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REPORT ID: **15039.00.T209.RP3**

Cedar Point Wind Power Project – Turbine WTG10 (CP209) IEC 61400-11 Edition 3.0 Measurement Report

Prepared for:

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09 March 2018 – Revision #3

SCC Accredited CB-P/S OCPS Accrédité CCN

Revision History

Revision Number	Description	Date
1	Issued Edition 2.1 test report	September 1, 2016
2	Issued Edition 3.0 test report	November 07, 2017
3	Minor changes to report tables and appendices to correct error; Update to Edition 3.0 test report Section 3.2.1 and Appendix G Information for Regulator	March 09, 2018

This report in its entirety, including appendices contains 126 pages.

Statement Qualifications and Limitations

This report was prepared by Aercoustics Engineering Limited in accordance with International Standard IEC 61400-11 (Edition 3.0, released 2012-11), "Wind turbine generator systems – Part 11: Acoustic noise measurement techniques". This report is specific only to the Wind Turbine identified in this report.

Aercoustics Engineering Limited shall not be responsible for any events or circumstances that may have occurred since the date on which the Wind Turbine was tested and/or this report was prepared, or for any inaccuracies contained in information that was provided to Aercoustics Engineering Limited. Further, Aercoustics Engineering Limited agrees that this report represents test data analysed as per the above described standard for the specific Wind Turbine described in this report, but Aercoustics Engineering Limited makes no other representations with respect to this report or any part thereof.

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This Statement of Qualifications and Limitations is attached to and forms part of this report.

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1 Introduction

Aercoustics Engineering Limited (Aercoustics) was retained by Cedar Point II Limited Partnership to conduct an acoustic measurement of turbine WTG10 (CP209) at the Cedar Point Wind Power Project ("CPWPP"). The purpose of the measurement was to provide verification of the maximum noise emission of the turbine. The measurement was carried out in accordance with International Standard IEC 61400-11 (Edition 3.0, released 2012-11), "Wind turbine generator systems – Part 11: Acoustic noise measurement techniques". This report is specific only to Turbine WTG10 (CP209).

2 Wind Turbine Information

2.1 Wind turbine equipment specific information

Wind turbine specific equipment information for turbine WTG10 (CP209) was provided by the manufacturer and is summarized in Tables 1 – 5.

Table 1 - Wind Turbine Details

Wind Turbine Details	
Manufacturer	Siemens
Model Number	SWT2.3-113
Turbine ID	2308888

Table 2 - Operating Details

Operating Details	
Vertical or Horizontal axis wind turbine	Horizontal
Upwind or downwind rotor	Upwind rotor
Hub height	99.5 m
Horizontal distance from rotor centre to tower axis	5.5 m
Diameter of rotor	113 m
Tower type (lattice or tube)	Tubular
Passive stall, active stall, or pitch controlled turbine	Pitch controlled turbine
Constant or variable speed	Variable speed
Power curve	See Figure B.01
Rotational speed at each integer standardised wind speed	See Figure B.02
Rated power output	2030 kW
Control software version	128.2.0.1

Table 3 - Rotor Details

Rotor Details	
Rotor control devices	Pitch control
Presence of vortex generators, stall strips, serrated trailing edges	Vortex generators and dino tails
Blade type	B55
Serial number	Blade A: 550325801 Blade B: 550325101 Blade C: 550325601
Number of blades	3

Table 4 - Gearbox Details

Gearbox Details	
Manufacturer	N/A Direct drive
Model number	N/A Direct drive
Serial number	N/A Direct drive

Table 5 - Generator Details

Generator Details	
Manufacturer	Siemens
Model number	DD22_01
Serial number	5100049451

2.2 Wind Turbine Location

Turbine WTG10 (CP209) is in the Municipality of Lambton near the town of Forest, Ontario. Specific UTM coordinates for WTG10 (CP209) are 419153mE, 47777369mN, Zone 17T. The area surrounding WTG10 (CP209) is primarily flat farmland.

A general layout of the area in which the turbine is located is provided in the site plan (Figure A.01).

3 Measurement Details

3.1 Measurement Equipment

3.1.1 Acoustic Measurement Equipment

A summary of acoustic equipment utilized by Aercoustics for the measurement of turbine WTG10 (CP209) is summarized in Table 6.

Table 6 - Acoustic Measurement Equipment

Equipment	Manufacturer Name & Model	Serial Number
Acoustic Data acquisition system	LMS SCADA Mobile	22143211
Microphone	B&K 4189	2625197
Pre-amplifier	B&K 2671	2614901
Acoustic calibrator	B&K 4231	2513182

Calibration of the measurement setup was carried out before and after Aercoustics set of measurements.

3.1.2 Meteorological Equipment

Wind speed for Turbine ON was derived from the power curve (as per procedures outlined in IEC 61400-11). Wind direction for turbine ON measurements was utilized from the yaw position from turbine WTG10 (CP209). Data for background measurements was obtained from a 10m high anemometer, which was placed as per guidelines outlined in IEC-61400-11 Ed 2.1.

The meteorological equipment is summarized in Table 7

Table 7 – Meteorological Measurement Equipment

Equipment	Manufacturer Name & Model	Serial Number
Anemometer	VAISALA WXT520	K2420011
Serial to Analog Converter	NOKEVAL 7470	A165152

3.2 Measurement Setup

3.2.1 Microphone Placement

The measurement microphone was setup 155m from the base of the turbine in 'Position 1', (i.e. downwind of the turbine, as per IEC 61400-11) at an elevation of 0m relative to the base of WTG10 (CP209). The slant distance (R_1) from microphone location to rotor centre includes the distance from rotor center (hub) to tower axis (R_1 = 188.8 m). The microphone was placed in the centre of a circular, acoustically reflective board.

During the measurement period only, data points for which the microphone was within 15 degrees of downwind from the turbine were used. The microphone position relative to

downwind of the turbine was monitoring via the yaw angle output provided from the turbine system (discussed further in Section 3.5). During placement of the microphone the turbine was parked and the reference yaw angle for that measurement logged.

At the time of the acoustic test of WTG10 (CP209), the surrounding lands were covered with remnants of harvested corn stalks. The location of the microphone board was cleared and leveled out prior to board placement. The influence from reflecting surfaces was also considered to be negligible as there were no nearby reflecting surfaces (houses, barns etc.) in the vicinity of the microphone.

Photos of the measurement setup are provided in Figure A.02, Appendix A.

3.2.2 Double Windscreen Setup

A double windscreen setup was not utilized.

3.3 Measurement Schedule

Table 8 provides a summary of the test date and times. Data was logged in 10 second intervals for post-processing (as per the measurement standard).

Table 8 - Measurement Schedule Summary

Date	Test Type	Start Time	Finish time
December 1, 2016	Turbine ON	12:21	12:42
	Background	12:45	13:45
	Turbine ON	13:51	14:54
	Turbine ON	15:05	15:11
	Background	15:12	15:40
	Turbine ON	15:49	16:35

3.4 Meteorological Conditions

Detailed meteorological data relevant to the measurement is provided in Appendix E.

As previously mentioned, wind speed for Turbine ON was derived from WTG10 (CP209)'s power curve (as per the standard), while wind direction was provided by WTG10 (CP209)'s yaw position. Background data was obtained from an anemometer located 10m above ground level near WTG10 (CP209).

Temperature and pressure readings during the measurement period were provided by the 10m anemometer, located near turbine WTG10 (CP209) for the duration of Aercoustics measurements.

3.5 Turbine operational information

Output data from the turbine (Power, yaw, RPM, pitch angle, and nacelle wind speed) were obtained as analog output signals that were simultaneously acquired with the acoustic and anemometer measurement data using Aercoustics data acquisition system.

4 Measurement Results

4.1 Deviations from IEC-61400-11 Edition 3.0

Originally, the test contract required measurements in accordance to edition 2.1 of the standard (61400-11) which requires the anemometer to be placed upwind of the turbine. This test report is a reprocessing of the originally acquired data and as such during the test, the anemometer position was erected in an upwind (Ed 2.1), rather than crosswind (Ed 3.0) position relative to the test turbine.

The acoustic signal to noise ratio for the noise levels is >7.6dB. This deviation is therefore considered to be negligible to the assessment of the maximum sound power of this turbine for this test. This method is in accordance with recommendations made by the convener of the IEC 61400-11 working group and is detailed in Note N6.023.17 and provided in Appendix F.

4.2 Special Notes & Considerations

No special notes and considerations.

4.3 Analysis Details

The following section outlines analysis of the measurement data acquired for WTG10 (CP209). The data presented is exclusive of transient events such as vehicle traffic, wildlife, air traffic etc. The site has been assessed to have a roughness length of 0.05m, representative of farmland with some vegetation.

4.3.1 Double Windscreen Adjustment

As previously mentioned, no double wind screen was used, as such the measurement data did not require adjustment.

4.3.2 Wind Speed Correction

The wind speed for each measurement data point for Turbine ON was derived through the power curve (as per Section 8.2.1.1 of IEC-61400-11). For data points during Turbine ON that were outside the allowed range of the power curve, the wind speed was derived from the nacelle anemometer wind speed (as specified in Section 8.2.1.2 of IEC-61400-11).

Background wind speed was derived utilizing data acquired with the 10m anemometer and normalizing the wind speed (as per Section 8.2.2 of IEC-61400-11).

4.4 Type B uncertainties

Type B uncertainties were obtained through interpretation of information provided in Annex C of IEC-61400-11, and instrument uncertainties obtained from the calibration certificate. A summary of Type B uncertainties is provided in Table 9, while detailed information (including data in 1/3 octave) is provided in Appendix C.

Table 9 - Summary of Type B uncertainties

Component	Typical (dB)	Used (dB)
Calibration	0.2	0.2
Board	0.3	0.3
Distance & direction	0.1	0.1
Air absorption	0	0
Weather conditions	0.5	0.5
Wind speed measured	0.7	0.7
Wind speed derived	0.2	0.2
Wind speed from power curve	0.2	0.2

4.5 Sound Pressure Level Measurements

Sound pressure level measurements are summarized in Table 10. Detailed 1/3 Octave band spectrum data, respective uncertainties, and analysis plots are provided in Appendix C. A copy of the measurement data used for analysis is provided in Appendix E and includes meteorological and turbine operational data.

Table 10 - Summary of Sound Pressure Level Measurements

Wind Speed (m/s)	Turbine ON		Background		Turbine ON, Background adjusted L_{eq}, (dBA)
	L_{eq}, (dBA)	# of data pts	L_{eq}, (dBA)	# of data pts	
7	50.2	21	39.5	13	49.8
7.5	51.7	21	39.9	20	51.4
8	51.9	21	42.0	16	51.5
8.5	52.1	23	40.8	25	51.7
9	52.0	17	42.2	30	51.6
9.5	51.8	61	42.4	37	51.3
10	51.9	85	43.7	32	51.2
10.5	52.1	83	44.2	37	51.3
11	52.1	105	44.4	35	51.3
11.5	52.2	61	44.2	30	51.5

4.6 Sound Power Level of Turbine

The calculated sound power level of the turbine WTG10 (CP209) (as per IEC 61400-11) is summarized in Table 11 (hub height) and Table 12 (10m height). Detailed 1/3 Octave band spectrum data and respective uncertainties are provided in Appendix C.

Table 11 - $L_{WA,K}$ at each integer wind speed

Wind Speed (m/s)	Apparent L_{WA}, (dBA)	Uncertainty (dB)
7	100.3	0.8
7.5	101.9	0.8
8	102.0	0.8
8.5	102.2	0.8
9	102.1	0.8
9.5	101.8	0.8
10	101.7	0.9
10.5	101.8	0.9
11	101.8	0.9
11.5	102.0	0.9

Table 12 - $L_{WA\ 10m,K}$ at each integer wind speed

Wind Speed (m/s)	Apparent L_{WA}, (dBA)	Uncertainty (dB)
5	100.9	0.8
6	102.1	0.8
7	101.7	0.9
8	101.9	0.8
9	102.0	1.1

4.7 Tonality Analysis

The tonality analysis for Turbine WTG10 (CP209) is summarized in Table 13, while plots of narrow band spectra at each wind speed are provided in Appendix D. The ΔL_{tn} and ΔL_a values reported represent the energy average of all data points with an identified tone that falls within the same frequency origin (as specified in Section 9.5.8 in IEC-61400-11).

The narrow band spectra provided in the plots represents an energy average of all data points in the given wind speed bin for both Turbine ON and Background.

Table 13 - Tonality Assessment Summary

Wind Speed (m/s)	Frequency (Hz)	Tonality, ΔL_{tn} (dB)	Tonal audibility, ΔL_a (dB)	FFT's with tones	Total # of FFT's	Presence (%)
7	59	-3.4	-1.4	21	21	100%
8	60	-4.0	-2.0	16	21	76%
8.5	61	-3.5	-1.5	17	23	74%
9	61	-2.6	-0.6	8	17	47%
9.5	59	-2.7	-0.7	25	61	41%
9.5	127	-4.5	-2.5	25	61	41%
10	61	-1.5	0.5	44	85	52%
10.5	61	-1.6	0.4	43	83	52%
11	60	-1.8	0.2	49	105	47%
11.5	59	-1.7	0.3	25	61	41%

5 Closure

Measurements and analysis as per International IEC 61400-11 (Edition 3.0, released 2012-11), "Wind turbine generator systems – Part 11: Acoustic noise measurement techniques" were carried on Turbine WTG10 (CP209) of the Cedar Point Wind Power Project on December 1st, 2016.

Should you have any questions or comments please do not hesitate to contact the authors of this report.

6 References

1. International Standard IEC 61400-11 (Edition 3.0, released 2012-11), "Wind turbine generator systems – Part 11: Acoustic noise measurement techniques".

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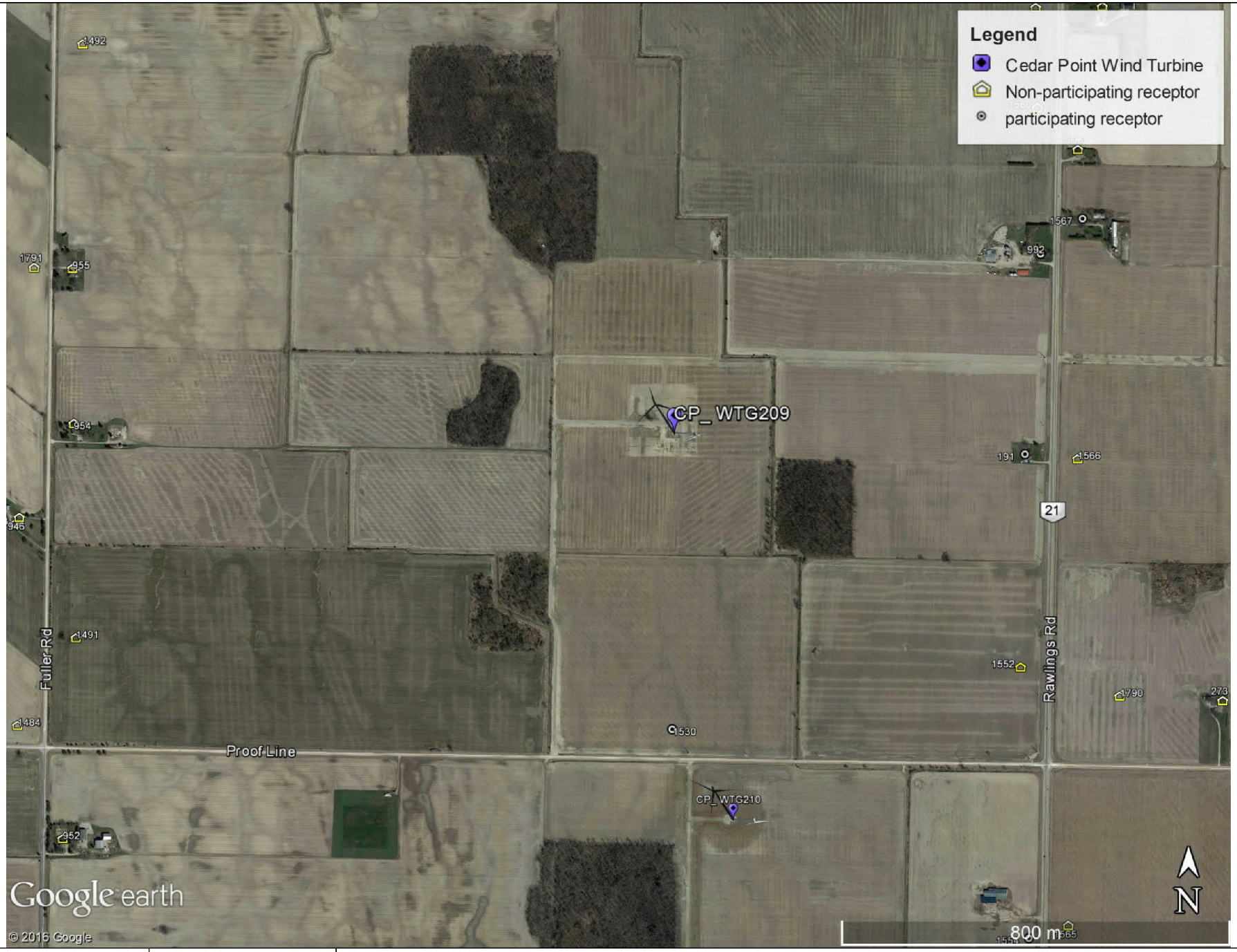
Appendix A
Site Details



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Reviewed by: PA
Date: Mar 07, 2018
Revision: 1

Project Name

Cedar Point Wind Power Project - Turbine CP209 - IEC61400-11 Edition 3.0

Figure Title

Site Plan

Figure A.01

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Scale: NTS
Drawn by: AM
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Date: Mar 7, 2018
Revision: 1

Project Name

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Figure Title

Site Photos

Figure A.02

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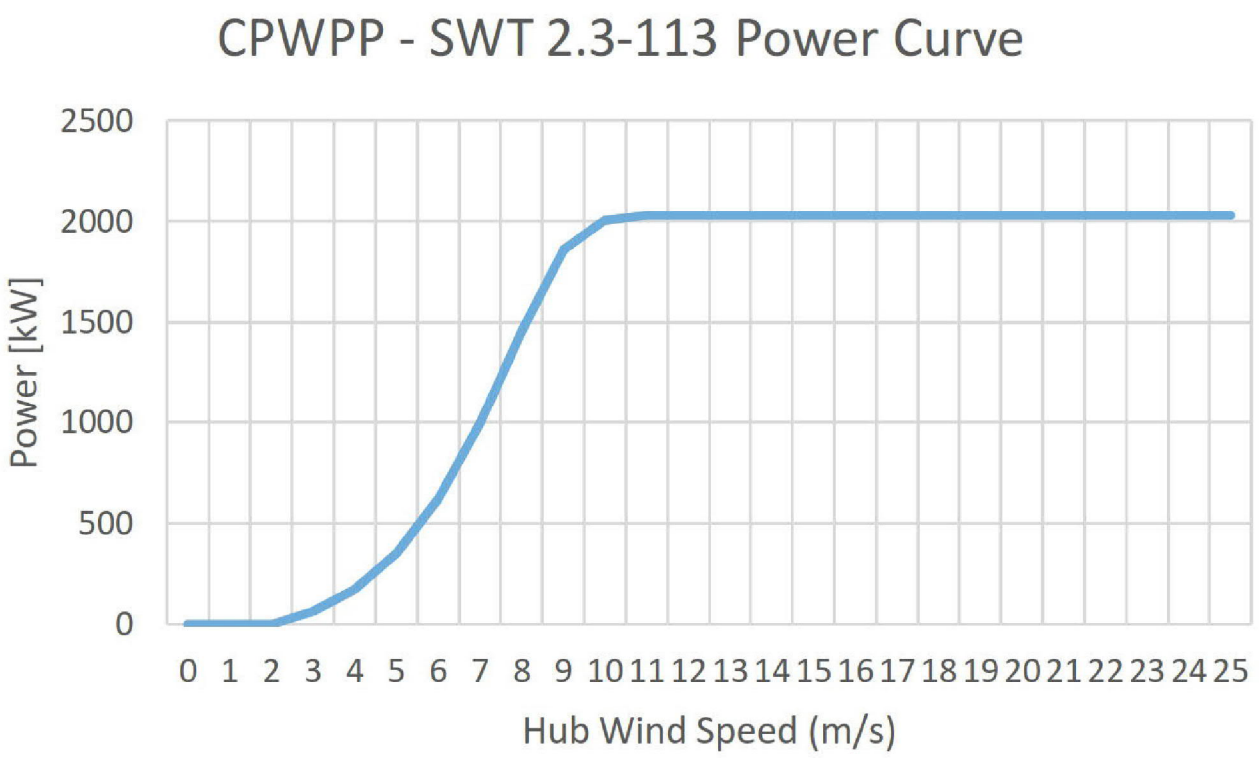
Appendix B
Turbine Information



Power Curve	
Hub Wind Speed (m/s)	Power [kW]
0	0
1	0
2	0
3	66
4	171
5	350
6	620
7	994
8	1454
9	1862
10	2005
11	2029
12	2030
13	2030
14	2030
15	2030
16	2030
17	2030
18	2030
19	2030
20	2030
21	2030
22	2030
23	2030
24	2030
25	2030

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Revision: 1

Project Name

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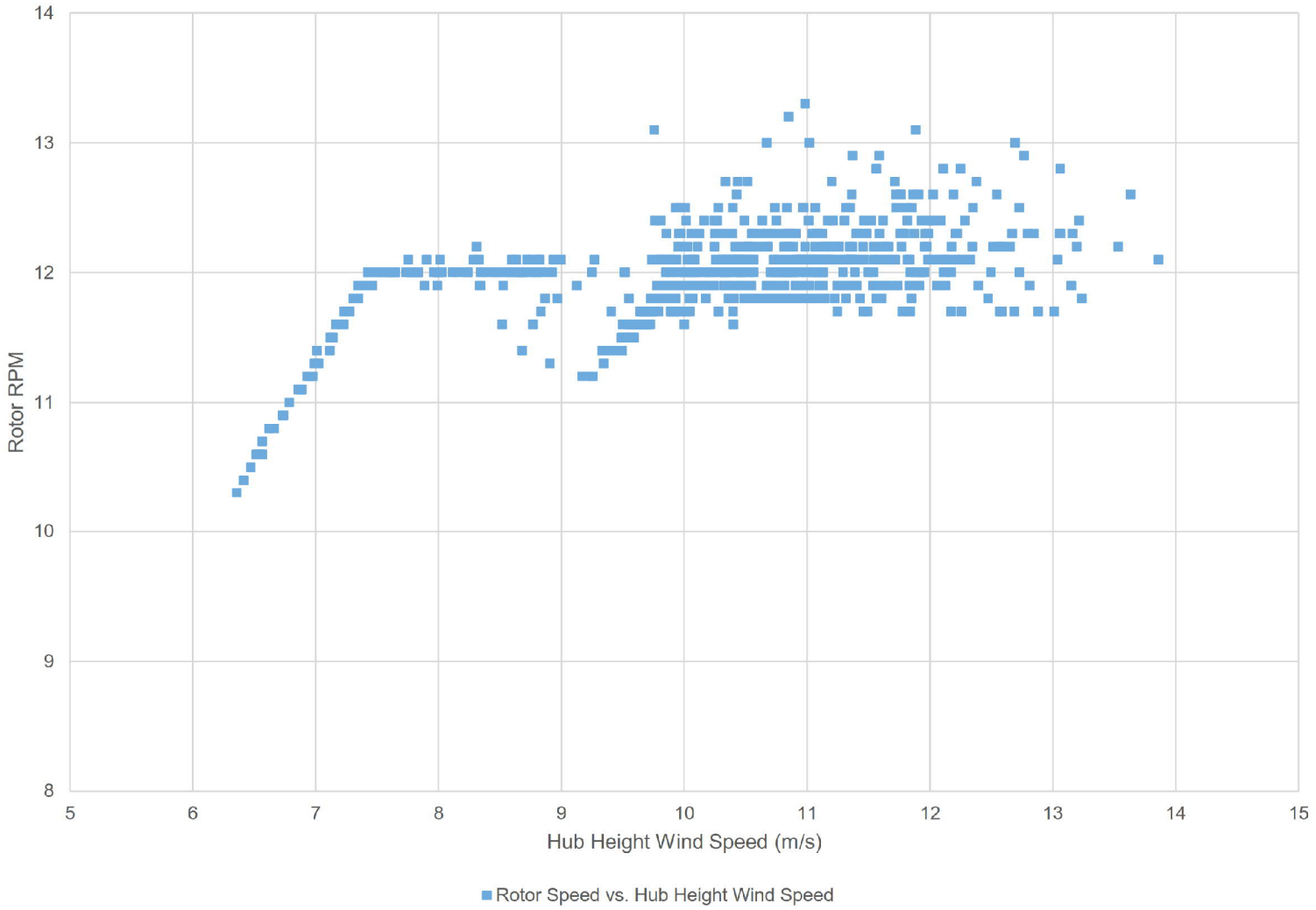
Figure Title

Power Curve

Figure B.01



aercoustics	15039.00.T209.RP3 Scale: NTS Drawn by: AM Reviewed by: PA Date: Mar 07, 2018 Revision: 1	**Project Name** Cedar Point Wind Power Project - Turbine CP209 - IEC61400-11 Edition 3.0 **Figure Title** Rotor RPM vs. wind speed

Figure B.02

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Appendix C
Apparent Sound Power Level

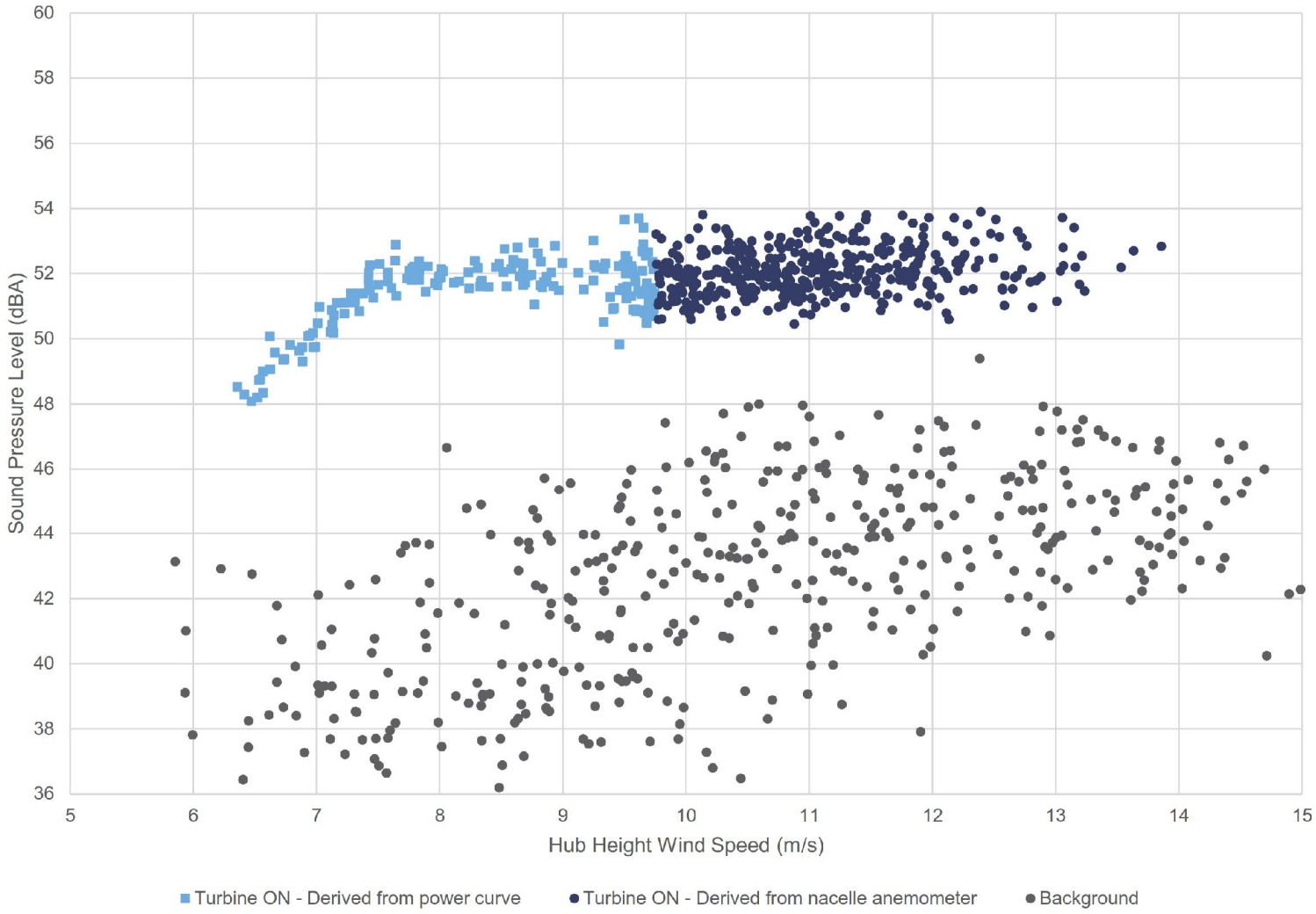

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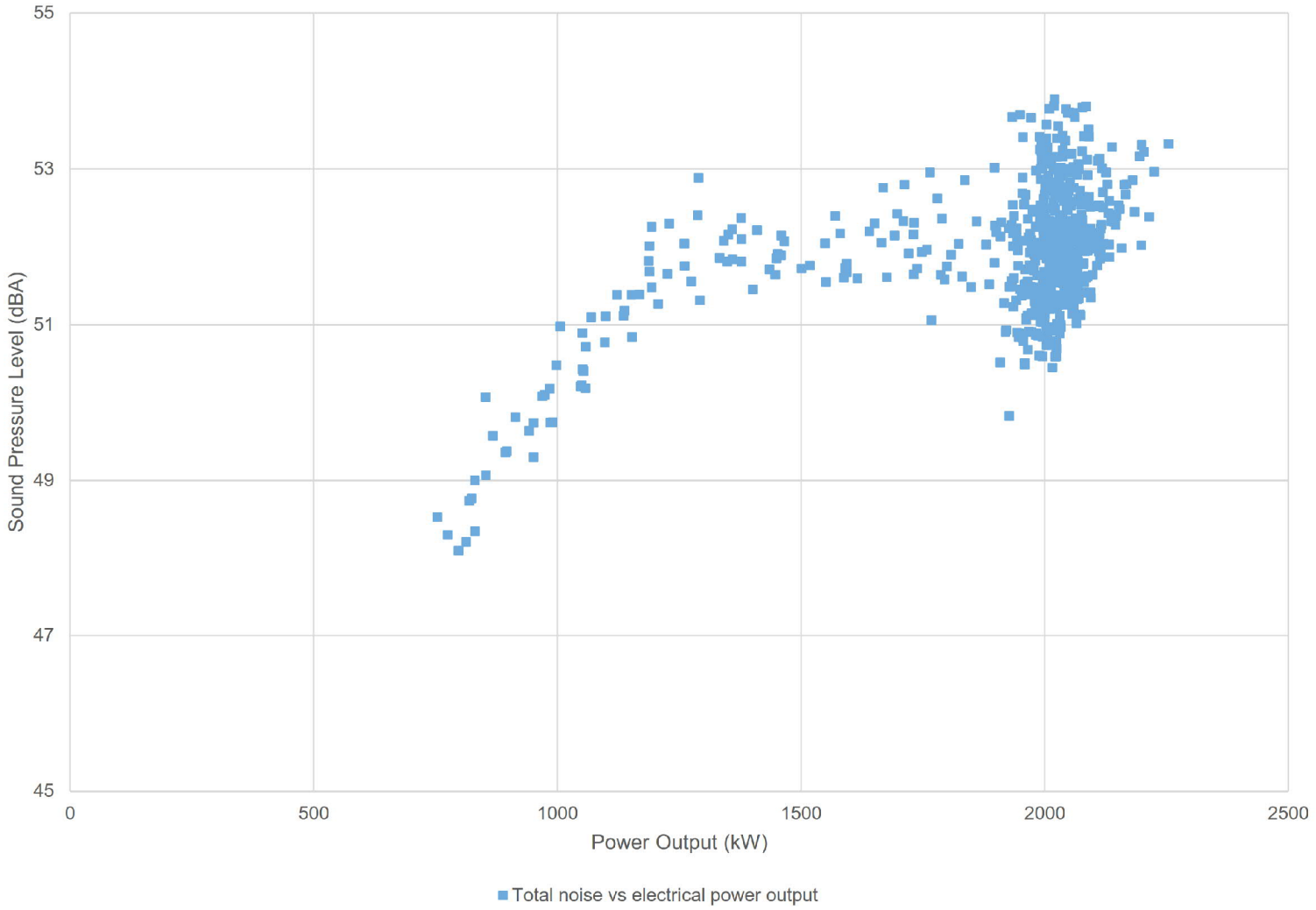
		Figure Title Plot of overall measurement data pairs at Position 1 (Turbine ON & Background)
		Figure C.01



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	Scale: NTS Drawn by: AM Reviewed by: PA Date: Mar 07, 2018 Revision: 1	Cedar Point Wind Power Project - Turbine CP209 - IEC61400-11 Edition 3.0
		Figure Title Plot of measured total noise vs electrical power output
		Figure C.02

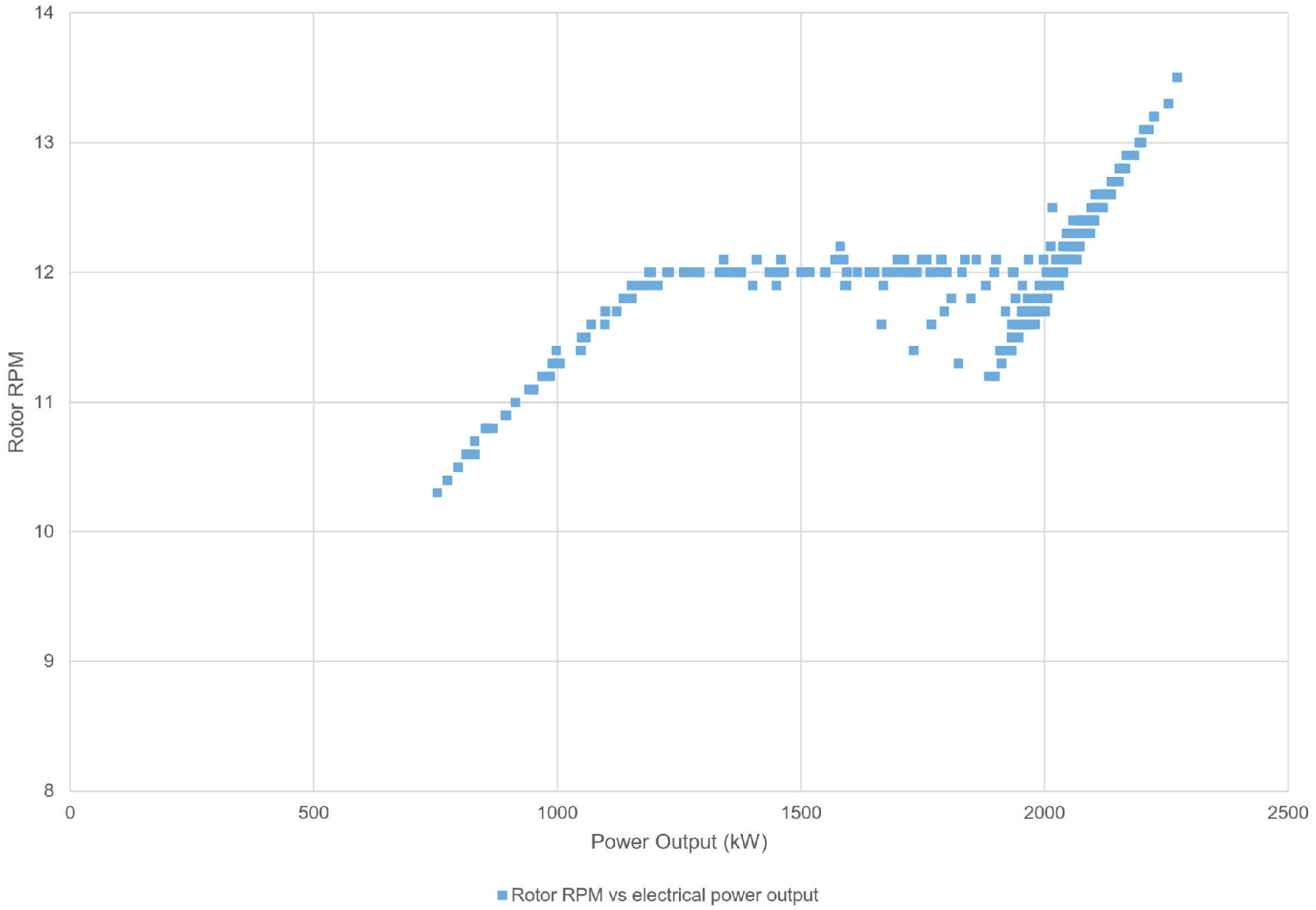

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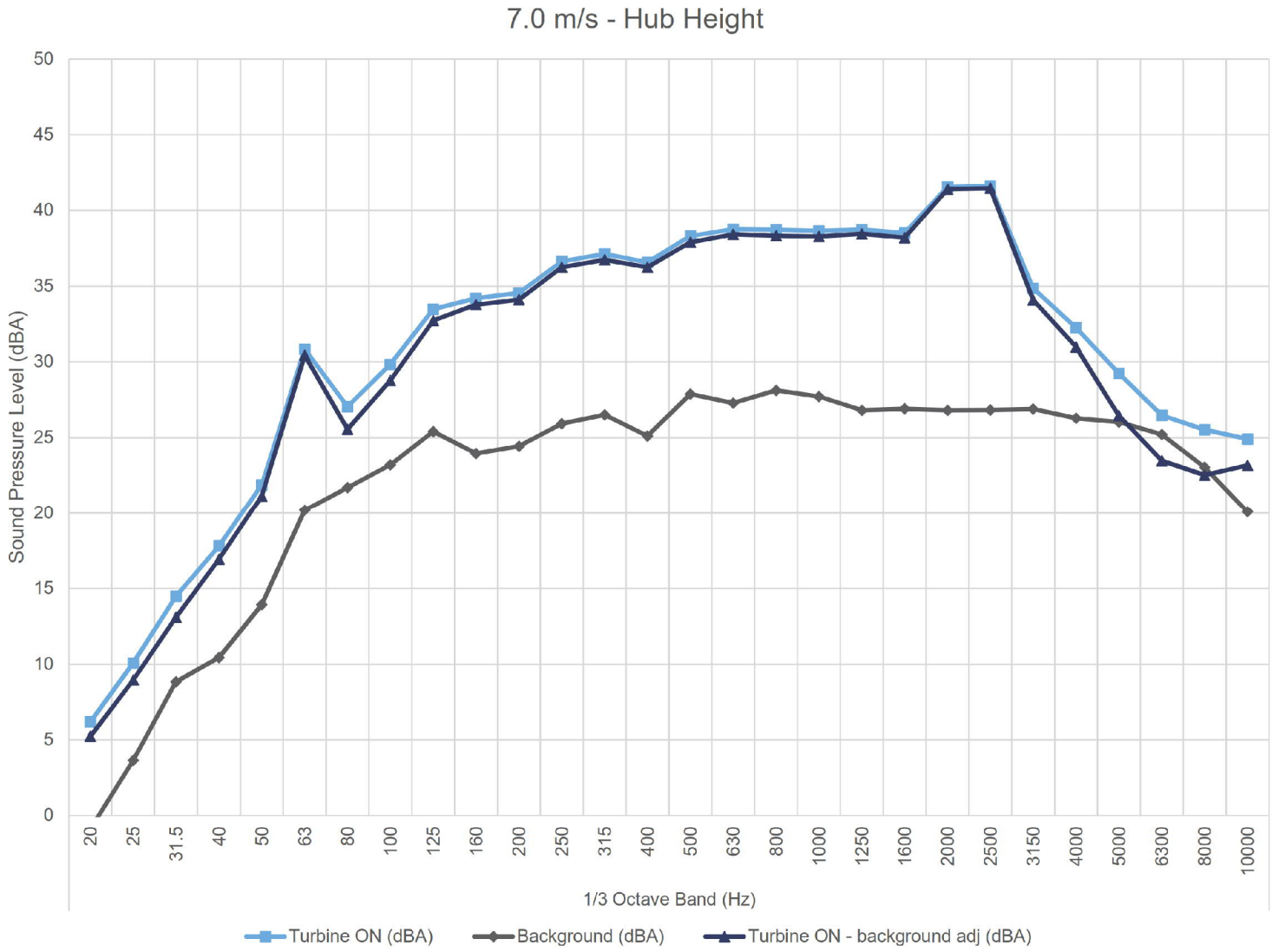
		Figure Title Plot of rotor RPM vs. electrical power output
		Figure C.04



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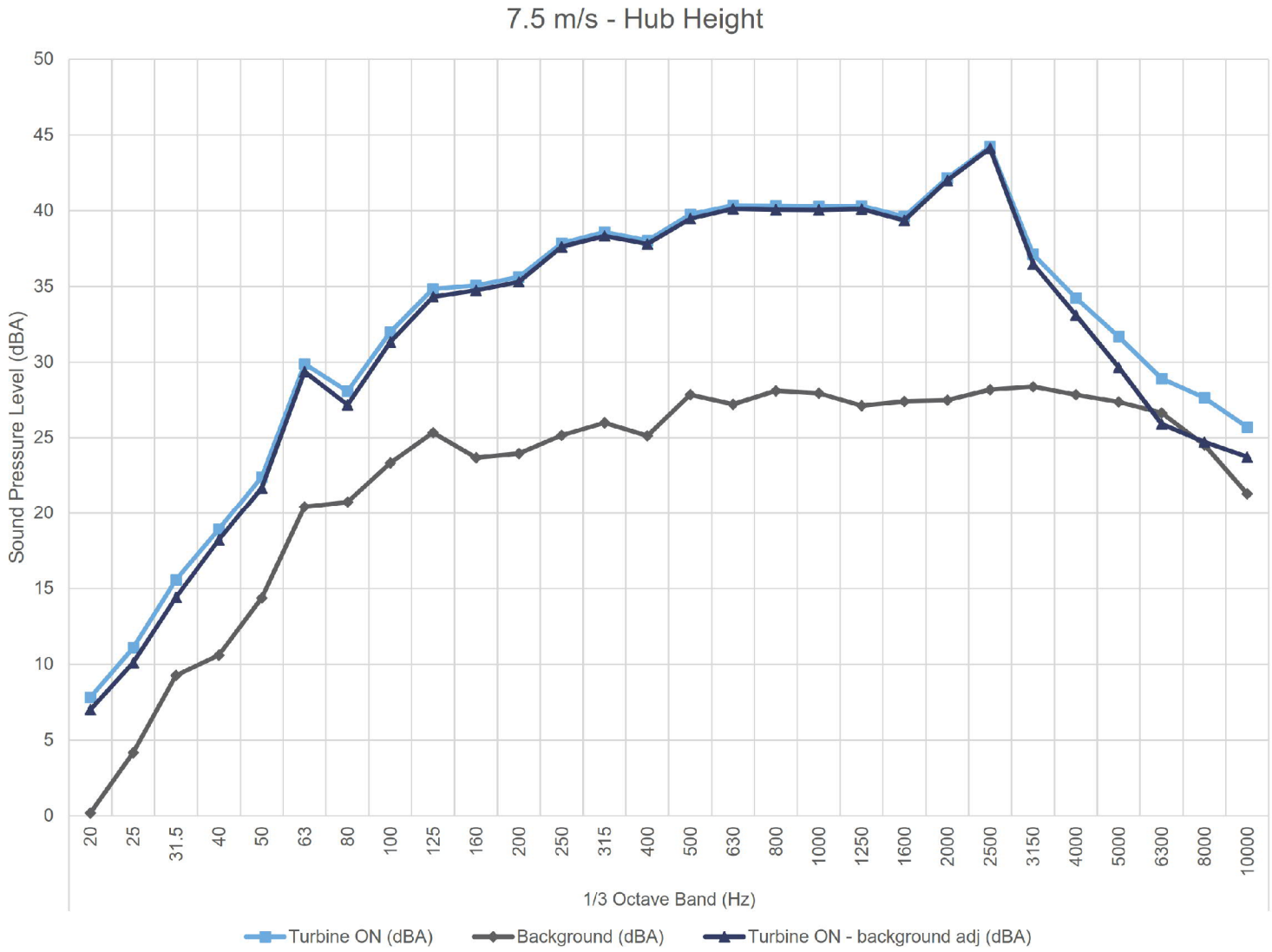
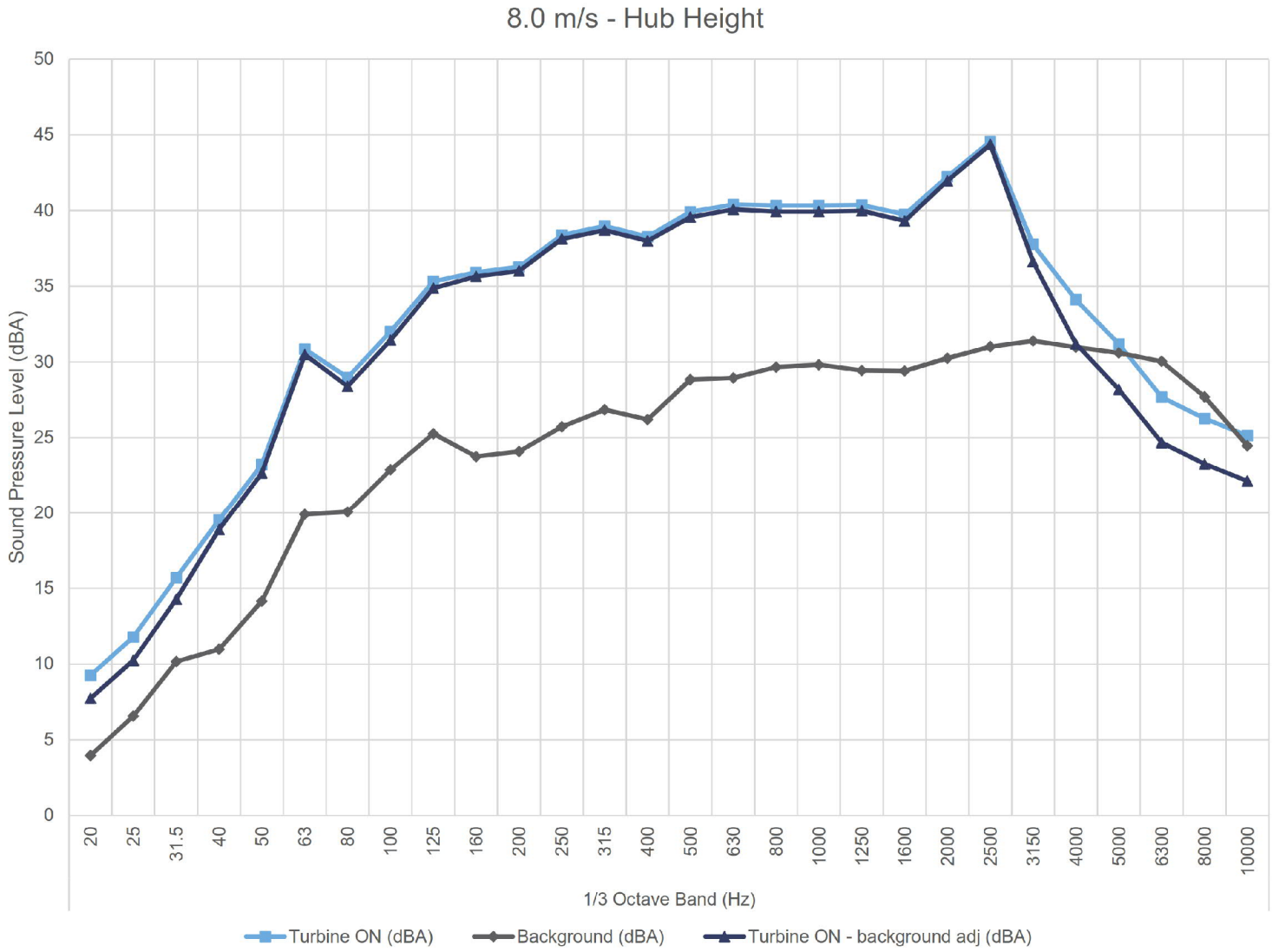
Scale: NTS Drawn by: AM Reviewed by: PA Date: Mar 07, 2018 Revision: 1	Cedar Point Wind Power Project - Turbine CP209 - IEC61400-11 Edition 3.0
	Figure Title Plot of sound pressure spectrum in 1/3 Octave at 7 m/s

Figure C.05



aercoustics	15039.00.T209.RP3 Scale: NTS Drawn by: AM Reviewed by: PA Date: Mar 07, 2018 Revision: 1	**Project Name** Cedar Point Wind Power Project - Turbine CP209 - IEC61400-11 Edition 3.0 **Figure Title** Plot of sound pressure spectrum in 1/3 Octave at 7.5 m/s

Figure C.06



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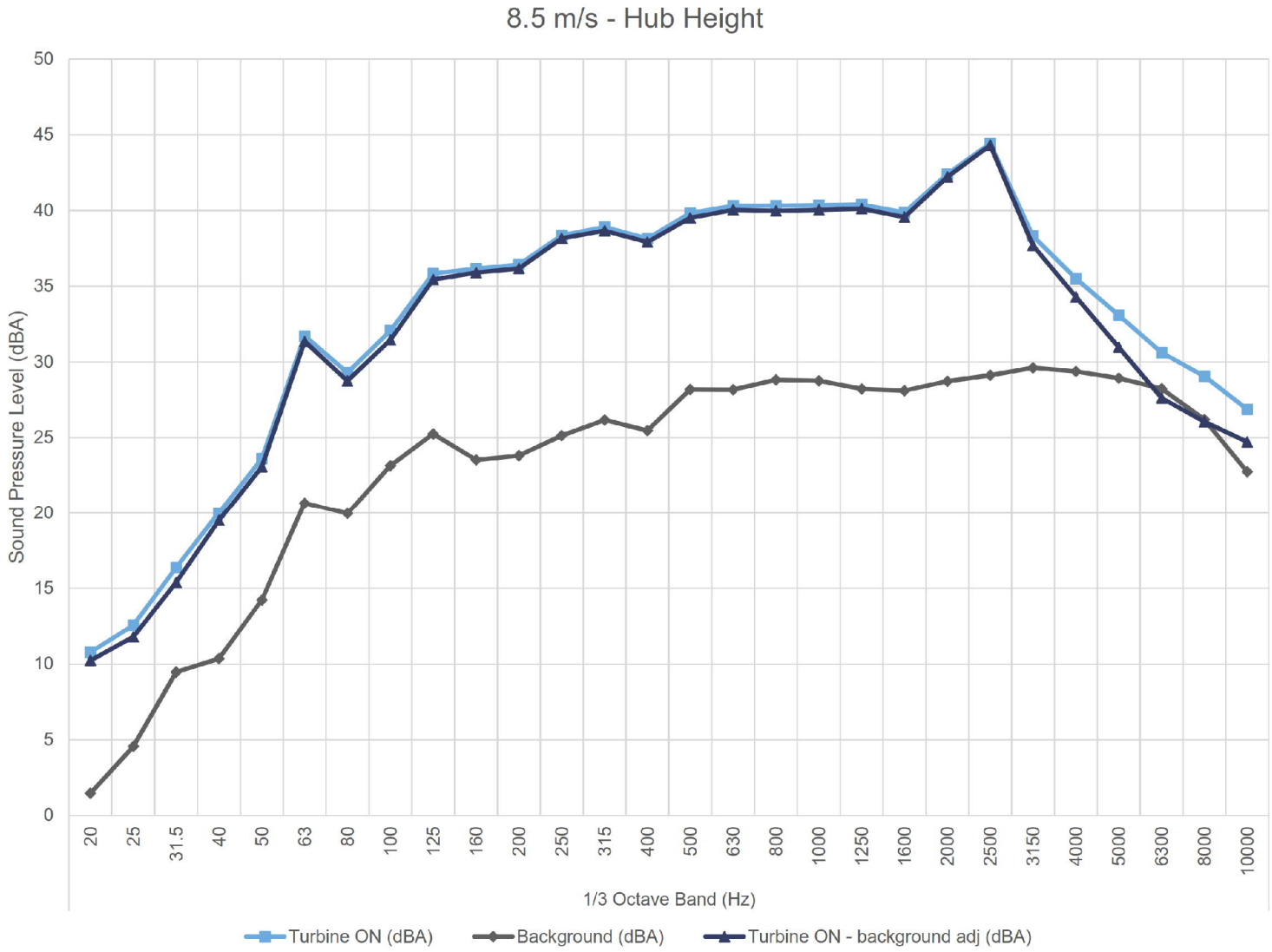
Scale: NTS Drawn by: AM Reviewed by: PA Date: Mar 07, 2018 Revision: 1	Cedar Point Wind Power Project - Turbine CP209 - IEC61400-11 Edition 3.0
	Figure Title Plot of sound pressure spectrum in 1/3 Octave at 8 m/s

Figure C.07



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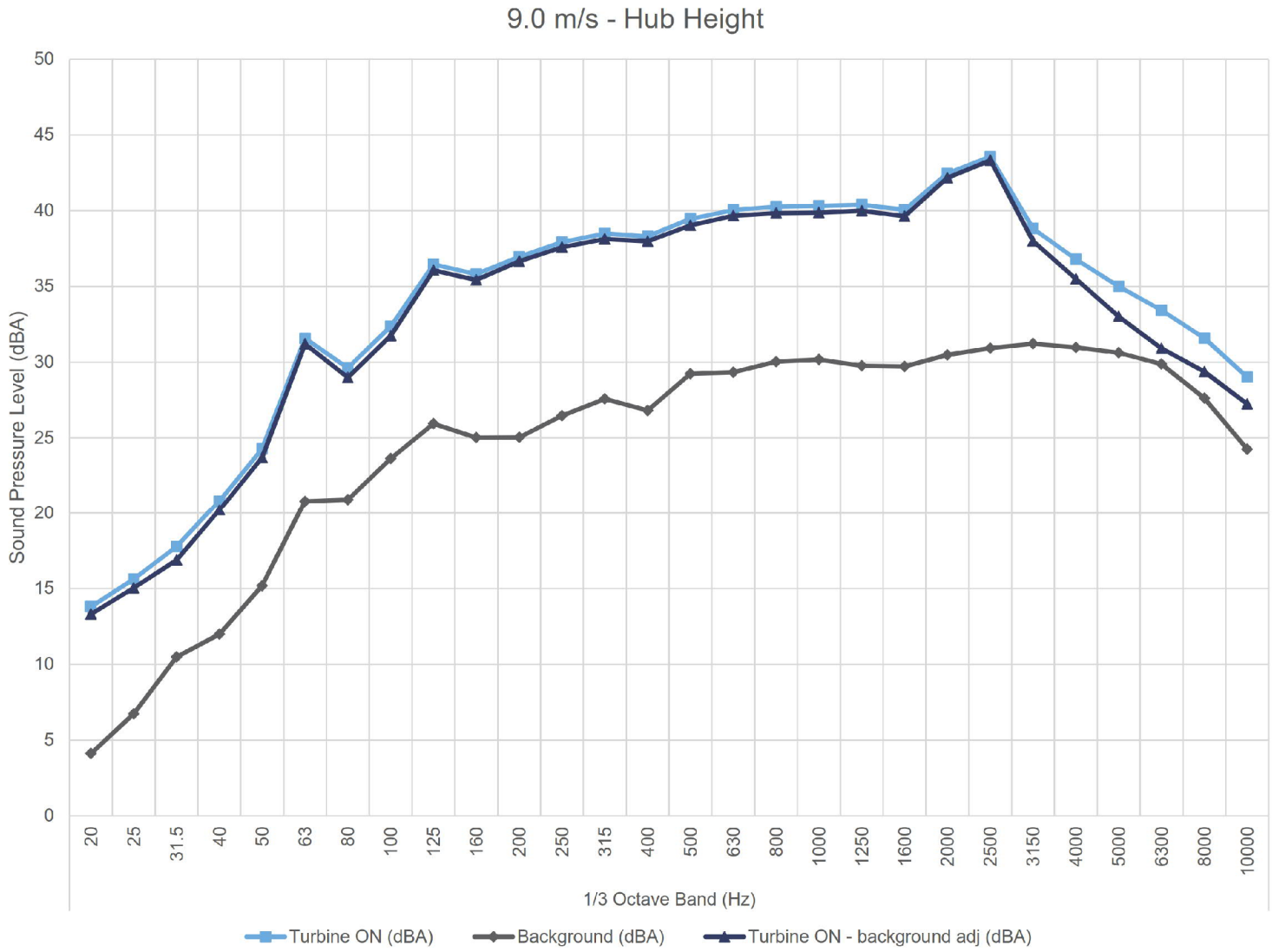
Scale: NTS Drawn by: AM Reviewed by: PA Date: Mar 07, 2018 Revision: 1	Cedar Point Wind Power Project - Turbine CP209 - IEC61400-11 Edition 3.0
	Figure Title Plot of sound pressure spectrum in 1/3 Octave at 8.5 m/s

Figure C.08



aercoustics	15039.00.T209.RP3 Scale: NTS Drawn by: AM Reviewed by: PA Date: Mar 07, 2018 Revision: 1	**Project Name** Cedar Point Wind Power Project - Turbine CP209 - IEC61400-11 Edition 3.0 **Figure Title** Plot of sound pressure spectrum in 1/3 Octave at 9 m/s

