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1/1 Octaves According to General Specification V90–1.8/2.0 MW

VCS, 50 Hz

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1 Introduction

The purpose of this document is to present the 1/1 octave noise spectrum corresponding to the estimated noise levels (sound power levels) given in 0004-6207 'General Specification', V09.

The presented 1/1 octave noise spectrum is based on noise measurements performed from 11 March 2005 to 29 March 2011.

2 Method

2.1 Physical Environment

The results are valid for measurements according to IEC 61400-11 Ed.2 2002 including amendments.

Roughness length	0.05
Corresponding wind shear	0.16
Inflow angle (Vertical):	$0 \pm 2^\circ$
Air density:	1.225 kg/m ³

2.2 Data Collection

The data has been collected from 11 March 2005 to 29 March 2011, on the updated Mk version from that time, located in Schönhagen in Germany, Porep in Germany, Magallon in Spain, Wallenhorst in Germany and Trelleborg in Sweden. The measurements have been performed by external institute or performed internally by Vestas.

The individual results can be found in the following noise reports:

958475	Acoustical Emission – V90-2.0 MW-VCS-50 Hz-Mode 0, report WT4128/05
958478	Acoustical Emission – V90-2.0 MW-VCS-50 Hz-Mode 1, report WT4142/05
961263	Acoustical Emission – V90-2.0 MW-VCS-50 Hz-Mode 0, report WT4848/06
961251	Acoustical Emission – V90-1.8 MW-VCS-50 Hz-Mode 0, report WT4282/05
961266	Acoustical Emission – V90-2.0 MW-VCS-50 Hz-Mode 1, report WT4862/06
958481	Acoustical Emission – V90-2.0 MW-VCS-50 Hz-Mode 2, report WT4146/05
0007-9881	Internal Noise Summary – V90-1.8/2.0 MW-VCS-50 Hz
0019-8129	Noise Emission – V90-2MW-Mk 7-Mode 0 – DANAK 2803
0019-8130	Noise Emission – V90-2MW-Mk 7-Mode 2 – DANAK 2804

2.3 Procedure

The evaluation of the 1/3 octaves spectrum, as a function of integer wind speeds in 10 m height (or corresponding power), is for hub height 80 m or hub height 105 m given in the individual noise reports (see 2.2 Data Collection, p. 3).

From these noise reports, the 1/3 octaves spectrum is calculated into 1/1 octave spectra for each integer wind speed, and for each integer wind speed a corresponding power value is calculated.

Each octave result for all the individual 1/1 octaves is then plotted against power, corresponding to the integer wind speeds, and a fourth order regression is used to determine values for different power values (similar to how the standard treats overall noise). Values are only calculated inside the range of where measured data exist; no extrapolation is used.

The integer wind speed in 10 m height is converted into wind speed in hub height using the hub height and the wind shear values corresponding to the roughness length 0.05 m (from standard). Those wind speeds are then transformed into power values using the respective power curves, and for each of the power values a corresponding octave value is found by using the above regression in all the individual octaves.

The 1/1 octave spectra are corrected to general specification level by adding the difference between the general specification value and the total spectrum value.

There are no measurement results for Mode 3, only an estimate of the range where Mode 3 operation is identical to Mode 0.

3 Results

All the evaluated 1/1 octave spectra corresponding to general specification level are given for each wind speed, mode, and hub height in 4 Appendix A, p. 5 through 10 Appendix , p. 23.

- V90-2.0 MW-VCS-50 Hz-Mode 0
- V90-2.0 MW-VCS-50 Hz-Mode 1
- V90-2.0 MW-VCS-50 Hz-Mode 2
- V90-2.0 MW-VCS-50 Hz-Mode 3

- V90-1.8 MW-VCS-50 Hz-Mode 0
- V90-1.8 MW-VCS-50 Hz-Mode 1
- V90-1.8 MW-VCS-50 Hz-Mode 2
- V90-1.8 MW-VCS-50 Hz-Mode 3

4 Appendix A**4.1 V90-2.0 MW-VCS-50 Hz-Mode 0****4.1.1 Sound Power Levels (according to 0004-6207 V09)**

Sound Power Level at Hub Height: Mode 0				
Conditions for Sound Power Level:	Measurement standard IEC 61400-11 ed. 2 2002			
	Wind shear: 0.16.			
	Max. turbulence at 10 metre height: 16%			
	Inflow angle (vertical): 0 ± 2°			
	Air density: 1.225 kg/m³			
Hub height [m]	80	95	105	125
L _{WA} @ 3 m/s (10 m above ground) [dBA]	92.6	92.8	92.9	93.0
Wind speed at hh [m/sec]	4.2	4.3	4.4	4.5
L _{WA} @ 4 m/s (10 m above ground) [dBA]	95.6	96.1	96.4	96.9
Wind speed at hh [m/sec]	5.6	5.7	5.8	6.0
L _{WA} @ 5 m/s (10 m above ground) [dBA]	99.8	100.3	100.6	101.2
Wind speed at hh [m/sec]	7.0	7.2	7.3	7.5
L _{WA} @ 6 m/s (10 m above ground) [dBA]	102.8	103.0	103.1	103.3
Wind speed at hh [m/sec]	8.4	8.6	8.7	9.0
L _{WA} @ 7 m/s (10 m above ground) [dBA]	103.7	103.8	103.8	103.8
Wind speed at hh [m/sec]	9.8	10.0	10.2	10.5
L _{WA} @ 8 m/s (10 m above ground) [dBA]	104.0	104.0	104.0	104.0
Wind speed at hh [m/sec]	11.2	11.5	11.7	12.0
L _{WA} @ 9 m/s (10 m above ground) [dBA]	104.0	104.0	104.0	104.0
Wind speed at hh [m/sec]	12.6	12.9	13.1	13.5
L _{WA} @ 10 m/s (10 m above ground) [dBA]	104.0	104.0	104.0	104.0
Wind speed at hh [m/sec]	13.9	14.3	14.6	15.0
L _{WA} @ 11 m/s (10 m above ground) [dBA]	104.0	104.0	104.0	104.0
Wind speed at hh [m/sec]	15.3	15.8	16.0	16.5
L _{WA} @ 12 m/s (10 m above ground) [dBA]	104.0	104.0	104.0	104.0
Wind speed at hh [m/sec]	16.7	17.2	17.5	18.0
L _{WA} @ 13 m/s (10 m above ground) [dBA]	104.0	104.0	104.0	104.0
Wind speed at hh [m/sec]	18.1	18.6	18.9	19.5

Table 4-1: Sound power levels V90-2.0 MW-VCS-50 Hz-Mode 0.

4.1.2 1/1 Octaves

V90-2.0 MW-VCS-50 Hz-Mode 0 – Hub Height 80 m											
Wind speed 10 m	3	4	5	6	7	8	9	10	11	12	13
Power [kW]	108.5	293.1	587.5	1023.5	1518.0	1903.1	1994.4	2000.0	2000.0	2000.0	2000.0
1/1 octaves	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA
[Hz]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]
16	44.5	50.2	55.7	58.6	60.9	62.9	63.0	63.0			
31.5	58.8	63.2	69.3	74.2	76.0	77.1	77.5	77.5			
63	71.7	75.5	79.6	82.3	84.4	86.0	86.0	86.0			
125	76.2	79.8	84.5	88.1	89.9	90.3	90.1	90.1			
250	82.6	85.5	89.5	92.6	93.7	94.2	94.3	94.3			
500	86.4	88.8	92.7	95.8	96.7	97.5	97.9	97.9			
1000	87.7	90.1	94.1	97.4	98.3	98.0	97.8	97.8			
2000	85.9	89.5	93.9	96.5	97.1	97.5	97.5	97.5			
4000	82.0	86.5	91.2	93.8	94.7	94.9	94.6	94.6			
8000	69.7	74.2	79.1	82.3	84.2	83.4	82.3	82.2			
Spectra value	92.6	95.6	99.8	102.8	103.7	104.0	104.0	104.0			

Table 4-2: Octaves for V90-2.0 MW-VCS-50 Hz-Mode 0, hub height = 80 m.

