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REPORT ID**: 15039.00.CP244.RP4**

Cedar Point Wind Power Project – Turbine WTG44 (CP244) IEC 61400-11 Edition 3.0 Measurement Report

Prepared for:

Cedar Point II Limited Partnership
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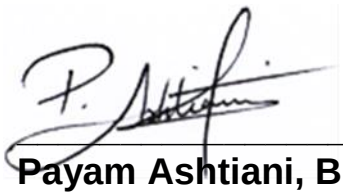

Payam Ashtiani, B.A.Sc., P.Eng.

March 07, 2018 – Revision 4

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SCC Accredited CB-P/S OCPS Accrédité CCN

Revision History

Revision Number	Description	Date
1	Issued Edition 2.1 test report	10.11.2016
2	Issued Edition 3.0 test report	07.11.2017
3	Minor changes to report tables and appendices to correct errors	26.01.2018
4	Updated to Edition 3.0 test report Section 3.2.1 and Appendix G Information for Regulator	09.03.2018

This report in its entirety, including appendices contains 133 pages.

Statement of 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.

Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. Aercoustics Engineering Limited accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

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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 WTG44 (CP244) 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 WTG44 (CP244).

2 Wind Turbine Information

2.1 Wind turbine equipment specific information

Wind turbine specific equipment information for turbine WTG44 (CP244) 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	2308923

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 Appendix B.01
Rotational speed at each integer standardised wind speed	See Appendix B.02
Rated power output	2221 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: 550329501 Blade B: 550241101 Blade C: 550240601
Number of blades	3

Table 4 - Gearbox Details

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

Table 5 - Generator Details

Generator Details	
Manufacturer	Siemens
Model number	DD22_01
Serial number	5100061140

2.2 Wind Turbine Location

Turbine WTG44 (CP244) is located in the municipality of Lambton near the town of Forest, Ontario. Specific UTM coordinates for WTG44 (CP244) are 409812 mE, 4769399 mN, Zone 17T. The area surrounding WTG44 (CP244) is flat and consists primarily of 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 WTG44 (CP244) is summarized in Table 6.

Table 6 - Acoustic Measurement Equipment

Equipment	Manufacturer Name & Model	Serial Number
Acoustic Data acquisition system	LMS SCADAS MOBILE	53103922
Microphone	B&K 4189	2625417
Pre-amplifier	B&K 2671	2614900
Acoustic calibrator	B&K 4231	3012378

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 angular yaw position from turbine WTG44 (CP244)'s nacelle yaw motor at a hub height of 99.5 meters. Data for background measurements was obtained from a 10m high anemometer, which was placed as per guidelines outlined in IEC-61400-11.

The meteorological equipment is summarized in Table 7

Table 7 – Meteorological Measurement Equipment

Equipment	Manufacturer Name & Model	Serial Number
Anemometer	VAISALA WXT520	G4420002
Serial to Analog Converter	NOKEVAL 7470	A159784

3.2 Measurement Setup

3.2.1 Microphone Placement

The measurement microphone was setup 156 meters downwind 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 WTG44 (CP244). The slant distance (R_1) from microphone location to rotor centre includes the distance from rotor center (hub) to tower axis (R_1 = 189.7m). 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 monitored 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.

When measurements of WTG44 (CP244) were taken, the surrounding land was planted with juvenile soy beans crop. The crop was short and as such the influence on the measurement was considered negligible. There were no nearby reflecting surfaces (houses, barns etc.); as such the influence from reflecting surfaces was considered to be negligible.

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
October 5, 2016	Background	12:33	12:39
	Turbine ON	12:42	12:48
	Turbine ON	12:57	13:00
	Background	13:02	13:33
	Turbine ON	13:40	14:09
	Background	14:12	14:38
	Turbine ON	14:46	15:47
	Turbine ON	16:31	17:45

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 WTG44 (CP244)'s power curve (as per the standard), while wind direction was provided by WTG44 (CP244)'s yaw position. Background data was obtained from an anemometer located 10m above ground level near WTG44 (CP244).

Temperature and pressure readings during the measurement period were provided by the 10m anemometer, located near turbine WTG44 (CP244) 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 >12.4 dB, and as such, the effect of this deviation on the resulting sound power levels are expected to be negligible. This method is in accordance with the recommendations made by the convenor of the IEC 61400-11 working group and is detailed in Note N6.023.17 and is provided in Appendix F.

4.2 Special Notes & Considerations

No special notes or considerations.

4.3 Analysis Details

The following section outlines analysis of the measurement data acquired for WTG44 (CP244). 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	50.3	22	37.9	18	50.0
7.5	51.9	46	38.3	30	51.7
8	52.9	79	38.3	23	52.7
8.5	53.2	88	38.2	33	53.0
9	53.0	107	38.3	29	52.9
9.5	52.8	80	38.2	38	52.7
10	52.7	140	38.0	28	52.5
10.5	52.6	143	38.6	30	52.4
11	52.6	93	38.4	24	52.4
11.5	52.7	52	38.6	26	52.5

4.6 Sound Power Level of Turbine

The calculated sound power level of the turbine WTG44 (CP244) (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	100.6	0.8
7.5	102.2	0.7
8	103.3	0.7
8.5	103.6	0.7
9	103.4	0.7
9.5	103.2	0.7
10	103.1	0.7
10.5	103.0	0.7
11	103.0	0.7
11.5	103.0	0.7

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

Wind Speed (m/s)	Apparent L_{WA}, (dBA)	Uncertainty (dB)
4	97.0	1.2
5	101.3	0.7
6	103.4	0.7
7	103.1	0.7
8	103.0	0.6
9	103.0	1.1

4.7 Tonality Analysis

The tonality analysis for Turbine WTG44 (CP244) 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 (%)
10.5	72	-3.4	-1.4	38	143	27%
11.5	71	-4.0	-2.0	13	52	25%

5 Closure

Measurements and analysis were carried on Turbine WTG44 (CP244) of the Cedar Point Wind Power Project, located in the municipality of Lambton as per International IEC 61400-11 (Edition 3.0, released 2012-11), "Wind turbine generator systems – Part 11: Acoustic noise measurement techniques".

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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Figure Title

Site Plan

Figure A.01

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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)	Electrical Power (kW)
0	0
1	0
2	0
3	66
4	171
5	350
6	620
7	997
8	1483
9	1963
10	2175
11	2217
12	2221
13	2221
14	2221
15	2221
16	2221
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18	2221
19	2221
20	2221
21	2221
22	2221
23	2221
24	2221
25	2221

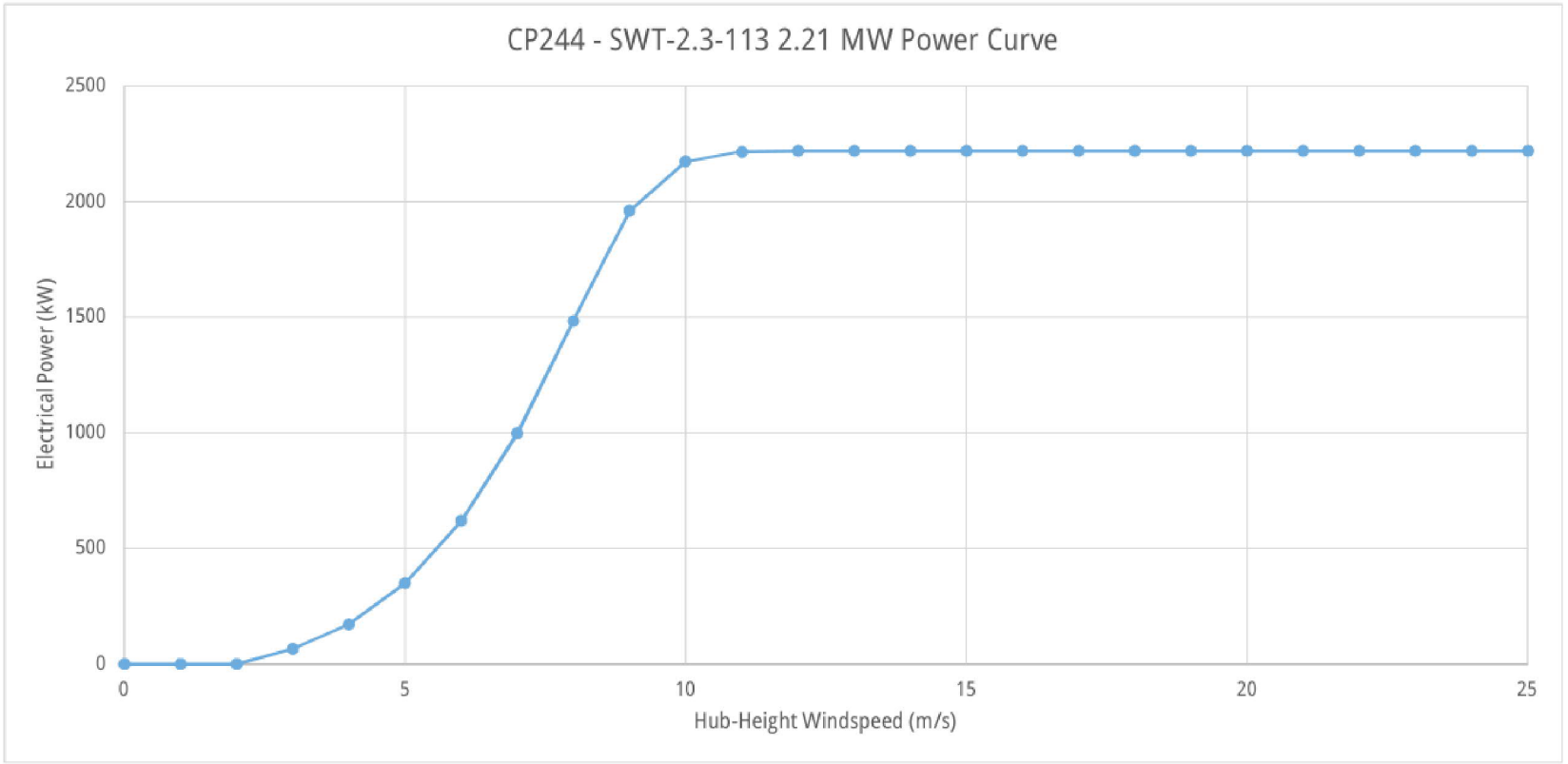

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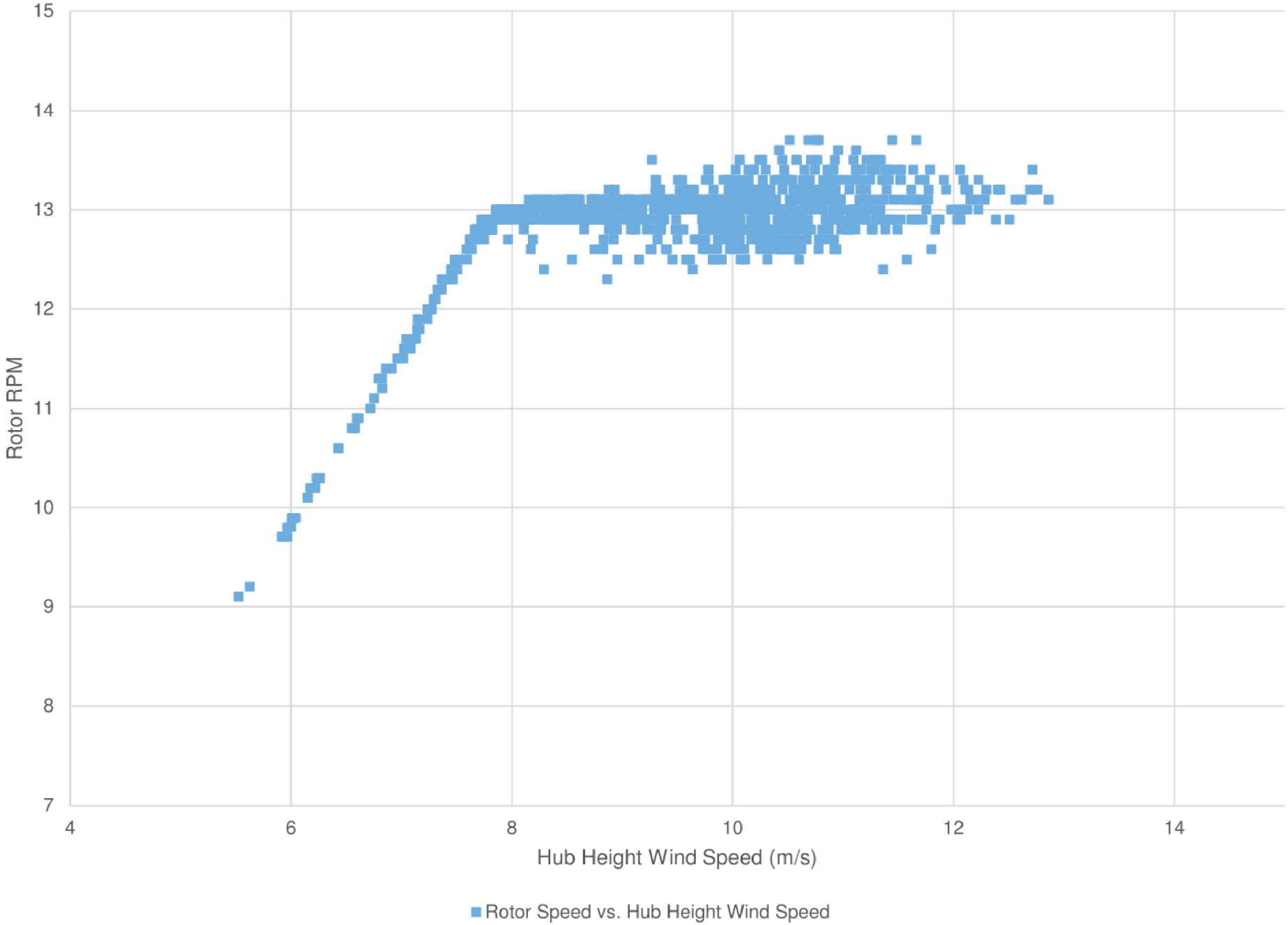
Figure Title

Power Curve

Figure B.01



aercoustics	Project ID: 15039.00.CP244.RP4 Scale: NTS Drawn by: KC Reviewed by: PA Date: January 2018 Revision: 3	**Project Name** Cedar Point Wind Power Project - Turbine CP244 - IEC 61400-11 - Edition 3.0 **Figure Title** Plot of Rotor RPM vs Wind Speed

Figure B.02

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Appendix C
Apparent Sound Power Level

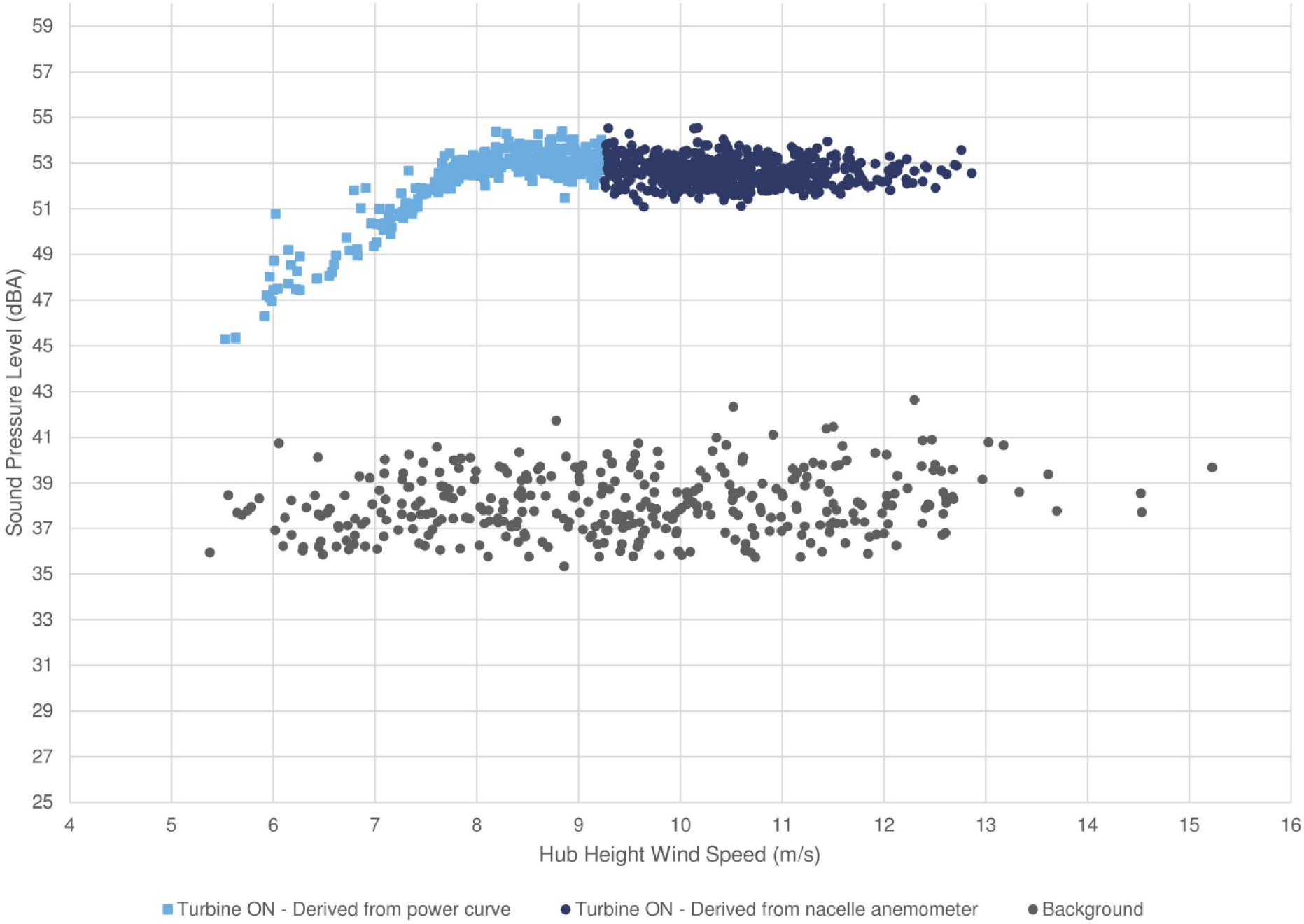

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Figure Title

Plot of overall measurement data pairs at Position 1 (Turbine ON & Background)

Figure C.01

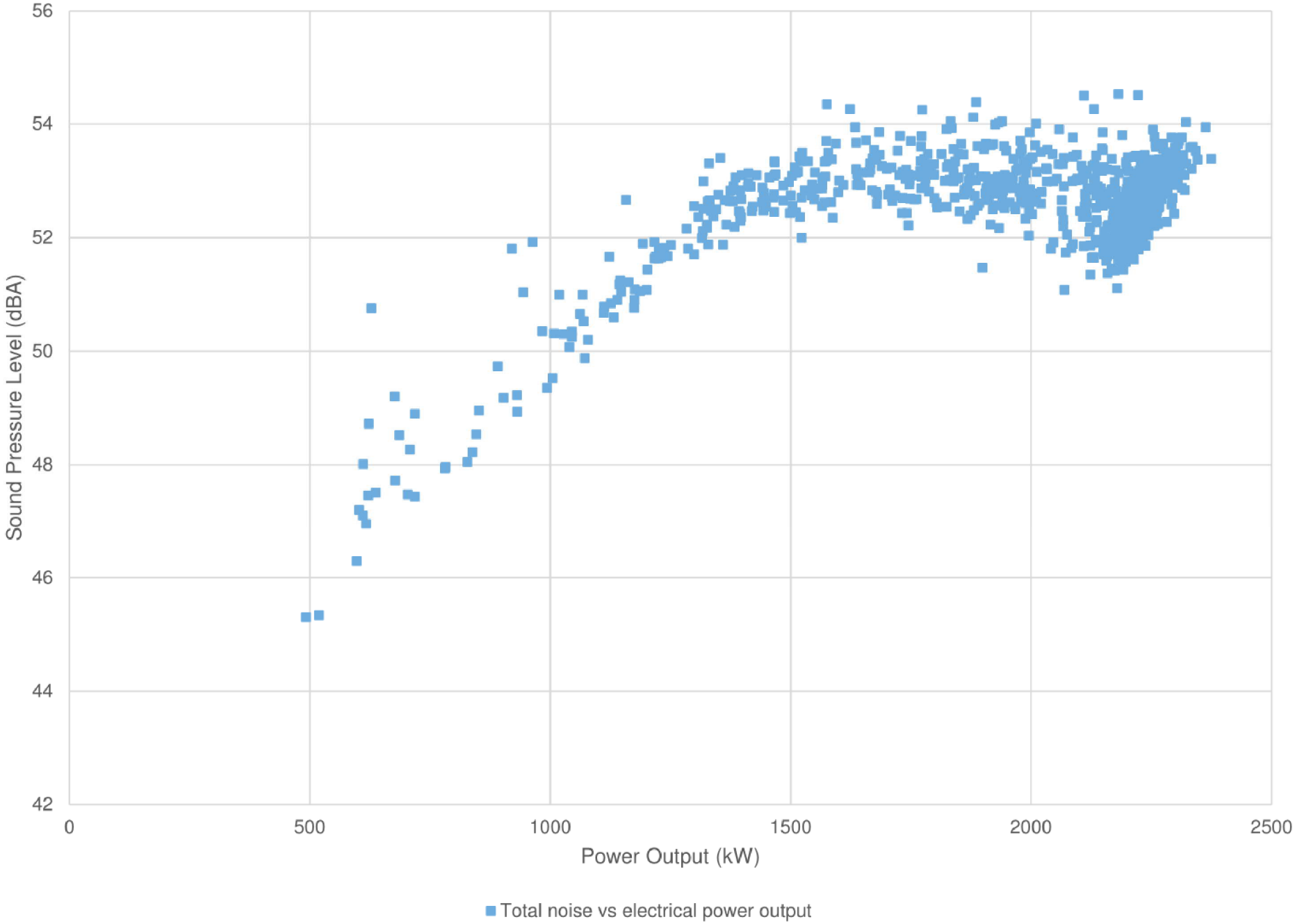

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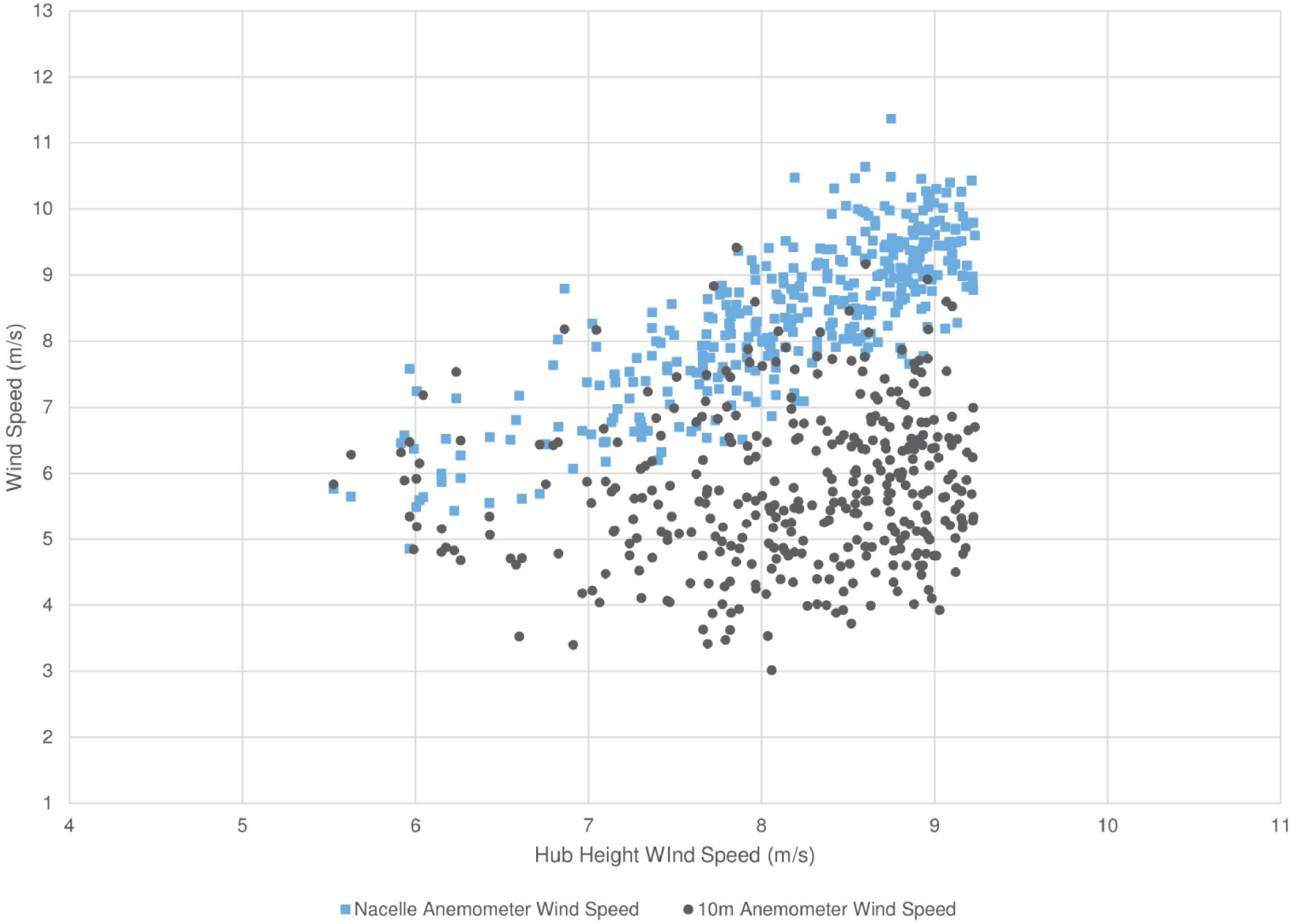
Figure C.02



aercoustics	Project ID: 15039.00.CP244.RP4 Scale: NTS Drawn by: KC Reviewed by: PA Date: January 2018 Revision: 3	**Project Name** Cedar Point Wind Power Project - Turbine CP244 - IEC 61400-11 - Edition 3.0 **Figure Title** Plot of power curve relative to nacelle anemometer and 10m anemometer

