IN}	6 m/s	1226 kW	-	
	7 m/s	1822 kW	-	
	8 m/s	2155 kW	-	
	9 m/s	> 95% P rated	-	
	10 m/s	-	-	1)

One-Third Octave Spectra Sound Power Level at Integer Wind Speed v10m = 9 m/s in dB(A)

Frequency	50	63	80	100	125	160	200	250	315	400	500	630
$L_{WA,P}$	76.9	80.5	83.3	85.7	91.6	88.1	88.6	89.6	89.3	90.5	90.8	91.8
Frequency	800	1000	1250	1600	2000	2500	3150	4000	5000	6300	8000	10000
$L_{WA,P}$	91.8	93.3	94.9	93.8	94.6	93.9	93.9	92.4	89.8	85.6	79.4	71.7

Octave Spectra Sound Power Level at Integer Wind Speed v10m = 9 m/s in dB(A)

Frequency	63	125	250	500	1000	2000	4000	8000
$L_{WA,P}$	85.7	93.9	94.0	95.8	98.3	98.9	97.1	86.6

This report is exclusively valid with manufacturer certificate dated 2015/01/07.

These specifications do not replace the report named above (particularly for determination of sound propagations).

Remarks: 1) Only one data set at a time in the operation noise of the WTG and in the background noise.

Deutsche WindGuard Consulting GmbH
Oldenburger Straße 65
D-26316 Varel
Germany

DAkkS Deutsche Akkreditierungsstelle D-PL-18020-01-00

Schallemission TR 1 FGW 2015 Konformitätssiegel

Deutsche WindGuard
Consulting GmbH
Oldenburger Straße 65
D-26316 Varel
Tel.: 04451 / 95 15 - 0 - Fax: 95 15 - 29

Date of Measurement: 2014/11/26
Date of Report: 2015/02/03

Sign: M. Meyer zu Hörste

Sign:

Carrowleagh Wind Farm and Bunnyconnellan Wind Farm, Enercon E70's, 2.3MW, Octaves at Maximum Sound Power Level

WIND-consult
Ingenieurgesellschaft für umweltschonende Energiewandlung mbH

Test Report

WICO 049SE206/01

Measurement of Noise Emission of Wind Turbine (WT) ENERCON E-70 E4 2.3 MW (Mode II)

in accordance with

IEC 61400-11 Ed.2 /1/

Location: *Holtriem (Lower Saxony)*

Bargeshagen, 2006-03-16

One third octave sound power level at reference point v_{10} = 8 m/s [dB(A)]												
Frequency	50	63	80	100	125	160	200	250	315	400	500	630
L_{WA}	76.8	81.2	84.8	88.4	90.8	91.3	90.5	94.0	94.5	92.5	91.8	92.4
L_{WA}		86.8			95.1			98.1			97.0	
Frequency	800	1000	1250	1600	2000	2500	3150	4000	5000	6300	8000	10000
L_{WA}	90.3	90.2	88.8	87.2	86.2	83.9	80.9	78.8	76.5	74.1	72.1	71.1
L_{WA}		94.6			90.7			83.9			77.4	

One third octave sound power level at reference point v_{10} = 9 m/s [dB(A)]												
Frequency	50	63	80	100	125	160	200	250	315	400	500	630
L_{WA}	78.0	81.1	83.8	87.2	90.1	92.6	91.5	95.1	96.2	94.9	94.3	94.4
L_{WA}		86.4			95.3			99.5			99.3	
Frequency	800	1000	1250	1600	2000	2500	3150	4000	5000	6300	8000	10000
L_{WA}	91.5	89.8	87.9	86.5	85.3	83.4	81.5	81.1	80.3	79.1	77.3	75.4
L_{WA}		94.7			90.0			85.8			82.3	

One third octave sound power level at reference point v_{10} = 10 m/s [dB(A)]												
Frequency	50	63	80	100	125	160	200	250	315	400	500	630
L_{WA}	78.4	82.7	86.3	89.7	92.0	93.7	92.2	95.4	95.6	93.4	92.6	93.5
L_{WA}		88.3			96.9			99.4			98.0	
Frequency	800	1000	1250	1600	2000	2500	3150	4000	5000	6300	8000	10000
L_{WA}	91.7	92.1	91.2	89.9	88.3	86.2	83.2	81.4	78.8	75.6	73.4	72.2
L_{WA}		96.5			93.2			86.3			78.7	

1) Sound power level at 95% of the rated power.

This extract of test report is valid only in connection with the enclosed „Manufacturer's certificate" from 2005-11-07.

This declaration does not replace above-mentioned report.

measured by: WIND-consult GmbH
Reuterstraße 9
D-18211 Bargeshagen

- PDF document was signed electronically -

3.3 Octave band levels of the loudest condition

3.3.1 Octave band level HH

Tab. 7: Octave band level in dB(A), based on wind speed v_H at hub height

v_H in m/s	Octave band level centre frequency in Hz								
	31.5	63	125	250	500	1000	2000	4000	8000
12	75.8	87.5	93.2	96.1	98.5	100.1	100.8	95.8	79.9

3.3.2 Octave band level E-138 EP3 E2-ST-81-FB-C-01

Tab. 8: Octave band level in dB(A), based on standardised wind speed v_s at a height of 10 m

v_S at a height of 10 m in m/s	Octave band level centre frequency in Hz								
	31.5	63	125	250	500	1000	2000	4000	8000
9	75.2	86.9	92.6	95.4	98.0	99.9	101.0	97.2	83.8

3.3.3 Octave band level E-138 EP3 E2-ST-111-FB-C-01

Tab. 9: Octave band level in dB(A), based on standardised wind speed v_s at a height of 10 m

v_S at a height of 10 m in m/s	Octave band level centre frequency in Hz								
	31.5	63	125	250	500	1000	2000	4000	8000
8.5	75.5	87.2	93.0	95.7	98.2	100.0	100.9	96.4	81.5

3.3.4 Octave band level E-138 EP3 E2-ST-131-FB-C-01

Tab. 10: Octave band level in dB(A), based on standardised wind speed v_s at a height of 10 m

v_S at a height of 10 m in m/s	Octave band level centre frequency in Hz								
	31.5	63	125	250	500	1000	2000	4000	8000
8.5	75.7	87.4	93.1	95.8	98.3	100.1	100.9	96.1	79.8

3.3.5 Octave band level E-138 EP3 E2-MST-131-FB-C-01

Tab. 11: Octave band level in dB(A), based on standardised wind speed v_s at a height of 10 m

v_S at a height of 10 m in m/s	Octave band level centre frequency in Hz								
	31.5	63	125	250	500	1000	2000	4000	8000
8.5	75.7	87.4	93.1	95.8	98.3	100.1	100.9	96.1	79.8