Figure C.09

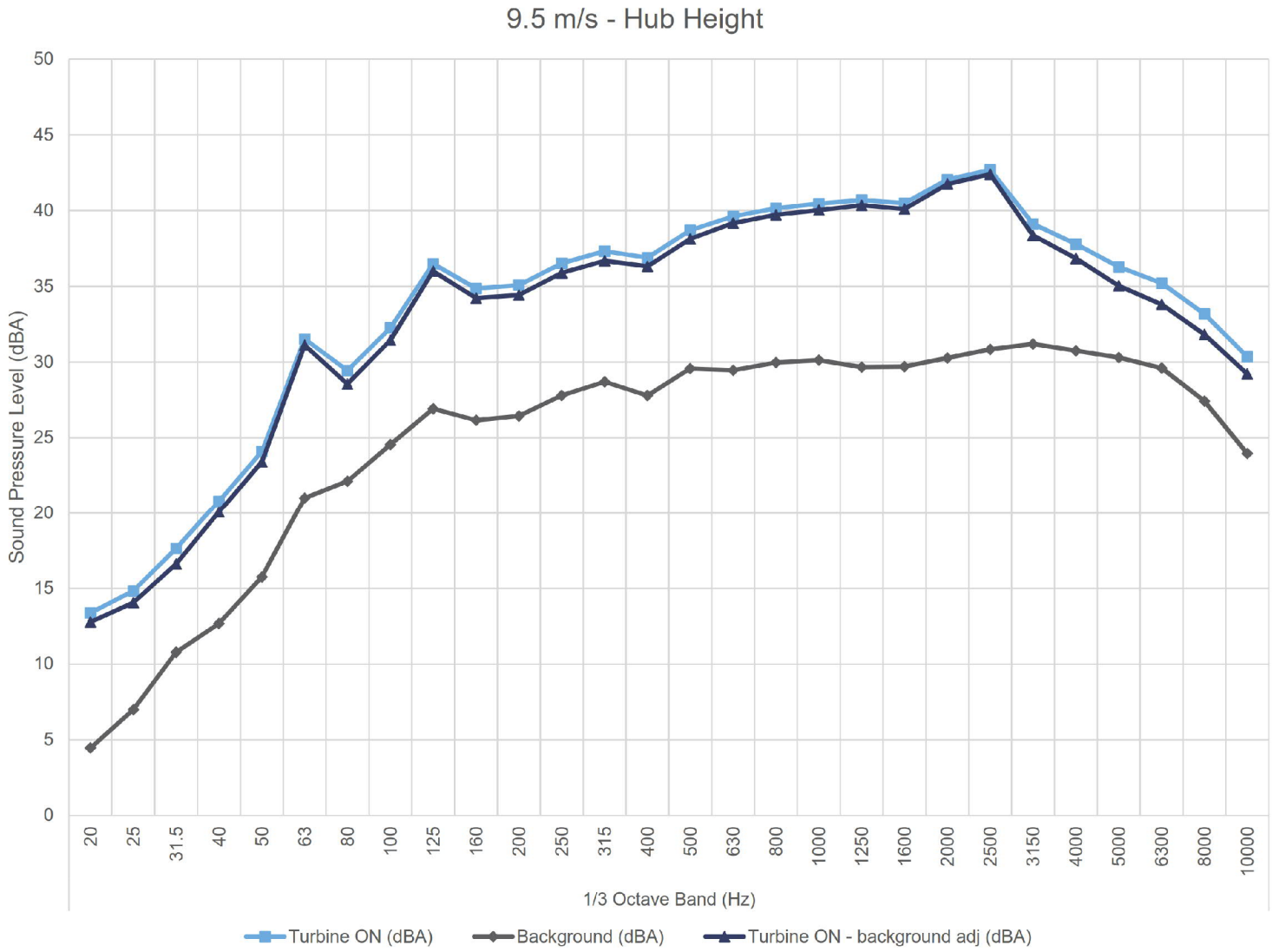


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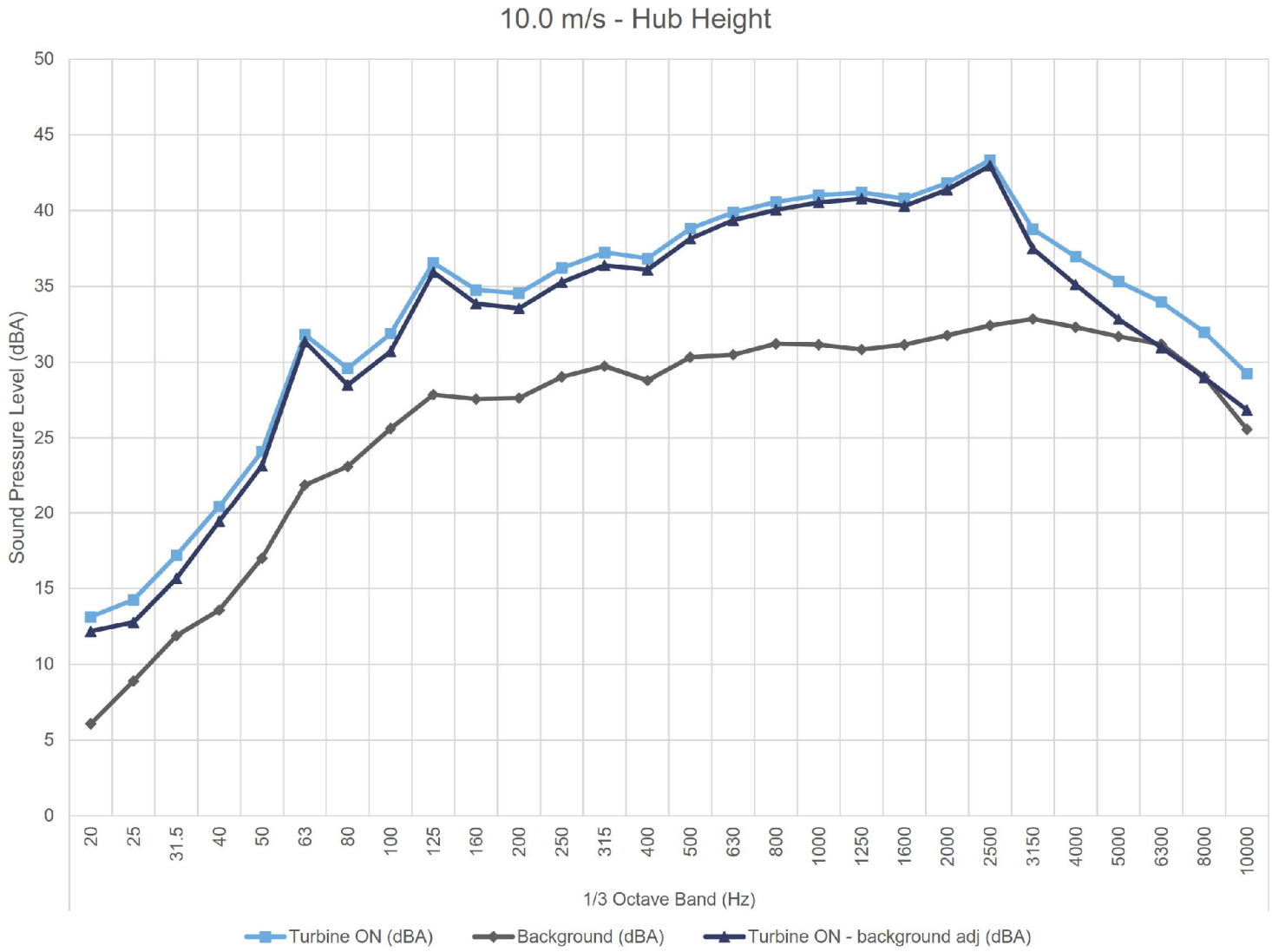
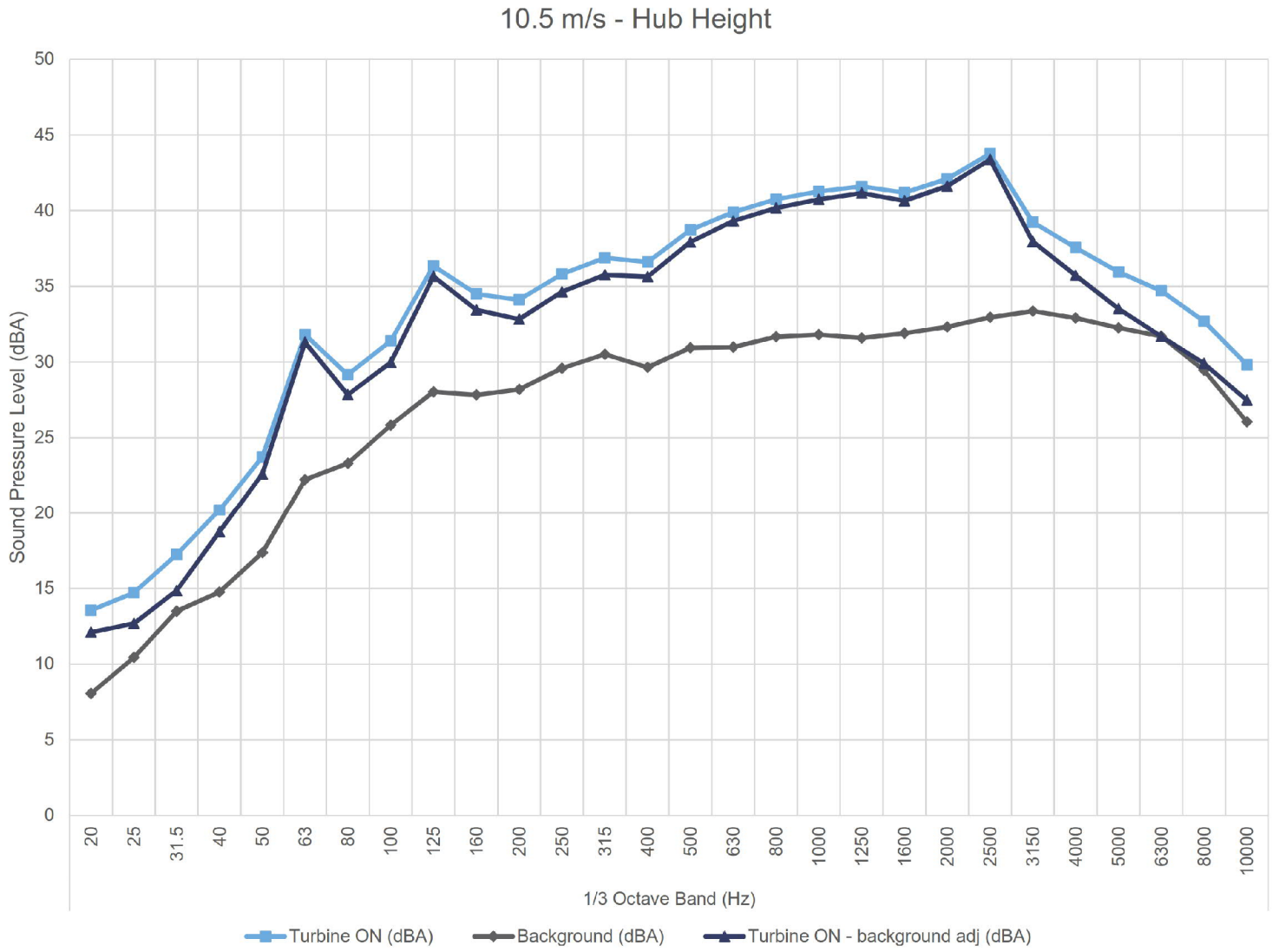
Figure C.10



aercoustics	15039.00.T209.RP3 Scale: NTS Drawn by: AM Reviewed by: PA Date: Mar 07, 2018 Revision: 1	**Project Name** Cedar Point Wind Power Project - Turbine CP209 - IEC61400-11 Edition 3.0 **Figure Title** Plot of sound pressure spectrum in 1/3 Octave at 10 m/s

Figure C.11



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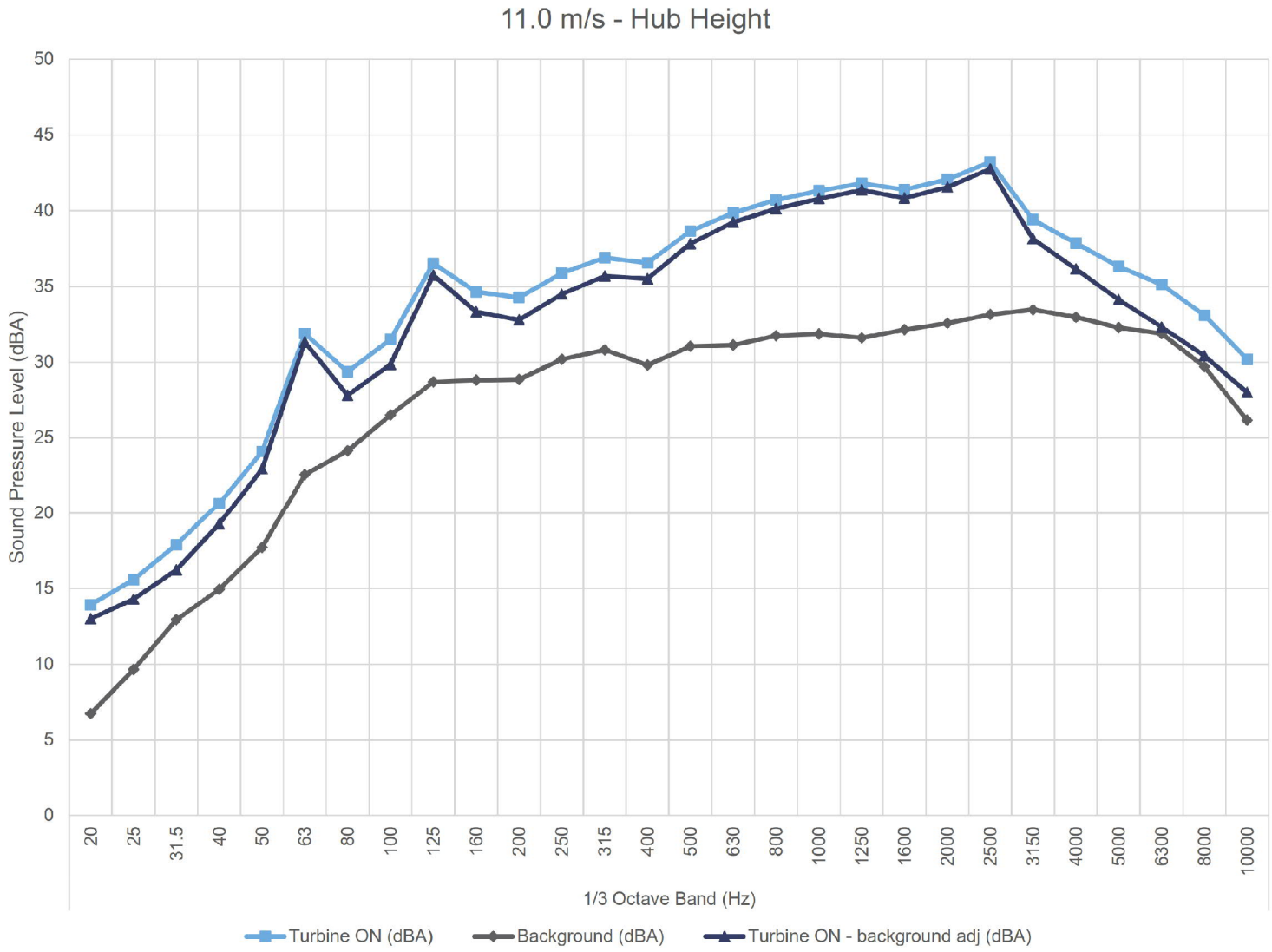
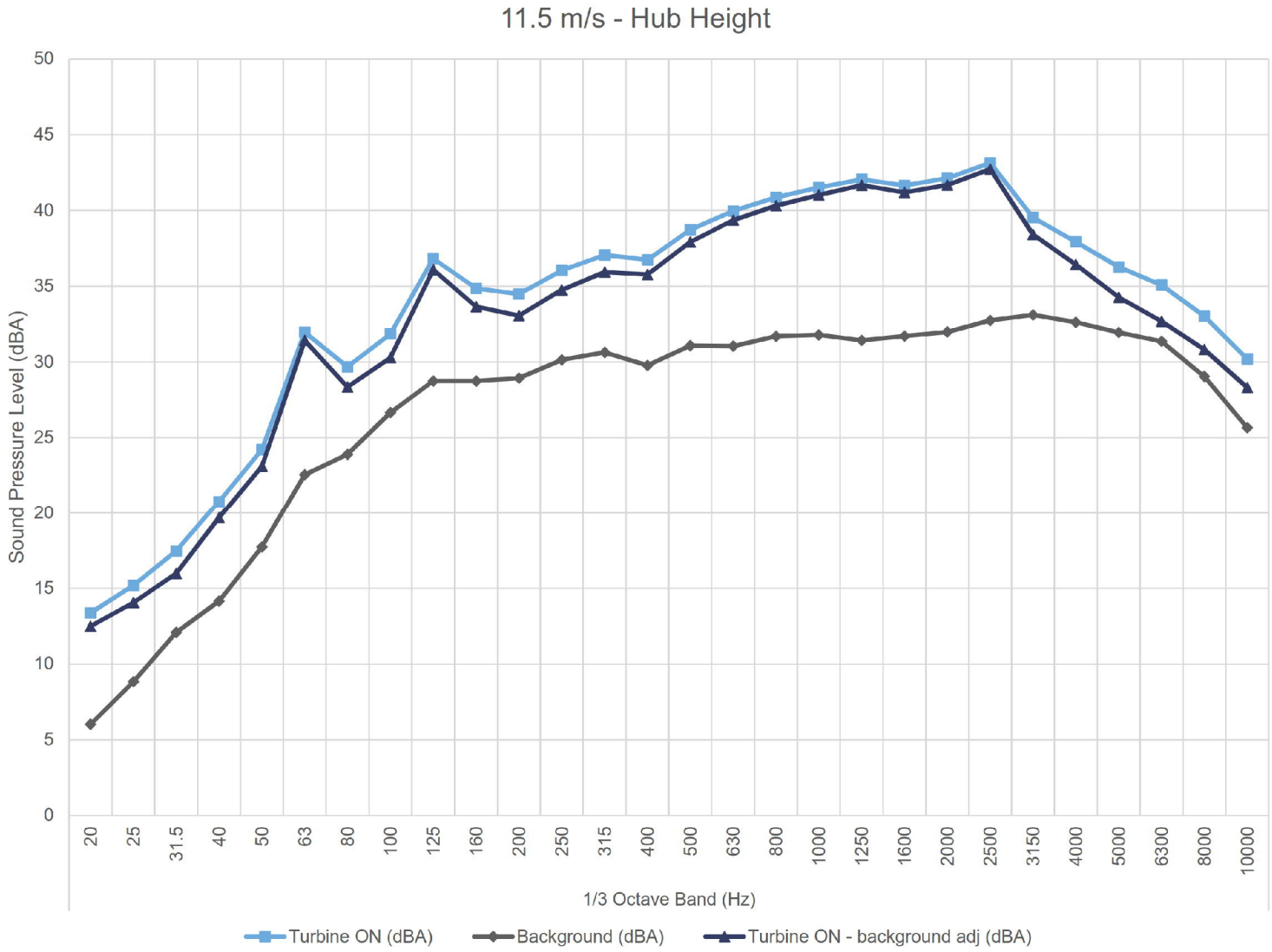
Scale: NTS Drawn by: AM Reviewed by: PA Date: Mar 07, 2018 Revision: 1	Cedar Point Wind Power Project - Turbine CP209 - IEC61400-11 Edition 3.0
	Figure Title Plot of sound pressure spectrum in 1/3 Octave at 10.5 m/s

Figure C.12



aercoustics	15039.00.T209.RP3 Scale: NTS Drawn by: AM Reviewed by: PA Date: Mar 07, 2018 Revision: 1	**Project Name** Cedar Point Wind Power Project - Turbine CP209 - IEC61400-11 Edition 3.0 **Figure Title** Plot of sound pressure spectrum in 1/3 Octave at 11 m/s

Figure C.13



aercoustics	15039.00.T209.RP3 Scale: NTS Drawn by: AM Reviewed by: PA Date: Mar 07, 2018 Revision: 1	**Project Name** Cedar Point Wind Power Project - Turbine CP209 - IEC61400-11 Edition 3.0 **Figure Title** Plot of sound pressure spectrum in 1/3 Octave at 11.5 m/s

Figure C.14

Table C.01 Detailed apparent sound power level data at hub height

Project: Cedar Point Wind Power Project - Turbine CP209 - IEC 61400-11 Measurement

Report ID: 15039.00.T209.RP3

Created on: 3/7/2018

1/3 Octave values marked with brackets [ ] denote less than 3 dB difference between Turbine ON and Background

Overall levels marked with an asterisk * denote 3 to 6 dB difference between Turbine ON and Background, while Overall values with less than 3 dB difference between Turbine ON and Background are not reported

Wind Bin (m/s)	Parameter	1/3 Octave Band (Hz)																													Overall
		20	25	31.5	40	50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000	6300	8000	10000	
7.0	Turbine ON (dBA)	6.2	10.1	14.5	17.8	21.9	30.8	27.1	29.8	33.5	34.2	34.6	36.6	37.1	36.6	38.3	38.8	38.7	38.7	38.8	38.5	41.6	41.6	34.9	32.3	29.3	26.5	25.5	24.9		50.2
	Background (dBA)	-0.9	3.6	8.8	10.4	13.9	20.2	21.7	23.2	25.4	24.0	24.4	25.9	26.5	25.1	27.9	27.3	28.1	27.7	26.8	26.9	26.8	26.8	26.9	26.3	26.0	25.2	23.0	20.1		39.5
	Turbine ON - background adj (dBA)	5.2	9.0	13.1	16.9	21.1	30.5	25.6	28.8	32.7	33.8	34.1	36.3	36.7	36.3	37.9	38.4	38.3	38.3	38.5	38.2	41.4	41.5	34.1	31.0	26.5	[23.5]	[22.5]	23.2		49.8
	Signal to noise (dB)	7.1	6.4	5.7	7.4	8.0	10.6	5.4	6.6	8.1	10.2	10.1	10.7	10.6	11.5	10.4	11.5	10.6	10.9	11.9	11.6	14.7	14.8	8.0	6.0	3.2	1.3	2.5	4.8		10.7
	Uncertainty (dB)	1.2	1.3	1.1	0.9	0.9	0.8	1.1	1.0	1.0	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.9	1.1	1.8	2.2	2.0	2.1		0.8
	PWL (dBA)	55.7	59.5	63.6	67.4	71.6	81.0	76.1	79.3	83.3	84.3	84.6	86.8	87.3	86.8	88.4	89.0	88.9	88.8	89.0	88.7	91.9	92.0	84.6	81.5	77.0	[74]	[73]	73.7		100.3
7.5	Turbine ON (dBA)	7.8	11.1	15.6	18.9	22.4	29.9	28.1	32.0	34.8	35.1	35.6	37.9	38.6	38.0	39.8	40.4	40.3	40.3	40.3	39.6	42.2	44.2	37.1	34.2	31.7	28.9	27.6	25.7		51.7
	Background (dBA)	0.2	4.2	9.3	10.6	14.4	20.4	20.8	23.3	25.3	23.7	24.0	25.2	26.0	25.1	27.9	27.2	28.1	28.0	27.1	27.4	27.5	28.2	28.4	27.9	27.4	26.7	24.5	21.3		39.9
	Turbine ON - background adj (dBA)	7.0	10.1	14.4	18.2	21.7	29.4	27.2	31.3	34.3	34.7	35.3	37.6	38.3	37.8	39.5	40.1	40.1	40.0	40.1	39.4	42.0	44.1	36.5	33.1	29.7	[25.9]	24.7	23.8		51.4
	Signal to noise (dB)	7.6	6.9	6.3	8.3	8.1	9.5	7.3	8.6	9.5	11.4	11.7	12.7	12.6	12.9	11.9	13.1	12.2	12.4	13.2	12.2	14.7	16.0	8.7	6.4	4.3	2.3	3.1	4.4		11.8
	Uncertainty (dB)	1.2	1.3	1.0	0.9	0.9	0.9	1.0	1.0	1.0	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.9	1.1	1.6	2.5	2.3	2.4		0.8
	PWL (dBA)	57.5	60.6	64.9	68.7	72.2	79.9	77.7	81.9	84.8	85.3	85.8	88.1	88.9	88.3	90.0	90.6	90.6	90.6	90.6	89.9	92.5	94.6	87.0	83.6	80.2	[76.4]	75.2	74.3		101.9
8.0	Turbine ON (dBA)	9.3	11.8	15.7	19.5	23.2	30.9	29.0	32.0	35.3	35.9	36.3	38.4	39.0	38.3	39.9	40.4	40.3	40.3	40.4	39.7	42.2	44.6	37.8	34.1	31.2	27.7	26.3	25.1		51.9
	Background (dBA)	4.0	6.6	10.2	11.0	14.1	19.9	20.1	22.9	25.3	23.8	24.1	25.7	26.8	26.2	28.8	28.9	29.7	29.8	29.4	29.4	30.2	31.0	31.4	31.0	30.6	30.0	27.7	24.5		42.0
	Turbine ON - background adj (dBA)	7.7	10.2	14.3	18.9	22.7	30.5	28.4	31.4	34.9	35.6	36.0	38.1	38.7	38.0	39.6	40.1	39.9	39.9	40.0	39.3	42.0	44.4	36.6	31.2	[28.2]	[24.7]	[23.3]	[22.1]		51.5
	Signal to noise (dB)	5.3	5.2	5.5	8.6	9.1	11.0	8.9	9.1	10.1	12.2	12.2	12.6	12.1	12.1	11.1	11.5	10.7	10.5	10.9	10.3	12.0	13.6	6.4	3.1	0.6	-2.4	-1.4	0.7		10.0
	Uncertainty (dB)	1.5	1.5	1.1	0.9	0.9	0.8	0.9	0.9	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	1.0	1.9	2.0	2.2	2.1	3.2		0.8
	PWL (dBA)	58.2	60.8	64.8	69.4	73.2	81.0	78.9	82.0	85.4	86.2	86.5	88.6	89.2	88.5	90.1	90.6	90.4	90.4	90.5	89.8	92.5	94.9	87.1	81.7	[78.7]	[75.2]	[73.8]	[72.6]		102.0
8.5	Turbine ON (dBA)	10.8	12.6	16.4	20.0	23.6	31.7	29.3	32.1	35.8	36.2	36.4	38.4	38.9	38.2	39.8	40.3	40.3	40.4	40.4	39.9	42.4	44.4	38.3	35.5	33.1	30.6	29.1	26.9		52.1
	Background (dBA)	1.5	4.6	9.5	10.4	14.2	20.7	20.0	23.2	25.3	23.5	23.8	25.1	26.2	25.5	28.2	28.2	28.8	28.8	28.2	28.1	28.7	29.1	29.6	29.4	28.9	28.2	26.2	22.8		40.8
	Turbine ON - background adj (dBA)	10.2	11.8	15.4	19.5	23.1	31.4	28.8	31.5	35.4	35.9	36.2	38.2	38.7	37.9	39.5	40.0	40.0	40.0	40.1	39.6	42.2	44.3	37.7	34.3	31.0	[27.6]	[26.1]	24.7		51.7
	Signal to noise (dB)	9.3	8.0	6.9	9.6	9.4	11.0	9.3	8.9	10.6	12.6	12.6	13.2	12.7	12.7	11.6	12.1	11.5	11.6	12.2	11.8	13.7	15.3	8.7	6.1	4.1	2.4	2.9	4.1		11.3
	Uncertainty (dB)	1.2	1.2	1.0	0.9	0.9	0.9	0.9	0.9	0.9	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.9	1.2	1.6	2.4	2.4	2.6		0.8
	PWL (dBA)	60.8	62.3	65.9	70.0	73.6	81.9	79.3	82.0	85.9	86.4	86.7	88.7	89.2	88.4	90.0	90.6	90.5	90.6	90.6	90.1	92.7	94.8	88.2	84.8	81.5	[78.1]	[76.6]	75.2		102.2
9.0	Turbine ON (dBA)	13.8	15.6	17.8	20.8	24.3	31.6	29.6	32.4	36.5	35.8	36.9	37.9	38.5	38.3	39.5	40.0	40.3	40.3	40.4	40.1	42.5	43.6	38.8	36.8	35.0	33.4	31.6	29.0		52.0
	Background (dBA)	4.1	6.7	10.5	12.0	15.2	20.8	20.9	23.6	25.9	25.0	25.0	26.5	27.6	26.8	29.2	29.3	30.0	30.2	29.8	29.7	30.5	30.9	31.2	31.0	30.6	29.9	27.6	24.3		42.2
	Turbine ON - background adj (dBA)	13.3	15.0	16.9	20.2	23.7	31.2	29.0	31.7	36.1	35.4	36.7	37.6	38.1	38.0	39.0	39.7	39.8	39.9	40.0	39.6	42.2	43.3	38.0	35.5	33.0	30.9	29.4	27.2		51.6
	Signal to noise (dB)	9.7	8.9	7.3	8.8	9.1	10.8	8.7	8.7	10.5	10.8	11.9	11.4	10.9	11.5	10.2	10.7	10.2	10.1	10.6	10.3	12.0	12.6	7.6	5.8	4.4	3.6	4.0	4.8		9.8
	Uncertainty (dB)	1.3	1.4	1.1	0.9	0.9	0.8	0.9	0.9	0.8	0.8	0.8	0.7	0.7	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	1.0	1.2	1.6	2.1	2.0	2.3		0.8
	PWL (dBA)	63.8	65.5	67.4	70.7	74.2	81.7	79.5	82.3	86.6	85.9	87.2	88.1	88.6	88.5	89.5	90.2	90.3	90.4	90.5	90.2	92.7	93.8	88.5	86.0	83.5	81.4	79.9	77.8		102.1
9.5	Turbine ON (dBA)	13.4	14.8	17.6	20.8	24.1	31.5	29.4	32.3	36.5	34.9	35.1	36.5	37.3	36.9	38.7	39.6	40.2	40.5	40.7	40.5	42.0	42.7	39.1	37.8	36.3	35.2	33.2	30.4		51.8
	Background (dBA)	4.5	7.0	10.8	12.7	15.8	21.0	22.1	24.6	26.9	26.2	26.5	27.8	28.7	27.8	29.6	29.5	30.0	30.1	29.7	29.7	30.3	30.8	31.2	30.7	30.3	29.6	27.4	24.0		42.4
	Turbine ON - background adj (dBA)	12.8	14.1	16.6	20.1	23.4	31.1	28.6	31.4	36.0	34.2	34.4	35.9	36.7	36.3	38.1	39.2	39.7	40.0	40.3	40.1	41.8	42.4	38.4	36.8	35.0	33.8	31.8	29.2		51.3
	Signal to noise (dB)	8.9	7.8	6.8	8.1	8.3	10.5	7.3	7.7	9.6	8.7	8.6	8.7	8.6	9.1	9.1	10.1	10.2	10.3	11.0	10.8	11.8	11.9	7.9	7.1	6.0	5.6	5.7	6.4		9.4
	Uncertainty (dB)	1.1	1.2	1.0	0.9	0.9	0.8	0.9	0.9	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.9	1.0	1.1	1.2	1.2	1.8		0.8
	PWL (dBA)	63.3	64.6	67.1	70.6	73.9	81.6	79.1	82.0	86.5	84.7	84.9	86.4	87.2	86.8	88.6	89.7	90.2	90.5	90.9	90.6	92.3	92.9	88.9	87.4	85.5	84.3	82.3	79.7		101.8
10.0	Turbine ON (dBA)	13.1	14.3	17.2	20.4	24.1	31.8	29.6	31.9	36.6	34.8	34.5	36.2	37.2	36.8	38.8	39.9	40.6	41.0	41.2	40.8	41.8	43.3	38.8	37.0	35.3	34.0	32.0	29.3		51.9
	Background (dBA)	6.1	8.9	11.9	13.6	17.0	21.9	23.1	25.6	27.9	27.6	27.6	29.0	29.8	28.8	30.3	30.5	31.2	31.2	30.8	31.2	31.8	32.4	32.9	32.3	31.7	31.2	29.0	25.6		43.7
	Turbine ON - background adj (dBA)	12.2	12.8	15.7	19.4	23.2	31.4	28.5	30.7	35.9	33.9	33.6	35.3	36.4	36.1	38.2	39.4	40.0	40.6	40.8	40.3	41.4	43.0	37.5	35.1	32.8	[31]	[29]	26.8		51.2
	Signal to noise (dB)	7.1	5.4	5.3	6.9	7.1	9.9	6.5	6.3	8.7	7.2	6.9	7.2	7.5	8.1	8.5	9.4	9.4	9.9	10.4	9.7	10.1	10.9	5.9	4.6	3.6	2.8	2.9	3.7		8.2
	Uncertainty (dB)	1.3	1.5	1.2	1.0	1.0	0.9	1.1	1.1	0.9	1.0	0.9	0.9	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.9	1.1	1.4	1.7	2.1	2.0	2.8		0.9
	PWL (dBA)	62.7	63.3	66.2	70.0	73.7	81.9	79.0	81.2	86.5	84.4	84.1	85.8	86.9	86.6	88.7	89.9	90.6	91.1	91.3	90.8	91.9	93.5	88.0	85.6	83.4	[81.5]	[79.5]	77.3		101.7
10.5	Turbine ON (dBA)	13.6	14.7	17.2	20.2	23.7	31.8	29.2	31.4	36.3	34.5	34.1	35.8	36.9	36.6	38.7	39.9	40.7	41.3	41.6	41.2	42.1	43.8	39.2	37.6	36.0	34.7	32.7	29.8		52.1
	Background (dBA)	8.1	10.4	13.5	14.8	17.4	22.2	23.3	25.8	28.0	27.8	28.2	29.6	30.5	29.7	30.9	31.0	31.7	31.8	31.6	31.9	32.3	33.0	33.4	32.9	32.3	31.7	29.5	26.1		44.2
	Turbine ON - background adj (dBA)	12.1	12.7	14.8	18.7	22.6	31.3	27.9	30.0	35.7	33.4	32.8	34.6	35.8	35.6	37.9	39.3	40.2	40.7	41.2	40.7	41.6	43.4	37.9	35.7	33.5	[31.7]	29.9	27.5		51.3
	Signal to noise (dB)	5.5	4.3	3.7	5.4	6.4	9.6	5.8	5.6	8.3	6.7	5.9	6.2	6.4	7.0	7.8	8.9	9.1	9.4	10.0	9.3	9.8	10.8	5.9	4.6	3.7	3.0	3.2	3.8		7.8
	Uncertainty (dB)	1.5	1.8	1.6	1.2	1.1	0.9	1.1	1.1	0.9	1.0	1.0	0.9	0.9	0.9	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.9	1.1	1.3	1.6	2.0	1.8	2.7		0.9
	PWL (dBA)	62.6	63.2	65.4	69.3	73.1	81.8	78.4	80.5	86.2	84.0	83.3	85.1	86.3	86.1	88.4	89.8	90.7	91.3	91.7	91.2	92.1	93.9	88.5	86.2	84.0	[82.2]	80.4	78.0		101.8

Table C.01 Detailed apparent sound power level data at hub height

Project: Cedar Point Wind Power Project - Turbine CP209 - IEC 61400-11 Measurement

Report ID: 15039.00.T209.RP3

Created on: 3/7/2018

1/3 Octave values marked with brackets [ ] denote less than 3 dB difference between Turbine ON and Background

Overall levels marked with an asterisk * denote 3 to 6 dB difference between Turbine ON and Background, while Overall values with less than 3 dB difference between Turbine ON and Background are not reported

Wind Bin (m/s)	Parameter	1/3 Octave Band (Hz)																													Overall
		20	25	31.5	40	50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000	6300	8000	10000	
11.0	Turbine ON (dBA)	13.9	15.6	17.9	20.6	24.1	31.9	29.4	31.5	36.5	34.6	34.3	35.9	36.9	36.5	38.6	39.9	40.7	41.3	41.8	41.4	42.1	43.2	39.4	37.9	36.3	35.1	33.1	30.2	52.1
	Background (dBA)	6.7	9.6	12.9	14.9	17.7	22.6	24.1	26.5	28.7	28.8	28.9	30.2	30.8	29.8	31.0	31.1	31.7	31.9	31.6	32.1	32.6	33.1	33.5	33.0	32.3	31.9	29.7	26.2	44.4
	Turbine ON - background adj (dBA)	13.0	14.3	16.2	19.3	22.9	31.3	27.8	29.8	35.7	33.3	32.8	34.5	35.7	35.5	37.8	39.2	40.1	40.8	41.4	40.8	41.5	42.8	38.1	36.2	34.1	32.3	30.4	28.0	51.3
	Signal to noise (dB)	7.2	5.9	5.0	5.7	6.4	9.3	5.2	5.0	7.8	5.8	5.4	5.7	6.1	6.7	7.6	8.7	9.0	9.5	10.2	9.2	9.5	10.1	5.9	4.9	4.0	3.2	3.4	4.0	7.6
	Uncertainty (dB)	1.3	1.4	1.3	1.1	1.1	0.9	1.2	1.2	1.0	1.1	1.0	1.0	0.9	0.9	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.9	1.1	1.3	1.5	1.9	1.8	2.6	0.9
	PWL (dBA)	63.5	64.8	66.7	69.8	73.5	81.8	78.3	80.4	86.3	83.8	83.3	85.0	86.2	86.0	88.3	89.7	90.6	91.3	91.9	91.4	92.1	93.3	88.7	86.7	84.6	82.8	80.9	78.5	101.8
11.5	Turbine ON (dBA)	13.4	15.2	17.5	20.8	24.2	32.0	29.7	31.8	36.8	34.9	34.5	36.1	37.1	36.8	38.7	40.0	40.9	41.5	42.1	41.7	42.1	43.1	39.5	37.9	36.3	35.1	33.0	30.2	52.2
	Background (dBA)	6.0	8.8	12.1	14.2	17.8	22.6	23.9	26.7	28.7	28.7	28.9	30.1	30.6	29.8	31.1	31.0	31.7	31.8	31.4	31.7	32.0	32.7	33.1	32.6	32.0	31.4	29.0	25.7	44.2
	Turbine ON - background adj (dBA)	12.5	14.1	16.0	19.7	23.1	31.4	28.3	30.3	36.1	33.6	33.1	34.8	35.9	35.8	37.9	39.4	40.3	41.0	41.7	41.2	41.7	42.7	38.4	36.4	34.3	32.7	30.8	28.3	51.5
	Signal to noise (dB)	7.4	6.4	5.4	6.6	6.5	9.4	5.8	5.2	8.1	6.1	5.6	5.9	6.4	7.0	7.7	8.9	9.2	9.7	10.6	9.9	10.1	10.4	6.4	5.3	4.3	3.7	4.0	4.5	8.0
	Uncertainty (dB)	1.3	1.4	1.2	1.0	1.0	0.9	1.1	1.2	0.9	1.1	1.0	0.9	0.9	0.9	0.8	0.8	0.8	0.7	0.7	0.7	0.7	0.9	1.0	1.2	1.4	1.7	1.6	2.3	0.9
	PWL (dBA)	63.0	64.6	66.5	70.2	73.6	81.9	78.9	80.8	86.6	84.2	83.6	85.3	86.5	86.3	88.4	89.9	90.8	91.5	92.2	91.7	92.2	93.2	88.9	86.9	84.8	83.2	81.3	78.8	102.0

Table C.02 Detailed apparent sound power level data at 10m height

Project: Cedar Point Wind Power Project - Turbine CP209 - IEC 61400-11 Measurement

Report ID: 15039.00.T209.RP3

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1/3 Octave values marked with brackets [ ] denote less than 3 dB difference between Turbine ON and Background

Overall levels marked with an asterisk * denote 3 to 6 dB difference between Turbine ON and Background, while Overall values with less than 3 dB difference between Turbine ON and Background are not reported

Wind Bin (m/s)	Parameter	1/3 Octave Band (Hz)																													Overall
		20	25	31.5	40	50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000	6300	8000	10000	
5.0	Turbine ON (dBA)	6.8	10.5	14.8	18.2	22.3	30.5	27.5	30.8	34.0	34.6	35.0	37.1	37.7	37.1	38.9	39.3	39.3	39.3	39.3	39.0	41.8	42.7	35.9	33.0	30.1	27.1	26.2	25.1	50.8
	Background (dBA)	0.4	4.1	9.3	10.6	14.2	20.2	21.2	23.2	25.4	23.8	24.4	25.8	26.6	25.4	28.1	27.5	28.4	28.2	27.4	27.5	27.7	28.2	28.3	27.8	27.4	26.7	24.5	21.3	40.1
	Turbine ON - background adj (dBA)	5.7	9.4	13.4	17.4	21.6	30.1	26.3	30.0	33.4	34.2	34.6	36.8	37.4	36.8	38.5	39.0	38.9	38.9	39.0	38.7	41.6	42.5	35.1	31.4	[27.1]	[24.1]	[23.2]	22.7	50.4
	Signal to noise (dB)	6.4	6.4	5.6	7.7	8.1	10.3	6.2	7.6	8.6	10.8	10.6	11.3	11.1	11.7	10.7	11.8	10.9	11.1	11.9	11.5	14.1	14.5	7.6	5.2	2.7	0.4	1.7	3.8	10.7
	Uncertainty (dB)	1.3	1.3	1.1	0.9	0.9	0.9	1.0	1.0	0.9	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.9	1.0	1.2	1.8	1.9	1.9	2.6	0.8
	PWL (dBA)	56.2	59.9	63.9	67.9	72.1	80.6	76.8	80.5	83.9	84.8	85.1	87.3	87.9	87.4	89.0	89.6	89.5	89.4	89.5	89.2	92.1	93.0	85.6	81.9	[77.6]	[74.6]	[73.7]	73.2	100.9
6.0	Turbine ON (dBA)	12.0	13.8	16.8	20.2	23.8	31.5	29.4	32.1	35.9	36.0	36.6	38.2	38.8	38.2	39.7	40.2	40.3	40.3	40.4	39.9	42.4	44.1	38.4	35.8	33.7	31.6	29.9	27.6	52.0
	Background (dBA)	3.1	6.0	10.0	11.3	14.6	20.6	20.4	23.3	25.6	24.2	24.4	25.8	26.9	26.2	28.8	28.9	29.5	29.6	29.2	29.1	29.9	30.4	30.7	30.5	30.1	29.4	27.2	23.8	41.7
	Turbine ON - background adj (dBA)	11.4	13.0	15.8	19.6	23.2	31.1	28.8	31.5	35.5	35.7	36.3	38.0	38.5	37.9	39.3	39.9	39.9	39.9	40.1	39.6	42.1	44.0	37.6	34.3	31.1	[28.6]	[26.9]	25.2	51.6
	Signal to noise (dB)	8.9	7.8	6.8	9.0	9.2	11.0	9.0	8.9	10.4	11.8	12.2	12.4	11.8	12.0	10.9	11.4	10.8	10.7	11.2	10.8	12.4	13.8	7.7	5.4	3.5	2.2	2.7	3.8	10.3
	Uncertainty (dB)	1.2	1.3	1.0	0.9	0.9	0.9	0.9	0.9	0.9	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	1.0	1.2	1.6	2.1	2.0	2.6	0.8
	PWL (dBA)	61.9	63.5	66.3	70.1	73.7	81.7	79.3	82.0	86.0	86.2	86.8	88.5	89.0	88.4	89.9	90.4	90.4	90.5	90.6	90.1	92.6	94.5	88.1	84.8	81.7	[79.1]	[77.4]	75.8	102.1
7.0	Turbine ON (dBA)	13.3	14.5	17.3	20.4	24.0	31.7	29.4	31.8	36.5	34.7	34.5	36.1	37.1	36.7	38.7	39.8	40.5	41.0	41.2	40.9	42.0	43.3	39.0	37.4	35.8	34.6	32.6	29.8	51.9
	Background (dBA)	6.7	9.2	12.3	13.9	16.9	21.8	23.0	25.5	27.7	27.4	27.6	29.0	29.8	28.9	30.4	30.4	31.1	31.2	30.9	31.1	31.6	32.2	32.6	32.1	31.5	31.0	28.8	25.4	43.6
	Turbine ON - background adj (dBA)	12.2	13.0	15.6	19.4	23.0	31.3	28.3	30.7	35.8	33.8	33.5	35.2	36.2	36.0	38.0	39.3	40.0	40.5	40.8	40.4	41.6	43.0	37.9	35.9	33.8	32.1	30.2	27.8	51.2
	Signal to noise (dB)	6.6	5.3	5.0	6.6	7.1	9.9	6.4	6.4	8.8	7.3	6.9	7.1	7.3	7.8	8.3	9.4	9.4	9.8	10.4	9.8	10.4	11.1	6.4	5.3	4.3	3.6	3.8	4.4	8.3
	Uncertainty (dB)	1.3	1.5	1.2	1.0	1.0	0.9	1.1	1.1	0.9	1.0	0.9	0.9	0.9	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.9	1.1	1.2	1.4	1.6	1.5	2.4	0.9
	PWL (dBA)	62.7	63.5	66.1	69.9	73.5	81.8	78.8	81.2	86.4	84.3	84.0	85.7	86.7	86.5	88.6	89.8	90.5	91.0	91.3	90.9	92.1	93.5	88.4	86.4	84.3	82.6	80.7	78.3	101.7
8.0	Turbine ON (dBA)	13.8	15.7	17.9	20.8	24.3	31.9	29.6	31.7	36.8	34.7	34.4	36.0	37.0	36.6	38.7	39.9	40.8	41.5	42.0	41.6	42.1	43.1	39.6	38.1	36.5	35.3	33.3	30.4	52.2
	Background (dBA)	7.0	9.6	12.5	14.7	17.8	22.8	24.2	26.7	28.9	28.9	29.0	30.3	30.9	30.0	31.2	31.3	31.9	32.0	31.6	32.0	32.4	33.1	33.4	33.0	32.3	31.7	29.5	26.0	44.4
	Turbine ON - background adj (dBA)	12.8	14.4	16.4	19.6	23.1	31.3	28.2	30.1	36.0	33.4	32.9	34.6	35.8	35.6	37.8	39.3	40.2	40.9	41.6	41.1	41.6	42.7	38.4	36.5	34.4	32.8	30.9	28.4	51.4
	Signal to noise (dB)	6.8	6.1	5.4	6.1	6.4	9.1	5.4	5.0	7.9	5.9	5.4	5.7	6.1	6.7	7.5	8.6	8.9	9.5	10.4	9.6	9.7	10.1	6.2	5.1	4.2	3.6	3.8	4.3	7.7
	Uncertainty (dB)	1.2	1.3	1.1	1.0	1.0	0.8	1.1	1.1	0.9	1.0	0.9	0.9	0.9	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.8	1.0	1.1	1.3	1.5	1.5	2.3	0.8
	PWL (dBA)	63.3	64.9	66.9	70.1	73.7	81.8	78.7	80.6	86.5	84.0	83.4	85.1	86.3	86.1	88.4	89.8	90.7	91.5	92.1	91.6	92.2	93.2	88.9	87.0	84.9	83.3	81.4	78.9	101.9
9.0	Turbine ON (dBA)	14.1	15.3	18.3	21.5	24.7	31.7	30.6	32.1	37.5	34.9	34.6	36.5	37.1	36.7	38.8	40.0	41.0	41.8	42.5	42.2	42.2	42.7	40.0	38.5	36.7	35.7	33.6	30.6	52.4
	Background (dBA)	8.1	10.3	12.8	14.9	18.2	22.8	24.7	27.3	29.4	29.7	29.8	31.0	31.6	30.5	31.7	31.8	32.4	32.4	32.1	32.8	33.2	33.9	34.1	33.7	33.0	32.6	30.4	26.9	45.1
	Turbine ON - background adj (dBA)	12.8	13.7	16.9	20.4	23.6	31.1	29.3	30.3	36.8	33.3	32.9	35.0	35.7	35.5	37.9	39.3	40.3	41.2	42.0	41.6	41.6	42.0	38.8	36.7	34.3	32.8	30.7	28.2	51.5
	Signal to noise (dB)	5.9	5.1	5.5	6.6	6.6	8.9	5.9	4.8	8.1	5.2	4.8	5.4	5.5	6.2	7.1	8.2	8.5	9.4	10.3	9.4	9.0	8.8	5.9	4.7	3.7	3.1	3.2	3.7	7.3
	Uncertainty (dB)	1.8	1.9	1.5	1.3	1.3	1.1	1.4	1.5	1.2	1.4	1.3	1.2	1.2	1.1	1.0	1.0	1.0	0.9	0.9	0.9	1.0	1.1	1.4	1.6	1.9	2.3	2.3	3.3	1.1
	PWL (dBA)	63.3	64.2	67.4	71.0	74.2	81.6	79.8	80.8	87.3	83.9	83.4	85.5	86.2	86.1	88.4	89.8	90.9	91.7	92.6	92.2	92.1	92.6	89.3	87.2	84.8	83.3	81.2	78.7	102.0

Table C.03 Type B measurement uncertainty summary

Overall Equipment Uncertainties		
	Typical values	Used values
Calibration	0.2 dB	0.2 dB
Board	0.3 dB	0.3 dB
Distance	0.1 dB	0.1 dB
Air absorption	0 dB	0 dB
Weather	0.5 dB	0.5 dB

1/3 Octave Band Uncertainties		
Frequency (Hz)	Microphone Uncertainty	Overall (including overall equipment Uncertainties)
20	0.8 dB	1 dB
25	0.8 dB	1 dB
31.5	0.5 dB	0.8 dB
40	0.5 dB	0.8 dB
50	0.5 dB	0.8 dB
63	0.5 dB	0.8 dB
80	0.5 dB	0.8 dB
100	0.5 dB	0.8 dB
125	0.5 dB	0.8 dB
160	0.5 dB	0.8 dB
200	0.3 dB	0.7 dB
250	0.3 dB	0.7 dB
315	0.3 dB	0.7 dB
400	0.3 dB	0.7 dB
500	0.3 dB	0.7 dB
630	0.3 dB	0.7 dB
800	0.3 dB	0.7 dB
1000	0.3 dB	0.7 dB
1250	0.3 dB	0.7 dB
1600	0.3 dB	0.7 dB
2000	0.3 dB	0.7 dB
2500	0.5 dB	0.8 dB
3150	0.5 dB	0.8 dB
4000	0.5 dB	0.8 dB
5000	0.5 dB	0.8 dB
6300	0.5 dB	0.8 dB
8000	0.5 dB	0.8 dB
10000	1.3 dB	1.4 dB

Table C.04 Detailed measruement uncertainty at hub height

Project: Cedar Point Wind Power Project - Turbine CP209 - IEC 61400-11 Measurement

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Wind Bin (m/s)	Parameter	Average Wind Speed (m/s)	# of data points	Parameter	1/3 Octave Band (Hz) 20	25	31.5	40	50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000	6300	8000	10000	Overall
7.0	Turbine ON	7.04	21	Average (dBA)	6.3	10.1	14.6	17.9	21.8	30.8	27.2	29.9	33.6	34.3	34.6	36.7	37.2	36.7	38.4	38.9	38.9	38.8	38.9	38.5	41.6	41.9	35.0	32.4	29.4	26.6	25.6	24.9	50.3
				Uncertainty A (dB)	0.3	0.3	0.2	0.2	0.1	0.2	0.2	0.2	0.3	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.3	0.1	0.2	0.3	0.6	0.5	0.2		
				Uncertainty B (dB)	1.0	1.0	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.8	0.8	1.4		
				Combined Uncertainty (dB)	1.1	1.1	0.8	0.8	0.8	0.8	0.8	0.8	0.9	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.9	0.8	0.8	0.9	1.0	0.9	1.5		
	Background	7.04	13	Average (dBA)	-0.9	3.6	8.8	10.4	14.0	20.3	21.7	23.2	25.4	24.0	24.4	25.8	26.4	25.0	27.8	27.3	28.1	27.7	26.8	26.9	26.8	26.8	26.9	26.3	26.0	25.2	23.0	20.1	39.4
				Uncertainty A (dB)	0.5	0.3	0.3	0.4	0.3	0.3	0.7	0.4	0.2	0.4	0.4	0.5	0.4	0.4	0.3	0.5	0.5	0.4	0.6	0.8	0.9	0.7	0.9	0.9	0.8	0.9	0.7	0.7		
				Uncertainty B (dB)	1.0	1.0	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.8	0.8	1.4		
				Combined Uncertainty (dB)	1.1	1.1	0.8	0.9	0.8	0.9	1.1	0.9	0.8	0.9	0.8	0.9	0.8	0.8	0.8	0.9	0.8	0.8	0.9	1.0	1.1	1.1	1.2	1.2	1.1	1.2	1.1	1.6		
7.5	Turbine ON	7.48	21	Average (dBA)	7.8	11.1	15.6	18.9	22.4	29.8	28.0	32.0	34.8	35.0	35.6	37.8	38.6	38.0	39.8	40.3	40.3	40.3	40.3	39.6	42.2	44.2	37.1	34.3	31.7	29.0	27.7	25.8	51.7
				Uncertainty A (dB)	0.2	0.2	0.1	0.2	0.2	0.2	0.2	0.4	0.4	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.3	0.5	0.8	0.7	0.4		
				Uncertainty B (dB)	1.0	1.0	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.8	0.8	1.4		
				Combined Uncertainty (dB)	1.0	1.0	0.8	0.8	0.8	0.8	0.8	0.9	0.9	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.9	0.9	1.2	1.1	1.5		
	Background	7.50	20	Average (dBA)	0.2	4.2	9.3	10.6	14.4	20.4	20.8	23.4	25.3	23.7	24.0	25.2	26.0	25.1	27.9	27.2	28.1	28.0	27.1	27.4	27.5	28.2	28.4	27.9	27.4	26.7	24.5	21.3	39.9
				Uncertainty A (dB)	0.6	0.4	0.3	0.3	0.3	0.3	0.4	0.3	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.5	0.7	0.8	0.8	0.9	0.9	0.8	0.9	0.9	0.7		
				Uncertainty B (dB)	1.0	1.0	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.8	0.8	1.4		
				Combined Uncertainty (dB)	1.2	1.1	0.8	0.8	0.9	0.9	0.9	0.9	0.8	0.9	0.8	0.7	0.7	0.8	0.8	0.8	0.8	0.8	0.9	1.0	1.0	1.1	1.2	1.2	1.2	1.2	1.2	1.6		
8.0	Turbine ON	7.95	21	Average (dBA)	9.1	11.7	15.6	19.5	23.2	30.8	29.0	32.0	35.3	35.9	36.3	38.4	39.0	38.3	39.9	40.4	40.3	40.3	40.4	39.7	42.2	44.6	37.7	34.0	31.0	27.4	26.0	25.0	51.9
				Uncertainty A (dB)	0.4	0.3	0.3	0.3	0.2	0.1	0.3	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.2	0.5	0.4	0.2		
				Uncertainty B (dB)	1.0	1.0	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.8	0.8	1.4		
				Combined Uncertainty (dB)	1.1	1.1	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.9	0.9	1.5		
	Background	7.98	16	Average (dBA)	4.0	6.6	10.2	11.0	14.1	19.9	20.1	22.9	25.3	23.8	24.1	25.7	26.9	26.2	28.9	29.0	29.7	29.9	29.5	29.4	30.3	31.1	31.5	31.0	30.6	30.1	27.8	24.5	42.0
				Uncertainty A (dB)	1.1	0.8	0.5	0.4	0.3	0.2	0.4	0.3	0.2	0.4	0.3	0.3	0.4	0.4	0.4	0.5	0.5	0.6	0.7	0.8	0.9	0.9	1.0	1.0	1.0	1.1	1.0	1.0		
				Uncertainty B (dB)	1.0	1.0	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.8	0.8	1.4		
				Combined Uncertainty (dB)	1.5	1.3	0.9	0.9	0.8	0.8	0.9	0.8	0.8	0.9	0.8	0.8	0.8	0.8	0.8	0.9	0.9	0.9	1.0	1.0	1.2	1.2	1.3	1.3	1.3	1.3	1.3	1.7		
8.5	Turbine ON	8.53	23	Average (dBA)	10.9	12.6	16.4	20.0	23.6	31.8	29.3	32.1	35.9	36.2	36.4	38.4	38.9	38.2	39.8	40.3	40.3	40.4	40.4	39.9	42.4	44.4	38.4	35.6	33.2	30.8	29.2	27.0	52.1
				Uncertainty A (dB)	0.4	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.4	0.5	0.8	0.7	0.5		
				Uncertainty B (dB)	1.0	1.0	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.8	0.8	1.4		
				Combined Uncertainty (dB)	1.1	1.1	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.9	0.9	1.1	1.1	1.5		
	Background	8.52	25	Average (dBA)	1.4	4.5	9.4	10.3	14.2	20.7	20.0	23.2	25.3	23.5	23.8	25.1	26.1	25.4	28.2	28.1	28.8	28.7	28.2	28.1	28.7	29.0	29.5	29.3	28.9	28.2	26.1	22.7	40.7
				Uncertainty A (dB)	0.7	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.2	0.3	0.3	0.3	0.4	0.4	0.3	0.5	0.4	0.5	0.6	0.6	0.7	0.7	0.8	0.8	0.8	0.9	0.9	0.8		
				Uncertainty B (dB)	1.0	1.0	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.8	0.8	1.4		
				Combined Uncertainty (dB)	1.2	1.1	0.9	0.9	0.9	0.9	0.9	0.9	0.8	0.9	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.9	0.9	1.0	1.1	1.1	1.2	1.1	1.2	1.2	1.6		
9.0	Turbine ON	8.94	17	Average (dBA)	13.8	15.7	17.8	20.8	24.3	31.6	29.6	32.4	36.5	35.9	37.2	38.1	38.6	38.5	39.5	40.1	40.3	40.3	40.4	40.0	42.5	43.7	38.8	36.7	34.8	33.2	31.4	28.9	52.1
				Uncertainty A (dB)	0.8	0.8	0.5	0.3	0.2	0.2	0.2	0.2	0.1	0.2	0.5	0.2	0.2	0.4	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.3	0.3	0.5	0.7	0.9	0.9	0.7		
				Uncertainty B (dB)	1.0	1.0	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.8	0.8	1.4		
				Combined Uncertainty (dB)	1.3	1.3	0.9	0.9	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.7	0.7	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.9	0.9	1.0	1.0	1.2	1.2	1.6		
	Background	8.97	30	Average (dBA)	4.1	6.7	10.5	12.0	15.2	20.8	20.8	23.6	25.9	25.0	25.0	26.4	27.5	26.8	29.2	29.3	30.0	30.2	29.8	29.7	30.5	30.9	31.2	31.0	30.6	29.9	27.6	24.3	42.2
				Uncertainty A (dB)	0.8	0.6	0.3	0.4	0.3	0.2	0.4	0.3	0.3	0.4	0.4	0.4	0.3	0.4	0.3	0.4	0.4	0.4	0.5	0.6	0.6	0.6	0.6	0.7	0.7	0.7	0.7	0.6		
				Uncertainty B (dB)	1.0	1.0	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.8	0.8	1.4		
				Combined Uncertainty (dB)	1.3	1.2	0.9	0.9	0.9	0.8	0.9	0.9	0.8	0.9	0.8	0.8	0.8	0.8	0.7	0.8	0.8	0.8	0.9	0.9	0.9	1.0	1.0	1.0	1.0	1.1	1.1	1.6		
9.5	Turbine ON	9.58	61	Average (dBA)	13.3	14.7	17.6	20.8	24.1	31.5	29.4	32.2	36.5	34.7	34.8	36.3	37.1	36.7	38.6	39.5	40.1	40.5	40.8	40.6	42.0	42.6	39.2	38.0	36.5	35.5	33.4	30.6	51.7
				Uncertainty A (dB)	0.4	0.3	0.2	0.2	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.3	0.4	0.5	0.5	0.4		
				Uncertainty B (dB)	1.0	1.0	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.8	0.8	1.4		
				Combined Uncertainty (dB)	1.1	1.1	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.9	0.9	0.9	0.9	1.5		
	Background	9.48	37	Average (dBA)	4.4	6.9	10.7	12.6	15.7	21.0	22.1	24.5	26.9	26.1	26.4	27.7	28.6	27.7	29.5	29.4	29.9	30.1	29.6	29.6	30.2	30.8	31.1	30.7	30.2	29.5	27.4	23.9	42.3
				Uncertainty A (dB)	0.7	0.5	0.3	0.3	0.3	0.3	0.4	0.4	0.3	0.4	0.4	0.4	0.4	0.4	0.3	0.3	0.3	0.3	0.4	0.5	0.5	0.5	0.5	0.6	0.5	0.6	0.6	0.5		
				Uncertainty B (dB)	1.0	1.0	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.8	0.8	1.4		
				Combined Uncertainty (dB)	1.2	1.1	0.9	0.9	0.9	0.8	0.9	0.9	0.9	0.9	0.8	0.8	0.8	0.8	0.7	0.8	0.8	0.8	0.8	0.8	0.9	0.9	1.0	1.0	1.0	1.0	1.0	1.5		
10.0	Turbine ON	9.99	85	Average (dBA)	13.1	14.3	17.2	20.4	24.1	31.8	29.6	31.9	36.6	34.8	34.6	36.2	37.2	36.9	38.8	39.9	40.6	41.0	41.2	40.8	41.8	43.3	38.8	36.9	35.3	33.9	32.0	29.2	51.9
				Uncertainty A (dB)	0.2	0.2	0.2	0.2	0.2	0.1	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.3	0.4	0.3	0.3		
				Uncertainty B (dB)	1.0	1.0	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.8	0.8	1.4		
				Combined Uncertainty (dB)	1.0	1.0	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.9	0.9	1.5		
	Background	10.00	32	Average (dBA)	6.1	8.9	11.9	13.6	17.0	21.9	23.1	25.6	27.9	27.6	27.6	29.0	29.8	28.8	30.3	30.5	31.2	31.2	30.8	31.2	31.8	32.4	32.9	32.3	31.7	31.2	29.0	25.6	43.7
				Uncertainty A (dB)	0.9	0.7	0.4	0.4	0.4	0.3	0.4	0.4	0.3	0.5	0.5	0.4	0.4	0.5	0.4	0.5	0.4	0.5	0.6	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.8	0.7		
				Uncertainty B (dB)	1.0	1.0	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.8	0.8	1.4		
				Combined Uncertainty (dB)	1.4	1.2	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.9	1.0	1.0	1.1	1.2	1.2	1.1	1.2	1.1	1.6		

Table C.04 Detailed measruement uncertainty at hub height

Project: Cedar Point Wind Power Project - Turbine CP209 - IEC 61400-11 Measurement

Report ID: 15039.00.T209.RP3

Created on: 3/7/2018

Wind Bin (m/s)	Parameter	Average Wind Speed (m/s)	# of data points	Parameter	1/3 Octave Band (Hz)																													Overall
					20	25	31.5	40	50	63	80	100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000	6300	8000	10000	
10.5	Turbine ON	10.49	83	Average (dBA)	13.5	14.7	17.2	20.2	23.7	31.8	29.2	31.4	36.3	34.5	34.1	35.8	36.9	36.6	38.7	39.9	40.7	41.3	41.6	41.2	42.1	43.8	39.2	37.5	35.9	34.7	32.7	29.8	52.1
				Uncertainty A (dB)	0.2	0.2	0.2	0.2	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.3	0.3	0.3	0.2		
				Uncertainty B (dB)	1.0	1.0	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.8	0.8	1.4		
				Combined Uncertainty (dB)	1.0	1.0	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.9	0.9	1.5		
	Background	10.49	37	Average (dBA)	8.1	10.5	13.5	14.8	17.3	22.2	23.3	25.8	28.0	27.8	28.2	29.6	30.5	29.7	30.9	31.0	31.7	31.8	31.6	31.9	32.3	33.0	33.4	32.9	32.3	31.7	29.5	26.0	44.2
				Uncertainty A (dB)	1.0	0.7	0.6	0.5	0.4	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.3	0.4	0.4	0.4	0.5	0.6	0.6	0.6	0.7	0.7	0.7	0.7	0.7	0.7		
				Uncertainty B (dB)	1.0	1.0	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.8	0.8	1.4		
				Combined Uncertainty (dB)	1.4	1.3	1.0	0.9	0.9	0.8	0.9	0.9	0.8	0.9	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.9	0.9	0.9	1.0	1.1	1.1	1.1	1.1	1.1	1.6		
11.0	Turbine ON	10.99	105	Average (dBA)	13.9	15.6	17.9	20.6	24.1	31.9	29.4	31.5	36.5	34.6	34.3	35.9	36.9	36.5	38.6	39.9	40.7	41.3	41.8	41.4	42.1	43.2	39.4	37.9	36.3	35.1	33.1	30.2	52.1
				Uncertainty A (dB)	0.3	0.3	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.3	0.4	0.3	0.3		
				Uncertainty B (dB)	1.0	1.0	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.8	0.8	1.4		
				Combined Uncertainty (dB)	1.0	1.0	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.9	0.9	0.9	1.5		
	Background	11.01	35	Average (dBA)	6.7	9.6	12.9	14.9	17.7	22.6	24.2	26.5	28.7	28.8	28.9	30.2	30.8	29.8	31.0	31.1	31.7	31.9	31.6	32.1	32.6	33.1	33.5	33.0	32.3	31.9	29.7	26.2	44.4
				Uncertainty A (dB)	0.7	0.5	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.4	0.4	0.4	0.5	0.5	0.6	0.6	0.7	0.7	0.7	0.8	0.7	0.7		
				Uncertainty B (dB)	1.0	1.0	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.8	0.8	1.4		
				Combined Uncertainty (dB)	1.3	1.1	0.9	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.9	0.9	1.0	1.0	1.1	1.1	1.1	1.1	1.6		
11.5	Turbine ON	11.48	61	Average (dBA)	13.3	15.1	17.4	20.7	24.2	32.0	29.7	31.8	36.8	34.9	34.5	36.0	37.1	36.8	38.7	40.0	40.9	41.5	42.1	41.6	42.1	43.2	39.5	37.9	36.2	35.0	33.0	30.2	52.2
				Uncertainty A (dB)	0.3	0.3	0.2	0.2	0.2	0.1	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.3	0.4	0.5	0.4	0.3		
				Uncertainty B (dB)	1.0	1.0	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.8	0.8	1.4		
				Combined Uncertainty (dB)	1.1	1.1	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.9	0.9	0.9	1.5		
	Background	11.53	30	Average (dBA)	6.0	8.8	12.0	14.1	17.8	22.6	23.9	26.7	28.7	28.7	28.9	30.1	30.6	29.8	31.1	31.0	31.7	31.8	31.4	31.7	31.9	32.7	33.1	32.6	31.9	31.3	29.0	25.6	44.2
				Uncertainty A (dB)	0.8	0.5	0.4	0.3	0.3	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.5	0.5	0.5	0.5	0.5	0.5		
				Uncertainty B (dB)	1.0	1.0	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.8	0.8	1.4		
				Combined Uncertainty (dB)	1.3	1.1	0.9	0.9	0.8	0.8	0.8	0.8	0.8	0.9	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.9	0.9	0.9	0.9	1.0	1.0	1.5		