Figure C.03

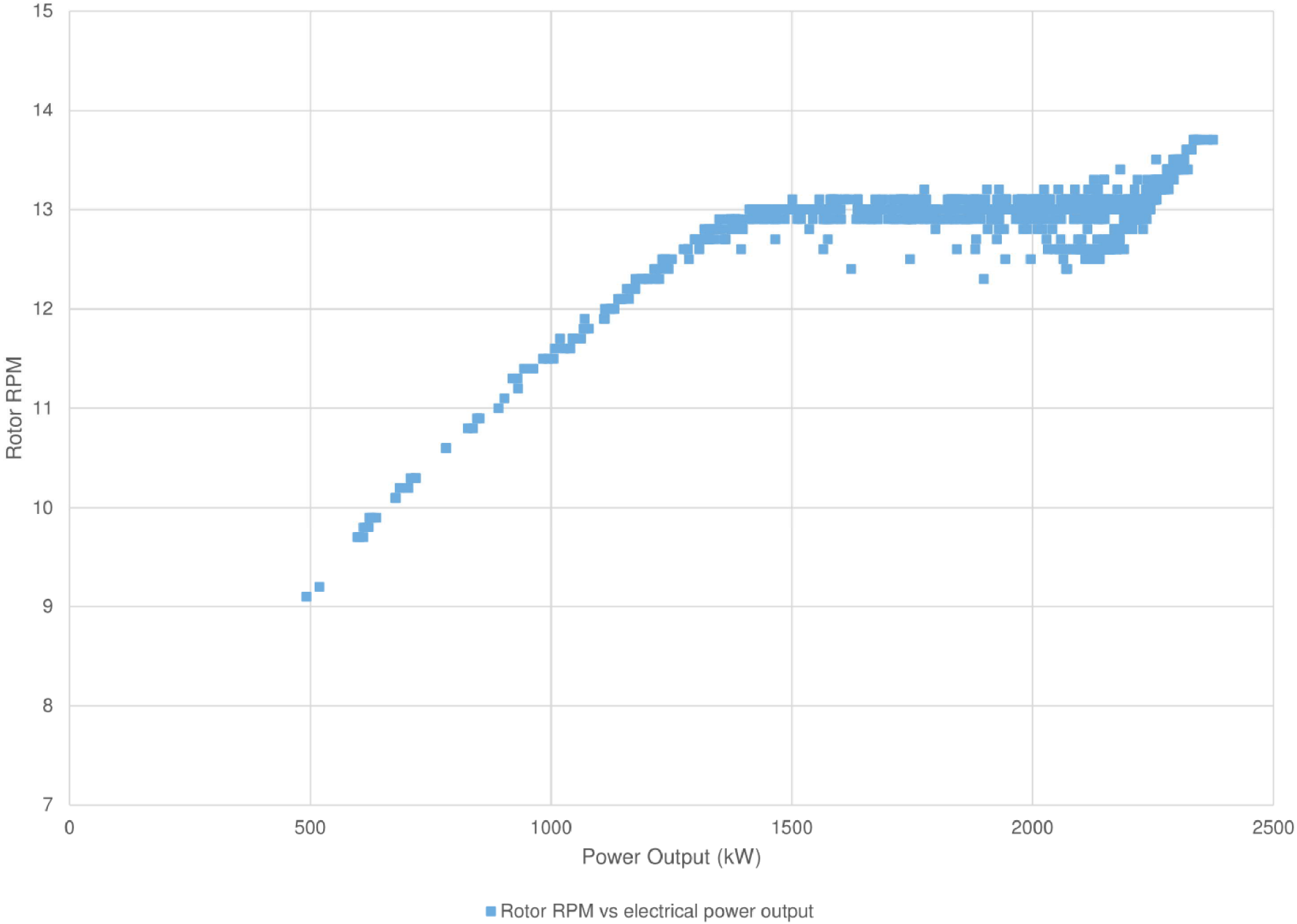


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Figure Title

Plot of rotor RPM vs. electrical power output

Figure C.03

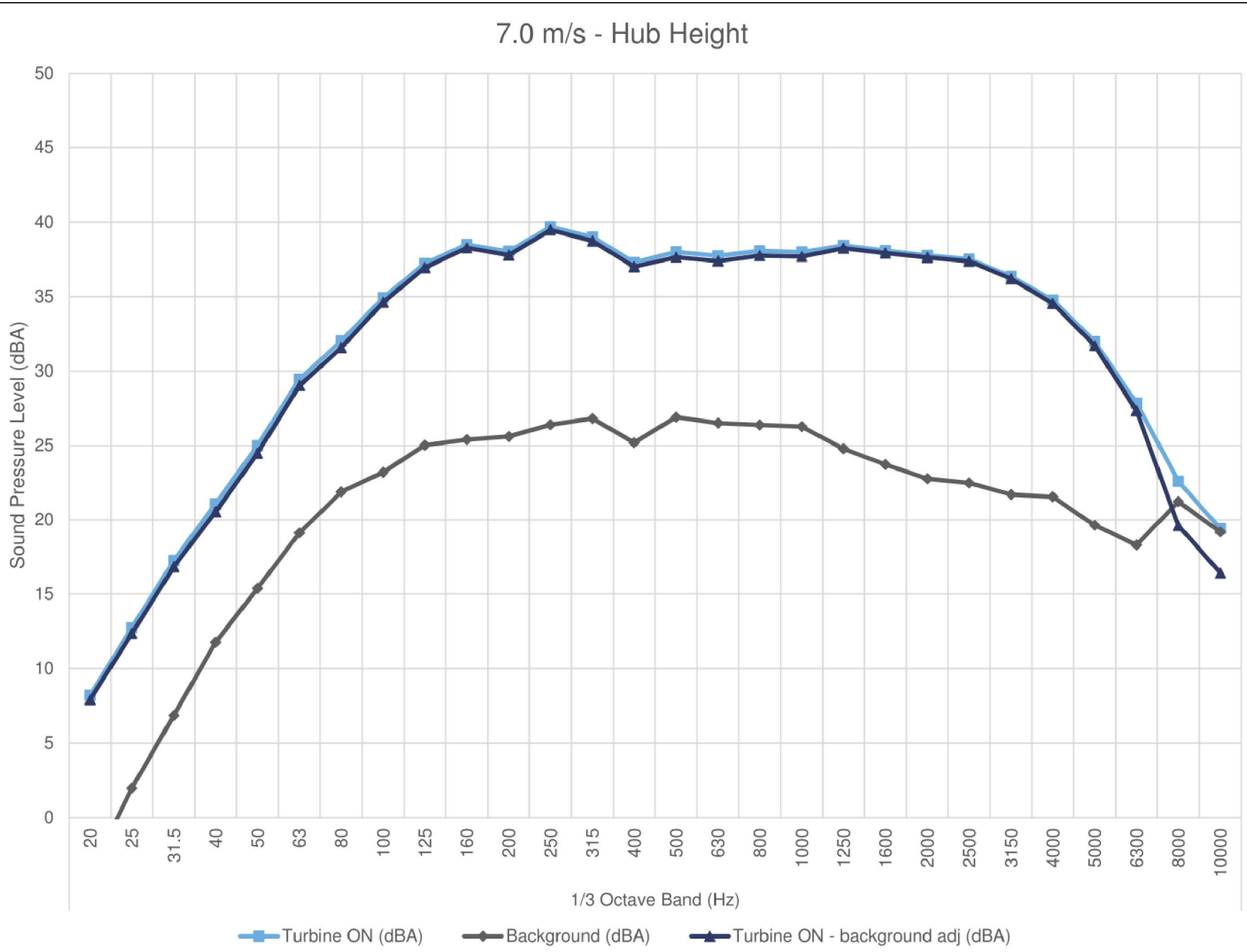

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Figure Title

Plot of sound pressure spectrum in 1/3 Octave at 7 m/s

Figure C.05

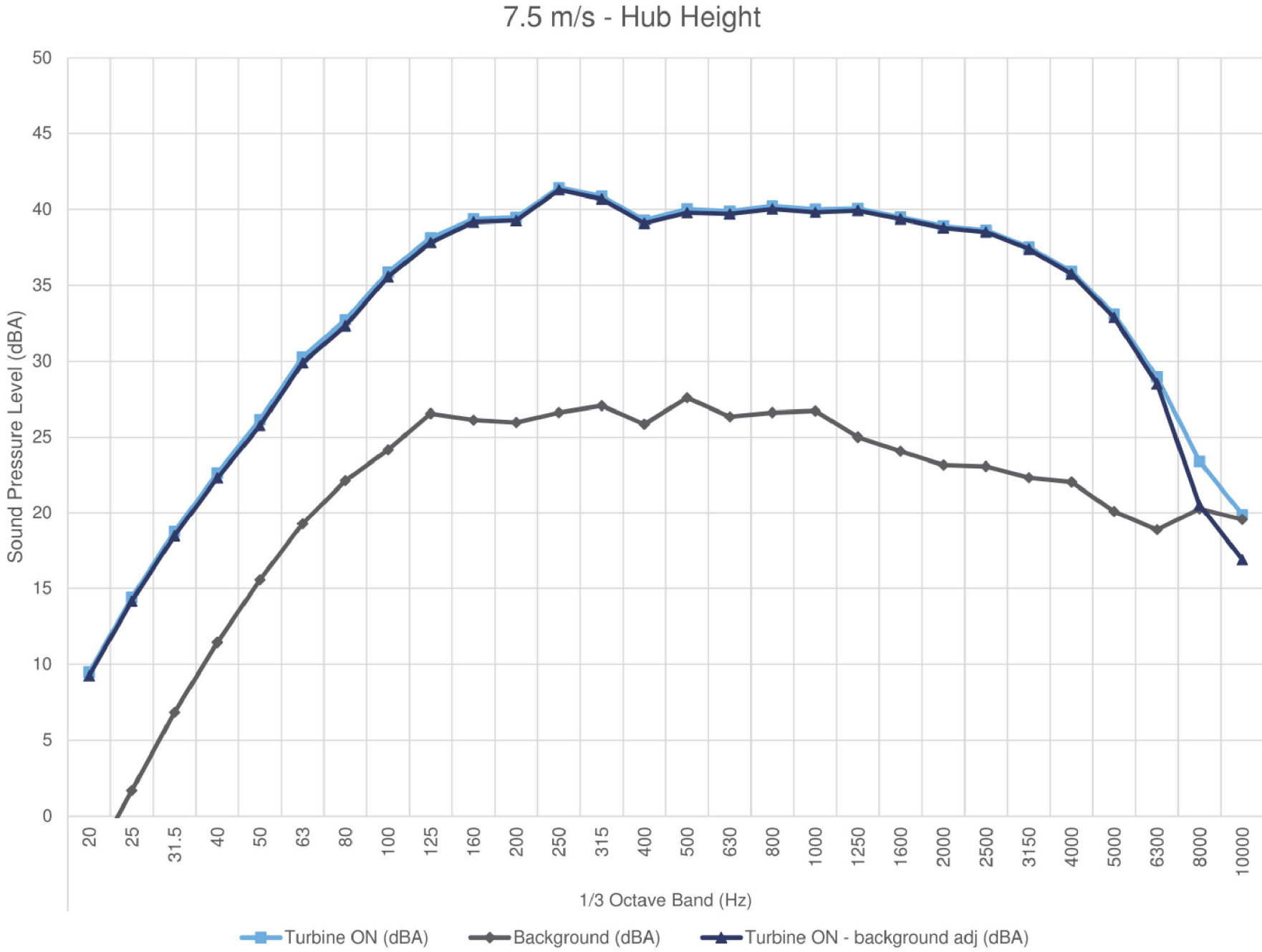

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Figure Title

Plot of sound pressure spectrum in 1/3 Octave at 7.5 m/s

Figure C.06

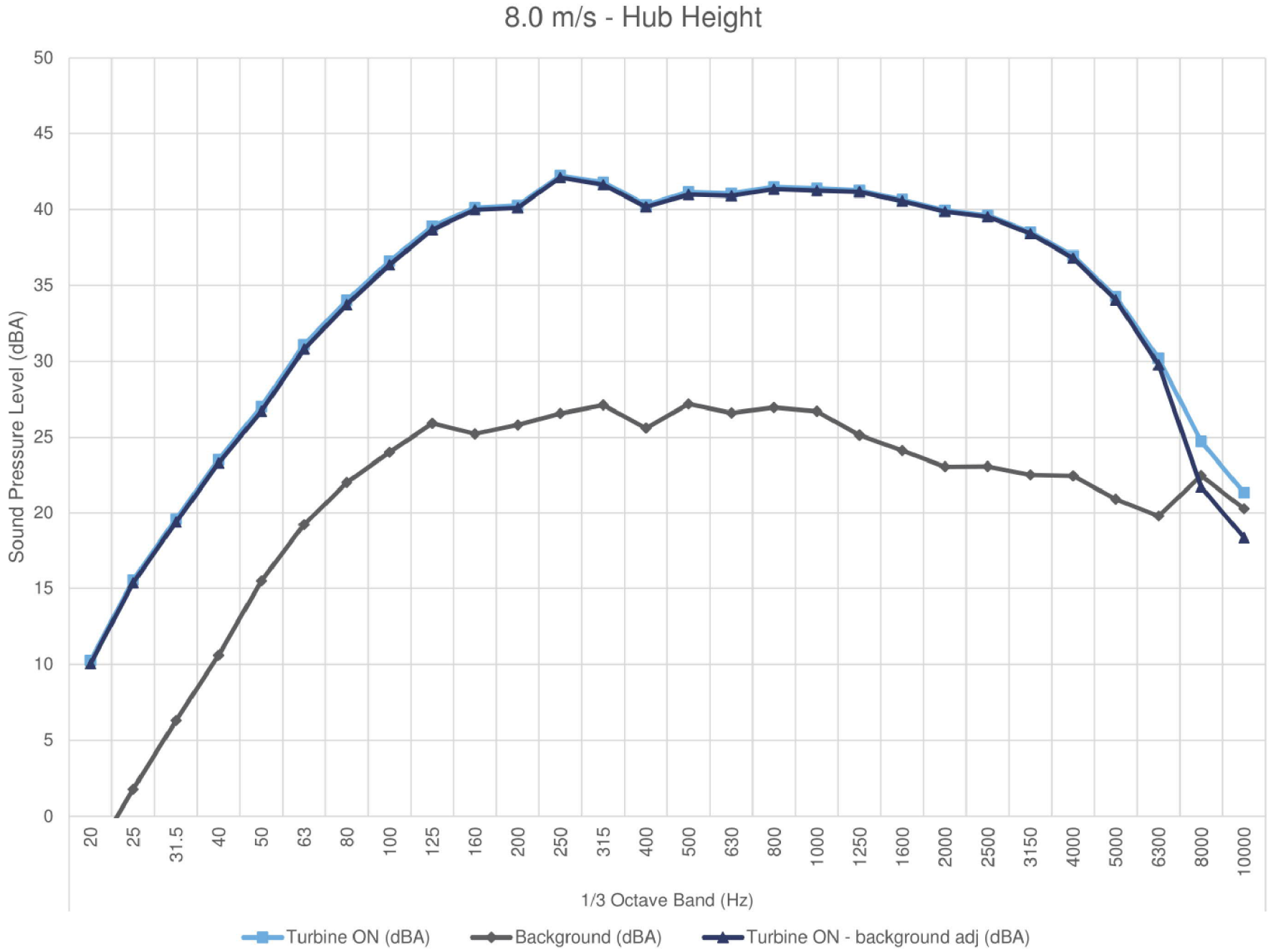

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Figure Title

Plot of sound pressure spectrum in 1/3 Octave at 8 m/s

Figure C.07

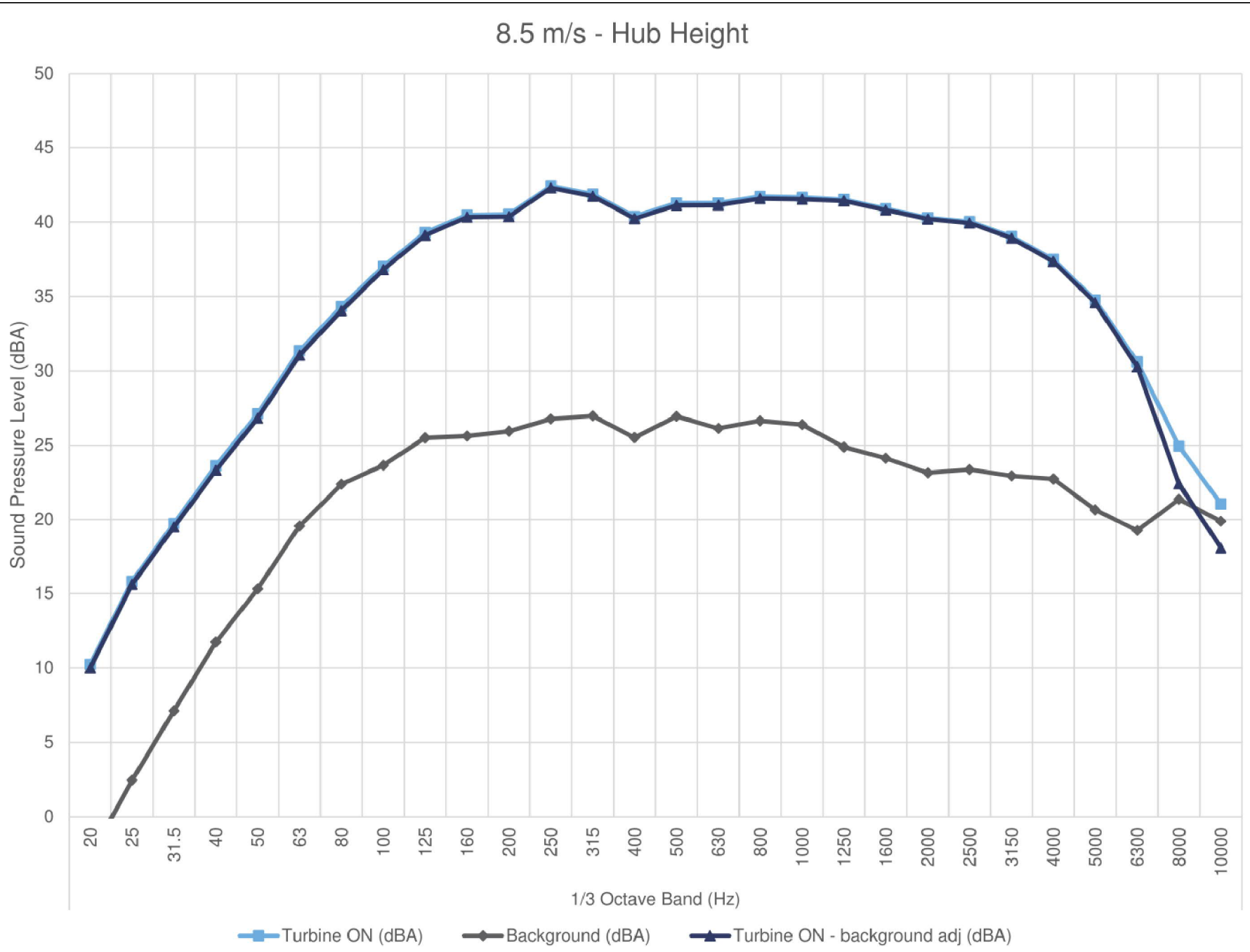

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Figure Title

Plot of sound pressure spectrum in 1/3 Octave at 8.5 m/s

Figure C.08

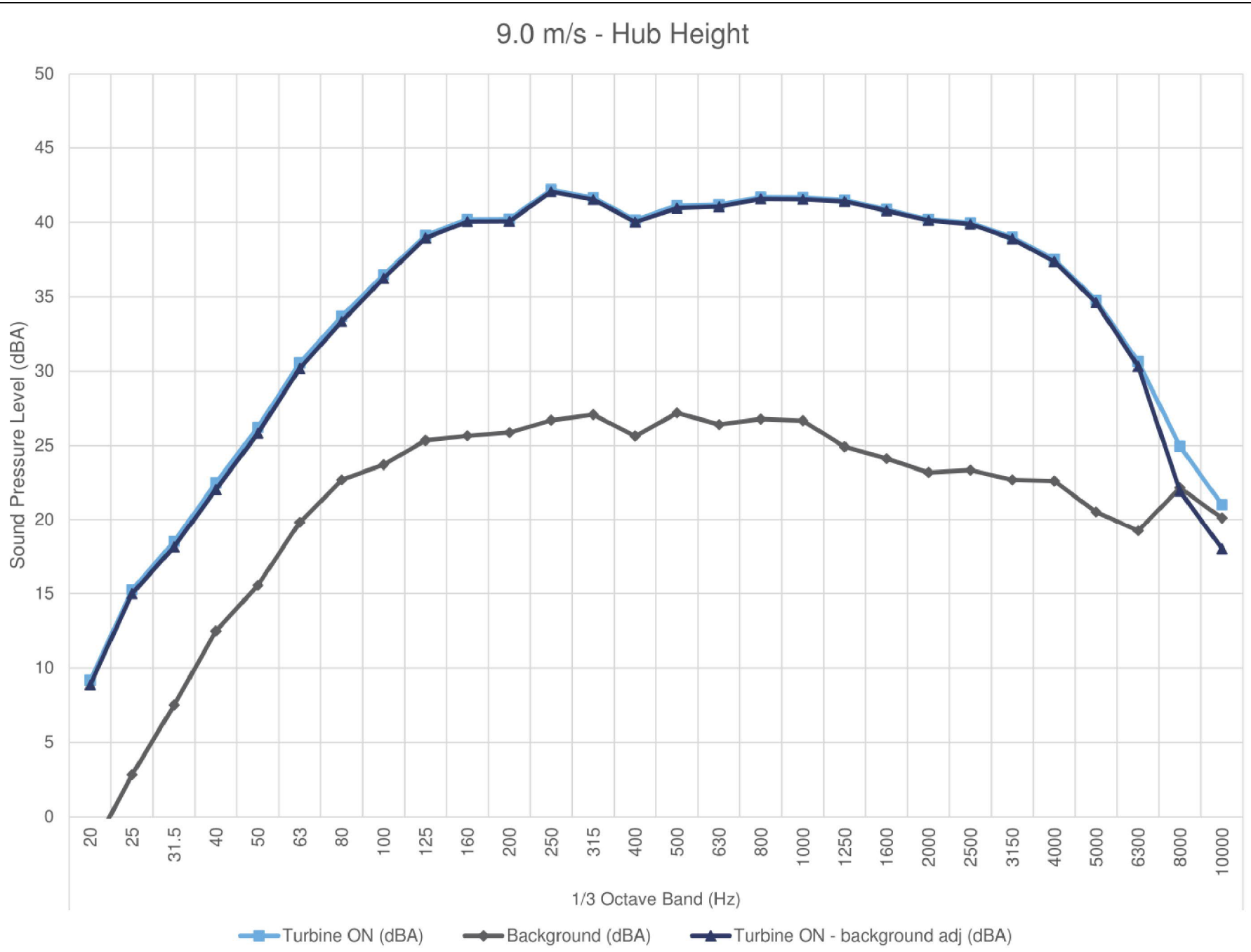

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Figure Title

Plot of sound pressure spectrum in 1/3 Octave at 9.0 m/s

Figure C.09

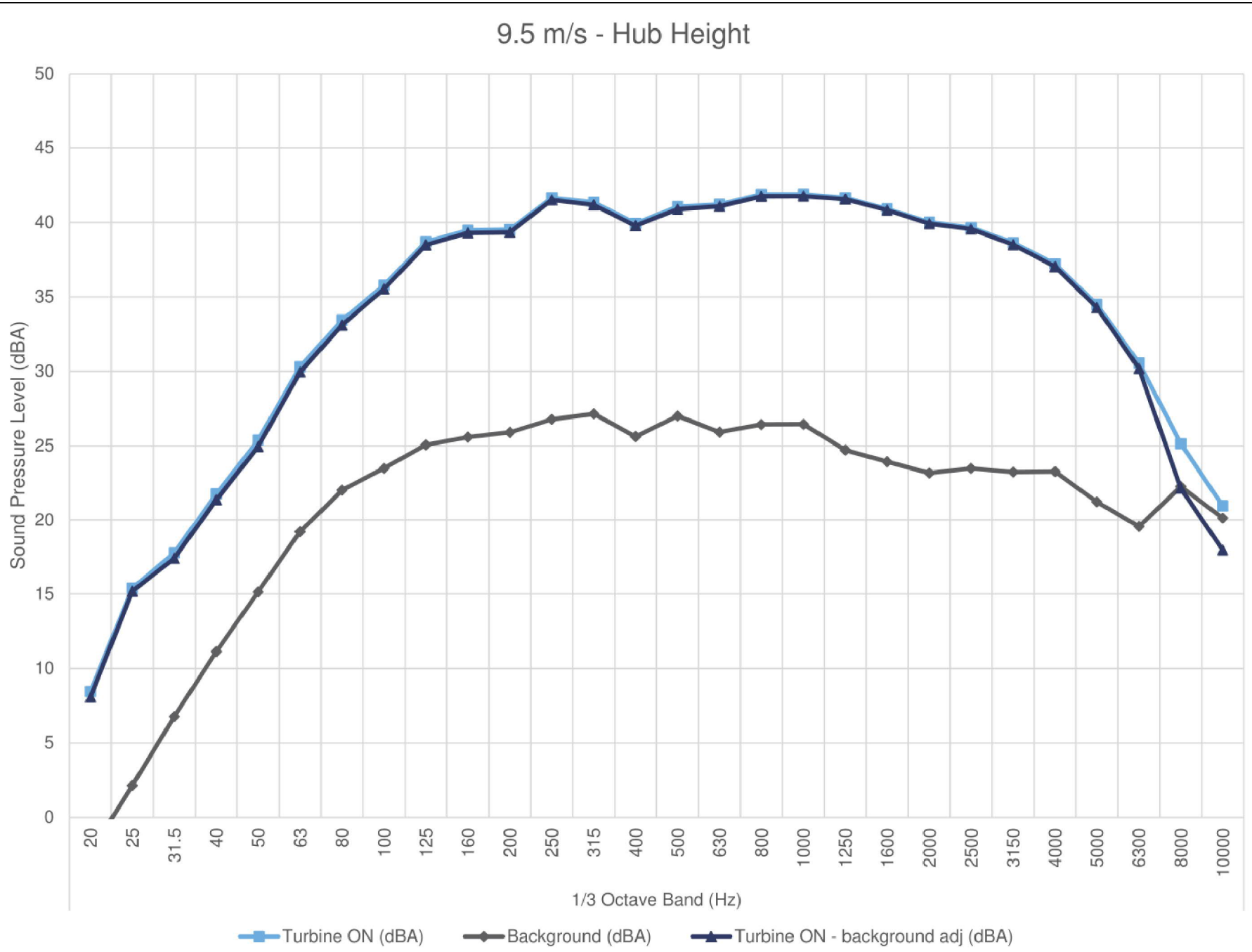

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Figure Title

Plot of sound pressure spectrum in 1/3 Octave at 9.5 m/s

Figure C.10

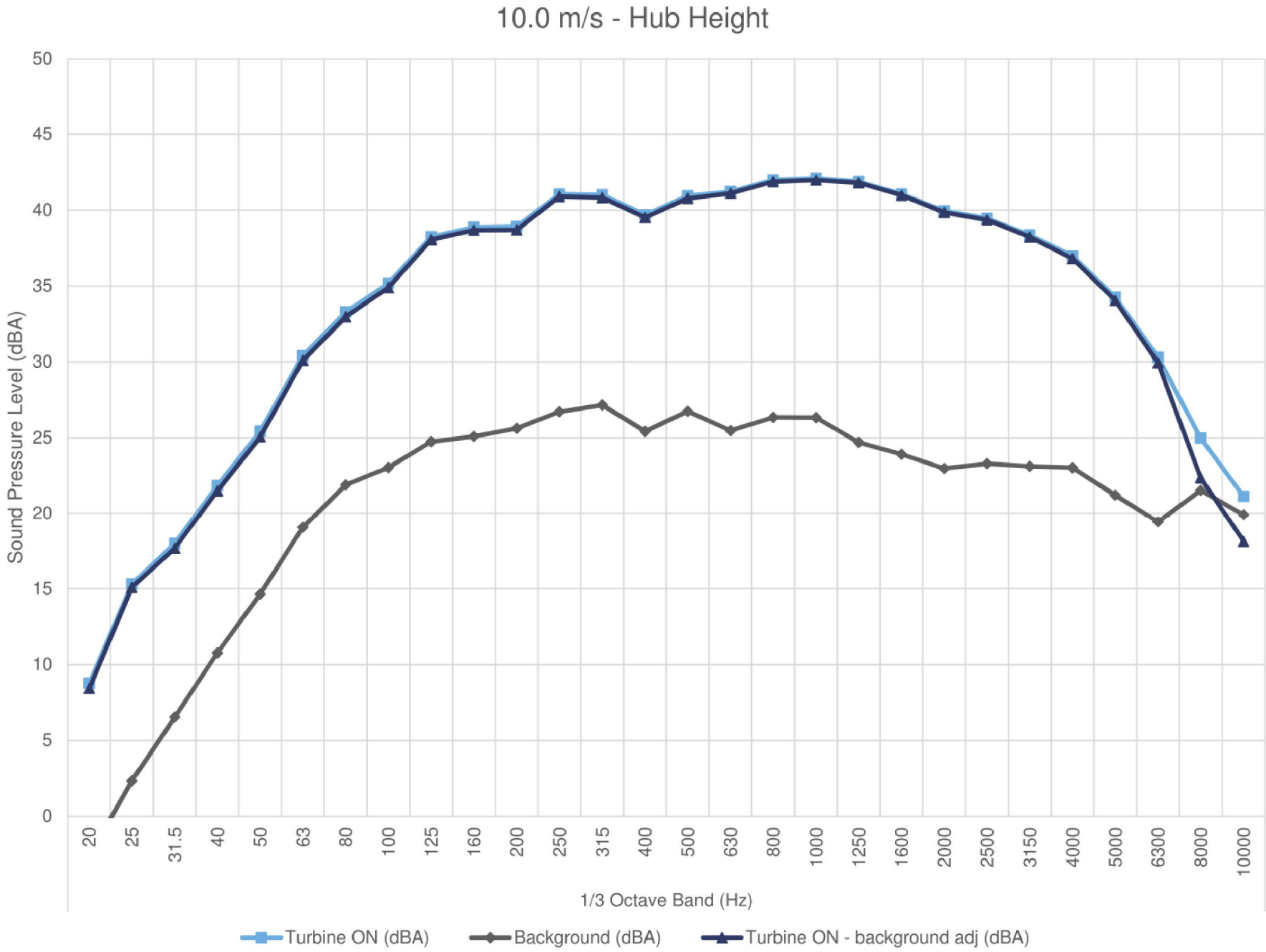

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Figure Title

Plot of sound pressure spectrum in 1/3 Octave at 10 m/s

Figure C.11

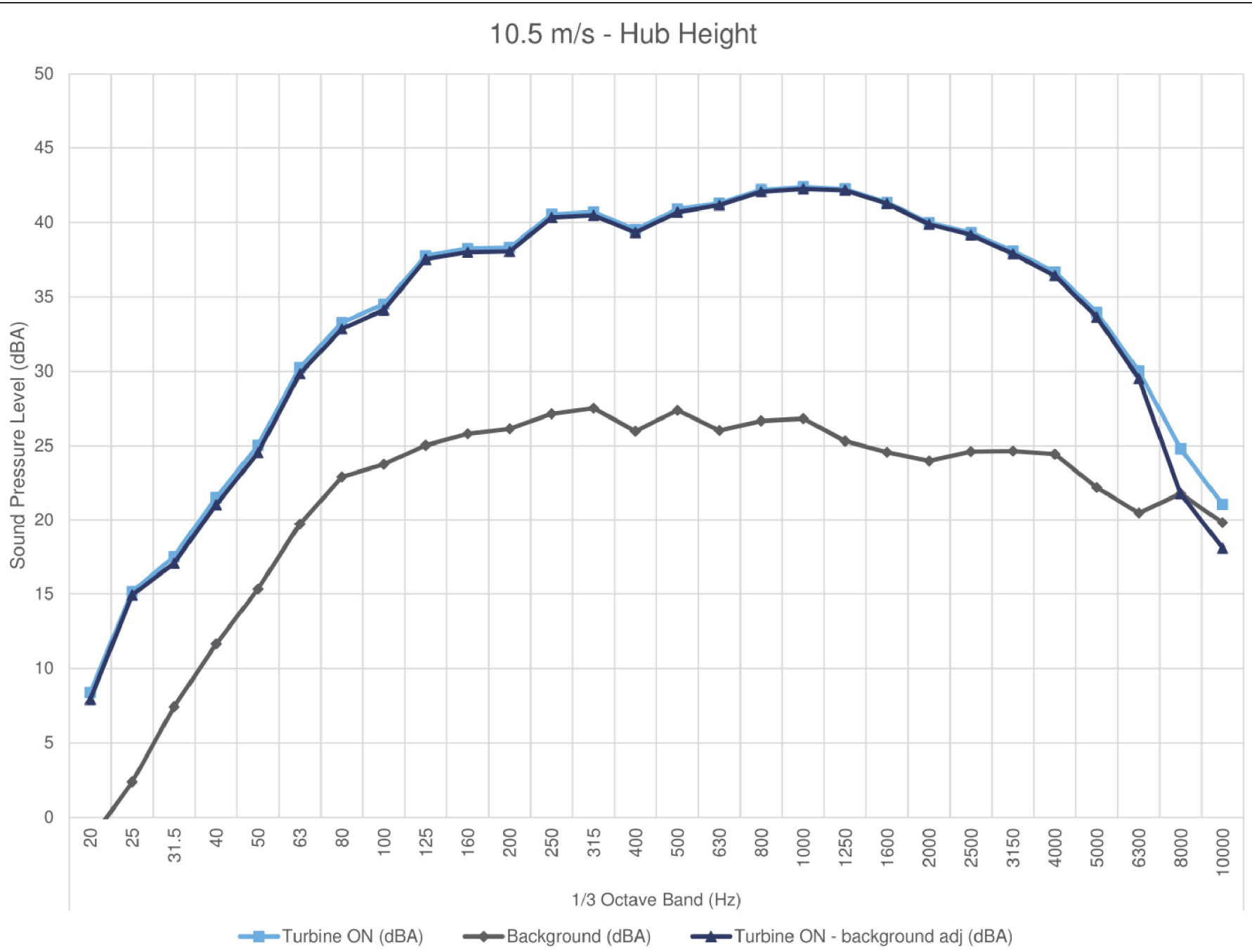

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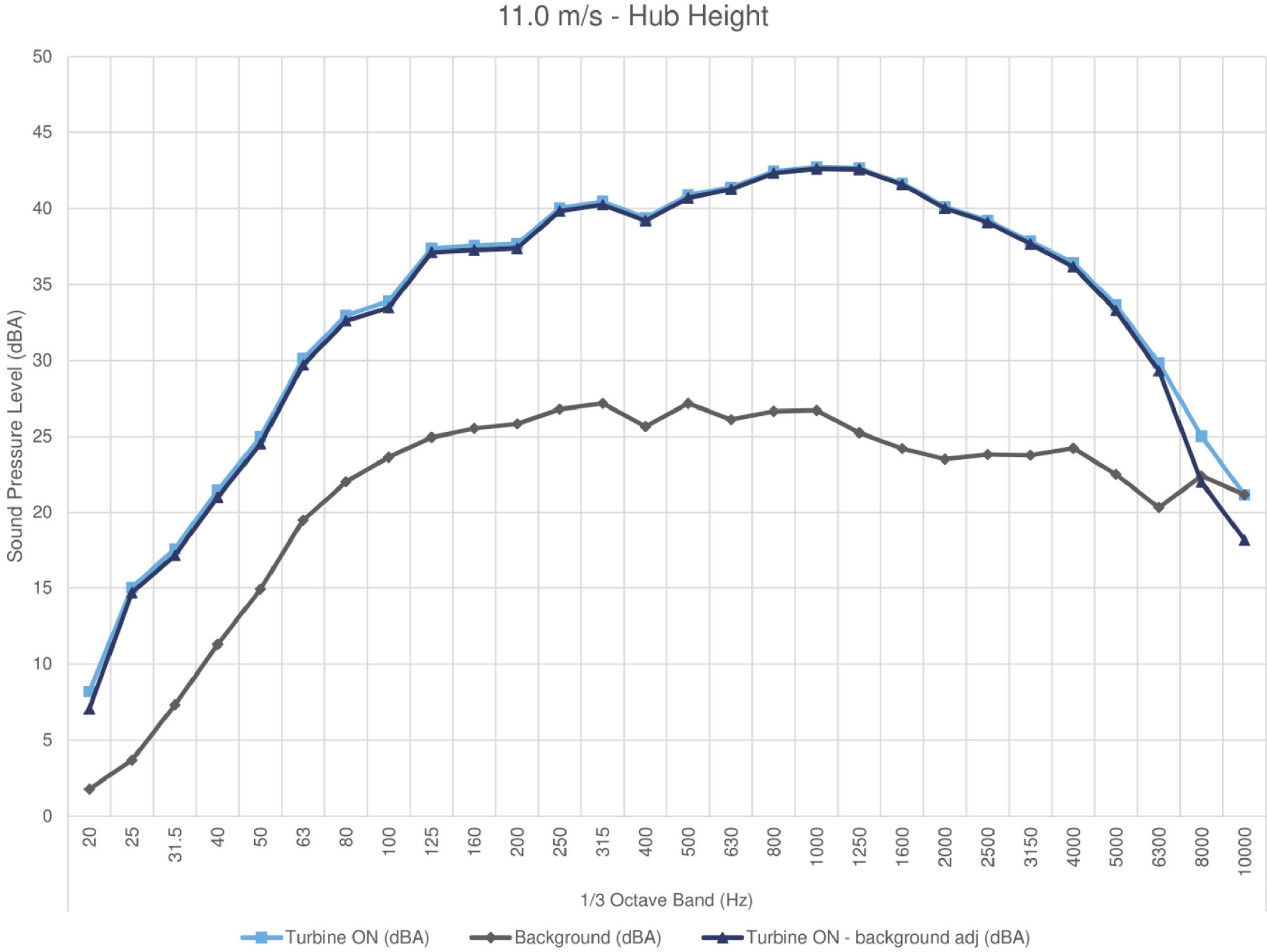
Figure Title

Plot of sound pressure spectrum in 1/3 Octave at 10.5 m/s

Figure C.12



aercoustics

Project ID: 15039.00.CP244.RP4

Scale: NTS
Drawn by: KC
Reviewed by: PA
Date: January 2018
Revision: 3

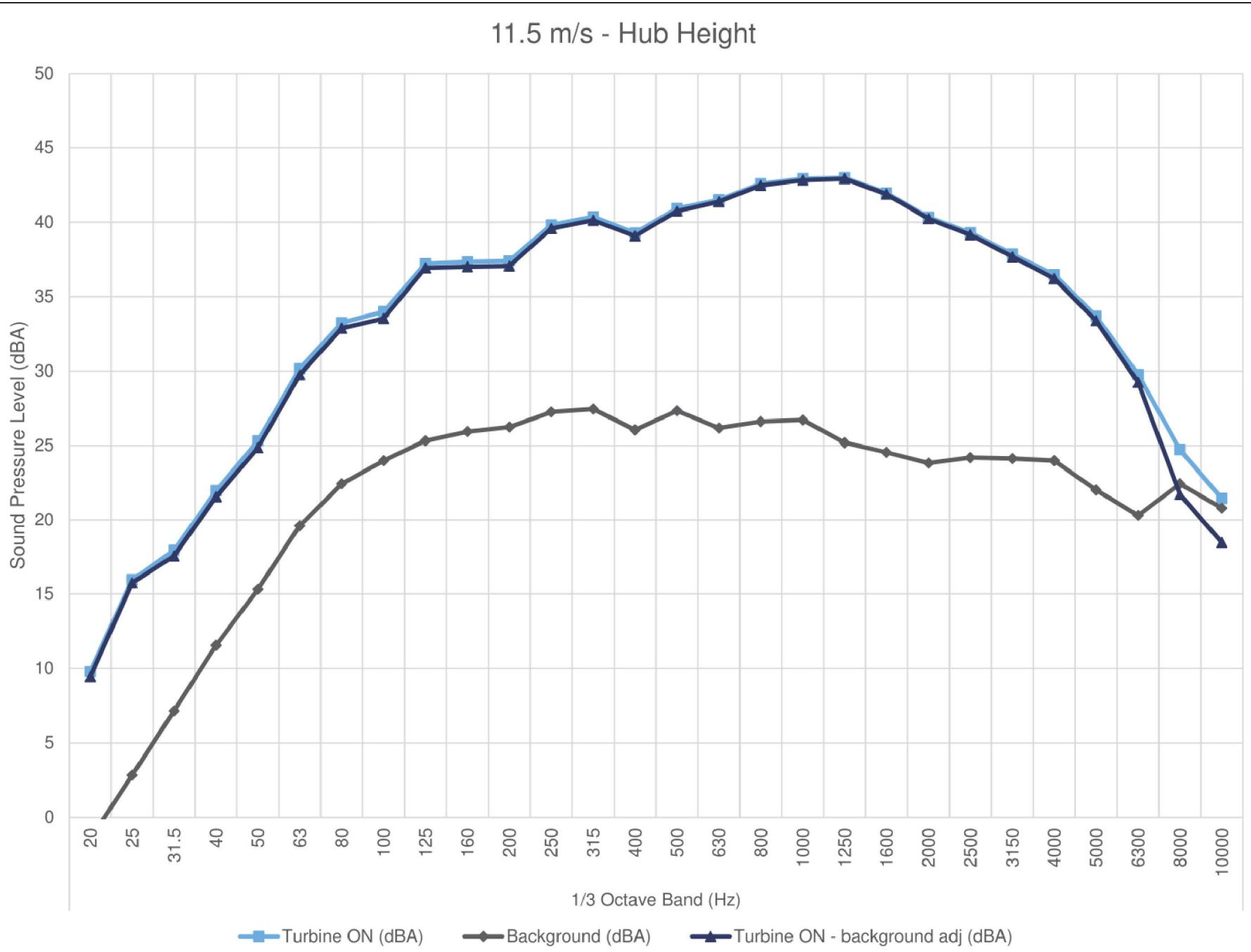
Project Name

Cedar Point Wind Power Project - Turbine CP244 - IEC 61400-11 - Edition 3.0

Figure Title

Plot of sound pressure spectrum in 1/3 Octave at 11 m/s

Figure C.13



aercoustics

Project ID: 15039.00.CP244.RP4

Scale: NTS
Drawn by: KC
Reviewed by: PA
Date: January 2018
Revision: 3

Project Name

Cedar Point Wind Power Project - Turbine CP244 - IEC 61400-11 - 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 CP244 - IEC 61400-11 Measurement

Report ID: 15039.00.CP244.RP4

Created on: 1/25/2018

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)	8.2	12.7	17.2	21.1	25.0	29.5	32.0	34.9	37.2	38.5	38.0	39.7	39.0	37.3	38.0	37.7	38.1	38.0	38.4	38.1	37.8	37.5	36.4	34.8	32.0	27.9	22.6	19.4	50.3
	Background (dBA)	-3.7	2.0	6.9	11.8	15.4	19.1	21.9	23.2	25.0	25.4	25.6	26.4	26.8	25.2	26.9	26.5	26.4	26.3	24.8	23.7	22.8	22.5	21.7	21.6	19.6	18.3	21.3	19.2	37.9
	Turbine ON - background adj (dBA)	7.9	12.4	16.8	20.6	24.5	29.0	31.6	34.6	37.0	38.3	37.8	39.5	38.7	37.0	37.6	37.4	37.8	37.7	38.2	37.9	37.6	37.4	36.2	34.5	31.7	27.3	[19.6]	[16.4]	50.0
	Signal to noise (dB)	11.9	10.8	10.4	9.3	9.6	10.3	10.1	11.7	12.2	13.1	12.4	13.3	12.2	12.1	11.1	11.2	11.7	11.7	13.6	14.3	15.0	15.0	14.6	13.2	12.3	9.6	1.4	0.2	12.4
	Uncertainty (dB)	1.1	1.2	1.0	1.0	1.0	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	0.8	0.8	0.8	0.9	1.9	3.1	0.8
	PWL (dBA)	58.5	62.9	67.4	71.1	75.0	79.6	82.1	85.2	87.5	88.8	88.3	90.0	89.3	87.6	88.2	87.9	88.3	88.2	88.8	88.5	88.2	87.9	86.8	85.1	82.3	77.9	[70.2]	[67]	100.6
7.5	Turbine ON (dBA)	9.5	14.4	18.8	22.7	26.2	30.3	32.7	35.9	38.1	39.4	39.5	41.4	40.9	39.3	40.0	39.9	40.2	40.0	40.1	39.5	38.9	38.6	37.5	35.9	33.1	29.0	23.4	19.9	51.9
	Background (dBA)	-3.4	1.7	6.8	11.4	15.6	19.3	22.1	24.2	26.6	26.1	26.0	26.6	27.1	25.9	27.6	26.3	26.6	26.7	25.0	24.1	23.2	23.1	22.3	22.0	20.1	18.9	20.3	19.6	38.3
	Turbine ON - background adj (dBA)	9.3	14.2	18.5	22.3	25.8	29.9	32.3	35.6	37.8	39.2	39.3	41.3	40.7	39.1	39.8	39.7	40.0	39.8	39.9	39.4	38.8	38.5	37.4	35.7	32.9	28.5	20.5	[16.9]	51.7
	Signal to noise (dB)	12.9	12.7	11.9	11.2	10.6	11.0	10.6	11.7	11.6	13.3	13.5	14.8	13.8	13.4	12.4	13.5	13.6	13.3	15.1	15.4	15.7	15.6	15.2	13.9	13.0	10.1	3.1	0.3	13.5
	Uncertainty (dB)	1.1	1.1	0.9	0.9	0.9	0.9	0.9	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	1.7	3.2	0.7
	PWL (dBA)	59.8	64.7	69.0	72.9	76.3	80.5	82.9	86.1	88.4	89.7	89.8	91.8	91.2	89.6	90.3	90.2	90.6	90.4	90.5	89.9	89.3	89.1	87.9	86.3	83.4	79.1	71.1	[67.4]	102.2
8.0	Turbine ON (dBA)	10.3	15.6	19.6	23.5	27.0	31.1	34.0	36.6	38.9	40.1	40.3	42.2	41.8	40.3	41.1	41.1	41.5	41.4	41.3	40.6	39.9	39.6	38.5	36.9	34.3	30.2	24.7	21.3	52.9
	Background (dBA)	-2.9	1.8	6.3	10.6	15.5	19.2	22.0	24.0	25.9	25.2	25.8	26.6	27.1	25.6	27.2	26.6	27.0	26.7	25.1	24.1	23.1	23.1	22.5	22.5	20.9	19.8	22.5	20.3	38.3
	Turbine ON - background adj (dBA)	10.0	15.4	19.4	23.3	26.7	30.8	33.7	36.4	38.7	40.0	40.1	42.1	41.6	40.2	41.0	40.9	41.3	41.2	41.1	40.6	39.9	39.5	38.4	36.8	34.1	29.8	[21.7]	[18.3]	52.7
	Signal to noise (dB)	13.2	13.8	13.3	12.9	11.5	11.9	12.0	12.6	13.0	14.9	14.5	15.6	14.7	14.7	14.0	14.5	14.5	14.7	16.1	16.5	16.9	16.5	16.0	14.5	13.3	10.4	2.2	1.1	14.6
	Uncertainty (dB)	1.1	1.1	0.9	0.9	0.9	0.9	0.9	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	1.9	3.3	0.7
	PWL (dBA)	60.6	65.9	69.9	73.9	77.3	81.4	84.3	86.9	89.2	90.5	90.7	92.7	92.2	90.7	91.5	91.4	91.9	91.8	91.7	91.1	90.4	90.1	89.0	87.3	84.6	80.3	[72.3]	[68.9]	103.3
8.5	Turbine ON (dBA)	10.2	15.8	19.7	23.6	27.1	31.4	34.3	37.0	39.3	40.5	40.5	42.4	41.9	40.4	41.3	41.3	41.7	41.7	41.5	40.9	40.3	40.0	39.0	37.5	34.8	30.6	24.9	21.1	53.2
	Background (dBA)	-2.6	2.5	7.1	11.7	15.3	19.5	22.4	23.7	25.5	25.6	25.9	26.8	27.0	25.5	26.9	26.1	26.6	26.4	24.9	24.1	23.2	23.4	22.9	22.7	20.7	19.2	21.4	19.9	38.2
	Turbine ON - background adj (dBA)	10.0	15.6	19.5	23.3	26.8	31.1	34.0	36.8	39.1	40.3	40.4	42.3	41.8	40.2	41.1	41.1	41.6	41.5	41.4	40.8	40.2	39.9	38.9	37.3	34.6	30.3	22.4	[18.1]	53.0
	Signal to noise (dB)	12.9	13.4	12.6	11.9	11.8	11.8	11.9	13.4	13.8	14.8	14.6	15.6	14.9	14.9	14.3	15.1	15.1	15.3	16.6	16.8	17.1	16.6	16.1	14.7	14.1	11.4	3.6	1.2	14.9
	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	0.8	1.5	3.0	0.7
	PWL (dBA)	60.6	66.2	70.0	73.9	77.4	81.6	84.6	87.4	89.7	90.9	90.9	92.9	92.3	90.8	91.7	91.7	92.1	92.1	92.0	91.4	90.8	90.5	89.5	87.9	85.1	80.8	73.0	[68.6]	103.6
9.0	Turbine ON (dBA)	9.2	15.3	18.5	22.5	26.2	30.6	33.7	36.5	39.1	40.2	40.2	42.2	41.7	40.2	41.1	41.2	41.7	41.7	41.5	40.9	40.2	40.0	39.0	37.5	34.8	30.6	24.9	21.0	53.0
	Background (dBA)	-2.4	2.8	7.5	12.5	15.6	19.8	22.7	23.7	25.3	25.6	25.9	26.7	27.1	25.6	27.2	26.4	26.8	26.7	24.9	24.1	23.2	23.3	22.7	22.6	20.5	19.2	22.2	20.1	38.3
	Turbine ON - background adj (dBA)	8.9	15.0	18.1	22.0	25.8	30.2	33.3	36.2	38.9	40.1	40.1	42.1	41.5	40.0	40.9	41.0	41.6	41.5	41.4	40.8	40.1	39.9	38.9	37.4	34.6	30.3	[21.9]	[18]	52.9
	Signal to noise (dB)	11.6	12.4	11.0	10.0	10.7	10.8	11.0	12.8	13.8	14.6	14.4	15.5	14.6	14.5	13.9	14.8	14.9	15.0	16.6	16.7	17.0	16.6	16.3	14.9	14.2	11.4	2.8	0.9	14.7
	Uncertainty (dB)	1.0	1.0	0.8	0.9	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	1.8	3.1	0.7
	PWL (dBA)	59.4	65.5	68.7	72.6	76.4	80.7	83.9	86.8	89.5	90.6	90.6	92.6	92.1	90.6	91.5	91.6	92.1	92.1	91.9	91.3	90.7	90.4	89.4	87.9	85.2	80.9	[72.5]	[68.6]	103.4
9.5	Turbine ON (dBA)	8.5	15.4	17.8	21.8	25.4	30.3	33.4	35.8	38.7	39.5	39.5	41.7	41.3	39.9	41.1	41.2	41.9	41.9	41.6	40.9	40.0	39.7	38.6	37.2	34.5	30.6	25.1	21.0	52.8
	Background (dBA)	-2.3	2.1	6.8	11.1	15.1	19.2	22.0	23.5	25.1	25.6	25.9	26.8	27.1	25.6	27.0	25.9	26.4	26.4	24.7	23.9	23.2	23.5	23.2	23.3	21.2	19.6	22.3	20.1	38.2
	Turbine ON - background adj (dBA)	8.1	15.2	17.4	21.4	24.9	30.0	33.1	35.5	38.5	39.3	39.3	41.5	41.2	39.8	40.9	41.1	41.8	41.8	41.6	40.8	39.9	39.5	38.5	37.0	34.3	30.2	[22.1]	[18]	52.7
	Signal to noise (dB)	10.8	13.3	11.0	10.6	10.2	11.1	11.4	12.3	13.6	13.9	13.6	14.9	14.2	14.3	14.1	15.3	15.5	15.4	16.9	17.0	16.8	16.2	15.4	14.0	13.3	11.0	2.9	0.8	14.6
	Uncertainty (dB)	1.1	1.0	0.9	0.9	0.9	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	1.8	3.1	0.7
	PWL (dBA)	58.6	65.7	68.0	71.9	75.5	80.5	83.7	86.1	89.1	89.8	89.9	92.1	91.7	90.3	91.4	91.6	92.3	92.3	92.1	91.4	90.5	90.1	89.1	87.6	84.8	80.8	[72.7]	[68.5]	103.2
10.0	Turbine ON (dBA)	8.8	15.3	18.0	21.8	25.4	30.4	33.3	35.2	38.3	38.9	38.9	41.1	41.0	39.7	40.9	41.2	42.0	42.1	41.9	41.1	40.0	39.5	38.4	37.0	34.3	30.3	25.0	21.1	52.7
	Background (dBA)	-2.6	2.3	6.5	10.8	14.6	19.1	21.9	23.1	24.7	25.1	25.6	26.7	27.2	25.4	26.7	25.5	26.3	26.3	24.7	23.9	23.0	23.3	23.1	23.0	21.2	19.4	21.5	19.9	38.0
	Turbine ON - background adj (dBA)	8.4	15.1	17.7	21.5	25.1	30.1	33.0	34.9	38.1	38.7	38.7	40.9	40.8	39.5	40.8	41.1	41.9	42.0	41.8	41.0	39.9	39.4	38.2	36.8	34.0	29.9	22.4	[18.1]	52.5
	Signal to noise (dB)	11.4	13.0	11.4	11.1	10.8	11.4	11.4	12.1	13.5	13.8	13.3	14.4	13.9	14.3	14.2	15.7	15.7	15.8	17.2	17.2	17.0	16.2	15.2	13.9	13.1	10.9	3.4	1.2	14.7
	Uncertainty (dB)	1.1	1.1	0.9	0.9	0.9	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	1.6	3.2	0.7
	PWL (dBA)	59.0	65.6	68.2	72.0	75.6	80.6	83.5	85.5	88.6	89.2	89.3	91.5	91.4	90.1	91.3	91.7	92.4	92.5	92.4	91.5	90.4	89.9	88.8	87.4	84.6	80.5	72.9	[68.7]	103.1
10.5	Turbine ON (dBA)	8.4	15.2	17.5	21.5	25.0	30.2	33.3	34.5	37.8	38.3	38.3	40.5	40.7	39.5	40.9	41.3	42.2	42.4	42.2	41.3	40.0	39.3	38.1	36.7	33.9	30.0	24.8	21.1	52.6
	Background (dBA)	-1.5	2.4	7.4	11.6	15.3	19.7	22.9	23.8	25.0	25.8	26.1	27.1	27.5	26.0	27.4	26.0	26.7	26.8	25.3	24.6	24.0	24.6	24.7	24.4	22.2	20.5	21.8	19.8	38.6
	Turbine ON - background adj (dBA)	7.9	14.9	17.1	21.0	24.5	29.8	32.9	34.1	37.5	38.0	38.0	40.3	40.5	39.3	40.7	41.2	42.1	42.3	42.2	41.2	39.9	39.2	37.9	36.4	33.6	29.5	21.8	[18.1]	52.4
	Signal to noise (dB)	9.9	12.8	10.1	9.9	9.7	10.5	10.4	10.8	12.7	12.4	12.2	13.4	13.2	13.5	13.5	15.3	15.5	15.6	16.9	16.8	16.0	14.7	13.4	12.2	11.7	9.5	3.0	1.3	13.9
	Uncertainty (dB)	1.1	1.1	0.9	0.9	0.9	0.9	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	0.8	0.8	0.8	0.9	1.8	3.2	0.7
	PWL (dBA)	58.5	65.5	67.6	71.6	75.1	80.4	83.4	84.7	88.1	88.5	88.6	90.9	91.0	89.9	91.2	91.7	92.6	92.8	92.7	91.8	90.4	89.7	88.4	87.0	84.2	80.1	72.3	[68.6]	103.0

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

Project: Cedar Point Wind Power Project - Turbine CP244 - IEC 61400-11 Measurement

