

NATION RISE WIND FARM

Specifications Report, Wind Facility

Nation Rise Wind Farm Limited Partnership

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A	22 March 2017	Draft report	A. Danaitis	A. Necessian	G. Constantin
B	13 July 2017	Update to report for REA submission	A. Danaitis	A. Necessian	G. Constantin
C	15 September 2017	Update for completeness review	A. Danaitis	A. Necessian	G. Constantin
D	26 September 2017	Update for completeness review	A. Danaitis	A. Necessian	G. Constantin
E	22 May 2019	Switch to acoustically equivalent Enercon E138 turbine	A. Necessian	K. Varnik	G. Constantin

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List of abbreviations

Abbreviation	Meaning
EPA	Ontario <i>Environmental Protection Act</i>
IESO	Independent Electricity System Operator
MECP	Ontario Ministry of Environment, Conservation and Parks
MW	Megawatt
NIA	Noise Impact Assessment
O. Reg	Ontario Regulation
REA	Renewable Energy Approval
SR	Specifications Report
TES	Trailing Edge Serrations

1 PREAMBLE

Nation Rise Wind Farm Limited Partnership (the “Proponent”) is proposing to develop the Nation Rise Wind Farm (the “Project”) which is subject to *Ontario Regulation (O. Reg.) 359/09* (Renewable Energy Approvals (REA) [1] under Part V.0.1 of the Ontario *Environmental Protection Act* (EPA)), as amended. The Proponent was awarded a contract for this Project in March 2016 from the Independent Electricity System Operator (IESO) under the Large Renewable Procurement (LRP), and has received its Renewable Energy Approval (REA) [0871-AV3TFM] from the Ontario Ministry of the Environment, Conservation and Parks (MECP, formerly the Ontario Ministry of the Environment and Climate Change) on 4 May 2018 [2]. The Project will be owned and operated by Nation Rise Wind Farm Limited Partnership, an indirectly owned of EDP Renewables Canada Ltd.

This Specifications Report, Wind Facility (SR) has been prepared in accordance with Table 1 of *O. Reg 359/09* and the Technical Guide to Renewable Energy Approvals, Chapter 9: Additional reports that may be required as part of an REA application, Section 13 Specifications Report Wind Facility (Not Class 2) [3]. Table 1-1 below presents the corresponding sections for each SR requirement.

Table 1-1: Specification Report Requirement and Corresponding Sections

Requirement	Section
Provide specifications of each wind turbine, including make, model, name plate capacity, hub height above grade, rotational speeds and acoustic emission data, including the sound power level and frequency spectrum, in terms of octave –band sound power levels.	2 and 3

2 TECHNICAL SPECIFICATIONS

This Project, with a total nameplate capacity of approximately 100 megawatts (MW), is considered to be a Class 4 wind facility. A total of 33 wind turbine locations have been permitted and the Proponent is currently evaluating different wind turbine technologies for the Project. The technology currently being considered is the Enercon E138 NR2 turbine with a capacity of 3.44 MW. This E138 model was customized for the Project with the intention of meeting the acoustically equivalent requirements of the REA (Condition A9).

The turbine rotor and nacelle will be placed on a tower with a hub-height of 131 m in height consisting of up to seven steel sections. The maximum sound power level of the proposed turbine is 104.3 dBA. A summary of technical specifications is provided below in Table 2-1.

Table 2-1: Summary of Turbine Technical Specifications

Model	Enercon E138 EP3 with Operating Mode NR2 s
Design	Steel tower or a hybrid tower made of precast concrete segments and a steel section
Rated Power	3.44 MW
Hub height	131 m
Rotor diameter	138.6 m
Number of blades	3
Blade modifications	Trailing Edge Serrations (TES)
Rotational Speed (rpm)	5 to 10.6
Cut-in wind speed	2.5 m/s
Cut-out wind speed	25 m/s
Nominal wind speed	14.5 m/s
Maximum sound power level	104.3 dBA

Additional technical information for this Enercon E138 EP3 model (mode OM NR2 s) with Trailing Edge Serrations is presented in Appendix A of this report. Moreover, an updated Wind Turbine Specifications Checklist is included in Appendix B.



3 ACOUSTIC EMISSIONS DATA

Broadband and octave-band sound power levels for all relevant noise operation modes of the Enercon E138 EP3 3.44 MW wind turbine (in operational mode OM NR2s) were provided by the manufacturer as shown in Appendix A.