V90-2.0 MW-VCS-50 Hz-Mode 0 – Hub Height 95 m											
Wind speed 10 m	3	4	5	6	7	8	9	10	11	12	13
Power [kW]	120.9	320.7	641.8	1105.2	1609.9	1946.7	1997.2	2000.0	2000.0	2000.0	2000.0
1/1 octaves	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA
[Hz]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]
16	44.9	51.0	56.2	58.8	61.5	63.0	63.0	63.0			
31.5	59.1	63.9	70.1	74.6	76.2	77.3	77.5	77.5			
63	71.9	76.0	80.0	82.5	84.9	86.0	86.0	86.0			
125	76.4	80.4	85.0	88.5	90.1	90.2	90.1	90.1			
250	82.8	86.0	90.0	92.8	93.8	94.2	94.3	94.3			
500	86.6	89.2	93.2	96.0	96.8	97.7	97.9	97.9			
1000	87.8	90.6	94.6	97.7	98.3	97.9	97.8	97.8			
2000	86.1	90.0	94.4	96.6	97.2	97.5	97.5	97.5			
4000	82.3	87.1	91.7	93.9	94.8	94.8	94.6	94.6			
8000	70.1	74.9	79.6	82.6	84.4	82.9	82.3	82.2			
Spectra value	92.8	96.1	100.3	103.0	103.8	104.0	104.0	104.0			

Table 4-3: Octaves for V90-2.0 MW-VCS-50 Hz-Mode 0, hub height = 95 m.

V90-2.0 MW-VCS-50 Hz-Mode 0 – Hub Height 105 m											
Wind speed 10 m	3	4	5	6	7	8	9	10	11	12	13
Power [kW]	128.3	337.2	674.6	1154.7	1659.8	1960.3	1998.4	2000.0	2000.0	2000.0	2000.0
1/1 octaves	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA
[Hz]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]
16	45.2	51.4	56.5	59.0	61.8	63.0	63.0	63.0			
31.5	59.3	64.3	70.6	74.8	76.3	77.3	77.5	77.5			
63	72.1	76.3	80.3	82.7	85.1	86.0	86.0	86.0			
125	76.6	80.7	85.4	88.6	90.2	90.2	90.1	90.1			
250	82.9	86.2	90.3	92.9	93.9	94.3	94.3	94.3			
500	86.6	89.5	93.5	96.1	96.9	97.8	97.9	97.9			
1000	87.9	90.8	94.9	97.8	98.3	97.9	97.8	97.8			
2000	86.3	90.4	94.7	96.7	97.2	97.5	97.5	97.5			
4000	82.5	87.5	92.0	94.0	94.9	94.8	94.6	94.6			
8000	70.3	75.2	79.9	82.8	84.3	82.8	82.3	82.2			
Spectra value	92.9	96.4	100.6	103.1	103.8	104.0	104.0	104.0			

Table 4-4: Octaves for V90-2.0 MW-VCS-50 Hz-Mode 0, hub height = 105 m.

V90-2.0 MW-VCS-50 Hz-Mode 0 – Hub Height 125 m											
Wind speed 10 m	3	4	5	6	7	8	9	10	11	12	13
Power [kW]	141.4	366.6	733.1	1242.7	1748.6	1980.0	1999.9	2000.0	2000.0	2000.0	2000.0
1/1 octaves	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA
[Hz]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]
16	45.5	52.1	57.1	59.4	62.2	63.0	63.0	63.0			
31.5	59.5	65.0	71.5	75.2	76.4	77.4	77.5	77.5			
63	72.3	76.8	80.8	83.1	85.4	86.0	86.0	86.0			
125	76.7	81.2	86.1	89.0	90.2	90.1	90.1	90.1			
250	83.0	86.7	90.9	93.1	93.9	94.3	94.3	94.3			
500	86.7	89.9	94.1	96.3	97.0	97.9	97.9	97.9			
1000	88.0	91.3	95.6	98.0	98.1	97.9	97.8	97.8			
2000	86.4	90.9	95.2	96.8	97.2	97.5	97.5	97.5			
4000	82.8	88.1	92.5	94.2	94.9	94.7	94.6	94.6			
8000	70.5	75.8	80.5	83.2	84.2	82.5	82.2	82.2			
Spectra value	93.0	96.9	101.2	103.3	103.8	104.0	104.0	104.0			

Table 4-5: Octaves for V90-2.0 MW-VCS-50 Hz-Mode 0, hub height = 125 m.

5 Appendix B**5.1 V90-2.0 MW-VCS-50 Hz-Mode 1****5.1.1 Sound Power Levels (according to 0004-6207 V09)**

Sound Power Level at Hub Height: Mode 1				
Conditions for Sound Power Level:	Measurement standard IEC 61400-11 ed. 2 2002			
	Wind shear: 0.16			
	Max. turbulence at 10 metre height: 16%			
	Inflow angle (vertical): 0 ± 2°			
	Air density: 1.225 kg/m³			
Hub height [m]	80	95	105	125
L_{WA} @ 3 m/s (10 m above ground) [dBA]	92.6	92.8	92.9	93.0
Wind speed at hh [m/sec]	4.2	4.3	4.4	4.5
L_{WA} @ 4 m/s (10 m above ground) [dBA]	95.6	96.1	96.4	96.9
Wind speed at hh [m/sec]	5.6	5.7	5.8	6.0
L_{WA} @ 5 m/s (10 m above ground) [dBA]	99.8	100.3	100.6	101.1
Wind speed at hh [m/sec]	7.0	7.2	7.3	7.5
L_{WA} @ 6 m/s (10 m above ground) [dBA]	102.7	102.9	103.0	103.0
Wind speed at hh [m/sec]	8.4	8.6	8.7	9.0
L_{WA} @ 7 m/s (10 m above ground) [dBA]	103.0	103.0	103.0	103.0
Wind speed at hh [m/sec]	9.8	10.0	10.2	10.5
L_{WA} @ 8 m/s (10 m above ground) [dBA]	103.0	103.0	103.0	103.0
Wind speed at hh [m/sec]	11.2	11.5	11.7	12.0
L_{WA} @ 9 m/s (10 m above ground) [dBA]	103.0	103.0	103.0	103.0
Wind speed at hh [m/sec]	12.6	12.9	13.1	13.5
L_{WA} @ 10 m/s (10 m above ground) [dBA]	103.0	103.0	103.0	103.0
Wind speed at hh [m/sec]	13.9	14.3	14.6	15.0
L_{WA} @ 11 m/s (10 m above ground) [dBA]	103.0	103.0	103.0	103.0
Wind speed at hh [m/sec]	15.3	15.8	16.0	16.5
L_{WA} @ 12 m/s (10 m above ground) [dBA]	103.0	103.0	103.0	103.0
Wind speed at hh [m/sec]	16.7	17.2	17.5	18.0
L_{WA} @ 13 m/s (10 m above ground) [dBA]	103.0	103.0	103.0	103.0
Wind speed at hh [m/sec]	18.1	18.6	18.9	19.5

Table 5-1: Sound power levels V90-2.0 MW-VCS-50 Hz-Mode 1.

5.1.2 1/1 Octaves

V90-2.0 MW-VCS-50 Hz-Mode 1 – Hub Height 80 m											
Wind speed 10 m	3	4	5	6	7	8	9	10	11	12	13
Power [kW]	108.5	292.1	587.5	1018.8	1485.2	1869.2	1989.7	1999.9	2000.0	2000.0	2000.0
1/1 octaves	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA
[Hz]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]
16	44.1	50.9	56.0	57.8	60.8	64.4	64.6	64.6	64.6		
31.5	58.7	63.5	69.7	74.0	75.0	76.2	77.1	77.1	77.1		
63	71.9	75.0	79.2	82.8	84.5	85.5	85.5	85.5	85.5		
125	76.2	79.8	84.6	88.5	90.0	90.9	90.9	90.9	90.9		
250	82.4	85.7	89.8	92.4	93.2	93.7	93.7	93.6	93.6		
500	86.3	89.0	92.8	95.5	96.0	96.0	95.9	95.9	95.9		
1000	87.7	90.1	94.2	97.5	97.8	97.3	97.2	97.2	97.2		
2000	86.0	89.3	93.7	96.4	96.3	96.5	96.7	96.7	96.7		
4000	82.2	86.2	91.0	93.6	93.3	93.2	93.3	93.3	93.3		
8000	69.7	74.4	79.6	82.2	81.6	79.8	78.8	78.7	78.7		
Spectra value	92.6	95.6	99.8	102.7	103.0	103.0	103.0	103.0	103.0		

Table 5-2: Octaves for V90-2.0 MW-VCS-50 Hz-Mode 1, hub height = 80 m.