Report ID: 15039.00.CP244.RP4

Created on: 1/25/2018

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)	8.2	15.0	17.6	21.5	25.0	30.1	33.0	33.9	37.4	37.5	37.7	40.0	40.4	39.4	40.9	41.4	42.4	42.7	42.6	41.6	40.1	39.2	37.8	36.4	33.6	29.8	25.0	21.2	52.6
	Background (dBA)	1.8	3.7	7.3	11.3	14.9	19.5	22.0	23.6	25.0	25.5	25.8	26.8	27.2	25.7	27.2	26.1	26.7	26.7	25.3	24.2	23.5	23.8	23.8	24.2	22.5	20.3	22.4	21.2	38.4
	Turbine ON - background adj (dBA)	7.1	14.7	17.1	21.0	24.5	29.7	32.6	33.5	37.1	37.3	37.4	39.8	40.2	39.2	40.7	41.2	42.3	42.6	42.6	41.6	40.0	39.1	37.7	36.2	33.3	29.3	[22]	[18.2]	52.4
	Signal to noise (dB)	6.4	11.4	10.3	10.1	10.1	10.6	10.9	10.3	12.4	12.0	11.8	13.2	13.3	13.7	13.7	15.3	15.8	16.0	17.4	17.4	16.6	15.4	14.1	12.2	11.1	9.5	2.6	0.0	14.1
	Uncertainty (dB)	1.4	1.1	0.9	0.9	0.9	0.9	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	0.8	0.8	0.8	0.9	1.9	3.2	0.7
	PWL (dBA)	57.6	65.3	67.7	71.6	75.1	80.3	83.2	84.0	87.7	87.8	87.9	90.4	90.8	89.7	91.2	91.8	92.9	93.2	93.1	92.1	90.6	89.6	88.2	86.7	83.8	79.9	[72.6]	[68.7]	103.0
11.5	Turbine ON (dBA)	9.8	16.0	17.9	22.0	25.3	30.2	33.3	34.0	37.2	37.3	37.4	39.8	40.4	39.3	40.9	41.5	42.6	42.9	43.0	42.0	40.3	39.3	37.9	36.5	33.7	29.8	24.7	21.5	52.7
	Background (dBA)	-1.4	2.8	7.2	11.6	15.3	19.6	22.4	24.0	25.3	26.0	26.2	27.3	27.5	26.1	27.3	26.2	26.6	26.7	25.2	24.5	23.8	24.2	24.1	24.0	22.0	20.3	22.4	20.8	38.6
	Turbine ON - background adj (dBA)	9.5	15.7	17.6	21.6	24.9	29.8	32.9	33.5	36.9	37.0	37.1	39.6	40.1	39.1	40.7	41.4	42.5	42.8	42.9	41.9	40.2	39.2	37.7	36.2	33.4	29.2	[21.7]	[18.5]	52.5
	Signal to noise (dB)	11.2	13.1	10.8	10.4	10.0	10.6	10.8	10.0	11.9	11.4	11.2	12.6	12.9	13.2	13.6	15.3	16.0	16.2	17.8	17.4	16.5	15.1	13.7	12.5	11.7	9.5	2.3	0.6	14.0
	Uncertainty (dB)	1.1	1.0	0.8	0.8	0.9	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	1.8	3.1	0.7
	PWL (dBA)	60.0	66.3	68.1	72.1	75.4	80.3	83.4	84.1	87.5	87.6	87.6	90.1	90.7	89.6	91.3	91.9	93.0	93.4	93.5	92.4	90.8	89.7	88.2	86.8	83.9	79.8	[72.3]	[69]	103.0

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

Project: Cedar Point Wind Power Project - Turbine CP244 - IEC 61400-11 Measurement

Report ID: 15039.00.CP244.RP4

Created on: 1/25/2018

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	
4.0	Turbine ON (dBA)	4.9	9.7	14.3	18.6	23.9	27.1	29.9	33.3	34.4	35.7	34.7	35.6	34.7	33.5	33.7	33.5	34.1	34.7	35.4	35.2	34.9	34.4	33.3	31.7	29.0	24.9	21.1	19.3	47.0
	Background (dBA)	-4.5	0.8	5.3	9.6	13.9	18.3	20.9	21.9	23.4	24.2	25.1	26.1	26.7	25.5	27.3	26.4	26.8	26.8	25.3	24.2	23.1	23.1	22.3	22.0	19.9	18.7	20.9	19.1	37.8
	Turbine ON - background adj (dBA)	4.4	9.2	13.8	18.0	23.5	26.5	29.3	33.0	34.1	35.3	34.2	35.1	34.0	32.7	32.5	32.6	33.2	33.9	34.9	34.8	34.6	34.1	32.9	31.3	28.4	23.7	[18.1]	[16.3]	46.4
	Signal to noise (dB)	9.4	8.9	9.0	9.0	10.0	8.9	9.0	11.4	11.1	11.5	9.7	9.5	8.1	8.0	6.3	7.1	7.3	7.9	10.0	11.0	11.8	11.4	10.9	9.7	9.0	6.2	0.3	0.2	9.1
	Uncertainty (dB)	1.5	1.5	1.2	1.2	1.2	1.3	1.2	1.2	1.2	1.1	1.0	1.1	1.1	1.2	1.3	1.2	1.2	1.2	1.1	1.1	1.0	1.2	1.2	1.2	1.2	1.4	2.6	4.2	1.2
	PWL (dBA)	54.9	59.7	64.3	68.6	74.0	77.1	79.9	83.5	84.6	85.9	84.8	85.6	84.5	83.3	83.1	83.2	83.7	84.4	85.5	85.4	85.1	84.7	83.4	81.8	78.9	74.3	[68.7]	[66.8]	97.0
5.0	Turbine ON (dBA)	8.7	13.6	17.9	21.9	25.7	29.7	32.3	35.4	37.5	38.7	38.6	40.3	39.7	38.2	38.9	38.7	39.1	39.1	39.2	38.8	38.2	37.9	36.8	35.2	32.4	28.3	23.1	19.9	51.0
	Background (dBA)	-3.5	1.7	6.7	11.3	15.1	19.0	21.8	23.5	25.6	25.6	25.7	26.4	26.9	25.5	27.3	26.5	26.5	26.5	24.9	23.9	23.0	22.8	22.1	21.9	20.1	18.9	20.3	19.4	38.1
	Turbine ON - background adj (dBA)	8.4	13.3	17.6	21.5	25.3	29.4	31.9	35.1	37.2	38.5	38.3	40.1	39.5	38.0	38.6	38.5	38.9	38.8	39.1	38.6	38.1	37.8	36.6	35.0	32.1	27.7	[20.1]	[16.9]	50.7
	Signal to noise (dB)	12.1	11.9	11.2	10.7	10.6	10.7	10.5	11.9	11.9	13.1	12.9	13.9	12.8	12.7	11.6	12.3	12.6	12.5	14.4	14.8	15.3	15.1	14.6	13.3	12.3	9.4	2.8	0.6	12.9
	Uncertainty (dB)	0.9	0.9	0.7	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.7	0.7	0.7	0.7	0.8	1.6	2.8	0.7
	PWL (dBA)	59.0	63.9	68.1	72.1	75.8	79.9	82.5	85.6	87.7	89.1	88.9	90.7	90.1	88.5	89.1	89.0	89.4	89.4	89.6	89.2	88.6	88.3	87.2	85.5	82.7	78.3	[70.7]	[67.5]	101.3
6.0	Turbine ON (dBA)	9.8	15.5	19.2	23.1	26.7	31.0	34.0	36.7	39.1	40.3	40.3	42.3	41.7	40.2	41.2	41.2	41.6	41.6	41.4	40.8	40.2	39.9	38.9	37.4	34.6	30.5	24.9	21.1	53.0
	Background (dBA)	-2.8	2.4	7.1	11.8	15.6	19.6	22.4	23.8	25.7	25.5	25.9	26.7	27.0	25.5	27.0	26.1	26.7	26.5	24.8	24.0	23.0	23.2	22.7	22.6	20.6	19.2	22.3	20.1	38.2
	Turbine ON - background adj (dBA)	9.5	15.3	18.9	22.8	26.4	30.6	33.7	36.5	38.9	40.1	40.2	42.1	41.6	40.1	41.0	41.0	41.5	41.4	41.3	40.7	40.1	39.8	38.8	37.2	34.5	30.2	[21.9]	[18.1]	52.9
	Signal to noise (dB)	12.6	13.1	12.1	11.3	11.2	11.4	11.6	12.9	13.4	14.8	14.4	15.6	14.7	14.7	14.1	15.0	15.0	15.1	16.6	16.8	17.1	16.7	16.2	14.8	14.1	11.3	2.6	1.0	14.8
	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	0.8	1.8	3.1	0.7
	PWL (dBA)	60.1	65.8	69.5	73.3	76.9	81.2	84.2	87.0	89.5	90.7	90.7	92.7	92.1	90.6	91.5	91.6	92.0	92.0	91.9	91.3	90.6	90.4	89.3	87.8	85.0	80.8	[72.5]	[68.6]	103.4
7.0	Turbine ON (dBA)	8.6	15.3	17.8	21.8	25.3	30.4	33.3	35.1	38.2	38.8	38.9	41.0	41.0	39.7	40.9	41.2	42.0	42.1	42.0	41.1	40.0	39.5	38.3	36.9	34.2	30.2	24.9	21.1	52.7
	Background (dBA)	-2.1	2.3	6.9	11.2	15.0	19.3	22.3	23.4	24.9	25.5	25.9	26.9	27.3	25.7	27.1	25.8	26.5	26.6	25.0	24.2	23.4	23.9	23.8	23.7	21.6	19.9	21.6	19.9	38.3
	Turbine ON - background adj (dBA)	8.2	15.0	17.4	21.4	24.9	30.0	33.0	34.8	38.0	38.6	38.6	40.9	40.8	39.5	40.8	41.1	41.9	42.0	41.9	41.0	39.9	39.3	38.2	36.7	34.0	29.8	22.1	[18.1]	52.5
	Signal to noise (dB)	10.7	13.0	10.9	10.5	10.3	11.0	11.0	11.7	13.3	13.3	13.0	14.2	13.7	14.0	13.9	15.4	15.5	15.6	17.0	16.9	16.5	15.6	14.5	13.3	12.6	10.4	3.2	1.2	14.4
	Uncertainty (dB)	1.1	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	1.6	3.1	0.7
	PWL (dBA)	58.8	65.6	68.0	71.9	75.5	80.5	83.5	85.4	88.5	89.2	89.2	91.4	91.4	90.1	91.3	91.7	92.5	92.6	92.4	91.6	90.4	89.9	88.7	87.3	84.5	80.4	72.7	[68.6]	103.1
8.0	Turbine ON (dBA)	8.7	15.3	17.6	21.7	25.2	30.2	33.2	33.9	37.2	37.3	37.4	39.8	40.3	39.2	40.8	41.4	42.5	42.8	42.9	41.8	40.2	39.2	37.9	36.5	33.7	29.8	24.8	21.3	52.6
	Background (dBA)	0.0	3.2	7.0	11.3	15.0	19.5	22.1	23.7	25.1	25.6	26.0	27.0	27.3	25.8	27.1	26.0	26.4	26.6	25.1	24.3	23.5	23.9	23.8	23.9	22.1	20.2	22.3	20.9	38.4
	Turbine ON - background adj (dBA)	8.1	15.1	17.2	21.2	24.8	29.8	32.9	33.4	36.9	37.0	37.1	39.6	40.1	39.0	40.6	41.3	42.4	42.7	42.8	41.8	40.1	39.1	37.7	36.2	33.4	29.3	[21.8]	[18.3]	52.4
	Signal to noise (dB)	8.7	12.2	10.6	10.4	10.2	10.7	11.1	10.2	12.2	11.7	11.4	12.8	13.0	13.5	13.7	15.4	16.1	16.3	17.8	17.5	16.7	15.4	14.0	12.5	11.6	9.6	2.5	0.4	14.2
	Uncertainty (dB)	1.0	0.9	0.8	0.8	0.8	0.7	0.7	0.8	0.7	0.7	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.7	0.7	0.7	0.7	0.8	1.6	2.8	0.6
	PWL (dBA)	58.6	65.6	67.8	71.8	75.3	80.4	83.4	84.0	87.5	87.6	87.6	90.1	90.6	89.6	91.2	91.8	92.9	93.3	93.4	92.3	90.7	89.7	88.2	86.8	83.9	79.8	[72.4]	[68.9]	103.0
9.0	Turbine ON (dBA)	8.1	15.2	17.6	21.8	25.9	30.7	34.2	33.6	37.0	36.8	36.6	39.1	39.8	38.8	40.6	41.4	42.6	43.1	43.4	42.3	40.6	39.4	38.0	36.6	33.8	29.7	24.4	21.5	52.6
	Background (dBA)	-0.8	4.0	7.6	11.8	15.7	19.8	23.1	24.3	25.6	26.3	26.5	27.6	27.9	26.3	27.6	26.4	27.1	27.1	26.3	28.1	24.3	24.7	24.8	24.5	22.9	21.0	22.9	21.7	39.2
	Turbine ON - background adj (dBA)	7.5	14.9	17.1	21.3	25.4	30.3	33.8	33.1	36.6	36.4	36.1	38.8	39.5	38.6	40.4	41.3	42.4	43.0	43.3	42.1	40.5	39.3	37.7	36.4	33.5	29.0	[21.4]	[18.5]	52.4
	Signal to noise (dB)	8.9	11.2	10.0	10.0	10.2	10.9	11.0	9.4	11.3	10.5	10.0	11.5	11.9	12.6	13.0	15.0	15.5	16.0	17.1	14.2	16.4	14.7	13.2	12.1	11.0	8.7	1.5	-0.2	13.4
	Uncertainty (dB)	1.7	1.6	1.4	1.3	1.4	1.3	1.3	1.3	1.2	1.3	1.1	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.2	1.2	1.2	1.2	1.3	2.4	4.3	1.1
	PWL (dBA)	58.1	65.4	67.6	71.9	76.0	80.9	84.4	83.7	87.2	87.0	86.7	89.4	90.0	89.1	90.9	91.8	93.0	93.6	93.9	92.7	91.1	89.8	88.3	86.9	84.0	79.6	[72]	[69.1]	103.0

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 measurement uncertainty at hub height

Project: Cedar Point Wind Power Project - Turbine CP244 - IEC 61400-11 Measurement

Report ID: 15039.00.CP244.RP4

Created on: 1/26/2018

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	
7.0	Turbine ON	7.03	22	Average (dBA)	8.3	12.8	17.3	21.2	25.1	29.5	32.1	35.0	37.3	38.6	38.1	39.8	39.1	37.4	38.1	37.9	38.2	38.1	38.5	38.2	37.9	37.6	36.5	34.9	32.1	27.9	22.7	19.4	50.4
				Uncertainty A (dB)	0.5	0.5	0.4	0.5	0.4	0.3	0.4	0.3	0.3	0.3	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	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	0.8	1.4	
				Combined Uncertainty (dB)	1.1	1.1	0.9	0.9	0.9	0.9	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	0.8	0.8	0.8	0.8	0.8	0.8	1.5	
	Background	6.98	18	Average (dBA)	-3.7	2.0	6.9	11.8	15.4	19.1	21.9	23.2	25.0	25.4	25.6	26.4	26.8	25.2	26.9	26.5	26.4	26.3	24.8	23.7	22.8	22.5	21.7	21.6	19.6	18.3	21.3	19.2	37.9
				Uncertainty A (dB)	0.4	0.3	0.4	0.6	0.5	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.3	0.3	0.3	0.6	0.4	0.3	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.8	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	0.8	1.4		
				Combined Uncertainty (dB)	1.1	1.1	0.9	1.0	0.9	0.9	0.9	0.9	0.9	0.9	0.8	0.8	0.8	0.8	0.8	0.8	0.9	0.8	0.8	0.8	0.8	0.9	0.9	0.9	0.9	0.8	1.1	1.5		
7.5	Turbine ON	7.52	46	Average (dBA)	9.5	14.5	18.8	22.7	26.2	30.3	32.7	35.9	38.2	39.4	39.5	41.5	40.9	39.4	40.1	40.0	40.3	40.1	40.1	39.5	38.9	38.7	37.6	36.0	33.2	29.0	23.4	19.9	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	0.1	0.1	0.1	0.1	0.1	0.1	0.1	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	0.7	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	0.8	0.8	0.8	1.5		
	Background	7.49	30	Average (dBA)	-3.4	1.7	6.9	11.4	15.6	19.3	22.1	24.2	26.6	26.1	26.0	26.6	27.1	25.9	27.6	26.3	26.6	26.7	25.0	24.1	23.2	23.1	22.3	22.0	20.1	18.8	20.2	19.5	38.3
				Uncertainty A (dB)	0.3	0.3	0.3	0.4	0.3	0.2	0.3	0.4	0.5	0.4	0.3	0.3	0.2	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.2	0.5	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	0.8	1.4		
				Combined Uncertainty (dB)	1.1	1.0	0.9	0.9	0.9	0.8	0.8	0.9	1.0	0.9	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	0.9	0.9	0.8	0.9	1.5			
8.0	Turbine ON	8.00	79	Average (dBA)	10.3	15.6	19.6	23.5	27.0	31.1	34.0	36.6	38.9	40.1	40.3	42.2	41.8	40.3	41.2	41.1	41.5	41.4	41.3	40.7	40.0	39.6	38.5	37.0	34.3	30.2	24.7	21.4	52.9
				Uncertainty A (dB)	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	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		
				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	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	0.8	0.8	0.8	1.5		
	Background	7.99	23	Average (dBA)	-3.0	1.8	6.3	10.6	15.5	19.2	22.0	24.0	25.9	25.2	25.8	26.6	27.1	25.6	27.2	26.6	27.0	26.7	25.1	24.1	23.1	23.1	22.5	22.5	20.9	19.8	22.5	20.3	38.3
				Uncertainty A (dB)	0.5	0.3	0.4	0.4	0.5	0.3	0.3	0.5	0.6	0.4	0.4	0.3	0.3	0.3	0.2	0.4	0.3	0.3	0.3	0.2	0.3	0.3	0.4	0.4	0.4	0.4	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	0.8	1.4		
				Combined Uncertainty (dB)	1.1	1.1	0.9	0.9	0.9	0.8	0.9	0.9	1.0	0.9	0.8	0.8	0.8	0.7	0.7	0.8	0.8	0.7	0.7	0.7	0.7	0.8	0.9	0.9	0.9	0.9	1.0	1.5			
8.5	Turbine ON	8.54	88	Average (dBA)	10.2	15.8	19.7	23.6	27.1	31.4	34.4	37.0	39.3	40.5	40.5	42.4	41.9	40.4	41.3	41.3	41.7	41.7	41.5	40.9	40.3	40.1	39.1	37.5	34.8	30.6	25.0	21.0	53.2
				Uncertainty A (dB)	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.1			
				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	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	0.8	0.8	0.8	1.4		
	Background	8.46	33	Average (dBA)	-2.6	2.4	7.1	11.7	15.3	19.5	22.4	23.7	25.5	25.6	26.0	26.8	27.0	25.5	26.9	26.1	26.6	26.4	24.9	24.1	23.1	23.4	23.0	22.8	20.7	19.2	21.3	19.9	38.2
				Uncertainty A (dB)	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.3	0.3	0.3	0.2	0.2	0.2	0.3	0.3	0.2	0.2	0.2	0.2	0.3	0.4	0.4	0.4	0.3	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	0.8	1.4		
				Combined Uncertainty (dB)	1.1	1.1	0.9	0.9	0.9	0.8	0.9	0.9	0.9	0.9	0.8	0.8	0.7	0.7	0.7	0.8	0.7	0.7	0.7	0.7	0.7	0.9	0.9	0.9	0.9	0.9	1.0	1.5			
9.0	Turbine ON	8.97	107	Average (dBA)	9.2	15.2	18.6	22.5	26.3	30.6	33.7	36.5	39.2	40.3	40.3	42.2	41.7	40.2	41.1	41.2	41.7	41.7	41.5	40.9	40.2	40.0	39.0	37.5	34.8	30.7	24.9	21.0	53.0
				Uncertainty A (dB)	0.2	0.1	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.1			
				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	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	0.8	0.8	0.8	1.4		
	Background	9.03	29	Average (dBA)	-2.4	2.8	7.5	12.5	15.6	19.8	22.7	23.7	25.3	25.6	25.9	26.7	27.1	25.6	27.2	26.4	26.8	26.7	24.9	24.1	23.2	23.3	22.7	22.6	20.5	19.2	22.2	20.1	38.3
				Uncertainty A (dB)	0.5	0.4	0.4	0.6	0.4	0.3	0.4	0.4	0.4	0.4	0.4	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.3	0.3	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	0.8	1.4		
				Combined Uncertainty (dB)	1.1	1.1	0.9	1.0	0.9	0.9	0.9	0.9	0.9	0.9	0.8	0.8	0.7	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.9	0.9	0.9	0.9	0.9	1.1	1.5			
9.5	Turbine ON	9.48	80	Average (dBA)	8.4	15.4	17.8	21.8	25.4	30.3	33.4	35.8	38.7	39.5	39.6	41.7	41.4	40.0	41.1	41.2	41.9	41.9	41.6	40.9	40.0	39.7	38.7	37.2	34.5	30.6	25.2	21.0	52.8
				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	0.1	0.1	0.1	0.1	0.1	0.1	0.1			
				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	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	0.8	0.8	0.8	1.4		
	Background	9.50	38	Average (dBA)	-2.3	2.1	6.8	11.1	15.1	19.2	22.0	23.5	25.1	25.6	25.9	26.8	27.1	25.6	27.0	25.9	26.4	26.4	24.7	23.9	23.2	23.5	23.2	23.3	21.2	19.6	22.3	20.1	38.2
				Uncertainty A (dB)	0.4	0.2	0.3	0.3	0.3	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.5	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	0.8	1.4		
				Combined Uncertainty (dB)	1.1	1.0	0.8	0.8	0.9	0.8	0.9	0.9	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	0.8	0.9	0.9	0.9	0.9	1.0	1.5			
10.0	Turbine ON	10.01	140	Average (dBA)	8.8	15.3	18.0	21.8	25.4	30.4	33.3	35.2	38.2	38.9	38.9	41.1	41.0	39.7	40.9	41.2	42.0	42.1	41.9	41.1	40.0	39.5	38.4	37.0	34.3	30.3	25.0	21.1	52.7
				Uncertainty A (dB)	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	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1			
				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	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	0.8	0.8	0.8	1.4		
	Background	9.99	28	Average (dBA)	-2.6	2.3	6.5	10.7	14.6	19.1	21.9	23.0	24.7	25.1	25.6	26.7	27.1	25.4	26.7	25.5	26.3	26.3	24.7	23.9	23.0	23.3	23.1	23.0	21.2	19.4	21.5	19.9	38.0
				Uncertainty A (dB)	0.5	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.2	0.2	0.3	0.2	0.2	0.2	0.2	0.3	0.4	0.4	0.4	0.3	0.5	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	0.9	0.9	0.9	0.8	0.9	0.9	0.9	0.9	0.7	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.9	0.9	0.9	0.8	1.0	1.5			

Table C.04 Detailed measurement uncertainty at hub height

Project: Cedar Point Wind Power Project - Turbine CP244 - IEC 61400-11 Measurement

Report ID: 15039.00.CP244.RP4

Created on: 1/26/2018

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	143	Average (dBA)	8.4	15.2	17.5	21.5	25.0	30.3	33.3	34.5	37.8	38.3	38.3	40.6	40.7	39.5	40.9	41.3	42.2	42.4	42.2	41.3	40.0	39.3	38.1	36.7	34.0	30.0	24.8	21.1	52.6
				Uncertainty A (dB)	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	0.0	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	
				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	0.8	0.8	1.4		
	Background	10.53	30	Average (dBA)	-1.5	2.4	7.5	11.7	15.4	19.8	23.0	23.8	25.0	25.9	26.2	27.2	27.6	26.0	27.4	26.1	26.7	26.8	25.4	24.6	24.0	24.7	24.7	24.5	22.3	20.6	21.8	19.8	38.7
				Uncertainty A (dB)	0.6	0.4	0.4	0.4	0.4	0.3	0.4	0.4	0.3	0.4	0.3	0.4	0.3	0.3	0.3	0.3	0.3	0.2	0.3	0.3	0.4	0.5	0.6	0.6	0.5	0.4	0.5	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)	1.2	1.1	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.8	0.8	0.8	0.8	0.7	0.7	0.8	0.7	0.8	0.7	0.8	0.9	1.0	1.0	0.9	0.9	1.0	1.5		
11.0	Turbine ON	10.98	93	Average (dBA)	8.1	15.0	17.6	21.4	25.0	30.1	33.0	33.9	37.4	37.5	37.7	40.0	40.5	39.4	40.9	41.4	42.4	42.7	42.6	41.6	40.1	39.2	37.8	36.4	33.6	29.8	25.0	21.2	52.6
				Uncertainty A (dB)	0.2	0.2	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	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.1		
				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	0.8	0.8	1.4		
	Background	11.05	24	Average (dBA)	2.1	3.8	7.3	11.3	14.9	19.4	21.9	23.6	24.9	25.5	25.8	26.8	27.2	25.6	27.2	26.1	26.6	26.7	25.2	24.2	23.5	23.7	23.7	24.2	22.5	20.3	22.5	21.3	38.4
				Uncertainty A (dB)	1.2	0.6	0.3	0.3	0.3	0.2	0.3	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.4	0.3	0.4	0.4	0.5	0.6	0.6	0.5	0.8	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)	1.6	1.2	0.9	0.9	0.8	0.8	0.8	0.9	0.9	0.8	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.7	0.8	0.8	0.8	0.9	0.9	1.0	1.0	0.9	1.1	1.6		
11.5	Turbine ON	11.46	52	Average (dBA)	10.0	16.0	18.0	22.0	25.4	30.2	33.3	34.0	37.3	37.4	37.5	39.9	40.4	39.3	41.0	41.5	42.6	42.9	43.0	42.0	40.3	39.3	37.9	36.5	33.7	29.8	24.7	21.5	52.7
				Uncertainty A (dB)	0.4	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	0.1	0.1	0.1	0.1	0.2	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	0.8	0.8	1.5		
	Background	11.51	26	Average (dBA)	-1.5	2.8	7.2	11.6	15.3	19.6	22.4	24.0	25.3	26.0	26.3	27.3	27.5	26.1	27.4	26.2	26.6	26.7	25.2	24.6	23.8	24.2	24.1	24.0	22.0	20.3	22.4	20.8	38.6
				Uncertainty A (dB)	0.6	0.4	0.3	0.4	0.4	0.3	0.4	0.5	0.4	0.4	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.5	0.5	0.5	0.4	0.6	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)	1.2	1.1	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.8	0.8	0.8	0.8	0.7	0.8	0.8	0.7	0.8	0.8	0.8	0.9	0.9	0.9	0.9	0.9	1.0	1.5		

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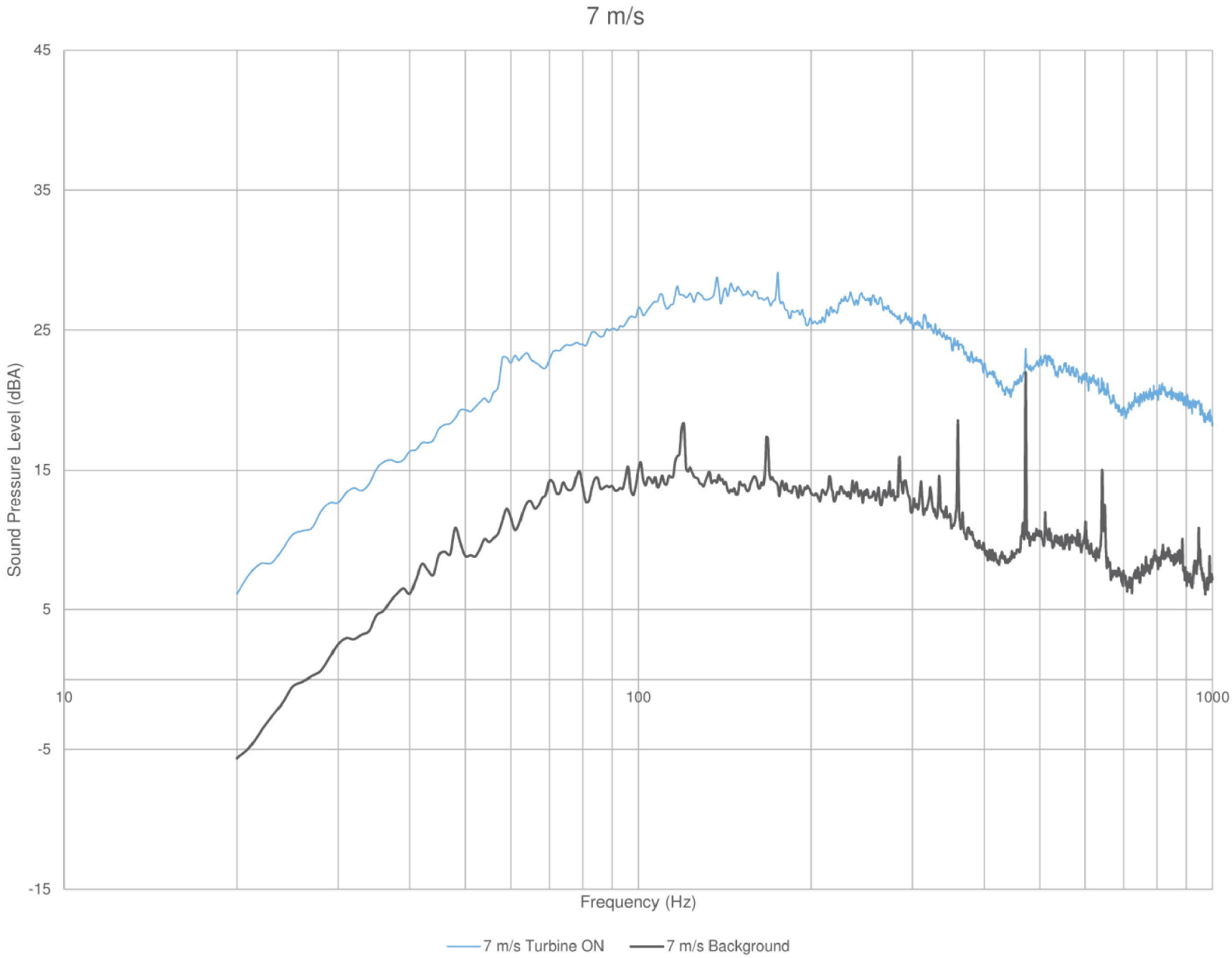
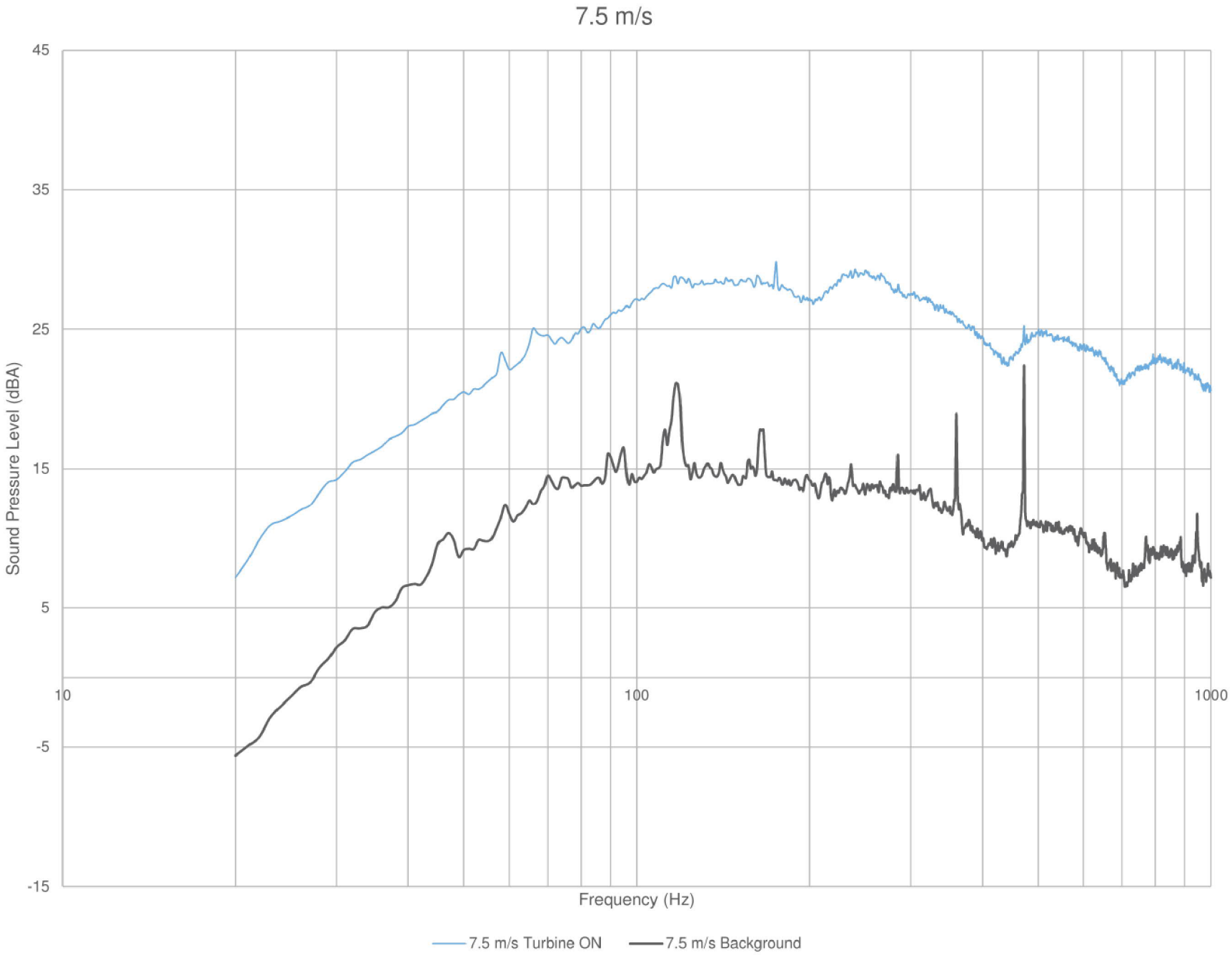
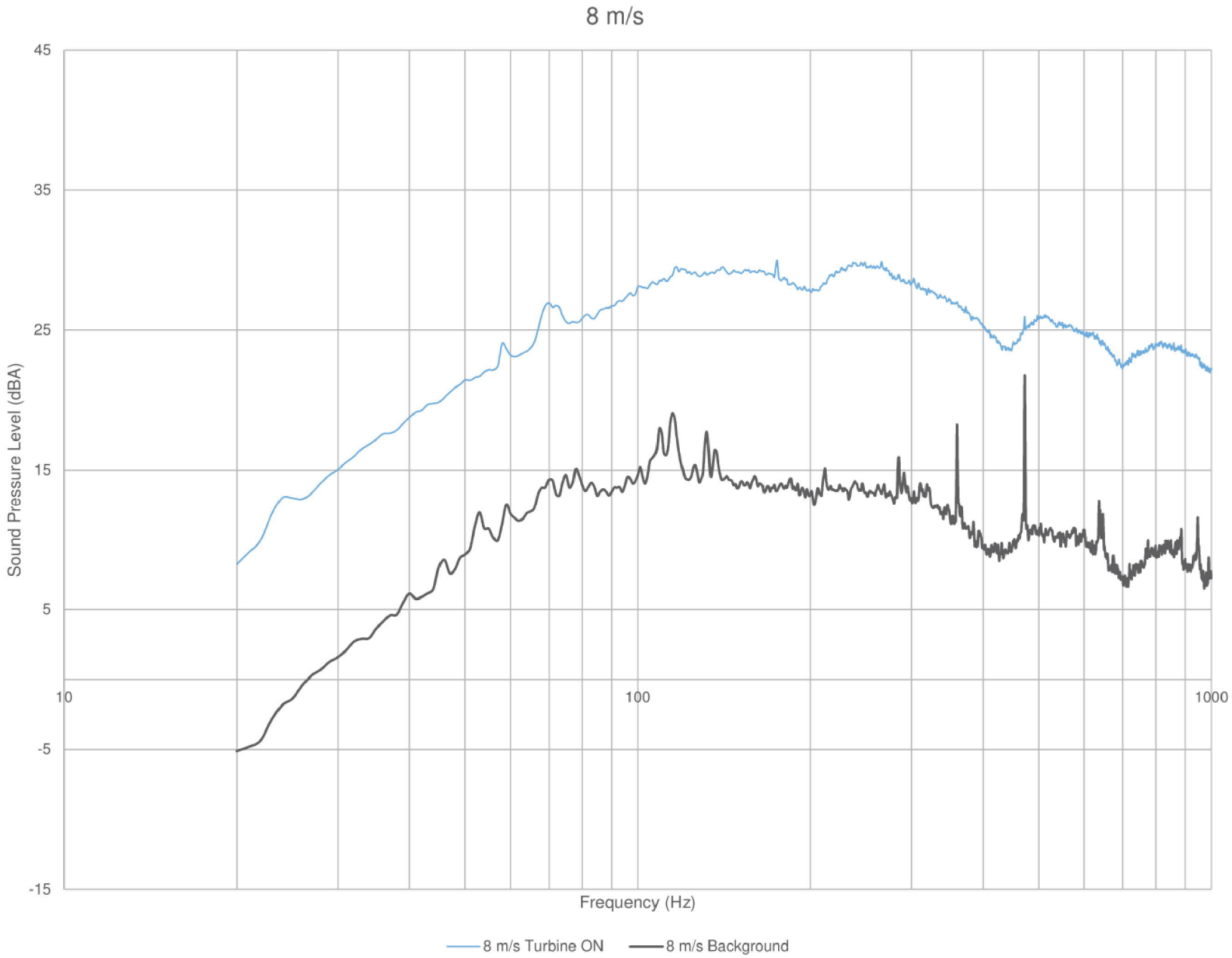
Appendix D
Tonality Assessment



aercoustics	Project ID: 15039.00.CP244.RP4	**Project Name**
	Scale: NTS Drawn by: KC Reviewed by: PA Date: January 2018 Revision: 3	Cedar Point Wind Power Project - Turbine CP244 - IEC 61400-11 - Edition 3.0
		Figure Title Plot of narrow band spectra - Turbine ON vs. Background at 7 m/s
		Figure D.01

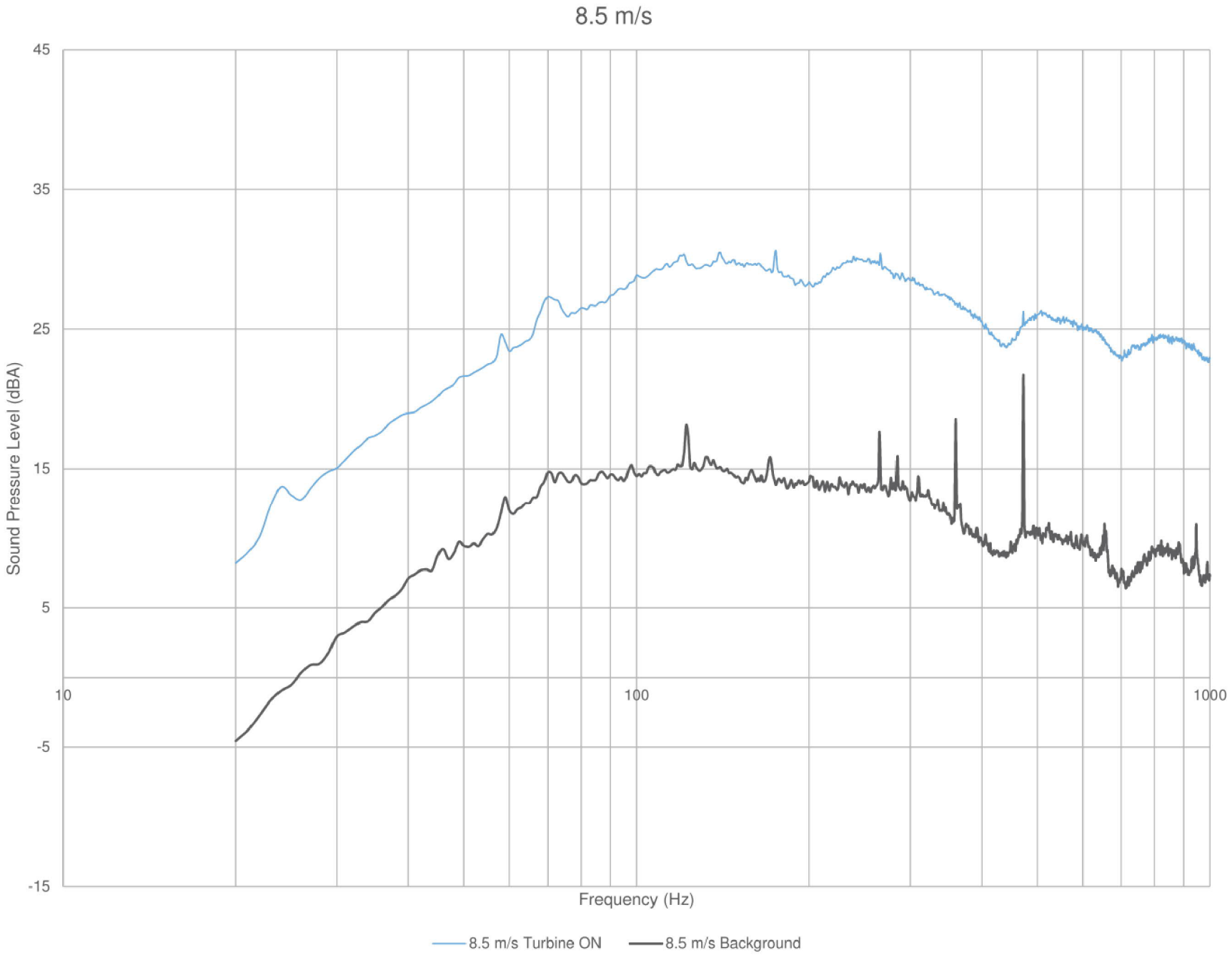


aercoustics	Project ID: 15039.00.CP244.RP4	**Project Name**
	Scale: NTS Drawn by: KC Reviewed by: PA Date: January 2018 Revision: 3	Cedar Point Wind Power Project - Turbine CP244 - IEC 61400-11 - Edition 3.0
		Figure Title Plot of narrow band spectra - Turbine ON vs. Background at 7.5 m/s
		Figure D.02



