Orenda Energy Solutions

EN-4153-A : Orenda Skye MCS Summary Report

Version A

Certificate number MCS: 2615/1059-CT.

Small Wind Turbine

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Contents

Introduction

The Orenda Energy Solutions Skye wind turbine (Skye), received MCS certification in March 2017, from SGS Tecnos, S.A.U, demonstrating compliance with MCS006 Issue 2.1 (2014) : Design Evaluation as per IEC61400-1 : 2005 Wind turbines – Part 1 : Design requirements.

This summary document provides reporting requirements as per Renewable UK Small Wind Turbine standard, 15th Jan 2014.

Further information can be obtained by contacting Orenda Energy Solutions (www.orendeenergy.com)

Power Performance

Power Performance testing was carried out in accordance with IEC61400-12-1:2006, by TUV:NEL, and results were reported in Report number 2016/327 Issue 2, release date Feb 2017.

The following summary provides the main results from this testing.

Power Curve

The folllowing table and graph are extracted from TUV:NEL report.

Measured power curve (database A)							
Reference air density: 1.225 kg/m^3 Rotor swept area: 280 m^2					Category A	Category B	Combined uncertainty
Bin no.	Hub Height Wind Speed m/s	Power output kW	Cp	No. of data sets 10-min.Avg.	Standard uncertainty s_i kW	Standard uncertainty u_i kW	Standard uncertainty u_{ci} kW
1	0.50	0.00	0.00	0	0.000	0.289	0.289
2	1.04	-0.33	-1.74	2	0.000	0.296	0.296
3	1.54	-0.32	-0.51	9	0.003	0.289	0.289
4	2.01	-0.33	-0.23	19	0.002	0.289	0.289
5	2.48	-0.61	-0.23	16	0.156	0.298	0.336
6	3.02	-0.42	-0.09	17	0.063	0.292	0.299
7	3.50	-0.36	-0.05	20	0.052	0.289	0.294
8	4.02	0.42	0.04	28	0.175	0.358	0.398
9	4.52	2.14	0.13	28	0.210	0.590	0.627
10	5.03	4.75	0.22	26	0.391	0.861	0.946
11	5.51	7.76	0.27	45	0.225	1.087	1.110
12	6.04	11.49	0.30	64	0.268	1.287	1.314
13	6.53	15.02	0.31	49	0.320	1.389	1.425
14	6.98	18.89	0.32	54	0.281	1.727	1.750
15	7.50	23.21	0.32	69	0.244	1.773	1.789
16	8.02	27.97	0.32	72	0.298	2.050	2.072
17	8.51	32.38	0.31	59	0.272	2.129	2.146
18	9.00	35.53	0.28	41	0.313	1.681	1.709
19	9.46	39.12	0.27	42	0.298	2.092	2.113
20	9.96	41.97	0.25	30	0.307	1.693	1.721
21	10.52	44.99	0.23	25	0.321	1.736	1.766
22	11.00	47.38	0.21	41	0.211	1.683	1.696
23	11.51	48.29	0.18	36	0.152	1.166	1.176
24	12.04	49.37	0.16	46	0.115	1.225	1.230
25	12.51	49.68	0.15	42	0.113	1.096	1.102
26	13.03	49.83	0.13	42	0.115	1.083	1.089
27	13.50	49.46	0.12	45	0.168	1.103	1.116
28	13.99	48.98	0.10	37	0.198	1.111	1.128
29	14.52	47.66	0.09	41	0.214	1.349	1.366
30	14.98	47.34	0.08	27	0.262	1.059	1.091
31	15.40	46.20	0.07	13	0.475	1.413	1.491
32	15.98	45.22	0.06	7	0.473	1.179	1.271
33	16.44	44.44	0.06	7	0.644	1.173	1.338
34	16.90	44.64	0.05	2	0.742	0.991	1.238
35	17.50	0.00	0.00	0	0.000	0.289	0.289
36	17.93	39.08	0.04	1	0.000	38.210	38.210

Figure 1 : Binned Power Data based on 10min averaged periods.

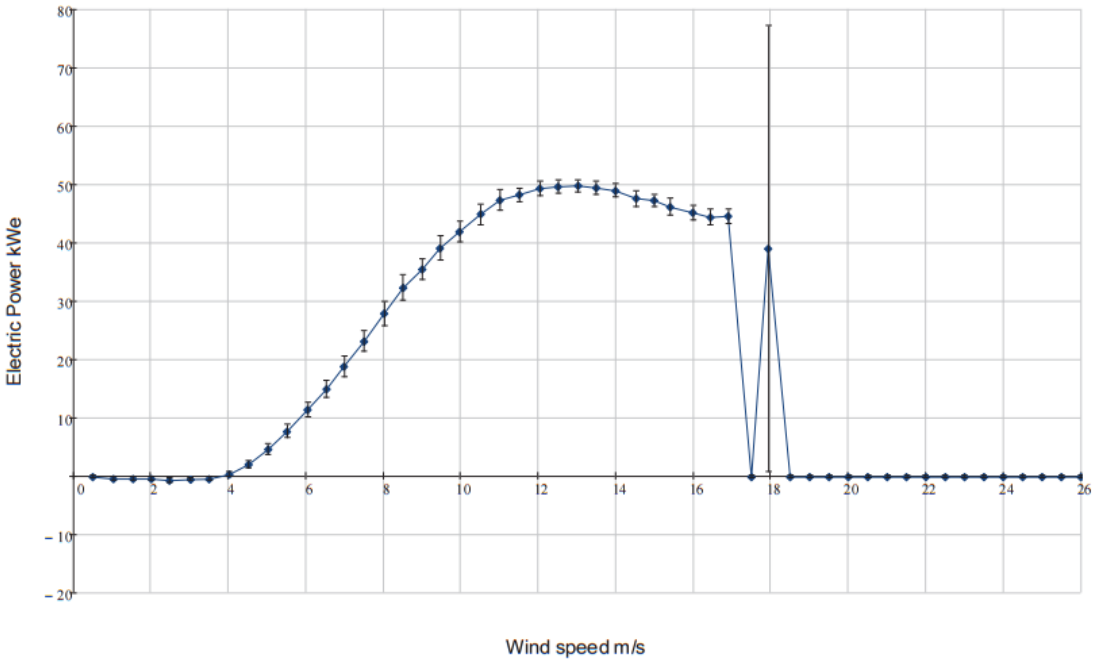


Figure 2 : Power Curve Based on 10 min average binned results.