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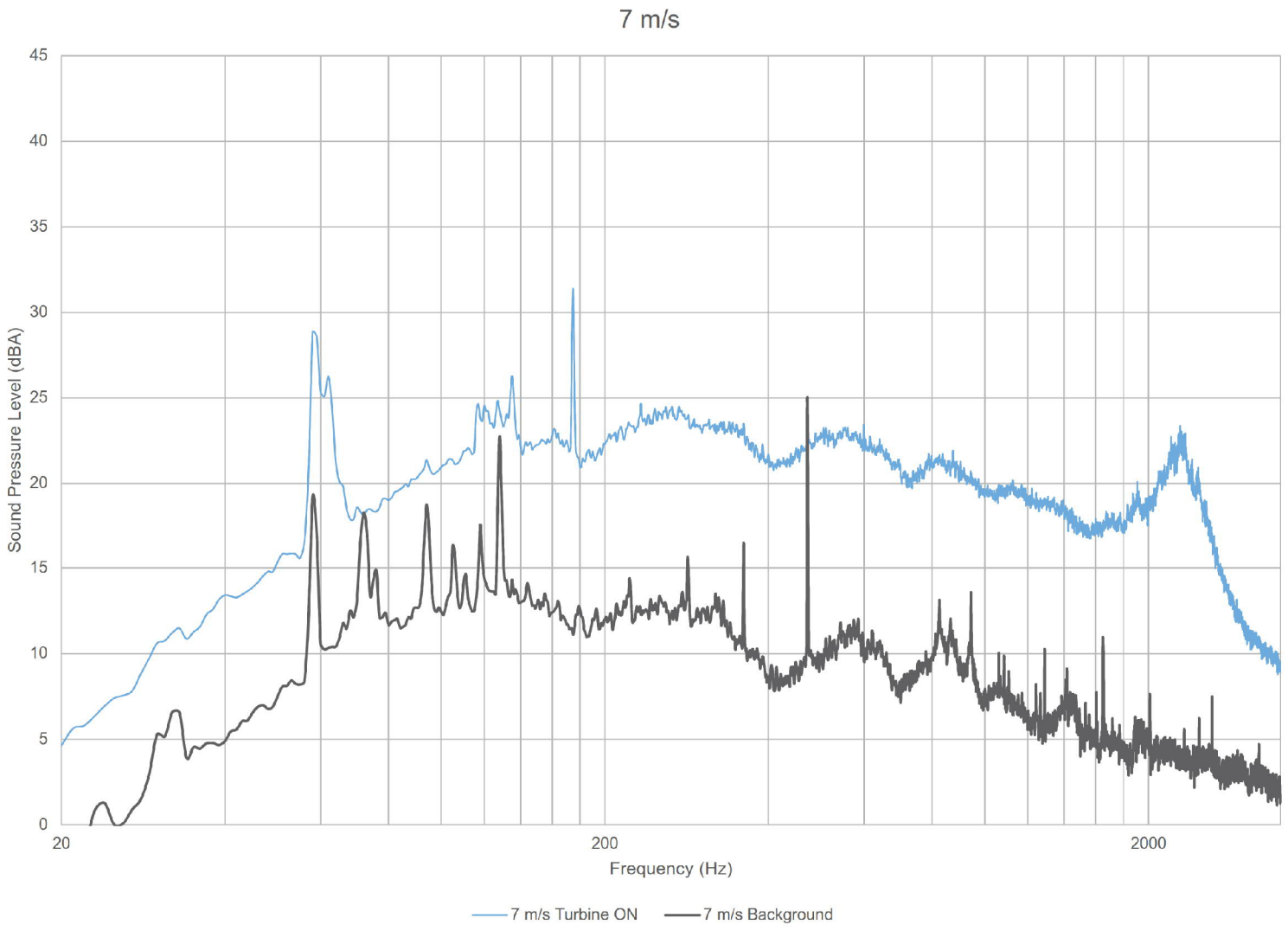
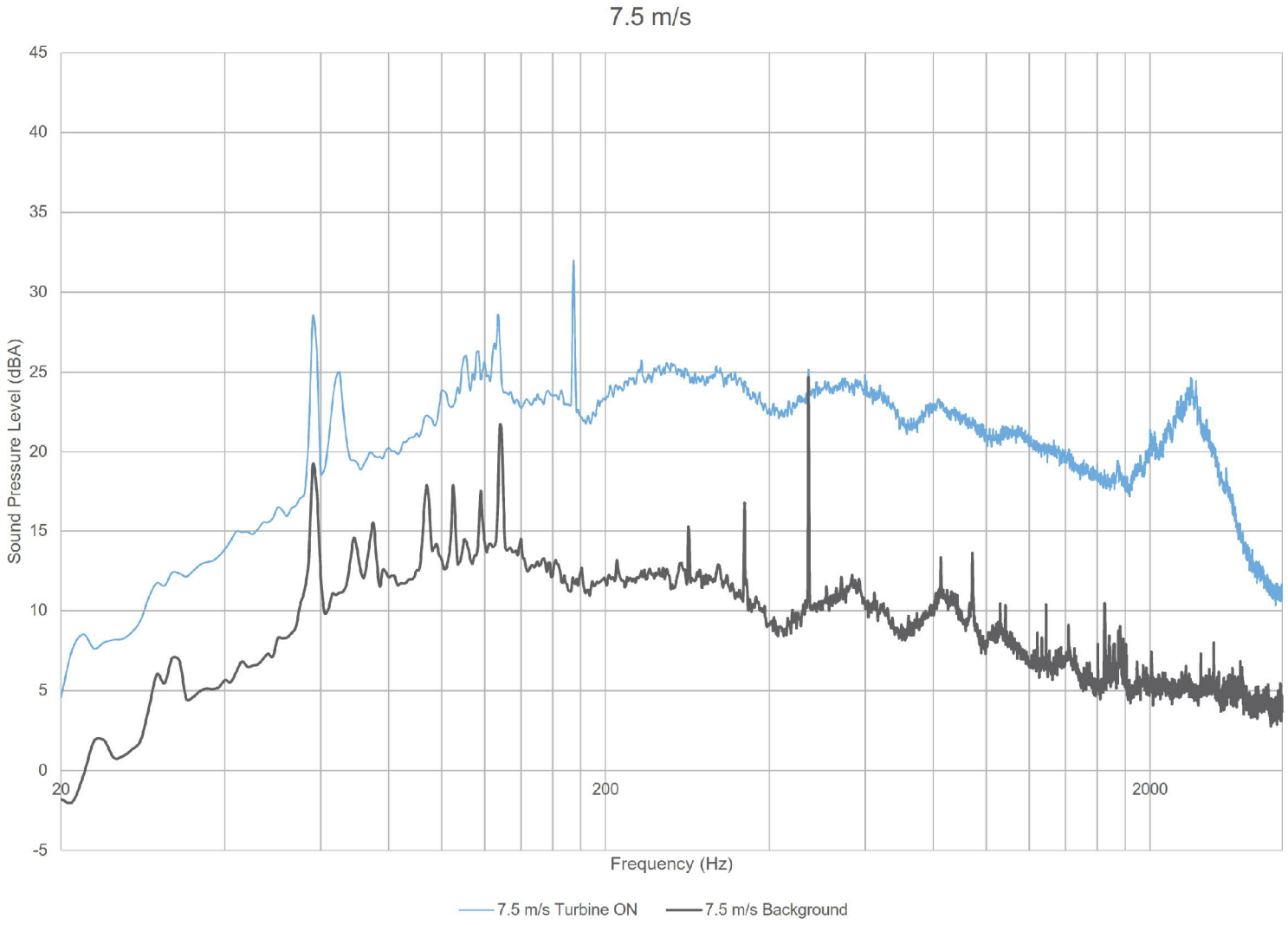
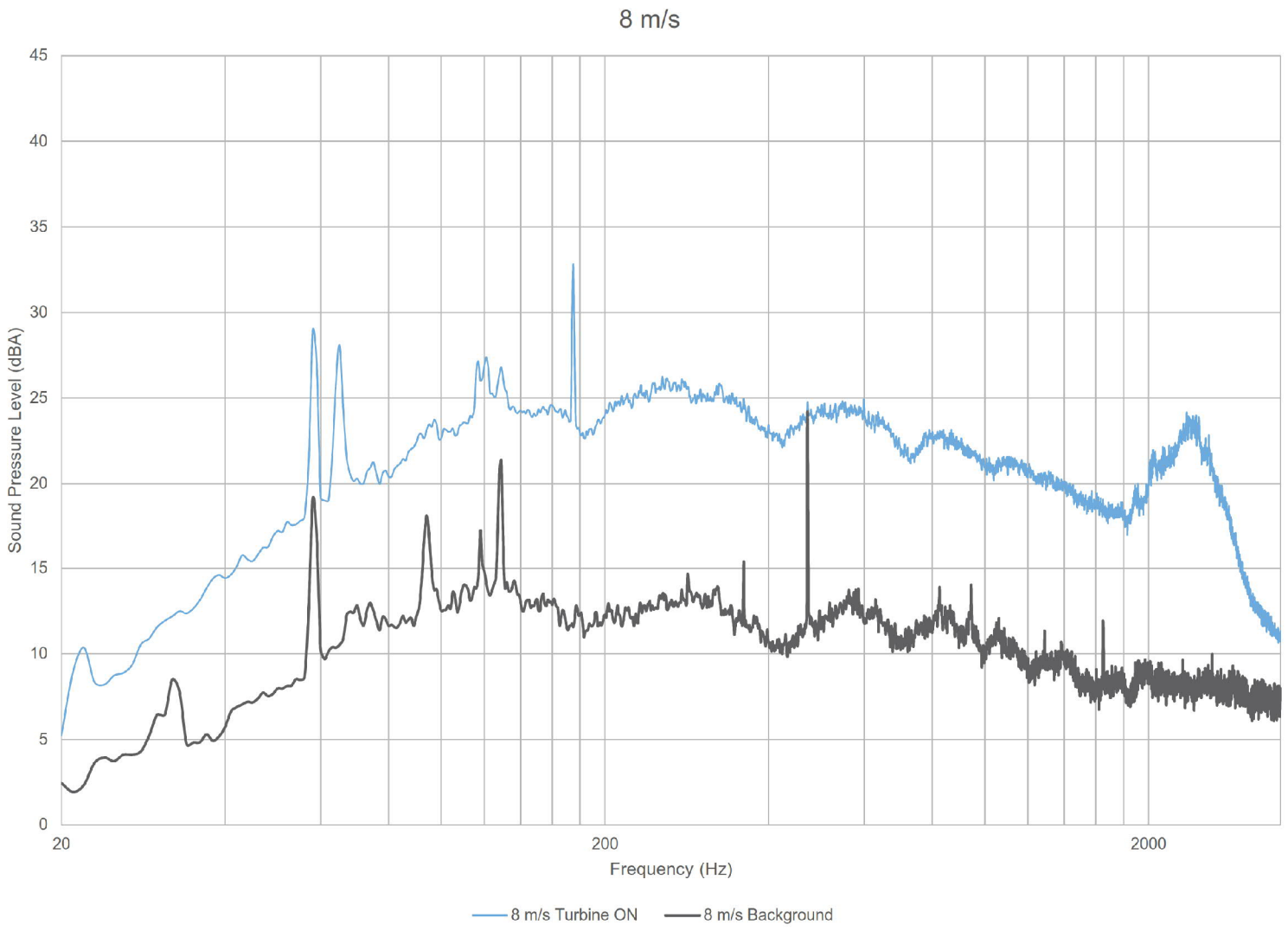
Appendix D
Tonality Assessment



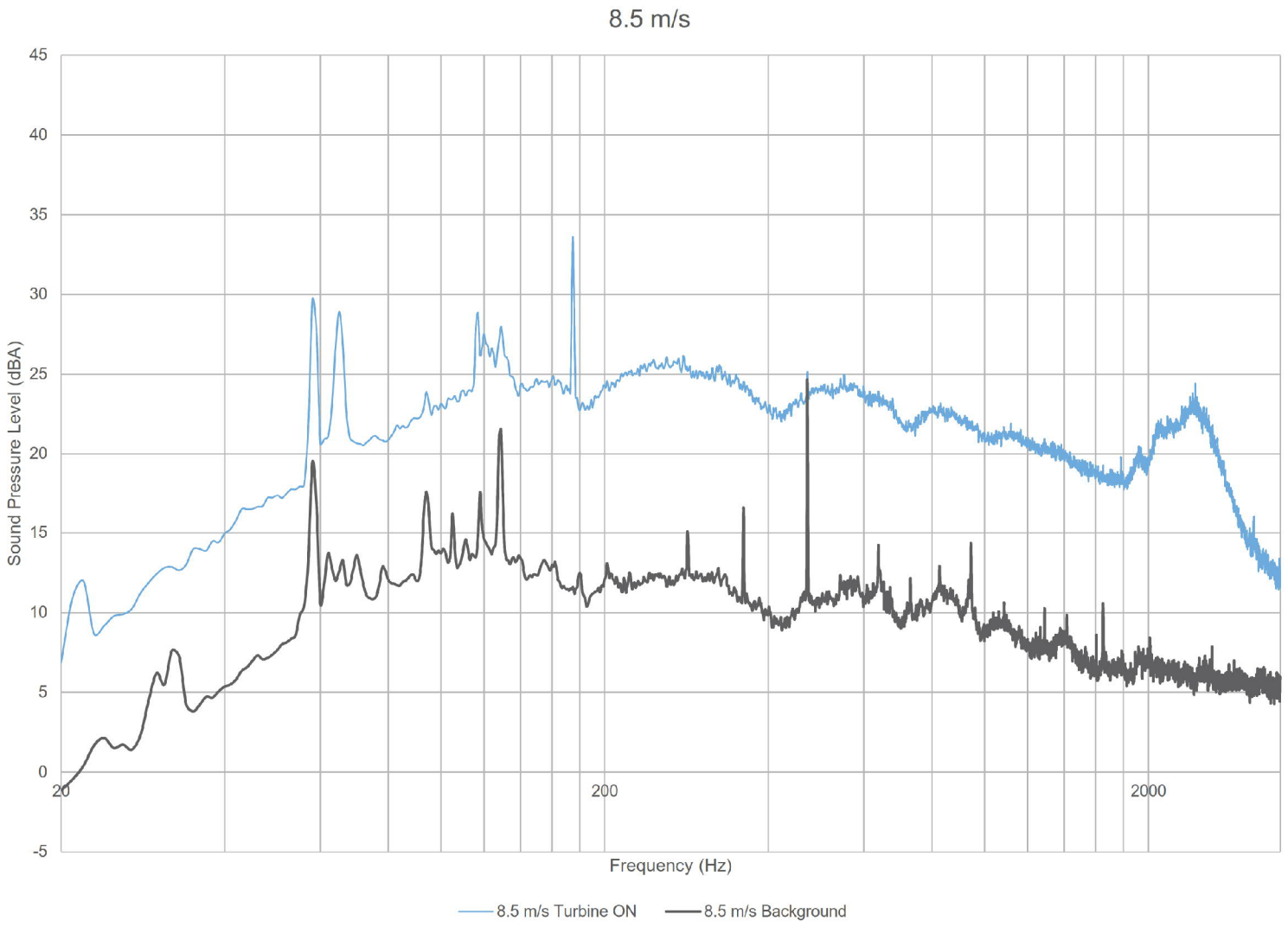
aercoustics	15039.00.T209.RP3	**Project Name**
	Scale: NTS Drawn by: AM Reviewed by: PA Date: Mar 07, 2018 Revision: 1	Cedar Point Wind Power Project - Turbine CP209 - IEC61400-11 Edition 3.0
		Figure Title Plot of narrow band spectra – Turbine ON vs. Background at 7 m/s
		Figure D.01



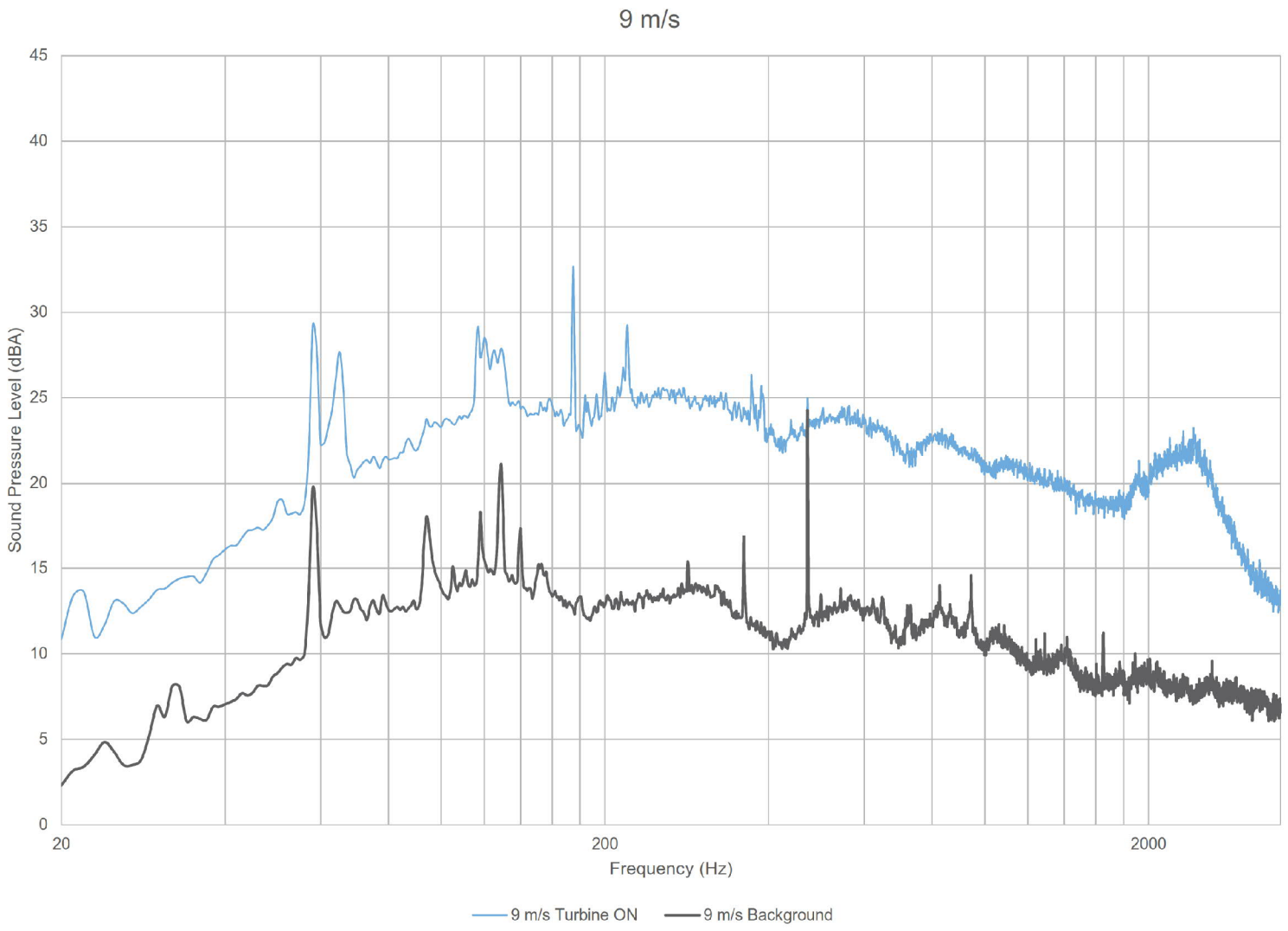
aercoustics	15039.00.T209.RP3	**Project Name**
	Scale: NTS Drawn by: AM Reviewed by: PA Date: Mar 07, 2018 Revision: 1	Cedar Point Wind Power Project - Turbine CP209 - IEC61400-11 Edition 3.0
		Figure Title Plot of narrow band spectra – Turbine ON vs. Background at 7.5 m/s
		Figure D.02



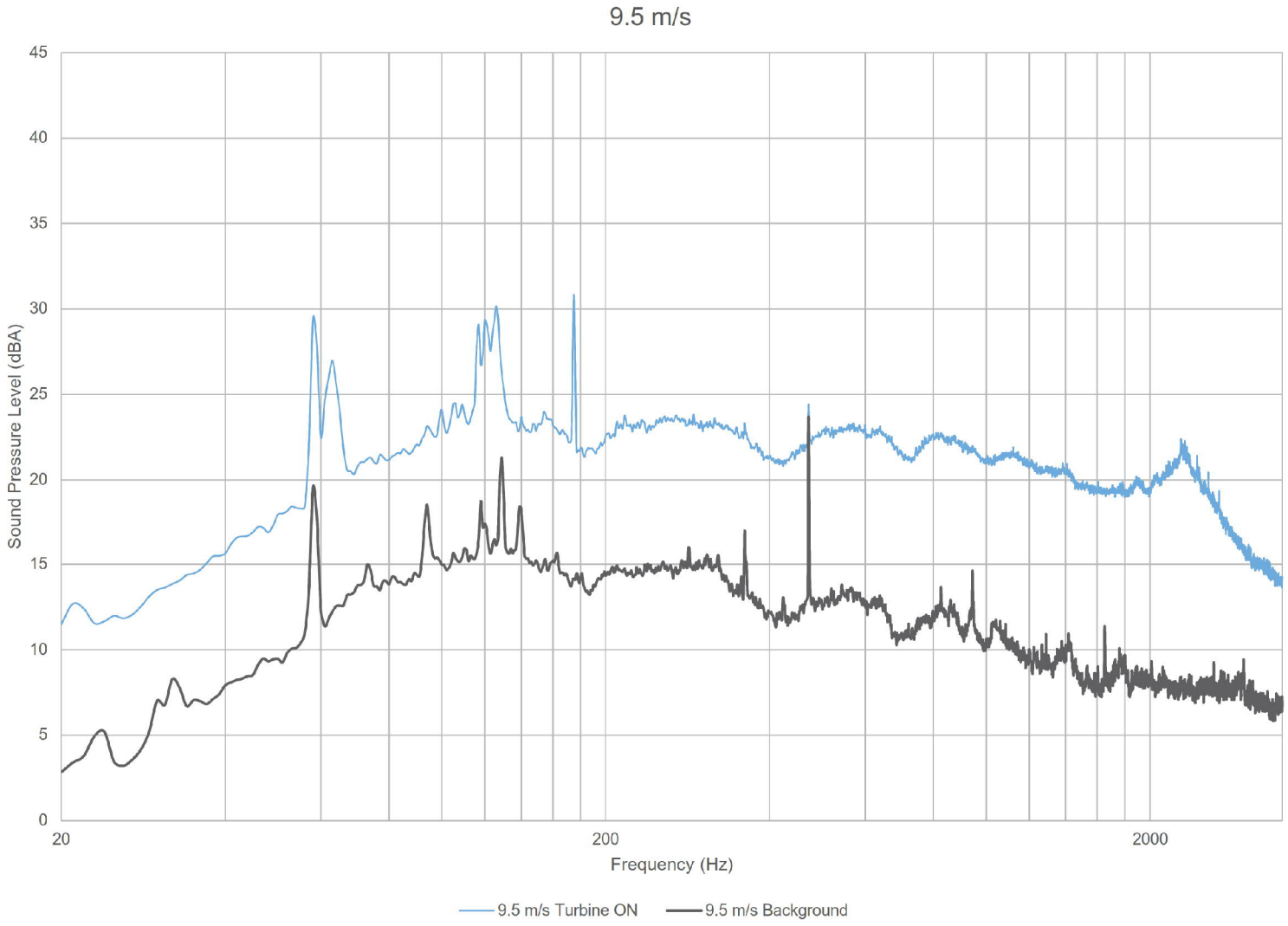
aercoustics	15039.00.T209.RP3	**Project Name**
	Scale: NTS Drawn by: AM Reviewed by: PA Date: Mar 07, 2018 Revision: 1	Cedar Point Wind Power Project - Turbine CP209 - IEC61400-11 Edition 3.0
		Figure Title Plot of narrow band spectra – Turbine ON vs. Background at 8 m/s
		Figure D.03



aercoustics	15039.00.T209.RP3	**Project Name**
	Scale: NTS Drawn by: AM Reviewed by: PA Date: Mar 07, 2018 Revision: 1	Cedar Point Wind Power Project - Turbine CP209 - IEC61400-11 Edition 3.0
		Figure Title Plot of narrow band spectra – Turbine ON vs. Background at 8.5 m/s
		Figure D.04

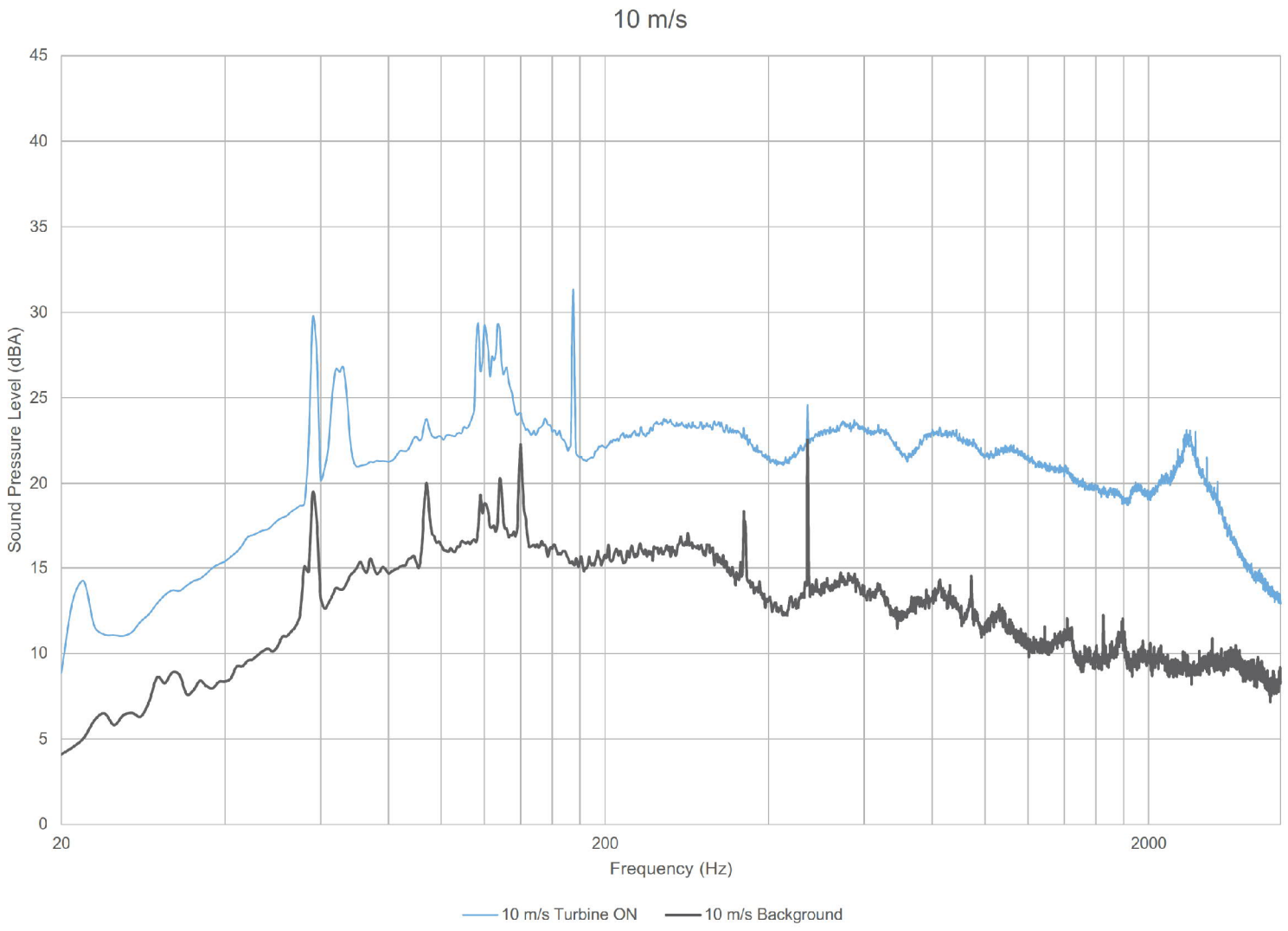


aercoustics	15039.00.T209.RP3	**Project Name**
	Scale: NTS Drawn by: AM Reviewed by: PA Date: Mar 07, 2018 Revision: 1	Cedar Point Wind Power Project - Turbine CP209 - IEC61400-11 Edition 3.0
		Figure Title Plot of narrow band spectra – Turbine ON vs. Background at 9 m/s
		Figure D.05

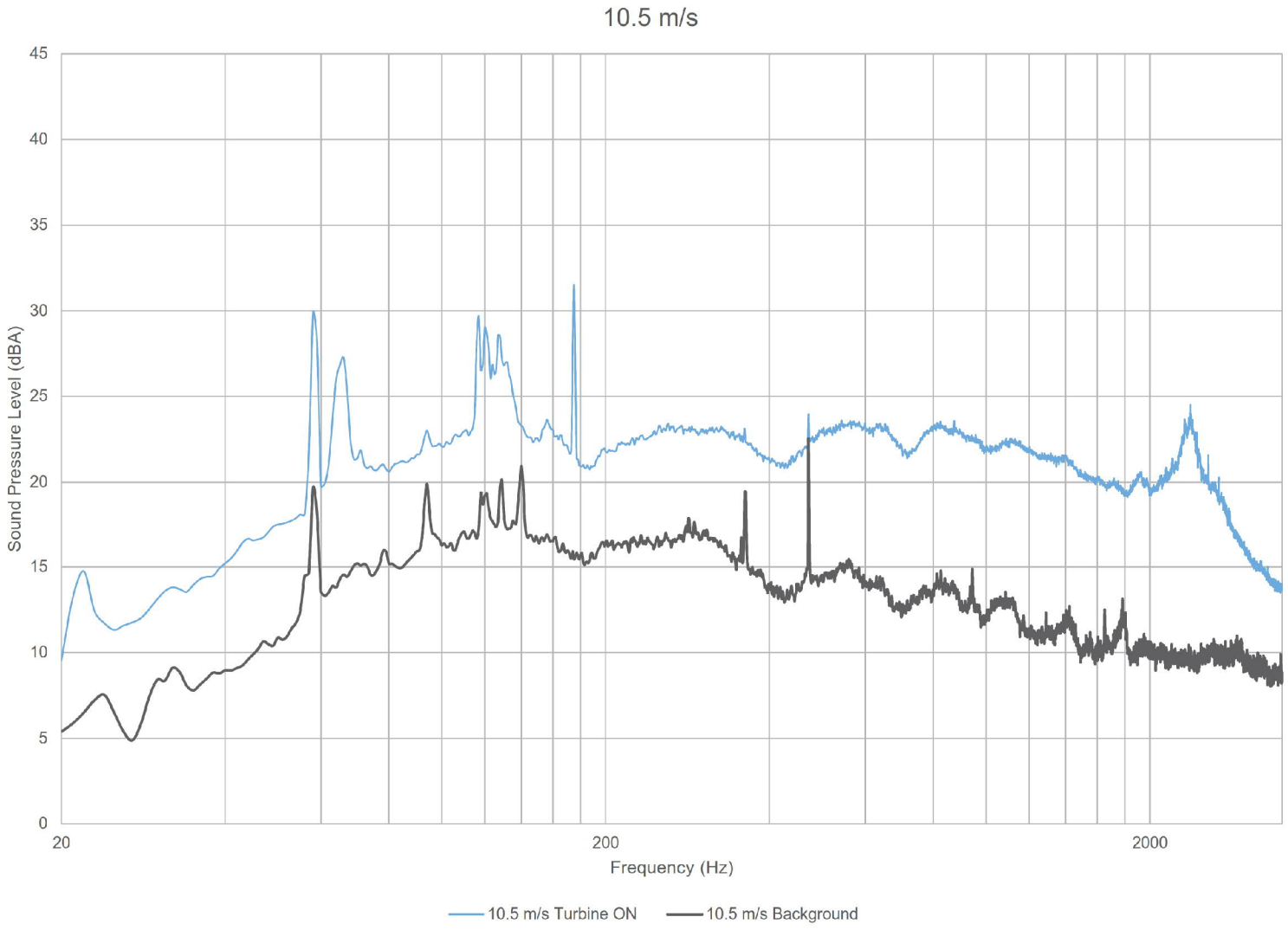


aercoustics	15039.00.T209.RP3 Scale: NTS Drawn by: AM Reviewed by: PA Date: Mar 07, 2018 Revision: 1	**Project Name** Cedar Point Wind Power Project - Turbine CP209 - IEC61400-11 Edition 3.0 **Figure Title** Plot of narrow band spectra – Turbine ON vs. Background at 9.5 m/s

Figure D.06

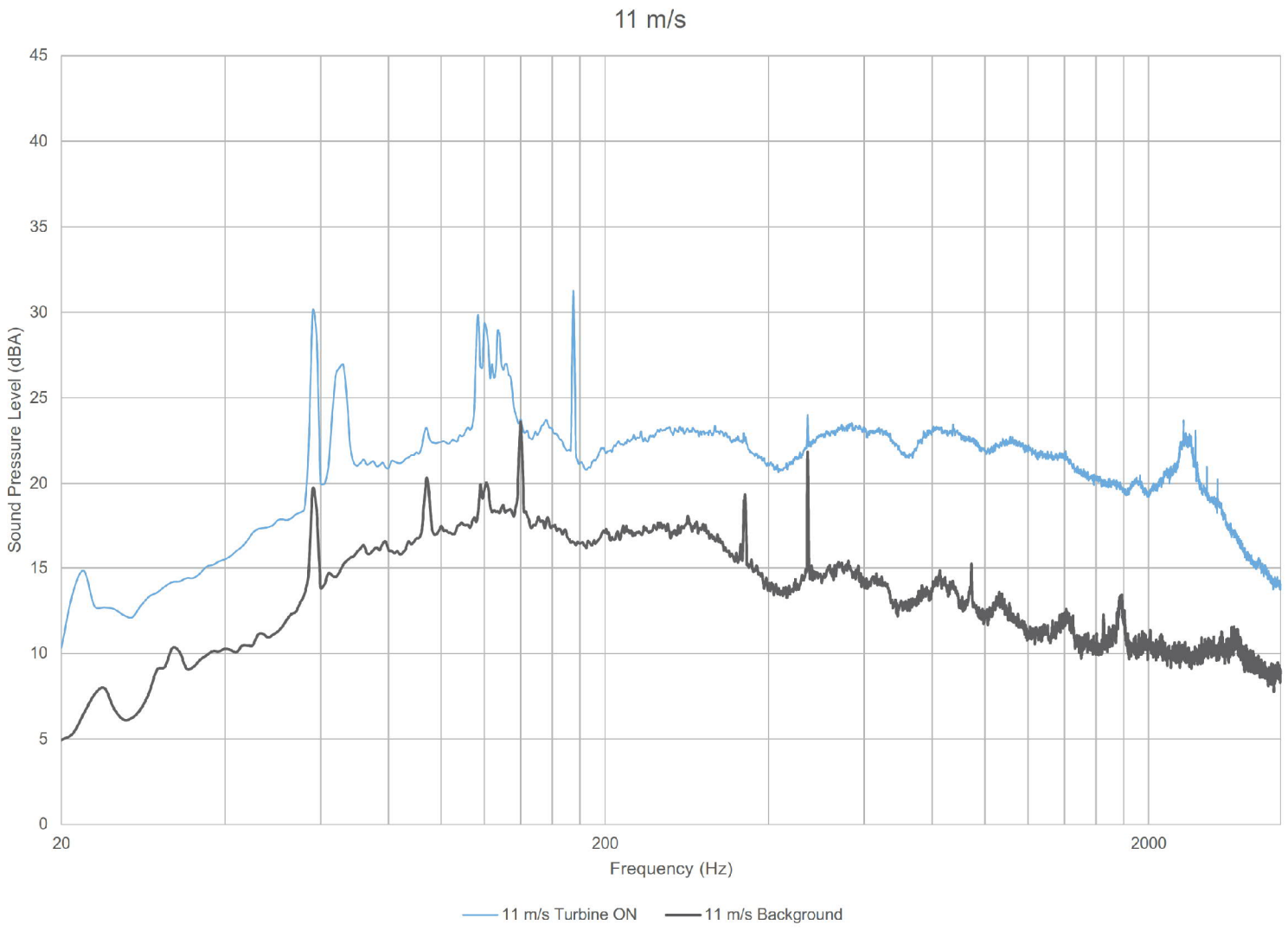


aercoustics	15039.00.T209.RP3	**Project Name**
	Scale: NTS Drawn by: AM Reviewed by: PA Date: Mar 07, 2018 Revision: 1	Cedar Point Wind Power Project - Turbine CP209 - IEC61400-11 Edition 3.0
		Figure Title Plot of narrow band spectra – Turbine ON vs. Background at 10 m/s
		Figure D.07

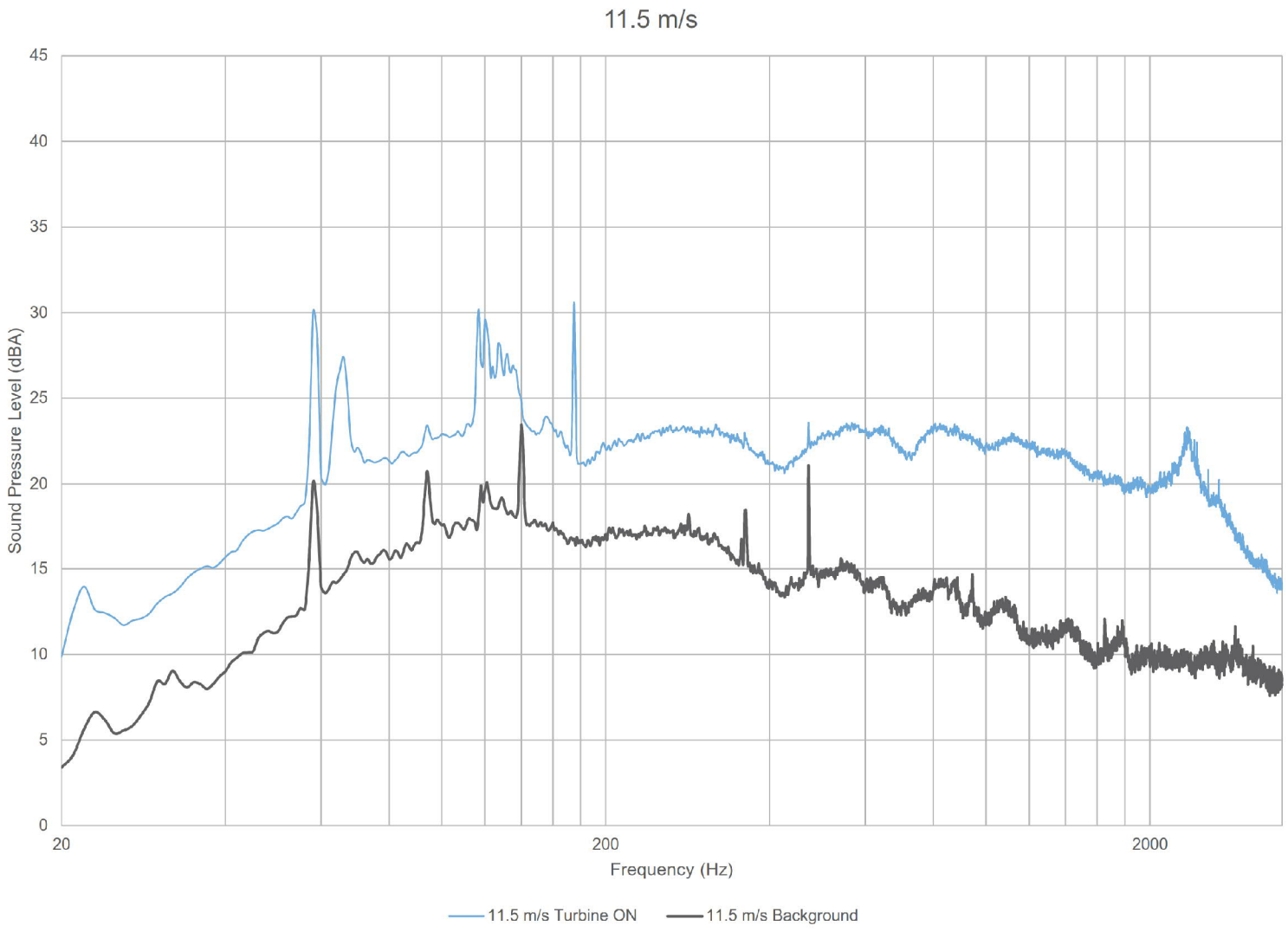


aercoustics	15039.00.T209.RP3 Scale: NTS Drawn by: AM Reviewed by: PA Date: Mar 07, 2018 Revision: 1	**Project Name** Cedar Point Wind Power Project - Turbine CP209 - IEC61400-11 Edition 3.0 **Figure Title** Plot of narrow band spectra – Turbine ON vs. Background at 10.5 m/s

Figure D.08



aercoustics	15039.00.T209.RP3	**Project Name**
	Scale: NTS Drawn by: AM Reviewed by: PA Date: Mar 07, 2018 Revision: 1	Cedar Point Wind Power Project - Turbine CP209 - IEC61400-11 Edition 3.0
		Figure Title Plot of narrow band spectra – Turbine ON vs. Background at 11 m/s
		Figure D.09



aercoustics	15039.00.T209.RP3 Scale: NTS Drawn by: AM Reviewed by: PA Date: Mar 07, 2018 Revision: 1	**Project Name** Cedar Point Wind Power Project - Turbine CP209 - IEC61400-11 Edition 3.0 **Figure Title** Plot of narrow band spectra – Turbine ON vs. Background at 11.5 m/s

Figure D.10

Table D.01 Tonality Assessment Table - 7 m/s

Project: Cedar Point Wind Power Project- Turbine CP209 - IEC 61400-11 Measurement

Report ID: 15039.00.T209.RP3

Created on: 3/7/2018

Measurement #	Centre frequency (Hz)	Energy average of all masking lines (dB)	Background (dB)	Background adjusted criterion level (dB)	Masking level (dB)	Tone level (dB)	Determination of tonality (dB)	Frequency dependent audibility criterion (dB)	Tonal Audibility (dB)
658	58			18.0	36.2	30.4	-5.8	-2.0	-3.8
682	58			19.0	37.2	34.6	-2.6	-2.0	-0.6
656	58			17.8	36.1	32.9	-3.2	-2.0	-1.2
704	58			20.7	39.0	33.8	-5.2	-2.0	-3.2
697	58			18.3	36.5	31.4	-5.1	-2.0	-3.1
687	58			18.7	36.9	33.3	-3.6	-2.0	-1.6
659	58			18.1	36.4	32.9	-3.5	-2.0	-1.5
691	58			18.1	36.3	35.2	-1.1	-2.0	0.9
684	58			18.4	36.7	30.2	-6.5	-2.0	-4.5
648	58			17.2	35.4	33.6	-1.8	-2.0	0.2
680	58			19.4	37.6	33.0	-4.7	-2.0	-2.7
700	58			18.2	36.4	32.5	-4.0	-2.0	-2.0
698	59			18.4	36.7	32.9	-3.8	-2.0	-1.8
683	59			19.0	37.3	32.8	-4.5	-2.0	-2.5
693	59			17.0	35.3	32.4	-2.9	-2.0	-0.9
696	59			18.0	36.3	36.5	0.2	-2.0	2.2
692	62			18.9	37.1	32.4	-4.7	-2.0	-2.7
661	62			19.5	37.7	34.1	-3.7	-2.0	-1.7
681	62			19.0	37.2	32.9	-4.4	-2.0	-2.4
660	62			18.2	36.4	32.8	-3.7	-2.0	-1.7
657	62			18.3	36.5	32.6	-3.9	-2.0	-1.9
Average	59						-3.4	-2.0	-1.4

Table D.02 Tonality Assessment Table - 7.5 m/s

Project: Cedar Point Wind Power Project- Turbine CP209 - IEC 61400-11 Measurement

Report ID: 15039.00.T209.RP3

Created on: 3/7/2018

Measurement #	Centre frequency (Hz)	Energy average of all masking lines (dB)	Background (dB)	Background adjusted criterion level (dB)	Masking level (dB)	Tone level (dB)	Determination of tonality (dB)	Frequency dependent audibility criterion (dB)	Tonal Audibility (dB)
No Reportable Tones									

Table D.03 Tonality Assessment Table - 8 m/s

Project: Cedar Point Wind Power Project- Turbine CP209 - IEC 61400-11 Measurement

Report ID: 15039.00.T209.RP3

Created on: 3/7/2018

Measurement #	Centre frequency (Hz)	Energy average of all masking lines (dB)	Background (dB)	Background adjusted criterion level (dB)	Masking level (dB)	Tone level (dB)	Determination of tonality (dB)	Frequency dependent audibility criterion (dB)	Tonal Audibility (dB)
482	58			20.1	38.4	34.1	-4.2	-2.0	-2.2
616	58			19.8	38.0	33.4	-4.6	-2.0	-2.6
615	58			19.7	37.9	32.7	-5.2	-2.0	-3.2
713	58			19.5	37.7	32.5	-5.2	-2.0	-3.2
671	58			19.4	37.7	33.0	-4.7	-2.0	-2.7
670	58			19.7	38.0	34.3	-3.7	-2.0	-1.7
714	58			19.1	37.4	33.1	-4.2	-2.0	-2.2
613	58			20.8	39.0	32.0	-7.0	-2.0	-5.0
484	58			19.6	37.8	34.1	-3.7	-2.0	-1.7
676	58			21.3	39.5	34.3	-5.2	-2.0	-3.2
668	58			18.5	36.7	38.1	1.4	-2.0	3.4
674	65			21.6	39.9	33.1	-6.8	-2.0	-4.8
712	65			19.3	37.6	34.2	-3.4	-2.0	-1.4
618	65			21.1	39.3	33.1	-6.2	-2.0	-4.2
483	65			19.5	37.7	34.9	-2.8	-2.0	-0.8
486	65			21.5	39.7	33.3	-6.4	-2.0	-4.4
Average	60						-4.0	-2.0	-2.0

Table D.04 Tonality Assessment Table - 8.5 m/s

Project: Cedar Point Wind Power Project- Turbine CP209 - IEC 61400-11 Measurement

Report ID: 15039.00.T209.RP3

Created on: 3/7/2018

Measurement #	Centre frequency (Hz)	Energy average of all masking lines (dB)	Background (dB)	Background adjusted criterion level (dB)	Masking level (dB)	Tone level (dB)	Determination of tonality (dB)	Frequency dependent audibility criterion (dB)	Tonal Audibility (dB)
642	58			19.6	37.8	32.9	-4.9	-2.0	-2.9
485	58			21.1	39.3	37.6	-1.7	-2.0	0.3
641	58			19.6	37.8	33.0	-4.8	-2.0	-2.8
478	58			20.7	38.9	35.3	-3.6	-2.0	-1.6
612	58			20.9	39.1	34.1	-5.0	-2.0	-3.0
643	58			19.3	37.6	34.4	-3.2	-2.0	-1.2
477	58			20.1	38.3	35.6	-2.8	-2.0	-0.8
481	58			20.2	38.5	35.7	-2.7	-2.0	-0.7
607	58			20.9	39.1	35.6	-3.5	-2.0	-1.5
619	65			22.0	40.3	33.4	-6.9	-2.0	-4.8
614	65			20.0	38.2	35.8	-2.4	-2.0	-0.4
706	65			19.5	37.8	34.6	-3.1	-2.0	-1.1
620	65			22.2	40.5	34.2	-6.2	-2.0	-4.2
707	65			20.4	38.6	35.3	-3.3	-2.0	-1.3
622	65			21.9	40.2	34.5	-5.6	-2.0	-3.6
621	65			21.2	39.4	35.2	-4.3	-2.0	-2.3
705	66			20.2	38.5	37.8	-0.6	-2.0	1.4
Average	61						-3.5	-2.0	-1.5

Table D.05 Tonality Assessment Table - 9 m/s

Project: Cedar Point Wind Power Project- Turbine CP209 - IEC 61400-11 Measurement

Report ID: 15039.00.T209.RP3

Created on: 3/7/2018

Measurement #	Centre frequency (Hz)	Energy average of all masking lines (dB)	Background (dB)	Background adjusted criterion level (dB)	Masking level (dB)	Tone level (dB)	Determination of tonality (dB)	Frequency dependent audibility criterion (dB)	Tonal Audibility (dB)
611	58			20.3	38.5	34.3	-4.2	-2.0	-2.2
634	58			20.7	38.9	36.5	-2.5	-2.0	-0.5
590	58			20.7	39.0	35.3	-3.7	-2.0	-1.7
640	58			19.3	37.5	35.1	-2.5	-2.0	-0.5
360	58			21.2	39.5	37.7	-1.7	-2.0	0.3
623	65			21.0	39.2	36.1	-3.1	-2.0	-1.1
588	65			19.9	38.1	35.5	-2.7	-2.0	-0.7
487	66			21.2	39.4	38.1	-1.3	-2.0	0.7
Average	61						-2.6	-2.0	-0.6

Table D.06 Tonality Assessment Table - 9.5 m/s

Project: Cedar Point Wind Power Project- Turbine CP209 - IEC 61400-11 Measurement

Report ID: 15039.00.T209.RP3

Created on: 3/7/2018

Measurement #	Centre frequency (Hz)	Energy average of all masking lines (dB)	Background (dB)	Background adjusted criterion level (dB)	Masking level (dB)	Tone level (dB)	Determination of tonality (dB)	Frequency dependent audibility criterion (dB)	Tonal Audibility (dB)
232	58			20.6	38.8	36.1	-2.7	-2.0	-0.7
625	58			19.8	38.0	34.6	-3.4	-2.0	-1.4
334	58			21.8	40.0	35.9	-4.1	-2.0	-2.1
511	58			19.3	37.5	35.9	-1.6	-2.0	0.4
352	58			19.6	37.8	35.4	-2.4	-2.0	-0.4
547	58			18.6	36.9	35.9	-1.0	-2.0	1.0
14	58			21.3	39.5	35.1	-4.4	-2.0	-2.4
235	58			21.0	39.2	33.9	-5.3	-2.0	-3.3
307	58			20.5	38.7	37.3	-1.4	-2.0	0.6
535	58			20.6	38.8	34.4	-4.4	-2.0	-2.4
340	58			19.4	37.6	34.6	-3.0	-2.0	-1.0
156	58			20.7	38.9	34.9	-4.0	-2.0	-2.0
209	58			19.8	38.1	34.4	-3.7	-2.0	-1.7
499	58			20.7	38.9	36.6	-2.4	-2.0	-0.4
415	58			20.0	38.2	36.7	-1.5	-2.0	0.5
341	58			18.7	36.9	36.1	-0.8	-2.0	1.2
475	58			18.4	36.7	35.2	-1.4	-2.0	0.6
184	58			19.6	37.9	33.7	-4.2	-2.0	-2.2
479	58			20.4	38.6	34.1	-4.5	-2.0	-2.5
210	58			19.4	37.6	36.2	-1.5	-2.0	0.5
586	59			20.5	38.7	35.5	-3.2	-2.0	-1.2
96	61			19.9	38.1	33.9	-4.3	-2.0	-2.3
53	62			22.0	40.2	33.4	-6.9	-2.0	-4.9
626	65			19.8	38.1	35.3	-2.8	-2.0	-0.8
322	74			20.5	38.7	38.7	0.0	-2.0	2.0
Average	59						-2.7	-2.0	-0.7

Table D.06 Tonality Assessment Table - 9.5 m/s

Project: Cedar Point Wind Power Project- Turbine CP209 - IEC 61400-11 Measurement

Report ID: 15039.00.T209.RP3

Created on: 3/7/2018

Measurement #	Centre frequency (Hz)	Energy average of all masking lines (dB)	Background (dB)	Background adjusted criterion level (dB)	Masking level (dB)	Tone level (dB)	Determination of tonality (dB)	Frequency dependent audibility criterion (dB)	Tonal Audibility (dB)
36	123			24.3	42.5	36.6	-5.9	-2.0	-3.9
90	124			23.0	41.3	35.0	-6.3	-2.0	-4.3
96	124			22.8	41.1	32.6	-8.4	-2.0	-6.4
511	124			22.6	40.9	32.7	-8.2	-2.0	-6.2
53	125			23.5	41.8	33.6	-8.2	-2.0	-6.2
95	125			23.0	41.3	34.2	-7.1	-2.0	-5.1
184	126			22.0	40.3	33.4	-6.9	-2.0	-4.9
89	126			22.7	41.0	36.1	-5.0	-2.0	-2.9
216	126			22.2	40.5	37.9	-2.6	-2.0	-0.6
88	126			21.5	39.8	38.8	-0.9	-2.0	1.1
535	126			24.4	42.7	35.0	-7.8	-2.0	-5.8
291	126			23.2	41.5	37.5	-3.9	-2.0	-1.9
307	126			23.7	42.0	38.3	-3.7	-2.0	-1.7
221	126			22.7	41.0	33.0	-8.0	-2.0	-6.0
15	126			23.4	41.7	37.4	-4.3	-2.0	-2.3
20	126			24.1	42.4	33.9	-8.6	-2.0	-6.6
425	126			21.7	40.0	38.1	-1.8	-2.0	0.2
243	126			22.1	40.4	39.1	-1.3	-2.0	0.7
340	126			21.4	39.7	37.2	-2.5	-2.0	-0.5
547	126			21.7	40.0	37.6	-2.4	-2.0	-0.4
278	127			22.8	41.0	35.7	-5.4	-2.0	-3.3
109	127			22.8	41.0	37.2	-3.8	-2.0	-1.8
14	127			24.1	42.4	37.6	-4.9	-2.0	-2.9
210	127			22.8	41.1	36.9	-4.2	-2.0	-2.2
322	148			24.1	42.5	37.1	-5.4	-2.0	-3.4
Average	127						-4.5	-2.0	-2.5

Table D.07 Tonality Assessment Table - 10 m/s

Project: Cedar Point Wind Power Project- Turbine CP209 - IEC 61400-11 Measurement

Report ID: 15039.00.T209.RP3

Created on: 3/7/2018

Measurement #	Centre frequency (Hz)	Energy average of all masking lines (dB)	Background (dB)	Background adjusted criterion level (dB)	Masking level (dB)	Tone level (dB)	Determination of tonality (dB)	Frequency dependent audibility criterion (dB)	Tonal Audibility (dB)
602	58			19.7	37.9	36.3	-1.6	-2.0	0.4
447	58			18.9	37.1	36.0	-1.1	-2.0	0.9
468	58			16.6	34.8	37.4	2.6	-2.0	4.6
433	58			17.7	35.9	36.7	0.9	-2.0	2.9
438	58			20.1	38.3	35.4	-2.9	-2.0	-0.9
510	58			19.6	37.9	35.7	-2.2	-2.0	-0.2
528	58			19.8	38.0	37.1	-0.9	-2.0	1.1
461	58			18.7	36.9	35.5	-1.4	-2.0	0.6
245	58			20.0	38.2	35.6	-2.7	-2.0	-0.7
413	58			20.2	38.4	37.4	-1.0	-2.0	1.0
585	58			20.6	38.8	35.2	-3.6	-2.0	-1.6
598	58			19.5	37.7	37.0	-0.7	-2.0	1.3
633	58			21.4	39.7	34.9	-4.7	-2.0	-2.7
551	58			16.7	35.0	36.0	1.1	-2.0	3.1
453	58			21.3	39.5	36.0	-3.5	-2.0	-1.5
549	58			17.5	35.7	36.8	1.0	-2.0	3.0
252	58			19.5	37.7	35.2	-2.5	-2.0	-0.5
536	58			21.0	39.2	35.7	-3.5	-2.0	-1.5
542	58			21.3	39.5	34.4	-5.1	-2.0	-3.1
458	58			17.7	35.9	36.4	0.5	-2.0	2.5
506	58			19.3	37.6	35.6	-2.0	-2.0	0.0
437	58			18.3	36.6	36.9	0.3	-2.0	2.3
520	58			20.3	38.5	36.1	-2.4	-2.0	-0.4
377	58			19.8	38.1	34.7	-3.4	-2.0	-1.4
283	58			21.3	39.5	34.0	-5.5	-2.0	-3.5
556	58			17.1	35.3	36.4	1.1	-2.0	3.1
445	58			19.2	37.4	34.5	-2.9	-2.0	-0.9
309	58			20.6	38.9	37.1	-1.8	-2.0	0.2
532	58			21.5	39.7	36.9	-2.8	-2.0	-0.8
157	59			20.6	38.8	36.9	-1.8	-2.0	0.2
596	64			19.8	38.0	35.3	-2.7	-2.0	-0.7
264	65			20.5	38.7	36.4	-2.4	-2.0	-0.4
114	66			21.7	40.0	34.5	-5.4	-2.0	-3.4
56	66			22.9	41.1	33.8	-7.4	-2.0	-5.4
59	66			22.4	40.6	34.8	-5.8	-2.0	-3.8
563	66			18.5	36.7	37.9	1.2	-2.0	3.2
593	66			18.9	37.1	37.3	0.2	-2.0	2.2
443	66			18.4	36.6	36.0	-0.6	-2.0	1.4
527	66			21.5	39.8	34.5	-5.3	-2.0	-3.3
39	66			21.9	40.1	33.6	-6.6	-2.0	-4.6
636	66			19.7	37.9	37.7	-0.2	-2.0	1.8
471	66			17.0	35.3	37.5	2.2	-2.0	4.2
67	67			22.7	40.9	34.1	-6.8	-2.0	-4.8
630	67			20.9	39.2	36.4	-2.8	-2.0	-0.8
Averge	61						-1.5	-2.0	0.5

Table D.08 Tonality Assessment Table - 10.5 m/s

Project: Cedar Point Wind Power Project- Turbine CP209 - IEC 61400-11 Measurement