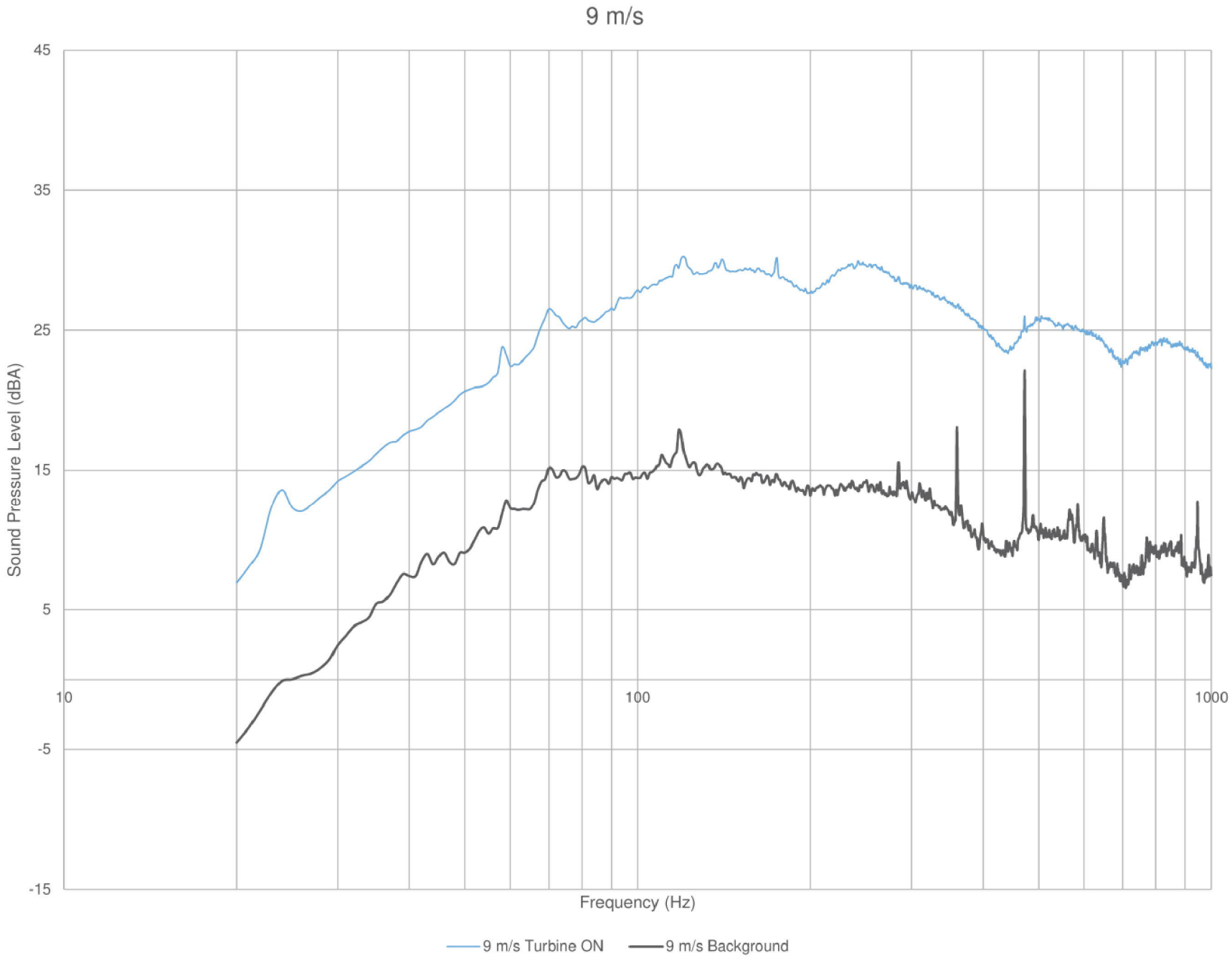
aercoustics	Project ID: 15039.00.CP244.RP4 Scale: NTS Drawn by: KC Reviewed by: PA Date: January 2018 Revision: 3	**Project Name** Cedar Point Wind Power Project - Turbine CP244 - IEC 61400-11 - Edition 3.0 **Figure Title** Plot of narrow band spectra - Turbine ON vs. Background at 8 m/s

Figure D.03

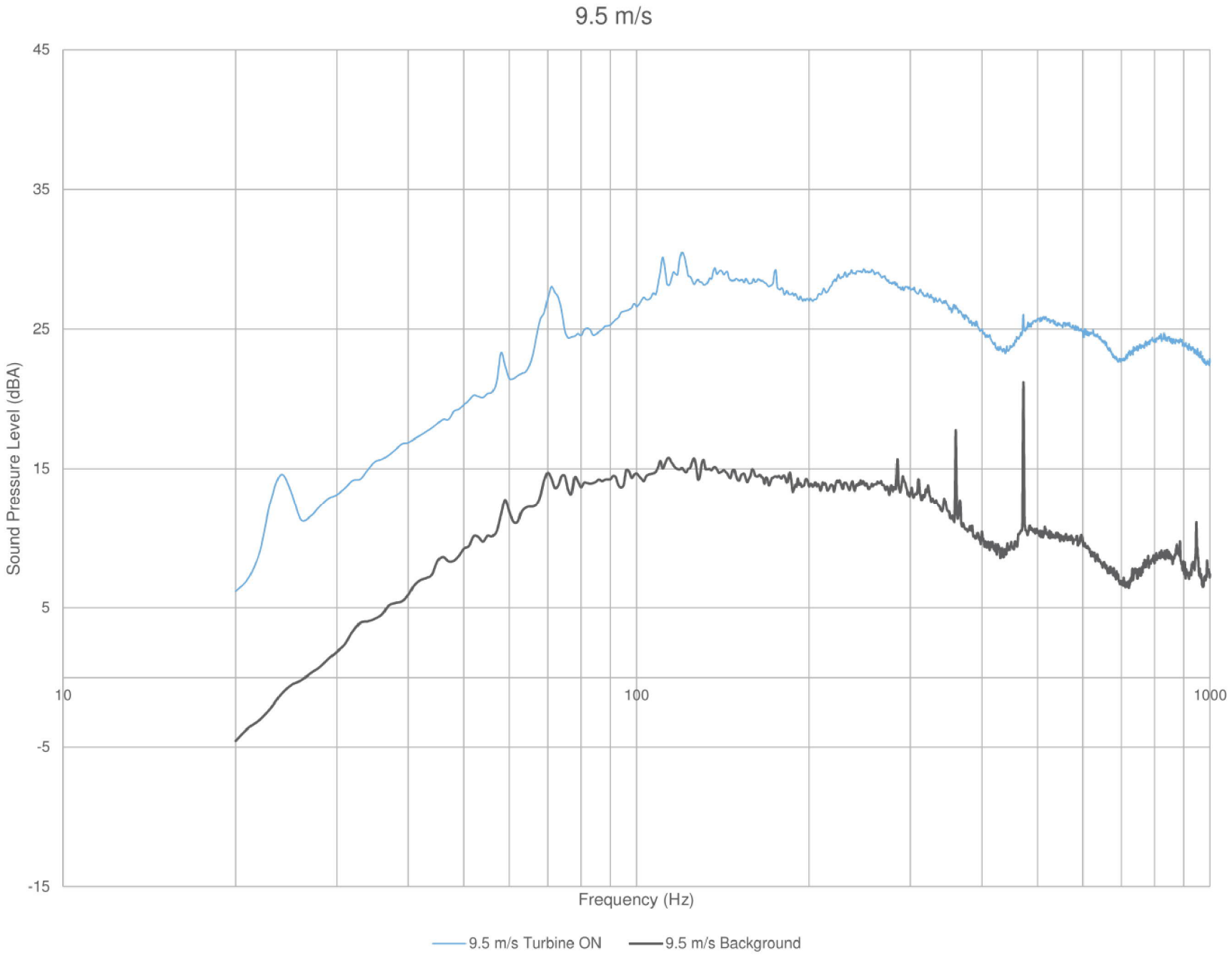


aercoustics	Project ID: 15039.00.CP244.RP4 Scale: NTS Drawn by: KC Reviewed by: PA Date: January 2018 Revision: 3	**Project Name** Cedar Point Wind Power Project - Turbine CP244 - IEC 61400-11 - Edition 3.0 **Figure Title** Plot of narrow band spectra - Turbine ON vs. Background at 8.5 m/s

Figure D.04



aercoustics	Project ID: 15039.00.CP244.RP4	**Project Name**
	Scale: NTS Drawn by: KC Reviewed by: PA Date: January 2018 Revision: 3	Cedar Point Wind Power Project - Turbine CP244 - IEC 61400-11 - Edition 3.0
		Figure Title Plot of narrow band spectra - Turbine ON vs. Background at 9 m/s
		Figure D.05



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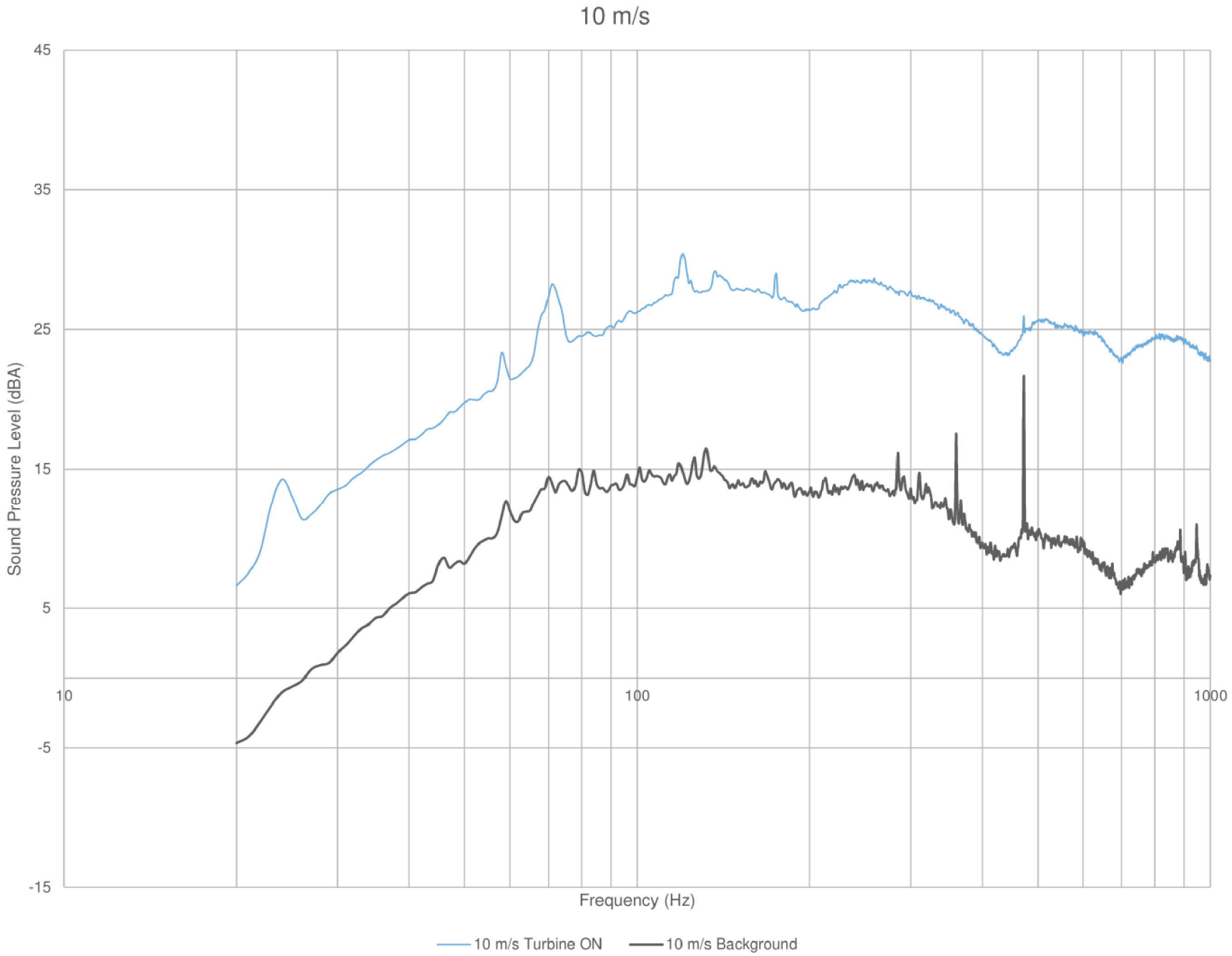
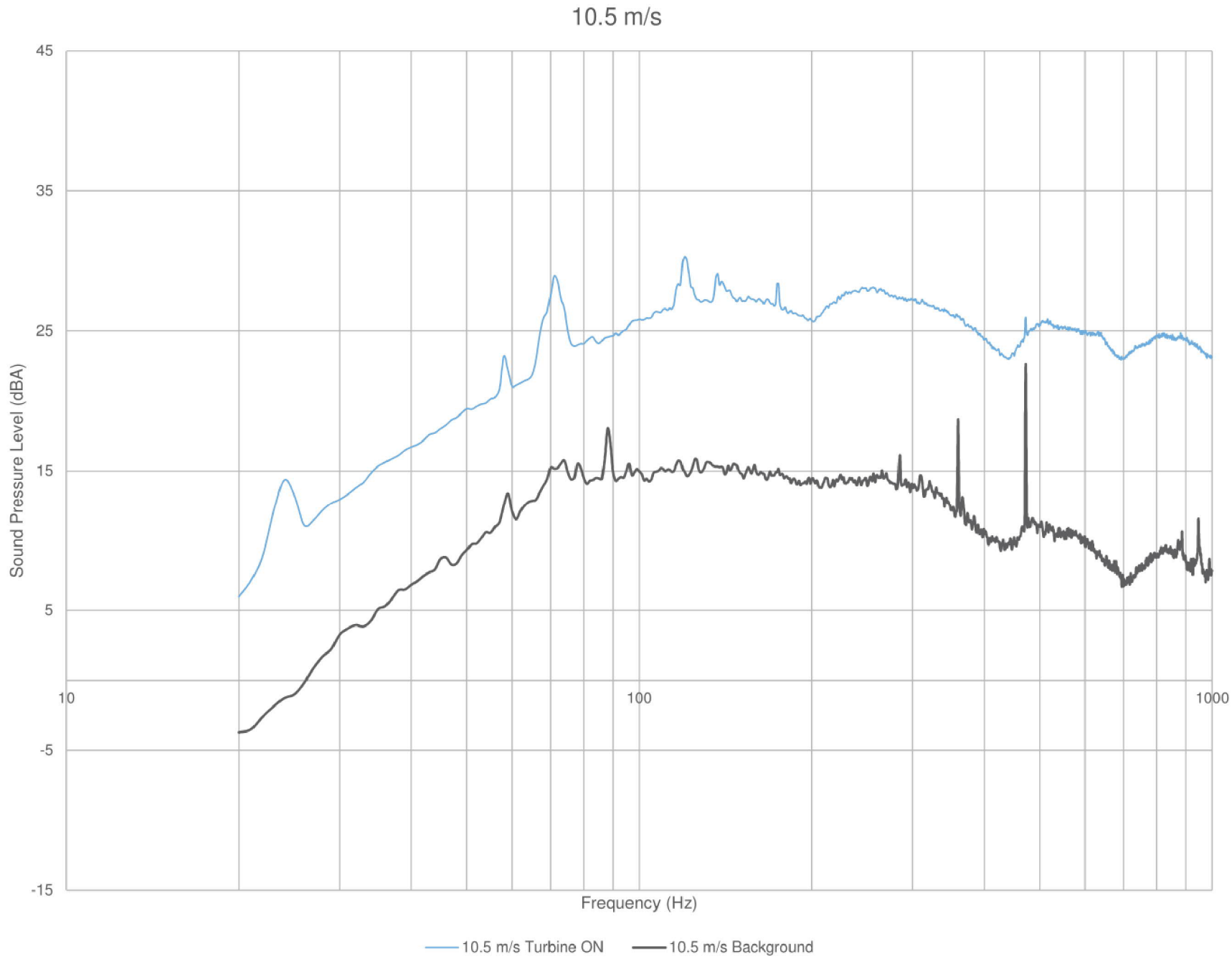
Project ID: 15039.00.CP244.RP4	**Project Name**
Scale: NTS Drawn by: KC Reviewed by: PA Date: January 2018 Revision: 3	Cedar Point Wind Power Project - Turbine CP244 - IEC 61400-11 - Edition 3.0
	Figure Title Plot of narrow band spectra - Turbine ON vs. Background at 9.5 m/s

Figure D.06



aercoustics	Project ID: 15039.00.CP244.RP4 Scale: NTS Drawn by: KC Reviewed by: PA Date: January 2018 Revision: 3	**Project Name** Cedar Point Wind Power Project - Turbine CP244 - IEC 61400-11 - Edition 3.0 **Figure Title** Plot of narrow band spectra - Turbine ON vs. Background at 10 m/s

Figure D.07



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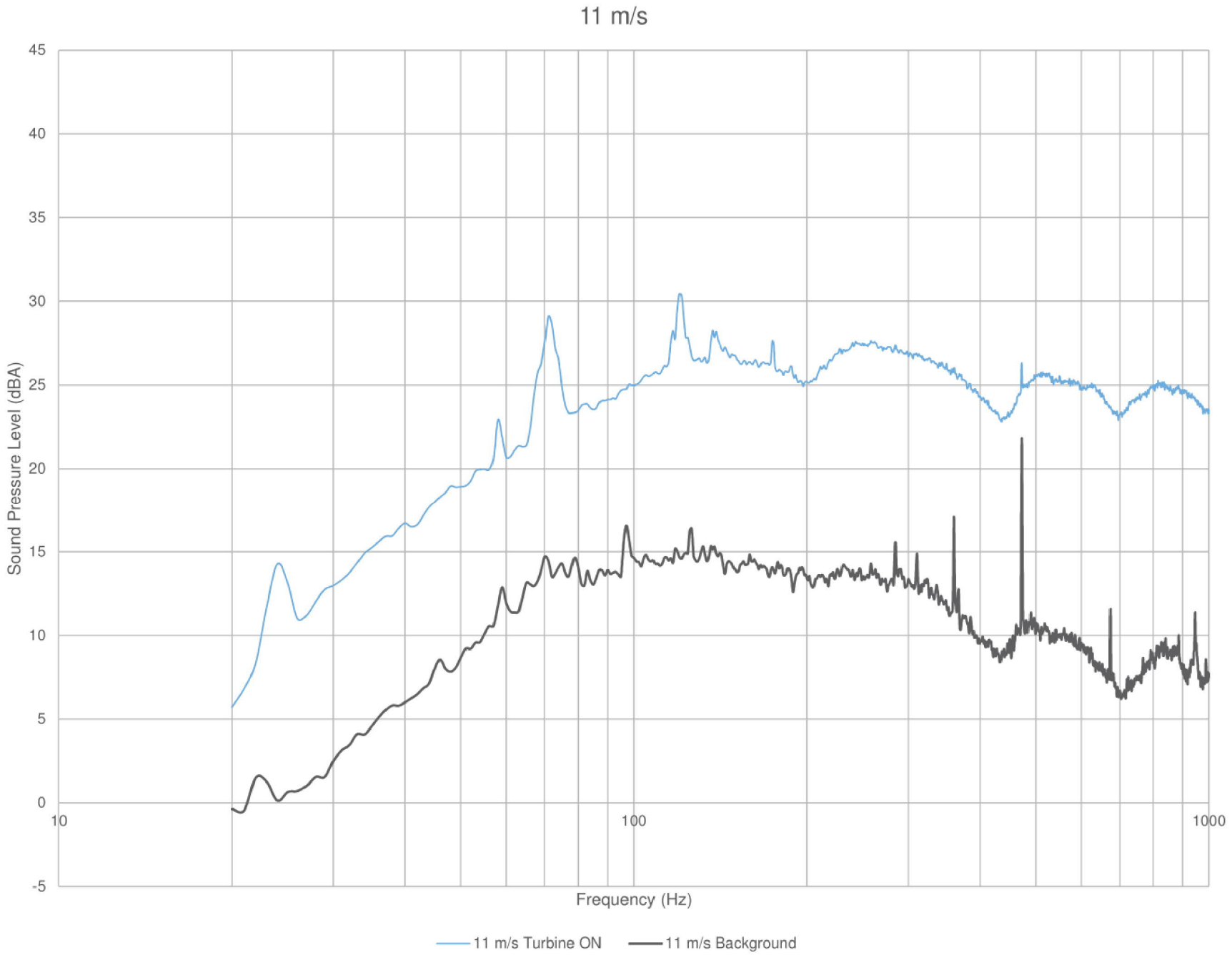
Project ID: 15039.00.CP244.RP4	**Project Name**
Scale: NTS Drawn by: KC Reviewed by: PA Date: January 2018 Revision: 3	Cedar Point Wind Power Project - Turbine CP244 - IEC 61400-11 - Edition 3.0
	Figure Title Plot of narrow band spectra - Turbine ON vs. Background at 10.5m/s

Figure D.08



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Project ID: 15039.00.CP244.RP4

Scale: NTS
Drawn by: KC
Reviewed by: PA
Date: January 2018
Revision: 3

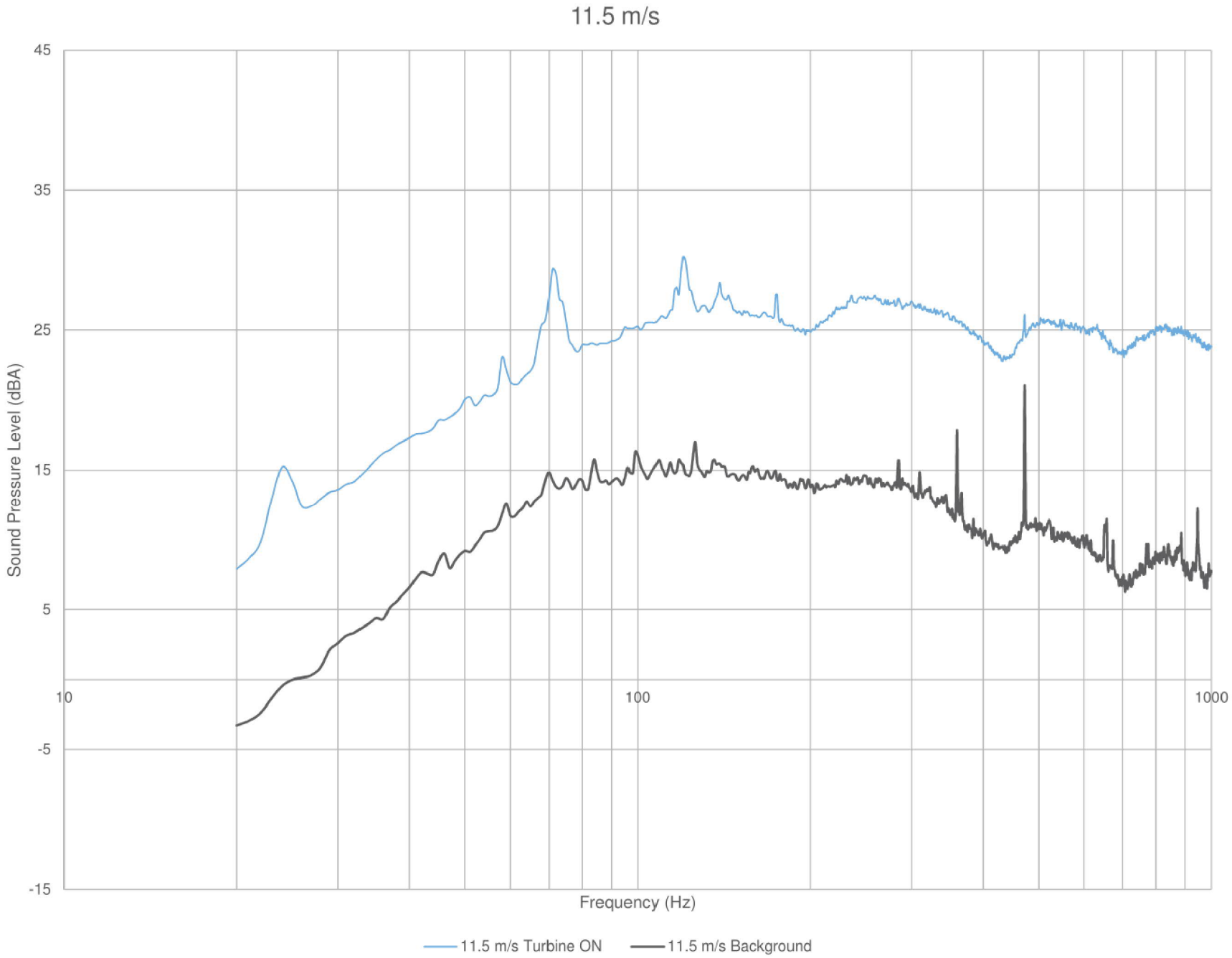
Project Name

Cedar Point Wind Power Project - Turbine CP244 - IEC 61400-11 - Edition 3.0

Figure Title

Plot of narrow band spectra - Turbine ON vs. Background at 11 m/s

Figure D.09



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Project ID: 15039.00.CP244.RP4

Scale: NTS
Drawn by: KC
Reviewed by: PA
Date: January 2018
Revision: 3

Project Name

Cedar Point Wind Power Project - Turbine CP244 - IEC 61400-11 - 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 CP244 - IEC 61400-11 Measurement

Report ID: 15039.00.CP244.RP4

Created on: 1/25/2018

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.02 Tonality Assessment Table - 7.5 m/s

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

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.04 Tonality Assessment Table - 8.5 m/s

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.05 Tonality Assessment Table - 9 m/s

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.06 Tonality Assessment Table - 9.5 m/s

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.07 Tonality Assessment Table - 10 m/s

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.08 Tonality Assessment Table - 10.5 m/s

Project: Cedar Point Wind Power Project - Turbine CP244 - IEC 61400-11 Measurement

Report ID: 15039.00.CP244.RP4

Created on: 1/26/2018

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	71			18.8	37.1	35.0	-2.1	-2.0	-0.1
435	71			19.5	37.8	34.4	-3.4	-2.0	-1.4
667	71			21.9	40.2	36.1	-4.0	-2.0	-2.0
416	71			19.2	37.5	35.7	-1.8	-2.0	0.2
543	71			22.3	40.6	32.5	-8.1	-2.0	-6.1
346	71			22.7	40.9	31.2	-9.7	-2.0	-7.7
576	71			21.2	39.4	35.4	-4.1	-2.0	-2.1
986	71			21.7	40.0	36.9	-3.1	-2.0	-1.1
490	71			20.2	38.5	33.8	-4.6	-2.0	-2.6
510	71			20.1	38.4	34.0	-4.4	-2.0	-2.4
300	71			21.9	40.2	35.3	-4.8	-2.0	-2.8
841	71			23.1	41.4	37.8	-3.5	-2.0	-1.5
555	71			19.9	38.1	37.0	-1.1	-2.0	0.9
488	71			19.8	38.1	33.0	-5.0	-2.0	-3.0
462	71			19.6	37.9	35.7	-2.2	-2.0	-0.2
262	71			20.7	39.0	34.9	-4.1	-2.0	-2.1
414	71			20.5	38.7	37.1	-1.7	-2.0	0.3
875	71			24.2	42.5	36.3	-6.2	-2.0	-4.2
965	71			21.8	40.1	38.2	-1.9	-2.0	0.1
299	71			23.2	41.4	31.0	-10.4	-2.0	-8.4
720	71			21.2	39.4	38.4	-1.1	-2.0	0.9
619	71			23.7	42.0	37.7	-4.3	-2.0	-2.3
345	71			21.7	39.9	34.9	-5.0	-2.0	-3.0
358	72			19.2	37.4	36.4	-1.0	-2.0	1.0
629	72			22.6	40.8	38.7	-2.1	-2.0	-0.1
750	72			21.1	39.3	37.6	-1.7	-2.0	0.3
487	72			21.4	39.6	33.8	-5.8	-2.0	-3.8
730	72			22.4	40.6	38.2	-2.4	-2.0	-0.4
861	72			21.7	39.9	38.3	-1.7	-2.0	0.3
518	72			23.2	41.4	34.0	-7.4	-2.0	-5.4
703	72			22.8	41.0	36.0	-5.1	-2.0	-3.0
984	72			23.0	41.2	38.2	-3.0	-2.0	-1.0
415	73			20.7	38.9	37.4	-1.5	-2.0	0.5
401	73			19.8	38.1	33.5	-4.6	-2.0	-2.6
506	73			22.5	40.8	32.5	-8.3	-2.0	-6.3
1014	74			23.1	41.4	41.6	0.2	-2.0	2.2
132	79			25	43	37	-6.4	-2.0	-4.4
94	83			26.8	45.1	37.8	-7.3	-2.0	-5.3
Average	72						-3.4	-2.0	-1.4

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

Project: Cedar Point Wind Power Project - Turbine CP244 - IEC 61400-11 Measurement

Report ID: 15039.00.CP244.RP4

Created on: 1/26/2018

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.10 Tonality Assessment Table - 11.5 m/s

Project: Cedar Point Wind Power Project - Turbine CP244 - IEC 61400-11 Measurement

Report ID: 15039.00.CP244.RP4

Created on: 1/26/2018

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)
941	71			22.0	40.3	37.1	-3.2	-2.0	-1.2
762	71			20.1	38.3	37.2	-1.2	-2.0	0.8
403	71			21.1	39.3	34.9	-4.5	-2.0	-2.4
651	71			23.2	41.4	36.9	-4.6	-2.0	-2.5
681	71			22.7	40.9	36.4	-4.5	-2.0	-2.5
691	71			22.9	41.1	37.4	-3.8	-2.0	-1.8
554	71			23.5	41.7	30.6	-11.1	-2.0	-9.1
966	71			22.1	40.3	36.3	-4.0	-2.0	-2.0
404	71			23.0	41.3	29.9	-11.4	-2.0	-9.4
676	72			22.9	41.1	33.0	-8.2	-2.0	-6.2
751	72			20.0	38.2	37.7	-0.6	-2.0	1.4
760	72			22.2	40.5	37.7	-2.7	-2.0	-0.7
628	72			23.7	41.9	37.2	-4.7	-2.0	-2.7
Average	71						-4.0	-2.0	-2.0

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Appendix E
Measurement Data

Table E.01 Measurement data - Turbine ON

Project: Cedar Point Wind Power Project - Turbine CP244 - IEC 61400-11 Measurement

Report ID: 15039.00.CP244.RP4

Created on: 1/25/2018

***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	9.5	53.8	2087	168.0	157.4	-1.6	13.0	9.7	5.0	22.1	99.1	59
2	8.8	53.5	1860	168.0	157.4	-1.8	12.9	9.5	4.2	22.2	99.1	59
3	8.9	53.7	1906	168.0	157.4	-1.0	13.0	9.6	4.0	22.3	99.1	58
4	8.9	53.6	1922	168.0	157.2	-1.0	13.0	9.3	4.6	22.3	99.1	58
5	8.7	53.9	1825	168.0	154.9	-1.6	12.9	9.4	5.0	22.3	99.1	58
6	8.2	53.7	1575	168.0	154.9	-1.8	12.9	7.2	4.8	22.3	99.1	58
7	7.7	53.4	1354	168.0	154.9	-1.8	12.8	6.8	5.0	22.3	99.0	58
8	8.4	53.5	1674	168.0	155.0	-1.7	13.1	8.2	5.4	22.3	99.0	58
9	8.7	53.1	1839	168.0	155.0	-1.8	13.1	8.7	6.2	22.3	99.0	58
10			2035	168.0	154.8	-1.6	13.1	8.9	5.2	22.3	99.0	58
11			2128	168.0	152.5	-1.2	13.1	9.4	6.5	22.3	99.0	58
12			2039	168.0	152.5	-0.9	13.0	9.0	5.5	22.3	99.0	58
13			1977	168.0	152.5	-1.1	13.0	9.4	5.4	22.3	98.9	58
14			1831	168.0	152.5	-1.8	13.0	8.4	6.6	22.3	98.9	57
15			1752	168.0	152.5	-1.8	13.0	8.0	6.3	22.3	99.0	57
16			1602	168.0	152.5	-1.8	12.9	8.2	6.1	22.3	98.9	57
17			1565	168.0	152.5	-1.8	13.0	7.6	5.5	22.3	98.9	57
18			1422	168.0	151.5	-1.8	13.0	7.9	4.7	22.3	98.9	57
19			1428	168.0	149.9	-1.8	13.0	7.7	4.9	22.3	98.9	57
20			1584	168.0	150.0	-1.8	13.1	8.9	3.2	22.2	98.9	58
21			1513	168.0	150.0	-1.6	13.0	7.6	4.7	22.2	98.9	59
22			1276	168.0	150.0	-1.5	12.6	8.2	4.9	22.2	99.0	59
23			1284	168.0	149.4	-1.5	12.6	7.2	3.8	22.2	99.0	59
24			1580	168.0	147.1	-1.5	13.1	7.8	3.7	22.2	99.0	59
25			1879	168.0	147.1	-1.5	13.1	9.5	4.3	22.2	99.0	59
26			1739	168.0	147.1	-1.5	13.0	8.5	4.2	22.2	99.0	59
27			1824	168.0	147.1	-2.0	13.1	10.1	5.9	22.2	99.0	60
28			2138	168.0	147.1	-1.7	13.1	9.6	6.3	22.2	99.0	60
29			2197	168.0	147.2	-0.9	13.0	10.3	6.3	22.2	99.0	60
30			2076	168.0	147.2	-1.1	13.0	9.6	5.9	22.2	98.9	60
31			1980	168.0	147.2	-1.4	13.0	8.8	4.8	22.2	98.4	60
32			1807	168.0	147.2	-1.8	12.9	9.2	4.5	22.2	96.8	60
33			1391	168.0	147.2	-1.9	12.8	7.6	5.8	22.3	96.9	59
34			1540	168.0	147.2	-1.8	13.0	7.8	6.6	22.3	97.1	59
35	10.1	52.8	2164	152.0	153.6	-0.7	13.0	10.3	7.5	22.6	99.0	57
36	9.3	52.7	2154	152.0	153.0	-0.6	13.0	9.5	5.9	22.6	99.0	57
37			2024	152.0	153.0	-1.0	13.0	8.6	5.5	22.7	99.0	57
38	9.0	52.5	1967	152.0	153.0	-1.1	13.0	9.0	6.6	22.7	99.0	57
39	8.7	52.5	1806	152.0	153.0	-1.7	12.9	8.0	7.1	22.7	99.1	57
40	8.6	53.5	1786	152.0	153.0	-1.5	13.0	8.7	6.8	22.7	99.1	57
41	8.5	52.8	1706	152.0	152.2	-1.8	13.0	8.6	5.6	22.7	99.0	57
42	8.3	52.9	1646	152.0	150.6	-1.8	13.0	9.4	8.1	22.6	99.1	56
43	9.1	53.5	1978	152.0	150.6	-1.7	13.1	10.2	7.5	22.6	99.0	56
44	8.5	53.1	1738	152.0	150.6	-1.8	12.9	8.5	5.9	22.6	99.1	56
45	7.9	53.1	1430	152.0	150.6	-1.8	12.9	6.5	5.0	22.6	99.1	56
46	8.7	53.9	1835	152.0	152.4	-1.6	13.1	9.2	5.7	22.6	99.1	56
47			136	152.0	153.4	8.8	13.7	6.5	8.7	22.6	99.2	56
48			0	152.0	153.4	14.9	11.5	4.4	8.0	22.5	99.2	56
49			0	152.0	155.4	18.6	9.0	6.3	6.0	22.5	99.3	57
50			0	152.0	155.8	19.2	8.2	8.6	5.0	22.5	99.3	57
51			0	152.0	155.8	20.0	8.1	8.6	7.0	22.5	99.3	57
52			0	152.0	156.5	20.8	8.0	9.5	6.8	22.5	99.3	57
53	8.0	52.8	1466	152.0	159.3	-1.5	12.7	8.9	4.3	23.2	99.6	54
54	8.6	52.7	1763	152.0	158.0	-1.5	13.1	8.5	6.4	23.2	99.6	54
55	7.7	51.9	1329	152.0	157.0	-1.8	12.7	6.5	5.7	23.2	99.6	54
56	7.4	51.4	1202	152.0	156.4	-1.8	12.3	6.3	5.1	23.2	99.6	54
57	7.8	52.6	1372	152.0	154.8	-1.8	12.9	8.8	5.0	23.2	99.6	54
58	8.3	52.9	1638	152.0	154.9	-1.8	13.1	7.8	4.0	23.2	99.6	54
59	8.2	52.6	1566	152.0	154.8	-1.8	13.0	8.3	5.1	23.2	99.6	54
60	7.9	52.5	1421	152.0	154.8	-1.8	13.0	8.4	4.9	23.2	99.6	54
61	7.8	52.9	1382	152.0	154.8	-1.8	12.9	8.1	3.5	23.2	99.6	55
62	7.7	52.5	1346	152.0	154.8	-2.1	12.8	8.3	3.9	23.3	99.6	55
63	8.1	53.5	1524	152.0	154.9	-2.0	13.0	8.7	4.7	23.3	99.6	55
64	8.2	53.0	1601	152.0	154.9	-2.1	13.0	7.1	6.8	23.3	99.6	55
65	7.6	51.7	1300	152.0	156.5	-2.1	12.7	6.7	6.8	23.3	99.6	55
66	7.1	50.1	1040	152.0	157.9	-2.1	11.6	6.5	6.7	23.3	99.6	55
67	6.8	49.2	931	152.0	160.0	-2.1	11.3	8.0	6.5	23.3	99.6	54
68	7.0	49.4	994	152.0	161.0	-1.7	11.5	7.4	5.9	23.3	99.6	54
69	7.2	49.9	1072	152.0	162.5	-1.5	11.8	7.4	5.8	23.3	99.6	54
70	7.4	50.8	1175	152.0	163.4	-1.5	12.2	8.2	5.7	23.3	99.6	54
71	7.4	51.1	1187	152.0	163.4	-1.5	12.3	8.0	6.8	23.3	99.6	54
72	7.4	51.1	1201	152.0	163.4	-1.5	12.3	8.0	6.6	23.3	99.6	54
73	7.4	50.9	1176	152.0	163.9	-1.5	12.2	7.8	6.2	23.3	99.6	54
74	7.5	51.7	1231	152.0	166.4	-2.0	12.5	8.6	5.4	23.3	99.6	54
75	7.8	52.2	1366	152.0	166.5	-2.1	12.9	8.7	4.8	23.3	99.6	54
76	7.8	52.2	1384	152.0	166.5	-2.1	12.9	8.5	7.5	23.3	99.6	54
77			1502	152.0	167.3	-2.1	13.1	8.3	7.5	23.3	99.6	54
78			1618	152.0	169.0	-2.1	13.1	8.4	7.2	23.3	99.6	54
79			1594	152.0	169.0	-2.1	13.0	9.3	7.3	23.3	99.6	54
80			1374	152.0	169.0	-1.7	12.8	8.7	8.0	23.3	99.6	54
81			1162	152.0	169.0	-1.5	12.1	6.8	6.2	23.3	99.6	54
82			1111	152.0	169.0	-1.5	11.9	7.3	8.0	23.3	99.6	54
83			1215	152.0	169.0	-1.3	12.4	8.0	9.4	23.3	99.6	54
84			2024	152.0	169.0	0.4	13.2	9.7	9.4	23.3	99.6	54
85			2152	152.0	169.0	0.5	13.0	9.3	8.2	23.3	99.6	54
86			2063	152.0	169.0	0.4	13.0	9.3	8.0	23.3	99.6	53
87			2168	152.0	169.0	0.4	13.0	9.1	6.6	23.3	99.6	53
88			2215	152.0	167.7	0.5	13.0	9.3	6.9	23.3	99.6	53