V90-2.0 MW-VCS-50 Hz-Mode 1 – Hub Height 95 m											
Wind speed 10 m	3	4	5	6	7	8	9	10	11	12	13
Power [kW]	120.9	319.7	641.8	1097.6	1571.5	1922.7	1994.6	2000.0	2000.0	2000.0	2000.0
1/1 octaves	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA
[Hz]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]
16	44.7	51.7	56.4	58.1	61.7	64.6	64.6	64.6			
31.5	59.0	64.2	70.5	74.3	75.1	76.6	77.1	77.1			
63	72.1	75.5	79.8	83.2	84.8	85.5	85.5	85.5			
125	76.4	80.4	85.2	88.9	90.3	90.9	90.9	90.9			
250	82.7	86.2	90.2	92.6	93.4	93.7	93.6	93.6			
500	86.5	89.5	93.3	95.7	96.0	96.0	95.9	95.9			
1000	87.8	90.6	94.8	97.8	97.7	97.2	97.2	97.2			
2000	86.2	89.9	94.2	96.5	96.3	96.5	96.7	96.7			
4000	82.5	86.8	91.5	93.7	93.3	93.2	93.3	93.3			
8000	70.1	75.0	80.1	82.3	81.3	79.4	78.8	78.7			
Spectra value	92.8	96.1	100.3	102.9	103.0	103.0	103.0	103.0			

Table 5-3: Octaves for V90-2.0 MW-VCS-50 Hz-Mode 1, hub height = 95 m.

V90-2.0 MW-VCS-50 Hz-Mode 1 – Hub Height 105 m											
Wind speed 10 m	3	4	5	6	7	8	9	10	11	12	13
Power [kW]	128.3	336.2	674.6	1144.8	1619.8	1941.3	1996.7	2000.0	2000.0	2000.0	2000.0
1/1 octaves	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA
[Hz]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]
16	45.0	52.1	56.5	58.3	62.2	64.6	64.6	64.6			
31.5	59.2	64.7	70.9	74.5	75.2	76.7	77.1	77.1			
63	72.3	75.8	80.1	83.4	85.0	85.5	85.5	85.5			
125	76.6	80.7	85.6	89.1	90.4	90.9	90.9	90.9			
250	82.8	86.5	90.5	92.8	93.5	93.7	93.6	93.6			
500	86.6	89.7	93.5	95.8	96.0	96.0	95.9	95.9			
1000	87.9	90.9	95.1	97.9	97.6	97.2	97.2	97.2			
2000	86.3	90.2	94.5	96.6	96.3	96.6	96.7	96.7			
4000	82.6	87.2	91.8	93.7	93.2	93.2	93.3	93.3			
8000	70.3	75.4	80.4	82.3	81.1	79.3	78.8	78.7			
Spectra value	92.9	96.4	100.6	103.0	103.0	103.0	103.0	103.0			

Table 5-4: Octaves for V90-2.0 MW-VCS-50 Hz-Mode 1, hub height = 105 m.

V90-2.0 MW-VCS-50 Hz-Mode 1 – Hub Height 125 m											
Wind speed 10 m	3	4	5	6	7	8	9	10	11	12	13
Power [kW]	141.4	365.6	733.1	1228.9	1705.8	1969.6	1998.9	2000.0	2000.0	2000.0	2000.0
1/1 octaves	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA
[Hz]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]
16	45.5	52.9	56.8	58.7	63.1	64.6	64.6	64.6			
31.5	59.5	65.4	71.7	74.6	75.5	76.9	77.1	77.1			
63	72.4	76.3	80.6	83.7	85.2	85.5	85.5	85.5			
125	76.7	81.3	86.2	89.3	90.6	90.9	90.9	90.9			
250	82.9	87.0	90.9	92.8	93.6	93.7	93.6	93.6			
500	86.6	90.2	94.0	95.8	96.1	95.9	95.9	95.9			
1000	88.0	91.3	95.6	97.9	97.5	97.2	97.2	97.2			
2000	86.5	90.7	94.9	96.5	96.3	96.6	96.7	96.7			
4000	82.8	87.7	92.3	93.6	93.2	93.3	93.3	93.3			
8000	70.5	76.1	80.9	82.2	80.7	79.0	78.7	78.7			
Spectra value	93.0	96.9	101.1	103.0	103.0	103.0	103.0	103.0			

Table 5-5: Octaves for V90-2.0 MW-VCS-50 Hz-Mode 1, hub height = 125 m.

6 Appendix C**6.1 V90-2.0 MW-VCS-50 Hz-Mode 2****6.1.1 Sound Power Levels (according to 0004-6207 V09)**

Sound Power Level at Hub Height: Mode 2				
Conditions for Sound Power Level:	Measurement standard IEC 61400-11 ed. 2 2002			
	Wind shear: 0.16			
	Max. turbulence at 10 metre height: 16%			
	Inflow angle (vertical): 0 ± 2°			
	Air density: 1.225 kg/m³			
Hub height [m]	80	95	105	125
L_{WA} @ 3 m/s (10 m above ground) [dBA]	92.6	92.8	92.9	93.0
Wind speed at hh [m/sec]	4.2	4.3	4.4	4.5
L_{WA} @ 4 m/s (10 m above ground) [dBA]	95.6	96.1	96.4	96.9
Wind speed at hh [m/sec]	5.6	5.7	5.8	6.0
L_{WA} @ 5 m/s (10 m above ground) [dBA]	99.8	100.1	100.2	100.5
Wind speed at hh [m/sec]	7.0	7.2	7.3	7.5
L_{WA} @ 6 m/s (10 m above ground) [dBA]	101.0	101.0	101.0	101.0
Wind speed at hh [m/sec]	8.4	8.6	8.7	9.0
L_{WA} @ 7 m/s (10 m above ground) [dBA]	101.0	101.0	101.0	101.0
Wind speed at hh [m/sec]	9.8	10.0	10.2	10.5
L_{WA} @ 8 m/s (10 m above ground) [dBA]	101.0	101.0	101.0	101.0
Wind speed at hh [m/sec]	11.2	11.5	11.7	12.0
L_{WA} @ 9 m/s (10 m above ground) [dBA]	101.0	101.0	101.0	101.0
Wind speed at hh [m/sec]	12.6	12.9	13.1	13.5
L_{WA} @ 10 m/s (10 m above ground) [dBA]	101.0	101.0	101.0	101.0
Wind speed at hh [m/sec]	13.9	14.3	14.6	15.0
L_{WA} @ 11 m/s (10 m above ground) [dBA]	101.0	101.0	101.0	101.0
Wind speed at hh [m/sec]	15.3	15.8	16.0	16.5
L_{WA} @ 12 m/s (10 m above ground) [dBA]	101.0	101.0	101.0	101.0
Wind speed at hh [m/sec]	16.7	17.2	17.5	18.0
L_{WA} @ 13 m/s (10 m above ground) [dBA]	101.0	101.0	101.0	101.0
Wind speed at hh [m/sec]	18.1	18.6	18.9	19.5

Table 6-1: Sound power levels V90-2.0 MW-VCS-50 Hz-Mode 2.