Report ID: 15039.00.T209.RP3

Created on: 3/7/2018

Measurement #	Centre frequency (Hz)	Energy average of all masking lines (dB)	Background (dB)	Background adjusted criterion level (dB)	Masking level (dB)	Tone level (dB)	Determination of tonality (dB)	Frequency dependent audibility criterion (dB)	Tonal Audibility (dB)
599	58			19.2	37.4	37.1	-0.3	-2.0	1.7
552	58			17.8	36.1	35.8	-0.2	-2.0	1.8
462	58			18.8	37.0	34.3	-2.7	-2.0	-0.7
257	58			19.3	37.6	35.6	-2.0	-2.0	0.0
249	58			18.4	36.6	35.9	-0.7	-2.0	1.3
188	58			19.4	37.6	34.5	-3.1	-2.0	-1.1
467	58			17.5	35.7	36.5	0.8	-2.0	2.8
381	58			20.5	38.7	37.7	-1.1	-2.0	0.9
440	58			20.2	38.4	37.6	-0.8	-2.0	1.2
372	58			19.5	37.7	36.5	-1.2	-2.0	0.8
391	58			19.8	38.0	36.3	-1.7	-2.0	0.3
578	58			20.0	38.3	36.7	-1.6	-2.0	0.4
451	58			19.5	37.7	35.4	-2.3	-2.0	-0.3
526	58			21.4	39.6	36.7	-3.0	-2.0	-1.0
397	58			19.7	37.9	38.1	0.2	-2.0	2.2
373	58			18.6	36.8	37.1	0.3	-2.0	2.3
246	58			20.1	38.4	35.8	-2.6	-2.0	-0.6
369	58			20.1	38.4	36.4	-2.0	-2.0	0.0
436	58			19.2	37.4	36.6	-0.8	-2.0	1.2
472	58			17.5	35.7	35.4	-0.3	-2.0	1.7
349	58			19.1	37.4	35.8	-1.6	-2.0	0.4
474	58			19.1	37.3	36.0	-1.3	-2.0	0.7
254	58			18.4	36.7	36.8	0.1	-2.0	2.1
428	58			18.6	36.9	36.7	-0.2	-2.0	1.8
267	58			21.3	39.6	35.4	-4.2	-2.0	-2.2
199	58			22.9	41.1	34.0	-7.1	-2.0	-5.1
396	58			20.0	38.2	37.1	-1.1	-2.0	0.9
465	58			19.1	37.3	36.3	-1.0	-2.0	1.0
150	59			20.5	38.7	35.5	-3.2	-2.0	-1.2
378	65			20.5	38.8	35.8	-3.0	-2.0	-1.0
580	65			18.0	36.3	36.2	-0.1	-2.0	1.9
312	66			19.2	37.4	35.5	-2.0	-2.0	0.1
595	66			20.2	38.5	37.4	-1.1	-2.0	0.9
459	66			19.5	37.7	36.6	-1.1	-2.0	0.9
99	66			22.3	40.6	34.0	-6.6	-2.0	-4.6
196	66			20.0	38.2	35.6	-2.6	-2.0	-0.6
120	66			21.9	40.1	32.1	-8.0	-2.0	-6.0
238	66			20.8	39.0	37.0	-2.0	-2.0	0.0
452	66			20.7	38.9	33.4	-5.6	-2.0	-3.6
117	66			23.1	41.3	33.7	-7.6	-2.0	-5.6
600	67			19.5	37.7	37.5	-0.3	-2.0	1.7
237	67			19.6	37.8	37.4	-0.4	-2.0	1.6
323	71			21.1	39.3	39.3	0.0	-2.0	2.0
Average	61						-1.6	-2.0	0.4

Table D.09 Tonality Assessment Table - 11 m/s

Project: Cedar Point Wind Power Project - Turbine CP209 - IEC 61400-11 Measurement

Report ID: 15039.00.T209.RP3

Created on: 3/7/2018

Measurement #	Centre frequency (Hz)	Energy average of all masking lines (dB)	Background (dB)	Background adjusted criterion level (dB)	Masking level (dB)	Tone level (dB)	Determination of tonality (dB)	Frequency dependent audibility criterion (dB)	Tonal Audibility (dB)
294	58			19.4	37.7	36.9	-0.8	-2.0	1.3
427	58			18.4	36.7	35.4	-1.3	-2.0	0.7
584	58			20.2	38.5	37.0	-1.5	-2.0	0.5
555	58			17.6	35.8	37.2	1.4	-2.0	3.4
275	58			20.4	38.7	36.4	-2.3	-2.0	-0.3
256	58			18.6	36.9	35.6	-1.3	-2.0	0.7
455	58			21.5	39.7	36.7	-3.0	-2.0	-1.0
346	58			17.8	36.0	36.6	0.6	-2.0	2.6
107	58			22.1	40.4	33.2	-7.2	-2.0	-5.2
332	58			21.2	39.5	35.4	-4.1	-2.0	-2.1
274	58			19.6	37.8	35.9	-1.9	-2.0	0.1
272	58			18.6	36.9	37.6	0.7	-2.0	2.7
152	58			20.7	38.9	34.6	-4.3	-2.0	-2.3
370	58			20.6	38.8	37.2	-1.6	-2.0	0.4
219	58			19.5	37.7	35.1	-2.6	-2.0	-0.6
562	58			18.4	36.7	36.7	0.0	-2.0	2.0
385	58			19.1	37.3	36.6	-0.7	-2.0	1.3
376	58			20.3	38.5	36.3	-2.2	-2.0	-0.2
414	58			20.5	38.7	36.2	-2.5	-2.0	-0.5
444	58			18.9	37.2	37.0	-0.1	-2.0	1.9
434	58			19.3	37.6	37.2	-0.3	-2.0	1.7
191	58			19.1	37.3	35.8	-1.5	-2.0	0.5
330	58			20.4	38.7	36.0	-2.7	-2.0	-0.7
218	58			20.2	38.4	36.1	-2.3	-2.0	-0.3
631	58			20.7	39.0	34.4	-4.5	-2.0	-2.5
392	58			19.7	38.0	37.4	-0.6	-2.0	1.4
379	58			20.9	39.2	36.3	-2.9	-2.0	-0.9
390	58			20.0	38.2	35.4	-2.8	-2.0	-0.8
217	58			20.7	39.0	35.5	-3.5	-2.0	-1.5
550	58			17.7	35.9	36.6	0.7	-2.0	2.7
544	58			20.4	38.7	34.6	-4.0	-2.0	-2.0
342	58			18.7	36.9	36.3	-0.6	-2.0	1.4
432	58			16.9	35.2	36.0	0.9	-2.0	2.9
220	58			20.5	38.7	33.6	-5.2	-2.0	-3.2
306	58			20.8	39.1	36.7	-2.4	-2.0	-0.4
353	58			20.0	38.2	37.0	-1.2	-2.0	0.8
393	58			20.0	38.2	36.5	-1.8	-2.0	0.2
148	58			19.9	38.1	36.7	-1.4	-2.0	0.6
91	66			20.4	38.7	36.3	-2.4	-2.0	-0.4
126	66			22.3	40.5	34.7	-5.9	-2.0	-3.9
234	66			19.9	38.2	37.5	-0.7	-2.0	1.3
569	66			19.5	37.7	36.6	-1.1	-2.0	0.9
122	66			22.3	40.5	32.7	-7.8	-2.0	-5.8
79	66			22.0	40.2	35.8	-4.5	-2.0	-2.5
435	66			19.5	37.8	37.2	-0.6	-2.0	1.4
42	66			22.3	40.5	32.5	-8.0	-2.0	-6.0
545	67			18.3	36.6	34.1	-2.5	-2.0	-0.5
201	67			20.6	38.8	35.4	-3.4	-2.0	-1.4
248	67			19.6	37.8	36.2	-1.6	-2.0	0.4
Average	60						-1.8	-2.0	0.2

Table D.10 Tonality Assessment Table - 11.5 m/s

Project: Cedar Point Wind Power Project- Turbine CP209 - IEC 61400-11 Measurement

Report ID: 15039.00.T209.RP3

Created on: 3/7/2018

Measurement #	Centre frequency (Hz)	Energy average of all masking lines (dB)	Background (dB)	Background adjusted criterion level (dB)	Masking level (dB)	Tone level (dB)	Determination of tonality (dB)	Frequency dependent audibility criterion (dB)	Tonal Audibility (dB)
355	58			21.1	39.4	36.3	-3.1	-2.0	-1.1
289	58			19.2	37.5	37.5	0.1	-2.0	2.1
420	58			19.5	37.7	37.7	0.0	-2.0	2.0
113	58			22.9	41.2	30.1	-11.0	-2.0	-9.0
348	58			18.7	37.0	36.8	-0.1	-2.0	1.9
345	58			17.9	36.2	36.1	0.0	-2.0	2.0
574	58			19.3	37.5	36.8	-0.7	-2.0	1.3
183	58			19.8	38.1	35.6	-2.5	-2.0	-0.5
178	58			21.4	39.7	32.3	-7.4	-2.0	-5.4
292	58			20.0	38.2	36.7	-1.5	-2.0	0.5
383	58			18.2	36.5	36.3	-0.2	-2.0	1.8
398	58			20.3	38.5	35.9	-2.6	-2.0	-0.6
195	58			20.6	38.8	35.3	-3.5	-2.0	-1.5
350	58			18.7	37.0	37.5	0.6	-2.0	2.6
273	58			19.1	37.4	35.7	-1.6	-2.0	0.4
387	58			19.4	37.7	36.3	-1.4	-2.0	0.6
358	58			19.5	37.8	37.6	-0.1	-2.0	1.9
255	58			18.3	36.5	35.4	-1.2	-2.0	0.8
441	58			19.5	37.7	36.8	-0.9	-2.0	1.1
416	58			20.8	39.0	35.7	-3.4	-2.0	-1.3
240	58			19.8	38.1	36.8	-1.3	-2.0	0.7
78	66			21.3	39.5	33.6	-5.9	-2.0	-3.9
127	66			21.7	39.9	35.2	-4.7	-2.0	-2.7
52	66			22.7	40.9	35.5	-5.4	-2.0	-3.4
421	67			19.0	37.2	36.4	-0.8	-2.0	1.2
Average	59						-1.7	-2.0	0.3

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Appendix E
Measurement Data

Table E.01 Measurement data - Turbine ON

Project: Cedar Point Wind Power Project - Turbine CP209 - IEC 61400-11 Measurement

Report ID: 15039.00.T209.RP3

Created on: 3/7/2018

***Blank data denotes values that were omitted in the analysis due to an extraneous event during recording

Data Point #	Standardized Wind Speed	LAeq	Turbine Power Output (kW)	Reference Yaw Angle (°)	Yaw Angle (°)	Pitch Angle (°)	Rotor RPM	Nacelle Anemometer Wind Speed (m/s)	10m Anemometer Wind Speed (m/s)	Air Temperature (-C)	Pressure (kPa)	Relative Humidity (%)
1	12.7	53.3	2200	240.0	244.3	12.7	13.0	12.9	9.5	4	97978	68
2	12.2	52.4	2076	240.0	244.3	12.7	12.3	12.4	8.9	4	97978	68
3	12.1	52.4	2037	240.0	244.3	12.7	12.1	12.2	9.3	4	97978	68
4	13.1	53.7	2051	240.0	244.3	13.3	12.3	13.2	10.2	4	97980	68
5	12.5	52.5	2022	240.0	244.3	13.2	12.0	12.7	10.4	4	97978	68
6			2014	240.0	244.3	13.0	12.0	12.1	10.7	4	97978	68
7			2077	240.0	244.3	14.2	12.3	13.4	11.4	4	97978	68
8			2059	240.0	244.3	14.7	12.3	14.8	11.6	4	97978	68
9			2023	240.0	244.3	14.5	12.0	13.5	11.9	4	97978	68
10			1988	240.0	244.3	14.0	11.8	13.1	10.8	4	97978	68
11	13.2	53.4	1990	240.0	244.3	13.4	11.9	13.3	10.7	4	97978	68
12	12.1	53.2	2037	240.0	244.3	14.0	12.1	12.3	10.1	4	97978	67
13	12.9	51.9	1978	240.0	244.3	13.1	11.7	13.1	9.6	4	97978	67
14	9.7	52.9	1955	240.0	245.6	12.0	11.7	12.2	11.2	4	97978	67
15	9.6	52.1	1954	240.0	246.8	10.8	11.6	11.7	10.8	4	97978	67
16	11.3	52.3	2034	240.0	246.9	11.4	12.1	11.5	9.6	4	97978	67
17	13.6	52.7	2119	240.0	246.9	13.3	12.6	13.8	10.4	4	97978	67
18	13.2	52.2	2070	240.0	246.9	13.7	12.3	13.4	10.5	4	97978	68
19	13.0	51.1	1974	240.0	246.9	12.4	11.7	13.2	9.5	4	97978	68
20	9.5	52.0	1935	240.0	246.9	10.7	11.5	12.3	10.6	4	97978	68
21	9.5	51.5	1934	240.0	244.7	9.4	11.6	10.1	10.4	4	97978	68
22	11.1	51.7	2061	240.0	243.9	10.6	12.2	11.2	9.7	4	97978	68
23	11.1	52.2	1997	240.0	243.9	9.8	11.9	11.3	9.0	4	97978	69
24	11.2	51.9	1974	240.0	243.9	8.4	11.7	11.4	9.5	4	97978	70
25	11.4	53.2	2037	240.0	243.9	9.0	12.1	11.5	8.9	4	97978	70
26	13.1	52.8	2164	240.0	243.9	11.9	12.8	13.3	9.5	4	97978	70
27	12.0	51.7	2049	240.0	243.9	11.7	12.2	12.1	9.2	4	97978	70
28	9.6	50.8	1947	240.0	243.9	9.4	11.5	11.7	11.6	4	97978	70
29	9.6	52.2	1942	240.0	243.8	7.7	11.5	10.9	11.6	4	97978	69
30	11.6	53.1	2088	240.0	243.9	9.5	12.4	11.8	11.7	4	97978	68
31	11.8	53.0	2118	240.0	243.9	11.2	12.5	12.0	13.1	4	97978	68
32	13.1	52.2	2075	240.0	243.8	11.7	12.3	13.3	12.0	4	97978	68
33	11.8	51.6	2004	240.0	243.9	10.8	11.9	12.0	10.1	4	97978	68
34	12.2	53.0	1982	240.0	243.9	10.0	11.7	12.4	9.0	4	97978	68
35	9.2	53.0	1898	240.0	243.9	6.7	11.2	10.4	9.1	4	97978	68
36	9.5	51.5	1928	240.0	243.9	4.6	11.4	10.2	10.1	4	97978	69
37			1974	240.0	242.8	3.4	11.7	9.7	11.4	4	97978	69
38	10.5	52.4	2148	240.0	241.1	7.3	12.7	10.7	10.3	4	97978	69
39	10.0	51.4	2065	240.0	241.2	7.3	12.2	10.1	10.1	4	97978	69
40	10.2	53.4	2004	240.0	241.2	6.0	11.9	10.4	9.3	4	97978	69
41			2137	240.0	241.2	8.9	12.6	11.6	8.8	4	97978	69
42	11.1	53.2	2055	240.0	241.2	8.7	12.1	11.2	7.4	4	97978	68
43	10.7	52.0	2002	240.0	241.2	7.9	11.9	10.8	8.3	4	97978	68
44	9.9	51.3	2007	240.0	241.2	7.4	11.9	10.0	8.5	4	97978	68
45	11.2	51.9	2048	240.0	241.1	7.8	12.2	11.3	7.9	4	97978	68
46	12.2	52.3	2137	240.0	241.1	10.4	12.6	12.4	7.6	4	97978	68
47	11.0	50.8	2018	240.0	241.1	9.4	11.9	11.1	8.2	4	97978	69
48	12.0	51.4	2028	240.0	240.1	9.3	12.1	12.2	9.2	4	97979	69
49	12.6	51.0	2066	240.0	238.7	10.4	12.2	12.8	8.5	4	97978	69
50	10.0	50.9	1982	240.0	238.7	9.0	11.7	10.2	10.0	4	97979	69
51	10.8	51.7	1999	240.0	238.7	8.4	11.9	11.0	10.9	4	97978	69
52	11.6	52.6	2055	240.0	238.7	9.4	12.2	11.8	10.3	4	97979	69
53	9.6	52.0	1946	240.0	238.7	7.0	11.5	10.0	8.6	4	97978	69
54	9.5	52.2	1927	240.0	238.7	4.3	11.4	9.9	7.9	4	97978	68
55	9.8	53.1	2006	240.0	238.7	4.4	11.9	9.9	9.1	4	97978	68
56	10.2	52.7	2073	240.0	238.7	5.6	12.2	10.4	8.6	4	97978	68
57			2032	240.0	238.7	5.5	12.0	9.5	8.1	4	97978	68
58			2043	240.0	238.7	5.4	12.1	9.5	9.5	4	97978	68
59	10.1	51.3	2067	240.0	238.7	6.6	12.2	10.3	9.0	4	97978	68
60	9.9	52.6	2021	240.0	238.7	5.8	12.0	10.0	8.1	4	97978	69
61			1989	240.0	238.7	4.7	11.7	8.9	8.1	4	97978	69
62			2016	240.0	238.7	4.4	11.9	9.1	8.6	4	97978	69
63	9.9	51.6	2025	240.0	238.7	4.3	11.9	10.1	8.4	4	97978	69
64	9.9	51.5	1996	240.0	238.7	3.2	11.8	10.1	8.6	4	97978	69
65			2030	240.0	238.7	3.0	12.0	9.8	10.2	4	97978	69
66	10.3	52.1	2112	240.0	238.7	5.6	12.5	10.4	9.2	4	97978	68
67	9.8	52.2	2095	240.0	238.7	6.5	12.4	10.0	8.2	4	97978	68
68	10.0	52.0	2116	240.0	238.7	8.1	12.5	10.2	10.3	4	97978	68
69	12.1	52.1	2097	240.0	238.7	9.2	12.4	12.3	10.7	4	97978	68
70	12.0	52.1	2082	240.0	238.7	10.1	12.4	12.2	9.2	4	97979	68
71	10.0	51.9	2003	240.0	240.6	9.4	11.9	10.1	9.4	4	97979	68
72	10.3	51.5	1971	240.0	241.2	7.8	11.7	10.4	11.2	4	97978	68
73	11.8	51.8	2069	240.0	241.2	9.5	12.3	12.0	12.0	4	97978	68
74	11.7	52.7	2037	240.0	241.2	9.2	12.1	11.8	12.1	4	97978	68
75	11.1	52.6	2069	240.0	241.3	10.4	12.3	11.2	10.8	4	97979	68
76			1999	240.0	241.3	9.4	11.8	10.9	10.6	4	97979	68
77	11.1	52.3	1982	240.0	241.3	8.4	11.8	11.3	11.6	4	97979	68
78	11.7	51.8	2051	240.0	241.3	9.2	12.2	11.8	10.4	4	97979	68
79	11.1	53.0	2047	240.0	241.3	9.6	12.1	11.3	9.8	4	97978	68
80	11.9	52.8	2017	240.0	241.3	9.3	11.9	12.1	9.8	4	97979	68
81	12.3	53.0	2058	240.0	241.3	9.9	12.2	12.5	10.2	4	97979	68
82	11.9	53.4	2090	240.0	241.3	11.1	12.4	12.1	10.0	4	97979	68
83	12.4	52.2	2105	240.0	241.3	12.5	12.5	12.5	10.8	4	97979	68
84	13.0	52.1	2045	240.0	241.3	12.5	12.1	13.2	10.4	4	97979	67
85	12.8	51.7	2068	240.0	241.3	13.2	12.3	13.0	11.5	4	97979	67
86	12.5	53.7	2062	240.0	241.3	14.0	12.2	12.7	10.5	4	97979	67
87	12.6	51.9	1974	240.0	241.3	12.6	11.7	12.8	11.0	4	97979	67
88	9.7	51.5	1959	240.0	243.3	11.7	11.7	11.8	9.5	4	97979	67

***Blank data denotes values that were omitted in the analysis due to an extraneous event during recording

Data Point #	Standardized Wind Speed	LAeq	Turbine Power Output (kW)	Reference Yaw Angle (°)	Yaw Angle (°)	Pitch Angle (°)	Rotor RPM	Nacelle Anemometer Wind Speed (m/s)	10m Anemometer Wind Speed (m/s)	Air Temperature (-C)	Pressure (kPa)	Relative Humidity (%)
89	9.7	51.5	1960	240.0	244.0	10.6	11.6	11.0	11.1	4	97979	67
90	9.6	52.1	1943	240.0	243.9	8.9	11.6	11.7	10.7	4	97979	67
91	10.8	51.4	2049	240.0	243.9	10.0	12.1	11.0	10.0	4	97979	67
92	10.5	52.7	2000	240.0	243.9	9.4	11.9	10.7	9.6	4	97979	67
93	10.8	53.1	1994	240.0	243.9	8.4	11.8	10.9	9.5	4	97979	67
94	10.9	52.9	2008	240.0	244.0	8.3	11.9	11.1	9.8	4	97979	67
95	9.7	51.5	1962	240.0	244.0	6.5	11.6	10.1	8.6	4	97979	67
96	9.5	51.6	1937	240.0	244.0	4.2	11.5	10.2	8.1	4	97979	68
97	9.8	52.0	1997	240.0	244.0	3.6	11.8	9.9	8.5	4	97979	68
98	9.8	51.8	2014	240.0	243.9	3.3	11.9	9.9	8.3	4	97979	68
99	10.4	52.3	2117	240.0	243.9	5.7	12.5	10.6	8.2	4	97979	68
100	10.9	53.0	2225	240.0	243.9	10.0	13.2	11.0	8.7	4	97979	68
101	11.8	51.9	2134	240.0	244.0	10.9	12.6	11.9	6.8	4	97979	69
102	10.9	50.4	2016	240.0	244.0	10.0	12.0	11.0	6.8	4	97979	69
103	9.5	49.8	1928	240.0	243.9	7.5	11.4	10.9	7.6	4	97979	69
104	9.2	51.5	1886	240.0	243.9	3.2	11.2	10.5	9.4	4	97979	69
105			2035	240.0	244.0	4.6	12.1	9.4	9.0	4	97979	69
106	11.6	52.8	2168	240.0	244.0	8.2	12.9	11.8	9.1	4	97979	69
107	11.0	52.5	2120	240.0	244.0	9.7	12.5	11.1	9.8	4	97979	69
108	10.5	51.6	2012	240.0	243.9	8.6	12.0	10.7	10.2	4	97979	69
109	9.6	51.5	1950	240.0	241.4	6.9	11.6	10.4	9.4	4	97979	69
110	9.5	52.3	1933	240.0	241.1	4.2	11.4	10.8	7.6	4	97979	69
111			1982	240.0	241.1	3.4	11.8	9.6	7.9	4	97979	69
112	9.9	52.0	2083	240.0	241.0	5.4	12.3	10.0	9.2	4	97979	69
113	11.3	52.2	2113	240.0	241.0	7.4	12.5	11.5	9.6	4	97979	69
114	10.0	50.9	2032	240.0	241.0	6.8	12.0	10.2	9.8	4	97979	69
115	9.8	52.1	1991	240.0	239.0	5.5	11.8	10.0	8.6	4	97979	69
116			2029	240.0	238.7	5.8	12.0	9.4	8.8	4	97979	69
117	10.6	52.3	2078	240.0	238.6	7.2	12.3	10.7	8.6	4	97979	69
118	10.1	52.7	2007	240.0	238.6	6.2	11.9	10.3	8.4	4	97979	69
119			1997	240.0	238.6	5.3	11.8	9.9	10.1	4	97979	69
120	10.4	51.6	2039	240.0	238.6	5.7	12.1	10.6	8.2	4	97979	69
121	11.4	52.4	2131	240.0	238.6	9.4	12.6	11.5	8.1	4	97979	69
122	10.9	52.1	2034	240.0	238.6	8.8	12.0	11.0	9.1	4	97979	69
123	9.9	51.9	1970	240.0	238.6	7.2	11.7	10.1	8.4	4	97979	69
124	10.5	51.5	1994	240.0	238.6	6.4	11.9	10.6	8.1	4	97979	69
125	11.9	52.2	2115	240.0	238.6	9.0	12.5	12.0	8.2	4	97979	69
126	11.2	51.3	2052	240.0	238.6	9.0	12.2	11.4	10.0	4	97979	69
127	11.3	52.1	2109	240.0	238.6	10.6	12.5	11.5	10.5	4	97979	69
128	12.1	52.0	2159	240.0	238.6	13.0	12.8	12.3	11.1	4	97979	69
129			2103	240.0	238.6	13.7	12.5	13.5	10.7	4	97979	69
130			1979	240.0	238.6	12.6	11.8	11.8	10.3	4	97979	69
131			1954	240.0	240.0	11.3	11.7	11.3	11.0	4	97979	67
132			2016	240.0	241.8	11.5	12.0	11.8	10.9	4	97979	67
133			2044	240.0	241.7	12.1	12.2	12.4	9.2	4	97979	67
134			1955	240.0	241.7	14.7	11.9	12.9	9.5	4	97979	67
135			375	240.0	241.7	37.6	7.2	11.9	9.5	4	97980	67
136			0	240.0	242.5	79.0	1.7	13.1	8.7	4	97979	67
137	12.6	51.5	2001	240.0	246.1	10.5	11.7	12.8	11.2	4	95394	71
138	11.9	52.9	2036	240.0	246.1	10.8	12.0	12.1	11.3	4	95269	70
139	10.8	52.1	2038	240.0	246.1	10.6	12.0	11.0	10.9	4	95070	70
140	11.7	51.8	2022	240.0	246.1	10.2	11.9	11.9	11.0	4	94860	70
141	12.4	53.9	2021	240.0	246.1	9.6	11.9	12.6	10.3	4	94844	70
142	11.6	53.0	2018	240.0	246.1	9.1	11.9	11.8	11.1	4	94613	70
143	11.5	52.0	2039	240.0	246.1	9.3	12.0	11.7	11.0	4	94689	70
144	11.5	53.0	2070	240.0	246.1	9.7	12.2	11.6	11.5	4	94666	70
145	10.8	52.8	2037	240.0	246.1	9.6	12.0	10.9	10.5	4	94667	70
146	10.8	51.9	2030	240.0	246.1	9.0	11.9	11.0	10.9	4	94766	70
147	11.2	52.5	2104	240.0	246.1	10.7	12.4	11.3	9.9	4	94721	70
148	11.2	52.9	2067	240.0	246.1	10.7	12.1	11.3	9.8	4	94664	70
149	11.2	53.2	2006	240.0	246.1	9.9	11.8	11.4	9.8	4	94712	70
150	10.4	51.8	1981	240.0	246.1	8.4	11.6	10.6	9.4	4	94590	70
151	10.6	51.9	1994	240.0	246.1	7.6	11.8	10.7	9.2	4	94371	70
152	10.9	52.6	2038	240.0	246.1	7.7	12.0	11.0	9.1	4	94383	70
153	10.6	52.2	2003	240.0	246.1	6.8	11.8	10.8	9.7	4	94363	70
154	11.1	52.2	2048	240.0	246.1	6.8	12.1	11.3	8.4	4	94620	70
155	10.8	51.4	2095	240.0	246.1	8.4	12.3	11.0	7.6	4	98044	71
156	9.7	51.1	1965	240.0	246.1	5.9	11.6	9.6	8.5	4	98056	72
157	10.0	51.1	1972	240.0	246.1	3.9	11.6	10.1	18.8	2	93599	63
158	11.6	52.7	2166	240.0	246.1	7.8	12.8	11.7	10.2	4	98055	72
159	11.4	52.4	2184	240.0	246.1	10.2	12.9	11.5	10.1	4	98055	72
160	12.8	52.9	2180	240.0	246.1	12.4	12.9	13.0	10.7	4	98055	72
161	12.7	53.1	2109	240.0	248.0	13.2	12.5	12.9	9.9	4	98055	71
162	13.9	52.8	2052	240.0	248.6	13.1	12.1	14.1	11.4	4	98055	71
163	12.1	51.3	2003	240.0	248.6	12.4	11.9	12.2	12.3	4	98055	71
164	11.6	52.2	2012	240.0	248.6	12.1	11.9	11.8	11.8	4	98055	71
165	12.2	53.0	2034	240.0	248.6	12.2	12.0	12.4	10.9	4	98055	71
166	12.2	53.7	2060	240.0	248.6	12.8	12.2	12.4	10.5	4	98055	71
167	12.7	52.1	2031	240.0	248.6	12.6	12.0	12.9	12.3	4	98055	70
168	13.2	51.7	2067	240.0	248.6	13.3	12.2	13.4	11.7	5	98055	69
169	12.6	51.5	2062	240.0	248.6	13.8	12.2	12.8	10.4	5	98055	69
170	13.5	52.2	2066	240.0	248.6	14.4	12.2	13.7	10.7	5	98055	69
171	13.2	51.5	1996	240.0	248.6	13.5	11.8	13.4	9.4	5	98055	69
172	12.7	51.9	1984	240.0	248.6	12.6	11.7	12.9	10.8	5	98055	69
173	12.3	51.5	1978	240.0	248.6	11.9	11.7	12.4	10.9	5	98055	70
174	12.5	53.2	1993	240.0	248.6	11.3	11.8	12.7	10.2	5	98055	70
175	12.1	51.9	2020	240.0	248.6	11.2	11.9	12.3	11.2	5	98055	70
176	11.5	51.4	2022	240.0	248.6	10.9	12.0	11.7	11.0	5	98055	70

Table E.01 Measurement data - Turbine ON

Project: Cedar Point Wind Power Project - Turbine CP209 - IEC 61400-11 Measurement

Report ID: 15039.00.T209.RP3

Created on: 3/7/2018

***Blank data denotes values that were omitted in the analysis due to an extraneous event during recording

Data Point #	Standardized Wind Speed	LAeq	Turbine Power Output (kW)	Reference Yaw Angle (°)	Yaw Angle (°)	Pitch Angle (°)	Rotor RPM	Nacelle Anemometer Wind Speed (m/s)	10m Anemometer Wind Speed (m/s)	Air Temperature (-C)	Pressure (kPa)	Relative Humidity (%)
177	11.1	53.4	1994	240.0	248.6	10.3	11.8	11.3	11.7	5	98055	70
178	11.4	53.4	2081	240.0	248.6	11.4	12.3	11.6	12.6	5	98055	69
179	12.8	51.8	2080	240.0	248.6	12.3	12.3	13.0	12.6	5	98055	68
180	11.7	51.3	2051	240.0	248.6	12.5	12.1	11.9	11.9	5	98055	68
181	11.9	51.9	1995	240.0	248.6	11.4	11.8	12.0	11.2	5	98055	68
182	11.9	53.2	2025	240.0	248.6	11.5	12.0	12.1	11.5	5	98055	68
183	11.6	52.8	2001	240.0	248.6	10.8	11.8	11.7	11.1	5	98055	68
184	9.7	52.7	1961	240.0	248.6	9.4	11.6	11.9	9.1	5	98055	69
185			1933	240.0	248.6	7.1	11.4	10.9	9.0	5	98055	69
186	9.9	52.2	1970	240.0	248.6	5.9	11.7	10.1	8.8	5	98055	69
187	10.5	51.5	2046	240.0	248.6	6.7	12.1	10.7	9.8	5	98055	69
188	10.4	52.7	2050	240.0	248.6	7.0	12.1	10.5	9.7	5	98055	69
189	10.8	51.7	2067	240.0	248.6	7.7	12.2	11.0	9.0	5	98055	69
190	10.5	51.2	2060	240.0	248.4	8.1	12.2	10.7	8.2	5	98055	70
191	11.1	51.8	2108	240.0	245.3	9.6	12.5	11.2	8.2	5	98055	71
192	10.1	52.7	2015	240.0	245.1	8.8	11.9	10.3	7.4	5	98055	71
193	9.3	52.3	1899	240.0	245.1	4.7	11.2	9.6	8.0	5	98055	71
194	11.4	52.5	2045	240.0	243.9	5.7	12.1	11.5	8.4	5	98055	71
195	11.7	52.0	2132	240.0	242.4	8.5	12.6	11.9	7.5	5	98055	71
196	10.7	51.9	2058	240.0	242.4	8.3	12.2	10.8	8.5	5	98055	71
197	11.4	52.6	1999	240.0	240.4	7.4	11.8	11.6	8.1	5	98055	71
198			2006	240.0	240.0	6.4	11.8	9.7	7.8	5	98055	71
199	10.3	51.8	2019	240.0	240.0	6.5	11.9	10.5	8.0	5	98055	71
200	11.4	52.1	2086	240.0	240.0	7.6	12.3	11.6	10.0	5	98055	71
201	11.2	51.6	2088	240.0	240.0	8.8	12.4	11.4	9.4	5	98055	71
202	11.7	52.3	2145	240.0	240.0	10.9	12.7	11.9	8.8	5	98055	71
203	12.7	51.5	2038	240.0	240.9	10.9	12.2	12.8	9.7	5	98055	70
204	12.1	50.6	2024	240.0	242.5	11.1	12.1	12.3	10.7	5	98055	70
205	12.7	51.9	2061	240.0	242.5	12.0	12.3	12.9	10.4	5	98055	70
206	12.2	52.3	2046	240.0	244.4	12.7	12.3	12.4	10.3	5	98055	70
207	12.2	52.1	2030	240.0	245.2	12.9	12.1	12.4	9.9	5	98055	70
208	9.6	50.9	1954	240.0	245.2	11.9	11.7	12.1	11.3	5	98055	70
209	9.6	51.3	1941	240.0	247.4	10.4	11.6	12.1	11.3	5	98055	70
210	9.7	52.4	1966	240.0	247.5	9.9	11.8	11.7	9.9	5	98055	70
211	11.0	53.6	2004	240.0	247.5	9.8	12.0	11.2	9.7	5	98055	70
212	11.9	52.5	2104	240.0	247.5	12.0	12.6	12.1	10.5	5	98055	70
213	13.2	52.5	2074	240.0	247.6	12.7	12.4	13.4	11.8	5	98055	70
214	11.4	53.0	1992	240.0	247.6	11.9	11.9	11.6	11.0	5	98055	70
215	11.9	51.1	1999	240.0	247.5	11.7	11.9	12.1	11.1	5	98055	69
216	9.7	51.7	1960	240.0	247.5	10.5	11.7	11.3	11.0	5	98055	69
217	11.1	52.0	1973	240.0	247.6	9.8	11.8	11.3	12.0	5	98055	69
218	11.0	51.3	1985	240.0	247.5	9.3	11.8	11.1	11.1	5	98055	69
219	10.9	51.4	1982	240.0	247.5	8.7	11.8	11.0	11.1	5	98055	69
220	10.8	52.5	2004	240.0	247.6	8.6	11.9	10.9	10.3	5	98055	69
221	9.5	52.5	1935	240.0	247.5	6.5	11.5	9.8	10.2	5	98055	69
222	9.4	51.3	1917	240.0	247.6	3.4	11.4	9.0	9.3	5	98055	69
223	9.6	53.7	1950	240.0	247.5	1.9	11.6	9.5	7.9	5	98055	69
224			2073	240.0	245.3	4.3	12.3	9.8	7.4	5	98055	69
225			2089	240.0	244.9	5.6	12.4	8.8	9.0	5	98055	69
226			2073	240.0	245.0	6.4	12.3	9.1	9.0	5	98055	69
227	11.8	52.8	2129	240.0	244.9	8.6	12.6	11.9	7.9	5	98055	70
228	11.5	51.5	2066	240.0	245.0	9.0	12.3	11.7	7.4	5	98055	70
229	11.0	51.6	2006	240.0	244.9	8.2	11.9	11.1	8.9	5	98055	70
230	11.0	52.2	2068	240.0	244.9	9.4	12.3	11.2	9.7	5	98055	70
231	10.3	50.9	1983	240.0	244.9	8.2	11.7	10.4	9.8	5	98055	70
232	9.7	51.4	1959	240.0	244.9	6.4	11.7	10.2	11.8	5	98054	70
233	10.8	51.8	2055	240.0	244.9	7.9	12.2	11.0	11.4	5	98054	70
234	10.9	51.2	2057	240.0	244.9	8.5	12.2	11.0	11.1	5	98054	70
235	9.7	52.5	1958	240.0	244.9	6.6	11.6	9.6	12.5	5	98054	70
236	10.5	51.9	1999	240.0	244.9	6.0	11.9	10.7	11.9	5	98053	70
237	10.3	52.0	2077	240.0	244.9	7.8	12.4	10.4	11.0	5	98053	70
238	10.7	52.3	2070	240.0	244.9	8.4	12.3	10.9	9.7	5	98053	70
239	11.0	52.1	2096	240.0	244.9	9.8	12.5	11.1	8.9	5	98053	70
240	11.3	53.0	2060	240.0	245.0	10.3	12.2	11.5	9.1	5	98053	70
241	10.4	52.4	1999	240.0	245.0	9.5	11.9	10.5	10.7	5	98053	70
242	9.7	51.4	1964	240.0	245.0	8.1	11.7	11.6	9.1	5	98052	70
243	9.7	51.4	1968	240.0	245.0	7.0	11.7	10.4	9.5	5	98052	70
244			1972	240.0	246.8	5.9	11.7	9.2	10.5	5	98051	70
245	9.9	52.5	2022	240.0	247.8	6.3	12.0	10.1	9.4	5	98049	69
246	10.5	53.0	2052	240.0	247.8	7.0	12.2	10.7	8.8	5	98044	69
247	11.9	52.6	2079	240.0	247.8	8.0	12.3	12.0	8.7	5	98034	69
248	11.1	53.2	2077	240.0	247.8	8.9	12.3	11.3	10.2	5	97989	69
249	10.4	51.8	2029	240.0	247.8	8.7	12.0	10.5	9.7	5	95380	69
250	10.8	52.8	2014	240.0	247.8	8.4	12.0	11.0	10.6	5	94686	69
251	11.0	52.3	1989	240.0	247.8	7.5	11.8	11.2	10.7	5	94574	69
252	9.9	52.9	1992	240.0	247.8	6.8	11.8	10.1	10.1	5	94774	69
253	10.3	53.4	2042	240.0	249.8	7.5	12.1	10.5	10.2	5	94832	69
254	10.7	52.5	2048	240.0	250.3	8.0	12.2	10.8	10.0	5	95147	69
255	11.3	51.5	2054	240.0	250.3	8.4	12.2	11.4	9.9	5	94946	69
256	11.1	52.3	2023	240.0	250.4	8.3	12.0	11.3	9.9	5	95254	69
257	10.4	52.3	1990	240.0	250.4	7.3	11.8	10.5	9.4	5	95493	69
258			1979	240.0	250.4	6.2	11.8	9.8	8.8	5	95850	69
259			2002	240.0	250.4	5.8	11.8	9.7	7.8	5	95888	69
260			1978	240.0	250.3	4.5	11.7	9.5	8.2	5	95865	69
261			1977	240.0	250.4	3.0	11.7	9.5	7.8	5	96045	69
262	10.1	53.8	2019	240.0	250.4	3.1	11.9	10.3	7.1	5	95900	70
263			1983	240.0	250.3	1.3	11.7	9.2	8.0	5	95959	72
264	10.1	53.4	2025	240.0	250.4	1.4	12.0	10.2	7.7	5	96069	72

***Blank data denotes values that were omitted in the analysis due to an extraneous event during recording

Data Point #	Standardized Wind Speed	LAeq	Turbine Power Output (kW)	Reference Yaw Angle (°)	Yaw Angle (°)	Pitch Angle (°)	Rotor RPM	Nacelle Anemometer Wind Speed (m/s)	10m Anemometer Wind Speed (m/s)	Air Temperature (-C)	Pressure (kPa)	Relative Humidity (%)
265			2097	240.0	250.4	3.5	12.4	9.7	8.4	5	96040	72
266	10.4	53.0	2126	240.0	250.3	5.7	12.6	10.6	8.9	5	96000	72
267	10.3	53.3	2138	240.0	250.3	7.8	12.7	10.5	9.7	5	96111	72
268	11.9	52.0	2121	240.0	248.5	9.4	12.6	12.0	11.8	5	96314	71
269	11.1	51.5	2063	240.0	248.0	9.6	12.2	11.3	12.1	5	96156	70
270	10.8	51.6	2038	240.0	248.0	9.7	12.1	10.9	11.7	5	96032	70
271	11.5	52.2	2034	240.0	248.1	9.8	12.1	11.7	12.5	5	96134	70
272	10.9	51.6	1996	240.0	248.1	9.0	11.8	11.0	11.5	5	95809	70
273	11.5	51.7	2010	240.0	248.0	8.8	11.9	11.7	11.1	5	95892	70
274	11.1	51.7	2014	240.0	248.0	8.7	11.9	11.3	11.4	5	96165	70
275	11.0	53.1	2012	240.0	248.0	8.3	12.0	11.2	10.6	5	96215	68
276	12.5	53.1	2113	240.0	248.0	10.4	12.6	12.7	10.5	5	96217	68
277	12.3	53.5	2090	240.0	248.0	11.5	12.4	12.5	9.0	5	96505	68
278	9.6	52.7	1955	240.0	248.0	9.5	11.6	11.5	8.0	5	96615	68
279	9.3	52.3	1912	240.0	248.0	6.8	11.3	10.8	9.4	5	96591	68
280	9.3	52.1	1910	240.0	248.0	3.8	11.4	10.1	10.1	5	96514	69
281			2036	240.0	248.0	5.0	12.0	9.6	9.3	5	96554	69
282	10.6	52.0	2073	240.0	248.0	6.3	12.3	10.8	8.4	5	96251	69
283	10.0	51.4	2087	240.0	248.0	7.6	12.3	10.1	10.6	5	96196	69
284	11.0	52.6	2047	240.0	248.0	7.4	12.1	11.1	9.5	5	95900	69
285	12.3	52.5	2154	240.0	248.0	10.2	12.8	12.4	8.6	5	95693	69
286	12.0	52.6	2133	240.0	248.0	11.9	12.6	12.2	8.5	5	95451	70
287	12.0	51.6	2075	240.0	248.0	12.3	12.4	12.2	8.3	5	95474	71
288	11.8	52.1	2035	240.0	248.0	12.2	12.1	12.0	10.2	5	95836	71
289	11.7	53.0	1996	240.0	248.0	11.6	11.9	11.8	10.6	5	95858	71
290	12.8	51.0	2006	240.0	248.0	11.4	11.9	13.0	9.4	5	95907	71
291	9.7	53.4	1956	240.0	248.0	10.0	11.6	12.2	9.0	5	95853	71
292	11.5	53.7	1972	240.0	248.0	9.1	11.7	11.6	8.9	5	95821	70
293	11.3	52.0	1977	240.0	248.0	8.3	11.8	11.5	10.1	5	95642	69
294	10.8	51.0	2031	240.0	248.0	8.6	12.0	10.9	10.0	5	95694	69
295	10.9	51.5	2040	240.0	248.0	9.1	12.1	11.1	10.4	5	95844	69
296	12.4	52.4	2148	240.0	248.0	11.6	12.7	12.6	10.7	5	96107	69
297	11.8	52.8	2030	240.0	248.0	11.4	12.1	12.0	10.8	5	96017	69
298			2018	240.0	248.0	11.4	12.0	11.8	10.3	5	96044	69
299			1952	240.0	248.0	9.6	11.6	11.5	11.4	5	96010	69
300	11.8	53.8	2078	240.0	248.0	11.3	12.3	11.9	11.5	5	96212	69
301	12.0	53.7	2048	240.0	248.0	11.7	12.2	12.1	10.7	5	96362	69
302	11.8	52.1	1973	240.0	248.0	10.3	11.7	12.0	10.4	5	96162	69
303	9.5	53.7	1934	240.0	248.0	8.4	11.5	11.2	11.6	5	96050	69
304	11.2	53.8	2010	240.0	248.0	8.5	11.9	11.4	9.3	5	95981	67
305	11.9	52.3	2033	240.0	248.0	8.8	12.0	12.1	10.8	5	95860	67
306	11.2	51.4	2009	240.0	248.0	8.4	11.9	11.4	10.9	5	95999	67
307	9.6	50.8	1955	240.0	248.0	6.5	11.6	9.3	10.6	5	95752	67
308	10.2	51.2	2028	240.0	248.0	7.0	12.0	10.3	11.1	5	95599	67
309	10.2	51.3	2037	240.0	248.0	7.1	12.0	10.4	10.6	5	95683	67
310			2023	240.0	248.0	7.0	12.0	9.8	10.4	5	95879	68
311	10.4	52.1	2046	240.0	248.0	7.1	12.1	10.6	9.4	5	95766	68
312	10.6	52.0	2072	240.0	248.0	8.3	12.3	10.7	8.5	5	95595	68
313	11.0	51.7	2056	240.0	248.0	8.7	12.2	11.1	7.8	5	95697	68
314	9.8	50.6	1989	240.0	248.0	7.5	11.8	9.9	6.9	5	95492	68
315	12.0	51.6	2077	240.0	248.0	8.8	12.3	12.2	7.6	5	95435	68
316	11.7	52.0	2106	240.0	248.0	10.3	12.5	11.9	8.5	5	95303	70
317	12.1	50.8	2024	240.0	248.0	9.8	12.0	12.3	8.4	5	95012	70
318	9.7	51.1	1963	240.0	248.0	8.2	11.7	11.6	8.8	5	95238	70
319	9.6	50.9	1947	240.0	247.5	6.6	11.6	10.3	10.7	5	95026	70
320	10.0	50.6	1996	240.0	245.5	6.2	11.8	10.2	10.8	5	95114	70
321			1980	240.0	245.5	4.9	11.7	9.8	10.5	5	94981	70
322	9.7	50.5	1959	240.0	245.5	2.8	11.6	11.1	9.2	5	94863	69
323	10.5	51.6	2048	240.0	245.5	3.9	12.1	10.6	8.5	5	95036	69
324	9.9	52.5	2112	240.0	245.5	6.0	12.5	10.1	8.2	5	95249	69
325			2072	240.0	245.5	6.6	12.2	9.7	8.1	5	95022	69
326			2014	240.0	245.5	5.7	11.9	9.8	7.7	5	95191	69
327			2017	240.0	245.5	5.4	11.9	9.3	8.3	5	95045	69
328	10.1	51.9	2083	240.0	245.5	6.6	12.3	10.2	9.0	5	95057	71
329	10.7	52.0	2105	240.0	245.5	8.3	12.5	10.9	9.1	5	95030	71
330	11.1	52.1	2038	240.0	245.5	8.0	12.1	11.2	10.2	5	95327	71
331	11.8	52.6	2092	240.0	245.5	9.2	12.4	12.0	11.2	5	94985	71
332	10.9	51.3	2070	240.0	245.5	10.1	12.3	11.0	11.4	5	94774	71
333	11.6	52.1	2044	240.0	245.5	10.1	12.1	11.8	11.0	5	94701	71
334	9.6	51.4	1953	240.0	245.4	8.1	11.6	11.1	9.9	5	94515	68
335			2109	240.0	245.4	10.4	12.5	12.7	9.9	5	94316	68
336			2053	240.0	246.7	10.9	12.2	12.9	9.2	5	94573	68
337			2035	240.0	248.1	11.3	12.1	12.1	9.4	5	94002	68
338			2065	240.0	248.1	11.9	12.3	12.5	9.8	5	93877	68
339	11.4	51.8	2036	240.0	248.1	12.1	12.1	11.5	9.7	5	94168	69
340	9.5	52.4	1937	240.0	248.1	10.1	11.5	10.5	9.9	5	94288	69
341	9.7	51.6	1965	240.0	248.1	8.8	11.7	11.1	11.0	5	94157	69
342	10.8	51.3	2022	240.0	248.1	9.4	12.0	10.9	10.1	5	94648	69
343	11.3	51.0	2034	240.0	250.3	9.7	12.0	11.5	9.3	5	94778	69
344	12.0	51.0	2025	240.0	250.6	9.5	12.0	12.1	9.1	5	95130	69
345	11.6	51.4	2055	240.0	250.6	10.2	12.2	11.8	10.6	5	94720	69
346	11.1	51.8	2018	240.0	250.6	9.8	12.0	11.3	9.8	5	94437	69
347	10.7	51.9	2031	240.0	250.6	9.8	12.0	10.9	8.8	5	94548	69
348	11.4	51.5	2009	240.0	250.6	9.5	11.9	11.5	8.9	5	94946	69
349	10.6	52.3	2036	240.0	250.1	9.9	12.1	10.7	9.1	5	95138	69
350	11.6	50.9	2006	240.0	248.0	9.4	11.9	11.8	9.1	5	94626	69
351	10.9	51.3	2000	240.0	247.9	8.7	11.8	11.0	10.4	5	94187	69
352	9.7	50.9	1968	240.0	247.9	7.4	11.7	10.4	10.0	5	94262	69

Table E.01 Measurement data - Turbine ON

Project: Cedar Point Wind Power Project - Turbine CP209 - IEC 61400-11 Measurement

Report ID: 15039.00.T209.RP3

Created on: 3/7/2018

***Blank data denotes values that were omitted in the analysis due to an extraneous event during recording

Data Point #	Standardized Wind Speed	LAeq	Turbine Power Output (kW)	Reference Yaw Angle (°)	Yaw Angle (°)	Pitch Angle (°)	Rotor RPM	Nacelle Anemometer Wind Speed (m/s)	10m Anemometer Wind Speed (m/s)	Air Temperature (-C)	Pressure (kPa)	Relative Humidity (%)
353	10.8	51.2	2011	240.0	248.0	7.0	11.9	11.0	9.7	5	94153	69
354	10.6	51.6	2085	240.0	248.0	8.7	12.4	10.8	8.6	5	94469	69
355	11.5	51.6	2099	240.0	248.0	9.9	12.4	11.7	10.8	5	94631	69
356	11.5	51.8	2044	240.0	247.3	10.1	12.2	11.7	11.4	5	94241	69
357	12.3	51.5	2047	240.0	245.1	10.3	12.1	12.5	9.1	5	94157	68
358	11.6	51.1	2000	240.0	245.1	9.5	11.8	11.8	8.8	5	93929	68
359	9.4	50.9	1921	240.0	245.1	6.8	11.4	10.1	8.4	5	93881	68
360	8.9	52.0	1824	240.0	245.1	3.4	11.3	9.6	8.1	5	94007	68
361	9.8	51.1	1991	240.0	245.0	3.6	11.8	9.9	8.3	5	94278	68
362	8.5	52.1	1666	240.0	245.0	0.2	11.6	9.2	8.6	5	94213	68
363	9.8	52.3	2059	240.0	245.0	2.6	12.4	9.9	9.9	5	94423	69
364	11.0	53.3	2255	240.0	245.0	8.7	13.3	11.1	11.4	5	94545	69
365	11.9	52.4	2215	240.0	245.0	11.3	13.1	12.1	10.5	5	94511	69
366	11.2	52.0	2052	240.0	245.0	10.6	12.1	11.4	11.1	5	95063	69
367	10.7	52.1	1998	240.0	245.0	9.5	11.9	10.9	9.5	5	95223	69
368			1996	240.0	245.0	9.1	11.8	11.2	9.8	5	95230	69
369	10.5	52.6	1997	240.0	245.0	8.4	11.9	10.7	10.2	5	95222	68
370	11.1	52.4	2031	240.0	245.0	8.6	12.0	11.3	9.9	5	95526	67
371	11.3	52.3	2046	240.0	245.0	9.1	12.1	11.5	11.1	5	95387	67
372	10.4	51.8	2023	240.0	245.0	8.9	11.9	10.6	10.6	5	95376	67
373	10.5	51.9	2006	240.0	245.0	8.2	11.9	10.7	9.8	5	95616	67
374	10.5	51.3	2012	240.0	245.0	8.0	11.9	10.6	10.3	5	95841	67
375	10.7	52.8	2003	240.0	245.0	7.3	11.9	10.8	10.2	5	95722	68
376	11.0	52.1	2007	240.0	245.0	7.0	11.8	11.2	9.2	5	95616	68
377	9.8	51.7	1978	240.0	245.0	4.0	11.7	9.9	9.3	5	96167	68
378	10.4	52.0	2051	240.0	245.0	5.0	12.1	10.6	9.8	5	96287	68
379	10.8	51.8	2114	240.0	245.0	7.1	12.5	11.0	12.0	5	96335	68
380	9.8	51.1	2056	240.0	245.0	7.2	12.1	10.0	9.5	5	96263	68
381	10.4	52.1	2049	240.0	245.0	7.1	12.2	10.6	10.4	5	96099	68
382			2172	240.0	245.0	10.5	12.9	12.1	10.8	5	96038	68
383	11.5	53.8	2085	240.0	245.0	10.8	12.4	11.6	10.9	5	96079	68
384	11.8	52.5	2054	240.0	245.0	11.1	12.2	11.9	11.2	5	96227	68
385	10.9	51.3	1995	240.0	245.0	10.1	11.8	11.1	11.6	5	96484	68
386	11.8	53.5	2028	240.0	245.0	10.4	12.0	12.0	10.4	5	96275	67
387	11.5	52.5	1976	240.0	245.0	9.2	11.7	11.7	10.2	5	96152	67
388			1995	240.0	245.0	8.7	11.8	11.5	9.5	5	96212	67
389	11.3	53.1	2014	240.0	245.0	8.5	11.9	11.4	10.0	5	96028	67
390	11.2	53.4	2037	240.0	245.0	8.9	12.1	11.3	9.5	5	96169	67
391	10.5	52.1	2024	240.0	245.0	8.7	12.0	10.6	10.1	5	96029	67
392	10.9	52.4	2003	240.0	245.0	8.0	11.9	11.1	9.1	5	96155	67
393	11.0	51.8	2047	240.0	245.0	8.6	12.1	11.1	9.4	5	96162	68
394	10.8	52.1	2028	240.0	245.3	8.7	12.0	11.0	9.0	5	96263	68
395	10.3	51.8	2013	240.0	247.6	8.1	11.9	10.5	11.0	5	96189	68
396	10.5	51.2	2026	240.0	247.7	8.2	12.0	10.6	10.0	5	95975	68
397	10.5	51.4	2015	240.0	247.7	7.7	11.9	10.7	9.6	5	95836	68
398	11.5	51.5	2069	240.0	247.7	8.9	12.3	11.7	9.6	5	95582	68
399			2011	240.0	247.7	8.1	11.9	10.6	9.3	5	95168	68
400			1964	240.0	247.7	6.4	11.6	10.3	9.4	5	94812	68
401	10.4	51.8	1970	240.0	247.7	5.0	11.7	10.6	9.2	5	94774	68
402	11.0	53.8	2043	240.0	247.7	5.8	12.1	11.2	9.0	5	94683	68
403	10.3	52.1	2052	240.0	247.7	6.4	12.1	10.5	9.2	5	94731	68
404			2003	240.0	247.7	5.1	11.8	9.9	8.3	5	94668	68
405			2081	240.0	247.6	6.8	12.3	10.3	9.4	5	94977	69
406			2003	240.0	247.6	5.7	11.8	9.6	8.3	5	95169	69
407	9.5	51.2	1936	240.0	247.6	2.5	11.5	9.1	8.0	5	95150	69
408			1988	240.0	247.7	1.6	11.7	9.6	7.7	5	95041	69
409			1992	240.0	247.7	0.2	11.8	9.7	7.7	5	94950	69
410			2058	240.0	247.7	1.5	12.2	9.0	10.0	5	94882	69
411	9.8	53.2	2204	240.0	247.7	6.1	13.1	9.9	8.9	5	94893	69
412	11.0	52.0	2199	240.0	247.6	9.5	13.0	11.2	10.4	5	95082	69
413	9.9	52.3	2048	240.0	247.7	8.5	12.1	10.0	10.1	5	94983	69
414	11.1	51.6	1985	240.0	247.7	7.4	11.8	11.2	8.9	5	95009	69
415	9.6	50.9	1944	240.0	247.7	4.8	11.5	9.7	8.7	5	94824	69
416	11.3	52.6	2081	240.0	247.7	7.1	12.4	11.5	8.5	5	94743	69
417	12.0	51.8	2080	240.0	245.1	9.1	12.3	12.1	9.8	5	94631	68
418	11.4	51.5	2025	240.0	245.1	8.6	12.0	11.6	10.5	5	94692	68
419	11.0	51.2	1998	240.0	245.1	7.8	11.9	11.2	10.2	5	94675	68
420	11.4	52.0	2074	240.0	245.1	9.1	12.3	11.6	10.5	5	94804	68
421	11.6	51.1	2074	240.0	245.1	10.1	12.3	11.8	10.3	5	94660	68
422	11.8	52.1	2068	240.0	245.0	10.5	12.3	11.9	8.7	5	94655	68
423	12.3	52.6	2040	240.0	245.0	10.8	12.1	12.4	8.2	5	94767	68
424	11.8	52.0	1976	240.0	245.0	9.5	11.7	12.0	9.6	5	94665	68
425	9.7	51.1	1962	240.0	245.0	8.2	11.6	11.0	8.0	5	94733	68
426	10.8	51.4	2020	240.0	245.0	8.4	12.0	11.0	9.3	5	94749	68
427	11.1	51.1	2032	240.0	245.0	8.7	12.0	11.3	8.4	5	94676	69
428	10.7	51.8	2033	240.0	245.0	8.8	12.1	10.9	8.4	5	94677	69
429	10.9	51.8	2023	240.0	245.0	8.7	12.0	11.1	9.8	5	95016	69
430	11.5	51.8	2035	240.0	245.0	8.8	12.1	11.6	11.0	5	95022	69
431	11.8	51.8	2070	240.0	245.0	9.9	12.3	12.0	10.6	5	95331	69
432	10.8	51.0	1996	240.0	245.0	8.9	11.8	10.9	10.4	5	95271	69
433	9.9	51.2	1997	240.0	245.0	8.2	11.8	10.1	8.8	5	95312	69
434	10.9	53.3	2006	240.0	245.0	7.9	11.9	11.1	8.3	5	95125	69
435	11.1	51.7	2052	240.0	245.0	8.7	12.2	11.3	9.7	5	95216	69
436	10.5	51.3	1990	240.0	245.0	7.7	11.8	10.7	9.1	5	95245	69
437	10.2	51.4	2013	240.0	245.0	7.2	11.9	10.3	9.3	5	95343	69
438	10.1	51.6	2045	240.0	245.0	8.0	12.1	10.2	8.5	5	95225	69
439			1988	240.0	245.0	6.6	11.8	9.3	9.2	5	95095	69
440	10.4	52.7	2045	240.0	245.0	7.4	12.1	10.6	10.6	5	95222	70