***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	52.5	2135	152.0	166.4	-0.4	12.9	9.9	6.3	23.3	99.6	53
90	9.4	52.5	2112	152.0	166.2	-0.2	13.0	9.6	5.2	23.3	99.6	53
91	9.5	52.8	2233	152.0	163.8	0.6	13.1	9.7	5.7	23.3	99.6	54
92	9.3	53.9	2254	152.0	163.7	1.5	13.2	9.5	6.9	23.3	99.6	55
93			2196	152.0	161.4	0.5	12.9	9.3	5.6	23.3	99.6	55
94	10.4	53.2	2147	152.0	161.4	-1.2	12.7	10.6	6.0	23.3	99.6	55
95			2026	152.0	161.2	-1.1	12.9	9.4	6.4	23.3	99.6	55
96			2063	152.0	158.6	-0.9	13.0	9.0	5.3	23.3	99.6	54
97	9.0	52.9	1956	152.0	158.6	-1.3	13.0	8.9	4.1	23.3	99.6	54
98	9.0	52.9	1939	152.0	158.6	-1.6	13.0	9.0	4.8	23.3	99.6	54
99	8.8	52.8	1868	152.0	156.8	-1.8	13.0	7.9	5.0	23.3	99.6	54
100	8.1	52.4	1520	152.0	155.9	-1.8	12.9	7.8	5.5	23.3	99.6	54
101	8.0	52.6	1504	152.0	154.3	-1.8	13.0	8.0	5.5	23.3	99.6	54
102	8.4	53.4	1671	152.0	152.8	-1.8	13.0	8.5	4.4	23.3	99.6	54
103	8.0	52.7	1501	152.0	152.8	-1.8	13.0	7.8	3.5	23.3	99.6	54
104	8.2	52.6	1571	152.0	152.9	-1.8	13.0	8.1	4.3	23.3	99.6	54
105	8.5	52.4	1732	152.0	152.9	-1.8	13.1	9.5	3.7	23.3	99.6	54
106	7.8	52.4	1397	152.0	152.9	-1.8	12.8	8.4	3.9	23.3	99.6	54
107	7.5	51.7	1219	152.0	152.9	-1.8	12.4	7.2	5.0	23.3	99.6	54
108	7.2	50.2	1079	152.0	152.9	-1.8	11.8	7.0	6.5	23.3	99.6	54
109	6.8	48.9	931	152.0	152.8	-2.0	11.2	6.7	4.8	23.3	99.6	54
110	6.6	49.0	852	152.0	152.8	-2.1	10.9	5.6	4.7	23.3	99.6	54
111	6.6	48.5	846	152.0	152.8	-2.1	10.9	7.2	3.5	23.3	99.6	54
112	7.0	50.3	1009	152.0	152.8	-2.1	11.6	8.3	4.2	23.3	99.6	54
113	7.3	50.6	1133	152.0	152.9	-2.1	12.0	7.7	5.0	23.3	99.6	54
114	7.1	50.3	1028	152.0	152.9	-2.1	11.6	7.3	4.0	23.3	99.6	55
115	6.6	48.2	839	152.0	152.9	-1.7	10.8	6.8	4.6	23.4	99.6	55
116	6.3	47.4	719	152.0	152.9	-1.5	10.3	6.3	6.5	23.4	99.6	55
117	6.2	47.7	678	152.0	155.6	-1.5	10.1	5.9	5.2	23.4	99.6	55
118	6.0	47.5	622	152.0	156.4	-1.5	9.8	5.5	5.9	23.4	99.6	55
119	5.9	47.2	603	152.0	159.1	-1.5	9.7	6.6	5.9	23.4	99.6	55
120	6.0	48.0	611	152.0	159.7	-1.5	9.8	7.6	6.5	23.4	99.6	55
121	6.0	47.5	637	152.0	159.7	-2.0	9.9	5.6	7.2	23.4	99.6	55
122	6.8	51.8	921	152.0	159.6	-2.1	11.3	7.6	6.4	23.4	99.6	55
123	7.9	52.6	1441	152.0	159.6	-1.3	12.9	7.9	5.2	23.4	99.6	55
124	8.0	53.3	1467	152.0	159.6	-2.1	13.0	8.1	4.2	23.4	99.6	55
125	7.8	52.6	1373	152.0	159.6	-2.1	12.9	7.5	4.0	23.4	99.6	55
126	8.1	52.7	1550	152.0	159.6	-2.1	13.0	7.9	5.2	23.5	99.6	55
127	7.7	52.7	1332	152.0	158.4	-1.9	12.8	8.6	3.4	23.5	99.6	55
128	7.5	51.6	1218	152.0	156.7	-1.8	12.3	7.6	4.1	23.5	99.6	55
129	7.1	51.0	1068	152.0	156.7	-1.8	11.8	6.8	5.1	23.5	99.6	55
130			1395	152.0	156.7	-1.0	12.6	8.3	4.8	23.5	99.6	55
131			2267	152.0	156.8	1.5	13.3	10.2	4.8	23.5	99.6	55
132	10.6	52.6	2255	152.0	156.8	2.9	13.2	10.8	4.1	23.5	99.6	54
133	9.4	52.3	2137	152.0	156.7	0.1	12.9	9.6	4.5	23.5	99.6	54
134	9.4	51.9	2087	152.0	156.7	-0.1	12.9	9.5	6.0	23.5	99.6	54
135	8.9	52.2	1934	152.0	156.8	-0.6	13.0	9.5	5.1	23.5	99.6	54
136	9.1	52.7	1984	152.0	156.8	-1.0	13.0	9.5	6.9	23.5	99.6	54
137	9.2	52.5	1996	152.0	156.8	-0.9	13.0	9.5	5.7	23.5	99.6	54
138			2093	152.0	156.8	-0.6	13.1	9.2	4.6	23.6	99.6	53
139			2228	152.0	156.8	-0.1	13.1	9.3	7.8	23.6	99.6	53
140	9.6	52.6	2257	152.0	156.8	1.3	13.2	9.8	6.2	23.6	99.6	53
141	9.8	52.7	2144	152.0	156.8	0.0	12.9	10.0	5.2	23.6	99.6	53
142	10.0	52.7	2064	152.0	156.7	0.0	13.0	10.2	6.0	23.6	99.6	53
143	8.7	52.5	1825	152.0	156.7	-1.1	12.9	10.0	7.4	23.5	99.6	53
144	8.4	52.6	1880	152.0	156.7	-1.8	12.9	9.4	7.7	23.5	99.6	53
145	9.3	53.0	2212	152.0	156.7	0.3	13.2	9.5	6.2	23.5	99.6	53
146			2175	152.0	156.8	0.2	13.0	9.4	8.1	23.5	99.6	53
147			2147	152.0	156.7	0.3	13.0	9.3	5.5	23.5	99.6	53
148	10.9	53.0	2253	152.0	156.8	1.5	13.2	11.1	6.6	23.5	99.6	53
149	10.2	52.7	2252	152.0	156.8	2.2	13.2	10.4	7.0	23.5	99.6	53
150	9.9	52.3	2214	152.0	156.8	2.0	13.0	10.1	7.8	23.5	99.6	53
151	8.8	52.5	1882	152.0	156.8	-1.3	12.6	9.0	7.0	23.5	99.6	53
152	7.8	53.1	1398	152.0	156.7	-1.8	12.8	7.0	6.5	23.5	99.6	53
153	8.5	52.7	1733	152.0	154.1	-1.3	13.1	8.0	7.7	23.5	99.6	53
154	8.9	52.8	1926	152.0	153.6	-1.7	13.1	8.5	7.5	23.5	99.6	53
155	8.8	52.8	1873	152.0	153.6	-1.8	13.0	7.8	7.9	23.4	99.6	53
156	9.1	52.7	1991	152.0	152.4	-1.8	13.1	8.3	6.5	23.4	99.6	53
157	8.8	52.6	1889	152.0	151.3	-1.8	13.0	8.9	6.8	23.4	99.6	53
158	9.1	52.6	1979	152.0	151.3	-1.7	13.1	9.2	5.9	23.4	99.6	53
159	9.7	52.8	2215	152.0	151.3	-0.7	13.1	9.9	6.8	23.4	99.6	53
160	9.9	52.7	2181	152.0	151.3	-0.6	13.0	10.1	7.5	23.4	99.6	53
161	9.2	52.8	2004	152.0	151.3	-1.0	12.9	9.8	6.7	23.4	99.6	53
162	9.1	52.8	1989	152.0	151.2	-1.1	13.0	9.7	5.0	23.4	99.6	53
163	9.0	52.8	1942	152.0	151.3	-1.5	13.0	9.4	5.3	23.4	99.6	53
164	8.6	53.1	1763	152.0	151.2	-1.8	12.9	10.0	7.5	23.4	99.6	53
165	8.6	53.0	1781	152.0	151.3	-1.7	13.0	8.4	5.9	23.4	99.6	53
166	8.2	53.1	1572	152.0	151.3	-1.8	12.9	9.1	5.8	23.4	99.6	53
167	7.9	52.9	1417	152.0	151.3	-1.8	13.0	9.4	5.5	23.3	99.6	53
168	8.0	52.6	1485	152.0	151.2	-1.8	13.0	8.0	5.7	23.3	99.6	53
169	8.0	52.4	1498	152.0	151.2	-1.8	13.0	8.1	6.5	23.3	99.6	53
170	8.1	52.7	1523	152.0	151.2	-1.8	13.0	7.2	5.3	23.3	99.6	53
171	7.7	52.0	1316	152.0	151.2	-1.8	12.7	7.9	6.9	23.3	99.6	53
172	7.5	51.8	1226	152.0	151.2	-1.8	12.4	7.0	5.8	23.3	99.6	53
173	7.3	51.2	1146	152.0	151.2	-1.7	12.1	6.6	4.1	23.3	99.6	54
174	7.1	50.3	1046	152.0	151.2	-1.5	11.7	6.5	4.5	23.3	99.6	54
175	7.4	51.1	1176	152.0	151.2	-1.5	12.3	8.4	4.7	23.3	99.6	54
176	8.5	52.7	1711	152.0	151.2	-0.9	13.1	8.0	4.2	23.3	99.6	54

Table E.01 Measurement data - Turbine ON

Project: Cedar Point Wind Power Project - Turbine CP244 - IEC 61400-11 Measurement

Report ID: 15039.00.CP244.RP4

Created on: 1/25/2018

***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	10.1	53.4	2136	152.0	151.3	-0.8	13.2	10.3	4.6	23.3	99.6	54
178	10.0	52.8	2198	152.0	151.3	0.5	13.1	10.2	5.6	23.3	99.6	54
179	10.0	52.9	2145	152.0	151.3	0.1	13.0	10.2	4.7	23.3	99.6	53
180	9.5	52.8	2113	152.0	151.2	-0.1	13.0	9.7	7.6	23.3	99.6	53
181	8.8	52.4	1874	152.0	151.2	-1.0	12.9	8.6	6.3	23.3	99.6	53
182	8.3	53.0	1641	152.0	151.2	-1.8	12.9	9.2	4.6	23.3	99.6	53
183	7.8	52.4	1395	152.0	151.2	-1.8	12.8	8.2	4.4	23.3	99.6	53
184	7.6	52.6	1300	152.0	152.9	-1.8	12.7	7.5	6.0	23.3	99.6	54
185	8.6	53.1	1772	152.0	154.0	-1.5	13.1	7.8	5.7	23.4	99.6	55
186	7.6	52.4	1308	152.0	154.1	-1.8	12.6	7.4	5.6	23.4	99.6	55
187	7.1	50.7	1062	152.0	154.6	-1.8	11.7	6.8	5.7	23.4	99.6	55
188	7.0	49.5	1006	152.0	157.0	-1.8	11.5	6.6	5.6	23.4	99.6	55
189	6.8	49.2	904	152.0	157.0	-1.8	11.1	6.4	5.8	23.4	99.6	55
190	6.2	47.5	704	152.0	157.0	-1.8	10.2	5.4	4.8	23.4	99.6	55
191	5.9	46.3	598	152.0	157.6	-1.9	9.7	6.5	6.3	23.5	99.6	55
192	5.6	45.3	520	152.0	159.5	-2.1	9.2	5.7	6.3	23.5	99.6	55
193	5.5	45.3	492	152.0	159.5	-2.1	9.1	5.8	5.8	23.5	99.6	55
194	6.0	48.7	623	152.0	159.5	-2.1	9.9	7.2	5.2	23.5	99.6	55
195	6.3	48.9	719	152.0	159.5	-2.1	10.3	5.9	4.7	23.5	99.6	55
196	6.2	49.2	677	152.0	159.5	-2.1	10.1	6.0	4.8	23.5	99.6	55
197	6.6	48.0	828	152.0	159.5	-1.8	10.8	6.5	4.7	23.6	99.6	55
198	6.4	48.0	782	152.0	159.5	-1.5	10.6	6.6	5.1	23.6	99.6	55
199	6.2	48.3	709	152.0	159.6	-1.5	10.3	7.1	7.5	23.6	99.6	55
200	7.0	51.0	1019	152.0	159.6	-1.5	11.7	7.9	8.2	23.6	99.6	55
201	8.1	52.0	1523	152.0	159.6	-1.0	13.0	7.6	7.7	23.6	99.6	55
202	8.6	52.9	1772	152.0	159.6	-1.5	13.1	8.1	9.2	23.6	99.6	53
203	9.2	52.7	2010	152.0	159.6	-1.6	13.1	8.8	7.0	23.7	99.6	52
204	8.9	53.1	1905	152.0	159.6	-1.8	13.0	9.9	6.4	23.7	99.6	52
205	8.5	52.6	1712	152.0	159.6	-1.8	12.9	8.6	6.6	23.7	99.6	52
206	8.6	52.9	1780	152.0	161.5	-1.8	13.0	8.4	8.1	23.7	99.6	52
207	8.6	52.7	1758	152.0	162.0	-1.8	13.0	8.0	7.2	23.7	99.6	52
208	7.9	52.5	1450	152.0	161.9	-1.8	12.9	7.6	7.7	23.6	99.6	52
209	7.9	53.1	1412	152.0	164.3	-1.9	13.0	7.3	9.4	23.6	99.6	53
210	7.9	52.8	1445	152.0	166.0	-2.1	13.0	7.2	7.9	23.6	99.6	53
211			1483	152.0	168.0	-2.1	13.0	7.9	6.0	23.6	99.6	53
212			1299	152.0	168.1	-2.1	12.7	7.6	6.1	23.6	99.6	53
213			1430	152.0	170.6	-2.1	13.0	8.2	5.4	23.5	99.6	53
214			1426	152.0	170.8	-1.9	13.0	8.2	5.3	23.5	99.6	54
215			1776	152.0	170.8	-1.1	13.2	7.9	6.0	23.5	99.6	54
216			1681	152.0	170.8	-1.5	13.0	8.6	7.2	23.5	99.6	54
217			1675	152.0	170.8	-1.5	13.0	9.2	8.5	23.5	99.6	54
218			1999	152.0	170.8	-1.4	13.1	10.6	8.1	23.5	99.6	54
219			2158	152.0	170.8	-0.8	13.1	10.8	9.1	23.5	99.6	53
220	8.2	54.4	1576	152.0	164.2	-1.2	12.7	10.5	7.6	23.5	99.0	54
221	9.0	53.1	1946	152.0	164.3	-0.8	13.1	9.7	8.2	23.5	99.0	54
222			2030	152.0	164.3	-1.7	13.1	8.0	8.0	23.5	99.0	54
223	8.9	52.9	1910	152.0	164.3	-1.8	13.0	8.7	7.6	23.5	99.0	54
224	8.2	52.9	1566	152.0	164.3	-1.8	12.9	8.5	7.1	23.5	99.0	54
225	8.5	53.1	1746	152.0	164.3	-1.8	13.0	9.4	6.0	23.5	99.0	54
226	7.8	52.5	1392	152.0	164.3	-1.8	12.9	8.3	6.5	23.5	99.0	54
227	7.5	51.8	1238	152.0	164.3	-1.8	12.5	8.1	7.0	23.5	99.0	54
228	7.1	50.3	1045	152.0	164.3	-1.8	11.7	6.2	5.9	23.5	99.0	54
229	6.4	47.9	781	152.0	164.3	-1.8	10.6	5.6	5.3	23.5	99.0	54
230	6.0	47.0	617	152.0	164.2	-1.8	9.8	6.4	4.8	23.5	99.0	54
231	6.2	48.5	686	152.0	164.2	-1.8	10.2	6.5	4.9	23.5	99.0	55
232	7.2	50.5	1070	152.0	162.3	-1.6	11.9	7.5	5.1	23.5	98.9	55
233	8.2	52.9	1557	152.0	160.7	-0.6	13.1	8.2	4.8	23.5	98.9	55
234	7.8	52.6	1380	152.0	158.0	-1.5	12.8	6.5	4.3	23.5	98.9	55
235	7.5	51.9	1251	152.0	157.7	-1.5	12.5	6.7	5.1	23.5	98.9	55
236	7.3	51.0	1148	152.0	157.8	-1.5	12.1	6.7	5.6	23.5	99.0	55
237	7.3	51.2	1144	152.0	157.8	-1.5	12.1	6.8	6.1	23.5	99.0	55
238	8.0	52.7	1465	152.0	157.8	-1.1	12.9	9.1	8.6	23.5	98.9	55
239	8.8	53.2	1869	152.0	157.8	-1.4	13.1	8.7	7.1	23.5	98.9	55
240	8.5	52.4	1742	152.0	157.8	-1.8	13.0	8.5	6.0	23.5	98.9	55
241	7.7	52.2	1326	152.0	157.8	-1.8	12.7	7.5	7.1	23.5	98.9	55
242	7.3	51.2	1163	152.0	157.8	-1.8	12.2	6.6	7.2	23.5	98.9	55
243	7.7	51.9	1360	152.0	157.7	-1.3	12.7	7.5	6.8	23.5	98.9	54
244	8.1	52.9	1545	152.0	157.7	-1.7	13.0	8.9	5.4	23.5	98.9	53
245	8.8	53.6	1855	152.0	157.7	-1.6	13.1	8.4	5.1	23.5	98.9	53
246	8.2	52.6	1585	152.0	157.8	-1.8	12.9	7.8	5.6	23.5	98.9	53
247	8.4	52.8	1670	152.0	157.8	-1.8	13.0	8.5	5.3	23.5	98.9	53
248	8.6	53.3	1780	152.0	157.8	-1.8	13.1	9.9	5.6	23.5	98.9	53
249	9.3	53.2	2152	152.0	157.8	-1.1	13.1	9.5	7.3	23.5	98.9	54
250	8.8	52.8	1861	152.0	157.8	-1.8	12.9	8.6	7.2	23.5	98.9	54
251	8.5	53.2	1701	152.0	157.8	-1.8	12.9	9.2	6.5	23.5	98.9	54
252	7.9	52.5	1444	152.0	157.8	-1.8	12.9	8.5	6.4	23.5	98.9	54
253	7.5	51.7	1244	152.0	157.8	-1.8	12.4	7.7	7.5	23.5	98.8	54
254	6.7	49.7	891	152.0	157.8	-1.8	11.0	5.7	6.4	23.5	98.9	54
255	6.0	47.1	611	152.0	157.7	-1.8	9.7	4.9	5.4	23.5	98.8	54
256	6.0	50.8	629	152.0	157.7	-1.9	9.9	5.6	6.2	23.5	98.9	55
257	6.9	51.0	945	152.0	157.7	-2.1	11.4	8.8	8.2	23.5	98.8	55
258	8.1	52.8	1530	152.0	157.7	-1.0	13.0	8.6	8.2	23.5	98.8	55
259	9.8	53.6	2147	152.0	157.8	0.0	13.3	10.0	6.8	23.5	98.8	55
260	10.0	51.9	2198	152.0	157.4	3.2	12.9	10.2	8.7	23.5	98.8	54
261	11.3	52.5	2223	152.0	155.5	3.0	13.0	11.5	7.0	23.5	98.8	54
262	10.4	52.5	2255	152.0	155.6	4.5	13.3	10.6	6.8	23.5	98.8	54
263	10.8	52.2	2245	152.0	155.6	5.0	13.2	11.0	6.9	23.5	98.9	54
264	10.2	51.5	2167	152.0	155.5	3.2	12.7	10.4	6.1	23.5	98.9	54

***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	10.0	51.9	2047	152.0	155.5	0.2	12.6	10.2	6.6	23.5	98.8	54
266	9.7	51.8	2041	152.0	155.6	0.1	12.8	9.9	5.9	23.5	98.9	53
267	8.8	52.3	1869	152.0	155.5	-0.4	12.9	9.1	5.9	23.5	98.9	53
268	9.4	52.9	2069	152.0	155.6	-0.3	13.1	9.6	7.1	23.5	98.9	53
269			2151	152.0	155.5	-0.1	13.0	8.9	6.3	23.5	98.9	53
270	8.9	52.8	1918	152.0	153.4	-1.0	12.9	9.3	6.5	23.5	98.9	53
271	9.1	52.9	1985	152.0	153.2	-1.0	13.0	9.3	6.0	23.5	98.9	53
272			2108	152.0	153.2	-0.6	13.0	8.9	6.5	23.4	98.9	54
273	9.2	52.6	2001	152.0	153.2	-0.9	13.0	9.7	4.9	23.4	98.9	54
274	8.8	52.5	1851	152.0	153.2	-1.8	13.0	9.0	4.8	23.4	98.9	54
275	9.0	53.2	1969	152.0	153.1	-1.3	13.1	9.8	3.9	23.4	98.9	54
276			2020	152.0	153.1	-0.5	13.0	9.2	4.8	23.4	98.9	54
277	9.0	52.9	1948	152.0	153.2	-0.9	13.0	9.7	6.1	23.4	98.9	54
278	9.3	53.2	2108	152.0	153.2	-0.5	13.1	9.5	6.7	23.4	98.9	54
279	9.0	53.2	1973	152.0	153.2	-1.0	12.9	10.0	5.6	23.4	98.9	54
280	8.5	53.1	1743	152.0	153.2	-1.8	12.9	10.5	5.5	23.4	98.9	54
281	8.6	53.3	1771	152.0	153.1	-1.7	13.0	10.6	4.9	23.4	98.9	54
282	7.8	52.7	1398	152.0	153.2	-1.8	12.8	8.1	4.9	23.4	98.9	54
283	7.4	51.9	1193	152.0	155.6	-1.8	12.3	6.2	5.5	23.4	98.9	54
284	7.3	50.9	1140	152.0	156.0	-1.8	12.1	6.8	4.5	23.5	98.9	55
285	7.7	52.5	1334	152.0	156.1	-1.7	12.8	8.4	4.3	23.5	98.9	55
286	8.3	52.9	1610	152.0	156.1	-1.5	13.1	8.4	4.0	23.5	98.9	55
287	7.8	52.7	1363	152.0	156.0	-1.5	12.7	7.3	5.7	23.5	99.0	55
288	7.3	51.7	1123	152.0	156.1	-1.5	12.0	7.4	5.3	23.5	99.0	55
289	8.4	52.8	1681	152.0	156.1	-0.3	13.0	8.3	5.7	23.5	98.9	55
290	9.8	52.8	2177	152.0	156.1	0.6	13.1	10.0	5.1	23.6	98.9	55
291	9.2	52.8	1998	152.0	156.1	0.2	13.0	9.0	5.3	23.6	98.9	55
292	10.1	53.1	2280	152.0	156.1	2.6	13.4	10.3	9.6	23.6	98.9	55
293	10.9	52.9	2280	152.0	156.1	4.7	13.3	11.1	9.1	23.6	99.0	55
294	10.5	51.7	2152	152.0	156.1	1.7	12.6	10.7	9.6	23.6	98.9	55
295	9.8	52.2	2209	152.0	155.0	1.9	13.0	10.0	9.1	23.6	98.9	55
296	10.4	52.3	2225	152.0	153.8	2.4	13.0	10.6	8.7	23.6	98.9	54
297	9.9	51.7	2209	152.0	153.8	2.0	12.9	10.1	7.6	23.6	98.9	53
298	10.0	52.3	2206	152.0	153.8	1.4	12.9	10.2	8.1	23.6	98.9	53
299	10.3	52.7	2257	152.0	153.8	3.0	13.2	10.5	7.8	23.6	98.8	53
300	10.5	52.2	2259	152.0	153.8	4.9	13.3	10.7	6.5	23.6	98.8	53
301	10.2	52.2	2235	152.0	153.7	5.1	13.1	10.4	6.6	23.5	98.9	54
302	10.7	52.1	2214	152.0	153.8	4.8	13.0	10.9	6.5	23.5	98.9	54
303	11.3	51.8	2185	152.0	153.8	3.9	12.8	11.5	7.2	23.5	98.9	54
304	10.0	51.7	2187	152.0	153.8	3.0	12.8	10.2	6.6	23.5	98.9	54
305	9.4	51.6	2188	152.0	153.8	2.2	12.8	9.5	6.2	23.5	98.9	54
306			2176	152.0	153.7	0.8	12.7	9.2	5.7	23.5	98.9	54
307			2182	152.0	153.7	0.0	12.8	9.0	7.7	23.4	98.9	54
308	9.0	52.7	1941	152.0	153.7	-1.7	12.8	9.0	7.2	23.4	98.9	54
309	8.9	52.7	1912	152.0	153.7	-1.8	13.0	9.4	4.8	23.4	98.9	54
310	8.7	52.6	1804	152.0	153.7	-1.8	12.9	9.0	6.2	23.4	98.8	54
311	8.6	52.8	1788	152.0	153.7	-1.8	13.0	8.5	6.8	23.4	98.9	54
312	8.9	54.0	1933	152.0	153.4	-1.8	13.1	7.8	7.2	23.4	98.9	54
313	9.5	54.3	2131	152.0	151.4	-1.2	13.1	9.7	4.9	23.4	98.9	54
314	10.3	53.2	2226	152.0	151.3	-0.2	13.1	10.5	4.5	23.4	98.9	54
315	10.2	53.2	2266	152.0	151.3	1.1	13.2	10.4	6.5	23.4	98.9	54
316			2104	152.0	151.8	0.6	12.9	9.1	6.6	23.4	98.9	54
317	8.4	53.3	1666	152.0	154.0	-1.5	12.9	9.0	6.0	23.4	98.8	54
318			2088	152.0	156.3	-0.1	13.2	9.3	6.4	23.4	98.8	54
319	9.5	53.0	2279	152.0	156.8	2.4	13.3	9.7	6.1	23.4	98.8	54
320	10.3	52.3	2236	152.0	156.7	2.4	13.1	10.5	4.6	23.4	98.8	54
321			2094	152.0	156.7	-0.4	12.6	9.0	4.1	23.4	98.9	54
322	10.2	52.3	2067	152.0	156.7	-0.2	13.0	10.4	4.5	23.4	98.9	54
323	10.1	52.7	2232	152.0	156.7	0.7	13.1	10.3	4.3	23.4	98.9	54
324	9.1	52.3	1989	152.0	156.7	-0.3	12.9	9.7	4.5	23.4	98.8	54
325	8.5	53.2	1741	152.0	156.7	-1.6	12.9	8.2	5.4	23.5	98.9	55
326	7.8	52.3	1395	152.0	156.7	-1.8	12.8	7.9	7.5	23.5	98.9	55
327	7.7	52.6	1328	152.0	156.8	-1.8	12.8	8.1	7.5	23.5	98.9	55
328	8.3	53.2	1637	152.0	156.8	-1.7	13.1	7.9	7.8	23.5	98.9	55
329	10.3	53.0	2054	152.0	156.8	-1.3	13.2	10.5	6.7	23.5	98.9	55
330	10.5	53.2	2274	152.0	156.8	1.2	13.3	10.7	7.5	23.5	98.9	55
331	10.1	52.9	2276	152.0	156.8	2.9	13.3	10.3	7.1	23.5	98.8	54
332	9.9	52.1	2197	152.0	156.7	1.5	12.9	10.1	7.1	23.5	98.8	54
333	8.3	54.3	1624	152.0	156.7	-1.5	12.4	7.7	5.5	23.5	98.8	54
334	8.4	53.2	1666	152.0	156.6	-0.8	13.0	8.9	6.6	23.5	98.8	54
335			2068	152.0	154.1	0.2	13.1	9.3	7.5	23.5	98.9	54
336			2235	152.0	153.9	0.5	13.1	9.1	7.5	23.5	98.9	54
337	10.0	53.2	2236	152.0	153.9	1.0	13.2	10.2	7.6	23.5	98.9	53
338	10.8	53.2	2311	152.0	153.9	4.6	13.5	11.0	6.3	23.5	98.9	53
339	11.8	52.3	2283	152.0	153.9	5.8	13.4	12.0	8.3	23.5	98.9	53
340	10.6	51.1	2179	152.0	153.9	4.9	12.8	10.8	7.6	23.5	98.9	53
341	9.6	51.1	2070	152.0	153.9	1.4	12.4	9.8	6.3	23.5	98.9	53
342	10.5	52.1	2191	152.0	153.9	1.2	12.9	10.7	5.6	23.5	98.9	54
343	11.4	52.9	2261	152.0	153.9	3.2	13.3	11.6	6.4	23.5	98.9	54
344	10.3	52.6	2240	152.0	153.9	3.7	13.1	10.5	5.6	23.5	99.0	54
345	10.4	52.5	2221	152.0	153.9	3.4	13.0	10.6	5.9	23.5	98.9	54
346	10.7	52.4	2248	152.0	153.9	4.5	13.2	10.9	7.6	23.5	98.9	54
347	10.7	51.9	2156	152.0	153.9	2.3	12.7	10.9	6.2	23.5	98.9	54
348	10.1	52.1	2177	152.0	153.9	1.1	12.8	10.3	6.3	23.5	98.9	54
349	10.8	53.0	2237	152.0	153.9	2.1	13.1	11.0	5.6	23.5	98.9	54
350	11.4	53.0	2286	152.0	153.9	4.6	13.4	11.6	6.0	23.5	98.9	54
351	12.1	52.7	2258	152.0	153.9	5.3	13.2	12.4	7.0	23.5	98.9	54
352	10.9	52.2	2211	152.0	153.9	4.8	13.0	11.1	6.2	23.5	98.9	54

Table E.01 Measurement data - Turbine ON

Project: Cedar Point Wind Power Project - Turbine CP244 - IEC 61400-11 Measurement

Report ID: 15039.00.CP244.RP4

Created on: 1/25/2018

***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	10.0	52.2	2183	152.0	153.9	3.8	12.8	10.2	9.5	23.5	98.9	54
354	10.9	52.2	2222	152.0	153.9	4.2	13.0	11.1	7.0	23.5	98.9	54
355	10.3	51.8	2214	152.0	153.9	4.0	13.0	10.5	6.5	23.4	98.9	54
356	9.9	52.4	2229	152.0	153.9	4.5	13.1	10.1	8.3	23.4	98.9	54
357	10.0	51.9	2197	152.0	153.9	3.6	12.9	10.2	7.4	23.4	98.9	54
358	10.4	51.6	2213	152.0	153.9	3.9	13.0	10.6	7.2	23.4	98.9	54
359	9.9	51.4	2192	152.0	153.9	3.0	12.8	10.1	7.4	23.4	98.9	54
360	10.5	51.6	2187	152.0	153.9	2.1	12.8	10.7	7.0	23.4	98.9	54
361	9.6	52.6	2233	152.0	153.9	2.7	13.1	9.7	8.0	23.4	98.9	54
362	9.5	52.1	2223	152.0	153.9	2.9	13.0	9.7	8.9	23.4	98.9	54
363	9.5	51.6	2182	152.0	153.9	1.5	12.8	9.7	7.4	23.4	98.9	54
364	9.8	52.1	2182	152.0	153.9	0.2	12.8	10.0	6.5	23.4	98.9	54
365	9.4	52.4	2113	152.0	153.9	-0.5	12.9	9.5	5.1	23.4	98.9	54
366			2060	152.0	153.9	-0.4	12.9	9.4	4.6	23.4	98.9	54
367	8.6	52.7	1749	152.0	153.9	-1.7	12.9	8.0	5.4	23.4	98.9	54
368	8.2	52.8	1599	152.0	151.4	-1.8	12.9	8.7	5.0	23.4	98.9	54
369	8.5	53.0	1747	152.0	151.0	-1.8	13.1	8.4	5.7	23.4	98.9	54
370	8.7	53.0	1839	152.0	149.5	-1.8	13.1	8.9	5.4	23.4	98.9	54
371	8.9	52.8	1907	152.0	148.5	-1.8	13.0	9.2	6.4	23.4	98.9	54
372	8.9	53.0	1939	152.0	148.5	-1.8	13.0	8.5	5.4	23.3	98.9	54
373	9.1	52.8	1976	152.0	148.6	-1.8	13.0	9.7	5.3	23.3	99.0	54
374	8.4	53.1	1663	152.0	148.6	-2.1	12.9	9.4	4.0	23.3	99.0	54
375	8.5	52.8	1703	152.0	148.6	-2.1	13.0	8.9	4.6	23.3	99.0	54
376	8.0	52.9	1486	152.0	148.6	-2.1	12.9	8.0	7.6	23.3	99.0	54
377	7.9	52.7	1446	152.0	148.6	-2.1	13.0	8.1	6.2	23.3	99.0	54
378	7.8	53.1	1386	152.0	148.6	-2.1	12.9	8.7	7.0	23.3	98.9	54
379	7.7	52.8	1350	152.0	148.6	-2.1	12.9	7.9	8.8	23.3	98.9	54
380	7.3	50.8	1126	152.0	148.6	-1.5	12.0	6.6	5.6	23.3	98.9	54
381	7.2	50.8	1113	152.0	148.5	-1.5	12.0	7.5	4.8	23.3	98.9	54
382	8.2	52.3	1588	152.0	148.6	-0.8	13.1	8.8	5.5	23.3	98.9	54
383	8.8	53.0	1845	152.0	148.6	-1.5	13.1	9.6	5.2	23.3	98.9	54
384	8.7	52.7	1800	152.0	148.6	-1.5	13.0	8.7	4.5	23.4	98.9	54
385	8.1	52.4	1511	152.0	148.6	-1.8	12.9	6.9	4.6	23.4	98.9	54
386	7.6	52.2	1284	152.0	148.6	-1.8	12.6	7.6	4.3	23.4	99.0	54
387	7.5	51.9	1218	152.0	149.2	-1.8	12.4	7.6	5.1	23.4	98.9	54
388	7.2	50.7	1112	152.0	152.3	-1.8	11.9	7.1	4.9	23.4	98.9	54
389	7.0	50.3	984	152.0	152.5	-1.8	11.5	6.6	4.2	23.4	98.9	54
390	6.9	51.9	964	152.0	155.0	-1.8	11.4	6.1	3.4	23.4	98.9	55
391	7.3	52.7	1157	152.0	155.1	-2.0	12.2	7.4	6.1	23.4	98.9	55
392	7.7	53.0	1319	152.0	155.1	-2.1	12.8	7.7	6.2	23.4	98.9	55
393	7.7	53.3	1330	152.0	155.1	-2.0	12.8	7.2	5.8	23.4	98.9	55
394	9.3	53.8	2149	152.0	155.1	0.0	13.3	9.5	6.8	23.4	98.9	55
395	10.3	53.1	2285	152.0	155.1	2.6	13.4	10.5	6.5	23.4	98.9	55
396	10.3	52.6	2260	152.0	155.1	3.4	13.2	10.5	5.8	23.5	98.9	54
397	9.9	52.0	2135	152.0	155.1	0.8	12.7	10.1	7.3	23.5	98.9	54
398	9.3	52.6	2150	152.0	155.2	0.4	12.9	9.5	6.5	23.5	99.0	54
399			2140	152.0	154.7	0.1	12.9	9.0	7.0	23.5	99.0	54
400			2239	152.0	153.1	1.6	13.3	9.4	8.9	23.5	99.0	54
401	10.4	52.8	2320	152.0	153.2	5.1	13.6	10.6	6.9	23.5	99.0	54
402	11.1	52.4	2298	152.0	153.2	6.6	13.4	11.3	5.9	23.5	99.0	54
403	11.6	52.2	2240	152.0	153.2	6.7	13.1	11.9	6.6	23.5	99.0	54
404	11.4	52.7	2238	152.0	153.1	6.9	13.1	11.6	7.2	23.5	99.0	54
405	12.3	52.1	2226	152.0	153.2	6.9	13.1	12.5	6.9	23.5	99.0	54
406	11.6	52.0	2233	152.0	153.2	7.3	13.1	11.8	7.1	23.5	99.0	54
407	11.7	52.1	2210	152.0	153.2	7.0	12.9	12.0	5.8	23.5	99.0	54
408	11.5	51.8	2198	152.0	153.2	6.4	12.9	11.7	5.8	23.4	99.0	54
409	11.0	51.9	2184	152.0	153.2	5.6	12.8	11.2	6.2	23.4	99.0	54
410	9.8	51.6	2131	152.0	153.2	2.7	12.5	10.0	6.0	23.4	99.0	54
411	11.1	52.4	2215	152.0	153.2	3.5	13.0	11.3	7.6	23.4	99.0	54
412	10.4	52.8	2229	152.0	153.2	3.6	13.0	10.7	5.8	23.4	98.9	54
413	10.9	52.4	2249	152.0	153.1	4.5	13.2	11.1	5.6	23.4	99.0	54
414	10.5	51.9	2221	152.0	150.9	4.2	13.0	10.7	5.3	23.4	99.0	55
415	10.7	52.2	2230	152.0	150.7	4.4	13.1	11.0	6.4	23.4	99.0	55
416	10.7	51.9	2213	152.0	150.7	4.0	12.9	10.9	8.2	23.4	99.0	55
417	10.9	52.0	2181	152.0	150.8	2.8	12.7	11.1	6.5	23.4	99.0	55
418	9.4	51.8	2084	152.0	150.8	0.1	12.6	9.6	6.1	23.4	99.0	55
419	8.9	52.5	1921	152.0	150.7	-0.5	12.9	9.7	7.7	23.4	99.0	55
420	8.7	52.7	1842	152.0	150.7	-1.0	12.9	10.5	5.7	23.3	99.0	54
421	8.4	52.8	1678	152.0	150.7	-1.8	12.9	9.9	5.9	23.3	99.0	54
422	8.0	52.4	1466	152.0	150.7	-1.8	12.9	8.3	5.6	23.3	99.0	54
423	8.0	53.1	1503	152.0	150.8	-1.8	13.0	9.4	4.9	23.3	99.0	54
424	8.9	53.1	1931	152.0	152.9	-1.4	13.2	9.0	4.6	23.3	99.0	54
425	9.5	53.4	2068	152.0	153.3	-1.8	13.1	9.7	5.2	23.3	99.0	55
426	9.4	53.4	2215	152.0	153.3	-0.8	13.1	9.6	5.6	23.3	99.0	55
427	10.7	53.2	2297	152.0	153.3	2.0	13.5	10.9	5.2	23.3	99.0	55
428	10.7	53.2	2334	152.0	154.8	6.0	13.7	10.9	5.7	23.3	99.0	55
429	11.2	53.0	2272	152.0	155.9	7.0	13.3	11.5	6.7	23.3	99.0	55
430	11.4	52.1	2205	152.0	155.9	5.9	12.9	11.7	6.6	23.3	99.0	54
431	9.8	51.7	2173	152.0	155.9	4.6	12.7	9.9	6.0	23.4	99.0	54
432	9.9	51.9	2177	152.0	155.9	3.5	12.7	10.1	6.6	23.4	99.0	54
433	11.2	52.2	2203	152.0	155.9	3.1	12.9	11.4	8.5	23.4	99.0	54
434	10.5	52.5	2246	152.0	155.8	4.2	13.1	10.8	8.3	23.4	99.0	54
435	10.7	52.5	2242	152.0	157.1	4.7	13.1	10.9	8.4	23.4	99.0	54
436	9.9	52.4	2222	152.0	158.5	4.5	13.0	10.1	7.2	23.4	99.0	54
437			2120	152.0	158.5	1.8	12.6	8.6	8.4	23.4	99.0	53
438			2101	152.0	158.5	0.0	12.6	8.6	6.6	23.4	99.0	53
439	8.9	52.6	1892	152.0	158.4	-0.5	12.9	7.7	6.4	23.4	99.0	53
440	9.0	52.6	1956	152.0	158.5	-0.9	13.0	8.8	6.4	23.4	99.0	53