6.1.2 1/1 Octaves

V90-2.0 MW-VCS-50 Hz-Mode 2 – Hub Height 80 m											
Wind speed 10 m	3	4	5	6	7	8	9	10	11	12	13
Power [kW]	108.5	292.2	587.5	977.2	1351.9	1695.5	1902.0	1953.8	1977.8	1993.4	1999.3
1/1 octaves	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA
[Hz]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]
16	44.4	50.5	56.6	57.9	58.1	59.7	61.2	61.6	61.8	62.0	62.0
31.5	58.9	63.2	69.7	73.9	75.9	76.3	75.8	75.5	75.4	75.3	75.2
63	71.8	75.3	80.0	81.7	82.3	83.2	83.9	84.1	84.2	84.2	84.2
125	76.2	79.7	84.6	86.7	87.5	88.2	88.4	88.4	88.4	88.4	88.4
250	82.4	85.7	89.9	90.9	90.8	91.0	91.1	91.2	91.2	91.2	91.2
500	86.3	88.9	92.8	94.0	94.1	94.0	93.9	93.9	93.9	93.9	93.8
1000	87.7	90.1	94.0	95.2	95.0	94.8	94.8	94.9	94.9	94.9	95.0
2000	85.9	89.4	93.9	95.1	95.2	95.4	95.4	95.3	95.3	95.2	95.2
4000	82.2	86.2	91.0	92.0	91.6	91.4	91.4	91.4	91.4	91.4	91.4
8000	69.9	74.1	78.6	78.9	78.2	77.3	76.2	75.8	75.6	75.4	75.4
Spectra value	92.6	95.6	99.8	101.0	101.0	101.0	101.0	101.0	101.0	101.0	101.0

Table 6-2: Octaves for V90-2.0 MW-VCS-50 Hz-Mode 2, hub height = 80 m.

V90-2.0 MW-VCS-50 Hz-Mode 2 – Hub Height 95 m											
Wind speed 10 m	3	4	5	6	7	8	9	10	11	12	13
Power [kW]	120.9	320.2	640.4	1041.7	1421.9	1761.4	1921.6	1960.4	1983.8	1996.2	2000.0
1/1 octaves	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA
[Hz]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]
16	44.9	51.3	57.0	57.8	58.3	60.1	61.4	61.7	61.9	62.0	62.0
31.5	59.2	63.9	70.4	74.3	76.1	76.2	75.7	75.5	75.3	75.3	75.2
63	72.0	75.8	80.3	81.8	82.4	83.4	83.9	84.1	84.2	84.2	84.2
125	76.5	80.3	85.0	86.9	87.7	88.2	88.4	88.4	88.4	88.4	88.4
250	82.7	86.2	90.2	90.8	90.9	91.1	91.1	91.2	91.2	91.2	91.2
500	86.5	89.4	93.1	94.0	94.1	94.0	93.9	93.9	93.9	93.8	93.8
1000	87.9	90.5	94.3	95.2	95.0	94.7	94.8	94.9	94.9	94.9	95.0
2000	86.2	90.0	94.2	95.1	95.3	95.4	95.3	95.3	95.2	95.2	95.2
4000	82.5	86.8	91.3	91.9	91.5	91.4	91.4	91.4	91.4	91.4	91.4
8000	70.2	74.7	78.8	78.8	78.0	77.0	76.0	75.7	75.5	75.4	75.3
Spectra value	92.8	96.1	100.1	101.0	101.0	101.0	101.0	101.0	101.0	101.0	101.0

Table 6-3: Octaves for V90-2.0 MW-VCS-50 Hz-Mode 2, hub height = 95 m.

V90-2.0 MW-VCS-50 Hz-Mode 2 – Hub Height 105 m											
Wind speed 10 m	3	4	5	6	7	8	9	10	11	12	13
Power [kW]	128.3	336.9	672.3	1079.4	1462.7	1793.0	1930.8	1964.4	1987.2	1997.9	2000.0
1/1 octaves	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA
[Hz]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]
16	45.1	51.8	57.1	57.8	58.4	60.3	61.4	61.7	61.9	62.0	62.0
31.5	59.3	64.3	70.7	74.5	76.2	76.2	75.6	75.4	75.3	75.2	75.2
63	72.2	76.2	80.5	81.8	82.5	83.5	84.0	84.1	84.2	84.2	84.2
125	76.6	80.7	85.2	86.9	87.8	88.3	88.4	88.4	88.4	88.4	88.4
250	82.8	86.6	90.2	90.8	90.9	91.1	91.1	91.2	91.2	91.2	91.2
500	86.6	89.7	93.2	94.1	94.1	93.9	93.9	93.9	93.9	93.8	93.8
1000	87.9	90.8	94.4	95.2	94.9	94.7	94.8	94.9	94.9	95.0	95.0
2000	86.3	90.3	94.3	95.1	95.3	95.4	95.3	95.3	95.2	95.2	95.2
4000	82.6	87.2	91.4	91.9	91.5	91.4	91.4	91.4	91.4	91.4	91.4
8000	70.4	75.1	78.8	78.7	77.9	76.9	76.0	75.7	75.5	75.4	75.3
Spectra value	92.9	96.4	100.2	101.0	101.0	101.0	101.0	101.0	101.0	101.0	101.0

Table 6-4: Octaves for V90-2.0 MW-VCS-50 Hz-Mode 2, hub height = 105 m.

V90-2.0 MW-VCS-50 Hz-Mode 2 – Hub Height 125 m											
Wind speed 10 m	3	4	5	6	7	8	9	10	11	12	13
Power [kW]	141.4	366.5	729.2	1146.7	1535.4	1846.4	1943.4	1972.6	1991.8	1999.0	2000.0
1/1 octaves	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA
[Hz]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]
16	45.5	52.6	57.5	57.8	58.7	60.8	61.6	61.8	62.0	62.0	62.0
31.5	59.5	65.0	71.5	74.9	76.3	76.0	75.6	75.4	75.3	75.2	75.2
63	72.3	76.7	80.8	81.9	82.7	83.7	84.0	84.1	84.2	84.2	84.2
125	76.7	81.2	85.6	87.1	87.9	88.3	88.4	88.4	88.4	88.4	88.4
250	82.9	87.1	90.5	90.8	90.9	91.1	91.2	91.2	91.2	91.2	91.2
500	86.6	90.1	93.5	94.1	94.0	93.9	93.9	93.9	93.9	93.8	93.8
1000	88.0	91.2	94.7	95.2	94.9	94.7	94.8	94.9	94.9	95.0	95.0
2000	86.4	90.9	94.6	95.1	95.4	95.4	95.3	95.3	95.2	95.2	95.2
4000	82.8	87.8	91.7	91.8	91.5	91.4	91.4	91.4	91.4	91.4	91.4
8000	70.6	75.6	79.0	78.6	77.8	76.6	75.9	75.6	75.4	75.4	75.3
Spectra value	93.0	96.9	100.5	101.0	101.0	101.0	101.0	101.0	101.0	101.0	101.0

Table 6-5: Octaves for V90-2.0 MW-VCS-50 Hz-Mode 2, hub height = 125 m.