***Blank data denotes values that were omitted in the analysis due to an extraneous event during recording

Data Point #	Standardized Wind Speed	LAeq	Turbine Power Output (kW)	Reference Yaw Angle (°)	Yaw Angle (°)	Pitch Angle (°)	Rotor RPM	Nacelle Anemometer Wind Speed (m/s)	10m Anemometer Wind Speed (m/s)	Air Temperature (-C)	Pressure (kPa)	Relative Humidity (%)
441	11.4	51.9	2040	240.0	245.0	7.6	12.1	11.6	9.9	5	95069	70
442	11.2	51.4	2041	240.0	245.0	7.7	12.1	11.4	10.3	5	95279	70
443	10.1	52.1	2045	240.0	245.0	8.1	12.1	10.2	9.4	5	95466	70
444	11.1	52.6	2019	240.0	245.1	7.7	12.0	11.2	9.2	5	95385	70
445	10.0	52.0	2013	240.0	245.1	7.3	11.9	10.1	10.1	5	95301	70
446	10.9	53.2	1990	240.0	246.2	6.5	11.8	11.1	9.2	5	95303	69
447	9.8	52.2	2006	240.0	247.7	6.1	11.9	10.0	7.7	5	95304	69
448			1990	240.0	247.7	5.0	11.8	9.6	8.7	5	95307	69
449			1995	240.0	247.7	4.1	11.8	9.9	8.0	5	95413	69
450			1990	240.0	247.6	2.9	11.8	9.8	7.8	5	95330	69
451	10.5	52.2	2096	240.0	247.7	5.1	12.4	10.6	7.3	5	95111	70
452	10.3	52.0	2092	240.0	247.7	6.5	12.3	10.5	6.6	5	95090	70
453	10.1	51.7	2027	240.0	247.7	5.7	12.0	10.2	7.0	5	95133	70
454	9.9	51.5	2054	240.0	247.7	6.4	12.1	10.0	6.4	5	95402	70
455	10.9	52.2	2022	240.0	247.6	5.9	12.0	11.0	7.3	5	95503	70
456	11.2	51.4	2059	240.0	247.4	6.9	12.2	11.4	7.3	5	95427	70
457	10.2	52.0	2019	240.0	245.2	6.5	12.0	10.4	8.3	5	95373	70
458	10.2	51.5	1993	240.0	245.2	5.3	11.8	10.3	8.1	5	95382	71
459	10.5	52.4	2063	240.0	245.2	6.5	12.2	10.6	9.0	5	95495	71
460			2025	240.0	245.2	6.3	12.0	9.6	7.7	5	95289	71
461	9.9	52.2	2009	240.0	245.2	5.5	11.9	10.0	8.2	5	95199	71
462	10.4	51.9	2035	240.0	245.2	5.8	12.0	10.5	9.4	5	95388	71
463	10.0	51.9	2019	240.0	245.2	5.4	11.9	10.1	8.9	5	95431	70
464			1997	240.0	245.2	4.5	11.8	9.5	9.3	5	95448	70
465	10.3	51.4	2026	240.0	245.2	4.3	12.0	10.5	8.8	5	95356	70
466			2095	240.0	245.2	6.3	12.4	9.8	9.3	5	95383	70
467	10.4	52.2	2076	240.0	245.2	7.1	12.3	10.5	9.2	5	95522	70
468	9.8	52.3	2010	240.0	245.2	6.2	11.9	10.0	9.2	5	95353	70
469			1997	240.0	245.2	5.2	11.8	9.6	8.4	5	95553	70
470	10.5	52.8	2060	240.0	245.2	6.2	12.2	10.7	8.0	5	95564	70
471	10.0	51.5	2081	240.0	245.2	7.5	12.3	10.1	8.2	5	95556	70
472	10.6	51.9	2048	240.0	245.2	7.5	12.1	10.7	8.7	5	95455	70
473	10.2	51.6	2006	240.0	245.2	6.7	11.9	10.4	8.2	5	95344	70
474	10.7	50.9	1987	240.0	245.2	5.9	11.8	10.8	7.6	5	95521	70
475	9.3	50.5	1909	240.0	245.2	2.7	11.4	8.9	7.7	5	95628	70
476	8.8	51.1	1768	240.0	245.2	0.6	11.6	8.8	6.1	5	95760	71
477	8.5	51.6	1676	240.0	245.2	0.3	12.0	7.8	6.0	5	95902	71
478	8.7	51.9	1721	240.0	245.2	-0.9	12.0	7.5	6.6	5	96183	71
479	9.3	52.2	1901	240.0	245.2	-0.7	12.1	7.8	6.9	5	96004	71
480	8.7	52.2	1731	240.0	244.9	-1.0	12.0	9.0	6.7	5	95934	71
481	8.5	52.3	1651	240.0	242.8	-1.7	12.0	8.7	6.2	5	96062	71
482	8.0	51.8	1450	240.0	242.8	-1.8	11.9	8.0	6.8	5	96125	72
483	8.1	51.7	1501	240.0	242.8	-1.8	12.0	8.6	8.0	5	96067	72
484	7.8	51.8	1360	240.0	242.8	-1.8	12.0	8.8	8.0	5	96053	72
485	8.3	51.6	1588	240.0	242.8	-1.8	12.1	8.4	7.6	5	96225	72
486	8.2	51.8	1519	240.0	242.8	-1.8	12.0	7.6	7.9	5	96339	72
487	8.9	52.9	1837	240.0	242.8	-1.3	12.1	8.5	7.0	5	96512	71
488	8.8	53.0	1765	240.0	242.8	-1.4	12.0	7.7	5.9	5	96385	71
489			2017	240.0	242.7	0.7	12.5	8.7	6.9	5	96303	71
490			2272	240.0	242.7	9.0	13.5	11.4	7.0	5	96671	71
491			2103	240.0	240.7	8.9	12.4	11.3	7.5	5	96600	71
492			1971	240.0	240.5	6.6	11.6	9.7	8.5	5	96682	71
493			2001	240.0	240.5	6.0	11.9	9.8	7.5	5	96741	71
494	11.1	52.0	2088	240.0	240.5	7.7	12.3	11.3	8.5	5	96859	71
495	10.8	52.9	2089	240.0	240.5	8.8	12.4	10.9	9.4	5	96903	71
496	11.3	51.6	2017	240.0	241.7	8.2	11.9	11.5	9.3	5	96859	71
497	10.3	50.7	2025	240.0	244.0	8.0	12.0	10.4	7.8	5	96898	71
498	10.0	50.9	1973	240.0	244.0	6.1	11.7	10.2	8.3	5	96896	70
499	9.7	50.5	1959	240.0	244.0	4.3	11.6	9.6	9.1	5	97052	69
500	9.6	51.4	1953	240.0	244.0	2.1	11.6	9.1	9.1	5	97068	69
501			2048	240.0	244.1	3.4	12.1	9.2	8.2	5	97083	69
502			2029	240.0	244.1	3.1	12.0	9.9	7.9	5	97161	69
503	10.2	52.6	2091	240.0	244.1	4.7	12.4	10.3	8.5	5	97206	69
504			2057	240.0	244.1	5.1	12.1	8.9	9.7	5	97325	70
505			1974	240.0	244.1	2.9	11.7	9.7	9.7	5	97399	70
506	10.2	52.0	2012	240.0	244.1	2.3	11.9	10.3	9.9	5	97402	70
507			2049	240.0	244.1	3.3	12.1	9.6	10.0	5	97452	70
508			1998	240.0	244.1	1.7	11.8	8.5	9.4	5	97353	70
509			1981	240.0	249.9	5.0	11.7	9.8	8.7	5	98109	69
510	9.9	51.0	2027	240.0	249.9	5.4	12.0	10.0	8.6	5	98109	69
511	9.5	51.6	1932	240.0	250.0	2.4	11.5	9.3	8.2	5	98109	69
512			2001	240.0	249.9	2.0	11.9	9.3	8.3	5	98109	69
513			2063	240.0	249.9	3.5	12.2	9.4	8.5	5	98109	69
514			2012	240.0	249.9	2.6	11.9	9.2	8.7	5	98109	69
515			2009	240.0	249.9	1.8	11.9	9.4	8.6	5	98109	69
516			2048	240.0	249.9	2.5	12.1	9.0	7.7	5	98108	69
517			2052	240.0	249.9	3.3	12.1	9.1	6.6	5	98107	69
518			2063	240.0	249.9	3.6	12.3	9.8	6.6	5	98107	69
519			2138	240.0	249.9	6.8	12.7	9.8	8.1	5	98104	70
520	9.8	51.0	1991	240.0	247.3	4.7	11.8	9.9	7.9	5	98101	70
521	9.9	51.3	1979	240.0	247.0	3.3	11.8	10.1	7.3	5	98094	70
522			2005	240.0	247.0	3.0	11.9	8.9	6.8	5	98073	70
523			2009	240.0	246.9	2.4	11.9	9.5	7.0	5	97285	70
524			2072	240.0	247.0	3.9	12.3	9.1	6.7	5	96724	70
525			2092	240.0	246.9	5.5	12.4	9.7	6.7	5	96512	70
526	10.5	51.4	2047	240.0	246.9	5.3	12.1	10.6	7.0	5	96206	70
527	9.8	51.3	2046	240.0	247.0	5.9	12.1	9.9	6.3	5	95992	70
528	10.2	51.2	1998	240.0	247.0	4.7	11.9	10.3	7.1	5	95767	70

Table E.01 Measurement data - Turbine ON

Project: Cedar Point Wind Power Project - Turbine CP209 - IEC 61400-11 Measurement

Report ID: 15039.00.T209.RP3

Created on: 3/7/2018

***Blank data denotes values that were omitted in the analysis due to an extraneous event during recording

Data Point #	Standardized Wind Speed	LAeq	Turbine Power Output (kW)	Reference Yaw Angle (°)	Yaw Angle (°)	Pitch Angle (°)	Rotor RPM	Nacelle Anemometer Wind Speed (m/s)	10m Anemometer Wind Speed (m/s)	Air Temperature (-C)	Pressure (kPa)	Relative Humidity (%)
529	10.2	52.1	2071	240.0	247.0	6.1	12.3	10.4	6.4	5	95699	70
530	10.1	50.9	2015	240.0	246.9	5.7	11.9	10.3	7.4	5	95445	70
531			1970	240.0	246.9	3.6	11.7	9.4	9.5	5	95349	70
532	10.1	51.3	2015	240.0	246.9	3.7	12.0	10.2	9.8	5	95328	70
533			2038	240.0	246.4	4.4	12.1	9.3	10.1	5	95317	70
534			1971	240.0	244.3	2.3	11.7	9.0	9.3	5	95542	70
535	9.4	50.9	1920	240.0	244.3	0.4	11.7	9.4	8.7	5	95662	70
536	10.0	52.1	2033	240.0	244.3	1.6	12.1	10.2	8.1	5	95362	70
537			2079	240.0	244.3	3.2	12.3	9.6	8.6	5	95287	68
538	9.0	51.5	1849	240.0	244.3	1.0	11.8	9.0	7.9	5	95378	68
539	9.1	52.0	1880	240.0	244.3	1.0	11.9	8.6	7.2	5	95573	68
540	8.8	51.7	1800	240.0	244.3	0.5	12.0	8.6	6.7	5	95115	68
541			2013	240.0	244.3	1.6	12.2	8.9	8.0	5	94816	68
542	10.0	51.9	2112	240.0	244.4	3.8	12.5	10.1	8.5	5	94512	68
543	10.7	53.2	2195	240.0	244.4	7.5	13.0	10.8	9.9	5	94744	68
544	11.2	52.3	2143	240.0	244.3	9.2	12.7	11.4	9.8	5	94842	68
545	11.0	52.5	2094	240.0	244.4	9.9	12.4	11.2	9.7	5	94904	68
546	10.6	51.5	2013	240.0	244.3	9.3	12.0	10.7	8.3	5	94971	68
547	9.7	50.7	1966	240.0	244.4	7.8	11.7	10.9	7.5	5	94754	68
548	10.4	52.9	2037	240.0	245.8	9.6	12.1	10.5	11.2	5	98128	67
549	9.9	52.0	1973	240.0	244.4	7.8	11.7	10.1	10.9	5	98128	67
550	11.0	52.1	2042	240.0	244.4	8.6	12.1	11.2	9.3	5	98128	67
551	10.1	51.7	2040	240.0	244.5	8.8	12.1	10.2	9.3	5	98128	67
552	10.3	53.2	2038	240.0	244.5	8.9	12.1	10.5	8.8	5	98128	67
553	10.5	52.9	2029	240.0	244.5	8.9	12.0	10.6	9.2	5	98128	67
554	11.0	51.6	2011	240.0	244.5	8.4	11.9	11.2	9.3	5	98128	67
555	11.1	51.8	2010	240.0	244.5	8.1	11.9	11.3	9.3	5	98128	67
556	10.1	51.8	2005	240.0	244.5	7.5	11.9	10.2	10.4	5	98128	67
557	11.4	51.6	2018	240.0	244.5	7.5	11.9	11.6	9.8	5	98128	67
558	9.9	51.1	2001	240.0	244.5	6.6	11.8	10.1	9.0	5	98128	67
559			2009	240.0	244.5	6.3	11.9	9.7	9.0	5	98128	67
560	10.0	51.7	2028	240.0	244.5	6.4	12.0	10.2	9.7	5	98128	67
561	10.4	51.8	2035	240.0	245.7	6.6	12.1	10.6	10.1	5	98128	67
562	11.0	51.5	2042	240.0	246.7	6.7	12.1	11.1	8.9	5	98128	68
563	10.0	53.1	2069	240.0	246.7	7.7	12.2	10.2	7.9	5	98128	68
564	11.3	51.4	2056	240.0	246.7	8.0	12.2	11.4	8.5	5	98128	68
565	11.4	51.5	2044	240.0	246.7	8.1	12.1	11.5	7.6	5	98128	68
566	11.1	51.0	2003	240.0	246.7	7.3	11.8	11.2	7.5	5	98128	68
567	10.4	50.8	1996	240.0	246.6	6.5	11.8	10.6	8.0	5	98128	68
568			2037	240.0	246.7	7.0	12.0	9.7	7.4	5	98128	69
569	11.0	51.3	2047	240.0	246.7	7.3	12.1	11.2	7.4	5	98128	69
570	10.4	51.7	2028	240.0	246.7	7.1	12.0	10.6	7.9	5	98128	69
571	10.8	51.3	2055	240.0	246.7	7.8	12.2	11.0	8.7	5	98128	69
572	11.2	51.6	2059	240.0	246.7	8.2	12.2	11.4	8.2	5	98128	69
573	10.9	51.1	2072	240.0	246.7	9.1	12.3	11.1	7.1	5	98128	69
574	11.4	51.4	2057	240.0	246.7	9.4	12.2	11.5	7.1	5	98129	68
575	11.1	51.0	2033	240.0	246.7	9.5	12.1	11.2	8.4	5	98129	68
576	10.7	52.4	1985	240.0	246.7	8.2	11.8	10.9	9.6	5	98129	68
577	11.0	52.5	1991	240.0	246.7	7.6	11.8	11.1	8.8	5	98128	68
578	10.5	51.1	1993	240.0	246.6	6.9	11.8	10.6	8.1	5	98129	68
579	11.0	50.7	2004	240.0	246.6	6.4	11.9	11.2	8.0	5	98129	68
580	10.7	51.6	2026	240.0	246.6	6.5	12.0	10.9	7.3	5	98131	68
581	9.8	50.6	2022	240.0	246.7	6.3	11.9	9.9	9.0	5	98129	68
582	9.7	50.8	1957	240.0	246.7	3.9	11.6	9.5	9.2	5	98129	68
583	10.6	51.8	2056	240.0	246.7	4.9	12.2	10.8	8.3	5	98128	68
584	10.8	51.4	2077	240.0	246.7	6.5	12.3	11.0	7.7	5	98129	68
585	9.9	51.3	1981	240.0	246.7	4.2	11.7	10.0	7.3	5	98129	68
586	9.6	51.8	1946	240.0	246.7	1.6	11.5	9.6	9.4	5	98129	69
587	9.6	52.2	1941	240.0	246.7	0.8	11.8	8.7	9.0	5	98129	69
588	8.9	51.6	1831	240.0	246.7	0.8	12.0	9.0	7.9	5	98129	69
589	8.8	52.6	1780	240.0	246.7	0.5	12.0	9.3	7.2	5	98129	69
590	9.0	52.3	1861	240.0	246.6	0.1	12.1	8.9	7.6	5	98129	69
591			2133	240.0	244.1	3.4	12.6	9.7	7.8	5	98142	68
592	10.4	52.5	2153	240.0	243.8	6.2	12.7	10.6	7.8	5	98157	68
593	10.1	52.5	2074	240.0	243.7	5.9	12.3	10.3	8.4	5	98157	68
594	10.2	51.3	2095	240.0	243.7	7.4	12.4	10.4	9.5	5	98157	68
595	10.5	51.9	2067	240.0	243.7	7.7	12.2	10.7	10.7	5	98157	68
596	10.1	51.1	1999	240.0	243.8	6.8	11.8	10.2	9.6	5	98157	68
597			1986	240.0	243.8	5.4	11.7	9.7	9.1	5	98157	67
598	9.9	52.0	2045	240.0	243.8	6.2	12.1	10.1	8.2	5	98157	67
599	10.3	52.7	2039	240.0	243.8	6.2	12.1	10.4	8.2	5	98157	67
600	10.7	52.1	2088	240.0	243.7	7.7	12.3	10.8	7.8	5	98157	67
601	10.3	52.7	2031	240.0	243.7	7.4	12.0	10.5	8.0	5	98157	67
602	10.0	50.8	2006	240.0	243.7	6.5	11.9	10.2	7.2	5	98157	67
603	10.0	50.9	1983	240.0	243.7	5.5	11.7	10.1	7.7	5	98156	67
604	8.7	52.3	1732	240.0	243.7	1.4	11.4	8.4	7.8	5	98157	68
605	8.5	52.8	1669	240.0	243.7	0.0	11.9	8.1	6.6	5	98157	68
606	8.6	52.3	1710	240.0	243.7	-0.5	12.0	8.1	6.9	5	98157	68
607	8.5	52.2	1641	240.0	243.7	-1.7	12.0	7.8	6.8	5	98157	68
608	8.8	52.4	1790	240.0	243.4	-1.3	12.1	9.0	6.3	5	98157	68
609			1998	240.0	241.4	-0.2	12.1	8.9	6.1	5	98157	68
610			2041	240.0	241.4	0.1	12.1	9.6	6.2	5	98157	69
611	9.2	51.8	1898	240.0	241.4	-0.3	12.0	8.4	6.2	5	98156	69
612	8.3	51.8	1594	240.0	241.4	-1.5	11.9	7.5	6.9	5	98156	69
613	8.2	51.5	1551	240.0	241.4	-1.8	12.0	8.4	7.4	5	98157	69
614	8.7	51.9	1748	240.0	241.4	-1.5	12.1	9.4	5.3	5	98157	69
615	8.2	52.0	1549	240.0	241.4	-1.8	12.0	8.4	6.1	5	98157	69
616	8.0	51.6	1447	240.0	241.4	-1.8	12.0	7.7	6.3	5	98157	69

***Blank data denotes values that were omitted in the analysis due to an extraneous event during recording

Data Point #	Standardized Wind Speed	LAeq	Turbine Power Output (kW)	Reference Yaw Angle (°)	Yaw Angle (°)	Pitch Angle (°)	Rotor RPM	Nacelle Anemometer Wind Speed (m/s)	10m Anemometer Wind Speed (m/s)	Air Temperature (-C)	Pressure (kPa)	Relative Humidity (%)
617	8.0	51.9	1459	240.0	241.4	-1.8	12.0	7.9	6.2	5	98157	69
618	8.0	52.1	1466	240.0	241.4	-1.8	12.0	8.0	6.3	5	98157	69
619	8.3	52.4	1571	240.0	241.3	-1.8	12.1	7.8	6.9	5	98157	69
620	8.6	52.4	1698	240.0	241.4	-1.7	12.1	8.7	7.6	5	98157	69
621	8.3	51.7	1595	240.0	241.4	-1.8	12.0	9.0	7.6	5	98157	69
622	8.4	51.6	1616	240.0	241.4	-1.7	12.0	9.3	6.8	5	98157	68
623	8.8	51.6	1787	240.0	241.4	-1.1	12.1	8.6	6.3	5	98157	68
624			2057	240.0	241.4	0.4	12.2	8.8	6.9	5	98157	68
625	9.5	52.2	1935	240.0	241.4	0.4	12.0	8.8	7.8	5	98157	68
626	9.5	52.2	1936	240.0	241.4	0.4	12.0	8.5	6.9	5	98156	68
627			2059	240.0	241.4	1.4	12.2	9.4	8.3	5	98156	68
628			2043	240.0	241.4	1.5	12.1	9.2	7.6	5	98155	68
629			2072	240.0	241.4	2.7	12.3	9.7	7.0	5	98156	68
630	10.0	52.1	2087	240.0	241.4	4.3	12.4	10.2	7.6	5	98156	68
631	10.9	51.5	2038	240.0	241.4	3.9	12.1	11.1	7.4	5	98156	68
632			2008	240.0	241.4	3.2	11.9	9.8	7.4	5	98155	68
633	9.9	51.1	1973	240.0	241.4	1.2	11.7	10.0	7.7	5	98155	68
634	8.8	51.6	1795	240.0	241.4	-0.6	11.7	9.0	7.2	5	98153	68
635	9.7	52.1	1967	240.0	241.4	0.7	12.1	9.0	6.2	5	98152	68
636	9.9	51.9	2059	240.0	241.4	1.5	12.2	10.1	6.7	5	98151	68
637			2080	240.0	241.4	3.1	12.3	9.5	5.9	5	98151	68
638			2038	240.0	241.4	2.7	12.1	9.1	6.6	5	98150	68
639			1996	240.0	241.4	1.6	11.8	9.7	6.0	5	98150	68
640	8.9	51.9	1809	240.0	241.4	0.0	11.8	8.4	7.6	5	98148	68
641	8.7	51.6	1732	240.0	240.2	0.3	12.0	8.4	7.3	5	98146	68
642	8.7	51.7	1738	240.0	238.8	0.0	12.0	8.7	7.7	5	98142	68
643	8.6	52.1	1692	240.0	238.7	-1.4	12.0	7.9	7.2	5	98139	68
644	7.9	51.4	1401	240.0	238.7	-1.8	11.9	6.8	7.3	5	98134	68
645	7.6	51.6	1275	240.0	238.6	-1.8	12.0	6.7	7.2	5	98129	67
646	7.5	51.7	1226	240.0	236.4	-1.8	12.0	7.8	6.2	5	98144	67
647	7.4	52.3	1194	240.0	236.3	-1.8	11.9	8.3	6.3	5	98153	67
648	7.1	50.2	1048	240.0	236.3	-1.8	11.4	7.0	5.8	5	98158	67
649	6.7	49.6	868	240.0	235.5	-1.8	10.8	6.0	5.0	5	98161	67
650	6.5	48.1	797	240.0	232.3	-1.8	10.5	6.2	5.0	5	98162	68
651	6.4	48.5	754	240.0	232.2	-1.9	10.3	6.4	5.3	5	98162	69
652	6.5	48.7	820	240.0	230.2	-2.1	10.6	6.4	5.1	5	98163	69
653	6.6	49.1	854	240.0	229.7	-2.1	10.8	6.1	5.4	5	98163	69
654	6.5	48.8	824	240.0	229.7	-2.1	10.6	7.6	5.0	5	98162	69
655	6.6	50.1	853	240.0	229.7	-2.1	10.8	7.4	4.6	5	98162	69
656	7.0	51.0	1006	240.0	229.7	-2.1	11.3	7.0	4.8	5	98178	69
657	7.2	51.1	1070	240.0	229.7	-1.9	11.6	7.3	5.8	5	98185	70
658	7.0	50.2	984	240.0	229.7	-1.5	11.2	5.9	5.6	5	98183	70
659	6.9	50.1	975	240.0	229.7	-1.5	11.2	7.3	6.9	5	98184	70
660	7.1	50.9	1052	240.0	229.7	-1.5	11.5	7.5	5.9	5	98186	70
661	7.1	50.2	1058	240.0	229.7	-1.5	11.5	6.5	6.5	5	98187	70
662	7.5	51.3	1207	240.0	229.7	-1.5	11.9	7.6	7.1	5	98174	69
663	7.8	51.8	1378	240.0	229.7	-1.7	12.0	7.2	6.9	5	98164	69
664	7.6	52.9	1290	240.0	229.7	-2.1	12.0	7.6	5.9	5	98165	69
665	7.5	52.3	1230	240.0	229.7	-2.1	12.0	7.0	5.0	5	98166	69
666	7.6	52.0	1261	240.0	229.7	-2.1	12.0	7.4	4.2	5	98166	69
667	7.6	52.4	1288	240.0	229.7	-2.1	12.0	7.9	5.6	5	98167	69
668	7.8	52.4	1377	240.0	229.7	-2.1	12.0	8.3	5.5	5	98181	68
669	8.0	52.1	1459	240.0	229.7	-1.5	12.1	8.5	5.5	5	98193	68
670	8.0	51.7	1436	240.0	229.7	-1.5	12.0	7.7	6.3	5	98192	68
671	8.0	51.9	1452	240.0	229.7	-1.5	12.0	7.7	5.5	5	98192	68
672	7.4	51.7	1189	240.0	229.7	-1.5	11.9	6.8	4.8	5	98192	68
673	7.6	51.3	1293	240.0	229.7	-1.5	12.0	6.6	4.9	5	98192	69
674	7.9	52.2	1410	240.0	229.7	-1.5	12.1	7.1	4.9	5	98191	69
675	7.8	52.2	1351	240.0	229.7	-2.1	12.0	8.2	4.4	5	98190	69
676	7.8	52.1	1378	240.0	229.7	-2.1	12.0	7.8	6.3	5	98191	69
677	7.7	51.9	1333	240.0	229.7	-2.1	12.0	7.7	6.6	5	98191	69
678	7.4	52.0	1189	240.0	231.3	-2.1	12.0	7.4	6.4	5	98191	69
679	7.4	51.5	1194	240.0	231.8	-2.1	12.0	7.4	6.7	5	98190	69
680	7.2	50.8	1098	240.0	231.8	-2.1	11.6	7.0	5.8	5	98189	68
681	7.1	50.4	1052	240.0	231.8	-1.5	11.5	6.0	5.9	5	98188	68
682	7.1	50.2	1050	240.0	231.8	-1.5	11.5	6.6	5.4	5	98186	68
683	6.9	49.6	942	240.0	231.8	-1.5	11.1	6.6	5.0	5	98186	68
684	6.9	50.1	970	240.0	231.8	-1.5	11.2	6.9	4.9	5	98186	68
685	7.3	51.1	1136	240.0	231.8	-1.5	11.8	8.3	4.6	5	98187	69
686	7.3	50.8	1154	240.0	231.8	-1.5	11.8	6.8	4.0	5	98187	69
687	7.2	51.1	1100	240.0	231.8	-2.1	11.7	6.5	4.0	5	98187	69
688	7.3	51.4	1153	240.0	231.8	-2.1	11.9	7.4	4.5	5	98187	69
689	7.4	51.4	1169	240.0	231.8	-2.1	11.9	7.9	5.2	5	98187	69
690	7.3	51.4	1123	240.0	231.8	-2.1	11.7	7.6	5.2	5	98187	69
691	7.1	50.7	1059	240.0	231.8	-2.1	11.5	7.3	4.3	5	98188	70
692	7.1	50.4	1054	240.0	231.8	-2.1	11.5	7.0	4.4	5	98188	71
693	7.0	49.7	986	240.0	231.8	-1.5	11.2	6.5	4.5	5	98189	71
694	6.6	48.3	832	240.0	231.8	-1.5	10.6	6.1	5.8	5	98189	71
695	6.6	49.0	831	240.0	231.8	-1.5	10.7	7.8	5.5	5	98189	71
696	6.8	49.8	914	240.0	231.8	-1.5	11.0	7.1	5.4	5	98189	71
697	7.0	49.7	990	240.0	231.8	-1.5	11.3	7.0	4.6	5	98189	71
698	6.9	49.3	952	240.0	231.8	-1.5	11.1	6.7	5.2	5	98189	70
699	6.7	49.4	894	240.0	231.8	-2.1	10.9	6.6	5.2	5	98189	70
700	6.9	49.7	951	240.0	231.8	-2.1	11.1	7.4	6.0	5	98188	70
701	6.7	49.4	896	240.0	231.8	-2.1	10.9	6.7	6.8	5	98188	70
702	6.5	48.2	813	240.0	231.8	-2.1	10.6	6.3	6.3	5	98188	70
703	6.4	48.3	775	240.0	231.8	-2.1	10.4	7.0	5.1	5	98190	70
704	7.0	50.5	998	240.0	231.8	-2.0	11.4	6.4	3.8	5	98190	70

Table E.01 Measurement data - Turbine ON

Project: Cedar Point Wind Power Project - Turbine CP209 - IEC 61400-11 Measurement

Report ID: 15039.00.T209.RP3

Created on: 3/7/2018

***Blank data denotes values that were omitted in the analysis due to an extraneous event during recording

Data Point #	Standardized Wind Speed	LAeq	Turbine Power Output (kW)	Reference Yaw Angle (°)	Yaw Angle (°)	Pitch Angle (°)	Rotor RPM	Nacelle Anemometer Wind Speed (m/s)	10m Anemometer Wind Speed (m/s)	Air Temperature (-C)	Pressure (kPa)	Relative Humidity (%)
705	8.3	52.2	1581	240.0	231.8	-1.1	12.2	8.1	4.8	5	98191	70
706	8.6	52.8	1713	240.0	231.8	-1.3	12.1	7.6	5.7	5	98191	70
707	8.7	52.0	1759	240.0	231.8	-1.2	12.1	8.3	4.3	5	98192	70
708	8.3	51.7	1591	240.0	231.8	-1.4	11.9	8.3	5.4	5	98192	70
709	7.6	51.8	1261	240.0	231.8	-1.5	12.0	7.5	5.8	5	98193	70
710	7.4	51.8	1188	240.0	231.8	-1.8	11.9	7.5	5.0	5	98192	70
711	7.3	51.2	1138	240.0	231.8	-1.8	11.8	7.8	5.3	5	98193	70
712	7.8	52.1	1342	240.0	231.8	-1.8	12.1	7.9	5.1	5	98193	70
713	7.8	51.8	1349	240.0	231.5	-1.8	12.0	7.6	4.0	5	98193	70
714	7.8	52.2	1359	240.0	229.1	-1.8	12.0	7.0	5.2	5	98193	70
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***Blank data denotes values that were omitted in the analysis due to an extraneous event during recording

Data Point #	Standardized Wind Speed	LAeq	Turbine Power Output (kW)	Reference Yaw Angle (°)	Yaw Angle (°)	Pitch Angle (°)	Rotor RPM	Nacelle Anemometer Wind Speed (m/s)	10m Anemometer Wind Speed (m/s)	Air Temperature (-C)	Pressure (kPa)	Relative Humidity (%)
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Table E.02 Measurement data - Background

Project: Cedar Point Wind Power Project - Turbine CP209 - IEC 61400-11 Measurement

Report ID: 15039.00.T209.RP3

Created on: 3/7/2018

***Blank data denotes values that were omitted in the analysis due to an extraneous event during recording

Data Point #	Standardized Wind Speed	LAeq	Rotor RPM	10m Anemometer Wind Speed (m/s)	Air Temperature (-C)	Pressure (kPa)	Relative Humidity (%)
1			0.7	11.2	4	97980	68
2			0.7	10.1	4	97979	68
3			0.5	9.7	4	97979	67
4			0.4	9.9	4	97979	67
5			0.5	9.2	4	97979	67
6			0.5	9.2	4	97980	67
7			0.5	9.6	4	97979	67
8			0.4	9.1	4	97979	67
9			0.4	9.0	4	97979	68
10			0.4	8.7	4	97979	68
11			0.5	8.4	4	97979	68
12	11.5	43.9	0.5	9.4	4	97979	68
13	10.3	42.6	0.5	8.4	4	97979	68
14	10.3	43.3	0.4	8.4	4	97979	68
15	13.0	40.9	0.4	10.6	4	97979	69
16	11.9	42.1	0.4	9.7	4	97979	69
17	10.8	44.0	0.5	8.9	4	97980	69
18	10.1	41.3	0.4	8.2	4	97979	69
19	10.0	43.1	0.6	8.2	4	97979	69
20	9.5	45.1	0.5	7.7	4	97979	69
21	11.0	45.1	0.4	9.0	4	97979	70
22	10.1	42.7	0.5	8.2	4	97979	70
23	12.2	41.6	0.5	10.0	4	97979	70
24	11.0	41.1	0.7	9.0	4	97979	70
25	11.9	40.3	0.6	9.7	4	97979	70
26	11.1	40.9	0.6	9.0	4	97980	70
27	11.2	40.0	0.5	9.1	4	97979	68
28	10.4	40.8	0.5	8.4	4	97980	68
29	10.0	46.2	0.4	8.2	4	97980	68
30	10.9	44.9	0.5	8.9	4	97979	68
31	11.5	41.6	0.5	9.4	4	97979	68
32	12.0	41.1	0.5	9.8	4	97980	68
33	10.9	42.4	0.4	8.9	4	97979	68
34	10.6	43.7	0.4	8.6	4	97980	68
35	9.9	41.2	0.4	8.1	4	97980	68
36	9.1	42.8	0.4	7.4	4	97980	68
37	7.7	43.6	0.4	6.3	4	97979	68
38	9.5	41.6	0.6	7.7	4	97979	68
39	11.0	39.9	0.6	9.0	4	97980	70
40	11.0	39.1	0.5	9.0	4	97980	70
41	11.1	45.9	0.6	9.1	4	97980	70
42	12.5	44.5	0.5	10.2	4	97980	70
43	12.7	46.1	0.5	10.4	4	97979	70
44	12.8	42.1	0.5	10.4	4	97980	70
45	14.7	40.2	0.5	12.0	4	97980	69
46	13.6	42.0	0.6	11.1	4	97980	69
47	13.8	43.6	0.5	11.2	4	97979	69
48			0.4	11.9	4	97981	69
49			0.4	11.4	4	97979	69
50			0.5	10.5	4	97979	69
51			0.5	10.6	4	97979	68
52			0.5	10.6	4	97979	68
53			0.5	10.4	4	97979	68
54			0.5	10.6	4	97980	68
55			0.5	10.7	4	97979	68
56			0.5	10.9	4	97980	68
57			0.4	9.7	4	97979	69
58			0.5	9.2	4	97979	69
59			0.6	7.5	4	97979	69
60			0.5	7.3	4	97979	69
61	11.4	43.5	0.4	9.3	4	97979	69
62	10.2	45.3	0.5	8.3	4	97979	69
63	10.5	41.8	0.5	8.6	4	97979	70
64	11.4	42.5	0.4	9.3	4	97979	71
65	10.3	46.5	0.6	8.4	4	97979	71
66	10.8	46.7	0.6	8.8	4	97979	71
67	10.7	45.9	0.5	8.8	4	97980	71
68	11.5	42.4	0.6	9.4	4	97979	71
69	12.1	44.3	0.5	9.8	4	97979	71
70	11.8	41.7	0.4	9.6	4	97979	71
71	12.1	43.2	0.7	9.9	4	97979	71
72	11.0	42.0	0.7	9.0	4	97978	71
73	11.8	44.3	0.6	9.6	4	97978	71
74	11.9	43.0	0.5	9.7	4	97978	71
75	9.6	43.6	0.6	7.8	4	98004	70
76	9.8	44.2	0.5	8.0	4	98005	70
77	9.9	43.5	0.5	8.1	4	98005	70
78	8.9	43.9	0.5	7.2	4	98005	70
79	8.9	43.8	0.5	7.3	4	98005	70
80	9.3	42.5	0.5	7.6	4	98005	70
81	11.2	43.4	0.5	9.2	4	97980	71
82	11.0	40.6	0.5	9.0	4	97978	71
83	11.8	44.2	0.4	9.6	4	97978	71

***Blank data denotes values that were omitted in the analysis due to an extraneous event during recording

Data Point #	Standardized Wind Speed	LAeq	Rotor RPM	10m Anemometer Wind Speed (m/s)	Air Temperature (-C)	Pressure (kPa)	Relative Humidity (%)
84	11.7	42.6	0.4	9.5	4	97978	71
85	11.0	46.9	0.5	9.0	4	97978	71
86	11.0	42.6	0.6	9.0	4	97980	71
87	10.3	44.6	0.6	8.4	4	98005	70
88	10.1	42.6	0.5	8.3	4	98005	70
89	11.1	41.1	0.5	9.1	4	98004	70
90	14.2	43.2	0.6	11.6	4	98004	70
91	15.0	42.8	0.6	12.3	4	98004	70
92	13.7	42.8	0.5	11.2	4	98005	70
93			0.4	9.8	4	97980	68
94			0.4	9.5	4	97978	68
95			0.5	10.4	4	97978	68
96			0.5	8.4	4	97978	68
97			0.5	9.9	4	97978	68
98			0.5	9.5	4	97978	68
99			0.6	8.6	4	97981	70
100			0.4	8.8	4	97978	70
101			0.4	10.0	4	97979	70
102			0.5	10.1	4	97979	70
103			0.4	8.2	4	97979	70
104	11.7	42.7	0.5	9.5	4	97980	70
105	9.8	42.4	0.5	8.0	4	98005	70
106	10.4	43.3	0.6	8.4	4	98006	70
107	11.5	41.2	0.6	9.4	4	98005	70
108			0.6	10.4	4	98005	70
109			0.4	9.4	4	98005	70
110	12.9	44.8	0.6	10.5	4	98005	70
111	11.5	44.3	0.5	9.4	4	97980	70
112	10.7	42.9	0.4	8.8	4	97979	70
113	13.0	43.7	0.5	10.6	4	97979	70
114	12.6	42.0	0.5	10.3	4	97979	70
115			0.4	9.7	4	97979	70
116			0.4	9.1	4	97979	70
117	11.5	44.2	0.4	9.4	4	98004	70
118	10.2	43.4	0.5	8.3	4	98005	70
119	9.8	45.3	0.4	8.0	4	98004	70
120	9.8	47.4	0.4	8.0	4	98003	70
121	9.8	44.7	0.5	8.0	4	98000	70
122			0.5	7.6	4	97996	70
123	10.3	46.0	0.4	8.4	4	97997	72
124	11.9	46.6	0.5	9.7	4	97996	72
125	10.8	43.8	0.6	8.8	4	97993	72
126	10.8	43.9	0.5	8.8	4	97983	72
127	10.3	41.9	0.5	8.4	4	97551	72
128	11.0	45.3	0.5	9.0	4	97529	72
129	9.5	44.8	0.4	7.7	4	97606	71
130	9.5	44.8	0.5	7.7	4	97626	71
131	10.3	47.7	0.5	8.4	4	97590	71
132	12.3	43.0	0.6	10.0	4	97456	71
133	13.7	42.6	0.7	11.2	4	97889	71
134	13.7	42.2	0.6	11.2	4	97998	71
135	13.1	42.3	0.6	10.7	4	97999	70
136	11.0	43.8	0.4	9.0	4	98000	69
137	10.4	43.6	0.5	8.5	4	98000	69
138	10.9	45.8	0.6	8.9	4	98000	69
139	12.6	45.7	0.5	10.3	4	98000	69
140	10.9	44.5	0.5	8.9	4	98000	69
141	10.8	44.7	0.6	8.8	4	98000	70
142	11.0	47.6	0.5	9.0	4	97999	70
143	11.8	43.2	0.5	9.6	4	97998	70
144	10.2	46.2	0.5	8.3	4	97904	70
145			0.4	9.3	4	97279	70
146	12.4	47.4	0.5	10.1	4	97295	70
147	12.1	46.5	0.5	9.9	4	97336	71
148	13.3	45.0	0.5	10.8	4	97319	71
149	14.5	45.2	0.5	11.8	4	97345	71
150			0.6	11.6	4	97386	71
151			0.6	10.4	4	97347	71
152			0.6	10.8	4	97360	71
153			0.5	10.4	4	97354	70
154			0.5	9.2	4	97306	70
155			0.5	11.1	4	97210	70
156			0.5	12.0	4	97238	70
157			0.5	11.9	4	97206	70
158			0.6	10.5	4	97216	70
159			0.6	9.5	4	97282	69
160	12.0	44.8	0.6	9.8	4	97262	68
161	12.9	47.2	0.5	10.5	4	97137	68
162	12.2	46.1	0.7	9.9	4	97149	68
163	11.7	45.4	0.6	9.6	4	97148	68
164	11.1	46.1	0.5	9.1	4	97130	68
165	10.5	43.2	0.5	8.6	4	97007	70
166	9.9	44.6	0.5	8.1	4	96800	70

***Blank data denotes values that were omitted in the analysis due to an extraneous event during recording

Data Point #	Standardized Wind Speed	LAeq	Rotor RPM	10m Anemometer Wind Speed (m/s)	Air Temperature (-C)	Pressure (kPa)	Relative Humidity (%)
167	10.5	42.5	0.5	8.6	4	96693	70
168	10.4	44.9	0.5	8.5	4	96558	70
169	9.6	43.4	0.5	7.8	4	96536	70
170	12.0	45.8	0.6	9.8	4	96646	70
171	11.2	47.0	0.5	9.2	4	96658	70
172	8.7	43.5	0.5	7.1	4	96652	70
173	9.4	43.5	0.5	7.7	4	96677	70
174			0.5	6.8	4	96604	70
175	9.6	46.0	0.6	7.8	4	96395	70
176	10.3	44.6	0.4	8.4	4	96166	70
177	11.4	44.5	0.4	9.3	4	95977	71
178	12.9	44.0	0.4	10.5	4	95829	71
179	12.9	42.8	0.6	10.5	4	95774	71
180	12.6	45.8	0.5	10.3	4	95540	71
181			0.6	9.8	4	95539	71
182			0.6	12.1	4	95565	71
183	13.4	47.0	0.7	10.9	4	95492	69
184	11.2	44.5	0.8	9.1	4	95455	69
185	12.3	43.5	0.5	10.0	4	95439	69
186	14.4	46.3	0.4	11.8	4	95250	69
187	12.9	46.1	0.6	10.5	4	95147	69
188	12.8	46.0	0.5	10.4	4	95080	69
189	13.8	46.6	0.4	11.3	4	95029	70
190			0.5	10.6	4	94990	70
191	10.2	45.7	0.4	8.3	4	95058	70
192	9.5	45.5	0.4	7.8	4	95176	70
193	10.6	42.3	0.5	8.6	4	95150	70
194	12.8	45.7	0.5	10.5	4	95078	70
195	13.6	46.7	0.6	11.1	4	95064	71
196	12.9	43.5	0.5	10.6	4	94977	71
197	13.2	47.2	0.5	10.8	4	94773	71
198	13.7	43.8	0.5	11.2	4	94808	71
199			0.5	10.9	4	94733	71
200			0.5	11.9	4	94721	71
201	14.0	46.3	0.6	11.4	4	94669	70
202	12.1	47.5	0.6	9.8	4	94544	70
203	13.2	46.8	0.8	10.8	4	94498	70
204			0.6	9.6	4	94588	70
205			0.4	11.1	4	94631	70
206			0.5	10.7	4	94838	70
207	14.0	43.8	0.4	11.5	4	94985	71
208	13.8	43.0	0.4	11.3	4	94984	71
209	14.3	42.9	0.6	11.7	4	94769	71
210	13.9	44.5	0.5	11.4	4	94778	71
211	13.0	43.9	0.5	10.6	4	94800	71
212	13.1	47.2	0.4	10.7	4	94233	71
213	12.9	43.6	0.4	10.5	4	94136	70
214	13.4	45.2	0.5	10.9	4	94221	70
215	13.3	42.9	0.6	10.9	4	94090	70
216	15.0	42.3	0.6	12.2	4	94170	70
217	13.9	44.0	0.7	11.4	4	94070	70
218	13.5	44.7	0.5	11.0	4	94061	70
219	13.2	47.5	0.6	10.8	4	94061	70
220			0.6	12.3	4	94133	70
221			0.6	10.2	4	94097	70
222			0.8	10.7	4	94215	70
223			0.7	10.8	4	94484	70
224	11.7	45.4	0.5	9.5	4	94171	70
225	15.1	45.5	0.5	12.3	4	94330	71
226	15.3	44.0	0.5	12.5	4	94094	71
227	13.5	46.9	0.6	11.0	4	94176	71
228			0.6	9.8	4	94260	71
229			0.6	11.2	4	94292	71
230			0.6	11.8	4	94188	71
231			0.5	10.0	4	94313	71
232			0.5	11.1	4	94154	71
233			0.5	11.3	4	94279	71
234			0.6	10.5	4	94323	71
235			0.6	10.5	4	94444	71
236			0.6	10.8	4	94551	71
237			0.6	10.7	4	94495	70
238			0.7	10.8	4	94516	70
239			0.5	11.3	4	94796	70
240			0.4	10.5	4	94596	70
241	12.4	49.4	0.4	10.1	4	94416	70
242	12.7	45.6	0.5	10.4	4	94379	70
243	14.0	45.5	0.6	11.4	4	94290	71
244	13.7	45.4	0.6	11.1	4	94404	71
245	13.9	43.9	0.6	11.4	4	94402	71
246	11.9	47.2	0.6	9.7	4	94501	71
247	13.3	47.2	0.5	10.9	4	94423	71
248	12.9	47.9	0.6	10.5	4	94213	71
249	14.6	45.6	0.5	11.9	4	94372	71

Table E.02 Measurement data - Background

Project: Cedar Point Wind Power Project - Turbine CP209 - IEC 61400-11 Measurement

Report ID: 15039.00.T209.RP3

Created on: 3/7/2018

***Blank data denotes values that were omitted in the analysis due to an extraneous event during recording

Data Point #	Standardized Wind Speed	LAeq	Rotor RPM	10m Anemometer Wind Speed (m/s)	Air Temperature (-C)	Pressure (kPa)	Relative Humidity (%)
250	13.9	45.1	0.4	11.4	4	94199	71
251	14.2	44.2	0.4	11.6	4	94199	71
252	13.5	45.0	0.4	11.0	4	94313	71
253	11.6	44.0	0.6	9.5	4	94244	71
254	12.1	45.6	0.5	9.9	4	94291	71
255	11.8	45.8	0.5	9.7	4	94249	71
256	10.5	43.2	0.4	8.6	4	94204	71
257	9.7	42.1	0.5	7.9	4	94164	71
258	9.7	42.8	0.5	7.9	4	94208	71
259	8.8	42.4	0.5	7.2	4	94095	71
260	11.1	41.9	0.4	9.1	4	94229	71
261	10.7	45.9	0.6	8.7	4	94243	73
262	11.6	44.6	0.5	9.5	4	94343	73
263	11.2	42.9	0.4	9.1	4	94347	73
264	10.5	47.9	0.5	8.6	4	94316	73
265	11.3	43.6	0.6	9.2	4	94413	73
266	13.6	45.2	0.6	11.1	4	94505	73
267	12.2	44.6	0.6	9.9	4	94394	71
268	12.3	45.1	0.5	10.0	4	94504	71
269	14.4	43.2	0.5	11.7	4	94461	71
270	14.0	42.3	0.6	11.4	4	94290	71
271			0.4	10.6	4	94500	71
272			0.5	9.6	4	94405	71
273			0.5	10.3	4	94425	71
274			0.3	9.3	4	94120	71
275			0.4	9.1	4	94244	71
276			0.4	8.8	4	93980	71
277			0.5	9.6	4	93680	71
278			0.4	9.0	4	93372	71
279			0.5	9.8	4	93270	73
280			0.6	9.2	4	93327	73
281			0.5	10.0	4	93333	73
282			0.5	9.4	4	93114	73
283	11.1	46.0	0.5	9.0	4	92959	73
284	10.9	48.0	0.4	8.9	4	92897	73
285	11.4	44.9	0.5	9.3	4	92758	73
286	10.1	43.9	0.7	8.2	4	92870	73
287	10.2	46.5	0.6	8.3	4	92931	73
288	11.7	44.8	0.4	9.6	4	92823	73
289	14.9	42.1	0.5	12.2	4	92832	73
290	14.1	45.7	0.6	11.5	4	92889	73
291	14.0	44.7	0.6	11.5	4	92824	72
292	14.5	46.7	0.4	11.9	4	93100	72
293			0.5	10.2	4	93102	72
294			0.5	9.4	4	93307	72
295			0.5	10.3	4	93200	72
296			0.5	11.8	4	93103	72
297			0.6	11.5	4	93123	71
298			0.7	10.7	4	93421	71
299			0.5	10.3	4	93082	71
300			0.5	11.2	4	92960	71
301			0.5	10.8	4	92940	71
302			0.5	11.0	4	93171	71
303			0.6	10.9	4	93046	71
304	13.2	46.8	0.6	10.7	4	93081	71
305	12.1	43.3	0.6	9.9	4	93486	71
306	13.3	44.1	0.5	10.9	4	93763	71
307	12.1	47.3	0.6	9.9	4	93963	71
308	11.9	44.8	0.5	9.7	4	94044	71
309	13.7	45.5	0.5	11.2	4	94089	72
310	13.4	43.2	0.5	11.0	4	93951	72
311	12.5	43.8	0.6	10.2	4	93749	72
312	13.8	44.7	0.6	11.3	4	93880	72
313	13.8	43.6	0.6	11.3	4	93970	72
314	13.0	42.6	0.6	10.6	4	94211	72
315	11.7	43.9	0.5	9.5	4	94188	71
316	12.9	44.2	0.5	10.5	4	94026	71
317	12.7	42.9	0.4	10.3	4	94054	71
318	12.7	44.7	0.5	10.4	4	93925	71
319	12.1	46.6	0.6	9.9	4	94038	71
320	11.6	47.7	0.6	9.4	4	94105	71
321			0.5	9.8	4	93993	72
322			0.5	9.1	4	94014	72
323	11.5	43.9	0.6	9.4	4	93974	72
324	11.7	42.3	0.4	9.6	4	94021	72
325	13.8	46.9	0.5	11.3	4	93968	72
326			0.6	10.3	4	94063	72
327	10.6	48.0	0.7	8.6	4	94199	72
328	13.1	45.9	0.4	10.7	4	93679	72
329	11.7	46.0	0.5	9.5	4	92829	72
330	10.2	46.4	0.6	8.4	4	93080	72
331	10.7	46.7	0.6	8.8	4	93634	72
332			0.6	11.6	4	93663	72

***Blank data denotes values that were omitted in the analysis due to an extraneous event during recording

Data Point #	Standardized Wind Speed	LAeq	Rotor RPM	10m Anemometer Wind Speed (m/s)	Air Temperature (-C)	Pressure (kPa)	Relative Humidity (%)
333	14.7	46.0	0.7	12.0	4	93677	71
334	13.9	43.4	0.6	11.4	4	93762	71
335	13.1	43.9	0.5	10.7	4	93637	71
336	13.1	44.9	0.6	10.7	4	93835	71
337	12.6	45.2	0.5	10.3	4	93872	71
338	12.2	42.4	0.4	10.0	4	94002	71
339	11.3	42.8	0.5	9.2	4	93870	71
340	12.8	41.0	0.5	10.4	4	94062	71
341	12.0	40.5	0.5	9.8	4	94101	71
342	11.1	43.4	0.4	9.1	4	94393	71
343	10.4	43.2	0.4	8.5	4	94441	71
344	11.7	41.0	0.5	9.5	4	94300	71
345	11.4	45.6	0.5	9.3	4	94483	72
346	13.0	47.8	0.5	10.6	4	93861	72
347	12.5	43.3	0.5	10.2	4	93884	72
348	11.7	45.2	0.5	9.6	4	93809	72
349	13.1	45.5	0.5	10.7	4	93806	72
350	14.3	46.8	0.5	11.7	4	93784	72
351			0.5	11.1	4	93810	71
352	14.4	45.0	0.5	11.7	4	93904	71
353	14.3	45.6	0.5	11.7	4	93828	71
354	12.8	44.7	0.5	10.5	4	94018	71
355			0.6	10.3	4	94348	71
356	11.4	45.8	0.5	9.3	4	94172	71
357	9.8	46.1	0.6	8.0	4	94017	72
358	10.9	43.9	0.4	8.9	4	94081	72
359	10.9	46.0	0.4	8.9	4	94005	72
360	10.5	39.2	0.3	8.6	5	94678	69
361	10.0	40.9	0.3	8.1	5	94802	69
362	10.1	43.9	0.2	8.3	5	94949	69
363	10.4	42.1	0.3	8.5	5	95105	69
364	9.9	42.8	0.3	8.1	5	95174	69
365	8.9	40.0	0.4	7.3	5	95127	69
366	8.7	43.7	0.3	7.1	5	94789	69
367	9.1	41.9	0.3	7.4	5	95387	70
368	8.8	42.3	0.3	7.2	5	95518	70
369	8.9	41.5	0.3	7.3	5	95863	70
370	8.7	38.7	0.4	7.1	5	95965	70
371	9.0	42.0	0.4	7.4	5	96186	70
372	9.3	43.3	0.4	7.6	5	95912	69
373	9.6	39.7	0.5	7.8	5	95924	69
374	10.0	38.1	0.5	8.1	5	95786	69
375	10.3	40.8	0.4	8.4	5	95812	69
376	9.7	37.6	0.3	7.9	5	95721	69
377	9.7	39.1	0.4	7.9	5	95877	69
378	9.6	40.5	0.5	7.8	5	95743	69
379	9.3	42.2	0.5	7.6	5	95850	68
380	9.3	43.1	0.6	7.6	5	95804	68
381	8.8	44.5	0.5	7.2	5	95842	68
382	8.9	41.8	0.4	7.3	5	95963	68
383	9.4	40.8	0.5	7.6	5	96055	68
384	7.7	43.4	0.3	6.3	5	95971	68
385	6.7	40.7	0.2	5.5	5	95965	69
386	6.7	39.4	0.3	5.5	5	95682	69
387	8.6	43.7	0.3	7.1	5	96005	69
388	9.5	39.5	0.3	7.8	5	96069	69
389	9.7	40.5	0.4	7.9	5	95985	69
390	9.0	45.4	0.3	7.3	5	96081	69
391	7.5	42.6	0.3	6.1	5	96080	68
392	8.4	39.0	0.3	6.8	5	96117	68
393	8.0	41.6	0.3	6.5	5	96252	68
394	7.5	40.8	0.4	6.1	5	96250	68
395	7.7	39.1	0.2	6.3	5	96199	68
396	7.3	42.4	0.3	5.9	5	96133	68
397	7.0	42.1	0.3	5.7	5	96135	69
398	9.2	37.5	0.4	7.5	5	96024	69
399	8.3	38.7	0.4	6.8	5	96156	69
400	8.5	40.0	0.4	6.9	5	96266	69
401	8.9	38.5	0.4	7.3	5	96283	69
402	8.7	39.9	0.4	7.1	5	96351	69
403	8.9	39.0	0.4	7.3	5	96077	69
404	8.7	39.4	0.4	7.1	5	96190	69
405	8.5	37.7	0.3	6.9	5	96156	69
406	8.6	38.2	0.3	7.0	5	96105	69
407	8.3	37.6	0.3	6.8	5	96074	69
408	8.4	39.1	0.3	6.9	5	96069	68
409	7.3	38.5	0.4	6.0	5	96106	68
410	6.4	36.4	0.5	5.2	5	96039	68
411	6.4	37.4	0.3	5.3	5	95944	68
412	6.7	38.7	0.3	5.5	5	95883	68
413	7.4	37.7	0.4	6.0	5	95859	68
414	5.9	39.1	0.4	4.8	5	95854	69
415	6.2	42.9	0.3	5.1	5	95881	70

***Blank data denotes values that were omitted in the analysis due to an extraneous event during recording

Data Point #	Standardized Wind Speed	LAeq	Rotor RPM	10m Anemometer Wind Speed (m/s)	Air Temperature (-C)	Pressure (kPa)	Relative Humidity (%)
416	5.9	43.1	0.4	4.8	5	95896	70
417	6.5	42.7	0.4	5.3	5	95816	70
418	8.1	39.0	0.3	6.6	5	95836	70
419	9.3	43.9	0.4	7.6	5	95923	70
420	9.0	39.8	0.3	7.4	5	95950	70
421	9.5	38.8	0.2	7.7	5	95807	68
422	8.7	38.5	0.3	7.1	5	95746	68
423	7.9	40.9	0.3	6.4	5	95694	68
424	8.7	37.2	0.4	7.1	5	95780	68
425	9.1	39.9	0.4	7.5	5	95735	68
426	9.6	39.5	0.4	7.8	5	95702	68
427	9.2	44.0	0.3	7.5	5	95779	69
428	8.4	39.1	0.3	6.8	5	95774	69
429	8.2	41.9	0.3	6.7	5	95756	69
430	8.8	40.0	0.4	7.2	5	95708	69
431	9.4	39.5	0.4	7.7	5	95751	69
432	10.2	37.3	0.2	8.3	5	95695	69
433	10.4	36.5	0.2	8.5	5	95660	69
434	10.2	36.8	0.2	8.3	5	95872	69
435	10.7	38.3	0.3	8.7	5	95867	69
436	10.6	43.4	0.4	8.7	5	95984	69
437	9.5	41.6	0.5	7.7	5	95651	69
438	9.9	40.9	0.4	8.0	5	95549	69
439	9.2	43.1	0.3	7.5	5	95513	68
440	9.3	39.3	0.3	7.6	5	95610	68
441	7.9	43.7	0.6	6.5	5	95703	68
442	8.3	44.9	0.5	6.8	5	95921	68
443	8.2	44.8	0.5	6.7	5	95956	68
444	7.8	39.1	0.4	6.4	5	95885	68
445	9.2	39.3	0.4	7.5	5	95742	68
446	8.5	41.2	0.4	7.0	5	95703	68
447	7.2	37.2	0.4	5.9	5	96110	68
448	7.1	37.7	0.4	5.8	5	96249	68
449	7.6	36.6	0.3	6.2	5	96753	68
450	7.0	40.6	0.3	5.7	5	96616	68
451	6.7	41.8	0.4	5.5	5	96698	69
452	6.0	37.8	0.4	4.9	5	96548	69
453	6.5	38.2	0.5	5.3	5	96835	69
454	6.8	38.4	0.4	5.6	5	97013	69
455	5.9	41.0	0.4	4.8	5	97840	69
456	6.6	38.4	0.4	5.4	5	98110	69
457	6.9	37.3	0.3	5.6	5	98113	70
458	7.3	38.5	0.3	6.0	5	98115	70
459	7.1	38.3	0.3	5.8	5	98118	70
460	8.5	36.9	0.3	6.9	5	98119	70
461	8.5	36.2	0.4	6.9	5	98120	70
462	8.9	39.2	0.4	7.2	5	98122	70
463	9.2	37.7	0.3	7.5	5	98123	70
464	9.3	37.6	0.2	7.6	5	98124	70
465	8.0	38.2	0.3	6.5	5	98124	70
466	8.9	38.6	0.4	7.2	5	98124	70
467	7.5	40.3	0.5	6.1	5	98124	70
468	7.8	43.7	0.5	6.4	5	98125	70
469	8.8	44.7	0.5	7.1	5	98126	71
470	7.9	42.5	0.4	6.5	5	98127	71
471	7.8	41.9	0.5	6.4	5	98127	71
472	7.6	39.7	0.5	6.2	5	98129	71
473	9.5	39.5	0.5	7.7	5	98130	71
474	9.3	40.9	0.4	7.6	5	98131	70
475	10.7	41.0	0.5	8.7	5	98131	70
476	9.4	42.9	0.6	7.7	5	98131	70
477	9.3	38.7	0.4	7.6	5	98132	70
478	9.6	39.6	0.3	7.8	5	98132	70
479	9.6	44.4	0.3	7.8	5	98132	70
480	8.9	45.7	0.4	7.2	5	98132	69
481	8.2	38.8	0.4	6.7	5	98132	68
482	8.3	39.4	0.4	6.8	5	98131	68
483	9.1	45.6	0.4	7.4	5	98130	68
484	8.4	44.0	0.5	6.9	5	98129	68
485	7.3	39.1	0.4	6.0	5	98128	68
486	7.5	37.7	0.3	6.1	5	98126	68
487	7.1	39.3	0.4	5.8	5	98124	69
488	7.5	39.0	0.4	6.1	5	98123	69
489	6.8	39.9	0.3	5.6	5	98120	69
490	7.1	41.1	0.3	5.8	5	98115	69
491	7.0	39.1	0.3	5.7	5	98108	69
492	7.6	37.7	0.4	6.2	5	98087	69
493	7.5	36.9	0.3	6.1	5	96956	69
494	7.5	37.1	0.3	6.1	5	96060	69
495	8.0	37.4	0.3	6.5	5	95754	69
496	7.6	38.2	0.3	6.2	5	95792	69
497	7.6	37.9	0.3	6.2	5	97317	69
498	7.1	39.3	0.5	5.8	5	98112	69

Table E.02 Measurement data - Background

Project: Cedar Point Wind Power Project - Turbine CP209 - IEC 61400-11 Measurement

Report ID: 15039.00.T209.RP3

Created on: 3/7/2018

***Blank data denotes values that were omitted in the analysis due to an extraneous event during recording

Data Point #	Standardized Wind Speed	LAeq	Rotor RPM	10m Anemometer Wind Speed (m/s)	Air Temperature (-C)	Pressure (kPa)	Relative Humidity (%)
499	7.0	39.3	0.4	5.7	5	98121	69
500	7.9	40.5	0.6	6.4	5	98122	69
501	7.9	39.5	0.6	6.4	5	98119	69
502	8.6	38.3	0.3	7.0	5	98114	69
503	9.1	41.4	0.3	7.4	5	98100	69
504	9.1	41.1	0.5	7.4	5	97440	69
505	8.9	38.6	0.4	7.2	5	95229	69
506	9.8	38.8	0.4	8.0	5	95045	69
507	9.9	40.7	0.4	8.1	5	95268	69
508	10.0	38.6	0.3	8.1	5	96512	69
509	9.9	37.7	0.3	8.1	5	97082	69
510	11.3	38.7	0.4	9.2	5	97634	69
511	12.9	41.8	0.5	10.5	5	98086	68
512	11.9	37.9	0.5	9.7	5	98106	68
513	10.7	38.9	0.4	8.7	5	98113	68
514	10.4	47.0	0.4	8.5	5	98111	68
515			0.4	9.6	5	98113	68
516	10.6	45.6	0.4	8.7	5	98117	68
517	9.5	43.6	0.3	7.7	5	98118	67
518	10.6	44.2	0.3	8.7	5	98121	67
519	11.4	46.0	0.4	9.3	5	98119	67
520	10.6	44.2	0.4	8.6	5	98119	67
521	9.4	40.9	0.4	7.6	5	98116	67
522	8.6	42.9	0.4	7.1	5	98115	68
523	8.1	46.7	0.4	6.6	5	98118	69
524	8.3	41.5	0.5	6.8	5	98118	69
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***Blank data denotes values that were omitted in the analysis due to an extraneous event during recording

Data Point #	Standardized Wind Speed	LAeq	Rotor RPM	10m Anemometer Wind Speed (m/s)	Air Temperature (-C)	Pressure (kPa)	Relative Humidity (%)
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***Blank data denotes values that were omitted in the analysis due to an extraneous event during recording

Data Point #	Standardized Wind Speed	LAeq	Rotor RPM	10m Anemometer Wind Speed (m/s)	Air Temperature (-C)	Pressure (kPa)	Relative Humidity (%)
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Appendix F
Note on anemometer position with IEC 61400-11 Ed 2.1 and Ed 3.0

Note N6.040.17

Note on anemometer position with IEC 61400-11 editions 2.1 and 3.0

Author: Bo Søndergaard

Project number: 35.6539.01
Date: 7/11/2017
Project manager: Bo Søndergaard
Controlled by: -

To : Aercoustics Engineering Limited
Att.: Payam Ashtiani

From : Bo Søndergaard

1. Purpose

In the capacity of convenor for Maintenance Team 11, the workgroup in charge of IEC 61400-11, since 2006, I have been asked to provide background information, and comment on the consequences of changing the anemometer position when going from edition 2.1 to edition 3, and the recommended method for using measurements based on edition 2.1 for an analysis with edition 3.

2. Comment

There are several differences between IEC 61400-11 standard edition 2.1 (November 2006) and edition 3.0 (November 2012). In particular, the general data treatment procedures for noise levels, and the tonality assessment were changed to keep up with the changes in wind turbine design at the time.

However, since edition 1.0 (1998), very few changes have been made to the IEC 61400-11 standard with respect to the measurement setup. In edition 1.0 the prescribed position of the anemometer was upwind (2 to 4 rotor diameters) as it was allowed to use the anemometer for determination of the standardized wind speed with the wind turbine running. At that time the distances were smaller and this setup is maintained in Annex F on small wind turbines in edition 3. Editions 2.0 and 2.1, still allowed such use of the anemometer

In Germany, modified versions of IEC 61400-11 edition 2 were introduced by the FGW. In revision 15 (from 2004), using the power for determination of the standardized wind speed was mandatory. In revision 16 (from 2005), it was stated that the position of the anemometer can deviate from the requirements in IEC 61400-11 edition 2, without specifying position requirements. Germany has had a strong influence on the development of the IEC 61400-11 standard through the experience from several measuring companies and German authorities. The decision to allow alternative positions for the anemometer is very representative of the situation. It is difficult to set up general requirements for the position of the anemometer that works at all sites. As such, it makes sense to allow for an expert

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judgement on the anemometer position in a given situation. In the Danish regulations, it is stated that the anemometer has to be close to the wind turbine in a position where neither the wind turbine nor objects in the terrain is expected to influence the wind speed measurements.