***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	8.1	52.7	1544	152.0	156.9	-1.8	12.9	9.0	4.9	23.4	99.0	53
442	8.0	53.1	1469	152.0	156.1	-1.8	13.0	8.3	6.6	23.4	99.0	53
443	8.9	53.1	1906	152.0	156.1	-1.6	13.2	9.3	7.4	23.4	99.0	54
444	8.7	53.0	1821	152.0	156.1	-1.8	13.0	9.0	6.8	23.4	99.0	54
445	8.3	53.1	1638	152.0	156.1	-1.8	13.0	8.8	7.5	23.4	99.0	54
446	8.5	53.2	1733	152.0	156.0	-1.8	13.0	8.1	6.4	23.4	99.1	54
447	8.9	53.6	1902	152.0	153.9	-1.8	13.1	9.7	5.7	23.4	99.1	54
448	8.6	53.2	1792	152.0	153.6	-1.8	13.0	9.5	6.5	23.4	99.1	54
449	8.3	53.1	1648	152.0	153.6	-1.8	13.0	8.7	6.8	23.4	99.1	54
450	9.0	53.6	1944	152.0	153.6	-1.4	13.1	10.1	7.7	23.4	99.1	54
451			2190	152.0	153.7	-0.2	13.1	9.4	6.1	23.4	99.1	54
452	9.2	52.4	2002	152.0	153.6	-0.6	13.0	8.8	5.9	23.4	99.1	54
453	8.9	52.8	1906	152.0	153.6	-0.9	13.0	8.9	6.0	23.4	99.1	54
454	8.1	53.3	1536	152.0	153.6	-1.5	12.8	8.6	4.4	23.4	99.1	54
455	8.0	53.1	1466	152.0	153.6	-1.4	13.0	7.6	5.4	23.4	99.1	55
456	9.1	52.9	1976	152.0	153.6	-0.8	13.1	8.2	5.7	23.4	99.1	55
457	9.2	53.2	2013	152.0	153.6	-1.6	13.1	9.6	6.7	23.4	99.1	55
458	10.2	53.4	2202	152.0	153.6	-0.7	13.1	10.4	7.0	23.4	99.1	55
459	9.9	53.3	2265	152.0	153.6	0.9	13.3	10.1	5.2	23.4	99.1	55
460	9.5	52.2	2265	152.0	153.7	3.8	13.3	9.7	6.4	23.4	99.1	54
461	10.2	52.1	2221	152.0	153.7	3.2	13.0	10.4	6.4	23.4	99.1	54
462	10.4	52.1	2219	152.0	152.4	3.6	13.0	10.6	5.6	23.4	99.1	54
463	10.0	52.1	2177	152.0	151.3	1.9	12.7	10.2	7.8	23.4	99.1	54
464	9.3	51.9	2161	152.0	151.3	0.1	12.6	9.4	6.8	23.4	99.1	54
465	8.9	52.6	1930	152.0	151.3	-1.3	12.8	9.4	5.7	23.4	99.1	54
466	9.9	52.5	2223	152.0	151.3	0.5	13.1	10.1	5.2	23.4	99.1	54
467			2230	152.0	151.3	0.7	13.0	9.1	6.0	23.4	99.1	54
468	8.9	52.2	1916	152.0	151.3	-0.6	12.9	9.1	5.5	23.4	99.1	54
469	8.8	52.9	1868	152.0	151.2	-1.7	13.0	9.5	4.9	23.4	99.1	54
470	9.7	53.2	2138	152.0	151.2	-0.8	13.1	9.9	5.2	23.4	99.0	54
471	9.8	53.0	2097	152.0	151.2	-0.3	13.0	10.0	4.6	23.4	99.1	54
472	8.5	53.1	1737	152.0	151.2	-1.7	12.9	8.7	4.3	23.4	99.1	54
473			1654	152.0	151.2	-1.8	13.0	8.6	4.3	23.4	99.1	54
474	8.8	53.2	1882	152.0	151.2	-1.7	13.1	8.7	5.1	23.4	99.1	54
475			2025	152.0	151.2	-1.8	13.0	9.3	5.8	23.4	99.1	54
476	8.6	53.4	1778	152.0	151.2	-1.8	12.9	7.9	5.2	23.4	99.1	54
477	8.0	53.3	1467	152.0	151.2	-1.7	12.9	7.1	6.3	23.4	99.1	54
478	9.6	53.1	2116	152.0	151.2	-0.1	13.2	9.8	5.1	23.4	99.1	55
479	10.0	52.6	2262	152.0	151.2	1.7	13.2	10.2	5.2	23.4	99.1	55
480	10.1	52.3	2226	152.0	151.2	1.4	13.0	10.3	5.9	23.4	99.1	55
481			2208	152.0	151.2	0.7	12.9	9.2	5.0	23.4	99.1	55
482	10.7	52.7	2267	152.0	151.3	2.4	13.3	10.9	5.3	23.4	99.1	55
483	10.0	52.9	2244	152.0	151.3	2.9	13.1	10.2	6.9	23.4	99.1	55
484	11.3	52.7	2209	152.0	151.2	2.1	12.9	11.5	6.0	23.4	99.1	54
485	11.7	52.8	2271	152.0	151.2	3.8	13.3	11.9	6.0	23.4	99.1	54
486	10.9	52.7	2261	152.0	151.2	4.9	13.2	11.1	8.3	23.4	99.1	54
487	10.7	52.3	2246	152.0	151.3	5.2	13.2	10.9	7.1	23.4	99.1	54
488	10.5	51.6	2214	152.0	151.3	5.0	12.9	10.7	8.4	23.4	99.1	54
489	10.5	51.9	2212	152.0	151.3	4.5	13.0	10.7	7.5	23.4	99.1	54
490	10.5	52.0	2217	152.0	151.3	4.8	13.0	10.7	6.9	23.4	99.1	53
491	10.4	51.7	2186	152.0	151.3	3.6	12.8	10.6	6.3	23.4	99.1	53
492	10.5	51.7	2159	152.0	151.2	1.9	12.7	10.7	5.2	23.4	99.1	53
493	10.7	52.4	2197	152.0	151.3	1.3	12.8	10.9	6.8	23.4	99.1	53
494			2056	152.0	151.3	-0.9	12.6	8.6	6.2	23.4	99.1	53
495			2022	152.0	151.2	-0.7	13.0	9.0	5.3	23.4	99.1	53
496	9.0	53.1	1943	152.0	151.2	-1.0	13.0	8.2	5.1	23.4	99.1	54
497	8.6	52.9	1747	152.0	151.2	-1.8	12.9	8.4	5.0	23.4	99.0	54
498	8.5	53.0	1740	152.0	151.2	-1.6	13.0	8.9	6.5	23.4	99.0	54
499	9.7	52.7	2136	152.0	151.2	-0.3	13.1	9.8	7.3	23.4	99.0	54
500	9.3	52.6	2117	152.0	151.2	0.0	13.0	9.5	7.4	23.4	99.1	54
501	9.8	52.5	2213	152.0	151.2	0.2	13.0	10.0	6.2	23.4	99.1	54
502	10.1	52.5	2249	152.0	151.3	1.2	13.2	10.3	5.7	23.4	99.1	54
503	9.3	52.7	2260	152.0	151.2	2.2	13.2	9.5	7.7	23.4	99.0	54
504	9.5	52.7	2258	152.0	151.2	3.1	13.2	9.7	7.1	23.4	99.1	54
505	10.4	52.3	2205	152.0	151.2	2.2	12.9	10.6	6.9	23.4	99.1	54
506	10.4	52.4	2231	152.0	151.2	2.6	13.1	10.6	6.9	23.4	99.1	54
507	10.0	52.5	2247	152.0	151.2	3.4	13.2	10.2	6.8	23.4	99.1	54
508	10.1	52.5	2262	152.0	151.2	4.3	13.2	10.3	6.9	23.4	99.1	54
509	10.9	52.2	2241	152.0	151.3	4.8	13.1	11.1	6.5	23.4	99.1	54
510	10.5	51.8	2224	152.0	151.3	4.7	13.1	10.7	8.0	23.4	99.1	54
511	10.9	52.5	2257	152.0	151.3	5.7	13.2	11.1	7.8	23.4	99.1	54
512	11.1	52.3	2261	152.0	151.3	7.0	13.3	11.3	6.5	23.4	99.1	54
513	10.4	51.4	2159	152.0	151.3	4.8	12.6	10.6	6.2	23.4	99.0	54
514	10.6	51.6	2157	152.0	151.3	3.3	12.7	10.8	6.3	23.4	99.1	54
515	10.1	51.9	2123	152.0	151.3	0.8	12.5	10.3	7.3	23.4	99.1	54
516	9.8	52.8	2121	152.0	151.3	0.3	12.9	10.0	7.7	23.4	99.1	54
517	10.2	52.8	2225	152.0	151.3	1.1	13.0	10.4	6.5	23.4	99.1	54
518	10.3	52.6	2218	152.0	151.3	0.9	13.0	10.5	7.3	23.4	99.1	54
519	10.6	53.0	2252	152.0	151.2	2.0	13.2	10.8	7.1	23.3	99.1	54
520	10.2	52.2	2215	152.0	151.3	1.5	12.9	10.4	6.5	23.3	99.1	54
521	10.2	53.9	2059	152.0	151.2	-0.6	12.7	10.4	6.1	23.3	99.1	54
522	8.3	53.9	1635	152.0	151.2	-0.9	12.9	9.1	6.3	23.3	99.2	54
523	8.8	53.0	1886	152.0	151.3	-0.4	13.1	9.9	4.6	23.3	99.2	54
524	9.0	53.1	1963	152.0	153.4	-0.1	13.0	10.1	4.8	23.3	99.2	54
525	9.1	52.7	1982	152.0	154.2	-0.1	13.0	10.4	5.2	23.4	99.2	54
526	11.1	52.8	2022	152.0	154.7	0.0	13.0	11.4	6.8	23.4	99.3	54
527	10.0	53.0	2034	152.0	157.0	0.0	13.0	10.2	5.5	23.4	99.3	54
528	8.6	53.7	1750	152.0	157.0	-1.1	12.9	10.0	6.5	23.4	99.3	54

Table E.01 Measurement data - Turbine ON

Project: Cedar Point Wind Power Project - Turbine CP244 - IEC 61400-11 Measurement

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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 (%)
529	8.1	53.1	1551	152.0	157.0	-1.8	13.0	9.5	7.9	23.4	99.3	54
530	8.5	53.1	1726	152.0	157.0	-1.8	13.1	8.1	8.5	23.4	99.3	54
531	8.7	53.3	1829	152.0	157.0	-1.7	13.1	9.5	6.4	23.4	99.4	54
532	10.0	53.2	2159	152.0	157.0	-0.8	13.1	10.2	6.7	23.4	99.4	54
533	8.7	53.3	1839	152.0	157.0	-1.4	12.9	10.0	6.7	23.4	99.4	54
534	8.2	53.1	1566	152.0	157.0	-1.8	12.9	8.3	7.0	23.4	99.4	54
535	8.7	53.0	1831	152.0	156.4	-1.6	13.1	8.7	5.8	23.4	99.5	54
536	8.7	53.2	1826	152.0	153.8	-1.7	13.0	9.2	6.5	23.4	99.5	54
537	9.8	53.3	2132	152.0	153.8	-1.3	13.1	10.0	5.6	23.5	99.5	54
538			2144	152.0	153.8	-0.8	13.0	9.4	5.6	23.5	99.5	54
539	9.1	53.1	1990	152.0	153.8	-1.2	13.0	9.5	5.8	23.5	99.5	54
540	9.8	53.5	2281	152.0	153.8	1.7	13.3	9.9	5.1	23.5	99.5	54
541	10.6	53.8	2303	152.0	153.8	3.9	13.5	10.8	5.4	23.5	99.5	54
542	10.9	52.7	2294	152.0	153.8	5.9	13.4	11.1	6.1	23.5	99.5	54
543	10.7	52.1	2227	152.0	153.8	5.5	13.1	10.9	6.7	23.6	99.5	54
544	10.1	52.1	2192	152.0	153.8	4.4	12.8	10.3	8.2	23.6	99.5	54
545	10.6	52.0	2195	152.0	153.8	3.7	12.9	10.8	8.2	23.6	99.5	54
546	11.4	52.3	2259	152.0	153.8	5.0	13.2	11.6	7.3	23.6	99.5	54
547	10.8	52.3	2251	152.0	153.8	5.9	13.2	11.0	8.1	23.6	99.5	54
548	10.6	51.7	2130	152.0	153.8	2.5	12.5	10.8	7.4	23.6	99.5	54
549	10.4	52.2	2173	152.0	153.8	1.2	12.7	10.6	5.4	23.6	99.5	53
550	10.6	53.0	2277	152.0	153.8	3.8	13.3	10.8	4.3	23.6	99.5	53
551	10.1	52.2	2253	152.0	153.8	4.3	13.2	10.3	5.4	23.6	99.5	53
552	10.8	51.8	2210	152.0	153.8	3.6	12.9	11.1	5.3	23.6	99.5	53
553	10.2	51.9	2231	152.0	153.8	3.9	13.1	10.4	5.3	23.6	99.5	53
554	11.7	52.8	2275	152.0	153.8	5.5	13.3	12.0	7.4	23.6	99.5	53
555	10.5	52.2	2224	152.0	153.8	5.4	13.0	10.7	6.1	23.6	99.5	53
556	9.6	51.4	2123	152.0	153.8	2.3	12.5	9.8	7.5	23.6	99.5	53
557	10.1	51.7	2152	152.0	152.1	0.5	12.6	10.3	6.0	23.6	99.5	53
558	10.3	52.5	2172	152.0	151.4	0.0	12.8	10.5	5.9	23.6	99.5	53
559	9.8	52.8	2246	152.0	151.4	1.3	13.2	10.0	4.8	23.6	99.5	53
560	10.0	52.8	2267	152.0	151.4	2.9	13.3	10.1	5.3	23.6	99.5	53
561	9.6	52.5	2228	152.0	151.4	2.7	13.0	9.7	7.4	23.6	99.5	53
562	9.5	52.4	2171	152.0	151.4	0.9	12.7	9.7	8.1	23.6	99.5	53
563	10.6	52.2	2210	152.0	151.4	0.8	13.0	10.8	8.0	23.6	99.5	53
564	10.0	52.2	2234	152.0	151.4	1.6	13.1	10.2	7.1	23.6	99.5	53
565	9.7	52.8	2202	152.0	151.4	1.0	12.9	9.9	6.6	23.6	99.5	53
566	8.9	54.0	1926	152.0	151.4	-1.2	12.7	10.5	6.8	23.6	99.5	53
567	9.5	53.0	2133	152.0	151.4	0.4	13.0	9.6	5.7	23.5	99.5	53
568	9.5	52.7	2113	152.0	151.4	0.1	13.0	9.7	5.9	23.5	99.5	53
569	10.2	52.9	2118	152.0	151.4	0.1	13.0	10.4	5.9	23.5	99.5	53
570	8.9	52.9	1927	152.0	151.5	-0.6	12.9	8.8	4.5	23.5	99.5	53
571			1718	152.0	151.5	-1.8	12.9	8.6	5.5	23.5	99.5	53
572			1637	152.0	151.4	-1.6	13.0	6.5	5.2	23.5	99.5	53
573			2176	152.0	151.4	-0.1	13.2	9.1	5.1	23.5		53
574	10.1	53.5	2301	152.0	151.4	3.3	13.5	10.3	6.2	23.5	99.5	53
575	11.5	53.2	2279	152.0	151.4	4.7	13.4	11.8	5.3	23.5	99.5	53
576	10.6	52.4	2256	152.0	151.4	5.4	13.2	10.8	5.9	23.5	99.5	53
577	11.2	52.0	2210	152.0	151.4	4.8	13.0	11.4	6.0	23.5	99.5	53
578	10.8	51.8	2179	152.0	151.4	3.7	12.8	11.0	7.0	23.5	99.5	53
579	10.6	52.0	2200	152.0	151.4	3.4	12.9	10.8	6.6	23.5	99.5	53
580	9.9	52.7	2228	152.0	151.4	3.6	13.1	10.1	5.6	23.5	99.5	53
581			1147	152.0	151.5	9.7	13.8	10.5	6.8	23.5	99.5	53
582	10.9	52.0	2174	152.0	152.5	2.8	12.6	11.1	7.0	23.3	99.5	54
583	10.8	52.5	2190	152.0	152.5	1.0	12.6	11.0	7.5	23.3	99.5	54
584	10.9	53.0	2237	152.0	152.6	1.2	12.9	11.1	6.7	23.3	99.5	54
585	10.5	52.6	2229	152.0	152.6	0.6	12.8	10.7	6.1	23.3	99.5	54
586	9.3	52.6	2021	152.0	152.6	-1.3	12.8	9.5	4.5	23.3	99.5	54
587	9.2	53.4	1998	152.0	152.6	-1.1	13.0	9.9	4.8	23.3	99.5	54
588	10.0	53.2	2033	152.0	152.5	-1.0	13.0	10.2	5.7	23.2	99.5	54
589	9.2	53.8	1997	152.0	152.6	-1.1	13.0	9.0	5.2	23.2	99.5	53
590	8.6	54.3	1774	152.0	152.6	-1.8	12.9	9.2	4.7	23.2	99.5	53
591	8.4	53.5	1685	152.0	152.6	-1.8	13.0	10.3	4.7	23.2	99.5	53
592	8.4	53.9	1684	152.0	152.6	-1.8	13.0	8.6	5.6	23.2	99.5	53
593	8.1	53.4	1518	152.0	152.6	-1.8	13.0	7.4	4.9	23.2	99.5	53
594	9.3	53.3	2127	152.0	152.6	-0.3	13.3	9.5	5.0	23.2	99.5	54
595	10.2	53.1	2283	152.0	152.6	1.5	13.2	10.4	3.9	23.2	99.5	54
596	9.2	52.7	2010	152.0	152.1	-0.2	12.9	8.9	5.3	23.2	99.5	54
597	9.9	53.0	2223	152.0	149.2	0.3	13.0	10.1	5.7	23.2	99.5	54
598	8.9	52.9	1907	152.0	149.1	-1.3	12.8	9.3	7.7	23.2	99.5	54
599	8.6	53.6	1771	152.0	149.1	-1.8	13.0	9.9	5.6	23.2	99.5	54
600	8.5	53.5	1723	152.0	149.2	-1.8	13.0	8.8	4.9	23.2	99.5	54
601	8.6	53.8	1772	152.0	149.2	-1.8	13.0	9.7	6.4	23.2	99.5	54
602	8.2	53.5	1578	152.0	149.1	-1.8	12.9	7.1	6.5	23.2	99.5	54
603	8.2	53.4	1586	152.0	149.1	-1.8	13.0	8.3	6.5	23.2	99.5	54
604	8.1	53.3	1520	152.0	149.2	-1.8	13.0	8.3	5.9	23.2	99.5	54
605	8.4	53.4	1679	152.0	149.1	-1.8	13.0	8.1	6.4	23.2	99.5	54
606	8.2	53.3	1571	152.0	149.1	-1.8	13.0	9.4	6.8	23.2	99.5	54
607	7.9	52.9	1411	152.0	149.1	-1.9	12.9	7.6	6.9	23.2	99.5	54
608	8.1	53.2	1509	152.0	149.1	-2.1	13.0	7.9	5.4	23.2	99.5	54
609	8.5	53.8	1728	152.0	149.2	-1.8	13.1	8.2	4.6	23.2	99.5	54
610			2130	152.0	149.2	-1.8	13.2	8.6	6.1	23.2	99.5	54
611	10.2	53.8	2314	152.0	148.9	1.5	13.5	10.4	5.3	23.2	99.5	54
612	10.5	53.4	2374	152.0	146.9	5.9	13.7	10.7	8.1	23.1	99.5	54
613	12.7	52.9	2313	152.0	146.8	7.0	13.4	13.0	7.7	23.1	99.5	54
614	11.3	52.1	2206	152.0	146.9	5.2	12.8	11.5	7.0	23.1	99.5	54
615	11.0	52.0	2245	152.0	146.8	5.5	13.0	11.2	7.9	23.1	99.5	54
616	10.8	52.2	2241	152.0	146.8	5.3	13.0	11.0	8.3	23.1	99.5	54

***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	11.0	52.2	2257	152.0	146.9	5.8	13.1	11.2	8.8	23.1	99.5	54
618	10.7	51.7	2206	152.0	146.9	4.6	12.8	10.9	7.2	23.1	99.5	54
619	10.4	52.9	2245	152.0	146.9	4.7	13.0	10.6	7.3	23.1	99.5	54
620	10.5	52.5	2222	152.0	146.8	4.3	12.9	10.7	7.3	23.1	99.5	54
621	11.1	52.4	2207	152.0	146.8	3.3	12.8	11.3	5.2	23.1	99.5	54
622	10.3	52.4	2117	152.0	146.6	-0.2	12.5	10.5	5.3	23.1	99.5	54
623	8.7	53.3	1798	152.0	144.6	-1.2	12.8	9.8	7.2	23.1	99.5	54
624	9.0	52.9	1962	152.0	144.5	-0.7	13.0	9.8	6.8	23.1	99.5	54
625	8.7	53.5	1814	152.0	144.5	-1.5	12.9	9.0	6.0	23.1	99.5	54
626	9.2	53.6	2009	152.0	144.5	-0.7	13.1	10.4	5.7	23.1	99.5	54
627	11.4	53.9	2363	152.0	144.5	4.8	13.7	11.7	7.1	23.1	99.5	54
628	11.5	53.3	2323	152.0	144.5	6.5	13.4	11.7	6.7	23.1	99.5	54
629	10.7	53.3	2293	152.0	144.5	7.1	13.3	10.9	5.6	23.1	99.5	54
630	12.1	52.8	2284	152.0	144.5	8.0	13.3	12.3	6.6	23.1	99.5	54
631	12.2	52.1	2235	152.0	144.5	7.4	13.0	12.5	8.3	23.1	99.5	54
632	12.6	52.7	2258	152.0	144.5	7.9	13.1	12.8	6.4	23.1	99.5	54
633	12.1	52.5	2268	152.0	144.6	8.5	13.2	12.3	7.1	23.1	99.5	54
634	11.1	51.9	2238	152.0	144.6	8.3	13.0	11.3	8.9	23.1	99.5	54
635	12.1	51.8	2217	152.0	144.6	7.9	12.9	12.3	8.2	23.1	99.5	54
636	11.2	52.3	2244	152.0	144.6	8.0	13.0	11.4	7.3	23.0	99.5	53
637	11.8	52.5	2242	152.0	144.6	8.4	13.0	12.0	7.3	23.0	99.5	53
638	11.8	52.0	2219	152.0	144.6	7.8	12.9	12.1	8.2	23.0	99.5	53
639	11.9	52.0	2205	152.0	143.2	7.2	12.9	12.1	8.6	23.0	99.5	53
640	11.5	52.0	2205	152.0	142.1	6.6	12.8	11.7	7.4	23.0	99.5	53
641	10.6	51.7	2163	152.0	142.1	4.7	12.6	10.8	6.1	23.0	99.5	53
642	11.0	52.3	2200	152.0	142.0	4.0	12.8	11.3	5.8	23.0	99.5	53
643	11.1	52.1	2207	152.0	142.1	3.4	12.8	11.3	6.6	23.0	99.5	53
644	10.9	52.6	2175	152.0	142.0	1.5	12.6	11.2	5.8	23.0	99.5	53
645	8.7	53.3	1843	152.0	142.1	-1.5	12.6	11.4	7.2	23.0	99.5	53
646	9.1	53.7	1978	152.0	142.0	-0.6	13.1	9.4	8.6	23.0	99.5	53
647			2267	152.0	142.0	1.1	13.2	9.4	9.4	23.0	99.5	53
648	11.1	53.6	2331	152.0	142.9	4.7	13.6	11.3	10.4	23.0	99.4	53
649	11.3	53.5	2316	152.0	145.1	6.3	13.4	11.5	6.8	23.0	99.4	53
650	10.8	53.1	2279	152.0	145.1	6.8	13.3	11.1	6.8	23.0	99.4	53
651	11.6	52.8	2259	152.0	145.7	7.1	13.2	11.8	6.4	23.0	99.4	53
652	12.8	53.6	2275	152.0	147.6	8.0	13.2	13.0	5.6	23.0	99.4	53
653	12.6	52.5	2249	152.0	147.6	8.2	13.1	12.9	7.7	23.0	99.5	53
654	12.9	52.5	2247	152.0	147.5	8.4	13.1	13.1	6.7	23.0	99.5	53
655	12.4	52.2	2215	152.0	147.6	7.9	12.9	12.6	7.3	23.0	99.5	53
656	11.4	52.0	2213	152.0	147.6	7.4	12.9	11.6	9.0	23.0	99.5	53
657	12.0	52.7	2216	152.0	149.5	7.2	13.0	12.3	7.2	23.0	99.5	53
658	12.4	52.9	2259	152.0	150.2	8.2	13.2	12.6	7.6	23.0	99.5	53
659	11.2	51.9	2208	152.0	150.1	7.4	12.9	11.4	6.7	23.0	99.5	53
660	10.7	51.4	2174	152.0	150.1	6.0	12.7	10.9	7.6	23.0	99.5	53
661	8.9	51.5	1899	152.0	150.1	2.1	12.3	10.2	6.5	23.0	99.5	53
662			2029	152.0	150.2	0.7	12.7	8.4	6.8	23.0	99.5	53
663	10.7	53.6	2299	152.0	150.2	3.8	13.4	10.9	8.0	23.0	99.5	53
664	11.5	53.4	2284	152.0	150.2	4.9	13.3	11.8	7.1	23.0	99.5	53
665	10.7	52.8	2281	152.0	150.2	6.1	13.3	10.9	6.3	23.0	99.5	53
666	10.7	53.1	2276	152.0	150.2	7.0	13.3	10.9	8.4	23.0	99.5	53
667	10.7	52.4	2254	152.0	148.1	7.5	13.1	10.9	6.6	23.0	99.5	53
668	10.3	51.9	2159	152.0	147.7	5.3	12.6	10.5	7.1	23.0	99.5	53
669	9.9	52.4	2201	152.0	147.6	4.8	12.8	10.1	8.2	23.0	99.5	53
670	10.1	51.9	2181	152.0	147.5	3.8	12.7	10.3	7.3	23.0	99.5	53
671	10.0	52.1	2182	152.0	145.1	2.6	12.7	10.2	6.7	23.0	99.5	53
672	9.6	52.6	2200	152.0	145.0	1.8	12.8	9.7	7.0	22.9	99.5	53
673	10.1	52.5	2250	152.0	145.0	2.7	13.1	10.3	7.2	22.9	99.5	53
674	10.0	52.8	2243	152.0	145.0	3.0	13.1	10.2	6.8	22.9	99.5	53
675	11.1	53.4	2298	152.0	145.0	5.0	13.4	11.3	8.0	22.9	99.5	53
676	11.4	53.0	2306	152.0	145.0	7.2	13.4	11.6	5.5	22.9	99.5	53
677	11.0	52.3	2220	152.0	145.0	6.3	13.0	11.2	6.1	22.9	99.5	53
678	10.9	52.1	2212	152.0	145.0	6.0	12.9	11.1	8.2	22.9	99.5	53
679	10.1	52.5	2231	152.0	145.0	5.9	13.0	10.3	8.4	22.9	99.5	53
680	10.9	52.1	2233	152.0	145.0	6.3	13.1	11.2	8.4	22.9	99.5	53
681	11.5	52.9	2272	152.0	145.0	7.3	13.3	11.7	9.6	22.9	99.5	53
682	12.4	52.8	2251	152.0	144.9	7.8	13.2	12.7	7.9	22.9	99.5	53
683	12.1	52.6	2214	152.0	146.5	7.5	13.0	12.4	8.7	22.9	99.5	53
684	11.6	52.0	2199	152.0	147.7	6.8	12.9	11.9	7.6	22.9	99.5	53
685	11.2	52.6	2217	152.0	147.8	6.9	13.0	11.5	6.0	22.9	99.5	53
686	12.2	52.9	2249	152.0	147.7	7.4	13.1	12.4	5.9	22.9	99.5	53
687	12.1	52.5	2226	152.0	148.4	7.5	13.0	12.3	5.2	22.9	99.5	53
688	11.1	52.1	2215	152.0	150.5	7.2	12.9	11.3	7.2	22.9	99.5	53
689	11.2	51.6	2197	152.0	150.4	6.5	12.9	11.4	7.1	22.9	99.5	53
690	12.7	52.9	2254	152.0	150.4	7.5	13.2	12.9	6.2	22.9	99.5	53
691	11.5	52.6	2240	152.0	150.5	7.7	13.1	11.7	7.7	22.9	99.5	53
692	11.8	52.2	2158	152.0	150.5	5.7	12.6	12.0	4.8	22.9	99.5	53
693	10.9	51.9	2167	152.0	151.2	4.4	12.7	11.1	6.7	22.9	99.5	53
694	11.0	52.0	2208	152.0	152.4	4.3	12.9	11.2	7.7	22.9	99.5	53
695	10.0	52.5	2212	152.0	152.4	4.2	12.9	10.2	8.0	22.9	99.5	53
696	9.8	52.5	2064	152.0	152.4	1.2	12.5	10.0	7.2	22.9	99.5	54
697	10.8	53.0	2225	152.0	152.4	1.7	13.0	11.0	7.0	22.9	99.5	54
698	9.4	52.9	2200	152.0	152.2	1.1	12.8	9.5	5.9	22.9	99.5	54
699	10.4	53.8	2190	152.0	149.9	0.0	12.9	10.7	6.7	22.9	99.5	54
700	10.0	53.1	2256	152.0	149.8	1.6	13.2	10.2	5.9	22.9	99.5	54
701	10.4	52.7	2235	152.0	148.7	1.6	13.1	10.6	4.0	22.9	99.5	54
702	10.1	53.4	2304	152.0	147.4	4.4	13.5	10.3	7.8	22.9	99.5	54
703	10.7	53.1	2304	152.0	147.4	6.8	13.4	11.0	7.0	22.9	99.5	54
704	11.9	53.0	2275	152.0	147.3	7.5	13.3	12.1	7.9	22.9	99.5	54

Table E.01 Measurement data - Turbine ON

***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	11.9	52.3	2263	152.0	147.3	8.2	13.2	12.2	7.1	22.9	99.5	54
706	12.5	51.9	2202	152.0	147.3	7.6	12.9	12.8	7.2	22.9	99.5	54
707	11.8	52.0	2189	152.0	147.3	6.7	12.8	12.1	5.8	22.9	99.5	54
708	11.4	51.7	2072	152.0	147.3	4.2	12.4	11.6	5.6	22.9	99.5	54
709	8.5	52.2	1745	152.0	147.3	0.7	12.5	9.4	6.1	22.9	99.5	54
710	9.1	53.6	1981	152.0	147.3	0.2	12.8	9.5	6.5	22.9	99.5	54
711	9.5	53.4	2088	152.0	147.4	0.7	13.1	9.7	5.9	22.9	99.5	54
712			2249	152.0	147.4	1.9	13.1	9.1	7.0	22.9	99.5	54
713	9.9	52.6	2199	152.0	147.4	0.6	12.8	10.1	8.8	22.9	99.5	54
714	9.5	53.1	2215	152.0	147.3	0.3	13.0	9.7	6.6	22.8	99.5	54
715	9.8	53.3	2287	152.0	147.3	2.9	13.4	10.0	7.2	22.8	99.5	54
716	11.3	53.2	2302	152.0	147.3	5.4	13.5	11.5	8.4	22.8	99.5	54
717	11.3	52.8	2244	152.0	147.3	5.5	13.1	11.5	8.4	22.8	99.5	54
718	11.1	52.2	2205	152.0	147.4	4.7	12.9	11.3	7.8	22.8	99.5	54
719	10.2	52.3	2246	152.0	147.4	5.6	13.2	10.4	6.6	22.8	99.5	54
720	10.4	52.3	2238	152.0	147.4	6.1	13.1	10.6	6.1	22.8	99.5	54
721	10.3	52.3	2185	152.0	147.4	4.9	12.8	10.5	5.5	22.8	99.5	54
722	10.6	52.1	2152	152.0	147.4	3.0	12.6	10.8	5.9	22.8	99.5	54
723	9.7	52.2	2123	152.0	147.4	0.4	12.6	9.9	6.8	22.8	99.5	54
724	10.3	52.8	2170	152.0	147.4	0.1	12.8	10.5	7.4	22.8	99.5	54
725	10.5	53.3	2269	152.0	147.3	2.2	13.3	10.7	6.7	22.8	99.5	54
726	10.9	53.3	2293	152.0	147.4	5.1	13.5	11.1	6.2	22.8	99.5	54
727	10.2	52.3	2250	152.0	147.4	5.4	13.2	10.4	5.8	22.8	99.5	54
728	9.9	51.9	2182	152.0	147.3	4.0	12.8	10.1	5.6	22.8	99.5	54
729	10.3	51.9	2141	152.0	147.3	1.5	12.6	10.5	5.8	22.8	99.5	54
730	10.7	52.8	2251	152.0	147.4	3.4	13.2	10.9	5.8	22.8	99.5	54
731	10.1	52.8	2231	152.0	147.4	3.7	13.1	10.3	7.4	22.8	99.5	54
732			2098	152.0	147.4	0.9	12.6	8.9	6.5	22.8	99.5	54
733	8.8	52.8	1862	152.0	147.4	-0.8	12.9	9.4	6.0	22.8	99.5	54
734	10.5	53.5	2236	152.0	147.4	1.0	13.2	10.7	5.5	22.8	99.5	54
735	10.3	53.8	2292	152.0	147.4	3.4	13.5	10.5	6.0	22.8	99.5	54
736	10.6	52.9	2296	152.0	147.3	5.8	13.5	10.8	5.7	22.8	99.5	54
737	11.1	52.9	2259	152.0	147.3	6.5	13.3	11.3	5.5	22.8	99.5	54
738	11.1	52.0	2209	152.0	147.4	5.8	12.9	11.3	7.2	22.8	99.5	54
739	11.3	51.6	2198	152.0	147.3	5.3	12.9	11.5	8.5	22.8	99.5	54
740	10.5	52.2	2212	152.0	147.3	5.2	13.0	10.7	7.6	22.8	99.5	54
741	10.2	51.8	2203	152.0	147.3	4.9	12.9	10.4	9.2	22.8	99.5	54
742	10.3	52.0	2201	152.0	146.3	4.7	13.0	10.5	9.9	22.8	99.5	54
743	10.5	52.1	2206	152.0	144.6	4.4	12.9	10.7	8.0	22.7	99.5	54
744	10.9	52.4	2193	152.0	144.6	3.7	12.9	11.1	6.5	22.7	99.5	54
745	10.1	52.5	2221	152.0	144.6	3.8	13.0	10.3	5.1	22.7	99.5	54
746	11.7	53.1	2240	152.0	144.6	4.6	13.1	11.9	4.9	22.7	99.5	54
747	10.2	52.8	2206	152.0	144.6	4.0	12.9	10.4	5.7	22.7	99.5	54
748	10.3	53.0	2201	152.0	144.6	3.3	12.9	10.5	6.0	22.7	99.5	54
749	10.0	52.6	2193	152.0	142.7	2.8	12.9	10.2	6.6	22.7	99.5	54
750	10.3	53.0	2263	152.0	141.7	4.3	13.3	10.5	7.0	22.7	99.5	54
751	11.4	52.5	2266	152.0	141.7	5.5	13.3	11.6	6.2	22.7	99.5	54
752	10.8	52.6	2238	152.0	141.7	5.7	13.1	11.0	5.8	22.7	99.5	54
753	10.0	52.5	2198	152.0	141.7	5.0	12.9	10.1	6.2	22.7	99.5	54
754	10.1	52.3	2137	152.0	141.7	2.2	12.5	10.3	6.0	22.7	99.5	54
755	9.8	52.5	2207	152.0	141.6	2.3	12.9	10.0	7.0	22.7	99.5	54
756	10.3	52.5	2224	152.0	141.6	2.7	13.0	10.5	6.6	22.7	99.5	54
757	9.8	53.2	2032	152.0	141.6	-0.1	12.6	10.0	5.9	22.7	99.5	54
758			2020	152.0	141.6	-0.4	13.0	7.6	5.8	22.7	99.5	54
759			2228	152.0	141.6	0.8	13.1	8.9	6.5	22.7	99.5	54
760	11.3	53.6	2306	152.0	141.6	3.7	13.5	11.6	5.4	22.7	99.5	54
761	11.0	53.1	2319	152.0	141.7	6.9	13.6	11.2	5.2	22.7	99.5	55
762	11.7	52.9	2238	152.0	141.7	6.6	13.1	11.9	5.7	22.7	99.5	55
763	10.8	51.8	2174	152.0	141.7	5.0	12.7	11.0	5.8	22.7	99.5	55
764	10.6	51.9	2140	152.0	141.7	2.5	12.6	10.8	5.3	22.7	99.5	55
765	10.8	52.5	2217	152.0	141.7	3.4	13.0	11.0	6.3	22.7	99.5	55
766	9.8	52.3	2213	152.0	141.7	3.0	12.9	10.0	6.6	22.7	99.5	55
767	10.2	52.2	2180	152.0	141.6	1.6	12.8	10.4	5.9	22.6	99.5	55
768	9.6	52.5	2232	152.0	141.7	2.4	13.0	9.8	6.0	22.6	99.5	55
769	10.2	52.2	2195	152.0	141.7	1.4	12.8	10.4	4.3	22.6	99.5	55
770	10.2	52.5	2102	152.0	141.7	-1.0	12.7	10.4	4.5	22.6	99.5	55
771	8.9	53.0	1914	152.0	141.7	-1.1	12.9	9.1	5.1	22.6	99.5	55
772			1801	152.0	141.7	-1.8	13.0	7.7	4.7	22.6	99.5	55
773			1750	152.0	141.8	-1.8	13.0	9.8	4.1	22.6	99.5	55
774	8.8	54.1	1880	152.0	144.3	-1.8	13.0	9.5	5.3	22.6	99.5	55
775	8.8	54.4	1886	152.0	144.6	-1.8	13.0	9.0	6.7	22.6	99.5	55
776	9.0	54.0	1940	152.0	144.7	-1.8	13.0	10.3	6.8	22.6	99.5	55
777	10.1	54.5	2110	152.0	147.4	-1.7	13.1	10.3	6.2	22.6	99.5	55
778	10.4	53.2	2199	152.0	147.6	-0.8	13.0	10.6	6.0	22.6	99.5	55
779	10.5	53.0	2046	152.0	148.1	-1.0	13.0	10.7	6.2	22.6	99.5	55
780	10.3	53.1	2183	152.0	150.6	-0.6	13.0	10.5	5.3	22.6	99.5	55
781	8.7	54.0	1833	152.0	150.5	-1.7	12.9	8.2	5.6	22.6	99.5	55
782	8.4	53.7	1657	152.0	150.6	-1.8	12.9	9.2	5.3	22.6	99.5	55
783	8.1	53.2	1515	152.0	150.6	-1.8	13.0	8.1	5.2	22.6	99.5	55
784	8.5	53.2	1710	152.0	150.6	-1.8	13.0	9.2	3.9	22.6	99.5	55
785	7.8	52.8	1395	152.0	150.6	-1.8	12.8	8.4	3.6	22.6	99.5	55
786	7.7	52.5	1320	152.0	150.6	-1.8	12.7	7.5	3.6	22.6	99.5	55
787	8.4	53.3	1690	152.0	150.5	-1.5	13.1	7.9	3.9	22.6	99.5	55
788	8.8	53.1	1850	152.0	150.5	-1.8	13.1	9.4	4.3	22.6	99.5	55
789	9.0	53.0	1946	152.0	150.5	-1.8	13.1	9.1	4.2	22.6	99.5	55
790	8.6	53.1	1786	152.0	150.5	-1.8	12.9	8.1	4.0	22.6	99.5	55
791	7.9	52.5	1420	152.0	150.5	-1.8	12.9	8.7	3.9	22.7	99.5	55
792	7.8	52.8	1375	152.0	150.5	-1.8	12.8	7.6	5.2	22.7	99.5	55

***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 (%)
793	7.7	52.2	1326	152.0	150.5	-1.8	12.7	7.9	5.5	22.7	99.5	55
794	7.7	52.1	1318	152.0	150.5	-1.8	12.7	7.8	4.7	22.7	99.5	55
795	7.9	53.0	1412	152.0	150.5	-1.8	12.9	8.6	4.7	22.7	99.5	55
796	7.7	52.4	1340	152.0	150.6	-1.8	12.7	7.8	5.3	22.7	99.5	55
797	7.6	51.8	1287	152.0	150.6	-1.8	12.5	6.6	5.1	22.7	99.5	55
798	7.5	51.6	1225	152.0	150.5	-1.6	12.3	8.2	4.0	22.7	99.5	55
799	8.1	53.1	1511	152.0	150.5	-1.3	13.0	8.9	3.0	22.7	99.5	55
800	8.0	53.0	1496	152.0	150.5	-1.5	13.0	9.1	4.2	22.7	99.5	55
801	8.1	52.9	1548	152.0	150.6	-1.5	13.0	8.4	4.8	22.7	99.5	55
802	7.9	52.9	1442	152.0	150.6	-1.5	13.0	7.8	5.6	22.7	99.5	55
803	7.9	53.1	1456	152.0	150.5	-1.5	13.0	9.2	4.6	22.7	99.5	55
804	8.2	53.3	1575	152.0	150.5	-2.0	13.0	8.7	5.5	22.7	99.5	55
805	8.2	53.7	1595	152.0	150.6	-2.1	13.1	9.0	4.8	22.7	99.5	55
806	10.2	54.5	2182	152.0	150.6	-0.7	13.4	10.4	5.0	22.7	99.5	55
807	10.8	53.6	2336	152.0	150.6	4.4	13.7	11.0	5.8	22.7	99.5	55
808	10.9	52.9	2280	152.0	150.6	5.4	13.3	11.1	5.1	22.7	99.5	55
809	11.2	52.5	2226	152.0	150.6	5.0	13.0	11.4	6.2	22.6	99.5	55
810	10.8	52.1	2172	152.0	150.6	3.2	12.7	11.0	5.8	22.6	99.5	55
811	9.5	51.8	2110	152.0	150.6	0.3	12.5	9.6	5.8	22.6	99.5	55
812	10.4	52.9	2233	152.0	150.6	1.4	13.1	10.6	6.3	22.6	99.5	55
813	10.9	53.0	2273	152.0	150.6	3.0	13.3	11.1	4.5	22.6	99.5	55
814	10.5	52.5	2247	152.0	150.6	3.8	13.1	10.7	7.0	22.6	99.5	55
815	11.2	53.0	2255	152.0	150.6	4.5	13.2	11.4	6.8	22.6	99.5	55
816	9.9	52.2	2214	152.0	150.6	3.7	12.9	10.1	5.9	22.6	99.5	55
817	9.5	52.4	2210	152.0	150.6	3.6	12.9	9.7	5.8	22.6	99.5	55
818	10.2	52.2	2162	152.0	150.6	3.2	12.6	10.5	4.7	22.6	99.5	55
819			2101	152.0	150.5	-0.9	12.6	9.4	5.4	22.6	99.5	55
820	10.1	53.4	2219	152.0	150.6	1.2	13.3	10.3	7.7	22.5	99.5	55
821	10.8	53.4	2347	152.0	150.6	6.3	13.7	11.0	8.3	22.5	99.4	54
822	9.8	52.2	2189	152.0	150.6	5.8	12.8	10.0	6.3	22.5	99.4	54
823	11.6	52.7	2197	152.0	150.5	4.9	12.9	11.8	5.7	22.5	99.4	54
824	11.1	52.8	2268	152.0	150.6	6.5	13.2	11.3	6.5	22.5	99.4	54
825	11.2	52.6	2259	152.0	150.6	7.0	13.2	11.4	7.1	22.5	99.5	54
826	11.5	52.7	2243	152.0	150.6	7.3	13.1	11.7	7.5	22.5	99.5	54
827	10.9	51.8	2215	152.0	150.6	6.9	12.9	11.1	7.6	22.5	99.5	54
828	10.5	51.7	2150	152.0	150.6	4.7	12.6	10.7	7.4	22.5	99.5	54
829	11.4	52.6	2205	152.0	150.6	4.7	12.9	11.7	7.1	22.5	99.5	54
830	11.3	52.5	2200	152.0	150.6	3.9	12.9	11.5	7.9	22.5	99.5	54
831	10.7	52.7	2243	152.0	150.6	4.8	13.1	10.9	7.2	22.5	99.5	54
832	9.9	52.2	2204	152.0	150.6	3.9	12.9	10.0	5.7	22.5	99.5	54
833	10.3	52.2	2217	152.0	150.6	3.7	12.9	10.5	4.7	22.5	99.5	54
834	9.4	52.1	2076	152.0	150.6	1.2	12.6	9.6	6.7	22.5	99.5	54
835	9.1	53.0	1985	152.0	150.6	-0.1	12.9	9.1	8.5	22.5	99.5	54
836	9.4	53.0	2086	152.0	150.6	0.3	12.9	9.5	7.8	22.5	99.5	54
837	9.0	53.4	1964	152.0	149.3	-0.1	13.0	9.6	6.4	22.5	99.5	54
838	9.6	53.2	2204	152.0	148.1	0.5	13.1	9.8	5.5	22.5	99.5	54
839	10.6	53.0	2246	152.0	148.1	1.2	13.1	10.8	5.9	22.5	99.5	54
840	9.7	53.3	2228	152.0	148.1	0.7	13.0	9.9	6.4	22.5	99.5	54
841	10.5	53.2	2281	152.0	146.8	2.8	13.4	10.7	6.1	22.5	99.5	54
842	9.7	52.7	2254	152.0	145.5	3.6	13.1	9.9	7.0	22.5	99.5	54
843	9.3	52.2	2067	152.0	145.5	0.2	12.6	9.4	8.0	22.4	99.5	55
844	9.2	52.7	2010	152.0	145.4	0.0	12.9	9.0	6.2	22.4	99.5	55
845	9.0	52.5	1945	152.0	145.4	-0.1	13.0	10.0	5.7	22.4	99.5	55
846	9.0	53.5	1949	152.0	145.4	-1.3	13.0	10.2	5.0	22.4	99.5	55
847	9.5	53.3	2058	152.0	145.4	-1.3	13.1	9.6	5.1	22.4	99.5	55
848	10.5	53.3	2236	152.0	145.5	-0.5	13.1	10.7	6.5	22.4	99.5	55
849	9.7	53.6	2260	152.0	145.5	0.6	13.2	9.8	6.1	22.4	99.5	55
850	9.9	52.9	2218	152.0	145.5	0.3	13.0	10.1	6.3	22.4	99.5	55
851	9.3	53.0	2131	152.0	145.5	0.0	13.0	9.5	5.5	22.4	99.5	55
852	9.0	52.9	1966	152.0	145.4	-0.7	12.9	10.3	4.8	22.4	99.5	55
853	9.1	53.3	1984	152.0	145.4	-1.0	13.0	9.3	6.4	22.4	99.5	55
854	8.8	53.0	1871	152.0	145.4	-1.8	13.0	8.8	6.0	22.4	99.5	55
855			2075	152.0	145.4	-1.2	13.1	9.2	5.7	22.3	99.5	55
856	10.2	53.3	2198	152.0	145.5	-0.1	13.1	10.4	7.4	22.3	99.5	55
857	10.4	54.0	2322	152.0	145.5	4.0	13.6	10.6	5.8	22.3	99.5	55
858	10.0	52.9	2274	152.0	145.4	4.7	13.3	10.2	6.3	22.3	99.5	55
859	10.4	52.4	2226	152.0	145.4	4.4	13.0	10.6	6.3	22.3	99.5	55
860	11.0	52.7	2233	152.0	145.4	4.4	13.1	11.2	5.3	22.3	99.5	55
861	10.6	52.5	2263	152.0	145.4	5.8	13.2	10.9	4.5	22.3	99.5	55
862	11.2	52.4	2228	152.0	145.5	5.8	13.1	11.4	4.9	22.3	99.5	56
863	11.4	52.2	2187	152.0	145.4	4.6	12.8	11.6	4.2	22.3	99.5	56
864	11.0	52.1	2199	152.0	145.4	4.3	12.9	11.2	5.0	22.3	99.5	56
865	11.3	52.0	2200	152.0	145.4	3.6	12.9	11.5	7.2	22.3	99.5	56
866	11.0	52.4	2233	152.0	145.4	4.2	13.1	11.2	6.7	22.3	99.5	56
867	11.1	52.3	2220	152.0	145.5	4.1	13.0	11.3	6.6	22.3	99.5	55
868	10.5	52.3	2170	152.0	145.5	2.3	12.7	10.7	8.1	22.3	99.5	55
869	10.1	52.7	2186	152.0	145.5	1.0	12.8	10.3	7.1	22.3	99.5	55
870	9.9	52.8	2271	152.0	145.5	3.5	13.3	10.1	7.8	22.3	99.5	55
871	10.2	52.6	2233	152.0	145.5	3.2	13.0	10.4	6.4	22.3	99.5	55
872	11.1	52.6	2221	152.0	145.5	3.0	13.0	11.3	6.6	22.3	99.5	55
873	10.3	52.1	2173	152.0	145.5	1.2	12.7	10.5	7.0	22.3	99.5	56
874	10.6	52.7	2189	152.0	145.5	-0.1	12.8	10.8	5.8	22.3	99.5	56
875	10.3	53.1	2246	152.0	145.5	1.4	13.1	10.5	5.2	22.3	99.5	56
876	10.4	52.6	2195	152.0	145.5	0.0	12.8	10.6	6.0	22.3	99.5	56
877	9.2	54.0	2011	152.0	145.5	-1.6	12.8	9.8	5.3	22.3	99.5	56
878	8.8	53.5	1849	152.0	145.5	-1.8	12.9	9.3	4.6	22.3	99.5	56
879	8.9	53.6	1903	152.0	145.5	-1.8	13.0	9.2	6.2	22.2	99.5	56
880	9.2	53.4	2003	152.0	145.5	-1.8	13.1	9.1	6.3	22.2	99.5	56