The octave band sound power levels used in the updated noise model are those stated for each octave band centre frequency in Table 3-1. These are all less than or equal to those used in the Noise Impact Assessment (NIA) at all frequencies [4].

Table 3-1: Enercon E138 3.44 MW (mode OM NR2s) wind turbine acoustic emission summary

Make and Model:	Enercon E138 3.44 MW (mode OMNR2s)																							
Electrical Rating:	3440 kW																							
Hub Height (m):	131																							
	Octave Band Sound Power Level (dB)																							
	Manufacturer's Emission Levels at bin centre wind speeds at hub height																					(A)	(B)	(A+B)
Wind Speeds at hub height (m/s)	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10.0	10.5	11.0	11.5	12.0	12.5	13.0	13.5	14.0	14.5	15.0	Manufacturer's Worst-Case Spectrum (dB)	Positive Overall Adjustment* (dB)	Maximum Sound Power Level (dB)
Frequency (Hz)																								
31.5	68.9	70.6	72.0	73.3	74.2	74.3	74.6	74.8	74.9	75.1	75.4	75.5	75.6	75.6	75.5	75.4	75.3	75.2	75.2	75.2	75.1	75.6	0	75.6
63	79.8	81.6	83.2	84.7	85.7	85.9	86.2	86.4	86.5	86.8	87.0	87.2	87.2	87.2	87.2	87.1	87.0	86.9	86.8	86.8	86.8	87.2	0	87.2
125	85.4	87.3	89.0	90.5	91.6	91.8	92.2	92.4	92.6	92.8	93.0	93.2	93.2	93.1	93.1	92.9	92.7	92.6	92.5	92.5	92.4	93.2	0	93.2
250	88.5	90.5	92.1	93.7	94.8	95.1	95.4	95.6	95.8	96.0	96.2	96.4	96.3	96.1	96.0	95.8	95.6	95.5	95.4	95.3	95.2	96.3	0.1	96.4
500	90.3	92.4	94.2	95.9	97.2	97.4	97.7	97.9	98.1	98.3	98.5	98.8	98.7	98.6	98.5	98.3	98.2	98.0	98.0	98.0	98.0	98.7	0.1	98.8
1,000	89.8	92.0	93.9	95.7	96.9	97.1	97.4	97.5	97.8	98.0	98.2	98.6	98.7	98.8	98.9	98.9	99.0	99.0	99.1	99.2	99.3	98.7	0	98.7
2,000	87.3	89.5	91.4	93.2	94.5	94.6	94.9	95.0	95.2	95.5	95.7	96.2	96.5	96.6	96.8	97.2	97.6	97.6	97.7	97.8	97.7	96.5	0	96.5
4,000	78.5	80.7	82.7	84.5	85.8	85.9	86.1	86.2	86.3	86.6	87.0	87.6	88.1	88.4	88.7	89.0	88.8	88.6	88.5	88.3	88.2	88.1	0	88.1
8,000	57.2	59.7	61.8	63.8	65.1	65.2	65.4	65.5	65.6	66.0	66.4	67.1	67.5	67.6	67.5	66.9	66.6	66.2	66.0	65.8	65.7	67.5	0	67.5
Overall A-weighted (dBA)	95.8	97.9	99.7	101.4	102.6	102.8	103.1	103.3	103.5	103.7	103.9	104.2	104.3	104.3	104.3	104.3	104.3	104.3	104.3	104.3	104.3	104.3	0	104.3

The spectrum corresponding to 11.0 m/s is the worst-case spectrum according to the definition in the 2016 Ontario Noise Guidelines.

For additional conservatism, a 0.1 dB positive adjustment has been added to the 250 Hz and 500 Hz frequencies, which represent the 10.5 m/s wind speed bin.

It can be noted that all three variants of the NR2 s model (3.5 MW, 3.45 MW and 3.44 MW) with TES have identical acoustic specifications according to [6].



3.1 Tonal audibility

Enercon states in a guarantee letter dated 15 May 2019 , that the typical tonal audibility for the E138 EP3 NR2s wind turbine generators has not exceeded 3 dBA as determined in accordance with the methods described in standard IEC 61400-11, Ed.3, 2012 [5]. This letter is shown in Appendix A.

The acoustic emissions data and technical specifications (including power curve) for the Enercon E138 EP3 3.44 MW (OM NR2s) are presented in Appendix A.