The German and Danish considerations on the position of the anemometer is based on the fact that the dominating background noise at the microphone position can be more or less dependent on wind speed; and can be generated by vegetation upwind, downwind or to the side of the wind turbine. This is often reflected in background noise with a weak dependence on wind speed.

Maintenance Team 11, responsible for revising IEC 61400-11, discussed this issue and there was a strong support from the measurement institutes for using the nacelle anemometer for background noise measurements. In most cases, this would give a reasonable correlation between wind speed and background noise. The nacelle anemometer is not influenced by terrain and represents, to a reasonable degree, the wind in the surroundings. However, the manufacturers argued that the nacelle anemometer might not be a part of future designs and could not be guaranteed. There was a general agreement that it was difficult to decide on an optimum position, but in most cases, downwind and to the side would make sense, resulting in Figure 5 of edition 3.0. The position of the anemometer is not considered an important issue and the wording is “guidance” and “acceptable” and not a stronger wording like “shall”. This is a deliberate decision by the Maintenance Team 11 to ensure flexibility when other choices make more sense.

The recommended method when using measurements made according to IEC 61400-11 edition 2.1 for analysis with IEC 61400-11 edition 3.0 is to use the nacelle anemometer for the background noise. This will work well in most cases. Alternatively, to use the measured wind speed at 10 m height if there is no strong influence from the background noise (e.g. when signal to noise ratio is better than 6 dB).

SWECO Danmark A/S

Bo Søndergaard

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Appendix G
Information for Regulator

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E-Audit Checklist

(2017 Compliance Protocol AF5): E-Audit checklist

Wind Energy Project – Screening Document – Acoustic Audit Report – Emmission IEC61400-11 Standard

Information Required in the Acoustic Audit Report – Immission

Item #	Description	Complete?	Comment
1	Characterization of the wind turbine Items 1 to 26; IEC61400-11:2013, Section 10.2	✓	
2	Physical environment Items 27 to 33; IEC61400-11:2013, Section 10.3, Physical Environment	✓	
3	Measurement instrumentation Items 34 to 39; IEC61400-11:2013, Section 10.4, Instrumentation	✓	
4	Acoustic data Items 40 to 52; IEC61400-11:2013, Section 10.5, Acoustic Data	✓	
5	Non-acoustic data Items 50 to 53, and 56; IEC61400-11:2003 Section 10.6, Non-Acoustic Data Items 59 and 60; NPC-233, Section 12.3, Acoustic Audit – Acoustical Data, bullet point number 8, All necessary and supporting calculations	✓	
6	Uncertainty the apparent sound power level at integer wind speeds one-third octave band spectrum of the noise at the reference position at each integer wind speed the Tonality of the sound emissions of the wind turbine measured at the reference position	✓	
7	Additional information Item 60; NPC-233, Section 10, Report Format, bullet point number 4, Conclusions and Recommendations Item 61; NPC-233, Section 12.3, Acoustic Audit – Acoustical Data, bullet point number 8, All necessary and supporting calculations Item 62; NPC-233, Section 12.3, Acoustic Audit – Acoustical Data, bullet point number 3, Details of measurement procedure	✓	All data Excel sheet provided
8	Items 68 to 72; IEC61400-11:2013, Section 10.5, Acoustic Data	⊘	Items 68 to 72 acoustic data as per IEC 61400-11 standard are optional; low frequency noise, infrasound, impulsivity, amplitude modulation not reported
9	Non-acoustic data Items 73 to 74 are from IEC61400-11:2013, Section 10.6, Non-Acoustic Data	⊘	Items 73 to 74 non-acoustic data as per IEC 64100-11 standard are optional; turbulence intensity during acoustic meeasurements not reported

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Sample Calculation

Allowed Range from Power Curve and Required Wind Speeds

Sample Calculation: Allowed range of power curve and required wind speeds

Power Curve & Required Wind Speeds		
Power Curve Tolerance	1%	
Min allowable range	1.5	m/s
Max allowable range	9.5	m/s
Power Output	2030	kW
85% Power	1725.5	kW
Corresponding wind speed	8.67	m/s
Minimum bin	7.0	m/s
Maximum bin	11.5	m/s

Power Curve Hub Wind Speed (m/s)	Power [kW]	+ value = acceptable slope of power curve
0	**0**	-40.6
1	0	-40.6
2	0	25.4
3	66	64.4
4	171	138.4
5	350	229.4
6	620	333.4
7	994	419.4
8	1454	367.4
9	1862	102.4
10	2005	-16.6
11	2029	-39.6
12	2030	-40.6
13	2030	-40.6
14	2030	-40.6
15	2030	-40.6
16	2030	-40.6
17	2030	-40.6
18	2030	-40.6
19	2030	-40.6
20	2030	-40.6
21	2030	-40.6
22	2030	-40.6
23	2030	-40.6
24	2030	-40.6
25	2030	

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Sample Calculation

K_{nac} and K_z

[as per IEC 61400-11 Edition 3.0 Section 8.2.1.2 and Section 8.2.2]

SAMPLE CALCULATION

This calculation example demonstrates the calculation of nacelle k-factor as per IEC 61400-11 Edition 3.0 section 8.2.1.2

Sample calculations have been based on measurement data collected and reported for Cedar Point Wind Power Project (Report ID: 15039.00.CP209.R3)

For all data points with power levels from the allowed range of the power curve, the average value of the ratio of the wind speed derived from the power curve $V_{P,n}$ and the measured nacelle wind speed $V_{nac,m}$, k_{nac}, is derived as per equation (1). Information to calculate k_{nac} is provided in Table 1.

$$k_{nac} = \frac{1}{n}\left(\sum_{i=1}^{n}\left(\frac{v_{p,n}}{v_{nac,m}}\right)_i\right) \quad (1)$$

where

$V_{nac,m}$ is measured nacelle wind speed

K_{nac} is nacelle k-factor

$V_{P,n}$ is wind speed derived from the power curve

k_{nac} = 0.9854

SAMPLE CALCULATION

This calculation example demonstrates the calculation of nacelle k-factor as per IEC 61400-11 Edition 3.0 section 8.2.1.2

Table 1 - Information to calculate K_{nac}

Data ID#	Data Point Excluded 1=yes, 0=no	Power (kW)	Hub Height Wind Speed (m/s) from power curve	Hub Wind speed in acceptable range 1=yes, 0=no	wind speed from acceptable range $V_{p,i}$ (m/s)	Nacelle Anemometer Wind Speed, $V_{nac,m}$ (m/s)	$V_{P,i}/V_{nac,m}$
1	0	2200		0	12.69	12.88	
2	0	2076		0	12.21	12.39	
3	0	2037		0	12.06	12.24	
4	0	2051		0	13.06	13.25	
5	0	2022	10.70	0	12.50	12.68	
6	1	2014	10.36	0		12.06	
7	1	2077		0		13.41	
8	1	2059		0		14.79	
9	1	2023	10.75	0		13.53	
10	1	1988	9.88	0		13.13	
11	0	1990	9.89	0	13.15	13.35	
12	0	2037		0	12.12	12.30	
13	0	1978	9.81	0	12.88	13.07	
14	0	1955	9.65	1	9.65	12.20	0.79
15	0	1954	9.65	1	9.65	11.70	0.82
16	0	2034		0	11.34	11.51	
17	0	2119		0	13.64	13.84	
18	0	2070		0	13.16	13.36	
19	0	1974	9.79	0	13.01	13.20	
20	0	1935	9.51	1	9.51	12.30	0.77
21	0	1934	9.50	1	9.50	10.15	0.94
22	0	2061		0	11.07	11.23	
23	0	1997	9.94	0	11.10	11.27	
24	0	1974	9.78	0	11.25	11.41	
25	0	2037		0	11.36	11.53	
26	0	2164		0	13.06	13.26	
27	0	2049		0	11.96	12.14	
28	0	1947	9.59	1	9.59	11.73	0.82
29	0	1942	9.56	1	9.56	10.89	0.88
30	0	2088		0	11.62	11.79	
31	0	2118		0	11.80	11.98	
32	0	2075		0	13.07	13.26	
33	0	2004	10.00	0	11.83	12.01	
34	0	1982	9.84	0	12.17	12.35	
35	0	1898	9.25	1	9.25	10.42	0.89
36	0	1928	9.46	1	9.46	10.24	0.92
37	0	1974	9.78	0		9.67	
38	0	2148		0	10.52	10.67	
39	0	2065		0	9.97	10.12	
40	0	2004	9.99	0	10.24	10.40	
41	1	2137		0		11.65	
42	0	2055		0	11.08	11.24	
43	0	2002	9.98	0	10.68	10.84	
44	0	2007	10.10	0	9.90	10.04	
45	0	2048		0	11.17	11.33	
46	0	2137		0	12.19	12.37	
47	0	2018	10.53	0	10.95	11.11	
48	0	2028	10.97	0	11.99	12.16	
49	0	2066		0	12.58	12.77	
50	0	1982	9.84	0	10.02	10.16	
51	0	1999	9.96	0	10.82	10.98	
52	0	2055		0	11.61	11.78	
53	0	1946	9.58	1	9.58	10.04	0.95
54	0	1927	9.46	1	9.46	9.89	0.96
55	0	2006	10.05	0	9.80	9.95	
56	0	2073		0	10.24	10.40	
57	0	2032		0		9.53	
58	0	2043		0		9.45	
59	0	2067		0	10.11	10.26	
60	0	2021	10.65	0	9.89	10.04	
61	0	1989	9.89	0		8.88	
62	0	2016	10.45	0		9.08	
63	0	2025	10.82	0	9.95	10.09	
64	0	1996	9.94	0	9.92	10.07	
65	0	2030		0		9.83	
66	0	2112		0	10.28	10.43	
67	0	2095		0	9.81	9.96	
68	0	2116		0	10.01	10.16	
69	0	2097		0	12.09	12.27	
70	0	2082		0	12.03	12.21	
71	0	2003	9.99	0	9.97	10.12	
72	0	1971	9.76	0	10.28	10.43	
73	0	2069		0	11.79	11.97	
74	0	2037		0	11.65	11.83	
75	0	2069		0	11.07	11.24	
76	1	1999	9.96	0		10.94	
77	0	1982	9.84	0	11.14	11.31	
78	0	2051		0	11.66	11.84	
79	0	2047		0	11.12	11.28	
80	0	2017	10.51	0	11.92	12.09	
81	0	2058		0	12.35	12.53	
82	0	2090		0	11.93	12.11	
83	0	2105		0	12.35	12.54	
84	0	2045		0	13.04	13.23	
85	0	2068		0	12.79	12.98	
86	0	2062		0	12.51	12.70	
87	0	1974	9.78	0	12.59	12.78	
88	0	1959	9.68	1	9.68	11.83	0.82
89	0	1960	9.68	1	9.68	10.99	0.88
90	0	1943	9.57	1	9.57	11.66	0.82
91	0	2049		0	10.83	11.00	
92	0	2000	9.97	0	10.50	10.66	
93	0	1994	9.92	0	10.77	10.93	
94	0	2008	10.11	0	10.91	11.07	
95	0	1962	9.70	1	9.70	10.13	0.96
96	0	1937	9.52	1	9.52	10.16	0.94
97	0	1997	9.94	0	9.78	9.93	
98	0	2014	10.36	0	9.78	9.93	
99	0	2117		0	10.40	10.55	
100	0	2225		0	10.85	11.01	
101	0	2134		0	11.76	11.94	
102	0	2016	10.48	0	10.88	11.04	
103	0	1928	9.46	1	9.46	10.86	0.87
104	0	1886	9.17	1	9.17	10.47	0.88
105	0	2035		0		9.40	
106	0	2168		0	11.59	11.76	
107	0	2120		0	10.96	11.13	
108	0	2012	10.29	0	10.53	10.69	
109	0	1950	9.61	1	9.61	10.39	0.92
110	0	1933	9.49	1	9.49	10.81	0.88
111	0	1982	9.84	0		9.56	
112	0	2083		0	9.86	10.00	
113	0	2113		0	11.35	11.52	
114	0	2032		0	10.02	10.17	
115	0	1991	9.90	0	9.84	9.99	
116	0	2029	11.00	0		9.45	
117	0	2078		0	10.55	10.71	
118	0	2007	10.09	0	10.14	10.29	
119	0	1997	9.94	0		9.87	
120	0	2039		0	10.44	10.60	
121	0	2131		0	11.36	11.53	
122	0	2034		0	10.88	11.05	
123	0	1970	9.75	0	9.93	10.07	
124	0	1994	9.92	0	10.45	10.61	
125	0	2115		0	11.85	12.03	
126	0	2052		0	11.21	11.37	
127	0	2109		0	11.32	11.48	
128	0	2159		0	12.11	12.29	
129	1	2103		0		13.52	
130	1	1979	9.82	0		11.78	
131	1	1954	9.65	1		11.28	
132	1	2016	10.44	0		11.79	
133	1	2044		0		12.40	
134	1	1955	9.65	1		12.90	
135	1	375	5.09	1		11.94	
136	1	0	2.00	1		13.11	
137	0	2001	9.97	0	12.57	12.76	
138	0	2036		0	11.94	12.11	
139	0	2038		0	10.82	10.98	
140	0	2022	10.73	0	11.73	11.91	
141	0	2021	10.66	0	12.39	12.58	
142	0	2018	10.56	0	11.63	11.80	
143	0	2039		0	11.50	11.67	
144	0	2070		0	11.46	11.63	
145	0	2037		0	10.78	10.94	
146	0	2030	11.85	0	10.81	10.97	
147	0	2104		0	11.17	11.33	
148	0	2067		0	11.16	11.33	
149	0	2006	10.03	0	11.23	11.39	
150	0	1981	9.83	0	10.40	10.56	
151	0	1994	9.93	0	10.58	10.74	
152	0	2038		0	10.89	11.05	
153	0	2003	9.98	0	10.64	10.80	
154	0	2048		0	11.10	11.26	
155	0	2095		0	10.80	10.96	
156	0	1965	9.72	1	9.72	9.60	1.01
157	0	1972	9.77	0	10.00	10.15	
158	0	2166		0	11.56	11.74	
159	0	2184		0	11.37	11.54	
160	0	2180		0	12.77	12.96	
161	0	2109		0	12.73	12.92	
162	0	2052		0	13.86	14.06	
163	0	2003	9.99	0	12.06	12.24	
164	0	2012	10.28	0	11.64	11.81	
165	0	2034		0	12.17	12.35	
166	0	2060		0	12.18	12.36	
167	0	2031		0	12.73	12.92	
168	0	2067		0	13.19	13.39	
169	0	2062		0	12.57	12.76	
170	0	2066		0	13.53	13.73	
171	0	1996	9.93	0	13.24	13.43	
172	0	1984	9.85	0	12.69	12.88	
173	0	1978	9.81	0	12.26	12.44	
174	0	1993	9.92	0	12.47	12.66	
175	0	2020	10.63	0	12.13	12.31	
176	0	2022	10.70	0	11.54	11.71	
177	0	1994	9.92	0	11.14	11.30	
178	0	2081		0	11.40	11.57	
179	0	2080		0	12.85	13.04	
180	0	2051		0	11.72	11.89	
181	0	1995	9.93	0	11.85	12.03	
182	0	2025	10.84	0	11.92	12.10	
183	0	2001	9.97	0	11.57	11.74	
184	0	1961	9.69	1	9.69	11.92	0.81
185	1	1933	9.50	1		10.90	
186	0	1970	9.76	0	9.94	10.08	
187	0	2046		0	10.51	10.67	
188	0	2050		0	10.39	10.55	
189	0	2067		0	10.84	11.00	
190	0	2060		0	10.52	10.67	
191	0	2108		0	11.07	11.23	
192	0	2015	10.43	0	10.13	10.28	
193	0	1899	9.26	1	9.26	9.57	0.97
194	0	2045		0	11.35	11.52	
195	0	2132		0	11.73	11.90	
196	0	2058		0	10.67	10.83	
197	0	1999	9.96	0	11.43	11.60	
198	0	2006	10.02	0		9.68	
199	0	2019	10.57	0	10.33	10.49	
200	0	2086		0	11.41	11.58	
201	0	2088		0	11.21	11.38	
202	0	2145		0	11.72	11.89	
203	0	2038		0	12.65	12.84	
204	0	2024	10.78	0	12.14	12.32	
205	0	2061		0	12.67	12.86	
206	0	2046		0	12.22	12.41	
207	0	2030		0	12.21	12.39	
208	0	1954	9.64	1	9.64	12.08	0.80
209	0	1941	9.56	1	9.56	12.08	0.79
210	0	1966	9.73	1	9.73	11.67	0.83
211	0	2004	10.00	0	11.04	11.21	
212	0	2104		0	11.91	12.09	
213	0	2074		0	13.22	13.41	
214	0	1992	9.91	0	11.40	11.57	
215	0	1999	9.96	0	11.89	12.07	
216	0	1960	9.68	1	9.68	11.26	0.86
217	0	1973	9.77	0	11.13	11.30	
218	0	1985	9.86	0	10.95	11.11	
219	0	1982	9.84	0	10.89	11.05	
220	0	2004	10.00	0	10.78	10.94	
221	0	1935	9.51	1	9.51	9.78	0.97
222	0	1917	9.39	1	9.39	8.97	1.05
223	0	1950	9.62	1	9.62	9.45	1.02
224	0	2073		0		9.77	
225	0	2089		0		8.82	
226	0	2073		0		9.10	
227	0	2129		0	11.77	11.94	
228	0	2066		0	11.49	11.66	
229	0	2006	10.05	0	10.95	11.12	
230	0	2068		0	11.04	11.21	
231	0	1983	9.85	0	10.28	10.43	
232	0	1959	9.68	1	9.68	10.25	0.94
233	0	2055		0	10.85	11.01	
234	0	2057		0	10.89	11.05	
235	0	1958	9.67	1	9.67	9.58	1.01
236	0	1999	9.96	0	10.55	10.70	
237	0	2077		0	10.27	10.42	
238	0	2070		0	10.72	10.88	
239	0	2096		0	10.97	11.14	
240	0	2060		0	11.35	11.52	
241	0	1999	9.96	0	10.37	10.52	
242	0	1964	9.71	1	9.71	11.60	0.84
243	0	1968	9.74	1	9.74	10.40	0.94
244	0	1972	9.77	0		9.20	
245	0	2022	10.71	0	9.95	10.09	
246	0	2052		0	10.53	10.69	
247	0	2079		0	11.87	12.05	
248	0	2077		0	11.09	11.25	
249	0	2029	11.42	0	10.37	10.53	
250	0	2014	10.37	0	10.83	10.99	
251	0	1989	9.89	0	11.03	11.20	
252	0	1992	9.91	0	9.93	10.08	
253	0	2042		0	10.32	10.48	
254	0	2048		0	10.68	10.84	
255	0	2054		0	11.26	11.43	
256	0	2023	10.75	0	11.13	11.29	
257	0	1990	9.90	0	10.36	10.51	
258	0	1979	9.82	0		9.76	
259	0	2002	9.98	0		9.69	
260	0	1978	9.81	0		9.51	
261	0	1977	9.80	0		9.45	
262	0	2019	10.60	0	10.14	10.29	
263	0	1983	9.85	0		9.16	
264	0	2025	10.84	0	10.10	10.25	

SAMPLE CALCULATION

This calculation example demonstrates the calculation of nacelle k-factor as per IEC 61400-11 Edition 3.0 section 8.2.1.2

Data ID#	Data Point Excluded 1=yes, 0=no	Power (kW)	Hub Height Wind Speed (m/s) from power curve	Hub Wind speed In acceptable range 1=yes, 0=no	wind speed from acceptable range $V_{p,n}$ (m/s)	Nacelle Anemometer Wind Speed, $V_{nac,m}$ (m/s)	$V_{P,n}/V_{nac,m}$
265	0	2097		0		9.71	
266	0	2126		0	10.43	10.58	
267	0	2138		0	10.34	10.49	
268	0	2121		0	11.87	12.04	
269	0	2063		0	11.14	11.31	
270	0	2038		0	10.76	10.92	
271	0	2034		0	11.54	11.71	
272	0	1996	9.94	0	10.88	11.04	
273	0	2010	10.20	0	11.54	11.71	
274	0	2014	10.35	0	11.12	11.29	
275	0	2012	10.29	0	10.99	11.16	
276	0	2113		0	12.55	12.73	
277	0	2090		0	12.29	12.47	
278	0	1955	9.65	1	9.65	11.46	0.84
279	0	1912	9.35	1	9.35	10.84	0.86
280	0	1910	9.33	1	9.33	10.15	0.92
281	0	2036		0		9.59	
282	0	2073		0	10.62	10.78	
283	0	2087		0	9.97	10.12	
284	0	2047		0	10.95	11.12	
285	0	2154		0	12.25	12.43	
286	0	2133		0	12.03	12.21	
287	0	2075		0	12.00	12.18	
288	0	2035		0	11.84	12.01	
289	0	1996	9.94	0	11.66	11.83	
290	0	2006	10.05	0	12.81	13.00	
291	0	1956	9.65	1	9.65	12.23	0.79
292	0	1972	9.77	0	11.46	11.63	
293	0	1977	9.81	0	11.32	11.49	
294	0	2031		0	10.75	10.91	
295	0	2040		0	10.90	11.07	
296	0	2148		0	12.38	12.56	
297	0	2030		0	11.82	12.00	
298	1	2018	10.55	0		11.84	
299	1	1952	9.63	1		11.48	
300	0	2078		0	11.76	11.93	
301	0	2048		0	11.97	12.15	
302	0	1973	9.78	0	11.84	12.02	
303	0	1934	9.50	1	9.50	11.18	0.85
304	0	2010	10.22	0	11.25	11.41	
305	0	2033		0	11.88	12.06	
306	0	2009	10.18	0	11.24	11.41	
307	0	1955	9.65	1	9.65	9.28	1.04
308	0	2028	10.98	0	10.17	10.32	
309	0	2037		0	10.23	10.38	
310	0	2023	10.76	0		9.77	
311	0	2046		0	10.44	10.60	
312	0	2072		0	10.56	10.71	
313	0	2056		0	10.99	11.15	
314	0	1989	9.89	0	9.80	9.95	
315	0	2077		0	11.99	12.17	
316	0	2106		0	11.73	11.90	
317	0	2024	10.78	0	12.11	12.29	
318	0	1963	9.70	1	9.70	11.58	0.84
319	0	1947	9.59	1	9.59	10.26	0.94
320	0	1996	9.94	0	10.04	10.19	
321	0	1980	9.83	0		9.76	
322	0	1959	9.68	1	9.68	11.08	0.87
323	0	2048		0	10.46	10.61	
324	0	2112		0	9.93	10.08	
325	0	2072		0		9.67	
326	0	2014	10.36	0		9.83	
327	0	2017	10.52	0		9.28	
328	0	2083		0	10.06	10.21	
329	0	2105		0	10.74	10.90	
330	0	2038		0	11.07	11.23	
331	0	2092		0	11.82	11.99	
332	0	2070		0	10.87	11.03	
333	0	2044		0	11.59	11.76	
334	0	1953	9.64	1	9.64	11.11	0.87
335	1	2109		0		12.68	
336	1	2053		0		12.85	
337	1	2035		0		12.08	
338	1	2065		0		12.49	
339	0	2036		0	11.37	11.54	
340	0	1937	9.53	1	9.53	10.47	0.91
341	0	1965	9.72	1	9.72	11.09	0.88
342	0	2022	10.70	0	10.79	10.95	
343	0	2034		0	11.29	11.46	
344	0	2025	10.84	0	11.96	12.14	
345	0	2055		0	11.64	11.81	
346	0	2018	10.54	0	11.12	11.29	
347	0	2031		0	10.73	10.88	
348	0	2009	10.17	0	11.36	11.52	
349	0	2036		0	10.57	10.72	
350	0	2006	10.03	0	11.58	11.75	
351	0	2000	9.97	0	10.86	11.02	
352	0	1968	9.74	1	9.74	10.36	0.94

Data ID#	Data Point Excluded 1=yes, 0=no	Power (kW)	Hub Height Wind Speed (m/s) from power curve	Hub Wind speed In acceptable range 1=yes, 0=no	wind speed from acceptable range $V_{p,n}$ (m/s)	Nacelle Anemometer Wind Speed, $V_{nac,m}$ (m/s)	$V_{P,n}/V_{nac,m}$
353	0	2011	10.26	0	10.81	10.97	
354	0	2085		0	10.64	10.80	
355	0	2099		0	11.53	11.70	
356	0	2044		0	11.54	11.72	
357	0	2047		0	12.33	12.51	
358	0	2000	9.96	0	11.61	11.78	
359	0	1921	9.42	1	9.42	10.13	0.93
360	0	1824	8.91	1	8.91	9.64	0.92
361	0	1991	9.90	0	9.78	9.93	
362	0	1666	8.52	1	8.52	9.24	0.92
363	0	2059		0	9.76	9.91	
364	0	2255		0	10.98	11.15	
365	0	2215		0	11.89	12.06	
366	0	2052		0	11.19	11.36	
367	0	1998	9.95	0	10.73	10.89	
368	1	1996	9.94	0		11.21	
369	0	1997	9.95	0	10.54	10.70	
370	0	2031		0	11.09	11.25	
371	0	2046		0	11.31	11.48	
372	0	2023	10.75	0	10.45	10.60	
373	0	2006	10.04	0	10.50	10.66	
374	0	2012	10.28	0	10.49	10.64	
375	0	2003	9.99	0	10.67	10.83	
376	0	2007	10.07	0	10.99	11.16	
377	0	1978	9.81	0	9.79	9.94	
378	0	2051		0	10.42	10.57	
379	0	2114		0	10.83	11.00	
380	0	2056		0	9.81	9.95	
381	0	2049		0	10.42	10.57	
382	1	2172		0		12.10	
383	0	2085		0	11.47	11.64	
384	0	2054		0	11.77	11.94	
385	0	1995	9.93	0	10.90	11.06	
386	0	2028	10.95	0	11.84	12.02	
387	0	1976	9.79	0	11.49	11.66	
388	1	1995	9.93	0		11.50	
389	0	2014	10.35	0	11.27	11.44	
390	0	2037		0	11.16	11.32	
391	0	2024	10.78	0	10.47	10.63	
392	0	2003	9.99	0	10.94	11.11	
393	0	2047		0	10.97	11.13	
394	0	2028	10.95	0	10.84	11.00	
395	0	2013	10.34	0	10.33	10.48	
396	0	2026	10.86	0	10.48	10.63	
397	0	2015	10.40	0	10.50	10.66	
398	0	2069		0	11.48	11.65	
399	1	2011	10.23	0		10.60	
400	1	1964	9.72	1		10.27	
401	0	1970	9.75	0	10.40	10.55	
402	0	2043		0	11.01	11.17	
403	0	2052		0	10.31	10.46	
404	0	2003	9.98	0		9.85	
405	1	2081		0		10.32	
406	0	2003	9.98	0		9.62	
407	0	1936	9.51	1	9.51	9.14	1.04
408	0	1988	9.88	0		9.61	
409	0	1992	9.91	0		9.74	
410	0	2058		0		9.04	
411	0	2204		0	9.76	9.90	
412	0	2199		0	11.02	11.18	
413	0	2048		0	9.86	10.01	
414	0	1985	9.86	0	11.07	11.24	
415	0	1944	9.57	1	9.57	9.71	0.99
416	0	2081		0	11.31	11.47	
417	0	2080		0	11.96	12.14	
418	0	2025	10.85	0	11.39	11.56	
419	0	1998	9.95	0	11.02	11.18	
420	0	2074		0	11.40	11.57	
421	0	2074		0	11.59	11.76	
422	0	2068		0	11.77	11.95	
423	0	2040		0	12.26	12.45	
424	0	1976	9.80	0	11.78	11.95	
425	0	1962	9.70	1	9.70	11.03	0.88
426	0	2020	10.63	0	10.84	11.00	
427	0	2032		0	11.13	11.30	
428	0	2033		0	10.73	10.89	
429	0	2023	10.76	0	10.95	11.11	
430	0	2035		0	11.46	11.63	
431	0	2070		0	11.78	11.95	
432	0	1996	9.94	0	10.79	10.95	
433	0	1997	9.94	0	9.93	10.07	
434	0	2006	10.04	0	10.91	11.07	
435	0	2052		0	11.14	11.30	
436	0	1990	9.90	0	10.55	10.70	
437	0	2013	10.35	0	10.20	10.35	
438	0	2045		0	10.06	10.21	
439	0	1988	9.88	0		9.26	
440	0	2045		0	10.44	10.60	

Data ID#	Data Point Excluded 1=yes, 0=no	Power (kW)	Hub Height Wind Speed (m/s) from power curve	Hub Wind speed In acceptable range 1=yes, 0=no	wind speed from acceptable range $V_{p,n}$ (m/s)	Nacelle Anemometer Wind Speed, $V_{nac,m}$ (m/s)	$V_{P,n}/V_{nac,m}$
441	0	2040		0	11.39	11.56	
442	0	2041		0	11.24	11.41	
443	0	2045		0	10.09	10.24	
444	0	2019	10.57	0	11.07	11.24	
445	0	2013	10.33	0	9.99	10.14	
446	0	1990	9.90	0	10.91	11.07	
447	0	2006	10.03	0	9.82	9.96	
448	0	1990	9.90	0		9.64	
449	0	1995	9.93	0		9.87	
450	0	1990	9.89	0		9.75	
451	0	2096		0	10.49	10.65	
452	0	2092		0	10.32	10.48	
453	0	2027	10.93	0	10.09	10.24	
454	0	2054		0	9.88	10.03	
455	0	2022	10.70	0	10.85	11.01	
456	0	2059		0	11.25	11.42	
457	0	2019	10.60	0	10.21	10.36	
458	0	1993	9.92	0	10.18	10.33	
459	0	2063		0	10.48	10.64	
460	0	2025	10.82	0		9.56	
461	0	2009	10.17	0	9.86	10.01	
462	0	2035		0	10.35	10.51	
463	0	2019	10.57	0	9.97	10.11	
464	0	1997	9.95	0		9.54	
465	0	2026	10.89	0	10.33	10.48	
466	0	2095		0		9.81	
467	0	2076		0	10.39	10.55	
468	0	2010	10.21	0	9.84	9.98	
469	0	1997	9.94	0		9.56	
470	0	2060		0	10.52	10.68	
471	0	2081		0	9.96	10.10	
472	0	2048		0	10.56	10.72	
473	0	2006	10.05	0	10.20	10.35	
474	0	1987	9.87	0	10.67	10.82	
475	0	1909	9.33	1	9.33	8.93	1.04
476	0	1768	8.77	1	8.77	8.83	0.99
477	0	1676	8.54	1	8.54	7.83	1.09
478	0	1721	8.65	1	8.65	7.48	1.16
479	0	1901	9.27	1	9.27	7.81	1.19
480	0	1731	8.68	1	8.68	9.01	0.96
481	0	1651	8.48	1	8.48	8.74	0.97
482	0	1450	7.99	1	7.99	7.95	1.01
483	0	1501	8.12	1	8.12	8.62	0.94
484	0	1360	7.79	1	7.79	8.75	0.89
485	0	1588	8.33	1	8.33	8.43	0.99
486	0	1519	8.16	1	8.16	7.64	1.07
487	0	1837	8.94	1	8.94	8.50	1.05
488	0	1765	8.76	1	8.76	7.71	1.14
489	1	2017	10.48	0		8.70	
490	1	2272		0		11.40	
491	1	2103		0		11.30	
492	0	1971	9.76	0		9.68	
493	0	2001	9.97	0		9.80	
494	0	2088		0	11.12	11.29	
495	0	2089		0	10.75	10.91	
496	0	2017	10.49	0	11.30	11.46	
497	0	2025	10.81	0	10.29	10.44	
498	0	1973	9.78	0	10.05	10.20	
499	0	1959	9.68	1	9.68	9.64	1.00
500	0	1953	9.64	1	9.64	9.05	1.06
501	0	2048		0		9.24	
502	0	2029	11.08	0		9.88	
503	0	2091		0	10.16	10.31	
504	0	2057		0		8.94	
505	0	1974	9.78	0		9.73	
506	0	2012	10.29	0	10.17	10.32	
507	0	2049		0		9.62	
508	0	1998	9.95	0		8.46	
509	0	1981	9.83	0		9.76	
510	0	2027	10.91	0	9.85	10.00	
511	0	1932	9.49	1	9.49	9.30	1.02
512	0	2001	9.98	0		9.27	
513	0	2063		0		9.45	
514	0	2012	10.29	0		9.21	
515	0	2009	10.15	0		9.41	
516	0	2048		0		8.98	
517	0	2052		0		9.08	
518	0	2063		0		9.79	
519	0	2138		0		9.77	
520	0	1991	9.91	0	9.77	9.92	
521	0	1979	9.82	0	9.91	10.06	
522	0	2005	10.00	0		8.93	
523	0	2009	10.17	0		9.51	
524	0	2072		0		9.07	
525	0	2092		0		9.68	
526	0	2047		0	10.49	10.65	
527	0	2046		0	9.80	9.95	
528	0	1998	9.95	0	10.17	10.32	

SAMPLE CALCULATION

This calculation example demonstrates the calculation of nacelle k-factor as per IEC 61400-11 Edition 3.0 section 8.2.1.2

Data ID#	Data Point Excluded 1=yes, 0=no	Power (kW)	Hub Height Wind Speed (m/s) from power curve	Hub Wind speed In acceptable range 1=yes, 0=no	wind speed from acceptable range $V_{p,n}$ (m/s)	Nacelle Anemometer Wind Speed, $V_{nac,m}$ (m/s)	$V_{P,n}/V_{nac,m}$
529	0	2071		0	10.25	10.40	
530	0	2015	10.40	0	10.12	10.27	
531	0	1970	9.75	0		9.41	
532	0	2015	10.40	0	10.06	10.21	
533	0	2038		0		9.29	
534	0	1971	9.76	0		9.03	
535	0	1920	9.41	1	9.41	9.38	1.00
536	0	2033		0	10.03	10.18	
537	0	2079		0		9.60	
538	0	1849	8.97	1	8.97	9.04	0.99
539	0	1880	9.13	1	9.13	8.60	1.06
540	0	1800	8.85	1	8.85	8.61	1.03
541	0	2013	10.32	0		8.93	
542	0	2112		0	9.96	10.11	
543	0	2195		0	10.67	10.83	
544	0	2143		0	11.20	11.37	
545	0	2094		0	11.02	11.18	
546	0	2013	10.35	0	10.57	10.72	
547	0	1966	9.73	1	9.73	10.91	0.89
548	0	2037		0	10.35	10.51	
549	0	1973	9.78	0	9.91	10.06	
550	0	2042		0	11.01	11.18	
551	0	2040		0	10.08	10.23	
552	0	2038		0	10.35	10.50	
553	0	2029	11.47	0	10.45	10.61	
554	0	2011	10.27	0	11.00	11.16	
555	0	2010	10.22	0	11.13	11.30	
556	0	2005	10.00	0	10.05	10.20	
557	0	2018	10.56	0	11.39	11.56	
558	0	2001	9.97	0	9.90	10.05	
559	0	2009	10.19	0		9.75	
560	0	2028	10.95	0	10.01	10.16	
561	0	2035		0	10.42	10.58	
562	0	2042		0	10.95	11.11	
563	0	2069		0	10.03	10.18	
564	0	2056		0	11.26	11.43	
565	0	2044		0	11.36	11.53	
566	0	2003	9.98	0	11.05	11.22	
567	0	1996	9.94	0	10.41	10.56	
568	0	2037		0		9.72	
569	0	2047		0	11.02	11.19	
570	0	2028	10.97	0	10.44	10.60	
571	0	2055		0	10.81	10.97	
572	0	2059		0	11.22	11.39	
573	0	2072		0	10.91	11.07	
574	0	2057		0	11.37	11.54	
575	0	2033		0	11.05	11.22	
576	0	1985	9.86	0	10.73	10.89	
577	0	1991	9.90	0	10.96	11.13	
578	0	1993	9.91	0	10.49	10.64	
579	0	2004	10.00	0	11.01	11.18	
580	0	2026	10.88	0	10.70	10.86	
581	0	2022	10.72	0	9.78	9.92	
582	0	1957	9.66	1	9.66	9.55	1.01
583	0	2056		0	10.60	10.76	
584	0	2077		0	10.84	11.00	
585	0	1981	9.84	0	9.89	10.04	
586	0	1946	9.59	1	9.59	9.55	1.00
587	0	1941	9.55	1	9.55	8.68	1.10
588	0	1831	8.92	1	8.92	9.03	0.99
589	0	1780	8.80	1	8.80	9.27	0.95
590	0	1861	9.00	1	9.00	8.87	1.01
591	0	2133		0		9.72	
592	0	2153		0	10.44	10.59	
593	0	2074		0	10.13	10.28	
594	0	2095		0	10.25	10.40	
595	0	2067		0	10.53	10.69	
596	0	1999	9.96	0	10.07	10.22	
597	0	1986	9.87	0		9.74	
598	0	2045		0	9.94	10.08	
599	0	2039		0	10.26	10.41	
600	0	2088		0	10.68	10.84	
601	0	2031		0	10.34	10.49	
602	0	2006	10.06	0	10.03	10.18	
603	0	1983	9.84	0	9.98	10.13	
604	0	1732	8.68	1	8.68	8.43	1.03
605	0	1669	8.53	1	8.53	8.11	1.05
606	0	1710	8.63	1	8.63	8.13	1.06
607	0	1641	8.46	1	8.46	7.85	1.08
608	0	1790	8.82	1	8.82	9.04	0.98
609	0	1998	9.95	0		8.87	
610	0	2041		0		9.63	
611	0	1898	9.25	1	9.25	8.40	1.10
612	0	1594	8.34	1	8.34	7.46	1.12
613	0	1551	8.24	1	8.24	8.37	0.98
614	0	1748	8.72	1	8.72	9.39	0.93
615	0	1549	8.23	1	8.23	8.41	0.98
616	0	1447	7.99	1	7.99	7.71	1.04

Data ID#	Data Point Excluded 1=yes, 0=no	Power (kW)	Hub Height Wind Speed (m/s) from power curve	Hub Wind speed In acceptable range 1=yes, 0=no	wind speed from acceptable range $V_{p,n}$ (m/s)	Nacelle Anemometer Wind Speed, $V_{nac,m}$ (m/s)	$V_{P,n}/V_{nac,m}$
617	0	1459	8.01	1	8.01	7.91	1.01
618	0	1466	8.03	1	8.03	7.98	1.01
619	0	1571	8.29	1	8.29	7.83	1.06
620	0	1698	8.60	1	8.60	8.70	0.99
621	0	1595	8.34	1	8.34	8.97	0.93
622	0	1616	8.40	1	8.40	9.27	0.91
623	0	1787	8.82	1	8.82	8.61	1.02
624	0	2057		0		8.76	
625	0	1935	9.51	1	9.51	8.77	1.09
626	0	1936	9.52	1	9.52	8.51	1.12
627	0	2059		0		9.40	
628	0	2043		0		9.22	
629	0	2072		0		9.66	
630	0	2087		0	10.02	10.16	
631	0	2038		0	10.91	11.07	
632	0	2008	10.14	0		9.81	
633	0	1973	9.78	0	9.89	10.04	
634	0	1795	8.83	1	8.83	9.00	0.98
635	0	1967	9.74	1	9.74	8.97	1.09
636	0	2059		0	9.95	10.10	
637	0	2080		0		9.45	
638	0	2038		0		9.12	
639	0	1996	9.94	0		9.66	
640	0	1809	8.87	1	8.87	8.36	1.06
641	0	1732	8.68	1	8.68	8.42	1.03
642	0	1738	8.70	1	8.70	8.71	1.00
643	0	1692	8.58	1	8.58	7.92	1.08
644	0	1401	7.89	1	7.89	6.82	1.16
645	0	1275	7.61	1	7.61	6.72	1.13
646	0	1226	7.50	1	7.50	7.79	0.96
647	0	1194	7.43	1	7.43	8.34	0.89
648	0	1048	7.12	1	7.12	7.04	1.01
649	0	868	6.66	1	6.66	5.97	1.12
650	0	797	6.47	1	6.47	6.20	1.04
651	0	754	6.36	1	6.36	6.37	1.00
652	0	820	6.53	1	6.53	6.37	1.03
653	0	854	6.62	1	6.62	6.13	1.08
654	0	824	6.55	1	6.55	7.61	0.86
655	0	853	6.62	1	6.62	7.44	0.89
656	0	1006	7.03	1	7.03	6.98	1.01
657	0	1070	7.16	1	7.16	7.35	0.97
658	0	984	6.97	1	6.97	5.92	1.18
659	0	975	6.95	1	6.95	7.34	0.95
660	0	1052	7.13	1	7.13	7.45	0.96
661	0	1058	7.14	1	7.14	6.48	1.10
662	0	1207	7.46	1	7.46	7.58	0.99
663	0	1378	7.83	1	7.83	7.20	1.09
664	0	1290	7.64	1	7.64	7.62	1.00
665	0	1230	7.51	1	7.51	7.03	1.07
666	0	1261	7.58	1	7.58	7.38	1.03
667	0	1288	7.64	1	7.64	7.92	0.96
668	0	1377	7.83	1	7.83	8.29	0.94
669	0	1459	8.01	1	8.01	8.53	0.94
670	0	1436	7.96	1	7.96	7.68	1.04
671	0	1452	8.00	1	8.00	7.68	1.04
672	0	1189	7.42	1	7.42	6.82	1.09
673	0	1293	7.65	1	7.65	6.60	1.16
674	0	1410	7.90	1	7.90	7.11	1.11
675	0	1351	7.78	1	7.78	8.18	0.95
676	0	1378	7.84	1	7.84	7.82	1.00
677	0	1333	7.74	1	7.74	7.68	1.01
678	0	1189	7.42	1	7.42	7.43	1.00
679	0	1194	7.43	1	7.43	7.42	1.00
680	0	1098	7.23	1	7.23	6.96	1.04
681	0	1052	7.13	1	7.13	6.05	1.18
682	0	1050	7.12	1	7.12	6.60	1.08
683	0	942	6.86	1	6.86	6.58	1.04
684	0	970	6.93	1	6.93	6.91	1.00
685	0	1136	7.31	1	7.31	8.31	0.88
686	0	1154	7.35	1	7.35	6.83	1.08
687	0	1100	7.23	1	7.23	6.53	1.11
688	0	1153	7.34	1	7.34	7.36	1.00
689	0	1169	7.38	1	7.38	7.86	0.94
690	0	1123	7.28	1	7.28	7.60	0.96
691	0	1059	7.14	1	7.14	7.34	0.97
692	0	1054	7.13	1	7.13	7.00	1.02
693	0	986	6.98	1	6.98	6.48	1.08
694	0	832	6.57	1	6.57	6.06	1.08
695	0	831	6.56	1	6.56	7.83	0.84
696	0	914	6.79	1	6.79	7.05	0.96
697	0	990	6.99	1	6.99	7.00	1.00
698	0	952	6.89	1	6.89	6.66	1.03
699	0	894	6.73	1	6.73	6.55	1.03
700	0	951	6.89	1	6.89	7.44	0.93
701	0	896	6.74	1	6.74	6.71	1.00
702	0	813	6.52	1	6.52	6.34	1.03
703	0	775	6.41	1	6.41	7.02	0.91
704	0	998	7.01	1	7.01	6.40	1.10

Data ID#	Data Point Excluded 1=yes, 0=no	Power (kW)	Hub Height Wind Speed (m/s) from power curve	Hub Wind speed In acceptable range 1=yes, 0=no	wind speed from acceptable range $V_{p,n}$ (m/s)	Nacelle Anemometer Wind Speed, $V_{nac,m}$ (m/s)	$V_{P,n}/V_{nac,m}$
705	0	1581	8.31	1	8.31	8.10	1.03
706	0	1713	8.63	1	8.63	7.60	1.14
707	0	1759	8.75	1	8.75	8.32	1.05
708	0	1591	8.33	1	8.33	8.30	1.00
709	0	1261	7.58	1	7.58	7.53	1.01
710	0	1188	7.42	1	7.42	7.54	0.98
711	0	1138	7.31	1	7.31	7.80	0.94
712	0	1342	7.76	1	7.76	7.91	0.98
713	0	1349	7.77	1	7.77	7.65	1.02
714	0	1359	7.79	1	7.79	6.96	1.12

SAMPLE CALCULATION

This calculation example demonstrates the calculation of nacelle k-factor as per IEC 61400-11 Edition 3.0 section 8.2.1.2

Sample calculations have been based on measurement data collected and reported for Cedar Point Wind Power Project (Report ID: 15039.00.CP209.R3)

For all data points with power levels from the allowed range of the power curve, the average value of the ratio of the wind speed derived from the power curve VP,n and the measured wind speed $V_{Z,m}$, k_Z, is derived as per equation (1) Information to calculate k_Z is provided in Table 1.

$$k_Z = \frac{1}{n}\left(\sum_{i=1}^{n}\left(\frac{v_{p,n}}{v_{Z,m}}\right)_i\right) \qquad (1)$$

where

$V_{P,n}$ is wind speed derived from power curve

K_Z is Background k-factor

$V_{Z,n}$ is measured 10m wind speed

k_Z = 1.2254

SAMPLE CALCULATION

This calculation example demonstrates the calculation of nacelle k-factor as per IEC 61400-11 Edition 3.0 section 8.2.1.2

Table 1 - Information to calculate K_z

Data ID#	Data Point Excluded 1=yes, 0=no	Power (kW)	Hub Height Wind Speed (m/s) from power curve	Hub Wind speed in acceptable range 1=yes, 0=no	wind speed from acceptable range $V_{z,n}$ (m/s)	10m Anemometer Wind Speed, $V_{z,m}$ (m/s)	$V_{P,n}/V_{z,m}$
1	0	2200		0	12.69	9.53	
2	0	2076		0	12.21	8.89	
3	0	2037		0	12.06	9.28	
4	0	2051		0	13.06	10.17	
5	0	2022	10.70	0	12.50	10.41	
6	1	2014	10.36	0		10.70	
7	1	2077		0		11.42	
8	1	2059		0		11.63	
9	1	2023	10.75	0		11.89	
10	1	1988	9.88	0		10.83	
11	0	1990	9.89	0	13.15	10.67	
12	0	2037		0	12.12	10.08	
13	0	1978	9.81	0	12.88	9.57	
14	0	1955	9.65	1	9.65	11.19	0.86
15	0	1954	9.65	1	9.65	10.77	0.90
16	0	2034		0	11.34	9.62	
17	0	2119		0	13.64	10.45	
18	0	2070		0	13.16	10.54	
19	0	1974	9.79	0	13.01	9.51	
20	0	1935	9.51	1	9.51	10.65	0.89
21	0	1934	9.50	1	9.50	10.42	0.91
22	0	2061		0	11.07	9.67	
23	0	1997	9.94	0	11.10	9.02	
24	0	1974	9.78	0	11.25	9.50	
25	0	2037		0	11.36	8.94	
26	0	2164		0	13.06	9.54	
27	0	2049		0	11.96	9.16	
28	0	1947	9.59	1	9.59	11.56	0.83
29	0	1942	9.56	1	9.56	11.55	0.83
30	0	2088		0	11.62	11.71	
31	0	2118		0	11.80	13.06	
32	0	2075		0	13.07	12.00	
33	0	2004	10.00	0	11.83	10.13	
34	0	1982	9.84	0	12.17	9.03	
35	0	1898	9.25	1	9.25	9.14	1.01
36	0	1928	9.46	1	9.46	10.08	0.94
37	0	1974	9.78	0		11.37	
38	0	2148		0	10.52	10.32	
39	0	2065		0	9.97	10.09	
40	0	2004	9.99	0	10.24	9.25	
41	1	2137		0		8.76	
42	0	2055		0	11.08	7.42	
43	0	2002	9.98	0	10.68	8.28	
44	0	2007	10.10	0	9.90	8.46	
45	0	2048		0	11.17	7.92	
46	0	2137		0	12.19	7.60	
47	0	2018	10.53	0	10.95	8.17	
48	0	2028	10.97	0	11.99	9.17	
49	0	2066		0	12.58	8.52	
50	0	1982	9.84	0	10.02	10.03	
51	0	1999	9.96	0	10.82	10.87	
52	0	2055		0	11.61	10.25	
53	0	1946	9.58	1	9.58	8.60	1.11
54	0	1927	9.46	1	9.46	7.92	1.19
55	0	2006	10.05	0	9.80	9.09	
56	0	2073		0	10.24	8.57	
57	0	2032		0		8.14	
58	0	2043		0		9.47	
59	0	2067		0	10.11	9.05	
60	0	2021	10.65	0	9.89	8.13	
61	0	1989	9.89	0		8.12	
62	0	2016	10.45	0		8.64	
63	0	2025	10.82	0	9.95	8.36	
64	0	1996	9.94	0	9.92	8.61	
65	0	2030		0		10.16	
66	0	2112		0	10.28	9.21	
67	0	2095		0	9.81	8.25	
68	0	2116		0	10.01	10.34	
69	0	2097		0	12.09	10.69	
70	0	2082		0	12.03	9.24	
71	0	2003	9.99	0	9.97	9.41	
72	0	1971	9.76	0	10.28	11.16	
73	0	2069		0	11.79	12.04	
74	0	2037		0	11.65	12.11	
75	0	2069		0	11.07	10.84	
76	1	1999	9.96	0		10.62	
77	0	1982	9.84	0	11.14	11.62	
78	0	2051		0	11.66	10.37	
79	0	2047		0	11.12	9.82	
80	0	2017	10.51	0	11.92	9.77	
81	0	2058		0	12.35	10.21	
82	0	2060		0	11.93	9.98	
83	0	2105		0	12.35	10.78	
84	0	2045		0	13.04	10.38	
85	0	2068		0	12.79	11.47	
86	0	2062		0	12.51	10.52	
87	0	1974	9.78	0	12.59	11.01	
88	0	1959	9.68	1	9.68	9.52	1.02
89	0	1960	9.68	1	9.68	11.10	0.87
90	0	1943	9.57	1	9.57	10.69	0.89
91	0	2049		0	10.83	10.00	
92	0	2000	9.97	0	10.50	9.63	
93	0	1994	9.92	0	10.77	9.47	
94	0	2008	10.11	0	10.91	9.76	
95	0	1962	9.70	1	9.70	8.61	1.13
96	0	1937	9.52	1	9.52	8.12	1.17
97	0	1997	9.94	0	9.78	8.53	
98	0	2014	10.36	0	9.78	8.35	
99	0	2117		0	10.40	8.16	
100	0	2225		0	10.85	8.65	
101	0	2134		0	11.76	6.76	
102	0	2016	10.48	0	10.88	6.76	
103	0	1928	9.46	1	9.46	7.61	1.24
104	0	1886	9.17	1	9.17	9.35	0.98
105	0	2035		0		9.00	
106	0	2168		0	11.59	9.06	
107	0	2120		0	10.96	9.79	
108	0	2012	10.29	0	10.53	10.17	
109	0	1950	9.61	1	9.61	9.38	1.02
110	0	1933	9.49	1	9.49	7.60	1.25
111	0	1982	9.84	0		7.94	
112	0	2083		0	9.86	9.22	
113	0	2113		0	11.35	9.63	
114	0	2032		0	10.02	9.84	
115	0	1991	9.90	0	9.84	8.63	
116	0	2029	11.00	0		8.78	
117	0	2078		0	10.55	8.59	
118	0	2007	10.09	0	10.14	8.36	
119	0	1997	9.94	0		10.08	
120	0	2039		0	10.44	8.25	
121	0	2131		0	11.36	8.13	
122	0	2034		0	10.88	9.10	
123	0	1970	9.75	0	9.93	8.37	
124	0	1994	9.92	0	10.45	8.07	
125	0	2115		0	11.85	8.23	
126	0	2052		0	11.21	9.99	
127	0	2109		0	11.32	10.51	
128	0	2159		0	12.11	11.09	
129	1	2103		0		10.69	
130	1	1979	9.82	0		10.33	
131	1	1954	9.65	1		10.99	
132	1	2016	10.44	0		10.90	
133	1	2044		0		9.18	
134	1	1955	9.65	1		9.50	
135	1	375	5.09	1		9.53	
136	1	0	2.00	1		8.70	
137	0	2001	9.97	0	12.57	11.21	
138	0	2036		0	11.94	11.33	
139	0	2038		0	10.82	10.94	
140	0	2022	10.73	0	11.73	10.97	
141	0	2021	10.66	0	12.39	10.29	
142	0	2018	10.56	0	11.63	11.14	
143	0	2039		0	11.50	10.99	
144	0	2070		0	11.46	11.53	
145	0	2037		0	10.78	10.47	
146	0	2030	11.85	0	10.81	10.86	
147	0	2104		0	11.17	9.90	
148	0	2067		0	11.16	9.78	
149	0	2006	10.03	0	11.23	9.76	
150	0	1981	9.83	0	10.40	9.38	
151	0	1994	9.93	0	10.58	9.19	
152	0	2038		0	10.89	9.06	
153	0	2003	9.98	0	10.64	9.69	
154	0	2048		0	11.10	8.39	
155	0	2095		0	10.80	7.60	
156	0	1965	9.72	1	9.72	8.50	1.14
157	0	1972	9.77	0	10.00	18.77	
158	0	2166		0	11.56	10.22	
159	0	2184		0	11.37	10.14	
160	0	2180		0	12.77	10.67	
161	0	2109		0	12.73	9.93	
162	0	2052		0	13.86	11.44	
163	0	2003	9.99	0	12.06	12.34	
164	0	2012	10.28	0	11.64	11.80	
165	0	2034		0	12.17	10.93	
166	0	2060		0	12.18	10.49	
167	0	2031		0	12.73	12.25	
168	0	2067		0	13.19	11.67	
169	0	2062		0	12.57	10.36	
170	0	2066		0	13.53	10.67	
171	0	1996	9.93	0	13.24	9.44	
172	0	1984	9.85	0	12.69	10.85	
173	0	1978	9.81	0	12.26	10.91	
174	0	1993	9.92	0	12.47	10.18	
175	0	2020	10.63	0	12.13	11.20	
176	0	2022	10.70	0	11.54	11.02	
177	0	1994	9.92	0	11.14	11.65	
178	0	2081		0	11.40	12.57	
179	0	2080		0	12.85	12.62	
180	0	2051		0	11.72	11.93	
181	0	1995	9.93	0	11.85	11.16	
182	0	2025	10.84	0	11.92	11.48	
183	0	2001	9.97	0	11.57	11.11	
184	0	1961	9.69	1	9.69	9.13	1.06
185	1	1933	9.50	1		8.97	
186	0	1970	9.76	0	9.94	8.81	
187	0	2046		0	10.51	9.75	
188	0	2050		0	10.39	9.69	
189	0	2067		0	10.84	9.00	
190	0	2060		0	10.52	8.17	
191	0	2108		0	11.07	8.19	
192	0	2015	10.43	0	10.13	7.35	
193	0	1899	9.26	1	9.26	8.00	1.16
194	0	2045		0	11.35	8.43	
195	0	2132		0	11.73	7.52	
196	0	2058		0	10.67	8.46	
197	0	1999	9.96	0	11.43	8.12	
198	0	2006	10.02	0		7.76	
199	0	2019	10.57	0	10.33	8.01	
200	0	2086		0	11.41	9.98	
201	0	2088		0	11.21	9.35	
202	0	2145		0	11.72	8.82	
203	0	2038		0	12.65	9.66	
204	0	2024	10.78	0	12.14	10.72	
205	0	2061		0	12.67	10.40	
206	0	2046		0	12.22	10.33	
207	0	2030		0	12.21	9.89	
208	0	1954	9.64	1	9.64	11.27	0.86
209	0	1941	9.56	1	9.56	11.26	0.85
210	0	1966	9.73	1	9.73	9.89	0.98
211	0	2004	10.00	0	11.04	9.66	
212	0	2104		0	11.91	10.53	
213	0	2074		0	13.22	11.83	
214	0	1992	9.91	0	11.40	11.02	
215	0	1999	9.96	0	11.89	11.12	
216	0	1960	9.68	1	9.68	11.03	0.88
217	0	1973	9.77	0	11.13	11.97	
218	0	1985	9.86	0	10.95	11.12	
219	0	1982	9.84	0	10.89	11.09	
220	0	2004	10.00	0	10.78	10.29	
221	0	1935	9.51	1	9.51	10.18	0.93
222	0	1917	9.39	1	9.39	9.34	1.01
223	0	1950	9.62	1	9.62	7.89	1.22
224	0	2073		0		7.42	
225	0	2089		0		8.95	
226	0	2073		0		9.00	
227	0	2129		0	11.77	7.86	
228	0	2066		0	11.49	7.41	
229	0	2006	10.05	0	10.95	8.93	
230	0	2068		0	11.04	9.69	
231	0	1983	9.85	0	10.28	9.80	
232	0	1959	9.68	1	9.68	11.81	0.82
233	0	2055		0	10.85	11.43	
234	0	2057		0	10.89	11.10	
235	0	1958	9.67	1	9.67	12.49	0.77
236	0	1999	9.96	0	10.55	11.87	
237	0	2077		0	10.27	11.01	
238	0	2070		0	10.72	9.74	
239	0	2096		0	10.97	8.85	
240	0	2060		0	11.35	9.05	
241	0	1999	9.96	0	10.37	10.68	
242	0	1964	9.71	1	9.71	9.08	1.07
243	0	1968	9.74	1	9.74	9.52	1.02
244	0	1972	9.77	0		10.47	
245	0	2022	10.71	0	9.95	9.37	
246	0	2052		0	10.53	8.78	
247	0	2079		0	11.87	8.66	
248	0	2077		0	11.09	10.17	
249	0	2029	11.42	0	10.37	9.74	
250	0	2014	10.37	0	10.83	10.55	
251	0	1989	9.89	0	11.03	10.73	
252	0	1992	9.91	0	9.93	10.05	
253	0	2042		0	10.32	10.24	
254	0	2048		0	10.68	9.98	
255	0	2054		0	11.26	9.93	
256	0	2023	10.75	0	11.13	9.92	
257	0	1990	9.90	0	10.36	9.43	
258	0	1979	9.82	0		8.80	
259	0	2002	9.98	0		7.77	
260	0	1978	9.81	0		8.22	
261	0	1977	9.80	0		7.82	
262	0	2019	10.60	0	10.14	7.11	
263	0	1983	9.85	0		7.98	
264	0	2025	10.84	0	10.10	7.68	

SAMPLE CALCULATION

This calculation example demonstrates the calculation of nacelle k-factor as per IEC 61400-11 Edition 3.0 section 8.2.1.2