Table E.01 Measurement data - Turbine ON

Project: Cedar Point Wind Power Project - Turbine CP244 - IEC 61400-11 Measurement

Report ID: 15039.00.CP244.RP4

Created on: 1/25/2018

***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 (%)
881	9.4	53.5	2034	152.0	145.4	-1.8	13.0	9.6	6.3	22.2	99.5	56
882	10.0	53.5	2045	152.0	145.4	-1.7	13.0	10.2	5.6	22.2	99.5	56
883	9.1	53.3	1993	152.0	145.5	-1.8	13.0	10.0	5.5	22.2	99.5	56
884	8.9	53.1	1895	152.0	145.5	-1.8	13.0	9.4	5.2	22.2	99.5	56
885	9.8	53.3	2105	152.0	145.5	-1.4	13.1	10.0	5.2	22.2	99.5	56
886	9.3	52.9	2139	152.0	145.5	-0.6	13.0	9.5	4.4	22.2	99.5	56
887	10.7	53.3	2066	152.0	145.5	-0.7	13.0	10.9	6.5	22.2	99.5	56
888	8.7	53.1	1799	152.0	145.5	-1.7	12.9	9.7	6.9	22.2	99.5	56
889	8.7	53.6	1839	152.0	145.5	-1.6	13.0	9.1	5.9	22.2	99.5	56
890	10.5	53.7	2259	152.0	145.5	1.2	13.3	10.7	6.0	22.2	99.5	56
891	10.9	53.5	2299	152.0	145.5	3.7	13.4	11.1	5.8	22.2	99.5	56
892	11.2	53.3	2299	152.0	145.5	5.5	13.5	11.4	6.2	22.2	99.5	56
893	11.4	53.0	2291	152.0	145.5	7.0	13.4	11.6	6.5	22.2	99.5	56
894	11.8	52.4	2236	152.0	145.5	6.9	13.1	12.0	6.6	22.2	99.5	56
895	9.7	51.8	2174	152.0	147.5	5.5	12.7	9.9	7.9	22.2	99.5	56
896	10.4	51.9	2153	152.0	147.9	3.2	12.6	10.6	6.6	22.2	99.5	56
897	11.2	52.5	2220	152.0	147.9	3.9	13.0	11.4	6.8	22.1	99.5	56
898	9.3	52.4	2175	152.0	147.9	2.1	12.7	9.5	6.5	22.1	99.5	56
899	9.4	52.8	2228	152.0	147.9	2.8	13.0	9.6	6.4	22.1	99.5	56
900			2169	152.0	147.8	0.4	12.7	8.8	5.1	22.1	99.5	56
901	9.8	53.3	2281	152.0	147.8	3.1	13.4	10.0	7.4	22.1	99.5	56
902	10.9	52.6	2241	152.0	147.9	3.7	13.1	11.2	7.3	22.1	99.5	56
903	10.8	52.2	2226	152.0	147.9	3.7	13.0	11.0	5.7	22.1	99.5	56
904	10.3	52.4	2192	152.0	147.8	2.4	12.8	10.5	5.8	22.1	99.5	56
905	10.8	52.7	2236	152.0	147.8	3.1	13.1	11.1	6.7	22.1	99.5	56
906	11.2	52.6	2234	152.0	147.8	3.3	13.1	11.4	6.3	22.1	99.5	56
907	10.5	52.9	2274	152.0	147.9	4.8	13.3	10.7	5.7	22.1	99.5	56
908	10.7	53.3	2252	152.0	147.9	5.4	13.1	10.9	5.4	22.1	99.5	57
909	10.4	52.2	2209	152.0	147.9	4.7	12.9	10.6	6.6	22.1	99.5	57
910	10.3	52.2	2175	152.0	147.9	3.3	12.7	10.5	6.8	22.1	99.5	57
911	9.2	52.0	1996	152.0	147.8	0.2	12.5	10.3	5.3	22.1	99.5	57
912	8.5	52.7	1718	152.0	147.9	-1.3	12.9	10.0	5.5	22.1	99.5	57
913	8.6	53.2	1770	152.0	147.9	-1.8	13.0	9.3	7.8	22.1	99.5	57
914	9.3	53.5	2095	152.0	147.8	-1.6	13.1	9.5	6.1	22.1	99.5	57
915	8.9	53.6	1916	152.0	147.8	-1.8	12.9	9.7	4.8	22.1	99.5	57
916	8.6	53.2	1789	152.0	147.8	-1.8	13.0	9.3	4.9	22.1	99.5	57
917	9.6	53.5	2020	152.0	147.8	-1.8	13.1	9.8	5.2	22.1	99.5	57
918	8.8	53.1	1873	152.0	147.8	-1.8	13.0	9.0	6.0	22.1	99.5	57
919			2037	152.0	147.8	-1.6	13.1	9.1	6.3	22.1	99.5	57
920	9.3	53.3	2266	152.0	147.8	0.3	13.2	9.5	6.2	22.1	99.5	57
921	9.4	52.6	2251	152.0	147.8	1.3	13.1	9.6	6.1	22.1	99.5	57
922	9.1	52.6	1989	152.0	147.8	-0.9	12.8	9.2	5.5	22.1	99.5	57
923	9.4	53.5	2149	152.0	147.8	-0.1	13.1	9.6	4.5	22.1	99.5	57
924	10.0	53.4	2252	152.0	147.8	0.8	13.2	10.2	5.1	22.1	99.5	57
925	10.2	53.1	2223	152.0	147.8	0.6	13.0	10.4	4.2	22.1	99.5	57
926	9.3	54.5	2223	152.0	147.9	0.4	13.0	9.5	4.6	22.1	99.5	57
927	11.0	53.2	2280	152.0	147.8	2.6	13.3	11.2	5.6	22.1	99.5	57
928	10.8	53.2	2263	152.0	147.9	3.5	13.3	11.0	7.8	22.1	99.5	57
929	10.4	53.0	2262	152.0	149.9	4.3	13.3	10.6	6.9	22.1	99.5	57
930	10.7	52.7	2240	152.0	150.0	4.8	13.1	10.9	6.5	22.1	99.5	57
931	11.3	53.3	2288	152.0	150.0	6.7	13.4	11.5	6.3	22.1	99.5	57
932	10.1	52.6	2188	152.0	150.0	5.4	12.8	10.3	7.2	22.1	99.5	57
933	9.6	52.0	2140	152.0	150.0	3.0	12.5	9.8	6.8	22.1	99.5	57
934	10.1	52.6	2170	152.0	150.0	1.8	12.8	10.3	5.5	22.1	99.5	57
935	11.1	52.8	2206	152.0	150.0	1.9	12.9	11.3	6.1	22.1	99.5	57
936	10.0	52.8	2200	152.0	150.1	1.3	12.9	10.2	5.7	22.1	99.5	57
937	10.1	52.8	2203	152.0	150.0	0.6	12.9	10.3	5.9	22.1	99.5	57
938	11.2	53.5	2293	152.0	150.0	3.6	13.4	11.4	5.3	22.1	99.5	57
939	10.9	53.1	2290	152.0	150.0	5.4	13.4	11.1	4.6	22.1	99.5	57
940	11.3	53.3	2286	152.0	150.0	7.1	13.4	11.5	6.1	22.1	99.5	57
941	11.3	52.3	2222	152.0	150.0	6.7	13.0	11.6	5.3	22.1	99.5	57
942	10.6	52.7	2157	152.0	150.0	2.4	12.7	10.8	5.4	22.1	99.5	57
943	12.1	53.3	2279	152.0	150.0	5.3	13.4	12.3	6.9	22.1	99.5	57
944	11.8	53.0	2253	152.0	150.0	6.0	13.2	12.0	7.1	22.1	99.5	56
945	12.2	53.2	2260	152.0	148.5	7.0	13.3	12.5	6.5	22.1	99.5	56
946	12.3	52.6	2258	152.0	147.7	7.8	13.2	12.5	6.1	22.1	99.5	56
947	11.7	52.3	2202	152.0	147.7	7.3	12.9	11.9	8.2	22.1	99.5	56
948	11.6	51.6	2127	152.0	147.7	4.6	12.5	11.8	9.7	22.1	99.5	56
949	10.0	51.9	2154	152.0	147.7	3.2	12.6	10.2	8.3	22.1	99.5	56
950	10.7	52.4	2215	152.0	147.7	3.7	13.0	10.9	8.3	22.1	99.5	56
951	10.1	52.9	2220	152.0	147.7	3.6	13.0	10.3	6.6	22.1	99.5	56
952	10.4	52.8	2214	152.0	147.7	3.5	12.9	10.6	6.4	22.1	99.5	56
953	10.2	52.8	2167	152.0	147.7	1.3	12.7	10.4	5.7	22.1	99.5	56
954	10.0	53.0	2210	152.0	147.7	1.5	12.9	10.2	6.1	22.1	99.5	56
955	10.3	53.0	2095	152.0	147.7	-1.0	12.7	10.6	6.9	22.1	99.5	56
956	10.5	53.2	2277	152.0	147.7	1.7	13.3	10.7	7.1	22.1	99.5	56
957	11.3	53.3	2308	152.0	147.7	4.5	13.5	11.5	5.9	22.1	99.5	56
958	11.2	53.3	2276	152.0	147.7	5.5	13.3	11.4	5.2	22.1	99.5	56
959	11.4	52.5	2209	152.0	147.7	4.6	12.9	11.7	5.0	22.1	99.5	56
960	10.7	52.3	2181	152.0	147.7	3.4	12.8	10.9	7.2	22.1	99.5	56
961	9.0	52.6	1944	152.0	147.7	-0.1	12.5	9.5	8.9	22.1	99.5	56
962	8.8	53.6	1889	152.0	147.7	-1.1	13.0	9.1	6.4	22.1	99.5	56
963	9.3	53.8	2257	152.0	147.7	1.9	13.5	9.5	6.3	22.1	99.5	56
964	11.7	53.5	2342	152.0	147.7	6.6	13.7	11.9	7.5	22.1	99.5	56
965	10.3	52.6	2264	152.0	147.7	6.7	13.2	10.5	5.9	22.1	99.5	56
966	11.4	52.7	2271	152.0	147.7	7.6	13.3	11.6	7.9	22.1	99.5	56
967	12.0	52.2	2218	152.0	147.7	7.2	13.0	12.2	7.9	22.1	99.5	56
968	12.2	52.3	2233	152.0	147.7	7.2	13.1	12.5	6.9	22.1	99.5	56

***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 (%)
969	12.0	52.2	2209	152.0	147.7	7.0	12.9	12.3	4.7	22.1	99.5	56
970	10.8	52.0	2178	152.0	147.7	5.8	12.7	11.0	5.3	22.1	99.5	56
971	10.2	52.0	2164	152.0	147.7	4.3	12.7	10.4	7.5	22.1	99.5	56
972	9.5	52.5	2183	152.0	147.7	3.5	12.8	9.7	7.1	22.1	99.5	56
973	11.0	52.8	2275	152.0	147.7	5.4	13.3	11.2	6.5	22.1	99.5	56
974	11.2	52.9	2247	152.0	147.7	5.9	13.1	11.5	5.5	22.1	99.5	56
975	10.9	51.8	2189	152.0	147.7	4.4	12.8	11.1	4.8	22.1	99.5	56
976	9.9	52.1	2121	152.0	147.7	1.9	12.5	10.1	5.7	22.1	99.5	56
977	8.8	52.7	1883	152.0	147.7	-0.2	12.7	9.1	5.8	22.1	99.5	56
978	9.9	53.4	2168	152.0	147.6	0.9	13.1	10.1	5.9	22.1	99.5	56
979	10.0	53.5	2291	152.0	147.7	3.4	13.4	10.2	7.8	22.1	99.5	56
980	10.1	52.4	2114	152.0	147.7	1.4	12.8	10.3	6.9	22.1	99.5	56
981	8.9	52.8	1931	152.0	147.7	-0.3	12.9	10.0	6.6	22.1	99.5	56
982	9.9	53.2	2253	152.0	147.7	1.6	13.1	10.0	5.5	22.1	99.5	56
983	9.7	53.0	2219	152.0	147.7	1.1	13.0	9.9	6.3	22.1	99.5	56
984	10.4	53.7	2275	152.0	147.7	2.8	13.3	10.6	7.0	22.1	99.5	56
985	11.6	53.2	2290	152.0	147.7	4.8	13.4	11.9	7.5	22.1	99.5	56
986	10.6	52.8	2253	152.0	147.7	5.0	13.2	10.8	7.4	22.1	99.5	56
987	10.9	52.1	2217	152.0	147.7	4.6	12.9	11.1	7.0	22.1	99.5	56
988	10.4	51.7	2158	152.0	147.7	2.4	12.6	10.7	8.4	22.1	99.5	56
989	9.9	52.4	2108	152.0	147.7	-0.2	12.6	10.1	7.9	22.1	99.5	56
990	9.9	53.0	2108	152.0	147.7	0.2	13.0	10.1	6.1	22.1	99.5	56
991	10.6	53.4	2266	152.0	147.7	1.9	13.2	10.8	6.0	22.1	99.5	57
992	9.4	52.5	2234	152.0	147.6	1.9	13.0	9.6	5.9	22.1	99.5	57
993	9.8	52.4	2178	152.0	147.7	0.0	12.8	10.0	5.8	22.1	99.5	57
994			2045	152.0	147.7	0.0	12.9	9.4	6.3	22.1	99.5	57
995	9.0	52.5	1968	152.0	147.7	-0.1	13.0	9.4	6.2	22.1	99.5	57
996	8.9	52.9	1929	152.0	147.7	-0.9	13.0	9.7	6.4	22.1	99.5	57
997	10.7	53.3	2247	152.0	147.6	0.7	13.2	11.0	5.9	22.1	99.5	57
998	10.5	53.4	2315	152.0	147.6	3.9	13.5	10.7	6.4	22.1	99.5	57
999	10.2	52.6	2292	152.0	147.6	5.4	13.4	10.4	7.2	22.1	99.5	57
1000	10.4	52.0	2201	152.0	147.7	4.1	12.9	10.6	6.4	22.1	99.5	57
1001	10.5	51.8	2153	152.0	147.7	1.6	12.6	10.7	5.0	22.1	99.5	57
1002	10.2	52.4	2177	152.0	147.7	0.1	12.7	10.4	8.0	22.1	99.5	57
1003	10.5	53.0	2226	152.0	147.7	0.7	13.0	10.7	6.8	22.1	99.5	57
1004	10.2	53.0	2229	152.0	147.7	0.7	13.0	10.4	5.2	22.1	99.5	57
1005	10.4	53.0	2257	152.0	147.7	2.0	13.1	10.6	5.8	22.1	99.5	57
1006	9.7	53.0	2174	152.0	147.7	-0.5	12.7	9.8	5.4	22.1	99.5	57
1007	10.7	53.3	2268	152.0	147.6	1.5	13.2	10.9	6.7	22.1	99.5	57
1008	11.1	53.7	2308	152.0	147.7	4.4	13.5	11.3	7.5	22.1	99.5	57
1009			2220	152.0	147.7	3.9	12.9	10.2	7.5	22.1	99.5	57
1010			2180	152.0	147.7	2.0	12.7	9.6	7.7	22.1	99.5	57
1011			2236	152.0	147.7	2.9	13.1	10.6	7.6	22.1	99.5	57
1012			2243	152.0	147.7	3.4	13.1	10.3	7.5	22.1	99.5	57
1013			2263	152.0	147.7	4.8	13.2	11.6	6.6	22.1	99.5	57
1014	10.4	52.7	2184	152.0	147.7	2.9	12.8	10.6	7.6	22.1	99.5	57
1015	10.6	52.5	2212	152.0	147.7	2.9	12.9	10.8	8.3	22.1	99.5	56
1016	9.8	52.5	2219	152.0	147.7	2.8	13.0	10.0	6.5	22.1	99.5	56
1017	10.3	52.3	2179	152.0	147.7	1.5	12.7	10.5	5.4	22.1	99.5	56
1018	8.2	52.9	1566	152.0	147.7	-1.7	12.6	8.8	5.3	22.1	99.5	56
1019	8.3	53.7	1637	152.0	147.7	-1.2	13.0	8.0	4.4	22.1	99.5	56
1020			2089	152.0	147.7	0.0	13.1	8.5	4.6	22.1	99.5	57
1021	9.4	53.2	2177	152.0	145.9	0.3	13.0	9.5	4.1	22.1	99.5	57
1022												
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Table E.02 Measurement data - Background

Project: Cedar Point Wind Power Project - Turbine CP244 - IEC 61400-11 Measurement

Report ID: 15039.00.CP244.RP4

Created on: 1/25/2018

***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	9.6	40.3	0.4	6.5	22	99.2	59
2	11.6	40.6	0.4	7.9	22	99.2	58
3	9.3	40.3	0.4	6.3	22	99.1	58
4	8.0	39.2	0.4	5.4	22	99.2	58
5	9.0	39.6	0.5	6.1	22	99.2	58
6	7.8	38.7	0.5	5.3	22	99.2	58
7	6.6	37.9	0.4	4.5	22	99.2	58
8	7.4	38.2	0.4	5.1	22	99.3	58
9	11.2	39.3	0.4	7.6	22	99.3	59
10	8.4	40.4	0.3	5.7	22	99.4	59
11	7.1	40.0	0.3	4.8	22	99.4	59
12	7.8	40.0	0.3	5.3	22	99.5	59
13	7.6	37.7	0.3	5.1	22	99.5	59
14	7.7	38.9	0.3	5.2	22	99.5	59
15	9.0	38.4	0.3	6.1	22	99.5	58
16	10.2	38.8	0.4	6.9	22	99.5	58
17	11.8	38.0	0.5	8.0	22	99.5	58
18	10.1	38.7	0.4	6.9	22	99.5	58
19	9.8	37.2	0.4	6.6	22	99.5	58
20	10.5	38.2	0.4	7.1	22	99.5	58
21	10.6	38.6	0.4	7.2	22	99.5	58
22	8.1	37.8	0.3	5.5	22	99.5	58
23	8.1	37.2	0.5	5.5	22	99.5	58
24	11.0	38.6	0.4	7.5	22	99.5	58
25	12.6	39.5	0.4	8.5	22	99.5	58
26	11.9	40.3	0.5	8.1	22	99.5	58
27	10.9	41.1	0.5	7.4	22	99.4	57
28	11.4	41.4	0.5	7.8	22	99.4	57
29	12.4	40.9	0.5	8.4	22	99.3	57
30	12.7	39.6	0.6	8.6	22	99.1	57
31	12.7	38.4	0.6	8.6	22	99.0	57
32	9.6	38.9	0.6	6.6	22	99.1	57
33	11.5	39.7	3.3	7.8	22	99.4	56
34	12.1	39.3	1.0	8.2	22	99.4	56
35	10.1	38.2	0.5	6.9	22	99.4	56
36	8.1	38.3	0.5	5.5	22	99.5	56
37	8.8	37.7	0.5	6.0	22	99.5	56
38	9.7	37.9	0.5	6.6	22	99.5	56
39	9.0	39.1	0.5	6.1	22	99.5	56
40	7.1	39.4	0.3	4.8	22	99.5	56
41	7.3	39.2	0.5	4.9	22	99.5	56
42	6.1	40.7	0.4	4.1	22	99.5	56
43	7.3	40.2	0.3	5.0	22	99.5	56
44	7.3	39.4	0.4	4.9	22	99.5	56
45	7.6	40.6	0.4	5.2	23	99.5	56
46	7.5	39.1	0.4	5.1	23	99.5	57
47	8.4	39.1	0.3	5.7	23	99.5	57
48	8.3	39.6	0.3	5.6	23	99.5	57
49	7.5	39.9	0.3	5.1	23	99.5	57
50	7.7	38.9	0.3	5.2	23	99.5	57
51	7.1	38.3	0.4	4.8	23	99.6	57
52	6.6	37.9	0.3	4.5	23	99.6	57
53	7.4	37.6	0.2	5.1	23	99.6	57
54	6.4	38.5	0.2	4.4	23	99.7	57
55	7.0	38.1	0.2	4.7	23	99.7	57
56	5.8	38.0	0.2	3.9	23	99.7	57
57	6.6	37.0	0.3	4.5	23	99.7	57
58	6.4	36.2	0.2	4.4	23	99.7	57
59	7.7	37.4	0.3	5.2	23	99.7	57
60	7.5	36.7	0.4	5.1	23	99.7	57
61	5.7	37.8	0.2	3.9	23	99.7	57
62	5.7	37.6	0.2	3.9	23	99.7	57
63	6.7	38.5	0.3	4.6	23	99.7	57
64	8.4	38.5	0.3	5.7	23	99.7	57
65	8.3	37.2	0.3	5.7	23	99.7	57
66	8.3	37.1	0.4	5.7	23	99.7	57
67	8.4	37.3	0.4	5.7	23	99.7	57
68	7.1	37.4	0.4	4.8	23	99.7	57
69	7.7	38.7	0.4	5.3	23	99.7	57
70	7.3	38.8	0.4	5.0	23	99.7	57
71			0.4	4.6	23	99.7	57
72			0.1	5.7	23	99.7	57
73	10.7	35.9	0.2	7.3	23	99.7	57
74	11.2	35.7	0.3	7.6	23	99.7	57
75	10.7	35.7	0.3	7.3	23	99.7	56
76	11.1	37.9	0.3	7.6	23	99.7	56
77	9.9	37.7	0.3	6.8	23	99.7	56
78	8.4	36.4	0.3	5.7	23	99.7	56
79	6.8	36.3	0.2	4.6	23	99.7	56
80	7.0	36.1	0.2	4.8	23	99.7	56
81	8.9	35.3	0.2	6.0	23	99.7	57
82	7.4	36.3	0.2	5.1	23	99.7	57
83	6.7	37.1	0.2	4.6	23	99.7	57

***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	8.5	36.8	0.2	5.8	23	99.7	57
85	8.3	37.8	0.2	5.6	23	99.7	57
86	9.5	37.2	0.5	6.5	23	99.7	57
87	11.8	37.3	0.3	8.0	23	99.6	56
88	11.8	35.9	0.4	8.1	23	99.6	56
89	10.0	35.8	0.3	6.8	23	99.6	56
90	9.2	37.2	0.1	6.3	23	99.6	56
91	7.8	38.3	0.2	5.3	23	99.6	56
92	9.0	38.5	0.2	6.1	23	99.6	56
93	9.2	39.5	0.3	6.3	23	99.6	55
94	10.5	36.5	0.2	7.2	23	99.6	55
95	10.0	37.9	0.4	6.8	23	99.6	55
96	10.6	36.0	0.5	7.2	23	99.6	55
97	9.8	35.8	0.5	6.7	23	99.6	55
98	9.1	36.7	0.4	6.2	23	99.6	55
99	11.1	37.1	0.5	7.5	23	99.5	55
100	10.8	39.0	0.8	7.3	23	99.5	55
101	9.4	37.7	0.7	6.4	23	99.5	55
102	11.0	37.5	0.8	7.5	23	99.5	55
103	12.6	38.1	0.6	8.6	23	99.6	55
104	11.7	37.3	0.6	8.0	23	99.6	55
105	10.7	37.0	0.5	7.3	23	99.6	55
106	11.2	36.7	0.4	7.6	23	99.6	55
107	9.4	36.0	0.5	6.4	23	99.6	55
108	7.8	36.1	0.4	5.3	23	99.6	55
109	6.5	36.4	0.4	4.4	23	99.6	55
110	6.0	36.9	0.3	4.1	23	99.6	55
111	5.6	37.7	0.4	3.8	23	99.6	56
112	6.4	37.6	0.5	4.4	23	99.6	57
113	7.4	37.0	0.3	5.0	23	99.6	57
114	8.2	37.2	0.2	5.6	23	99.6	57
115	11.4	37.8	0.3	7.8	23	99.6	57
116	12.6	38.6	0.4	8.6	23	99.7	57
117	8.9	37.3	0.5	6.1	23	99.7	56
118	6.9	36.2	0.2	4.7	23	99.7	55
119	5.6	38.5	0.3	3.8	23	99.7	55
120	8.5	39.2	0.4	5.8	23	99.7	55
121	7.7	38.4	0.5	5.3	23	99.7	55
122	9.3	39.9	0.4	6.3	23	99.7	55
123	9.3	36.9	0.4	6.3	23	99.7	55
124	8.8	41.7	0.3	6.0	23	99.7	55
125	9.2	36.3	0.5	6.2	23	99.7	55
126	9.5	37.1	0.6	6.5	23	99.7	55
127	8.4	38.7	0.4	5.7	23	99.7	55
128	9.7	36.9	0.5	6.6	23	99.7	55
129	9.2	36.4	0.5	6.3	23	99.7	55
130	9.4	37.4	0.4	6.4	23	99.7	55
131	7.4	37.5	0.4	5.0	23	99.7	55
132	9.0	37.7	0.4	6.1	23	99.7	55
133	11.4	39.0	0.4	7.7	23	99.7	55
134	12.0	37.7	0.4	8.1	23	99.7	55
135			0.3	7.0	23	99.7	55
136			0.3	6.2	23	99.6	55
137	8.1	37.3	0.3	5.5	23	99.6	55
138	8.1	37.8	0.4	5.5	23	99.6	55
139	11.1	38.0	0.4	7.6	23	99.6	55
140	10.1	38.6	0.5	6.8	23	99.6	55
141	10.5	38.3	0.4	7.1	23	99.6	55
142	10.1	38.1	0.4	6.8	23	99.6	55
143	11.4	37.2	0.5	7.7	23	99.6	55
144	9.6	36.4	0.5	6.5	23	99.6	55
145	11.5	36.8	0.5	7.8	23	99.6	55
146	9.6	36.8	0.3	6.5	23	99.6	55
147	11.5	37.3	0.4	7.8	23	99.6	56
148	9.9	37.0	0.4	6.7	23	99.6	56
149	10.0	36.0	0.5	6.8	23	99.6	56
150	8.5	35.7	0.4	5.8	23	99.6	56
151	8.0	36.3	0.4	5.5	23	99.6	56
152	11.6	36.3	0.5	7.9	23	99.6	56
153	9.4	36.3	0.4	6.4	23	99.6	56
154	9.5	35.8	0.3	6.5	23	99.6	56
155	11.3	36.3	0.3	7.7	23	99.6	56
156	12.0	36.8	0.3	8.2	23	98.4	56
157	12.4	37.9	0.3	8.4	23	98.5	56
158	11.2	38.9	0.4	7.6	23	98.4	56
159	11.2	39.7	0.3	7.6	23	98.4	56
160	11.0	38.4	0.3	7.5	23	98.4	56
161	12.6	38.4	0.3	8.6	23	98.4	56
162	11.7	37.7	0.4	8.0	23	98.4	56
163	9.1	38.2	0.4	6.2	23	98.4	56
164	8.4	38.4	0.4	5.7	23	98.3	56
165	11.5	38.7	0.5	7.8	23	98.3	56
166	12.5	38.0	0.4	8.5	23	98.3	56

***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	12.0	40.2	0.3	8.2	23	98.3	56
168	12.4	38.1	0.2	8.5	23	98.2	56
169	11.1	39.6	0.3	7.5	23	98.2	56
170	9.4	37.5	0.3	6.4	23	98.2	56
171	9.3	36.9	0.3	6.3	23	98.2	56
172	11.4	36.0	0.3	7.7	23	98.1	57
173	10.1	36.0	0.3	6.9	23	98.1	57
174	12.0	37.2	0.3	8.2	23	98.1	57
175	12.3	42.6	0.3	8.4	23	98.2	57
176	9.8	39.3	0.3	6.6	23	98.2	57
177	10.5	37.8	0.3	7.2	23	98.1	56
178	9.9	37.4	0.3	6.7	23	98.2	56
179			0.3	5.8	23	98.1	56
180			0.4	7.1	23	98.1	56
181	10.6	36.3	0.4	7.2	23	98.0	56
182	10.7	36.7	0.4	7.3	23	98.0	56
183	11.5	37.2	0.4	7.8	23	97.9	56
184	10.6	37.6	0.5	7.2	23	97.8	55
185	9.4	37.0	0.6	6.4	23	98.0	55
186	9.4	37.4	0.5	6.4	23	98.0	55
187	9.5	38.4	0.5	6.4	23	98.0	55
188	9.7	38.2	0.5	6.6	23	98.2	55
189	11.5	37.2	0.3	7.8	23	98.1	55
190	10.8	37.7	0.4	7.3	23	98.1	55
191	12.2	38.8	0.5	8.3	23	98.0	55
192	9.5	37.6	0.5	6.5	23	97.9	55
193	8.4	37.1	0.4	5.7	23	98.1	55
194	8.6	36.4	0.4	5.9	23	98.1	55
195	7.9	37.5	0.4	5.4	23	98.2	55
196	8.4	37.8	0.5	5.7	23	98.2	55
197	9.0	38.4	0.5	6.1	23	98.2	55
198	8.6	39.1	0.5	5.9	23	98.2	55
199	9.7	37.5	0.3	6.6	23	98.1	55
200	6.7	36.5	0.4	4.6	23	98.1	55
201	6.9	37.2	0.5	4.7	23	98.3	54
202	10.3	38.0	0.4	7.0	23	98.1	54
203	10.0	36.9	0.2	6.8	23	98.1	54
204	9.6	36.4	0.2	6.5	23	98.0	54
205	9.6	36.2	0.4	6.5	23	98.1	54
206	8.1	35.8	0.4	5.5	23	98.0	54
207	9.2	35.7	0.5	6.3	23	98.1	55
208	6.8	36.7	0.4	4.6	23	98.2	55
209	9.1	36.6	0.3	6.2	23	98.3	55
210	8.9	37.4	0.2	6.0	23	98.3	55
211	6.8	37.4	0.1	4.6	23	98.3	55
212	5.9	38.3	0.2	4.0	23	98.3	55
213	7.6	37.3	0.3	5.2	23	98.3	56
214	7.1	36.6	0.4	4.8	23	98.2	56
215	6.5	37.7	0.4	4.4	23	98.0	56
216	7.5	36.2	0.4	5.1	23	97.9	56
217	6.3	36.2	0.4	4.3	23	97.8	56
218	8.3	36.6	0.2	5.6	23	97.7	56
219	8.7	36.2	0.3	5.9	23	97.7	56
220	6.7	36.1	0.4	4.6	23	97.6	55
221			0.4	4.6	23	97.6	55
222			0.3	3.9	23	97.5	55
223	6.6	36.2	0.1	4.5	23	97.4	55
224	12.5	40.9	0.4	8.5	23	99.6	53
225	10.4	39.7	0.3	7.1	23	99.6	53
226	11.4	39.8	0.4	7.7	23	99.6	53
227	11.5	38.6	0.4	7.8	23	99.6	53
228	10.4	41.0	0.4	7.0	23	99.6	53
229	10.5	40.7	0.4	7.1	23	99.6	53
230	9.6	40.7	0.4	6.5	23	99.6	53
231	9.0	39.8	0.4	6.1	23	99.6	53
232	8.6	39.7	0.3	5.9	23	99.6	53
233	10.4	39.5	0.2	7.1	23	99.6	53
234	7.8	39.7	0.3	5.3	23	99.6	54
235	7.8	40.1	0.3	5.3	23	99.6	54
236	9.3	39.9	0.2	6.3	23	99.6	54
237	7.9	40.1	0.2	5.4	23	99.6	54
238	8.5	39.3	0.3	5.8	23	99.6	54
239	6.9	39.2	0.5	4.7	23	99.6	54
240	6.8	39.3	0.6	4.7	23	99.6	55
241	9.6	39.4	0.5	6.5	23	99.6	55
242	10.7	38.4	0.5	7.3	23	99.6	55
243	9.6	37.3	0.3	6.5	23	99.6	55
244	11.2	37.1	0.3	7.6	23	99.6	55
245	12.6	36.8	0.3	8.6	23	99.6	55
246	12.6	36.7	0.1	8.5	24	99.6	54
247	12.4	37.2	0.2	8.4	24	99.6	53
248	9.9	37.6	0.3	6.7	24	99.6	53
249	9.2	37.1	0.4	6.2	24	99.6	53

Table E.02 Measurement data - Background

Project: Cedar Point Wind Power Project - Turbine CP244 - IEC 61400-11 Measurement

Report ID: 15039.00.CP244.RP4

Created on: 1/25/2018

***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	6.4	40.1	0.6	4.4	24	99.6	53
251	8.2	37.5	0.6	5.6	24	99.6	53
252	10.3	37.6	0.6	7.0	24	99.6	53
253	9.8	37.9	0.5	6.6	24	99.6	53
254	8.9	38.4	0.5	6.1	24	99.6	53
255	8.5	38.5	0.5	5.8	24	99.6	53
256	9.0	36.9	0.6	6.1	24	99.6	53
257	8.3	37.1	0.6	5.7	24	99.6	53
258	9.2	38.5	0.5	6.3	24	99.6	53
259	6.9	37.3	0.4	4.7	24	99.6	53
260	6.1	37.5	0.4	4.2	24	99.6	53
261	8.5	36.6	0.4	5.8	24	99.6	53
262	10.4	36.8	0.3	7.1	24	99.6	53
263	10.1	38.4	0.4	6.8	24	99.6	53
264	8.0	39.5	0.1	5.4	24	99.6	53
265	9.3	37.6	0.3	6.3	24	99.6	53
266	7.2	36.9	0.6	4.9	24	99.6	53
267	7.3	38.8	0.5	5.0	24	99.6	53
268	7.6	39.5	0.5	5.2	24	99.6	53
269	8.2	39.7	0.6	5.6	24	99.6	53
270	8.7	39.3	0.6	5.9	24	99.6	53
271	7.5	37.6	0.4	5.1	24	99.6	53
272	8.3	37.3	0.4	5.6	24	99.6	53
273	7.9	37.4	0.3	5.4	24	99.6	53
274	10.0	37.8	0.4	6.8	24	99.6	53
275	8.9	37.1	0.4	6.0	24	99.6	53
276	13.7	37.8	0.4	9.3	24	99.6	53
277	15.2	39.7	0.5	10.4	24	99.6	53
278			0.5	9.6	24	99.6	53
279			0.6	9.1	24	99.6	53
280			0.5	9.1	24	99.6	53
281			0.4	8.4	24	99.6	53
282			0.3	7.9	24	99.6	53
283			0.2	7.6	24	99.6	52
284			0.3	7.3	24	99.6	52
285			0.5	6.8	24	99.6	52
286			0.6	6.6	24	99.6	52
287			0.5	8.3	24	99.6	52
288			0.5	7.9	24	99.6	53
289	10.6	40.1	0.5	7.2	23	99.6	53
290	13.0	39.2	0.5	8.8	23	99.6	53
291	13.6	39.4	0.4	9.3	23	99.6	53
292	11.5	37.8	0.4	7.8	23	99.6	53
293	9.8	40.4	0.4	6.6	23	99.6	53
294	11.6	39.8	0.5	7.9	24	99.5	53
295	10.8	37.9	0.5	7.3	23	99.5	53
296	11.5	38.1	0.4	7.8	23	99.5	53
297	14.5	38.6	0.4	9.9	23	99.5	53
298	13.3	38.6	0.4	9.1	23	99.5	53
299			0.4	9.3	23	99.5	53
300	10.3	39.2	0.4	7.0	23	99.5	53
301	10.6	40.0	0.3	7.2	23	99.5	53
302	12.5	39.6	0.4	8.5	23	99.6	53
303	11.6	40.0	0.3	7.9	23	99.6	53
304	9.3	38.7	0.3	6.3	23	99.6	53
305	11.1	39.1	0.2	7.5	23	99.6	53
306	12.4	39.7	0.2	8.4	23	99.6	53
307	12.5	39.8	0.3	8.5	23	99.6	53
308	9.5	39.7	0.3	6.5	23	99.6	53
309	8.9	40.1	0.2	6.0	23	99.6	53
310	8.6	39.6	0.4	5.8	23	99.6	53
311			0.5	5.9	23	99.6	53
312			0.5	6.0	23	99.6	53
313	10.2	39.5	0.5	6.9	23	99.6	53
314	11.5	41.5	0.6	7.8	23	99.6	53
315	11.1	39.2	0.6	7.6	23	99.6	53
316	9.7	38.6	0.6	6.6	23	99.6	53
317	9.0	39.3	0.5	6.1	23	99.6	53
318	8.0	38.0	0.6	5.5	23	99.6	53
319	8.7	38.4	0.6	5.9	23	99.6	53
320	10.5	38.5	0.5	7.2	23	99.6	53
321	10.6	38.6	0.4	7.2	23	99.6	53
322	10.2	38.0	0.5	6.9	23	99.6	53
323	8.3	39.5	0.3	5.6	23	99.6	53
324	9.2	38.9	0.2	6.3	23	99.6	54
325	9.5	39.8	0.3	6.5	23	99.6	54
326	9.0	39.7	0.3	6.1	23	99.6	54
327	8.4	38.5	0.4	5.7	23	99.6	54
328	8.3	38.2	0.4	5.6	23	99.6	54
329	7.0	38.7	0.3	4.8	23	99.6	54
330	7.4	38.0	0.4	5.0	23	99.6	54
331	7.3	38.1	0.4	4.9	23	99.6	54
332	10.9	38.8	0.2	7.4	23	99.6	54