Annual Energy Production (AEP)

Annual Energy Product, calculated as per the requirements of IEC641400-12, based on 10 min average binned data is presented in Figure 3, extracted from TUV:NEL report.

Estimated Annual Energy Production (Database A) Reference Air density: 1.225 kg/m³ Cut-out wind speed: N/A (extrapolation by constant power from last bin)				
Hub height annual avg. wind speed (Rayleigh) m/s	AEP-measured (measured power curve) kWh	Standard uncertainty in AEP kWh	Standard uncertainty in AEP %	AEP-extrapolated (extrapolated power curve) kWh
4	43287	5858.2	13.5	43287
5	86353	7808.5	9.0	86380
6	131525	9318.2	7.1	131985
7	171257	10572.7	6.2	173817
8	201165	11785.1	5.9	208950
9	220098	12941.1	5.9	236573
10	229179	13915.7	6.1	256827
11	230533	14611.7	6.3	270265

Figure 3 : AEP data, with uncertainty data.

Noise Emission

Acoustic Measurements were carried out in accordance with IEC61400-11:2002, by TUV:NEL, and results were reported in Report number 2016/328 Issue 2, release date Feb 2017.

Figure 4 is the Immission Data reported by TUV:NEL

ACOUSTIC NOISE LEVELS

Turbine Make:	Orenda	Model:	Skye

IEC 61400-11:2012 NOISE EMISSION LEVELS

Wind Speed (m/s) at Rotor Centre Height	3	4	5	6	7	8	9	10	11	12	13	14
Apparent Sound Power Level, L_{WA}, dB(A) re 10^{-12}W	84.8	85.2	89.2	90.6	91.7	91.8	91.9	92.4	93.4	95.6	96.8	98.8
Combined Uncertainty, U_c, dB	1.06	0.84	0.64	0.64	0.62	0.63	0.62	0.62	0.63	0.66	0.68	0.77
Declared Sound Power Level, L_{Wd}, dB(A) re 10^{-12}W	86.5	86.6	90.3	91.7	92.7	92.9	93.0	93.5	94.5	96.7	98.0	100.1

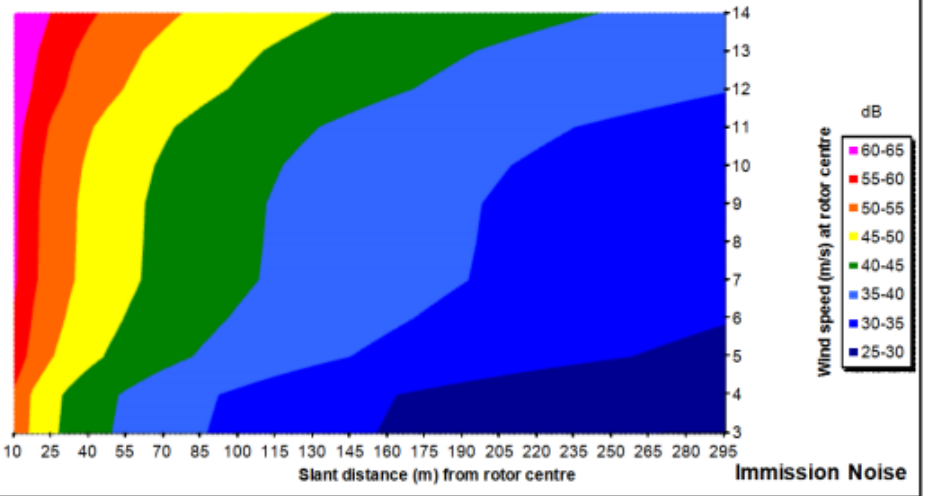
IEC 61400-11:2012 TONALITY

General Comment	0-20 kHz narrow-band analysis using Δf = 1.5625 Hz

Wind Speed (m/s) at Rotor Centre Height	3	4	5	6	7	8	9	10	11	12	13	14
Critical Band Centre Frequency (Hz)	591	591	591	-	-	-	-	-	-	-	-	-
Tonal Audibility, ΔL_a	+1.6	+2.7	+0.5	-	-	-	-	-	-	-	-	-

ESTIMATED NOISE IMMISSION LEVELS (dB(A) at a distant observer location)

Note: based on 'Apparent' Sound Power Level at Hub-height and 'Spherical' propagation.



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Feb. 2017

IEC 61400-11:2012 TONALITY

General Comment	0-20 kHz narrow-band analysis using Δf = 1.5625 Hz

Wind Speed (m/s) at Rotor Centre Height	3	4	5	6	7	8	9	10	11	12	13	14
Critical Band Centre Frequency (Hz)	6250	6250	-	-	-	-	-	-	-	-	-	-
Tonal Audibility, ΔL_a	+1.3	+2.3	-	-	-	-	-	-	-	-	-	-

Figure 4 : Orenda Skye Noise Immission map

Apparent Sound Power Level

As described in Renewable UK SWT Standard, the Apparent Sound Power level, at 8.0m/s at hub height is 91.8dB(A).