Data ID#	Data Point Excluded 1=yes, 0=no	Power (kW)	Hub Height Wind Speed (m/s) from power curve	Hub Wind speed in acceptable range 1=yes, 0=no	wind speed from acceptable range $V_{p,n}$ (m/s)	10m Anemometer Wind Speed, $V_{z,m}$ (m/s)	$V_{P,n}/V_{Z,m}$
265	0	2097		0		8.35	
266	0	2126		0	10.43	8.91	
267	0	2138		0	10.34	9.66	
268	0	2121		0	11.87	11.81	
269	0	2063		0	11.14	12.10	
270	0	2038		0	10.76	11.67	
271	0	2034		0	11.54	12.53	
272	0	1996	9.94	0	10.88	11.49	
273	0	2010	10.20	0	11.54	11.11	
274	0	2014	10.35	0	11.12	11.44	
275	0	2012	10.29	0	10.99	10.61	
276	0	2113		0	12.55	10.50	
277	0	2090		0	12.29	9.00	
278	0	1955	9.65	1	9.65	7.97	1.21
279	0	1912	9.35	1	9.35	9.37	1.00
280	0	1910	9.33	1	9.33	10.05	0.93
281	0	2036		0		9.35	
282	0	2073		0	10.62	8.43	
283	0	2087		0	9.97	10.63	
284	0	2047		0	10.95	9.50	
285	0	2154		0	12.25	8.58	
286	0	2133		0	12.03	8.46	
287	0	2075		0	12.00	8.28	
288	0	2035		0	11.84	10.19	
289	0	1996	9.94	0	11.66	10.57	
290	0	2006	10.05	0	12.81	9.40	
291	0	1956	9.65	1	9.65	9.04	1.07
292	0	1972	9.77	0	11.46	8.86	
293	0	1977	9.81	0	11.32	10.11	
294	0	2031		0	10.75	10.03	
295	0	2040		0	10.90	10.44	
296	0	2148		0	12.38	10.71	
297	0	2030		0	11.82	10.77	
298	1	2018	10.55	0		10.30	
299	1	1952	9.63	1		11.37	
300	0	2078		0	11.76	11.49	
301	0	2048		0	11.97	10.73	
302	0	1973	9.78	0	11.84	10.42	
303	0	1934	9.50	1	9.50	11.65	0.82
304	0	2010	10.22	0	11.25	9.35	
305	0	2033		0	11.88	10.80	
306	0	2009	10.18	0	11.24	10.86	
307	0	1955	9.65	1	9.65	10.58	0.91
308	0	2028	10.98	0	10.17	11.08	
309	0	2037		0	10.23	10.64	
310	0	2023	10.76	0		10.39	
311	0	2046		0	10.44	9.38	
312	0	2072		0	10.56	8.52	
313	0	2056		0	10.99	7.83	
314	0	1989	9.89	0	9.80	6.87	
315	0	2077		0	11.99	7.56	
316	0	2106		0	11.73	8.53	
317	0	2024	10.78	0	12.11	8.38	
318	0	1963	9.70	1	9.70	8.85	1.10
319	0	1947	9.59	1	9.59	10.70	0.90
320	0	1996	9.94	0	10.04	10.76	
321	0	1980	9.83	0		10.54	
322	0	1959	9.68	1	9.68	9.23	1.05
323	0	2048		0	10.46	8.52	
324	0	2112		0	9.93	8.17	
325	0	2072		0		8.09	
326	0	2014	10.36	0		7.67	
327	0	2017	10.52	0		8.33	
328	0	2083		0	10.06	8.97	
329	0	2105		0	10.74	9.10	
330	0	2038		0	11.07	10.22	
331	0	2092		0	11.82	11.24	
332	0	2070		0	10.87	11.36	
333	0	2044		0	11.59	11.02	
334	0	1953	9.64	1	9.64	9.88	0.98
335	1	2109		0		9.91	
336	1	2053		0		9.23	
337	1	2035		0		9.41	
338	1	2065		0		9.82	
339	0	2036		0	11.37	9.68	
340	0	1937	9.53	1	9.53	9.94	0.96
341	0	1965	9.72	1	9.72	11.02	0.88
342	0	2022	10.70	0	10.79	10.09	
343	0	2034		0	11.29	9.30	
344	0	2025	10.84	0	11.96	9.06	
345	0	2055		0	11.64	10.57	
346	0	2018	10.54	0	11.12	9.77	
347	0	2031		0	10.73	8.78	
348	0	2009	10.17	0	11.36	8.87	
349	0	2036		0	10.57	9.13	
350	0	2006	10.03	0	11.58	9.12	
351	0	2000	9.97	0	10.86	10.40	
352	0	1968	9.74	1	9.74	10.04	0.97
353	0	2011	10.26	0	10.81	9.65	
354	0	2085		0	10.64	8.55	
355	0	2099		0	11.53	10.83	
356	0	2044		0	11.54	11.39	
357	0	2047		0	12.33	9.09	
358	0	2000	9.96	0	11.61	8.83	
359	0	1921	9.42	1	9.42	8.42	1.12
360	0	1824	8.91	1	8.91	8.06	1.10
361	0	1991	9.90	0	9.78	8.32	
362	0	1666	8.52	1	8.52	8.61	0.99
363	0	2059		0	9.76	9.89	
364	0	2255		0	10.98	11.43	
365	0	2215		0	11.89	10.49	
366	0	2052		0	11.19	11.11	
367	0	1998	9.95	0	10.73	9.48	
368	1	1996	9.94	0		9.79	
369	0	1997	9.95	0	10.54	10.25	
370	0	2031		0	11.09	9.93	
371	0	2046		0	11.31	11.11	
372	0	2023	10.75	0	10.45	10.56	
373	0	2006	10.04	0	10.50	9.84	
374	0	2012	10.28	0	10.49	10.28	
375	0	2003	9.99	0	10.67	10.19	
376	0	2007	10.07	0	10.99	9.23	
377	0	1978	9.81	0	9.79	9.29	
378	0	2051		0	10.42	9.80	
379	0	2114		0	10.83	11.98	
380	0	2056		0	9.81	9.54	
381	0	2049		0	10.42	10.45	
382	1	2172		0		10.80	
383	0	2085		0	11.47	10.94	
384	0	2054		0	11.77	11.16	
385	0	1995	9.93	0	10.90	11.58	
386	0	2028	10.95	0	11.84	10.39	
387	0	1976	9.79	0	11.49	10.23	
388	1	1995	9.93	0		9.46	
389	0	2014	10.35	0	11.27	10.02	
390	0	2037		0	11.16	9.48	
391	0	2024	10.78	0	10.47	10.09	
392	0	2003	9.99	0	10.94	9.08	
393	0	2047		0	10.97	9.44	
394	0	2028	10.95	0	10.84	9.01	
395	0	2013	10.34	0	10.33	10.97	
396	0	2026	10.86	0	10.48	10.00	
397	0	2015	10.40	0	10.50	9.62	
398	0	2069		0	11.48	9.58	
399	1	2011	10.23	0		9.25	
400	1	1964	9.72	1		9.45	
401	0	1970	9.75	0	10.40	9.17	
402	0	2043		0	11.01	8.96	
403	0	2052		0	10.31	9.24	
404	0	2003	9.98	0		8.27	
405	1	2081		0		9.37	
406	0	2003	9.98	0		8.35	
407	0	1936	9.51	1	9.51	7.98	1.19
408	0	1988	9.88	0		7.65	
409	0	1992	9.91	0		7.70	
410	0	2058		0		10.01	
411	0	2204		0	9.76	8.92	
412	0	2199		0	11.02	10.38	
413	0	2048		0	9.86	10.08	
414	0	1985	9.86	0	11.07	8.92	
415	0	1944	9.57	1	9.57	8.71	1.10
416	0	2081		0	11.31	8.53	
417	0	2080		0	11.96	9.81	
418	0	2025	10.85	0	11.39	10.54	
419	0	1998	9.95	0	11.02	10.24	
420	0	2074		0	11.40	10.46	
421	0	2074		0	11.59	10.29	
422	0	2068		0	11.77	8.69	
423	0	2040		0	12.26	8.17	
424	0	1976	9.80	0	11.78	9.56	
425	0	1962	9.70	1	9.70	7.98	1.21
426	0	2020	10.63	0	10.84	9.30	
427	0	2032		0	11.13	8.42	
428	0	2033		0	10.73	8.40	
429	0	2023	10.76	0	10.95	9.75	
430	0	2035		0	11.46	11.01	
431	0	2070		0	11.78	10.59	
432	0	1996	9.94	0	10.79	10.36	
433	0	1997	9.94	0	9.93	8.76	
434	0	2006	10.04	0	10.91	8.27	
435	0	2052		0	11.14	9.72	
436	0	1990	9.90	0	10.55	9.13	
437	0	2013	10.35	0	10.20	9.32	
438	0	2045		0	10.06	8.51	
439	0	1988	9.88	0		9.18	
440	0	2045		0	10.44	10.55	
441	0	2040		0	11.39	9.90	
442	0	2041		0	11.24	10.26	
443	0	2045		0	10.09	9.40	
444	0	2019	10.57	0	11.07	9.22	
445	0	2013	10.33	0	9.99	10.10	
446	0	1990	9.90	0	10.91	9.18	
447	0	2006	10.03	0	9.82	7.70	
448	0	1990	9.90	0		8.75	
449	0	1995	9.93	0		7.97	
450	0	1990	9.89	0		7.79	
451	0	2096		0	10.49	7.32	
452	0	2092		0	10.32	6.59	
453	0	2027	10.93	0	10.09	7.03	
454	0	2054		0	9.88	6.44	
455	0	2022	10.70	0	10.85	7.34	
456	0	2059		0	11.25	7.30	
457	0	2019	10.60	0	10.21	8.30	
458	0	1993	9.92	0	10.18	8.14	
459	0	2063		0	10.48	9.01	
460	0	2025	10.82	0		7.70	
461	0	2009	10.17	0	9.86	8.24	
462	0	2035		0	10.35	9.37	
463	0	2019	10.57	0	9.97	8.93	
464	0	1997	9.95	0		9.25	
465	0	2026	10.89	0	10.33	8.79	
466	0	2095		0		9.25	
467	0	2076		0	10.39	9.24	
468	0	2010	10.21	0	9.84	9.21	
469	0	1997	9.94	0		8.39	
470	0	2060		0	10.52	8.04	
471	0	2081		0	9.96	8.20	
472	0	2048		0	10.56	8.65	
473	0	2006	10.05	0	10.20	8.25	
474	0	1987	9.87	0	10.67	7.61	
475	0	1909	9.33	1	9.33	7.71	1.21
476	0	1768	8.77	1	8.77	6.06	1.45
477	0	1676	8.54	1	8.54	6.00	1.42
478	0	1721	8.65	1	8.65	6.61	1.31
479	0	1901	9.27	1	9.27	6.89	1.35
480	0	1731	8.68	1	8.68	6.66	1.30
481	0	1651	8.48	1	8.48	6.19	1.37
482	0	1450	7.99	1	7.99	6.81	1.17
483	0	1501	8.12	1	8.12	8.05	1.01
484	0	1360	7.79	1	7.79	7.99	0.97
485	0	1588	8.33	1	8.33	7.58	1.10
486	0	1519	8.16	1	8.16	7.90	1.03
487	0	1837	8.94	1	8.94	6.96	1.28
488	0	1765	8.76	1	8.76	5.90	1.48
489	1	2017	10.48	0		6.92	
490	1	2272		0		7.01	
491	1	2103		0		7.50	
492	0	1971	9.76	0		8.53	
493	0	2001	9.97	0		7.54	
494	0	2088		0	11.12	8.52	
495	0	2089		0	10.75	9.44	
496	0	2017	10.49	0	11.30	9.28	
497	0	2025	10.81	0	10.29	7.75	
498	0	1973	9.78	0	10.05	8.29	
499	0	1959	9.68	1	9.68	9.09	1.07
500	0	1953	9.64	1	9.64	9.14	1.05
501	0	2048		0		8.25	
502	0	2029	11.08	0		7.89	
503	0	2091		0	10.16	8.52	
504	0	2057		0		9.70	
505	0	1974	9.78	0		9.74	
506	0	2012	10.29	0	10.17	9.87	
507	0	2049		0		9.97	
508	0	1998	9.95	0		9.42	
509	0	1981	9.83	0		8.71	
510	0	2027	10.91	0	9.85	8.63	
511	0	1932	9.49	1	9.49	8.17	1.16
512	0	2001	9.98	0		8.33	
513	0	2063		0		8.50	
514	0	2012	10.29	0		8.69	
515	0	2009	10.15	0		8.58	
516	0	2048		0		7.67	
517	0	2052		0		6.58	
518	0	2063		0		6.63	
519	0	2138		0		8.10	
520	0	1991	9.91	0	9.77	7.89	
521	0	1979	9.82	0	9.91	7.28	
522	0	2005	10.00	0		6.78	
523	0	2009	10.17	0		7.02	
524	0	2072		0		6.75	
525	0	2092		0		6.68	
526	0	2047		0	10.49	6.97	
527	0	2046		0	9.80	6.33	
528	0	1998	9.95	0	10.17	7.11	

SAMPLE CALCULATION

This calculation example demonstrates the calculation of nacelle k-factor as per IEC 61400-11 Edition 3.0 section 8.2.1.2

Data ID#	Data Point Excluded 1=yes, 0=no	Power (kW)	Hub Height Wind Speed (m/s) from power curve	Hub Wind speed in acceptable range 1=yes, 0=no	wind speed from acceptable range $V_{p,n}$ (m/s)	10m Anemometer Wind Speed, $V_{z,m}$ (m/s)	$V_{p,n}/V_{z,m}$
529	0	2071		0	10.25	6.40	
530	0	2015	10.40	0	10.12	7.42	
531	0	1970	9.75	0		9.46	
532	0	2015	10.40	0	10.06	9.81	
533	0	2038		0		10.10	
534	0	1971	9.76	0		9.34	
535	0	1920	9.41	1	9.41	8.69	1.08
536	0	2033		0	10.03	8.06	
537	0	2079		0		8.62	
538	0	1949	8.97	1	8.97	7.94	1.13
539	0	1880	9.13	1	9.13	7.24	1.26
540	0	1800	8.85	1	8.85	6.69	1.32
541	0	2013	10.32	0		8.05	
542	0	2112		0	9.96	8.52	
543	0	2195		0	10.67	9.86	
544	0	2143		0	11.20	9.81	
545	0	2094		0	11.02	9.72	
546	0	2013	10.35	0	10.57	8.29	
547	0	1966	9.73	1	9.73	7.52	1.29
548	0	2037		0	10.35	11.23	
549	0	1973	9.78	0	9.91	10.94	
550	0	2042		0	11.01	9.34	
551	0	2040		0	10.08	9.34	
552	0	2038		0	10.35	8.84	
553	0	2029	11.47	0	10.45	9.24	
554	0	2011	10.27	0	11.00	9.29	
555	0	2010	10.22	0	11.13	9.33	
556	0	2005	10.00	0	10.05	10.40	
557	0	2018	10.56	0	11.39	9.77	
558	0	2001	9.97	0	9.90	9.01	
559	0	2009	10.19	0		9.04	
560	0	2028	10.95	0	10.01	9.68	
561	0	2035		0	10.42	10.05	
562	0	2042		0	10.95	8.90	
563	0	2069		0	10.03	7.90	
564	0	2056		0	11.26	8.49	
565	0	2044		0	11.36	7.62	
566	0	2003	9.98	0	11.05	7.49	
567	0	1996	9.94	0	10.41	7.99	
568	0	2037		0		7.41	
569	0	2047		0	11.02	7.38	
570	0	2028	10.97	0	10.44	7.92	
571	0	2055		0	10.81	8.72	
572	0	2059		0	11.22	8.25	
573	0	2072		0	10.91	7.11	
574	0	2057		0	11.37	7.06	
575	0	2033		0	11.05	8.44	
576	0	1985	9.86	0	10.73	9.59	
577	0	1991	9.90	0	10.96	8.84	
578	0	1993	9.91	0	10.49	8.07	
579	0	2004	10.00	0	11.01	7.98	
580	0	2026	10.88	0	10.70	7.27	
581	0	2022	10.72	0	9.78	9.04	
582	0	1957	9.66	1	9.66	9.20	1.05
583	0	2056		0	10.60	8.29	
584	0	2077		0	10.84	7.69	
585	0	1981	9.84	0	9.89	7.31	
586	0	1946	9.59	1	9.59	9.36	1.02
587	0	1941	9.55	1	9.55	8.99	1.06
588	0	1831	8.92	1	8.92	7.88	1.13
589	0	1780	8.80	1	8.80	7.21	1.22
590	0	1861	9.00	1	9.00	7.59	1.18
591	0	2133		0		7.83	
592	0	2153		0	10.44	7.83	
593	0	2074		0	10.13	8.38	
594	0	2095		0	10.25	9.52	
595	0	2067		0	10.53	10.74	
596	0	1999	9.96	0	10.07	9.55	
597	0	1986	9.87	0		9.12	
598	0	2045		0	9.94	8.22	
599	0	2039		0	10.26	8.20	
600	0	2088		0	10.68	7.84	
601	0	2031		0	10.34	7.95	
602	0	2006	10.06	0	10.03	7.18	
603	0	1983	9.84	0	9.98	7.70	
604	0	1732	8.68	1	8.68	7.75	1.12
605	0	1669	8.53	1	8.53	6.57	1.30
606	0	1710	8.63	1	8.63	6.93	1.24
607	0	1641	8.46	1	8.46	6.82	1.24
608	0	1790	8.82	1	8.82	6.27	1.41
609	0	1998	9.95	0		6.06	
610	0	2041		0		6.23	
611	0	1898	9.25	1	9.25	6.21	1.49
612	0	1594	8.34	1	8.34	6.88	1.21
613	0	1551	8.24	1	8.24	7.45	1.11
614	0	1748	8.72	1	8.72	5.27	1.66
615	0	1549	8.23	1	8.23	6.14	1.34
616	0	1447	7.99	1	7.99	6.25	1.28

Data ID#	Data Point Excluded 1=yes, 0=no	Power (kW)	Hub Height Wind Speed (m/s) from power curve	Hub Wind speed in acceptable range 1=yes, 0=no	wind speed from acceptable range $V_{p,n}$ (m/s)	10m Anemometer Wind Speed, $V_{z,m}$ (m/s)	$V_{p,n}/V_{z,m}$
617	0	1459	8.01	1	8.01	6.18	1.30
618	0	1466	8.03	1	8.03	6.31	1.27
619	0	1571	8.29	1	8.29	6.88	1.20
620	0	1698	8.60	1	8.60	7.63	1.13
621	0	1595	8.34	1	8.34	7.61	1.10
622	0	1616	8.40	1	8.40	6.85	1.23
623	0	1787	8.82	1	8.82	6.29	1.40
624	0	2057		0		6.88	
625	0	1935	9.51	1	9.51	7.76	1.23
626	0	1936	9.52	1	9.52	6.87	1.39
627	0	2059		0		8.31	
628	0	2043		0		7.56	
629	0	2072		0		7.02	
630	0	2087		0	10.02	7.59	
631	0	2038		0	10.91	7.44	
632	0	2008	10.14	0		7.38	
633	0	1973	9.78	0	9.89	7.67	
634	0	1795	8.83	1	8.83	7.21	1.23
635	0	1967	9.74	1	9.74	6.17	1.58
636	0	2059		0	9.95	6.65	
637	0	2080		0		5.89	
638	0	2038		0		6.63	
639	0	1996	9.94	0		6.00	
640	0	1809	8.87	1	8.87	7.61	1.17
641	0	1732	8.68	1	8.68	7.26	1.20
642	0	1738	8.70	1	8.70	7.70	1.13
643	0	1692	8.58	1	8.58	7.20	1.19
644	0	1401	7.89	1	7.89	7.31	1.08
645	0	1275	7.61	1	7.61	7.22	1.05
646	0	1226	7.50	1	7.50	6.15	1.22
647	0	1194	7.43	1	7.43	6.28	1.18
648	0	1048	7.12	1	7.12	5.83	1.22
649	0	868	6.66	1	6.66	5.03	1.33
650	0	797	6.47	1	6.47	4.99	1.30
651	0	754	6.36	1	6.36	5.29	1.20
652	0	820	6.53	1	6.53	5.12	1.28
653	0	854	6.62	1	6.62	5.44	1.22
654	0	824	6.55	1	6.55	4.99	1.31
655	0	853	6.62	1	6.62	4.61	1.44
656	0	1006	7.03	1	7.03	4.81	1.46
657	0	1070	7.16	1	7.16	5.84	1.23
658	0	984	6.97	1	6.97	5.62	1.24
659	0	975	6.95	1	6.95	6.89	1.01
660	0	1052	7.13	1	7.13	5.92	1.20
661	0	1058	7.14	1	7.14	6.52	1.09
662	0	1207	7.46	1	7.46	7.09	1.05
663	0	1378	7.83	1	7.83	6.95	1.13
664	0	1290	7.64	1	7.64	5.94	1.29
665	0	1230	7.51	1	7.51	5.01	1.50
666	0	1261	7.58	1	7.58	4.24	1.79
667	0	1288	7.64	1	7.64	5.62	1.36
668	0	1377	7.83	1	7.83	5.53	1.42
669	0	1459	8.01	1	8.01	5.54	1.45
670	0	1436	7.96	1	7.96	6.33	1.26
671	0	1452	8.00	1	8.00	5.46	1.46
672	0	1189	7.42	1	7.42	4.76	1.56
673	0	1293	7.65	1	7.65	4.94	1.55
674	0	1410	7.90	1	7.90	4.93	1.60
675	0	1351	7.78	1	7.78	4.36	1.78
676	0	1378	7.84	1	7.84	6.34	1.24
677	0	1333	7.74	1	7.74	6.58	1.18
678	0	1189	7.42	1	7.42	6.44	1.15
679	0	1194	7.43	1	7.43	6.72	1.11
680	0	1098	7.23	1	7.23	5.82	1.24
681	0	1052	7.13	1	7.13	5.86	1.22
682	0	1050	7.12	1	7.12	5.39	1.32
683	0	942	6.86	1	6.86	5.02	1.37
684	0	970	6.93	1	6.93	4.93	1.41
685	0	1136	7.31	1	7.31	4.61	1.59
686	0	1154	7.35	1	7.35	3.99	1.84
687	0	1100	7.23	1	7.23	3.97	1.82
688	0	1153	7.34	1	7.34	4.49	1.64
689	0	1169	7.38	1	7.38	5.17	1.43
690	0	1123	7.28	1	7.28	5.18	1.41
691	0	1059	7.14	1	7.14	4.35	1.64
692	0	1054	7.13	1	7.13	4.35	1.64
693	0	986	6.98	1	6.98	4.45	1.57
694	0	832	6.57	1	6.57	5.81	1.13
695	0	831	6.56	1	6.56	5.50	1.19
696	0	914	6.79	1	6.79	5.41	1.25
697	0	990	6.99	1	6.99	4.60	1.52
698	0	952	6.89	1	6.89	5.21	1.32
699	0	894	6.73	1	6.73	5.18	1.30
700	0	951	6.89	1	6.89	6.01	1.15
701	0	896	6.74	1	6.74	6.82	0.99
702	0	813	6.52	1	6.52	6.34	1.03
703	0	775	6.41	1	6.41	5.11	1.26
704	0	998	7.01	1	7.01	3.78	1.85

Data ID#	Data Point Excluded 1=yes, 0=no	Power (kW)	Hub Height Wind Speed (m/s) from power curve	Hub Wind speed in acceptable range 1=yes, 0=no	wind speed from acceptable range $V_{p,n}$ (m/s)	10m Anemometer Wind Speed, $V_{z,m}$ (m/s)	$V_{p,n}/V_{z,m}$
705	0	1581	8.31	1	8.31	4.81	1.73
706	0	1713	8.63	1	8.63	5.74	1.50
707	0	1759	8.75	1	8.75	4.32	2.03
708	0	1591	8.33	1	8.33	5.37	1.55
709	0	1261	7.58	1	7.58	5.80	1.31
710	0	1188	7.42	1	7.42	5.03	1.48
711	0	1138	7.31	1	7.31	5.35	1.37
712	0	1342	7.76	1	7.76	5.06	1.53
713	0	1349	7.77	1	7.77	4.03	1.93
714	0	1359	7.79	1	7.79	5.18	1.50

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Sample Calculation

Standardized Wind Speed Through Power Curve
Standardized Wind Speed with Nacelle Anemometer
[as per IEC 61400-11 Edition 3.0 Section 8.2.1.1 and Section 8.2.1.2]

SAMPLE CALCULATION

This calculation example demonstrates the calculation of standardized wind speed through power curve and the calculation of standardized wind speed with Nacelle anemometer as per IEC 61400-11 Edition 3.0 section 8.2.1.1 and section 8.2.1.2

Sample calculations have been based on measurement data collected and reported for Cedar Point Wind Power Project (Report ID: 15039.00.T209.R3) for data points collected during Turbine ON measurements [Data point #5 and #1]

8.2.1.1 Determination of Wind Speed through power curve (m/s)

Step 1: Determine Acceptable Range of Power Curve
The power curve relates the power to the wind speed at hub height. The wind speed is determined from the measured electric power. Correlation between measured sound level and measured electric power is very high for the allowed intervals of the power curve, see Equation (3).
The intervals on the power curve that can be used are all intervals where no duplicated values exist and the slope of the power curve including the uncertainty is positive. The demand on the slope of the power curve is satisfied for any interval on the power curve, where the following is fulfilled:

$$(P_{k+1} - P_{tol}) - (P_k + P_{tol}) > 0 \qquad (3)$$

where
k is the wind speed bin number of the power curve;
P_k is the power curve value at wind bin k;
P_{tol} is the tolerance on the power reading, typical values for Ptol are 1 to 5% of maximum value

The Acceptable Range of the power curve based on the slope of the power curve is highlighted in table 1.

Step2: Determine Standardized Wind Speed from linear interpolation from power curve for Data Point # 5

Average Active Power measured for Data Point #5 (x) = 2022 kW

$$y = y_0 + (x - x_0)\frac{y_1 - y_0}{x_1 - x_0} = \frac{y_0(x_1 - x) + y_1(x - x_0)}{x_1 - x_0},$$

y_0 =	10	m/s
x_0 =	2005	kW
y_1 =	11	m/s
x_1 =	2029	kW
x =	2022	kW
y =	10.70	m/s

8.2.1.2 Determination of Wind Speed with Nacelle Anemometer

For all data points with power levels from the allowed range of the power curve, the average value of the ratio of the wind speed derived from the power curve $V_{P,n}$ and the measured nacelle wind speed $V_{nac,m}$,k_{nac}, is derived. This value is applied to the measured nacelle wind speed for the data points with power levels outside the allowed range of the power curve to derive the normalised wind speed using Equation (4).

$$V_{nac,n} = \kappa_{nac} V_{nac,m} \qquad (4)$$

$V_{nac,m}$ is the wind speed measured with the nacelle anemometer;
$V_{nac,n}$ is the normalised wind speed from the nacelle anemometer, corrected to hub height

Determine Standardized Wind Speed using eq(4) for Data Point #1

K_{nac} =	0.9854	
$V_{nac,m}$ =	12.88	m/s
$V_{nac,n}$ =	12.69	m/s

Table 1 - Power Curve and Acceptable Range of Power Curve

Power Curve		+ value = acceptable
Hub Wind Speed (m/s)	Power [kW]	slope of power curve
0	0	-40.6
1	0	-40.6
2	0	25.4
3	66	64.4
4	171	138.4
5	350	229.4
6	620	333.4
7	994	419.4
8	1454	367.4
9	1862	102.4
10	2005	-16.6
11	2029	-39.6
12	2030	-40.6
13	2030	-40.6
14	2030	-40.6
15	2030	-40.6
16	2030	-40.6
17	2030	-40.6
18	2030	-40.6
19	2030	-40.6
20	2030	-40.6
21	2030	-40.6
22	2030	-40.6
23	2030	-40.6
24	2030	-40.6
25	2030	

Table 2 - Power Curve & Required Wind Speeds

Power Curve & Required Wind Speeds		
Power Curve Tolerance	1%	
Acceptable range min	2	m/s
Acceptable range max	9	m/s
Min allowable range	1.5	m/s
Max allowable range	9.5	m/s
Power Output	2030	kW
85% Power	1725.5	kW
Corresponding wind speed	8.67	m/s
Minimum bin	7.0	m/s
Maximum bin	11.5	m/s

Table 3 - Nacelle K-factor and Bacground K-factor

Environmental Details		
k_nac	0.9854	
k_Z	1.2254	

aercoustics

Aercoustics Engineering Ltd.
1004 Middlegate Road, Suite 1100
Mississauga, ON L4Y 0G1

Tel: 416-249-3361
Fax 416-249-3613
aercoustics.com

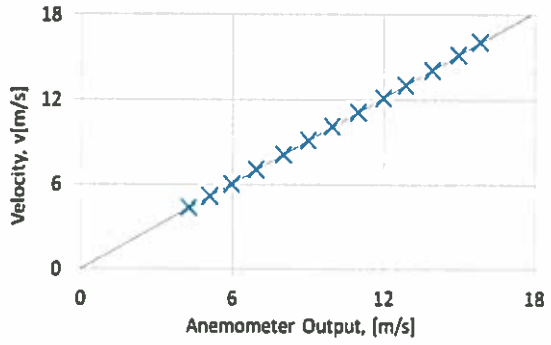
Calibration Certificates

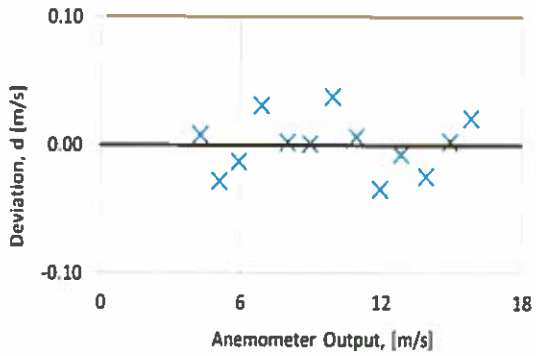
SOH Wind Engineering LLC
141 Leroy Road · Williston, VT 05495 · USA
Tel 802.316.4368 · Fax 802.735.9106 · www.sohwind.com

CERTIFICATE FOR CALIBRATION OF SONIC ANEMOMETER

Certificate number: 16.US1.06097 **Date of issue:** July 5, 2016
Type: Vaisala Weather Transmitter, WXT520 **Serial number:** K2420011.0deg
Manufacturer: VAISALA Oyj, Pl 26, FIN-00421 Helsinki, Finland
Client: Aercoustics Engineering Ltd., 50 Ronson Dr, Suite 165, Toronto, ON M9W 1B3, Canada
Anemometer received: June 28, 2016 **Anemometer calibrated:** 10:48 July 5, 2016
Calibrated by: mej **Procedure:** MEASNET, IEC 61400-12-1:2005(E) Annex F
Certificate prepared by: ejf **Approved by:** Calibration engineer, rds
Calibration equation obtained: v [m/s] = 1.01362 · f [m/s] + -0.00805
Standard uncertainty, slope: 0.00170 **Standard uncertainty, offset:** -2.27147
Covariance: -0.0000296 (m/s)²/m/s **Coefficient of correlation:** ρ = 0.999984
Absolute maximum deviation: 0.037 m/s at 10.080 m/s
Barometric pressure: 995.5 hPa **Relative humidity:** 40.4%

Succession	Velocity pressure, q. [Pa]	Temperature in wind tunnel [°C]	d.p. box [°C]	Wind velocity, v. [m/s]	Anemometer Output, f. [m/s]	Deviation, d. [m/s]	Uncertainty u_c (k=2) [m/s]
2	10.39	28.4	27.9	4.309	4.252	0.008	0.025
4	14.78	28.5	28.0	5.133	5.100	-0.028	0.025
6	20.54	28.5	28.0	6.008	5.948	-0.013	0.027
8	27.78	28.5	28.0	7.033	6.916	0.030	0.030
10	36.94	28.5	28.0	8.103	8.000	0.002	0.033
12	46.48	28.5	28.0	9.099	8.984	0.001	0.036
13-last	57.18	28.5	28.0	10.080	9.916	0.037	0.039
11	69.26	28.5	28.0	11.099	10.952	0.007	0.042
9	82.18	28.5	28.0	12.071	11.952	-0.035	0.046
7	95.15	28.5	28.0	12.995	12.835	-0.007	0.049
5	110.58	28.5	28.0	14.040	13.884	-0.024	0.052
3	128.53	28.5	28.0	15.117	14.919	0.003	0.056
1-first	144.29	28.4	27.9	16.024	15.797	0.020	0.059





AC-1746

EQUIPMENT USED

Serial Number	Description
Njord 1	Wind tunnel, blockage factor = 1.004
2254	Control cup anemometer
-	Mounting tube, D = 30 mm
TT004	Summit RT-AUI, wind tunnel
TP001	Summit RT-AUI, differential pressure box
DP006	Setra Model 239 pressure transducer
HY003	Dwyer Instruments RHP-2D20 humidity transmitter
BP002	Setra Model 278 barometer
PL8	Pitot tube
XB002	Computer Board. 16 bit A/D data acquisition board
9PRZRW1	PC dedicated to data acquisition

Traceable calibrations of the equipment are carried out by external accredited institutions: Atlantic Scale, Essco Calibration Labs & Furness Controls. A real-time analysis module within the data acquisition software detects pulse frequency.

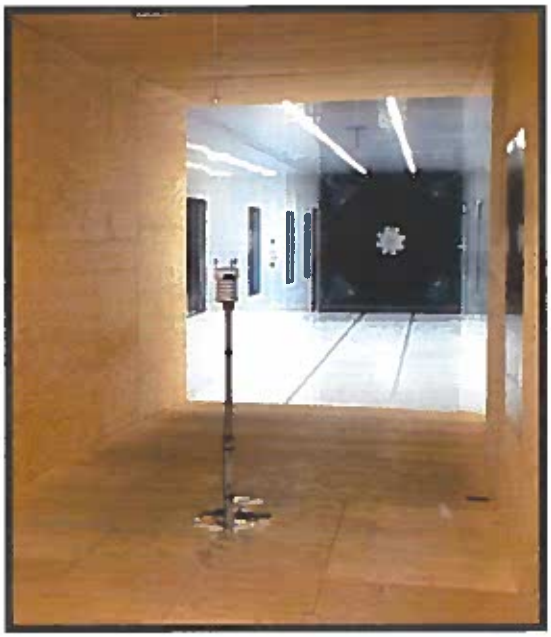


Photo of the wind tunnel setup. The cross-sectional area is 2.5 x 2.5 m.

UNCERTAINTIES

The documented uncertainty is the total combined uncertainty at 95% confidence level (k=2) in accordance with EA-4/02. The uncertainty at 10 m/s comply with the requirements in the IEC 61400-12-1:2005 procedure. See Document US.12.01.004 for further details.

Certificate number: 16.US1.06097

SOH Wind Engineering LLC
141 Leroy Road · Williston, VT 05495 · USA
Tel 802.316.4368 · Fax 802.735.9106 · www.sohwind.com

CERTIFICATE FOR CALIBRATION OF SONIC ANEMOMETER

Certificate number: 16.US1.06098 **Date of issue:** July 5, 2016

Type: Vaisala Weather Transmitter, WXT520 **Serial number:** K2420011.90deg

Manufacturer: VAISALA Oyj, Pl 26, FIN-00421 Helsinki, Finland

Client: Aercoustics Engineering Ltd., 50 Ronson Dr, Suite 165, Toronto, ON M9W IB3, Canada

Anemometer received: June 28, 2016 **Anemometer calibrated:** 11:08 July 5, 2016

Calibrated by: mej **Procedure:** MEASNET, IEC 61400-12-1:2005(E) Annex F

Certificate prepared by: ejf **Approved by:** Calibration engineer, rds

Calibration equation obtained: v [m/s] = 0.99840 · f [m/s] + 0.23389

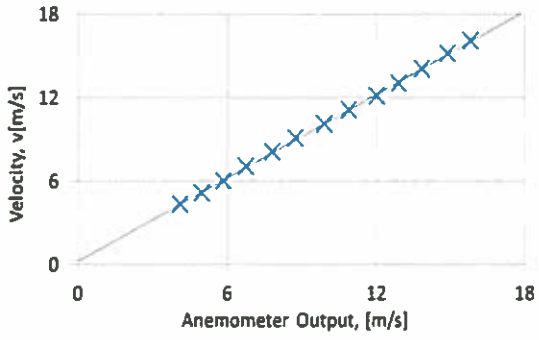
Standard uncertainty, slope: 0.00605 **Standard uncertainty, offset:** 0.27227

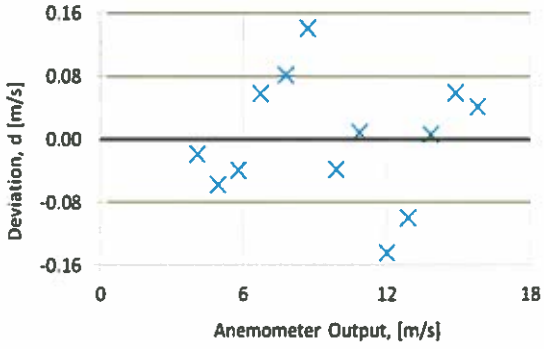
Covariance: -0.0003601 (m/s)²/m/s **Coefficient of correlation:** ρ = 0.999799

Absolute maximum deviation: 0.143 m/s at 12.071 m/s

Barometric pressure: 995.3 hPa **Relative humidity:** 40.2%

Succession	Velocity pressure, q. [Pa]	Temperature in wind tunnel [°C]	d.p. box [°C]	Wind velocity, v. [m/s]	Anemometer Output, f. [m/s]	Deviation, d. [m/s]	Uncertainty u_c (k=2) [m/s]
2	10.48	28.6	28.0	4.309	4.100	-0.018	0.025
4	14.88	28.6	28.0	5.133	4.965	-0.057	0.026
6	20.41	28.6	28.0	6.008	5.823	-0.039	0.027
8	27.86	28.6	28.0	7.033	6.752	0.058	0.030
10	36.96	28.6	28.0	8.103	7.800	0.082	0.033
12	46.52	28.6	28.0	9.099	8.739	0.140	0.036
13-last	57.08	28.6	28.0	10.080	9.900	-0.038	0.039
11	69.14	28.6	28.0	11.099	10.874	0.009	0.042
9	82.16	28.6	28.0	12.071	12.000	-0.143	0.046
7	94.99	28.6	28.0	12.995	12.881	-0.099	0.049
5	110.48	28.6	28.0	14.040	13.823	0.006	0.052
3	128.65	28.6	28.0	15.117	14.848	0.059	0.056
1-first	144.01	28.5	28.0	16.024	15.774	0.041	0.058





AC-1746

EQUIPMENT USED

Serial Number	Description
Njord 1	Wind tunnel, blockage factor = 1.004
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-	Mounting tube, D = 30 mm
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TP001	Summit RT-AUI, differential pressure box
DP006	Setra Model 239 pressure transducer
HY003	Dwyer Instruments RHP-2D20 humidity transmitter
BP002	Setra Model 278 barometer
PL8	Pitot tube
XB002	Computer Board. 16 bit A/D data acquisition board
9PRZRW1	PC dedicated to data acquisition

Traceable calibrations of the equipment are carried out by external accredited institutions: Atlantic Scale, Esseo Calibration Labs & Furness Controls. A real-time analysis module within the data acquisition software detects pulse frequency.

Photo of the wind tunnel setup. The cross-sectional area is 2.5 x 2.5 m.

UNCERTAINTIES

The documented uncertainty is the total combined uncertainty at 95% confidence level (k=2) in accordance with EA-4/02. The uncertainty at 10 m/s comply with the requirements in the IEC 61400-12-1:2005 procedure. See Document US.12.01.004 for further details.

Certificate number: 16.US1.06098

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CERTIFICATE OF CALIBRATION

SCC Accredited LAB — LAB Accrédité CCN
CLAS NRC·CNRC
CLAS 2000-03

Customer: AEROCOUSTICS ENGINEERING LTD
50 RONSON DRIVE
SUITE 165
TORONTO, ON M9W 1B3

PO Number: 2016.06.27C

Certificate/SO Number: 9-Q0G8J-20-1 Revision 0

Manufacturer: Nokeval
Model Number: 7470
Description: Serial to Analog Converter
Serial Number: A165152
ID: NONE

As-Found: In Tolerance
As-Left: In Tolerance

Calibration Date: July 11, 2016
Due Date: July 11, 2018

Calibrated To: Manufacturer Specification
Calibration Procedure: 1-AC58014-0

Transcat Calibration Laboratories have been audited and found in compliance with ISO/IEC 17025:2005. Accredited calibrations performed within the Lab's Scope of Accreditation are indicated by the presence of the Accrediting Body's Logo and Certificate Number on this Certificate of Calibration. Any measurements on an accredited calibration not covered by that Lab's Scope of Accreditation are listed in the notes section of the certificate. This report must not be used to claim product certification, approval, or endorsement by NVLAP, NIST, SCC, NRC, CLAS, ANAB or any agency of the Federal Government. NVLAP, NIST, SCC, NRC, CLAS or ANAB do not guarantee the accuracy of an individual calibration by accredited laboratories.

Transcat calibrations, as applicable, are performed in compliance with the requirements of the Transcat Quality Manual Revision I, ISO 9001:2008, ANSI/NCSL Z540.1-1994 (R2002), and ISO 10012:2003. When specified contractually, the requirements of ISO TS16949:2009, 10CFR21, 10CFR50 App. B and ASME NQA-1:2012 are also covered. Complete records of work performed are maintained by Transcat and are available for inspection. Laboratory standards used in the performance of this calibration are shown on the Supplemental Report.

Transcat documents the traceability of measurements to the SI units through the National Institute of Standards and Technology (NIST), or the National Research Council of Canada (NRC), or other recognized national measurement institutes (NMI) that are signatories to the CIPM Mutual Recognition Arrangement, or accepted fundamental and/or natural physical constants, or by the use of specified methods, consensus standards or ratio type measurements. Documentation supporting traceability information is available for review at a Transcat facility. The measured quantity and the measurement uncertainty are required for further dissemination of traceability.

Uncertainties are reported with a coverage factor k=2, providing a level of confidence of approximately 95%. All calibrations have been performed using processes having a TUR of 4:1 or better (3:1 for mass calibrations), unless otherwise noted on the Supplemental Report. The Test Uncertainty Ratio (TUR) is calculated in accordance with NCSL International RP-18. For mass calibrations: Conventional mass referenced to 8.0 g/cm³.

The results in this report relate only to the item calibrated or tested, and the determination of in or out of tolerance is specific to the model/serial no. referenced above based on the tolerances shown on the supplemental report; these tolerances are either the original equipment manufacturer's (OEM's) warranted specifications or the client's requested specifications. Any number of factors can cause a unit to drift out of tolerance at any time following its calibration. Limitations on the uses of this instrument are detailed in the OEM's operating instructions. This certificate may not be reproduced except in full, without the written approval of Transcat. Additional information, if applicable may be included on separate report(s).

Notes:

Calibrated At:
916 Gateway
Burlington, ON L7L 5K7

Facility Responsible:
916 Gateway
Burlington, ON L7L 5K7
800-828-1470

Calibrated By:
Digitally Signed By
Lawrence Loi
Date: July 11, 2016
Lawrence Loi
Calibration Technician

Reviewed By:
Digitally Signed By
Robert Whittaker
Date: July 11, 2016
Robert Whittaker
Lab Manager

Unit Barcode: 901B0165859
Date Received: June 27, 2016

Customer Number: 9-322110-000

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SUPPLEMENTAL REPORT

CALIBRATION LAB DATA AS FOUND / AS LEFT

Customer: AEROCOUSTICS ENGINEERING LTD
PO Number: 2016.06.27C

Certificate/SO Number: 9-Q0G8J-20-1 Revision 0

Manufacturer: Nokeval
Model Number: 7470
Description: Serial to Analog Converter
Serial Number: A165152
ID: NONE

Service Type: R9

Calibration Date: Jul 11, 2016
Date Due: Jul 11, 2018

Calibration Procedure: 1-AC58014-0

Description	Setpoints	Accuracy	Low Limit	High Limit	As Found / As Left	OOT	Cal Process Uncertainty	Measurement Uncertainty	Units	TUR
DC Current % Source - 4-20mA Ch #1										
4 - 20mA	0%	±(0.1% Span)	3.984	4.016	4.001 mA		1.6e-004	1.9e-003	mA	100.0 : 1
	25%	±(0.1% Span)	7.984	8.016	7.998 mA		2.6e-004	1.9e-003	mA	61.5 : 1
	50%	±(0.1% Span)	11.984	12.016	12.002 mA		1.1e-003	2.2e-003	mA	14.5 : 1
	75%	±(0.1% Span)	15.984	16.016	16.000 mA		1.3e-003	2.3e-003	mA	12.3 : 1
	100%	±(0.1% Span)	19.984	20.016	20.001 mA		1.4e-003	2.3e-003	mA	11.4 : 1
DC Current % Source - 4-20mA Ch #2										
4 - 20mA	0%	±(0.1% Span)	3.984	4.016	3.996 mA		1.6e-004	1.9e-003	mA	100.0 : 1
	25%	±(0.1% Span)	7.984	8.016	7.996 mA		2.6e-004	1.9e-003	mA	61.5 : 1
	50%	±(0.1% Span)	11.984	12.016	11.997 mA		1.1e-003	2.2e-003	mA	14.5 : 1
	75%	±(0.1% Span)	15.984	16.016	16.003 mA		1.3e-003	2.3e-003	mA	12.3 : 1
	100%	±(0.1% Span)	19.984	20.016	20.001 mA		1.4e-003	2.3e-003	mA	11.4 : 1

The column labeled Cal Process Uncertainty (CPU) does not include the short term component of the UUT. The column labeled Measurement Uncertainty includes both CPU and the short term component of the UUT. TUR is calculated using CPU.
Note: Reported resolution of the UUT does not represent calibration uncertainty or accuracy of the UUT.

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SUPPLEMENTAL REPORT

CALIBRATION LAB DATA AS FOUND / AS LEFT

Customer: AEROCOUSTICS ENGINEERING LTD

PO Number: 2016.06.27C

Certificate/SO Number: 9-Q0G8J-20-1 Revision 0

Description	Setpoints	Accuracy	Low Limit	High Limit	As Found / As Left	OOT	Cal Process Uncertainty	Measurement Uncertainty	Units	TUR
DC Current % Source - 4-20mA Ch #3										
4 - 20mA	0%	±(0.1% Span)	3.984	4.016	3.997 mA		1.6e-004	1.9e-003	mA	100.0 : 1
	25%	±(0.1% Span)	7.984	8.016	8.000 mA		2.6e-004	1.9e-003	mA	61.5 : 1
	50%	±(0.1% Span)	11.984	12.016	12.000 mA		1.1e-003	2.2e-003	mA	14.5 : 1
	75%	±(0.1% Span)	15.984	16.016	15.999 mA		1.3e-003	2.3e-003	mA	12.3 : 1
	100%	±(0.1% Span)	19.984	20.016	20.001 mA		1.4e-003	2.3e-003	mA	11.4 : 1
DC Current % Source - 4-20mA Ch #4										
4 - 20mA	0%	±(0.1% Span)	3.984	4.016	4.002 mA		1.6e-004	1.9e-003	mA	100.0 : 1
	25%	±(0.1% Span)	7.984	8.016	8.000 mA		2.6e-004	1.9e-003	mA	61.5 : 1
	50%	±(0.1% Span)	11.984	12.016	12.000 mA		1.1e-003	2.2e-003	mA	14.5 : 1
	75%	±(0.1% Span)	15.984	16.016	16.004 mA		1.3e-003	2.3e-003	mA	12.3 : 1
	100%	±(0.1% Span)	19.984	20.016	20.001 mA		1.4e-003	2.3e-003	mA	11.4 : 1
DC Current % Source - 0-20mA Ch #1										
0 - 20mA	0%	±(0.1% Span)	-0.020	0.020	0.003 mA		9.2e-007	2.3e-003	mA	100.0 : 1
	25%	±(0.1% Span)	4.980	5.020	5.000 mA		1.9e-004	2.3e-003	mA	100.0 : 1
	50%	±(0.1% Span)	9.980	10.020	10.000 mA		3.1e-004	2.3e-003	mA	64.5 : 1
	75%	±(0.1% Span)	14.980	15.020	14.999 mA		1.2e-003	2.6e-003	mA	16.7 : 1
	100%	±(0.1% Span)	19.980	20.020	20.001 mA		1.4e-003	2.7e-003	mA	14.3 : 1

The column labeled Cal Process Uncertainty (CPU) does not include the short term component of the UUT. The column labeled Measurement Uncertainty includes both CPU and the short term component of the UUT. TUR is calculated using CPU

Note: Reported resolution of the UUT does not represent calibration uncertainty or accuracy of the UUT.

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SUPPLEMENTAL REPORT

CALIBRATION LAB DATA AS FOUND / AS LEFT

Customer: AEROCOUSTICS ENGINEERING LTD
PO Number: 2016.06.27C

Certificate/SO Number: 9-Q0G8J-20-1 Revision 0

Description	Setpoints	Accuracy	Low Limit	High Limit	As Found / As Left	OOT	Cal Process Uncertainty	Measurement Uncertainty	Units	TUR
DC Current % Source - 0-20mA Ch #2										
0 - 20mA	0%	±(0.1% Span)	-0.020	0.020	0.000 mA		9.2e-007	2.3e-003	mA	100.0 : 1
	25%	±(0.1% Span)	4.980	5.020	4.998 mA		1.9e-004	2.3e-003	mA	100.0 : 1
	50%	±(0.1% Span)	9.980	10.020	9.996 mA		3.1e-004	2.3e-003	mA	64.5 : 1
	75%	±(0.1% Span)	14.980	15.020	15.000 mA		1.2e-003	2.6e-003	mA	16.7 : 1
	100%	±(0.1% Span)	19.980	20.020	20.001 mA		1.4e-003	2.7e-003	mA	14.3 : 1
DC Current % Source - 0-20mA Ch #3										
0 - 20mA	0%	±(0.1% Span)	-0.020	0.020	0.000 mA		9.2e-007	2.3e-003	mA	100.0 : 1
	25%	±(0.1% Span)	4.980	5.020	4.998 mA		1.9e-004	2.3e-003	mA	100.0 : 1
	50%	±(0.1% Span)	9.980	10.020	10.001 mA		3.1e-004	2.3e-003	mA	64.5 : 1
	75%	±(0.1% Span)	14.980	15.020	15.001 mA		1.2e-003	2.6e-003	mA	16.7 : 1
	100%	±(0.1% Span)	19.980	20.020	20.001 mA		1.4e-003	2.7e-003	mA	14.3 : 1
DC Current % Source - 0-20mA Ch #4										
0 - 20mA	0%	±(0.1% Span)	-0.020	0.020	0.000 mA		9.2e-007	2.3e-003	mA	100.0 : 1
	25%	±(0.1% Span)	4.980	5.020	5.000 mA		1.9e-004	2.3e-003	mA	100.0 : 1
	50%	±(0.1% Span)	9.980	10.020	10.003 mA		3.1e-004	2.3e-003	mA	64.5 : 1
	75%	±(0.1% Span)	14.980	15.020	15.000 mA		1.2e-003	2.6e-003	mA	16.7 : 1
	100%	±(0.1% Span)	19.980	20.020	20.001 mA		1.4e-003	2.7e-003	mA	14.3 : 1

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TRANSCAT CANADA
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SUPPLEMENTAL REPORT

CALIBRATION LAB DATA AS FOUND / AS LEFT

Customer: AEROCOUSTICS ENGINEERING LTD

PO Number: 2016.06.27C

Certificate/SO Number: 9-Q0G8J-20-1 Revision 0

Description	Setpoints	Accuracy	Low Limit	High Limit	As Found / As Left	OOT	Cal Process Uncertainty	Measurement Uncertainty	Units	TUR
DC Voltage % Source - 0-5V Ch#1										
0 -5V	0%	±(0.1% Span)	-0.0050	0.0050	0.0008 V		5.8e-007	5.8e-004	V	100.0 : 1
	20%	±(0.1% Span)	0.9950	1.0050	0.9996 V		5.6e-006	5.8e-004	V	100.0 : 1
	40%	±(0.1% Span)	1.9950	2.0050	1.9987 V		1.1e-005	5.8e-004	V	100.0 : 1
	60%	±(0.1% Span)	2.9950	3.0050	3.0009 V		1.6e-005	5.8e-004	V	100.0 : 1
	80%	±(0.1% Span)	3.9950	4.0050	4.0007 V		2.1e-005	5.8e-004	V	100.0 : 1
	100%	±(0.1% Span)	4.9950	5.0050	5.0003 V		2.6e-005	5.8e-004	V	100.0 : 1
DC Voltage % Source - 0-5V Ch#2										
0 -5V	0%	±(0.1% Span)	-0.0050	0.0050	0.0011 V		5.8e-007	5.8e-004	V	100.0 : 1
	20%	±(0.1% Span)	0.9950	1.0050	1.0001 V		5.6e-006	5.8e-004	V	100.0 : 1
	40%	±(0.1% Span)	1.9950	2.0050	1.9989 V		1.1e-005	5.8e-004	V	100.0 : 1
	60%	±(0.1% Span)	2.9950	3.0050	3.0009 V		1.6e-005	5.8e-004	V	100.0 : 1
	80%	±(0.1% Span)	3.9950	4.0050	4.0003 V		2.1e-005	5.8e-004	V	100.0 : 1
	100%	±(0.1% Span)	4.9950	5.0050	4.9998 V		2.6e-005	5.8e-004	V	100.0 : 1
DC Voltage % Source - 0-5V Ch#3										
0 -5V	0%	±(0.1% Span)	-0.0050	0.0050	0.0016 V		5.8e-007	5.8e-004	V	100.0 : 1
	20%	±(0.1% Span)	0.9950	1.0050	0.9994 V		5.6e-006	5.8e-004	V	100.0 : 1
	40%	±(0.1% Span)	1.9950	2.0050	1.9994 V		1.1e-005	5.8e-004	V	100.0 : 1
	60%	±(0.1% Span)	2.9950	3.0050	3.0000 V		1.6e-005	5.8e-004	V	100.0 : 1
	80%	±(0.1% Span)	3.9950	4.0050	4.0007 V		2.1e-005	5.8e-004	V	100.0 : 1
	100%	±(0.1% Span)	4.9950	5.0050	5.0014 V		2.6e-005	5.8e-004	V	100.0 : 1

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SUPPLEMENTAL REPORT

CALIBRATION LAB DATA AS FOUND / AS LEFT

Customer: AEROCOUSTICS ENGINEERING LTD
PO Number: 2016.06.27C

Certificate/SO Number: 9-Q0G8J-20-1 Revision 0

Description	Setpoints	Accuracy	Low Limit	High Limit	As Found / As Left	OOT	Cal Process Uncertainty	Measurement Uncertainty	Units	TUR
DC Voltage % Source - 0-5V Ch#4										
0 -5V	0%	±(0.1% Span)	-0.0050	0.0050	0.0005 V		5.8e-007	5.8e-004	V	100.0 : 1
	20%	±(0.1% Span)	0.9950	1.0050	1.0013 V		5.6e-006	5.8e-004	V	100.0 : 1
	40%	±(0.1% Span)	1.9950	2.0050	2.0004 V		1.1e-005	5.8e-004	V	100.0 : 1
	60%	±(0.1% Span)	2.9950	3.0050	3.0001 V		1.6e-005	5.8e-004	V	100.0 : 1
	80%	±(0.1% Span)	3.9950	4.0050	4.0001 V		2.1e-005	5.8e-004	V	100.0 : 1
	100%	±(0.1% Span)	4.9950	5.0050	4.9999 V		2.6e-005	5.8e-004	V	100.0 : 1
DC Voltage % Source - 0-10V Ch#1										
0 - 10V	0%	±(0.1% Span)	-0.010	0.010	0.001 V		5.8e-007	1.2e-003	V	100.0 : 1
	20%	±(0.1% Span)	1.990	2.010	1.999 V		1.1e-005	1.2e-003	V	100.0 : 1
	40%	±(0.1% Span)	3.990	4.010	4.001 V		2.1e-005	1.2e-003	V	100.0 : 1
	60%	±(0.1% Span)	5.990	6.010	6.000 V		3.1e-005	1.2e-003	V	100.0 : 1
	80%	±(0.1% Span)	7.990	8.010	8.002 V		4.1e-005	1.2e-003	V	100.0 : 1
	100%	±(0.1% Span)	9.990	10.010	10.000 V		5.2e-005	1.2e-003	V	100.0 : 1
DC Voltage % Source - 0-10V Ch#2										
0 - 10V	0%	±(0.1% Span)	-0.010	0.010	0.001 V		5.8e-007	1.2e-003	V	100.0 : 1
	20%	±(0.1% Span)	1.990	2.010	1.999 V		1.1e-005	1.2e-003	V	100.0 : 1
	40%	±(0.1% Span)	3.990	4.010	4.000 V		2.1e-005	1.2e-003	V	100.0 : 1
	60%	±(0.1% Span)	5.990	6.010	6.002 V		3.1e-005	1.2e-003	V	100.0 : 1
	80%	±(0.1% Span)	7.990	8.010	8.000 V		4.1e-005	1.2e-003	V	100.0 : 1
	100%	±(0.1% Span)	9.990	10.010	10.000 V		5.2e-005	1.2e-003	V	100.0 : 1

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SUPPLEMENTAL REPORT

CALIBRATION LAB DATA AS FOUND / AS LEFT

Customer: AEROCOUSTICS ENGINEERING LTD
PO Number: 2016.06.27C

Certificate/SO Number: 9-Q0G8J-20-1 Revision 0

Description	Setpoints	Accuracy	Low Limit	High Limit	As Found / As Left	OOT	Cal Process Uncertainty	Measurement Uncertainty	Units	TUR
DC Voltage % Source - 0-10V Ch#3										
0 - 10V	0%	±(0.1% Span)	-0.010	0.010	0.002 V		5.8e-007	1.2e-003	V	100.0 : 1
	20%	±(0.1% Span)	1.990	2.010	1.999 V		1.1e-005	1.2e-003	V	100.0 : 1
	40%	±(0.1% Span)	3.990	4.010	4.001 V		2.1e-005	1.2e-003	V	100.0 : 1
	60%	±(0.1% Span)	5.990	6.010	6.002 V		3.1e-005	1.2e-003	V	100.0 : 1
	80%	±(0.1% Span)	7.990	8.010	8.001 V		4.1e-005	1.2e-003	V	100.0 : 1
	100%	±(0.1% Span)	9.990	10.010	10.001 V		5.2e-005	1.2e-003	V	100.0 : 1
DC Voltage % Source - 0-10V Ch#4										
0 - 10V	0%	±(0.1% Span)	-0.010	0.010	0.001 V		5.8e-007	1.2e-003	V	100.0 : 1
	20%	±(0.1% Span)	1.990	2.010	2.000 V		1.1e-005	1.2e-003	V	100.0 : 1
	40%	±(0.1% Span)	3.990	4.010	4.000 V		2.1e-005	1.2e-003	V	100.0 : 1
	60%	±(0.1% Span)	5.990	6.010	6.000 V		3.1e-005	1.2e-003	V	100.0 : 1
	80%	±(0.1% Span)	7.990	8.010	8.002 V		4.1e-005	1.2e-003	V	100.0 : 1
	100%	±(0.1% Span)	9.990	10.010	10.000 V		5.2e-005	1.2e-003	V	100.0 : 1

As Found and As Left Data recorded on July 11, 2016

Temperature 75.0°F / 23.9°C Relative Humidity 39% Temp/RH Asset LEM-0005

Asset	Manufacturer	Model	Description	Cal Date	Due Date	Traceability Numbers
NT0339	HP	3458A Opt 002	Digital Multimeter, 8.5 Digit	Nov 21, 2015	Nov 30, 2016	1-7363155174-1

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ISO17025

As Left RECALIBRATION CERTIFICATE

Sales Region:	AMERICAS
Account:	Aercoustics engineering Limited
Instrument:	LMS SCADAS
Manufacturer:	Siemens Industry Software B.V.
Type:	SCR202
Serial number(s):	22143211
Calibration method:	Two calibrated external standards (DC voltage and frequency) are used to calibrate the internal LMS SCADAS references: time/frequency accuracy of the internal system clock and amplitude accuracy of the internal signal sources. All input channels are calibrated against the internal references.
Ambient conditions:	The calibrations have been carried out in a controlled environment, at an ambient temperature of 22,8°C and a relative humidity of 50,2%.
Calibration date:	August 17, 2016
Results:	The calibration results, together with their associated uncertainties, are included in this calibration certificate. *Calibration results within specification.*
Uncertainty:	The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k =2, which for a normal distribution corresponds to a coverage probability of approximately 95%. The standard uncertainty of measurement has been determined in accordance with publication EA-4/02.
Traceability:	The measurements have been executed using methods for which the traceability to international standards has been demonstrated towards the Raad voor Accreditatie.

Breda, August 17, 2016

Calibration performed by:

H. Dam

Certificate approved by:

M.C.A.G. Damen

Siemens Industry Software B.V.
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Table of contents

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1 Explanation of the factory calibration procedure

The production process of an LMS SCADAS front-end consists of a number of stages.
Every single board or module that will be part of the system is tested extensively on reliability and functionality before it is inserted in the LMS SCADAS frame.
After assembly, the amplitude accuracy and offset errors of all input and output channels are adjusted to a value as close to zero as possible. The adjustment procedure incorporates external measurement equipment, which is documented in the next section of this report.

As a final step, the front-end is submitted to a factory calibration. The factory calibration verifies whether all input and output channels meet their published specifications with respect to amplitude accuracy, offset, and a number of dynamic capabilities such as distortion, signal to noise ratio and inter-channel crosstalk. The measurements that are done as a part of the calibration use an internal reference source, which has been calibrated against an external standard (documented in the next section of this report).
The results of this calibration procedure are documented in the *Calibration Certificate* you have in front of you.

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2 External reference - used equipment

	Type	Serial Number	Cal Certificate	Cal Date
Digital multimeter	Agilent 34401A	MY41040399	201604476.00	22-July-2016
Calibration software	2.10.0001	Na	Na	Na

The external reference (DMM) is calibrated on a yearly basis by a calibration laboratory that is ISO17025:2005 accredited by The Dutch Accreditation Council RvA.

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3 System configuration

Frame	*Backplane Module*	*Conditioner*	*Unique number*	*Hardware version*	*Software version*	*Option*
Master (0)			0022143211			
	V8_E (1)		2013333008	18	0	
	V8_E (2)		2013333032	18	0	
	SYSCON_REC (3)		2013215010	11	0	
		SYSCPB (0)	2013376010	3	0	
	PS12-2 MOB (4)		2014154022	17	11	

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4 V8_E_h18s0

4.1 Gain Accuracy after Adjustment

Description of calibration:
Determination of the amplitude accuracy of the input channels over all input ranges and available ADC bandwidths, by applying an accurate 1kHz -3dBFS (max 4V) sine wave which is generated by the internal reference generator. For charge amplifiers, the reference voltage signal is translated to a reference charge signal.
The reported values represent the deviations from the expected signal amplitude, both absolute (either in Volt or Coulomb, depending on the input channel type) and relative (in %).