7 Appendix D**7.1 V90-2.0 MW-VCS-50 Hz-Mode 3****7.1.1 Sound Power Levels (according to 0004-6207 V09)**

Sound Power Level at Hub Height: Mode 3				
Conditions for Sound Power Level:	Measurement standard IEC 61400-11 ed. 2 2002			
	Wind shear: 0.16			
	Max. turbulence at 10 metre height: 16%			
	Inflow angle (vertical): $0 \pm 2^\circ$			
	Air density: 1.225 kg/m³			
Hub height [m]	80	95	105	125
L_{WA} @ 3 m/s (10 m above ground) [dBA]	92.5	92.5	92.6	92.7
Wind speed at hh [m/sec]	4.2	4.3	4.4	4.5
L_{WA} @ 4 m/s (10 m above ground) [dBA]	94.6	95.0	95.3	95.7
Wind speed at hh [m/sec]	5.6	5.7	5.8	6.0
L_{WA} @ 5 m/s (10 m above ground) [dBA]	98.8	99.3	99.6	100.1
Wind speed at hh [m/sec]	7.0	7.2	7.3	7.5
L_{WA} @ 6 m/s (10 m above ground) [dBA]	101.8	102.0	102.1	102.3
Wind speed at hh [m/sec]	8.4	8.6	8.7	9.0
L_{WA} @ 7 m/s (10 m above ground) [dBA]	103.5	103.8	103.8	103.8
Wind speed at hh [m/sec]	9.8	10.0	10.2	10.5
L_{WA} @ 8 m/s (10 m above ground) [dBA]	103.6	104.0	104.0	104.0
Wind speed at hh [m/sec]	11.2	11.5	11.7	12.0
L_{WA} @ 9 m/s (10 m above ground) [dBA]	104.0	104.0	104.0	104.0
Wind speed at hh [m/sec]	12.6	12.9	13.1	13.5
L_{WA} @ 10 m/s (10 m above ground) [dBA]	104.0	104.0	104.0	104.0
Wind speed at hh [m/sec]	13.9	14.3	14.6	15.0
L_{WA} @ 11 m/s (10 m above ground) [dBA]	104.0	104.0	104.0	104.0
Wind speed at hh [m/sec]	15.3	15.8	16.0	16.5
L_{WA} @ 12 m/s (10 m above ground) [dBA]	104.0	104.0	104.0	104.0
Wind speed at hh [m/sec]	16.7	17.2	17.5	18.0
L_{WA} @ 13 m/s (10 m above ground) [dBA]	104.0	104.0	104.0	104.0
Wind speed at hh [m/sec]	18.1	18.6	18.9	19.5

Table 7-1: Sound power levels V90-2.0 MW-VCS-50 Hz-Mode 3.

7.1.2 1/1 Octaves

V90-2.0 MW-VCS-50 Hz-Mode 3 – Hub Height 80 m											
Wind speed 10 m	3	4	5	6	7	8	9	10	11	12	13
Power [kW]	108.5	289.7	584.6	1005.6	1499.7	1899.1	1993.5	2000.0	2000.0	2000.0	2000.0
1/1 octaves	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA
[Hz]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]
16						62.5	63.0	63.0			
31.5						76.7	77.5	77.5			
63						85.6	86.0	86.0			
125						89.9	90.1	90.1			
250						93.8	94.3	94.3			
500						97.1	97.9	97.9			
1000						97.7	97.8	97.8			
2000						97.1	97.5	97.5			
4000						94.5	94.6	94.6			
8000						83.0	82.3	82.2			
Spectra value						103.6	104.0	104.0			

Table 7-2: Octaves for V90-2.0 MW-VCS-50 Hz-Mode 3, hub height = 80 m.

V90-2.0 MW-VCS-50 Hz-Mode 3 – Hub Height 95 m											
Wind speed 10 m	3	4	5	6	7	8	9	10	11	12	13
Power [kW]	120.9	316.8	637.7	1084.6	1594.3	1944.5	1997.0	2000.0	2000.0	2000.0	2000.0
1/1 octaves	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA
[Hz]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]
16						63.0	63.0	63.0			
31.5						77.3	77.5	77.5			
63						86.0	86.0	86.0			
125						90.2	90.1	90.1			
250						94.2	94.3	94.3			
500						97.7	97.9	97.9			
1000						98.0	97.8	97.8			
2000						97.5	97.5	97.5			
4000						94.8	94.6	94.6			
8000						83.0	82.3	82.2			
Spectra value						104.0	104.0	104.0			

Table 7-3: Octaves for V90-2.0 MW-VCS-50 Hz-Mode 3, hub height = 95 m.

V90-2.0 MW-VCS-50 Hz-Mode 3 – Hub Height 105 m											
Wind speed 10 m	3	4	5	6	7	8	9	10	11	12	13
Power [kW]	128.3	332.9	669.9	1133.2	1646.2	1958.6	1998.4	2000.0	2000.0	2000.0	2000.0
1/1 octaves	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA
[Hz]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]
16						63.0	63.0	63.0			
31.5						77.3	77.5	77.5			
63						86.0	86.0	86.0			
125						90.2	90.1	90.1			
250						94.3	94.3	94.3			
500						97.8	97.9	97.9			
1000						97.9	97.8	97.8			
2000						97.5	97.5	97.5			
4000						94.8	94.6	94.6			
8000						82.8	82.3	82.2			
Spectra value						104.0	104.0	104.0			

Table 7-4: Octaves for V90-2.0 MW-VCS-50 Hz-Mode 3, hub height = 105 m.

V90-2.0 MW-VCS-50 Hz-Mode 3 – Hub Height 125 m											
Wind speed 10 m	3	4	5	6	7	8	9	10	11	12	13
Power [kW]	141.4	361.6	727.2	1219.8	1738.5	1979.0	1999.9	2000.0	2000.0	2000.0	2000.0
1/1 octaves	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA
[Hz]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]
16						63.0	63.0	63.0			
31.5						77.4	77.5	77.5			
63						86.0	86.0	86.0			
125						90.1	90.1	90.1			
250						94.3	94.3	94.3			
500						97.8	97.9	97.9			
1000						97.9	97.8	97.8			
2000						97.5	97.5	97.5			
4000						94.7	94.6	94.6			
8000						82.5	82.2	82.2			
Spectra value						104.0	104.0	104.0			

Table 7-5: Octaves for V90-2.0 MW-VCS-50 Hz-Mode 3, hub height = 125 m.

8 Appendix E**8.1 V90-1.8 MW-VCS-50 Hz-Mode 0****8.1.1 Sound Power Levels (according to 0004-6207 V09)**

Sound Power Level at Hub Height: Mode 0				
Conditions for Sound Power Level:	Measurement standard IEC 61400-11 ed. 2 2002			
	Wind shear: 0.16			
	Max. turbulence at 10 metre height: 16%			
	Inflow angle (vertical): 0 ± 2°			
	Air density: 1.225 kg/m³			
Hub height [m]	80	95	105	
L_{WA} @ 3 m/s (10 m above ground) [dBA]	92.6	92.8	92.9	
Wind speed at hh [m/sec]	4.2	4.3	4.4	
L_{WA} @ 4 m/s (10 m above ground) [dBA]	95.6	96.1	96.4	
Wind speed at hh [m/sec]	5.6	5.7	5.8	
L_{WA} @ 5 m/s (10 m above ground) [dBA]	99.8	100.3	100.6	
Wind speed at hh [m/sec]	7.0	7.2	7.3	
L_{WA} @ 6 m/s (10 m above ground) [dBA]	102.8	103.0	103.1	
Wind speed at hh [m/sec]	8.4	8.6	8.7	
L_{WA} @ 7 m/s (10 m above ground) [dBA]	103.7	103.8	103.8	
Wind speed at hh [m/sec]	9.8	10.0	10.2	
L_{WA} @ 8 m/s (10 m above ground) [dBA]	104.0	104.0	104.0	
Wind speed at hh [m/sec]	11.2	11.5	11.7	
L_{WA} @ 9 m/s (10 m above ground) [dBA]	104.0	104.0	104.0	
Wind speed at hh [m/sec]	12.6	12.9	13.1	
L_{WA} @ 10 m/s (10 m above ground) [dBA]	104.0	104.0	104.0	
Wind speed at hh [m/sec]	13.9	14.3	14.6	
L_{WA} @ 11 m/s (10 m above ground) [dBA]	104.0	104.0	104.0	
Wind speed at hh [m/sec]	15.3	15.8	16.0	
L_{WA} @ 12 m/s (10 m above ground) [dBA]	104.0	104.0	104.0	
Wind speed at hh [m/sec]	16.7	17.2	17.5	
L_{WA} @ 13 m/s (10 m above ground) [dBA]	104.0	104.0	104.0	
Wind speed at hh [m/sec]	18.1	18.6	18.9	

Table 8-1: Sound power levels V90-1.8 MW-VCS-50 Hz-Mode 0.