4 REFERENCES

- [1] Ontario Regulation 359/09, made under the Environmental Protection Act, Renewable Energy Approvals under Part 1.0 of the Act.
- [2] Ontario Ministry of the Environment and Climate Change, Renewable Energy Approval (0871-AV3TFM) – Nation Rise Wind Farm, 4 May 2018.
- [3] Technical Guide to Renewable Energy Approvals, Ontario Ministry of the Environment and Climate Change, 2017.
- [4] DNV GL, Noise Impact Assessment, Nation Rise Wind Farm, 26 September 2017.
- [5] IEC 61400 – 11 Ed. 3.0 Wind turbines– Part 11: Acoustic noise measurement techniques. 58 p.
- [6] Enercon. Document D0778163-1. *Data Sheet-Operating Modes E-138 EP3 / 3500 kW with TES (Nation Rise)*. December 12, 2018



APPENDIX A – ENERCON E138 EP3 NR2 S SPECIFICATIONS

This appendix contains the following supporting documentation for the Enercon E138 EP3 NR2 s 3.44 MW turbine model:

1. General specifications and power curve
2. Calculated one-third octave band sound power levels provided by Enercon
3. Enercon Guarantee letter

6 Operating mode NR2 s 3440 kW

6.1 Calculated power, c_p and c_t values – operating mode NR2 s 3440 kW

Tab. 24: Calculated power, c_p and c_t values for E-138 EP3 / 3500 kW – operating mode NR2 s 3440 kW

Wind speed v in m/s	Power P in kW	c_p value	c_t value
0.00	0	0.00	0.00
0.50	0	0.00	0.00
1.00	0	0.00	0.00
1.50	0	0.00	0.00
2.00	8	0.11	0.75
2.50	33	0.23	1.02
3.00	81	0.33	1.00
3.50	154	0.39	0.94
4.00	252	0.43	0.91
4.50	377	0.45	0.89
5.00	524	0.45	0.87
5.50	702	0.46	0.86
6.00	912	0.46	0.85
6.50	1155	0.46	0.82
7.00	1429	0.45	0.80
7.50	1726	0.44	0.76
8.00	2034	0.43	0.73
8.50	2337	0.41	0.68
9.00	2617	0.39	0.63
9.50	2858	0.36	0.57
10.00	3051	0.33	0.52
10.50	3195	0.30	0.46
11.00	3294	0.27	0.41
11.50	3359	0.24	0.36
12.00	3397	0.21	0.32
12.50	3419	0.19	0.28
13.00	3431	0.17	0.25
13.50	3436	0.15	0.22
14.00	3439	0.14	0.19

Wind speed v in m/s	Power P in kW	c_p value	c_t value
14.50	3440	0.12	0.17
15.00	3440	0.11	0.16
15.50	3440	0.10	0.14
16.00	3440	0.09	0.13
16.50	3440	0.08	0.12
17.00	3440	0.08	0.11
17.50	3440	0.07	0.10
18.00	3440	0.06	0.09
18.50	3440	0.06	0.08
19.00	3440	0.05	0.08
19.50	3438	0.05	0.07
20.00	3427	0.05	0.07
20.50	3405	0.04	0.06
21.00	3367	0.04	0.06
21.50	3305	0.04	0.05
22.00	3214	0.03	0.05
22.50	3091	0.03	0.05
23.00	2934	0.03	0.04
23.50	2746	0.02	0.04
24.00	2530	0.02	0.03
24.50	2304	0.02	0.03
25.00	1858	0.01	0.02

6.2 Calculated sound power levels – operating mode NR2 s 3440 kW

In mode NR2 s 3440 kW the wind energy converter operates with reduced power. The highest expected sound power level is 104.3 dB(A) in the nominal power range. Once nominal power has been achieved, a steady level is guaranteed.

Tab. 25: Technical specifications

Parameter	Value	Unit
Nominal power (P_n)	3440	kW
Nominal wind speed	14.5	m/s
Minimum operating speed	5.0	rpm
Speed setpoint	10.6	rpm

The following sound power levels apply, taking into account the specified uncertainties in ch. 3, p. 9.