AdcBw 102400Hz, Range 0.316V Alternating voltage 100mV < IR <= 316mV Spec: <= ±0.100% Uncertainty: 72µV	
Chan	Value
0,1,x,0	-0.124 mV, -0.055%
0,1,x,1	-0.126 mV, -0.056%
0,1,x,2	-0.128 mV, -0.057%
0,1,x,3	-0.127 mV, -0.057%
0,1,x,4	-0.127 mV, -0.057%
0,1,x,5	-0.131 mV, -0.058%
0,1,x,6	-0.125 mV, -0.056%
0,1,x,7	-0.125 mV, -0.056%
0,2,x,0	-0.127 mV, -0.057%
0,2,x,1	-0.128 mV, -0.057%
0,2,x,2	-0.125 mV, -0.056%
0,2,x,3	-0.128 mV, -0.057%
0,2,x,4	-0.126 mV, -0.057%
0,2,x,5	-0.128 mV, -0.057%
0,2,x,6	-0.127 mV, -0.057%
0,2,x,7	-0.128 mV, -0.057%

AdcBw 102400Hz, Range 1V Alternating voltage 316mV < IR <= 1V Spec: <= ±0.100% Uncertainty: 140µV	
Chan	Value
0,1,x,0	-0.311 mV, -0.044%
0,1,x,1	-0.320 mV, -0.045%
0,1,x,2	-0.318 mV, -0.045%
0,1,x,3	-0.317 mV, -0.045%
0,1,x,4	-0.311 mV, -0.044%
0,1,x,5	-0.323 mV, -0.046%
0,1,x,6	-0.312 mV, -0.044%
0,1,x,7	-0.313 mV, -0.044%
0,2,x,0	-0.322 mV, -0.046%
0,2,x,1	-0.324 mV, -0.046%
0,2,x,2	-0.318 mV, -0.045%
0,2,x,3	-0.321 mV, -0.045%
0,2,x,4	-0.316 mV, -0.045%
0,2,x,5	-0.319 mV, -0.045%
0,2,x,6	-0.320 mV, -0.045%
0,2,x,7	-0.318 mV, -0.045%

AdcBw 102400Hz, Range 3.16V Alternating voltage 1V < IR <= 3.16V Spec: <= ±0.100% Uncertainty: 370µV	
Chan	Value
0,1,x,0	-0.796 mV, -0.036%
0,1,x,1	-0.831 mV, -0.037%
0,1,x,2	-0.825 mV, -0.037%
0,1,x,3	-0.823 mV, -0.037%
0,1,x,4	-0.813 mV, -0.036%
0,1,x,5	-0.840 mV, -0.038%
0,1,x,6	-0.803 mV, -0.036%
0,1,x,7	-0.816 mV, -0.037%
0,2,x,0	-0.849 mV, -0.038%
0,2,x,1	-0.835 mV, -0.037%
0,2,x,2	-0.827 mV, -0.037%
0,2,x,3	-0.848 mV, -0.038%
0,2,x,4	-0.820 mV, -0.037%
0,2,x,5	-0.820 mV, -0.037%
0,2,x,6	-0.838 mV, -0.038%
0,2,x,7	-0.818 mV, -0.037%

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AdcBw 102400Hz, Range 10V Alternating voltage 3.16V < IR <= 10V Spec: <= ±0.100% Uncertainty: 640µV	
Chan	Value
0,1,x,0	-1.261 mV, -0.032%
0,1,x,1	-1.283 mV, -0.032%
0,1,x,2	-1.302 mV, -0.033%
0,1,x,3	-1.308 mV, -0.033%
0,1,x,4	-1.290 mV, -0.032%
0,1,x,5	-1.331 mV, -0.033%
0,1,x,6	-1.287 mV, -0.032%
0,1,x,7	-1.288 mV, -0.032%
0,2,x,0	-1.317 mV, -0.033%
0,2,x,1	-1.285 mV, -0.032%
0,2,x,2	-1.272 mV, -0.032%
0,2,x,3	-1.307 mV, -0.033%
0,2,x,4	-1.305 mV, -0.033%
0,2,x,5	-1.285 mV, -0.032%
0,2,x,6	-1.290 mV, -0.032%
0,2,x,7	-1.299 mV, -0.032%

AdcBw 51200Hz, Range 1V Alternating voltage 316mV < IR <= 1V Spec: <= ±0.100% Uncertainty: 140µV	
Chan	Value
0,1,x,0	-0.169 mV, -0.024%
0,1,x,1	-0.178 mV, -0.025%
0,1,x,2	-0.176 mV, -0.025%
0,1,x,3	-0.175 mV, -0.025%
0,1,x,4	-0.171 mV, -0.024%
0,1,x,5	-0.182 mV, -0.026%
0,1,x,6	-0.171 mV, -0.024%
0,1,x,7	-0.172 mV, -0.024%
0,2,x,0	-0.181 mV, -0.026%
0,2,x,1	-0.180 mV, -0.026%
0,2,x,2	-0.174 mV, -0.025%
0,2,x,3	-0.178 mV, -0.025%
0,2,x,4	-0.174 mV, -0.025%
0,2,x,5	-0.176 mV, -0.025%
0,2,x,6	-0.177 mV, -0.025%
0,2,x,7	-0.176 mV, -0.025%

AdcBw 51200Hz, Range 10V Alternating voltage 3.16V < IR <= 10V Spec: <= ±0.100% Uncertainty: 640µV	
Chan	Value
0,1,x,0	-0.766 mV, -0.019%
0,1,x,1	-0.787 mV, -0.020%
0,1,x,2	-0.802 mV, -0.020%
0,1,x,3	-0.808 mV, -0.020%
0,1,x,4	-0.793 mV, -0.020%
0,1,x,5	-0.829 mV, -0.021%
0,1,x,6	-0.795 mV, -0.020%
0,1,x,7	-0.794 mV, -0.020%
0,2,x,0	-0.818 mV, -0.020%
0,2,x,1	-0.786 mV, -0.020%
0,2,x,2	-0.777 mV, -0.019%
0,2,x,3	-0.810 mV, -0.020%
0,2,x,4	-0.804 mV, -0.020%
0,2,x,5	-0.787 mV, -0.020%
0,2,x,6	-0.797 mV, -0.020%
0,2,x,7	-0.803 mV, -0.020%

AdcBw 51200Hz, Range 0.316V Alternating voltage 100mV < IR <= 316mV Spec: <= ±0.100% Uncertainty: 72µV	
Chan	Value
0,1,x,0	-0.060 mV, -0.027%
0,1,x,1	-0.063 mV, -0.028%
0,1,x,2	-0.065 mV, -0.029%
0,1,x,3	-0.064 mV, -0.028%
0,1,x,4	-0.063 mV, -0.028%
0,1,x,5	-0.066 mV, -0.030%
0,1,x,6	-0.062 mV, -0.028%
0,1,x,7	-0.062 mV, -0.028%
0,2,x,0	-0.064 mV, -0.029%
0,2,x,1	-0.064 mV, -0.029%
0,2,x,2	-0.062 mV, -0.028%
0,2,x,3	-0.064 mV, -0.029%
0,2,x,4	-0.063 mV, -0.028%
0,2,x,5	-0.064 mV, -0.029%
0,2,x,6	-0.064 mV, -0.029%
0,2,x,7	-0.065 mV, -0.029%

AdcBw 51200Hz, Range 3.16V Alternating voltage 1V < IR <= 3.16V Spec: <= ±0.100% Uncertainty: 370µV	
Chan	Value
0,1,x,0	-0.479 mV, -0.021%
0,1,x,1	-0.512 mV, -0.023%
0,1,x,2	-0.504 mV, -0.023%
0,1,x,3	-0.504 mV, -0.023%
0,1,x,4	-0.500 mV, -0.022%
0,1,x,5	-0.524 mV, -0.023%
0,1,x,6	-0.492 mV, -0.022%
0,1,x,7	-0.503 mV, -0.023%
0,2,x,0	-0.528 mV, -0.024%
0,2,x,1	-0.511 mV, -0.023%
0,2,x,2	-0.505 mV, -0.023%
0,2,x,3	-0.526 mV, -0.024%
0,2,x,4	-0.503 mV, -0.022%
0,2,x,5	-0.502 mV, -0.022%
0,2,x,6	-0.517 mV, -0.023%
0,2,x,7	-0.503 mV, -0.022%

AdcBw 25600Hz, Range 0.316V Alternating voltage 100mV < IR <= 316mV Spec: <= ±0.100% Uncertainty: 72µV	
Chan	Value
0,1,x,0	-0.040 mV, -0.018%
0,1,x,1	-0.042 mV, -0.019%
0,1,x,2	-0.043 mV, -0.019%
0,1,x,3	-0.042 mV, -0.019%
0,1,x,4	-0.042 mV, -0.019%
0,1,x,5	-0.045 mV, -0.020%
0,1,x,6	-0.041 mV, -0.018%
0,1,x,7	-0.042 mV, -0.019%
0,2,x,0	-0.043 mV, -0.019%
0,2,x,1	-0.042 mV, -0.019%
0,2,x,2	-0.041 mV, -0.018%
0,2,x,3	-0.043 mV, -0.019%
0,2,x,4	-0.042 mV, -0.019%
0,2,x,5	-0.043 mV, -0.019%
0,2,x,6	-0.042 mV, -0.019%
0,2,x,7	-0.043 mV, -0.019%

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AdcBw 25600Hz, Range 1V Alternating voltage 316mV < IR <= 1V Spec: <= ±0.100% Uncertainty: 140µV	
Chan	Value
0,1,x,0	-0.120 mV, -0.017%
0,1,x,1	-0.128 mV, -0.018%
0,1,x,2	-0.126 mV, -0.018%
0,1,x,3	-0.125 mV, -0.018%
0,1,x,4	-0.122 mV, -0.017%
0,1,x,5	-0.131 mV, -0.019%
0,1,x,6	-0.122 mV, -0.017%
0,1,x,7	-0.123 mV, -0.017%
0,2,x,0	-0.130 mV, -0.018%
0,2,x,1	-0.129 mV, -0.018%
0,2,x,2	-0.125 mV, -0.018%
0,2,x,3	-0.128 mV, -0.018%
0,2,x,4	-0.125 mV, -0.018%
0,2,x,5	-0.126 mV, -0.018%
0,2,x,6	-0.128 mV, -0.018%
0,2,x,7	-0.126 mV, -0.018%

AdcBw 25600Hz, Range 3.16V Alternating voltage 1V < IR <= 3.16V Spec: <= ±0.100% Uncertainty: 370µV	
Chan	Value
0,1,x,0	-0.328 mV, -0.015%
0,1,x,1	-0.354 mV, -0.016%
0,1,x,2	-0.350 mV, -0.016%
0,1,x,3	-0.349 mV, -0.016%
0,1,x,4	-0.347 mV, -0.016%
0,1,x,5	-0.367 mV, -0.016%
0,1,x,6	-0.341 mV, -0.015%
0,1,x,7	-0.350 mV, -0.016%
0,2,x,0	-0.370 mV, -0.017%
0,2,x,1	-0.356 mV, -0.016%
0,2,x,2	-0.350 mV, -0.016%
0,2,x,3	-0.367 mV, -0.016%
0,2,x,4	-0.349 mV, -0.016%
0,2,x,5	-0.349 mV, -0.016%
0,2,x,6	-0.361 mV, -0.016%
0,2,x,7	-0.347 mV, -0.016%

AdcBw 25600Hz, Range 10V Alternating voltage 3.16V < IR <= 10V Spec: <= ±0.100% Uncertainty: 640µV	
Chan	Value
0,1,x,0	-0.544 mV, -0.014%
0,1,x,1	-0.561 mV, -0.014%
0,1,x,2	-0.573 mV, -0.014%
0,1,x,3	-0.576 mV, -0.014%
0,1,x,4	-0.560 mV, -0.014%
0,1,x,5	-0.589 mV, -0.015%
0,1,x,6	-0.567 mV, -0.014%
0,1,x,7	-0.567 mV, -0.014%
0,2,x,0	-0.583 mV, -0.015%
0,2,x,1	-0.558 mV, -0.014%
0,2,x,2	-0.550 mV, -0.014%
0,2,x,3	-0.575 mV, -0.014%
0,2,x,4	-0.571 mV, -0.014%
0,2,x,5	-0.559 mV, -0.014%
0,2,x,6	-0.567 mV, -0.014%
0,2,x,7	-0.573 mV, -0.014%

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4.2 Residual Offset after Adjustment

Description of calibration:
Determination of the residual input offsets of the input channels over all input ranges and available ADC bandwidths, by internally shorting the input channels to ground.

AdcBw 102400Hz, Range 0.316V Direct voltage IR <= 316mV Spec: <= ±0.316 mV Uncertainty: 4.8µV	
Chan	Value
0,1,x,0	-0.002 mV
0,1,x,1	0.002 mV
0,1,x,2	0.004 mV
0,1,x,3	0.011 mV
0,1,x,4	0.009 mV
0,1,x,5	0.009 mV
0,1,x,6	0.007 mV
0,1,x,7	0.014 mV
0,2,x,0	0.010 mV
0,2,x,1	0.008 mV
0,2,x,2	0.002 mV
0,2,x,3	0.003 mV
0,2,x,4	-0.002 mV
0,2,x,5	-0.002 mV
0,2,x,6	0.001 mV
0,2,x,7	0.000 mV

AdcBw 102400Hz, Range 3.16V Direct voltage 1V < IR <= 3.16V Spec: <= ±3.160 mV Uncertainty: 8µV	
Chan	Value
0,1,x,0	0.006 mV
0,1,x,1	0.002 mV
0,1,x,2	0.021 mV
0,1,x,3	0.009 mV
0,1,x,4	0.013 mV
0,1,x,5	0.014 mV
0,1,x,6	0.016 mV
0,1,x,7	0.007 mV
0,2,x,0	0.017 mV
0,2,x,1	0.020 mV
0,2,x,2	0.007 mV
0,2,x,3	0.007 mV
0,2,x,4	0.010 mV
0,2,x,5	0.002 mV
0,2,x,6	0.001 mV
0,2,x,7	0.023 mV

AdcBw 51200Hz, Range 0.316V Direct voltage IR <= 316mV Spec: <= ±0.316 mV Uncertainty: 4.8µV	
Chan	Value
0,1,x,0	-0.001 mV
0,1,x,1	-0.003 mV
0,1,x,2	0.003 mV
0,1,x,3	0.007 mV
0,1,x,4	0.002 mV
0,1,x,5	0.002 mV
0,1,x,6	0.002 mV
0,1,x,7	0.001 mV
0,2,x,0	0.005 mV
0,2,x,1	0.005 mV
0,2,x,2	0.001 mV
0,2,x,3	0.001 mV
0,2,x,4	-0.001 mV
0,2,x,5	-0.004 mV
0,2,x,6	0.001 mV
0,2,x,7	0.000 mV

AdcBw 51200Hz, Range 3.16V Direct voltage 1V < IR <= 3.16V Spec: <= ±3.160 mV Uncertainty: 8µV	
Chan	Value
0,1,x,0	0.006 mV
0,1,x,1	0.002 mV
0,1,x,2	0.024 mV
0,1,x,3	0.016 mV
0,1,x,4	0.014 mV
0,1,x,5	0.005 mV
0,1,x,6	0.017 mV
0,1,x,7	0.005 mV
0,2,x,0	0.008 mV
0,2,x,1	0.011 mV
0,2,x,2	0.009 mV
0,2,x,3	0.011 mV
0,2,x,4	0.013 mV
0,2,x,5	-0.002 mV
0,2,x,6	0.013 mV
0,2,x,7	0.014 mV

AdcBw 102400Hz, Range 1V Direct voltage 316mV < IR <= 1V Spec: <= ±1.000 mV Uncertainty: 5.2µV	
Chan	Value
0,1,x,0	0.003 mV
0,1,x,1	-0.000 mV
0,1,x,2	0.005 mV
0,1,x,3	0.010 mV
0,1,x,4	0.007 mV
0,1,x,5	0.008 mV
0,1,x,6	0.006 mV
0,1,x,7	0.011 mV
0,2,x,0	0.009 mV
0,2,x,1	0.007 mV
0,2,x,2	0.003 mV
0,2,x,3	0.004 mV
0,2,x,4	0.003 mV
0,2,x,5	-0.000 mV
0,2,x,6	0.002 mV
0,2,x,7	0.004 mV

AdcBw 102400Hz, Range 10V Direct voltage 3.16V < IR <= 10V Spec: <= ±10.000 mV Uncertainty: 21µV	
Chan	Value
0,1,x,0	0.024 mV
0,1,x,1	0.025 mV
0,1,x,2	0.057 mV
0,1,x,3	0.035 mV
0,1,x,4	0.033 mV
0,1,x,5	0.008 mV
0,1,x,6	0.044 mV
0,1,x,7	0.017 mV
0,2,x,0	0.036 mV
0,2,x,1	0.044 mV
0,2,x,2	0.020 mV
0,2,x,3	0.012 mV
0,2,x,4	0.024 mV
0,2,x,5	0.024 mV
0,2,x,6	0.024 mV
0,2,x,7	0.050 mV

AdcBw 51200Hz, Range 1V Direct voltage 316mV < IR <= 1V Spec: <= ±1.000 mV Uncertainty: 5.2µV	
Chan	Value
0,1,x,0	0.003 mV
0,1,x,1	-0.003 mV
0,1,x,2	0.007 mV
0,1,x,3	0.007 mV
0,1,x,4	0.005 mV
0,1,x,5	0.002 mV
0,1,x,6	0.004 mV
0,1,x,7	0.001 mV
0,2,x,0	0.007 mV
0,2,x,1	0.005 mV
0,2,x,2	0.003 mV
0,2,x,3	0.005 mV
0,2,x,4	0.002 mV
0,2,x,5	-0.003 mV
0,2,x,6	0.002 mV
0,2,x,7	0.003 mV

AdcBw 51200Hz, Range 10V Direct voltage 3.16V < IR <= 10V Spec: <= ±10.000 mV Uncertainty: 21µV	
Chan	Value
0,1,x,0	0.022 mV
0,1,x,1	0.023 mV
0,1,x,2	0.054 mV
0,1,x,3	0.046 mV
0,1,x,4	0.013 mV
0,1,x,5	0.029 mV
0,1,x,6	0.036 mV
0,1,x,7	0.020 mV
0,2,x,0	0.032 mV
0,2,x,1	0.054 mV
0,2,x,2	0.033 mV
0,2,x,3	0.020 mV
0,2,x,4	0.040 mV
0,2,x,5	-0.017 mV
0,2,x,6	0.037 mV
0,2,x,7	0.039 mV

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AdcBw 25600Hz, Range 0.316V Direct voltage IR <= 316mV Spec: <= ±0.316 mV Uncertainty: 4.8µV	
Chan	Value
0,1,x,0	0.003 mV
0,1,x,1	-0.003 mV
0,1,x,2	0.004 mV
0,1,x,3	0.003 mV
0,1,x,4	0.001 mV
0,1,x,5	0.004 mV
0,1,x,6	-0.002 mV
0,1,x,7	0.002 mV
0,2,x,0	0.004 mV
0,2,x,1	0.002 mV
0,2,x,2	-0.001 mV
0,2,x,3	0.002 mV
0,2,x,4	-0.001 mV
0,2,x,5	-0.005 mV
0,2,x,6	0.004 mV
0,2,x,7	-0.002 mV

AdcBw 25600Hz, Range 3.16V Direct voltage 1V < IR <= 3.16V Spec: <= ±3.160 mV Uncertainty: 8µV	
Chan	Value
0,1,x,0	0.008 mV
0,1,x,1	-0.005 mV
0,1,x,2	0.021 mV
0,1,x,3	0.014 mV
0,1,x,4	0.008 mV
0,1,x,5	0.009 mV
0,1,x,6	0.013 mV
0,1,x,7	0.010 mV
0,2,x,0	0.014 mV
0,2,x,1	0.010 mV
0,2,x,2	0.009 mV
0,2,x,3	0.009 mV
0,2,x,4	0.012 mV
0,2,x,5	-0.006 mV
0,2,x,6	0.013 mV
0,2,x,7	0.012 mV

AdcBw 25600Hz, Range 1V Direct voltage 316mV < IR <= 1V Spec: <= ±1.000 mV Uncertainty: 5.2µV	
Chan	Value
0,1,x,0	0.005 mV
0,1,x,1	-0.004 mV
0,1,x,2	0.005 mV
0,1,x,3	0.006 mV
0,1,x,4	0.005 mV
0,1,x,5	0.004 mV
0,1,x,6	0.002 mV
0,1,x,7	0.003 mV
0,2,x,0	0.007 mV
0,2,x,1	0.002 mV
0,2,x,2	0.002 mV
0,2,x,3	0.007 mV
0,2,x,4	0.001 mV
0,2,x,5	-0.001 mV
0,2,x,6	0.004 mV
0,2,x,7	0.003 mV

AdcBw 25600Hz, Range 10V Direct voltage 3.16V < IR <= 10V Spec: <= ±10.000 mV Uncertainty: 21µV	
Chan	Value
0,1,x,0	0.021 mV
0,1,x,1	-0.005 mV
0,1,x,2	0.053 mV
0,1,x,3	0.038 mV
0,1,x,4	0.046 mV
0,1,x,5	0.034 mV
0,1,x,6	0.043 mV
0,1,x,7	0.012 mV
0,2,x,0	0.050 mV
0,2,x,1	0.017 mV
0,2,x,2	0.029 mV
0,2,x,3	0.023 mV
0,2,x,4	0.047 mV
0,2,x,5	0.010 mV
0,2,x,6	0.029 mV
0,2,x,7	0.036 mV

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4.3 Total Harmonic Distortion

Description of calibration:
Determination of the harmonic distortion of the input channels over all input ranges, by applying an accurate 1kHz -3dBFS (max 4V) sine wave which is generated by the internal reference generator. For charge amplifiers, the reference voltage signal is translated to a reference charge signal. Harmonic components 2, 3, 4 and 5 are determined to calculate the harmonic content (either in Volt or Coulomb, depending on the input channel type) and the ratio between the fundamental tone and its harmonics (in dB).

Range 10V
Distortion 3.16V < IR <= 10V
Spec: <= -94.0dB
Uncertainty: 2.6µV

Chan	Value
0,1,x,0	13.957 µV, -109.1dB
0,1,x,1	14.186 µV, -109.0dB
0,1,x,2	13.857 µV, -109.2dB
0,1,x,3	14.156 µV, -109.0dB
0,1,x,4	14.211 µV, -109.0dB
0,1,x,5	13.944 µV, -109.2dB
0,1,x,6	14.361 µV, -108.9dB
0,1,x,7	14.856 µV, -108.6dB
0,2,x,0	14.242 µV, -109.0dB
0,2,x,1	14.357 µV, -108.9dB
0,2,x,2	13.956 µV, -109.1dB
0,2,x,3	14.460 µV, -108.8dB
0,2,x,4	14.146 µV, -109.0dB
0,2,x,5	14.835 µV, -108.6dB
0,2,x,6	13.401 µV, -109.5dB
0,2,x,7	15.577 µV, -108.2dB

Range 1 V
Distortion 316mV < IR <= 1V
Spec: <= -94.0dB
Uncertainty: 290nV

Chan	Value
0,1,x,0	3.486 µV, -106.1dB
0,1,x,1	3.403 µV, -106.4dB
0,1,x,2	3.676 µV, -105.7dB
0,1,x,3	3.348 µV, -106.5dB
0,1,x,4	3.489 µV, -106.1dB
0,1,x,5	3.314 µV, -106.6dB
0,1,x,6	3.826 µV, -105.3dB
0,1,x,7	3.525 µV, -106.0dB
0,2,x,0	3.305 µV, -106.6dB
0,2,x,1	3.392 µV, -106.4dB
0,2,x,2	2.942 µV, -107.6dB
0,2,x,3	3.093 µV, -107.2dB
0,2,x,4	3.520 µV, -106.1dB
0,2,x,5	3.712 µV, -105.6dB
0,2,x,6	3.693 µV, -105.6dB
0,2,x,7	3.616 µV, -105.8dB

Range 3.16V
Distortion 1V < IR <= 3.16V
Spec: <= -94.0dB
Uncertainty: 0.8µV

Chan	Value
0,1,x,0	7.051 µV, -110.0dB
0,1,x,1	7.029 µV, -110.0dB
0,1,x,2	6.916 µV, -110.2dB
0,1,x,3	6.992 µV, -110.1dB
0,1,x,4	7.025 µV, -110.1dB
0,1,x,5	7.099 µV, -110.0dB
0,1,x,6	7.951 µV, -109.0dB
0,1,x,7	8.450 µV, -108.4dB
0,2,x,0	7.248 µV, -109.8dB
0,2,x,1	8.000 µV, -108.9dB
0,2,x,2	6.448 µV, -110.8dB
0,2,x,3	6.918 µV, -110.2dB
0,2,x,4	7.573 µV, -109.4dB
0,2,x,5	8.423 µV, -108.5dB
0,2,x,6	6.587 µV, -110.6dB
0,2,x,7	9.166 µV, -107.7dB

Range 0.316V
Distortion 100mV < IR <= 316mV
Spec: <= -91.0dB
Uncertainty: 140nV

Chan	Value
0,1,x,0	3.069 µV, -97.2dB
0,1,x,1	3.126 µV, -97.1dB
0,1,x,2	3.278 µV, -96.7dB
0,1,x,3	3.146 µV, -97.0dB
0,1,x,4	3.132 µV, -97.1dB
0,1,x,5	3.132 µV, -97.1dB
0,1,x,6	3.390 µV, -96.4dB
0,1,x,7	3.171 µV, -97.0dB
0,2,x,0	3.046 µV, -97.3dB
0,2,x,1	3.291 µV, -96.6dB
0,2,x,2	2.925 µV, -97.7dB
0,2,x,3	3.050 µV, -97.3dB
0,2,x,4	3.217 µV, -96.8dB
0,2,x,5	3.498 µV, -96.1dB
0,2,x,6	3.566 µV, -95.9dB
0,2,x,7	3.258 µV, -96.7dB

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4.4 RMS Noise

Description of calibration:
Determination of the noise contribution of the input channels, by internally shorting the input channels to ground. The reported values are RMS values over the corresponding bandwidth.

Range 10V, Bw 80kHz
Not in Scope
Spec: < 311.0000µVrms

Chan	Value
0,1,x,0	219.0446µVrms
0,1,x,1	215.5567µVrms
0,1,x,2	214.0229µVrms
0,1,x,3	211.9270µVrms
0,1,x,4	214.3002µVrms
0,1,x,5	214.2469µVrms
0,1,x,6	215.3279µVrms
0,1,x,7	211.1399µVrms
0,2,x,0	216.1295µVrms
0,2,x,1	229.9419µVrms
0,2,x,2	237.2607µVrms
0,2,x,3	217.7047µVrms
0,2,x,4	213.7526µVrms
0,2,x,5	215.1412µVrms
0,2,x,6	223.5220µVrms
0,2,x,7	214.6153µVrms

Range 10V, Bw 40kHz
Not in Scope
Spec: < 42.0000µVrms

Chan	Value
0,1,x,0	30.4720µVrms
0,1,x,1	29.9859µVrms
0,1,x,2	29.7392µVrms
0,1,x,3	29.6890µVrms
0,1,x,4	30.1631µVrms
0,1,x,5	29.8736µVrms
0,1,x,6	30.0771µVrms
0,1,x,7	29.8148µVrms
0,2,x,0	29.7523µVrms
0,2,x,1	32.9458µVrms
0,2,x,2	33.7534µVrms
0,2,x,3	30.9976µVrms
0,2,x,4	30.1570µVrms
0,2,x,5	30.5237µVrms
0,2,x,6	31.6733µVrms
0,2,x,7	30.4409µVrms

Range 10V, Bw 20kHz
Noise 3.16V < IR <= 10V
Spec: <= 29.000 µV
Uncertainty: 3.4nV

Chan	Value
0,1,x,0	20.547 µV
0,1,x,1	20.520 µV
0,1,x,2	20.342 µV
0,1,x,3	19.928 µV
0,1,x,4	20.965 µV
0,1,x,5	20.080 µV
0,1,x,6	20.444 µV
0,1,x,7	20.056 µV
0,2,x,0	20.199 µV
0,2,x,1	20.513 µV
0,2,x,2	20.464 µV
0,2,x,3	20.991 µV
0,2,x,4	20.520 µV
0,2,x,5	20.915 µV
0,2,x,6	20.524 µV
0,2,x,7	20.505 µV

Range 0.316V, Bw 80kHz
Not in Scope
Spec: < 10.5000µVrms

Chan	Value
0,1,x,0	7.3205µVrms
0,1,x,1	7.3448µVrms
0,1,x,2	7.1902µVrms
0,1,x,3	7.1770µVrms
0,1,x,4	7.1586µVrms
0,1,x,5	7.2702µVrms
0,1,x,6	7.2457µVrms
0,1,x,7	7.0986µVrms
0,2,x,0	7.3025µVrms
0,2,x,1	7.7135µVrms
0,2,x,2	7.7701µVrms
0,2,x,3	7.2762µVrms
0,2,x,4	7.1374µVrms
0,2,x,5	7.2662µVrms
0,2,x,6	7.5538µVrms
0,2,x,7	7.2434µVrms

Range 0.316V, Bw 40kHz
Not in Scope
Spec: < 2.8000µVrms

Chan	Value
0,1,x,0	2.1055µVrms
0,1,x,1	2.0961µVrms
0,1,x,2	2.0925µVrms
0,1,x,3	2.0993µVrms
0,1,x,4	2.0962µVrms
0,1,x,5	2.1039µVrms
0,1,x,6	2.1076µVrms
0,1,x,7	2.1053µVrms
0,2,x,0	2.0782µVrms
0,2,x,1	2.1181µVrms
0,2,x,2	2.1473µVrms
0,2,x,3	2.0894µVrms
0,2,x,4	2.0762µVrms
0,2,x,5	2.0870µVrms
0,2,x,6	2.1065µVrms
0,2,x,7	2.0784µVrms

Range 0.316V, Bw 20kHz
Noise IR <= 316mV
Spec: <= 1.980 µV
Uncertainty: 2.0nV

Chan	Value
0,1,x,0	1.491 µV
0,1,x,1	1.489 µV
0,1,x,2	1.477 µV
0,1,x,3	1.483 µV
0,1,x,4	1.478 µV
0,1,x,5	1.487 µV
0,1,x,6	1.491 µV
0,1,x,7	1.482 µV
0,2,x,0	1.463 µV
0,2,x,1	1.472 µV
0,2,x,2	1.505 µV
0,2,x,3	1.475 µV
0,2,x,4	1.489 µV
0,2,x,5	1.480 µV
0,2,x,6	1.475 µV
0,2,x,7	1.465 µV

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4.5 Spurious Free Floor

Description of calibration:
Determination of the peak spurious components generated by the input channels, by internally shorting the input channels to ground. The reported values are peak values over the corresponding bandwidth.

Range 10V, Bw 80kHz Not in Scope Spec: < 40.0000µV	
Chan	Value
0,1,x,0	19.2538µV
0,1,x,1	18.7518µV
0,1,x,2	22.2457µV
0,1,x,3	21.8555µV
0,1,x,4	19.2275µV
0,1,x,5	21.6950µV
0,1,x,6	19.8464µV
0,1,x,7	21.3278µV
0,2,x,0	23.2187µV
0,2,x,1	19.2456µV
0,2,x,2	24.0384µV
0,2,x,3	22.7264µV
0,2,x,4	18.8870µV
0,2,x,5	17.6961µV
0,2,x,6	24.2841µV
0,2,x,7	23.4342µV

Range 10V, Bw 40kHz Not in Scope Spec: < 3.0000µV	
Chan	Value
0,1,x,0	1.8185µV
0,1,x,1	2.1372µV
0,1,x,2	1.8303µV
0,1,x,3	1.5170µV
0,1,x,4	1.7215µV
0,1,x,5	1.4665µV
0,1,x,6	1.7835µV
0,1,x,7	1.9818µV
0,2,x,0	1.5034µV
0,2,x,1	2.1010µV
0,2,x,2	2.1691µV
0,2,x,3	1.9195µV
0,2,x,4	2.3745µV
0,2,x,5	2.0012µV
0,2,x,6	1.9528µV
0,2,x,7	2.4614µV

Range 10V, Bw 20kHz Spurious 3.16V < IR <= 10V Spec: <= 2.300 µV Uncertainty: 3.4nV	
Chan	Value
0,1,x,0	1.435 µV
0,1,x,1	1.487 µV
0,1,x,2	1.256 µV
0,1,x,3	1.365 µV
0,1,x,4	1.251 µV
0,1,x,5	1.140 µV
0,1,x,6	1.261 µV
0,1,x,7	1.195 µV
0,2,x,0	1.217 µV
0,2,x,1	1.296 µV
0,2,x,2	1.364 µV
0,2,x,3	1.812 µV
0,2,x,4	0.974 µV
0,2,x,5	2.232 µV
0,2,x,6	1.387 µV
0,2,x,7	1.402 µV

ICP Not in Scope Spec: < 0.2600µVp	
Chan	Value
0,1,x,0	0.0767µVp
0,1,x,1	0.0727µVp
0,1,x,2	0.0826µVp
0,1,x,3	0.0991µVp
0,1,x,4	0.0860µVp
0,1,x,5	0.0793µVp
0,1,x,6	0.0993µVp
0,1,x,7	0.0853µVp
0,2,x,0	0.0950µVp
0,2,x,1	0.0848µVp
0,2,x,2	0.0896µVp
0,2,x,3	0.0841µVp
0,2,x,4	0.0791µVp
0,2,x,5	0.0866µVp
0,2,x,6	0.0804µVp
0,2,x,7	0.0679µVp

Range 0.316V, Bw 80kHz Not in Scope Spec: < 1.2000µV	
Chan	Value
0,1,x,0	0.7142µV
0,1,x,1	0.6543µV
0,1,x,2	0.5939µV
0,1,x,3	0.5608µV
0,1,x,4	0.6519µV
0,1,x,5	0.5498µV
0,1,x,6	0.5648µV
0,1,x,7	0.6774µV
0,2,x,0	0.6248µV
0,2,x,1	0.6736µV
0,2,x,2	0.7115µV
0,2,x,3	0.8499µV
0,2,x,4	0.6765µV
0,2,x,5	0.6215µV
0,2,x,6	0.6478µV
0,2,x,7	0.6009µV

Range 0.316V, Bw 40kHz Not in Scope Spec: < 0.1600µV	
Chan	Value
0,1,x,0	0.0839µV
0,1,x,1	0.0835µV
0,1,x,2	0.0898µV
0,1,x,3	0.0987µV
0,1,x,4	0.0982µV
0,1,x,5	0.1038µV
0,1,x,6	0.0782µV
0,1,x,7	0.1087µV
0,2,x,0	0.0873µV
0,2,x,1	0.0876µV
0,2,x,2	0.1089µV
0,2,x,3	0.0865µV
0,2,x,4	0.0995µV
0,2,x,5	0.0865µV
0,2,x,6	0.0864µV
0,2,x,7	0.0806µV

Range 0.316V, Bw 20kHz Spurious IR <= 316mV Spec: <= 0.130 µV Uncertainty: 2.0nV	
Chan	Value
0,1,x,0	0.077 µV
0,1,x,1	0.071 µV
0,1,x,2	0.064 µV
0,1,x,3	0.064 µV
0,1,x,4	0.059 µV
0,1,x,5	0.070 µV
0,1,x,6	0.067 µV
0,1,x,7	0.077 µV
0,2,x,0	0.075 µV
0,2,x,1	0.084 µV
0,2,x,2	0.083 µV
0,2,x,3	0.067 µV
0,2,x,4	0.060 µV
0,2,x,5	0.071 µV
0,2,x,6	0.063 µV
0,2,x,7	0.061 µV

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4.6 Inter-channel Crosstalk

Description of calibration:
Determination of the crosstalk between the input channels in a system. The channel under calibration is internally shorted to ground, while its neighbour channels are fed with a near full scale sine wave signal which is generated by the internal reference generator. This is done for two input range settings of the channel under calibration, and two signal frequencies. The reported results represent the measured crosstalk values in the channels under calibration (either in Volt or Coulomb, depending on the input channel type) and the ratio between the applied signal amplitude and the crosstalk values (in dB).

Range 0.316V, F 1K5 Crosstalk 100mV < IR <= 316mV Spec: <= -120.0dB Uncertainty: 68nV	
Chan	Value
0,1,x,0	0.124 µV, -132.1dB
0,1,x,1	0.120 µV, -132.4dB
0,1,x,2	0.124 µV, -132.1dB
0,1,x,3	0.106 µV, -133.5dB
0,1,x,4	0.092 µV, -134.7dB
0,1,x,5	0.071 µV, -136.9dB
0,1,x,6	0.103 µV, -133.7dB
0,1,x,7	0.102 µV, -133.8dB
0,2,x,0	0.128 µV, -131.9dB
0,2,x,1	0.116 µV, -132.7dB
0,2,x,2	0.133 µV, -131.5dB
0,2,x,3	0.102 µV, -133.8dB
0,2,x,4	0.096 µV, -134.3dB
0,2,x,5	0.090 µV, -134.9dB
0,2,x,6	0.130 µV, -131.7dB
0,2,x,7	0.137 µV, -131.2dB

Range 10V, F 1K5 Crosstalk 3.16V < IR <= 10V Spec: <= -108.0dB Uncertainty: 1.3µV	
Chan	Value
0,1,x,0	0.310 µV, -124.2dB
0,1,x,1	0.528 µV, -119.5dB
0,1,x,2	0.361 µV, -122.8dB
0,1,x,3	0.460 µV, -120.7dB
0,1,x,4	0.249 µV, -126.0dB
0,1,x,5	0.469 µV, -120.6dB
0,1,x,6	0.347 µV, -123.2dB
0,1,x,7	0.402 µV, -121.9dB
0,2,x,0	0.247 µV, -126.1dB
0,2,x,1	0.337 µV, -123.4dB
0,2,x,2	0.180 µV, -128.9dB
0,2,x,3	0.478 µV, -120.4dB
0,2,x,4	0.258 µV, -125.8dB
0,2,x,5	0.467 µV, -120.6dB
0,2,x,6	0.504 µV, -119.9dB
0,2,x,7	0.128 µV, -131.8dB

Range 0.316V, F 15K Crosstalk 100mV < IR <= 316mV Spec: <= -107.0dB Uncertainty: 68nV	
Chan	Value
0,1,x,0	0.815 µV, -115.8dB
0,1,x,1	1.362 µV, -111.3dB
0,1,x,2	1.374 µV, -111.2dB
0,1,x,3	1.381 µV, -111.2dB
0,1,x,4	1.381 µV, -111.2dB
0,1,x,5	1.349 µV, -111.4dB
0,1,x,6	1.181 µV, -112.5dB
0,1,x,7	1.116 µV, -113.0dB
0,2,x,0	0.818 µV, -115.7dB
0,2,x,1	1.330 µV, -111.5dB
0,2,x,2	1.387 µV, -111.1dB
0,2,x,3	1.377 µV, -111.2dB
0,2,x,4	1.373 µV, -111.2dB
0,2,x,5	1.340 µV, -111.4dB
0,2,x,6	1.240 µV, -112.1dB
0,2,x,7	1.084 µV, -113.3dB

Range 10V, F 15K Crosstalk 3.16V < IR <= 10V Spec: <= -105.0dB Uncertainty: 1.3µV	
Chan	Value
0,1,x,0	0.911 µV, -114.8dB
0,1,x,1	1.402 µV, -111.0dB
0,1,x,2	1.593 µV, -109.9dB
0,1,x,3	1.599 µV, -109.9dB
0,1,x,4	1.723 µV, -109.3dB
0,1,x,5	1.399 µV, -111.1dB
0,1,x,6	1.602 µV, -109.9dB
0,1,x,7	1.082 µV, -113.3dB
0,2,x,0	0.910 µV, -114.8dB
0,2,x,1	1.560 µV, -110.1dB
0,2,x,2	1.548 µV, -110.2dB
0,2,x,3	1.506 µV, -110.4dB
0,2,x,4	1.460 µV, -110.7dB
0,2,x,5	1.464 µV, -110.7dB
0,2,x,6	1.752 µV, -109.1dB
0,2,x,7	1.130 µV, -112.9dB

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4.7 Inter-channel Phase Match

Description of calibration:
Determination of the phase difference between the input channels in a system, by applying an accurate -3dBFS (max 4V) sine wave which is generated by the internal reference generator. For charge amplifiers, the reference voltage signal is translated to a reference charge signal. The reported values represent the highest phase differences found between any of the channels in the system. This is done for two input range settings and two signal frequencies.

Range 10V, F 9k9 Not in Scope Spec: < 0.3000°	
Chan	Value
0,1,x,0	0.0169°
0,1,x,1	0.0308°
0,1,x,2	0.0242°
0,1,x,3	0.0170°
0,1,x,4	0.0237°
0,1,x,5	0.0230°
0,1,x,6	0.0156°
0,1,x,7	0.0291°
0,2,x,0	0.0308°
0,2,x,1	0.0191°
0,2,x,2	0.0210°
0,2,x,3	0.0175°
0,2,x,4	0.0158°
0,2,x,5	0.0219°
0,2,x,6	0.0200°
0,2,x,7	0.0279°

Range 10V, F 19k9 Not in Scope Spec: < 0.4000°	
Chan	Value
0,1,x,0	0.0333°
0,1,x,1	0.0612°
0,1,x,2	0.0483°
0,1,x,3	0.0333°
0,1,x,4	0.0471°
0,1,x,5	0.0461°
0,1,x,6	0.0306°
0,1,x,7	0.0593°
0,2,x,0	0.0612°
0,2,x,1	0.0389°
0,2,x,2	0.0424°
0,2,x,3	0.0358°
0,2,x,4	0.0318°
0,2,x,5	0.0437°
0,2,x,6	0.0398°
0,2,x,7	0.0554°

Range 0.316V, F 9k9 Not in Scope Spec: < 0.3000°	
Chan	Value
0,1,x,0	0.0473°
0,1,x,1	0.0646°
0,1,x,2	0.0699°
0,1,x,3	0.0613°
0,1,x,4	0.0665°
0,1,x,5	0.0544°
0,1,x,6	0.0494°
0,1,x,7	0.0454°
0,2,x,0	0.0563°
0,2,x,1	0.0689°
0,2,x,2	0.0515°
0,2,x,3	0.0642°
0,2,x,4	0.0859°
0,2,x,5	0.0732°
0,2,x,6	0.0859°
0,2,x,7	0.0594°

Range 0.316V, F 19k9 Not in Scope Spec: < 0.6000°	
Chan	Value
0,1,x,0	0.0923°
0,1,x,1	0.1270°
0,1,x,2	0.1372°
0,1,x,3	0.1198°
0,1,x,4	0.1303°
0,1,x,5	0.1121°
0,1,x,6	0.1013°
0,1,x,7	0.0870°
0,2,x,0	0.1124°
0,2,x,1	0.1369°
0,2,x,2	0.1028°
0,2,x,3	0.1296°
0,2,x,4	0.1720°
0,2,x,5	0.1464°
0,2,x,6	0.1720°
0,2,x,7	0.1199°

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5 SYSCON_REC_h11s0

5.1 Gain Accuracy after Adjustment

Description of calibration:
Determination of the amplitude accuracy of the input channels over all input ranges and available ADC bandwidths, by applying an accurate 1kHz -3dBFS (max 4V) sine wave which is generated by the internal reference generator. For charge amplifiers, the reference voltage signal is translated to a reference charge signal.
The reported values represent the deviations from the expected signal amplitude, both absolute (either in Volt or Coulomb, depending on the input channel type) and relative (in %).

BW 25k6 **Alternating voltage 3.16V < IR <= 10V** **Spec: <= ±0.100%** **Uncertainty: 640µV**	
Chan	Value
0,x,x,0	0.239 mV, 0.006%
0,x,x,1	0.420 mV, 0.011%

BW 51k2 **Alternating voltage 3.16V < IR <= 10V** **Spec: <= ±0.100%** **Uncertainty: 640µV**	
Chan	Value
0,x,x,0	0.398 mV, 0.010%
0,x,x,1	0.529 mV, 0.013%

BW 102k4 **Not in Scope** **Spec: 1.00000 ±0.10%**	
Chan	Value
0,x,x,0	1.00008, 0.01%
0,x,x,1	1.00012, 0.01%

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West Caldwell Calibration Laboratories Inc.

Certificate of Calibration

for

ACOUSTICAL CALIBRATOR

Manufactured by:	BRUEL & KJAER
Model No:	4231
Serial No:	2513182
Calibration Recall No:	27880

Submitted By:

Customer:

Company: Aercoustics Egineering LTD

Address:

The subject instrument was calibrated to the indicated specification using standards traceable to the National Institute of Standards and Technology or to accepted values of natural physical constants. This document certifies that the instrument met the following specification upon its return to the submitter.

West Caldwell Calibration Laboratories Procedure No. 4231 BRUE

Upon receipt for Calibration, the instrument was found to be:

Within (X)

tolerance of the indicated specification. See attached Report of Calibration.

West Caldwell Calibration Laboratories' calibration control system meets the requirements, ISO 10012-1 MIL-STD-45662A, ANSI/NCSL Z540-1, IEC Guide 25, ISO 9001:2008 and ISO 17025.

Note: With this Certificate, Report of Calibration is included.

Approved by: FC

Calibration Date: 25-Jul-17

Felix Christopher (QA Mgr.)

Certificate No: 27880 - 2

ISO/IEC 17025:2005

ACCREDITED

Calibration Lab. Cert. # 1533.01

West Caldwell Calibration Laboratories, Inc.
uncompromised calibration
1575 State Route 96, Victor, NY 14564, U.S.A.

West Caldwell Calibration Laboratories, Inc.
uncompromised calibration
1575 State Route 96, Victor NY 14564

ISO/IEC 17025: 2005
ACCREDITED
Calibration Lab. Cert. # 1533.01

REPORT OF CALIBRATION

for

Brüel & Kjær Acoustical Calibrator **Model No.: 4231** **Serial No.: 2513182**
Company: Aercoustics Engineering LTD **ID No.: XXXX**

Calibration results:

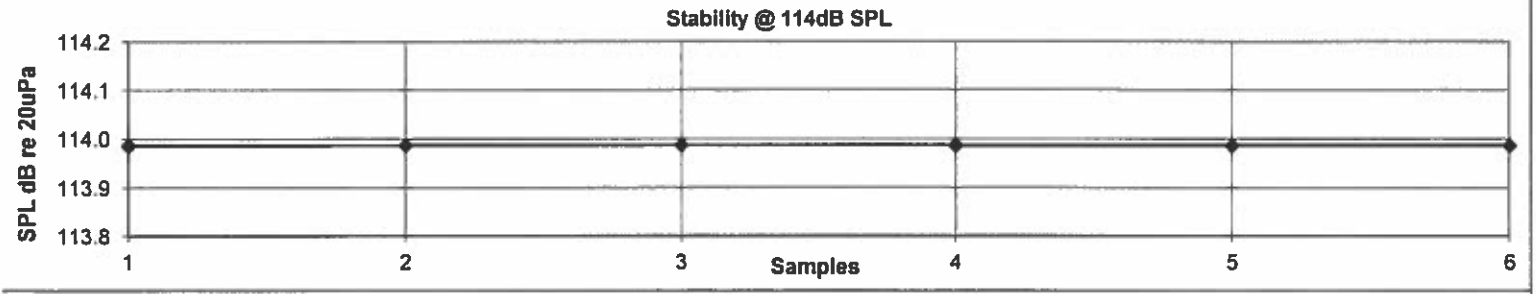
Before data: ..... **After data:** .....
Before & after data same: ...X...
Sound Pressure Level at 1000.0 Hz and pressure of 1013 hPa (mbar)
was 113.99 dB re 20µPa
(Calibrator tested with ½" adaptor UC 0210)
IEC 1094-4 Type WS 2 P Microphone was used for measurement.

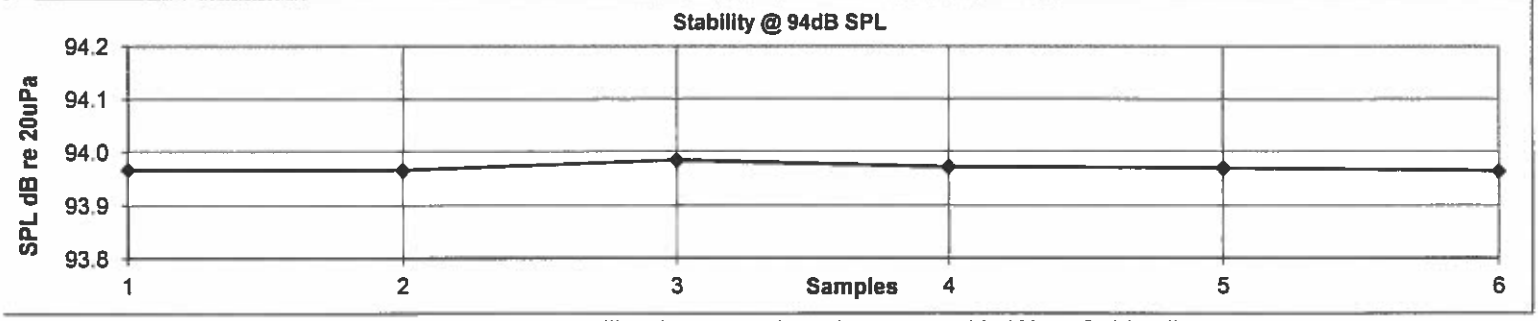
	114dB	94dB
Sound Pressure Level:	Pass	Pass
Frequency:	Pass	Pass
Distortion:	Pass	Pass
Stability:	Pass	Pass
All tested parameters:		Pass

Laboratory Environment:		
Ambient Temperature:	22.6	°C
Ambient Humidity:	54.8	% RH
Ambient Pressure:	99.611	kPa
Calibration Date:	25-Jul-2017	
Calibration Due:	25-Jul-2019	
Report Number:	27880 -2	
Control Number:	27880	

The above listed instrument meets or exceeds the tested manufacturer's specifications
The IEC 942:1988 Class 1 specifications, passed.
The ANSI S1.4-1984 specifications, passed.
This Calibration is traceable through NIST test numbers: 683/284413-14
The expanded uncertainty of calibration: 0.09dB at 95% confidence level with a coverage factor of k=2.

Graph represents six samples of Sound Pressure Level measured at 5sec. interval.





The above listed instrument was checked using calibration procedure documented in West Caldwell Calibration Laboratories Inc. procedure : **Rev. 7.0 Jan. 24, 2014 Doc. # 1038 4231B&K**

Calibration was performed by West Caldwell Calibration Laboratories Inc. under Operating Procedures intended to implement the requirements of ISO10012-1, IEC Guide 25, ANSI/NCSL Z540-1, (MIL-STD-45662A) and ISO 9001:2008, ISO 17025

Cal. Date: 25-Jul-2017

Measurements performed by: .....
James Zhu

Calibrated on WCCL system type 9700

West Caldwell Calibration Laboratories Inc.
1575 State Route 96, Victor NY 14564
Tel. (585) 586-3900 FAX (585) 586-4327

Calibration Data Record

for

Brüel & Kjær Acoustical Calibrator **Model No.: 4231** **Serial No.: 2513182**
Company: Aercoustics Engineering LTD

All tested parameters: Pass

Measured Sound Pressure Level (Six samples measured at 5 sec. interval)

Sample	1	113.99 dB re 20µPa		93.97 dB re 20µPa	
	2	113.99		93.97	
	3	113.99		93.98	
	4	113.99		93.97	
	5	113.99		93.97	
	6	113.99		93.96	
	Average	**113.99**	Spec. 114dB ± 0.2dB	**93.97**	Spec. 94dB ± 0.2dB

Frequency measured (Three samples at 30 sec. Interval)

Sample	1	999.98 Hz		1000.00 Hz	
	2	999.98		999.96	
	3	999.98		999.95	
	Average	**999.98**		**999.97**	Spec. 1000Hz ±0.1%

The Frequency expanded uncertainty of calibration:45µHz/Hz at 95% confidence level with a coverage factor of k=2.

Distortion measured	-49.9 dB		-46.6 dB	Spec. ≤-40dB

Instruments used for calibration:			Date of Cal.	Traceability No.	Re-cal. Due Date
Brüel & Kjær	4231	S/N 2205492	1-Nov-2016	683/284413-14	1-Nov-2017
Brüel & Kjær	4134	S/N 173494	1-Nov-2016	683/284413-14	1-Nov-2017
Brüel & Kjær	2669	S/N 1835080	1-Nov-2016	683/284413-14	1-Nov-2017
HP	34401A	S/N MY440029	1-Nov-2016	,287708	1-Nov-2017
Brüel & Kjær	2636	S/N 1487493	1-Nov-2016	683/284413-14	1-Nov-2017
HP	33120A	S/N SG400116	1-Nov-2016	,287708	1-Nov-2017

Cal. Date: 25-Jul-2017 **Tested by: James Zhu**

Calibrated on WCCL system type 9700

West Caldwell Calibration Laboratories Inc.

Certificate of Calibration

for

MICROPHONE UNIT

Manufactured by:	BRUEL & KJAER
Model No:	4189-A-021
Serial No:	2622170
Calibration Recall No:	28047

Submitted By:

Customer:

Company: Aercoustics Engineering LTD

Address:

The subject instrument was calibrated to the indicated specification using standards traceable to the National Institute of Standards and Technology or to accepted values of natural physical constants. This document certifies that the instrument met the following specification upon its return to the submitter.

West Caldwell Calibration Laboratories Procedure No. 4189-A-021 BRUE

Upon receipt for Calibration, the instrument was found to be:

Within (X)

tolerance of the indicated specification. See attached Report of Calibration.

West Caldwell Calibration Laboratories' calibration control system meets the requirements, ISO 10012-1 MIL-STD-45662A, ANSI/NCSL Z540-1, IEC Guide 25, ISO 9001:2008 and ISO 17025.

Note: With this Certificate, Report of Calibration is included.

Approved by: FC

Calibration Date: 20-Sep-17

Felix Christopher (QA Mgr.)

Certificate No: 28047 - 1

ISO/IEC 17025:2005

ACCREDITED

Calibration Lab. Cert. # 1533.01

uncompromised calibration West Caldwell Calibration Laboratories, Inc.
1575 State Route 96, Victor, NY 14564, U.S.A.

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1575 State Route 96, Victor NY 14564

ISO/IEC 17025: 2005
ACCREDITED
Calibration Lab. Cert. # 1533.01

REPORT OF CALIBRATION

for

Brüel & Kjær Microphone Unit

Model No.: 4189-A-021 — **Serial No.: 2622170**
Mic. Model No.: 4189 — **Serial No.: 2625197**
Preamp. Model No.: 2671 — **Serial No.: 2614901**
Company: Aercoustics Engineering LTD — **I. D. No.: XXXX**

Calibration results:

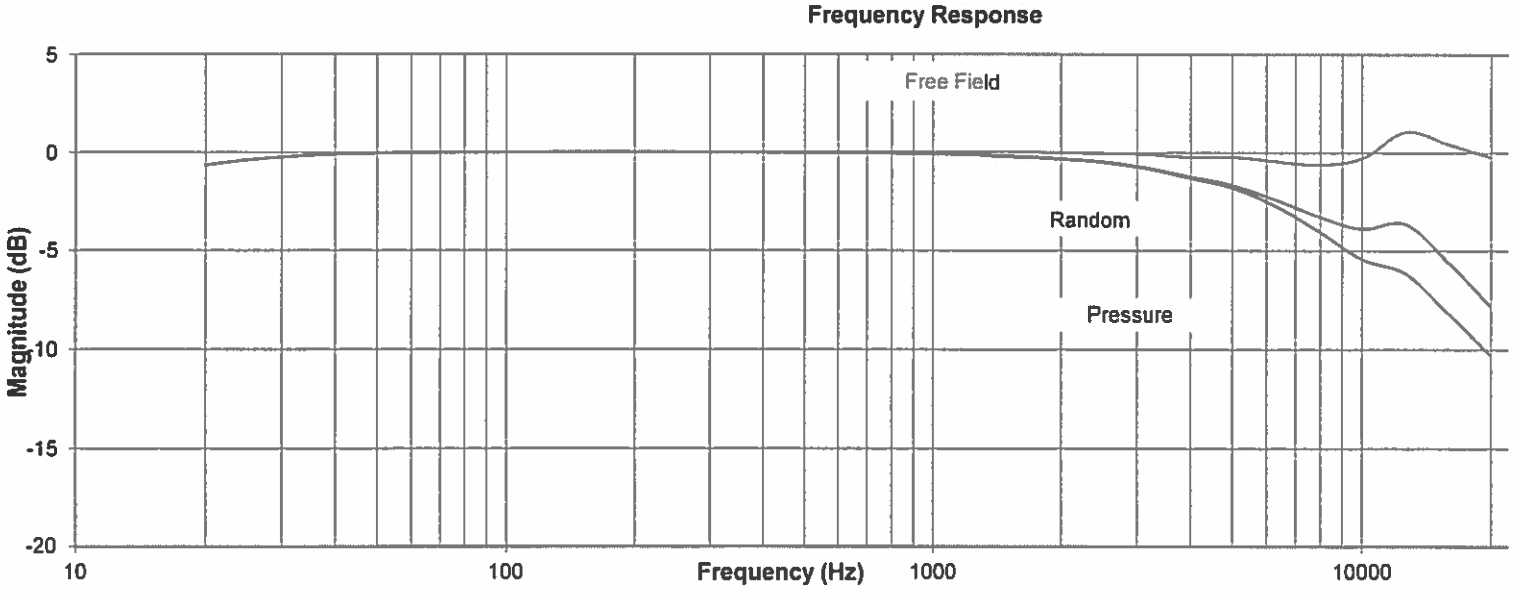
Before & after data same: ...X...

Combined Sensitivity @ **250** **Hz** **and pressure of** **99.456** **kPa**
(Sens. with mic. and preamp.) **0** Volts Polarization voltage (External):

-26.69 dB re.1V/Pascal
46.31 mV/Pascal
0.69 Ko (- dB re 50 mV/Pascal)
Sensitivity: **Pass**
Freq. Response: **Pass**
All tests: **Pass**

Ambient Temperature:	21.6	°C
Ambient Humidity:	53.6	% RH
Ambient Pressure:	99.456	kPa
Calibration Date:	20-Sep-2017	
Calibration Due:	20-Sep-2018	
Report Number:	28047	-1
Control Number:	28047	

The above listed instrument meets or exceeds the tested manufacturer's specifications.
The IEC 651:1979 & 1993 Type 1 specification passed.
This Calibration is traceable through NIST test numbers: 683/284413-14
The expanded uncertainty of calibration: 0.079dB at 95% confidence level with a coverage factor of k=2.
The pressure response recorded with electroacoustic method.



The above listed instrument was checked using calibration procedure documented in West Caldwell Calibration Laboratories Inc. procedure : **Rev. 7.0 Jan. 24, 2014 Doc. # 1038 P4189A021B&K**
Calibration was performed by West Caldwell Calibration Laboratories Inc. under Operating Procedures intended to implement the requirements of ISO10012-1, IEC Guide 25, ANSI/NCSL Z540-1, (MIL-STD-45662A) and ISO 9001:2008, ISO 17025

Measurements performed by: .....
James Zhu

Calibrated on WCCL system type 9700

West Caldwell Calibration Laboratories Inc.
1575 State Route 96, Victor NY 14564
Tel. (585) 586-3900 FAX (585) 586-4327

Calibration Data Record

for

Brüel & Kjær Microphone Unit **Model No.: 4189-A-021** **Serial No.: 2622170**
Company: Aercoustics Engineering LTD **I. D. No.: XXXX**

Frequency Response (Reference = 0 dB @ 250Hz)

Frequency [Hz]	Pressure [dB]	Free Field (dB)	Random (dB)
19.95	-0.65	-0.65	-0.65
25.12	-0.38	-0.38	-0.38
31.62	-0.21	-0.21	-0.21
39.81	-0.10	-0.10	-0.10
50.12	-0.04	-0.04	-0.04
63.10	-0.01	-0.01	-0.01
79.43	0.00	0.00	0.00
100.00	0.00	0.00	0.00
125.89	0.00	0.00	0.00
158.49	0.01	0.01	0.01
199.53	0.00	0.00	0.00
251.19	0.00	0.00	0.00
316.23	0.00	0.00	0.00
398.11	-0.01	0.00	-0.01
501.19	-0.01	0.01	-0.01
630.96	-0.02	0.02	-0.02
794.33	-0.04	0.03	-0.04
1000.00	-0.07	0.02	-0.09
1258.93	-0.11	0.04	-0.14
1584.89	-0.20	0.02	-0.25
1995.26	-0.33	-0.01	-0.34
2511.89	-0.51	-0.03	-0.47
3162.28	-0.81	-0.10	-0.77
3981.07	-1.30	-0.23	-1.21
5011.87	-1.80	-0.22	-1.66
6309.57	-2.72	-0.44	-2.41
7943.28	-4.00	-0.62	-3.25
10000.00	-5.41	-0.28	-3.87
12589.25	-6.14	1.05	-3.63
15848.93	-8.16	0.43	-5.57
19952.62	-10.27	-0.22	-7.79

Freq. response: Expanded Uncertainty (dB) with coverage factor K = 2
20 to 63Hz 0.1dB, 63 to 12.5kHz 0.094dB, 12.5k to 16kHz 0.10dB, 16k to 20kHz 0.5dB.

Instruments used for calibration:			Date of Cal.	Traceability No.	Re-cal. Due Date
Brüel & Kjær	4226	S/N 1445428	3-Nov-2016	683/284413-14	3-Nov-2017
Brüel & Kjær	3560	S/N 2202374	3-Nov-2016	683/284413-14	3-Nov-2017
HP	33120A	S/N 36043716	1-Oct-2016	,287708	1-Oct-2017
HP	34401A	S/N 36064102	1-Oct-2016	,287708	1-Oct-2017

Cal. Date: 20-Sep-2017 **Tested by: James Zhu**

Calibrated on WCCL system type 9700

Aercoustics Engineering Ltd.
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End of Report