8.1.2 1/1 Octaves

V90-1.8 MW-VCS-50 Hz-Mode 0 – Hub Height 80 m											
Wind speed 10 m	3	4	5	6	7	8	9	10	11	12	13
Power [kW]	108.5	293.1	587.5	1023.5	1504.6	1772.0	1799.1	1800.0	1800.0	1800.0	1800.0
1/1 octaves	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA
[Hz]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]
16	44.5	50.2	55.7	58.6	60.9	62.5	62.6	62.6			
31.5	58.8	63.2	69.3	74.2	76.0	76.7	76.8	76.8			
63	71.7	75.5	79.6	82.3	84.4	85.7	85.8	85.8			
125	76.2	79.8	84.5	88.1	89.9	90.4	90.4	90.4			
250	82.6	85.5	89.5	92.6	93.7	94.1	94.2	94.2			
500	86.4	88.8	92.7	95.8	96.7	97.2	97.3	97.3			
1000	87.7	90.1	94.1	97.4	98.4	98.3	98.2	98.2			
2000	85.9	89.5	93.9	96.5	97.1	97.4	97.4	97.4			
4000	82.0	86.5	91.2	93.8	94.7	95.1	95.1	95.1			
8000	69.7	74.2	79.1	82.3	84.2	84.3	84.1	84.1			
Spectra value	92.6	95.6	99.8	102.8	103.7	104.0	104.0	104.0			

Table 8-2: Octaves for V90-1.8 MW-VCS-50 Hz-Mode 0, hub height = 80 m.

V90-1.8 MW-VCS-50 Hz-Mode 0 – Hub Height 95 m											
Wind speed 10 m	3	4	5	6	7	8	9	10	11	12	13
Power [kW]	120.9	320.7	641.8	1105.2	1585.9	1785.6	1799.8	1800.0	1800.0	1800.0	1800.0
1/1 octaves	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA
[Hz]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]
16	44.9	51.0	56.2	58.8	61.4	62.6	62.6	62.6			
31.5	59.1	63.9	70.1	74.6	76.2	76.7	76.8	76.8			
63	71.9	76.0	80.0	82.5	84.8	85.7	85.8	85.8			
125	76.4	80.4	85.0	88.5	90.1	90.4	90.4	90.4			
250	82.8	86.0	90.0	92.8	93.8	94.1	94.2	94.2			
500	86.6	89.2	93.2	96.0	96.8	97.2	97.3	97.3			
1000	87.8	90.6	94.6	97.7	98.4	98.3	98.2	98.2			
2000	86.1	90.0	94.4	96.6	97.2	97.4	97.4	97.4			
4000	82.3	87.1	91.7	93.9	94.8	95.1	95.1	95.1			
8000	70.1	74.9	79.6	82.6	84.4	84.2	84.1	84.1			
Spectra value	92.8	96.1	100.3	103.0	103.8	104.0	104.0	104.0			

Table 8-3: Octaves for V90-1.8 MW-VCS-50 Hz-Mode 0, hub height = 95 m.

V90-1.8 MW-VCS-50 Hz-Mode 0 – Hub Height 105 m											
Wind speed 10 m	3	4	5	6	7	8	9	10	11	12	13
Power [kW]	128.3	337.2	674.6	1154.7	1621.8	1789.8	1800.0	1800.0	1800.0	1800.0	1800.0
1/1 octaves	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA
[Hz]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]
16	45.2	51.4	56.5	59.0	61.6	62.6	62.6	62.6			
31.5	59.3	64.3	70.6	74.8	76.2	76.7	76.8	76.8			
63	72.1	76.3	80.3	82.7	84.9	85.7	85.8	85.8			
125	76.6	80.7	85.4	88.6	90.1	90.4	90.4	90.4			
250	82.9	86.2	90.3	92.9	93.8	94.2	94.2	94.2			
500	86.6	89.5	93.5	96.1	96.8	97.2	97.3	97.3			
1000	87.9	90.8	94.9	97.8	98.3	98.3	98.2	98.2			
2000	86.3	90.4	94.7	96.7	97.2	97.4	97.4	97.4			
4000	82.5	87.5	92.0	94.0	94.8	95.1	95.1	95.1			
8000	70.3	75.2	79.9	82.8	84.4	84.2	84.1	84.1			
Spectra value	92.9	96.4	100.6	103.1	103.8	104.0	104.0	104.0			

Table 8-4: Octaves for V90-1.8 MW-VCS-50 Hz-Mode 0, hub height = 105 m.

9 Appendix F**9.1 V90-1.8 MW-VCS-50 Hz-Mode 1****9.1.1 Sound Power Levels (according to 0004-6207 V09)**

Sound Power Level at Hub Height: Mode 1				
Conditions for Sound Power Level:	Measurement standard IEC 61400-11 ed. 2 2002			
	Wind shear: 0.16			
	Max. turbulence at 10 metre height: 16%			
	Inflow angle (vertical): 0 ± 2°			
	Air density: 1.225 kg/m³			
Hub height [m]	80	95	105	
L_{WA} @ 3 m/s (10 m above ground) [dBA]	92.6	92.8	92.9	
Wind speed at hh [m/sec]	4.2	4.3	4.4	
L_{WA} @ 4 m/s (10 m above ground) [dBA]	95.6	96.1	96.4	
Wind speed at hh [m/sec]	5.6	5.7	5.8	
L_{WA} @ 5 m/s (10 m above ground) [dBA]	99.8	100.3	100.6	
Wind speed at hh [m/sec]	7.0	7.2	7.3	
L_{WA} @ 6 m/s (10 m above ground) [dBA]	102.7	102.9	103.0	
Wind speed at hh [m/sec]	8.4	8.6	8.7	
L_{WA} @ 7 m/s (10 m above ground) [dBA]	103.0	103.0	103.0	
Wind speed at hh [m/sec]	9.8	10.0	10.2	
L_{WA} @ 8 m/s (10 m above ground) [dBA]	103.0	103.0	103.0	
Wind speed at hh [m/sec]	11.2	11.5	11.7	
L_{WA} @ 9 m/s (10 m above ground) [dBA]	103.0	103.0	103.0	
Wind speed at hh [m/sec]	12.6	12.9	13.1	
L_{WA} @ 10 m/s (10 m above ground) [dBA]	103.0	103.0	103.0	
Wind speed at hh [m/sec]	13.9	14.3	14.6	
L_{WA} @ 11 m/s (10 m above ground) [dBA]	103.0	103.0	103.0	
Wind speed at hh [m/sec]	15.3	15.8	16.0	
L_{WA} @ 12 m/s (10 m above ground) [dBA]	103.0	103.0	103.0	
Wind speed at hh [m/sec]	16.7	17.2	17.5	
L_{WA} @ 13 m/s (10 m above ground) [dBA]	103.0	103.0	103.0	
Wind speed at hh [m/sec]	18.1	18.6	18.9	

Table 9-1: Sound power levels V90-1.8 MW-VCS-50 Hz-Mode 1.

9.1.2 1/1 Octaves

V90-1.8 MW-VCS-50 Hz-Mode 1 – Hub Height 80 m											
Wind speed 10 m	3	4	5	6	7	8	9	10	11	12	13
Power [kW]	108.5	292.1	587.5	1018.8	1478.0	1760.1	1799.1	1800.0	1800.0	1800.0	1800.0
1/1 octaves	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA
[Hz]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]
16	44.1	50.9	56.0	57.8	60.7	63.6	64.0	64.0			
31.5	58.7	63.5	69.7	74.0	74.9	75.7	75.9	75.9			
63	71.9	75.0	79.2	82.8	84.5	85.3	85.4	85.4			
125	76.2	79.8	84.6	88.5	90.0	90.7	90.8	90.8			
250	82.4	85.7	89.8	92.4	93.2	93.7	93.7	93.7			
500	86.3	89.0	92.8	95.5	96.0	96.1	96.0	96.0			
1000	87.7	90.1	94.2	97.5	97.8	97.4	97.4	97.4			
2000	86.0	89.3	93.7	96.4	96.3	96.4	96.4	96.4			
4000	82.2	86.2	91.0	93.6	93.3	93.2	93.2	93.2			
8000	69.7	74.4	79.6	82.2	81.6	80.5	80.3	80.2			
Spectra value	92.6	95.6	99.8	102.7	103.0	103.0	103.0	103.0			

Table 9-2: Octaves for V90-1.8 MW-VCS-50 Hz-Mode 1, hub height = 80 m.