Tab. 26: Calculated sound power level in dB(A), based on standardised wind speed v_s at a height of 10 m

Wind speed (v_s) at a height of 10 m	Sound power level in dB(A)
	HH 131 m
3 m/s	93.2
3.5 m/s	96.6
4 m/s	99.5
4.5 m/s	101.8
5 m/s	102.8
5.5 m/s	103.2
6 m/s	103.5
6.5 m/s	103.8
7 m/s	104.1
7.5 m/s	104.3
8 m/s	104.3
8.5 m/s	104.3
9 m/s	104.3
9.5 m/s	104.3
10 m/s	104.3
10.5 m/s	104.3
11 m/s	104.3
11.5 m/s	104.3
12 m/s	104.3

Wind speed (v_{10}) at a height of 10 m	Sound power level in dB(A)
	HH 131 m
95 % P_n	104.3

Tab. 27: Calculated sound power level in dB(A), based on wind speed at hub height

Wind speed at hub height (v_{HH})	Sound power level in dB(A)
5 m/s	95.8
5.5 m/s	97.9
6 m/s	99.7
6.5 m/s	101.4
7 m/s	102.6
7.5 m/s	102.8
8 m/s	103.1
8.5 m/s	103.3
9 m/s	103.5
9.5 m/s	103.7
10 m/s	103.9
10.5 m/s	104.2
11 m/s	104.3
11.5 m/s	104.3
12 m/s	104.3
12.5 m/s	104.3
13 m/s	104.3
13.5 m/s	104.3
14 m/s	104.3
14.5 m/s	104.3
15 m/s	104.3

6.3 One-third octave band level at HH

In the following tables, the values at which the maximum sound power level is reached for the first time are displayed in italics.

Tab. 28: One-third octave band level in dB(A), based on wind speed v_H at hub height

One-third octave band level centre frequency in Hz	v_H in m/s										
	5	5.5	6	6.5	7	7.5	8	8.5	9	9.5	10
20	51.6	53.1	54.3	55.4	56.2	56.3	56.6	56.7	56.8	57.1	57.3
25	57.6	59.1	60.4	61.6	62.4	62.5	62.8	62.9	63.1	63.3	63.5
31.5	62.8	64.4	65.7	67.0	67.9	68.0	68.3	68.5	68.6	68.8	69.0
40	67.3	69.0	70.4	71.7	72.7	72.8	73.1	73.3	73.4	73.6	73.9
50	71.1	72.9	74.4	75.8	76.8	77.0	77.3	77.4	77.6	77.8	78.0
63	74.5	76.3	77.8	79.3	80.3	80.5	80.8	81.0	81.1	81.4	81.6
80	77.3	79.2	80.8	82.3	83.3	83.5	83.8	84.0	84.2	84.4	84.6
100	79.4	81.3	83.0	84.5	85.6	85.8	86.1	86.3	86.5	86.7	86.9
125	80.7	82.6	84.2	85.8	86.9	87.1	87.4	87.6	87.8	88.0	88.2
160	81.6	83.5	85.1	86.7	87.8	88.0	88.4	88.6	88.8	89.0	89.2
200	82.5	84.5	86.1	87.7	88.8	89.0	89.4	89.6	89.8	90.0	90.2
250	83.7	85.7	87.3	88.9	90.0	90.3	90.6	90.8	91.0	91.2	91.4
315	84.6	86.7	88.3	89.9	91.1	91.3	91.7	91.9	92.1	92.3	92.4
400	85.4	87.4	89.1	90.8	92.0	92.2	92.5	92.8	93.0	93.2	93.3
500	85.7	87.8	89.6	91.3	92.6	92.8	93.1	93.3	93.5	93.7	93.9
630	85.6	87.8	89.7	91.4	92.7	92.9	93.2	93.4	93.6	93.8	94.0
800	85.3	87.5	89.3	91.1	92.4	92.6	92.9	93.0	93.3	93.5	93.7
1000	85.0	87.2	89.1	90.9	92.1	92.3	92.6	92.8	93.0	93.2	93.4
1250	84.8	87.0	88.9	90.7	91.9	92.1	92.3	92.5	92.7	92.9	93.1
1600	84.1	86.3	88.2	90.0	91.2	91.4	91.7	91.8	92.0	92.3	92.5
2000	82.5	84.7	86.6	88.4	89.7	89.8	90.1	90.2	90.4	90.7	90.9
2500	80.1	82.3	84.3	86.1	87.3	87.5	87.7	87.8	88.0	88.3	88.5
3150	76.9	79.1	81.1	82.9	84.2	84.3	84.5	84.6	84.7	85.0	85.4
4000	72.4	74.7	76.7	78.5	79.8	79.8	80.0	80.1	80.2	80.6	80.9
5000	66.2	68.6	70.6	72.5	73.8	73.9	74.1	74.1	74.2	74.6	75.0
6300	57.0	59.5	61.6	63.6	64.9	65.0	65.2	65.3	65.4	65.8	66.2
8000	43.4	45.9	48.0	50.1	51.5	51.6	51.8	51.9	52.1	52.5	52.8
10000	25.3	27.8	30.0	32.1	33.5	33.7	33.9	34.0	34.2	34.6	34.9