V90-1.8 MW-VCS-50 Hz-Mode 1 – Hub Height 95 m											
Wind speed 10 m	3	4	5	6	7	8	9	10	11	12	13
Power [kW]	120.9	319.7	641.8	1097.6	1557.2	1780.0	1799.8	1800.0	1800.0	1800.0	1800.0
1/1 octaves	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA
[Hz]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]
16	44.7	51.7	56.4	58.1	61.5	63.8	64.0	64.0			
31.5	59.0	64.2	70.5	74.3	75.1	75.8	75.9	75.9			
63	72.1	75.5	79.8	83.2	84.8	85.4	85.4	85.4			
125	76.4	80.4	85.2	88.9	90.2	90.7	90.8	90.8			
250	82.7	86.2	90.2	92.6	93.4	93.7	93.7	93.7			
500	86.5	89.5	93.3	95.7	96.0	96.1	96.0	96.0			
1000	87.8	90.6	94.8	97.8	97.7	97.4	97.4	97.4			
2000	86.2	89.9	94.2	96.5	96.3	96.4	96.4	96.4			
4000	82.5	86.8	91.5	93.7	93.3	93.2	93.2	93.2			
8000	70.1	75.0	80.1	82.3	81.3	80.4	80.2	80.2			
Spectra value	92.8	96.1	100.3	102.9	103.0	103.0	103.0	103.0			

Table 9-3: Octaves for V90-1.8 MW-VCS-50 Hz-Mode 1, hub height = 95 m.

V90-1.8 MW-VCS-50 Hz-Mode 1 – Hub Height 105 m											
Wind speed 10 m	3	4	5	6	7	8	9	10	11	12	13
Power [kW]	128.3	336.2	674.6	1144.8	1594.8	1785.7	1800.0	1800.0	1800.0	1800.0	1800.0
1/1 octaves	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA
[Hz]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]
16	45.0	52.1	56.5	58.3	61.9	63.8	64.0	64.0			
31.5	59.2	64.7	70.9	74.5	75.2	75.8	75.9	75.9			
63	72.3	75.8	80.1	83.4	84.9	85.4	85.4	85.4			
125	76.6	80.7	85.6	89.1	90.3	90.7	90.8	90.8			
250	82.8	86.5	90.5	92.8	93.4	93.7	93.7	93.7			
500	86.6	89.7	93.5	95.8	96.0	96.1	96.0	96.0			
1000	87.9	90.9	95.1	97.9	97.6	97.4	97.4	97.4			
2000	86.3	90.2	94.5	96.6	96.3	96.4	96.4	96.4			
4000	82.6	87.2	91.8	93.7	93.2	93.2	93.2	93.2			
8000	70.3	75.4	80.4	82.3	81.2	80.3	80.2	80.2			
Spectra value	92.9	96.4	100.6	103.0	103.0	103.0	103.0	103.0			

Table 9-4: Octaves for V90-1.8 MW-VCS-50 Hz-Mode 1, hub height = 105 m.

10 Appendix G**10.1 V90-1.8 MW-VCS-50 Hz-Mode 2****10.1.1 Sound Power Levels (according to 0004-6207 V09)**

Sound Power Level at Hub Height: Mode 2				
Conditions for Sound Power Level:	Measurement standard IEC 61400-11 ed. 2 2002			
	Wind shear: 0.16			
	Max. turbulence at 10 metre height: 16%			
	Inflow angle (vertical): 0 ± 2°			
	Air density: 1.225 kg/m³			
Hub height [m]	80	95	105	
L_{WA} @ 3 m/s (10 m above ground) [dBA]	92.6	92.8	92.9	
Wind speed at hh [m/sec]	4.2	4.3	4.4	
L_{WA} @ 4 m/s (10 m above ground) [dBA]	95.6	96.1	96.4	
Wind speed at hh [m/sec]	5.6	5.7	5.8	
L_{WA} @ 5 m/s (10 m above ground) [dBA]	99.8	100.1	100.2	
Wind speed at hh [m/sec]	7.0	7.2	7.3	
L_{WA} @ 6 m/s (10 m above ground) [dBA]	101.0	101.0	101.0	
Wind speed at hh [m/sec]	8.4	8.6	8.7	
L_{WA} @ 7 m/s (10 m above ground) [dBA]	101.0	101.0	101.0	
Wind speed at hh [m/sec]	9.8	10.0	10.2	
L_{WA} @ 8 m/s (10 m above ground) [dBA]	101.0	101.0	101.0	
Wind speed at hh [m/sec]	11.2	11.5	11.7	
L_{WA} @ 9 m/s (10 m above ground) [dBA]	101.0	101.0	101.0	
Wind speed at hh [m/sec]	12.6	12.9	13.1	
L_{WA} @ 10 m/s (10 m above ground) [dBA]	101.0	101.0	101.0	
Wind speed at hh [m/sec]	13.9	14.3	14.6	
L_{WA} @ 11 m/s (10 m above ground) [dBA]	101.0	101.0	101.0	
Wind speed at hh [m/sec]	15.3	15.8	16.0	
L_{WA} @ 12 m/s (10 m above ground) [dBA]	101.0	101.0	101.0	
Wind speed at hh [m/sec]	16.7	17.2	17.5	
L_{WA} @ 13 m/s (10 m above ground) [dBA]	101.0	101.0	101.0	
Wind speed at hh [m/sec]	18.1	18.6	18.9	

Table 10-1: Sound power levels V90-1.8 MW-VCS-50 Hz-Mode 2.

10.1.2 1/1 Octaves

V90-1.8 MW-VCS-50 Hz-Mode 2 – Hub Height 80 m											
Wind speed 10 m	3	4	5	6	7	8	9	10	11	12	13
Power [kW]	108.5	292.2	587.5	977.2	1350.9	1652.2	1752.0	1772.4	1787.4	1797.0	1800.0
1/1 octaves	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA
[Hz]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]
16	44.4	50.5	56.6	57.9	58.1	59.4	60.0	60.2	60.3	60.4	60.4
31.5	58.9	63.2	69.7	73.9	75.9	76.4	76.2	76.2	76.2	76.1	76.1
63	71.8	75.3	80.0	81.7	82.3	83.0	83.3	83.4	83.5	83.5	83.5
125	76.2	79.7	84.6	86.7	87.5	88.1	88.2	88.3	88.3	88.3	88.3
250	82.4	85.7	89.9	90.9	90.8	91.0	91.1	91.1	91.1	91.1	91.1
500	86.3	88.9	92.8	94.0	94.1	94.0	94.0	94.0	94.0	93.9	93.9
1000	87.7	90.1	94.0	95.2	95.0	94.8	94.7	94.7	94.7	94.7	94.7
2000	85.9	89.4	93.9	95.1	95.2	95.4	95.4	95.4	95.4	95.4	95.4
4000	82.2	86.2	91.0	92.0	91.6	91.4	91.4	91.4	91.4	91.4	91.4
8000	69.9	74.1	78.6	78.9	78.2	77.4	77.0	77.0	76.9	76.8	76.8
Spectra value	92.6	95.6	99.8	101.0	101.0	101.0	101.0	101.0	101.0	101.0	101.0

Table 10-2: Octaves for V90-1.8 MW-VCS-50 Hz-Mode 2, hub height = 80 m.