Tab. 29: One-third octave band level in dB(A), based on wind speed v_H at hub height

One-third octave band level centre frequency in Hz	v_H in m/s									
	10.5	11	11.5	12	12.5	13	13.5	14	14.5	15
20	57.3	57.4	57.4	57.4	57.3	57.2	57.1	57.1	57.0	57.0
25	63.6	63.7	63.7	63.6	63.5	63.5	63.4	63.3	63.3	63.3
31.5	69.1	69.2	69.2	69.2	69.1	69.0	68.9	68.8	68.8	68.8
40	74.0	74.1	74.1	74.0	73.9	73.8	73.7	73.7	73.7	73.6
50	78.2	78.3	78.2	78.2	78.1	78.0	77.9	77.9	77.8	77.8
63	81.8	81.8	81.8	81.8	81.7	81.6	81.5	81.4	81.4	81.4
80	84.8	84.9	84.8	84.8	84.7	84.6	84.5	84.5	84.4	84.4
100	87.1	87.1	87.1	87.1	86.9	86.8	86.7	86.7	86.6	86.6
125	88.4	88.4	88.4	88.3	88.1	88.0	87.9	87.8	87.8	87.7
160	89.4	89.4	89.3	89.2	89.0	88.8	88.7	88.6	88.6	88.5
200	90.4	90.3	90.2	90.1	89.9	89.7	89.5	89.5	89.4	89.3
250	91.6	91.5	91.3	91.2	91.0	90.8	90.7	90.6	90.5	90.4
315	92.6	92.5	92.3	92.2	92.0	91.8	91.6	91.6	91.4	91.4
400	93.5	93.4	93.2	93.1	92.9	92.7	92.5	92.5	92.4	92.3
500	94.1	94.1	93.9	93.8	93.6	93.4	93.3	93.3	93.2	93.2
630	94.3	94.3	94.3	94.2	94.1	94.0	93.9	93.9	93.9	93.9
800	94.0	94.1	94.1	94.2	94.1	94.1	94.1	94.1	94.2	94.2
1000	93.8	94.0	94.0	94.1	94.1	94.2	94.3	94.4	94.5	94.5
1250	93.6	93.8	93.9	94.0	94.1	94.3	94.4	94.6	94.7	94.8
1600	92.9	93.2	93.3	93.5	93.7	94.1	94.2	94.4	94.5	94.5
2000	91.4	91.7	91.9	92.1	92.5	92.9	93.0	93.1	93.1	93.1
2500	89.1	89.4	89.7	89.9	90.5	90.8	90.7	90.6	90.5	90.4
3150	85.9	86.4	86.7	87.0	87.5	87.4	87.2	87.1	86.9	86.8
4000	81.6	82.1	82.5	82.7	82.8	82.5	82.2	82.0	81.9	81.7
5000	75.7	76.3	76.5	76.6	76.2	75.8	75.6	75.4	75.2	75.0
6300	66.9	67.3	67.4	67.3	66.7	66.4	66.0	65.8	65.6	65.5
8000	53.5	53.7	53.7	53.6	53.0	52.6	52.2	52.0	51.8	51.6
10000	35.5	35.7	35.7	35.5	34.9	34.4	34.0	33.7	33.5	33.3



Michael Weidemann
Executive Vice-President
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May 15, 2019

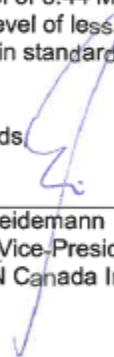
Enercon Canada Inc.
700 rue de la Gauchetière, Suite 1200
Montreal, Quebec
H3B 5M2

Re: Tonal Audibility Level Warranty and Maximum Sound Power Level

Dear Sir/Madam,

With respect to the Nation Rise wind farm project, ENERCON Canada Inc. warrants that the E-138 EP3 E1 wind energy converter using the operating mode (OM) NR2, with a maximum rated power level of 3.44 MW and a maximum sound power level of 104.3 dB(A) will have a tonal audibility level of less than or equal to 3 dB, when measured according to the methods described in standard IEC 61400-11, Ed. 3, 2012.

Kind regards,



Michael Weidemann
Executive Vice-President
ENERCON Canada Inc.