V90-1.8 MW-VCS-50 Hz-Mode 2 – Hub Height 95 m											
Wind speed 10 m	3	4	5	6	7	8	9	10	11	12	13
Power [kW]	120.9	320.2	640.4	1041.7	1419.3	1693.9	1758.3	1776.4	1791.2	1798.4	1800.0
1/1 octaves	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA
[Hz]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]
16	44.9	51.3	57.0	57.8	58.3	59.6	60.1	60.2	60.3	60.4	60.4
31.5	59.2	63.9	70.4	74.3	76.1	76.3	76.2	76.2	76.2	76.1	76.1
63	72.0	75.8	80.3	81.8	82.4	83.2	83.4	83.4	83.5	83.5	83.5
125	76.5	80.3	85.0	86.9	87.7	88.2	88.2	88.3	88.3	88.3	88.3
250	82.7	86.2	90.2	90.8	90.9	91.0	91.1	91.1	91.1	91.1	91.1
500	86.5	89.4	93.1	94.0	94.1	94.0	94.0	94.0	94.0	93.9	93.9
1000	87.9	90.5	94.3	95.2	95.0	94.8	94.7	94.7	94.7	94.7	94.7
2000	86.2	90.0	94.2	95.1	95.3	95.4	95.4	95.4	95.4	95.4	95.4
4000	82.5	86.8	91.3	91.9	91.5	91.4	91.4	91.4	91.4	91.4	91.4
8000	70.2	74.7	78.8	78.8	78.0	77.3	77.0	76.9	76.9	76.8	76.8
Spectra value	92.8	96.1	100.1	101.0	101.0	101.0	101.0	101.0	101.0	101.0	101.0

Table 10-3: Octaves for V90-1.8 MW-VCS-50 Hz-Mode 2, hub height = 95 m.

V90-1.8 MW-VCS-50 Hz-Mode 2 – Hub Height 105 m											
Wind speed 10 m	3	4	5	6	7	8	9	10	11	12	13
Power [kW]	128.3	336.9	672.3	1079.4	1457.2	1708.8	1761.6	1778.8	1793.2	1799.0	1800.0
1/1 octaves	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA
[Hz]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]
16	45.1	51.8	57.1	57.8	58.4	59.7	60.1	60.2	60.3	60.4	60.4
31.5	59.3	64.3	70.7	74.5	76.2	76.3	76.2	76.2	76.2	76.1	76.1
63	72.2	76.2	80.5	81.8	82.5	83.2	83.4	83.4	83.5	83.5	83.5
125	76.6	80.7	85.2	86.9	87.8	88.2	88.2	88.3	88.3	88.3	88.3
250	82.8	86.6	90.2	90.8	90.9	91.0	91.1	91.1	91.1	91.1	91.1
500	86.6	89.7	93.2	94.1	94.1	94.0	94.0	94.0	93.9	93.9	93.9
1000	87.9	90.8	94.4	95.2	94.9	94.7	94.7	94.7	94.7	94.7	94.7
2000	86.3	90.3	94.3	95.1	95.3	95.4	95.4	95.4	95.4	95.4	95.4
4000	82.6	87.2	91.4	91.9	91.5	91.4	91.4	91.4	91.4	91.4	91.4
8000	70.4	75.1	78.8	78.7	77.9	77.2	77.0	76.9	76.8	76.8	76.8
Spectra value	92.9	96.4	100.2	101.0	101.0	101.0	101.0	101.0	101.0	101.0	101.0

Table 10-4: Octaves for V90-1.8 MW-VCS-50 Hz-Mode 2, hub height = 105 m.

11 Appendix H**11.1 V90-1.8 MW-VCS-50 Hz-Mode 3****11.1.1 Sound Power Levels (according to 0004-6207 V09)**

Sound Power Level at Hub Height: Mode 3				
Conditions for Sound Power Level:	Measurement standard IEC 61400-11 ed. 2 2002			
	Wind shear: 0.16			
	Max. turbulence at 10 metre height: 16%			
	Inflow angle (vertical): 0 ± 2°			
	Air density: 1.225 kg/m³			
Hub height [m]	80	95	105	
L_{WA} @ 3 m/s (10 m above ground) [dBA]	92.5	92.5	92.6	
Wind speed at hh [m/sec]	4.2	4.3	4.4	
L_{WA} @ 4 m/s (10 m above ground) [dBA]	94.6	95.0	95.3	
Wind speed at hh [m/sec]	5.6	5.7	5.8	
L_{WA} @ 5 m/s (10 m above ground) [dBA]	98.8	99.3	99.6	
Wind speed at hh [m/sec]	7.0	7.2	7.3	
L_{WA} @ 6 m/s (10 m above ground) [dBA]	101.8	102.0	102.1	
Wind speed at hh [m/sec]	8.4	8.6	8.7	
L_{WA} @ 7 m/s (10 m above ground) [dBA]	103.5	103.8	103.8	
Wind speed at hh [m/sec]	9.8	10.0	10.2	
L_{WA} @ 8 m/s (10 m above ground) [dBA]	104.0	104.0	104.0	
Wind speed at hh [m/sec]	11.2	11.5	11.7	
L_{WA} @ 9 m/s (10 m above ground) [dBA]	104.0	104.0	104.0	
Wind speed at hh [m/sec]	12.6	12.9	13.1	
L_{WA} @ 10 m/s (10 m above ground) [dBA]	104.0	104.0	104.0	
Wind speed at hh [m/sec]	13.9	14.3	14.6	
L_{WA} @ 11 m/s (10 m above ground) [dBA]	104.0	104.0	104.0	
Wind speed at hh [m/sec]	15.3	15.8	16.0	
L_{WA} @ 12 m/s (10 m above ground) [dBA]	104.0	104.0	104.0	
Wind speed at hh [m/sec]	16.7	17.2	17.5	
L_{WA} @ 13 m/s (10 m above ground) [dBA]	104.0	104.0	104.0	
Wind speed at hh [m/sec]	18.1	18.6	18.9	

Table 11-1: Sound power levels V90-1.8 MW-VCS-50 Hz-Mode 3.

11.1.2 1/1 Octaves

V90-1.8 MW-VCS-50 Hz-Mode 3 – Hub Height 80 m											
Wind speed 10 m	3	4	5	6	7	8	9	10	11	12	13
Power [kW]	108.5	289.7	584.6	1005.6	1486.8	1769.6	1799.1	1800	1800	1800	1800
1/1 octaves	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA
[Hz]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]
16						62.5	62.6	62.6			
31.5						76.7	76.8	76.8			
63						85.7	85.8	85.8			
125						90.4	90.4	90.4			
250						94.1	94.2	94.2			
500						97.2	97.3	97.3			
1000						98.3	98.2	98.2			
2000						97.4	97.4	97.4			
4000						95.1	95.1	95.1			
8000						84.3	84.1	84.1			
Spectra value						104.0	104.0	104.0			

Table 11-2: Octaves for V90-1.8 MW-VCS-50 Hz-Mode 3, hub height = 80 m.

V90-1.8 MW-VCS-50 Hz-Mode 3 – Hub Height 95 m											
Wind speed 10 m	3	4	5	6	7	8	9	10	11	12	13
Power [kW]	120.9	316.8	637.7	1084.4	1571.2	1784.5	1799.8	1800.0	1800.0	1800.0	1800.0
1/1 octaves	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA
[Hz]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]
16						62.6	62.6	62.6			
31.5						76.7	76.8	76.8			
63						85.7	85.8	85.8			
125						90.4	90.4	90.4			
250						94.1	94.2	94.2			
500						97.2	97.3	97.3			
1000						98.3	98.2	98.2			
2000						97.4	97.4	97.4			
4000						95.1	95.1	95.1			
8000						84.2	84.1	84.1			
Spectra value						104.0	104.0	104.0			

Table 11-3: Octaves for V90-1.8 MW-VCS-50 Hz-Mode 3, hub height = 95 m.

V90-1.8 MW-VCS-50 Hz-Mode 3 – Hub Height 105 m											
Wind speed 10 m	3	4	5	6	7	8	9	10	11	12	13
Power [kW]	128.3	332.9	669.9	1132.7	1608.8	1789.1	1800.0	1800.0	1800.0	1800.0	1800.0
1/1 octaves	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA	LWA
[Hz]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]	[dB(A)]
16						62.6	62.6	62.6			
31.5						76.7	76.8	76.8			
63						85.7	85.8	85.8			
125						90.4	90.4	90.4			
250						94.2	94.2	94.2			
500						97.2	97.3	97.3			
1000						98.3	98.2	98.2			
2000						97.4	97.4	97.4			
4000						95.1	95.1	95.1			
8000						84.2	84.1	84.1			
Spectra value						104.0	104.0	104.0			

Table 11-4: Octaves for V90-1.8 MW-VCS-50 Hz-Mode 3, hub height = 105 m.