700, De La Gauchetière Street West, Suite 1200, Montreal, Quebec H3B 5M2
Telephone: (514) 363-7266 • Fax: (514) 687-2539

APPENDIX B – WIND TURBINE SPECIFICATIONS CHECKLIST

Specifications	Details
Wind Turbine Information	
Manufacturer	Enercon GmbH
Model	E138 EP3 3500kW
Hub Height (m)	130.54 m
Operation Information	
Speed regulation	Pitch Control – Pitch regulated with variable speed
Rotational Speed per wind speed bin	At 6.0 m/s: 8.9 rpm
	At 6.5 m/s: 9.5 rpm
	At 7.0 m/s: 9.8 rpm
	At 7.5 m/s: 9.9 rpm
	At 8.0 m/s: 10.0 rpm
	At 8.5 m/s: 10.1 rpm
	At 9.0 m/s: 10.1 rpm
	At 9.5 m/s: 10.2 rpm
	At 10.0 m/s: 10.2 rpm
	At 10.5 m/s: 10.4 rpm
	At 11.0 m/s: 10.7 rpm
	At 11.5 m/s: 10.7 rpm
	At 12.0 m/s: 10.7 rpm
	At 12.5 m/s: 10.7 rpm
At 13.0 m/s: 10.8 rpm	
At 13.5 m/s: 10.8 rpm	
At 14.0 m/s: 10.9 rpm	
At 14.5 m/s: 11.0 rpm	
Version Software for control of wind turbine	EP3-CS-02-a-01 / E-138 EP3 3500kW - OMNR2s 3440kW Rev 0.0
Rotor Information	
Type (Default is a 3 blade, horizontal, upwind turbine)	3 blade, horizontal, upwind turbine
Horizontal Distance from rotor centre to tower axis (m)	5.99 m
Diameter of Rotor (m)	138.25 m
Rotor Control Devices	Electrical pitch system
Blade Modifications	<input checked="" type="checkbox"/> Trailing Edge Serrations <input checked="" type="checkbox"/> Vortex Generators
Blade Length (m)	66.89 m
Gearbox Information	
Type	Direct Drive
Manufacturer	Not Applicable
Model Number	Not Applicable

Generator Information	
Manufacturer	Enercon GmbH
Model Number	E-138 EP3-GE-01
Nominal Power (MW)	3.44 MW
Sound Data for tested wind turbine	
Overall sound power level IEC61400-11 test at hub height	Mode OM NR2 s
	At 6.0 m/s: 98.4 dBA
	At 6.5 m/s: 99.7 dBA
	At 7.0 m/s: 100.6 dBA
	At 7.5 m/s: 101.5 dBA
	At 8.0 m/s: 102.0 dBA
	At 8.5 m/s: 102.2 dBA
	At 9.0 m/s: 102.3 dBA
	At 9.5 m/s: 102.4 dBA
	At 10.0 m/s: 102.6 dBA
	At 10.5 m/s: 103.0 dBA
	At 11.0 m/s: 103.3 dBA
	At 11.5 m/s: 103.3 dBA
	At 12.0 m/s: 103.4 dBA
	At 12.5 m/s: 103.6 dBA
At 13.0 m/s: 103.8 dBA	
At 13.5 m/s: 103.9 dBA	
At 14.0 m/s: 104.1 dBA	
At 14.5 m/s: 104.2 dBA	
Measurement Uncertainty (dB)	Max 0.8 dB
Grid Terminal Frequency of Tester	50 Hz
Additional Specifications	Details
Operating Information	
Swept Area (m ²)	15,011 m ²
Rated Power Output (MW)	3.44 MW
Aerodynamic Brakes	No
Cut-in Wind Speed (m/s)	2.5 m/s
Cut-out Wind Speed (m/s)	25.0 m/s
Nominal Power Wind Speed (m/s)	14.5 m/s
Rotor Information	
Aerodynamic Profile of Blade	EC1
Sound Data for tested wind turbine	
Maximum tonal audibility (dB)	-2.5
Provide a Power Curve for each wind turbine proposed for the Project	See Appendix A



ABOUT DNV GL

Driven by our purpose of safeguarding life, property and the environment, DNV GL enables organizations to advance the safety and sustainability of their business. We provide classification, technical assurance, software and independent expert advisory services to the maritime, oil & gas and energy industries. We also provide certification services to customers across a wide range of industries. Combining leading technical and operational expertise, risk methodology and in-depth industry knowledge, we empower our customers' decisions and actions with trust and confidence. We continuously invest in research and collaborative innovation to provide customers and society with operational and technological foresight. Operating in more than 100 countries, our professionals are dedicated to helping customers make the world safer, smarter and greener.