***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	10.5	38.6	0.2	7.1	23	99.6	54
334	9.5	39.9	0.2	6.5	23	99.6	54
335	10.7	38.5	0.3	7.3	23	99.6	54
336	11.2	39.5	0.3	7.6	24	99.6	53
337	10.5	38.9	0.4	7.1	24	99.6	53
338	12.1	38.0	0.3	8.2	24	99.6	53
339	10.9	37.5	0.3	7.4	24	99.6	53
340	11.9	36.6	0.3	8.1	24	99.6	53
341	10.3	40.4	0.3	7.0	24	99.6	53
342	11.7	38.2	0.3	8.0	24	99.6	53
343	14.5	37.7	0.4	9.9	24	99.6	53
344	11.6	37.2	0.4	7.9	24	99.6	53
345	11.0	36.9	0.3	7.5	24	99.6	53
346	12.0	38.1	0.2	8.2	24	99.6	53
347	12.0	38.4	0.3	8.2	24	99.6	53
348	9.8	39.8	0.4	6.7	24	99.6	53
349	11.3	39.9	0.5	7.7	24	99.6	53
350	13.0	40.8	0.4	8.9	24	99.6	53
351	12.1	38.5	0.4	8.2	24	99.6	53
352	10.9	36.9	0.4	7.4	24	99.6	53
353	12.6	37.7	0.5	8.6	24	99.6	53
354	12.7	38.3	0.5	8.6	23	99.6	54
355	10.0	38.6	0.4	6.8	23	99.6	54
356	10.2	37.7	0.6	6.9	23	99.6	54
357	9.6	38.0	0.5	6.5	23	99.6	54
358	10.2	37.7	0.4	6.9	23	99.5	54
359	8.6	37.8	0.4	5.8	23	99.5	54
360	6.5	37.6	0.5	4.4	23	99.5	54
361	7.7	38.4	0.5	5.2	23	99.4	54
362	7.1	37.7	0.4	4.8	23	99.0	54
363	6.1	36.2	0.4	4.1	23	99.0	54
364	7.8	37.4	0.5	5.3	23	99.0	54
365	7.3	37.6	0.4	4.9	23	99.0	54
366	7.6	36.9	0.5	5.1	23	98.9	54
367	6.6	37.1	0.4	4.5	23	98.9	54
368	6.2	36.7	0.4	4.2	23	99.0	54
369	7.6	36.1	0.3	5.2	23	99.0	54
370	6.3	36.0	0.3	4.3	23	98.9	54
371	6.3	37.9	0.3	4.3	23	98.9	54
372	6.2	38.2	0.3	4.2	23	98.9	55
373	5.4	35.9	0.5	3.7	23	98.9	55
374	6.5	35.9	0.4	4.4	23	98.9	55
375	10.0	36.8	0.4	6.8	23	99.0	55
376	12.1	36.2	0.5	8.2	23	99.0	55
377	11.9	36.7	0.5	8.1	23	99.0	55
378	9.4	39.1	0.5	6.4	23	99.0	53
379	10.5	42.3	0.7	7.2	23	99.0	53
380	13.2	40.7	0.7	9.0	23	99.0	53
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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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Appendi xF
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

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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	2	m/s
Max allowable range	9	m/s
Power Output	2221	kW
85% Power	1887.85	kW
Corresponding wind speed	8.84	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**	-44.42
1	0	-44.42
2	0	21.58
3	66	60.58
4	171	134.58
5	350	225.58
6	620	332.58
7	997	441.58
8	1483	435.58
9	1963	167.58
10	2175	-2.42
11	2217	-40.42
12	2221	-44.42
13	2221	-44.42
14	2221	-44.42
15	2221	-44.42
16	2221	-44.42
17	2221	-44.42
18	2221	-44.42
19	2221	-44.42
20	2221	-44.42
21	2221	-44.42
22	2221	-44.42
23	2221	-44.42
24	2221	-44.42
25	2221	

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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.CP244.R4)

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} = 0.9808

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 $V_{p,n}$ (m/s)	Nacelle Anemometer Wind Speed, $V_{nac,m}$ (m/s)	$V_{P,n}/V_{nac,m}$
1		2087	9.58	0	9.52	9.71	
2		1860	8.79	1	8.79	9.51	0.92
3		1906	8.88	1	8.88	9.61	0.92
4		1922	8.91	1	8.91	9.29	0.96
5		1825	8.71	1	8.71	9.42	0.93
6		1575	8.19	1	8.19	7.22	1.13
7		1354	7.73	1	7.73	6.80	1.14
8		1674	8.40	1	8.40	8.23	1.02
9		1839	8.74	1	8.74	8.68	1.01
10		2035	9.34	0		8.86	
11		2128	9.78	0		9.37	
12		2039	9.36	0		8.95	
13		1977	9.06	1	9.06	9.35	0.97
14		1831	8.72	1	8.72	8.39	1.04
15		1752	8.56	1	8.56	8.05	1.06
16		1602	8.25	1	8.25	8.22	1.00
17		1565	8.17	1	8.17	7.59	1.08
18		1422	7.87	1	7.87	7.90	1.00
19		1428	7.89	1	7.89	7.67	1.03
20		1584	8.21	1	8.21	8.92	0.92
21		1513	8.06	1	8.06	7.57	1.07
22		1276	7.57	1	7.57	8.24	0.92
23		1284	7.59	1	7.59	7.21	1.05
24		1580	8.20	1	8.20	7.76	1.06
25		1879	8.83	1	8.83	9.49	0.93
26		1739	8.53	1	8.53	8.49	1.00
27		1824	8.71	1	8.71	10.12	0.86
28		2138	9.83	0	9.46	9.64	
29		2197	10.52	0	10.14	10.34	
30		2076	9.53	0	9.39	9.57	
31		1980	9.08	1	9.08	8.80	1.03
32		1807	8.68	1	8.68	9.24	0.94
33		1391	7.81	1	7.81	7.56	1.03
34		1540	8.12	1	8.12	7.76	1.05
35		2164	9.95	0	10.06	10.26	
36		2154	9.90	0	9.29	9.47	
37		2024	9.29	0		8.60	
38		1967	9.02	1	9.02	9.00	1.00
39		1806	8.67	1	8.67	7.98	1.09
40		1786	8.63	1	8.63	8.69	0.99
41		1706	8.47	1	8.47	8.56	0.99
42		1646	8.34	1	8.34	9.40	0.89
43		1978	9.07	1	9.07	10.25	0.89
44		1738	8.53	1	8.53	8.49	1.01
45		1430	7.89	1	7.89	6.51	1.21
46		1835	8.73	1	8.73	9.16	0.95
47	1	136	3.67	1		6.47	
48	1	0	2.00	1		4.38	
49	1	0	2.00	1		6.26	
50	1	0	2.00	1		8.59	
51	1	0	2.00	1		8.56	
52	1	0	2.00	1		9.55	
53		1466	7.97	1	7.97	8.92	0.89
54		1763	8.58	1	8.58	8.48	1.01
55		1329	7.68	1	7.68	6.54	1.17
56		1202	7.42	1	7.42	6.32	1.17
57		1372	7.77	1	7.77	8.84	0.88
58		1638	8.32	1	8.32	7.81	1.07
59		1566	8.17	1	8.17	8.29	0.99
60		1421	7.87	1	7.87	8.42	0.93
61		1382	7.79	1	7.79	8.09	0.96
62		1346	7.72	1	7.72	8.34	0.93
63		1524	8.09	1	8.09	8.71	0.93
64		1601	8.25	1	8.25	7.09	1.16
65		1300	7.62	1	7.62	6.72	1.13
66		1040	7.09	1	7.09	6.47	1.10
67		931	6.82	1	6.82	8.02	0.85
68		994	6.99	1	6.99	7.38	0.95
69		1072	7.15	1	7.15	7.38	0.97
70		1175	7.37	1	7.37	8.20	0.90
71		1187	7.39	1	7.39	8.00	0.92
72		1201	7.42	1	7.42	7.98	0.93
73		1176	7.37	1	7.37	7.78	0.95
74		1231	7.48	1	7.48	8.56	0.87
75		1366	7.76	1	7.76	8.70	0.89
76		1384	7.80	1	7.80	8.55	0.91
77		1502	8.04	1	8.04	8.31	0.97
78		1618	8.28	1	8.28	8.43	0.98
79		1594	8.23	1	8.23	9.31	0.88
80		1374	7.78	1	7.78	8.72	0.89
81		1162	7.34	1	7.34	6.78	1.08
82		1111	7.23	1	7.23	7.28	0.99
83		1215	7.45	1	7.45	7.97	0.93
84		2024	9.29	0	9.55	9.73	
85		2152	9.89	0		9.32	
86		2063	9.47	0		9.28	
87		2168	9.97	0		9.08	
88		2215	10.96	0		9.28	
89		2135	9.81	0	9.73	9.92	
90		2112	9.70	0	9.40	9.58	
91		2233		0	9.54	9.73	
92		2254		0	9.35	9.53	
93		2196	10.50	0		9.34	
94		2147	9.87	0	10.38	10.58	
95		2026	9.30	0		9.39	
96		2063	9.47	0		8.98	
97		1956	8.98	1	8.98	8.93	1.01
98		1939	8.95	1	8.95	9.05	0.99
99		1868	8.80	1	8.80	7.90	1.11
100		1520	8.08	1	8.08	7.81	1.03
101		1504	8.04	1	8.04	7.95	1.01
102		1671	8.39	1	8.39	8.49	0.99
103		1501	8.04	1	8.04	7.78	1.03
104		1571	8.18	1	8.18	8.14	1.01
105		1732	8.52	1	8.52	9.51	0.90
106		1397	7.82	1	7.82	8.38	0.93
107		1219	7.46	1	7.46	7.24	1.03
108		1079	7.17	1	7.17	6.98	1.03
109		931	6.83	1	6.83	6.71	1.02
110		852	6.62	1	6.62	5.62	1.18
111		846	6.60	1	6.60	7.18	0.92
112		1009	7.02	1	7.02	8.27	0.85
113		1133	7.28	1	7.28	7.74	0.94
114		1028	7.06	1	7.06	7.34	0.96
115		839	6.58	1	6.58	6.81	0.97
116		719	6.26	1	6.26	6.28	1.00
117		678	6.15	1	6.15	5.87	1.05
118		622	6.00	1	6.00	5.50	1.09
119		603	5.94	1	5.94	6.58	0.90
120		611	5.97	1	5.97	7.58	0.79
121		637	6.05	1	6.05	5.64	1.07
122		921	6.80	1	6.80	7.64	0.89
123		1441	7.91	1	7.91	7.91	1.00
124		1467	7.97	1	7.97	8.15	0.98
125		1373	7.77	1	7.77	7.51	1.03
126		1550	8.14	1	8.14	7.91	1.03
127		1332	7.69	1	7.69	8.64	0.89
128		1218	7.45	1	7.45	7.56	0.99
129		1068	7.15	1	7.15	6.84	1.04
130	1	1395	7.82	1		8.26	
131	1	2267		0		10.18	
132		2255		0	10.55	10.76	
133		2137	9.82	0	9.38	9.56	
134		2087	9.59	0	9.36	9.55	
135		1934	8.94	1	8.94	9.50	0.94
136		1984	9.10	1	9.10	9.50	0.96
137		1996	9.16	1	9.16	9.51	0.96
138		2093	9.61	0		9.21	
139		2228		0		9.32	
140		2257		0	9.61	9.80	
141		2144	9.85	0	9.83	10.03	
142		2064	9.48	0	10.03	10.22	
143		1825	8.71	1	8.71	10.04	0.87
144		1680	8.41	1	8.41	9.39	0.90
145		2212	10.88	0	9.30	9.48	
146		2175	10.00	0		9.41	
147		2147	9.87	0		9.29	
148		2253		0	10.85	11.06	
149		2252		0	10.19	10.38	
150		2214	10.92	0	9.88	10.07	
151		1882	8.83	1	8.83	9.01	0.98
152		1398	7.83	1	7.83	7.03	1.11
153		1733	8.52	1	8.52	8.04	1.06
154		1926	8.92	1	8.92	8.49	1.05
155		1873	8.81	1	8.81	7.81	1.13
156		1991	9.13	1	9.13	8.28	1.10
157		1889	8.85	1	8.85	8.89	1.00
158		1979	9.08	1	9.08	9.22	0.99
159		2215	10.95	0	9.74	9.93	
160		2181	10.15	0	9.93	10.13	
161		2004	9.19	1	9.19	9.78	0.94
162		1989	9.12	1	9.12	9.70	0.94
163		1942	8.96	1	8.96	9.43	0.95
164		1763	8.58	1	8.58	9.96	0.86
165		1781	8.62	1	8.62	8.40	1.03
166		1572	8.19	1	8.19	9.11	0.90
167		1417	7.86	1	7.86	9.36	0.84
168		1485	8.00	1	8.00	8.01	1.00
169		1498	8.03	1	8.03	8.05	1.00
170		1523	8.08	1	8.08	7.19	1.12
171		1316	7.66	1	7.66	7.93	0.97
172		1226	7.47	1	7.47	7.05	1.06
173		1146	7.31	1	7.31	6.55	1.12
174		1046	7.10	1	7.10	6.48	1.10
175		1176	7.37	1	7.37	8.43	0.87
176		1711	8.47	1	8.47	8.03	1.06
177		2136	9.82	0	10.06	10.26	
178		2198	10.56	0	10.03	10.22	
179		2145	9.86	0	9.96	10.16	
180		2113	9.71	0	9.50	9.69	
181		1874	8.81	1	8.81	8.62	1.02
182		1641	8.33	1	8.33	9.18	0.91
183		1395	7.82	1	7.82	8.22	0.95
184		1300	7.62	1	7.62	7.52	1.01
185		1772	8.60	1	8.60	7.83	1.10
186		1308	7.64	1	7.64	7.35	1.04
187		1062	7.13	1	7.13	6.77	1.05
188		1006	7.02	1	7.02	6.60	1.06
189		904	6.75	1	6.75	6.45	1.05
190		704	6.22	1	6.22	5.44	1.14
191		598	5.92	1	5.92	6.46	0.92
192		520	5.63	1	5.63	5.65	1.00
193		492	5.53	1	5.53	5.77	0.96
194		623	6.01	1	6.01	7.25	0.83
195		719	6.26	1	6.26	5.93	1.06
196		677	6.15	1	6.15	6.00	1.02
197		828	6.55	1	6.55	6.51	1.01
198		782	6.43	1	6.43	6.55	0.98
199		709	6.24	1	6.24	7.14	0.87
200		1019	7.05	1	7.05	7.92	0.89
201		1523	8.08	1	8.08	7.60	1.06
202		1772	8.60	1	8.60	8.10	1.06
203		2010	9.22	1	9.22	8.77	1.05
204		1905	8.88	1	8.88	9.86	0.90
205		1712	8.48	1	8.48	8.61	0.98
206		1780	8.62	1	8.62	8.40	1.03
207		1758	8.57	1	8.57	8.05	1.07
208		1450	7.93	1	7.93	7.60	1.04
209		1412	7.85	1	7.85	7.25	1.08
210		1445	7.92	1	7.92	7.17	1.11
211		1483	8.00	1	8.00	7.94	1.01
212		1299	7.62	1	7.62	7.58	1.01
213		1430	7.89	1	7.89	8.19	0.96
214		1426	7.88	1	7.88	8.22	0.96
215		1776	8.61	1	8.61	7.86	1.10
216		1681	8.41	1	8.41	8.59	0.98
217		1675	8.40	1	8.40	9.16	0.92
218		1999	9.17	1	9.17	10.65	0.86
219		2158	9.92	0	10.62	10.83	
220		1576	8.19	1	8.19	10.47	0.78
221		1946	8.96	1	8.96	9.70	0.92
222		2030	9.32	0		8.00	
223		1910	8.89	1	8.89	8.74	1.02
224		1566	8.17	1	8.17	8.49	0.96
225		1746	8.55	1	8.55	9.37	0.91
226		1392	7.81	1	7.81	8.27	0.94
227		1238	7.50	1	7.50	8.10	0.93
228		1045	7.10	1	7.10	6.18	1.15
229		781	6.43	1	6.43	5.55	1.16
230		617	5.99	1	5.99	6.37	0.94
231		686	6.18	1	6.18	6.52	0.95
232		1070	7.15	1	7.15	7.50	0.95
233		1557	8.15	1	8.15	8.22	0.99
234		1380	7.79	1	7.79	6.49	1.20
235		1251	7.52	1	7.52	6.71	1.12
236		1148	7.31	1	7.31	6.70	1.09
237		1144	7.30	1	7.30	6.78	1.08
238		1465	7.96	1	7.96	9.09	0.88
239		1869	8.80	1	8.80	8.69	1.01
240		1742	8.54	1	8.54	8.50	1.00
241		1326	7.68	1	7.68	7.48	1.03
242		1163	7.34	1	7.34	6.64	1.10
243		1360	7.75	1	7.75	7.46	1.04
244		1545	8.13	1	8.13	8.88	0.92
245		1855	8.77	1	8.77	8.43	1.04
246		1585	8.21	1	8.21	7.85	1.05
247		1670	8.39	1	8.39	8.46	0.99
248		1780	8.62	1	8.62	9.90	0.87
249		2152	9.89	0	9.33	9.51	
250		1861	8.79	1	8.79	8.55	1.03
251		1701	8.45	1	8.45	9.23	0.92
252		1444	7.92	1	7.92	8.46	0.94
253		1244	7.51	1	7.51	7.69	0.98
254		891	6.72	1	6.72	5.70	1.18
255		611	5.97	1	5.97	4.85	1.23
256		629	6.02	1	6.02	5.59	1.08
257		945	6.86	1	6.86	8.79	0.78
258		1530	8.10	1	8.10	8.64	0.94
259		2147	9.87	0	9.78	9.97	
260		2198	10.55	0	9.96	10.15	
261		2223		0	11.28	11.50	
262		2255		0	10.44	10.64	
263		2245		0	10.83	11.04	
264		2167	9.96	0	10.19	10.39	

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		2047	9.39	0	9.98	10.17	
266		2041	9.37	0	9.73	9.92	
267		1869	8.80	1	8.80	9.11	0.97
268		2069	9.50	0	9.45	9.63	
269		2151	9.89	0		8.90	
270		1918	8.91	1	8.91	9.27	0.96
271		1985	9.10	1	9.10	9.31	0.98
272		2108	9.68	0		8.86	
273		2001	9.18	1	9.18	9.74	0.94
274		1851	8.77	1	8.77	8.95	0.98
275		1969	9.03	1	9.03	9.82	0.92
276		2020	9.27	0		9.18	
277		1948	8.97	1	8.97	9.67	0.93
278		2108	9.68	0	9.30	9.48	
279		1973	9.05	1	9.05	10.01	0.90
280		1743	8.54	1	8.54	10.46	0.82
281		1771	8.60	1	8.60	10.63	0.81
282		1398	7.82	1	7.82	8.11	0.96
283		1193	7.40	1	7.40	6.20	1.19
284		1140	7.29	1	7.29	6.85	1.07
285		1334	7.69	1	7.69	8.37	0.92
286		1610	8.26	1	8.26	8.44	0.98
287		1363	7.75	1	7.75	7.28	1.07
288		1123	7.26	1	7.26	7.38	0.98
289		1681	8.41	1	8.41	8.28	1.02
290		2177	10.05	0	9.79	9.98	
291		1998	9.16	1	9.16	8.99	1.02
292		2280		0	10.14	10.34	
293		2280		0	10.90	11.11	
294		2152	9.89	0	10.53	10.74	
295		2209	10.81	0	9.84	10.04	
296		2225		0	10.39	10.60	
297		2209	10.80	0	9.92	10.11	
298		2206	10.74	0	10.04	10.24	
299		2257		0	10.29	10.49	
300		2259		0	10.51	10.72	
301		2235		0	10.18	10.38	
302		2214	10.92	0	10.71	10.92	
303		2185	10.23	0	11.27	11.50	
304		2187	10.28	0	9.98	10.18	
305		2188	10.32	0	9.36	9.54	
306		2176	10.02	0		9.21	
307		2182	10.17	0		9.03	
308		1941	8.95	1	8.95	8.99	1.00
309		1912	8.89	1	8.89	9.36	0.95
310		1804	8.67	1	8.67	8.98	0.97
311		1788	8.63	1	8.63	8.46	1.02
312		1933	8.94	1	8.94	7.78	1.15
313		2131	9.79	0	9.50	9.69	
314		2226		0	10.26	10.46	
315		2266		0	10.20	10.40	
316		2104	9.67	0		9.14	
317		1666	8.38	1	8.38	9.02	0.93
318		2088	9.59	0		9.35	
319		2279		0	9.55	9.73	
320		2236		0	10.33	10.53	
321		2094	9.62	0		9.00	
322		2067	9.49	0	10.22	10.42	
323		2232		0	10.07	10.26	
324		1989	9.12	1	9.12	9.68	0.94
325		1741	8.54	1	8.54	8.23	1.04
326		1395	7.82	1	7.82	7.90	0.99
327		1328	7.68	1	7.68	8.11	0.95
328		1637	8.32	1	8.32	7.86	1.06
329		2054	9.43	0	10.34	10.54	
330		2274		0	10.50	10.71	
331		2276		0	10.08	10.28	
332		2197	10.53	0	9.87	10.07	
333		1624	8.29	1	8.29	7.67	1.08
334		1666	8.38	1	8.38	8.95	0.94
335		2068	9.50	0		9.28	
336		2235		0		9.05	
337		2236		0	9.98	10.17	
338		2311		0	10.77	10.98	
339		2283		0	11.79	12.02	
340		2179	10.10	0	10.60	10.81	
341		2070	9.50	0	9.64	9.83	
342		2191	10.37	0	10.53	10.73	
343		2261		0	11.36	11.58	
344		2240		0	10.28	10.48	
345		2221	11.95	0	10.38	10.58	
346		2248		0	10.66	10.87	
347		2156	9.91	0	10.67	10.88	
348		2177	10.05	0	10.06	10.26	
349		2237		0	10.82	11.03	
350		2286		0	11.38	11.60	
351		2258		0	12.14	12.37	
352		2211	10.86	0	10.91	11.12	

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		2183	10.19	0	10.00	10.19	
354		2222		0	10.93	11.15	
355		2214	10.93	0	10.27	10.47	
356		2229		0	9.92	10.11	
357		2197	10.52	0	9.96	10.16	
358		2213	10.90	0	10.42	10.62	
359		2192	10.40	0	9.95	10.14	
360		2187	10.29	0	10.52	10.73	
361		2233		0	9.56	9.75	
362		2223		0	9.47	9.65	
363		2182	10.16	0	9.54	9.73	
364		2182	10.16	0	9.83	10.02	
365		2113	9.71	0	9.36	9.55	
366		2060	9.46	0		9.40	
367		1749	8.55	1	8.55	7.99	1.07
368		1599	8.24	1	8.24	8.66	0.95
369		1747	8.55	1	8.55	8.41	1.02
370		1839	8.74	1	8.74	8.88	0.98
371		1907	8.88	1	8.88	9.24	0.96
372		1939	8.95	1	8.95	8.52	1.05
373		1976	9.06	1	9.06	9.73	0.93
374		1663	8.38	1	8.38	9.39	0.89
375		1703	8.46	1	8.46	8.93	0.95
376		1486	8.01	1	8.01	7.99	1.00
377		1446	7.92	1	7.92	8.06	0.98
378		1386	7.80	1	7.80	8.74	0.89
379		1350	7.73	1	7.73	7.91	0.98
380		1126	7.27	1	7.27	6.63	1.10
381		1113	7.24	1	7.24	7.54	0.96
382		1588	8.22	1	8.22	8.83	0.93
383		1845	8.75	1	8.75	9.56	0.92
384		1800	8.66	1	8.66	8.75	0.99
385		1511	8.06	1	8.06	6.87	1.17
386		1284	7.59	1	7.59	7.55	1.00
387		1218	7.45	1	7.45	7.62	0.98
388		1112	7.24	1	7.24	7.13	1.01
389		984	6.97	1	6.97	6.65	1.05
390		964	6.91	1	6.91	6.08	1.14
391		1157	7.33	1	7.33	7.40	0.99
392		1319	7.66	1	7.66	7.68	1.00
393		1330	7.69	1	7.69	7.24	1.06
394		2149	9.88	0	9.30	9.48	
395		2285		0	10.30	10.50	
396		2260		0	10.29	10.50	
397		2135	9.81	0	9.87	10.06	
398		2150	9.88	0	9.30	9.48	
399		2140	9.83	0		9.01	
400		2239		0		9.36	
401		2320		0	10.42	10.63	
402		2298		0	11.12	11.34	
403		2240		0	11.65	11.88	
404		2238		0	11.37	11.59	
405		2226		0	12.29	12.53	
406		2233		0	11.60	11.82	
407		2210	10.83	0	11.72	11.95	
408		2198	10.54	0	11.52	11.75	
409		2184	10.20	0	10.99	11.20	
410		2131	9.79	0	9.82	10.02	
411		2215	10.96	0	11.08	11.29	
412		2229		0	10.45	10.65	
413		2249		0	10.90	11.12	
414		2221		0	10.46	10.66	
415		2230		0	10.74	10.96	
416		2213	10.89	0	10.69	10.90	
417		2181	10.15	0	10.92	11.13	
418		2084	9.57	0	9.40	9.58	
419		1921	8.91	1	8.91	9.74	0.92
420		1842	8.75	1	8.75	10.48	0.83
421		1678	8.41	1	8.41	9.93	0.85
422		1466	7.97	1	7.97	8.27	0.96
423		1503	8.04	1	8.04	9.41	0.85
424		1931	8.93	1	8.93	8.98	1.00
425		2068	9.50	0	9.55	9.74	
426		2215	10.95	0	9.39	9.58	
427		2297		0	10.71	10.92	
428		2334		0	10.69	10.90	
429		2272		0	11.25	11.47	
430		2205	10.72	0	11.44	11.66	
431		2173	9.99	0	9.75	9.95	
432		2177	10.06	0	9.94	10.13	
433		2203	10.67	0	11.21	11.43	
434		2246		0	10.55	10.75	
435		2242		0	10.70	10.91	
436		2222		0	9.93	10.12	
437		2120	9.74	0		8.63	
438		2101	9.65	0		8.60	
439		1892	8.85	1	8.85	7.66	1.16
440		1956	8.98	1	8.98	8.75	1.03

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		1544	8.13	1	8.13	8.97	0.91
442		1469	7.97	1	7.97	8.29	0.96
443		1906	8.88	1	8.88	9.27	0.96
444		1821	8.70	1	8.70	9.02	0.96
445		1638	8.32	1	8.32	8.75	0.95
446		1733	8.52	1	8.52	8.08	1.05
447		1902	8.87	1	8.87	9.67	0.92
448		1792	8.64	1	8.64	9.52	0.91
449		1648	8.34	1	8.34	8.75	0.95
450		1944	8.96	1	8.96	10.15	0.88
451		2190	10.37	0		9.43	
452		2002	9.19	1	9.19	8.82	1.04
453		1906	8.88	1	8.88	8.87	1.00
454		1536	8.11	1	8.11	8.63	0.94
455		1466	7.97	1	7.97	7.55	1.05
456		1976	9.06	1	9.06	8.19	1.11
457		2013	9.23	1	9.23	9.60	0.96
458		2202	10.63	0	10.20	10.40	
459		2265		0	9.94	10.14	
460		2265		0	9.51	9.69	
461		2221	11.97	0	10.16	10.36	
462		2219	11.50	0	10.44	10.65	
463		2177	10.04	0	10.01	10.21	
464		2161	9.94	0	9.27	9.45	
465		1930	8.93	1	8.93	9.40	0.95
466		2223		0	9.94	10.13	
467		2230		0		9.08	
468		1916	8.90	1	8.90	9.15	0.97
469		1868	8.80	1	8.80	9.45	0.93
470		2138	9.82	0	9.75	9.94	
471		2097	9.63	0	9.83	10.02	
472		1737	8.53	1	8.53	8.66	0.98
473	1	1654	8.36	1		8.65	
474		1882	8.83	1	8.83	8.65	1.02
475		2025	9.29	0		9.31	
476		1778	8.61	1	8.61	7.91	1.09
477		1467	7.97	1	7.97	7.08	1.13
478		2116	9.72	0	9.59	9.77	
479		2262		0	10.03	10.22	
480		2226		0	10.08	10.28	
481		2208	10.79	0		9.17	
482		2267		0	10.69	10.90	
483		2244		0	10.04	10.24	
484		2269	10.82	0	11.30	11.52	
485		2271		0	11.70	11.93	
486		2261		0	10.93	11.15	
487		2246		0	10.67	10.88	
488		2214	10.93	0	10.46	10.66	
489		2212	10.87	0	10.53	10.73	
490		2217	10.99	0	10.53	10.74	
491		2186	10.25	0	10.40	10.60	
492		2159	9.92	0	10.47	10.67	
493		2197	10.53	0	10.71	10.92	
494		2056	9.44	0		8.56	
495		2022	9.28	0		9.02	
496		1943	8.96	1	8.96	8.22	1.09
497		1747	8.55	1	8.55	8.39	1.02
498		1740	8.53	1	8.53	8.88	0.96
499		2136	9.82	0	9.65	9.84	
500		2117	9.73	0	9.33	9.51	
501		2213	10.90	0	9.82	10.01	
502		2249		0	10.06	10.26	
503		2260		0	9.34	9.52	
504		2258		0	9.52	9.71	
505		2205	10.72	0	10.43	10.63	
506		2231		0	10.38	10.58	
507		2247		0	10.04	10.23	
508		2262		0	10.11	10.30	
509		2241		0	10.93	11.15	
510		2224		0	10.53	10.74	
511		2257		0	10.89	11.10	
512		2261		0	11.09	11.30	
513		2159	9.93	0	10.43	10.63	
514		2157	9.92	0	10.58	10.79	
515		2123	9.76	0	10.08	10.27	
516		2121	9.74	0	9.82	10.02	
517		2225		0	10.16	10.36	
518		2218	11.35	0	10.34	10.54	
519		2252		0	10.58	10.79	
520		2215	10.95	0	10.22	10.42	
521		2059	9.45	0	10.17	10.37	
522		1635	8.32	1	8.32	9.14	0.91
523		1886	8.84	1	8.84	9.92	0.89
524		1963	9.00	1	9.00	10.09	0.89
525		1982	9.09	1	9.09	10.39	0.87
526		2022	9.28	0	11.13	11.35	
527		2034	9.33	0	10.03	10.23	
528		1750	8.56	1	8.56	9.99	0.86

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		1551	8.14	1	8.14	9.51	0.86
530		1726	8.51	1	8.51	8.13	1.05
531		1829	8.72	1	8.72	9.46	0.92
532		2159	9.92	0	9.98	10.18	
533		1839	8.74	1	8.74	9.97	0.88
534		1566	8.17	1	8.17	8.33	0.98
535		1831	8.72	1	8.72	8.68	1.01
536		1826	8.71	1	8.71	9.21	0.95
537		2132	9.80	0	9.80	9.99	
538		2144	9.86	0		9.41	
539		1990	9.13	1	9.13	9.49	0.96
540		2281		0	9.76	9.95	
541		2303		0	10.58	10.79	
542		2294		0	10.91	11.13	
543		2227		0	10.67	10.88	
544		2192	10.40	0	10.06	10.26	
545		2195	10.49	0	10.62	10.83	
546		2259		0	11.40	11.62	
547		2251		0	10.80	11.01	
548		2130	9.79	0	10.61	10.81	
549		2173	9.99	0	10.36	10.56	
550		2277		0	10.64	10.85	
551		2253		0	10.12	10.32	
552		2210	10.83	0	10.84	11.06	
553		2231		0	10.16	10.36	
554		2275		0	11.74	11.97	
555		2224		0	10.46	10.67	
556		2123	9.76	0	9.58	9.77	
557		2152	9.89	0	10.11	10.31	
558		2172	9.99	0	10.32	10.53	
559		2246		0	9.83	10.02	
560		2267		0	9.95	10.15	
561		2228		0	9.56	9.74	
562		2171	9.98	0	9.50	9.69	
563		2210	10.83	0	10.62	10.83	
564		2234		0	10.01	10.20	
565		2202	10.64	0	9.73	9.92	
566		1926	8.92	1	8.92	10.45	0.85
567		2133	9.80	0	9.46	9.64	
568		2113	9.71	0	9.54	9.73	
569		2118	9.73	0	10.21	10.41	
570		1927	8.92	1	8.92	8.79	1.02
571	1	1718	8.49	1		8.56	
572	1	1637	8.32	1		6.47	
573		2176	10.03	0		9.06	
574		2301		0	10.07	10.26	
575		2279		0	11.53	11.75	
576		2256		0	10.59	10.79	
577		2210	10.83	0	11.23	11.45	
578		2179	10.08	0	10.81	11.02	
579		2200	10.59	0	10.60	10.81	
580		2228		0	9.88	10.07	
581	1	1147	7.31	1		10.47	
582		2174	10.00	0	10.92	11.14	
583		2190	10.36	0	10.78	10.99	
584		2237		0	10.87	11.08	
585		2229		0	10.49	10.70	
586		2021	9.27	0	9.30	9.49	
587		1998	9.16	1	9.16	9.89	0.93
588		2033	9.33	0	9.96	10.16	
589		1997	9.16	1	9.16	8.98	1.02
590		1774	8.61	1	8.61	9.22	0.93
591		1685	8.42	1	8.42	10.31	0.82
592		1684	8.42	1	8.42	8.62	0.98
593		1518	8.07	1	8.07	7.42	1.09
594		2127	9.78	0	9.31	9.49	
595		2283		0	10.17	10.37	
596		2010	9.22	1	9.22	8.85	1.04
597		2223		0	9.93	10.13	
598		1907	8.88	1	8.88	9.33	0.95
599		1771	8.60	1	8.60	9.94	0.87
600		1723	8.50	1	8.50	8.84	0.96
601		1772	8.60	1	8.60	9.65	0.89
602		1578	8.20	1	8.20	7.10	1.16
603		1586	8.21	1	8.21	8.35	0.98
604		1520	8.08	1	8.08	8.34	0.97
605		1679	8.41	1	8.41	8.09	1.04
606		1571	8.18	1	8.18	9.42	0.87
607		1411	7.85	1	7.85	7.65	1.03
608		1509	8.05	1	8.05	7.92	1.02
609		1728	8.51	1	8.51	8.19	1.04
610		2130	9.79	0		8.65	
611		2314		0	10.24	10.44	
612		2374		0	10.52	10.72	
613		2313		0	12.72	12.96	
614		2206	10.74	0	11.26	11.48	
615		2245		0	10.99	11.21	
616		2241		0	10.77	10.98	

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		2257		0	10.97	11.19	
618		2206	10.75	0	10.69	10.90	
619		2245		0	10.37	10.57	
620		2222		0	10.48	10.69	
621		2207	10.76	0	11.06	11.28	
622		2117	9.72	0	10.32	10.52	
623		1798	8.66	1	8.66	9.82	0.88
624		1962	9.00	1	9.00	9.80	0.92
625	0	1814	8.69	1	8.69	9.01	0.96
626	0	2009	9.21	1	9.21	10.43	0.88
627	0	2363		0	11.45	11.67	
628	0	2323		0	11.49	11.71	
629	0	2293		0	10.70	10.91	
630	0	2284		0	12.09	12.33	
631	0	2235		0	12.23	12.47	
632	0	2258		0	12.56	12.81	
633	0	2268		0	12.11	12.35	
634	0	2238		0	11.11	11.33	
635	0	2217	11.11	0	12.07	12.30	
636	0	2244		0	11.22	11.44	
637	0	2242		0	11.76	11.99	
638	0	2219	11.52	0	11.85	12.08	
639	0	2205	10.71	0	11.87	12.11	
640	0	2205	10.72	0	11.49	11.72	
641	0	2163	9.94	0	10.56	10.76	
642	0	2200	10.59	0	11.04	11.26	
643	0	2207	10.76	0	11.11	11.33	
644	0	2175	10.00	0	10.94	11.15	
645	0	1843	8.75	1	8.75	11.36	0.77
646	0	1978	9.07	1	9.07	9.44	0.96
647	0	2267		0		9.38	
648	0	2331		0	11.12	11.34	
649	0	2316		0	11.27	11.49	
650	0	2279		0	10.84	11.06	
651	0	2259		0	11.62	11.85	
652	0	2275		0	12.76	13.01	
653	0	2249		0	12.62	12.87	
654	0	2247		0	12.87	13.12	
655	0	2215	10.95	0	12.39	12.63	
656	0	2213	10.91	0	11.36	11.58	
657	0	2216	10.97	0	12.05	12.28	
658	0	2259		0	12.41	12.65	
659	0	2208	10.79	0	11.18	11.40	
660	0	2174	10.00	0	10.67	10.88	
661	0	1899	8.87	1	8.87	10.18	0.87
662	0	2029	9.31	0		8.41	
663	0	2299		0	10.65	10.86	
664	0	2284		0	11.53	11.75	
665	0	2281		0	10.66	10.86	
666	0	2276		0	10.66	10.87	
667	0	2254		0	10.69	10.90	
668	0	2159	9.92	0	10.32	10.52	
669	0	2201	10.62	0	9.91	10.10	
670	0	2181	10.14	0	10.07	10.26	
671	0	2182	10.16	0	10.02	10.21	
672	0	2200	10.59	0	9.56	9.75	
673	0	2250		0	10.10	10.30	
674	0	2243		0	9.98	10.17	
675	0	2298		0	11.13	11.34	
676	0	2306		0	11.42	11.64	
677	0	2220	11.73	0	10.98	11.19	
678	0	2212	10.89	0	10.93	11.14	
679	0	2231		0	10.13	10.33	
680	0	2233		0	10.94	11.16	
681	0	2272		0	11.52	11.75	
682	0	2251		0	12.42	12.67	
683	0	2214	10.92	0	12.13	12.37	
684	0	2199	10.56	0	11.65	11.88	
685	0	2217	11.05	0	11.24	11.46	
686	0	2249		0	12.15	12.39	
687	0	2226		0	12.07	12.30	
688	0	2215	10.94	0	11.06	11.28	
689	0	2197	10.53	0	11.21	11.43	
690	0	2254		0	12.70	12.94	
691	0	2240		0	11.46	11.68	
692	0	2158	9.92	0	11.80	12.03	
693	0	2167	9.96	0	10.87	11.09	
694	0	2208	10.79	0	10.96	11.18	
695	0	2212	10.88	0	9.99	10.18	
696	0	2064	9.47	0	9.84	10.03	
697	0	2225		0	10.82	11.03	
698	0	2200	10.59	0	9.35	9.53	
699	0	2190	10.35	0	10.45	10.65	
700	0	2256		0	9.96	10.16	
701	0	2235		0	10.39	10.60	
702	0	2304		0	10.07	10.26	
703	0	2304		0	10.75	10.96	
704	0	2275		0	11.92	12.15	

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	2263		0	11.94	12.17	
706	0	2202	10.65	0	12.51	12.75	
707	0	2189	10.34	0	11.84	12.07	
708	0	2072	9.52	0	11.37	11.59	
709	0	1745	8.55	1	8.55	9.37	0.91
710	0	1981	9.08	1	9.08	9.50	0.96
711	0	2088	9.59	0	9.50	9.69	
712	0	2249		0		9.06	
713	0	2199	10.57	0	9.94	10.13	
714	0	2215	10.95	0	9.47	9.66	
715	0	2287		0	9.78	9.97	
716	0	2302		0	11.32	11.54	
717	0	2244		0	11.31	11.53	
718	0	2205	10.72	0	11.07	11.29	
719	0	2246		0	10.22	10.42	
720	0	2238		0	10.36	10.56	
721	0	2185	10.25	0	10.27	10.48	
722	0	2152	9.89	0	10.62	10.83	
723	0	2123	9.75	0	9.73	9.92	
724	0	2170	9.98	0	10.34	10.55	
725	0	2269		0	10.54	10.75	
726	0	2293		0	10.93	11.14	
727	0	2250		0	10.21	10.41	
728	0	2182	10.17	0	9.93	10.12	
729	0	2141	9.84	0	10.32	10.52	
730	0	2251		0	10.65	10.86	
731	0	2231		0	10.06	10.26	
732	0	2098	9.64	0		8.94	
733	0	1862	8.79	1	8.79	9.42	0.93
734	0	2236		0	10.45	10.66	
735	0	2292		0	10.27	10.47	
736	0	2296		0	10.58	10.79	
737	0	2259		0	11.10	11.32	
738	0	2209	10.80	0	11.13	11.34	
739	0	2198	10.54	0	11.33	11.55	
740	0	2212	10.89	0	10.49	10.69	
741	0	2203	10.66	0	10.20	10.40	
742	0	2201	10.61	0	10.32	10.52	
743	0	2206	10.73	0	10.48	10.68	
744	0	2193	10.43	0	10.88	11.09	
745	0	2221	11.96	0	10.13	10.33	
746	0	2240		0	11.67	11.90	
747	0	2206	10.74	0	10.17	10.37	
748	0	2201	10.62	0	10.30	10.50	
749	0	2193	10.42	0	10.05	10.24	
750	0	2263		0	10.28	10.48	
751	0	2266		0	11.36	11.58	
752	0	2238		0	10.83	11.04	
753	0	2198	10.55	0	9.95	10.15	
754	0	2137	9.82	0	10.12	10.31	
755	0	2207	10.76	0	9.76	9.95	
756	0	2224		0	10.26	10.47	
757	0	2032	9.33	0	9.78	9.97	
758	0	2020	9.27	0		7.62	
759	0	2228		0		8.88	
760	0	2306		0	11.35	11.57	
761	0	2319		0	10.96	11.17	
762	0	2238		0	11.71	11.94	
763	0	2174	10.00	0	10.80	11.02	
764	0	2140	9.84	0	10.58	10.79	
765	0	2217	11.00	0	10.77	10.98	
766	0	2213	10.91	0	9.84	10.04	
767	0	2180	10.12	0	10.21	10.41	
768	0	2232		0	9.62	9.81	
769	0	2195	10.48	0	10.23	10.43	
770	0	2102	9.65	0	10.17	10.37	
771	0	1914	8.90	1	8.90	9.10	0.98
772	1	1801	8.66	1		7.71	
773	1	1750	8.56	1		9.83	
774	0	1880	8.83	1	8.83	9.49	0.93
775	0	1886	8.84	1	8.84	8.95	0.99
776	0	1940	8.95	1	8.95	10.27	0.87
777	0	2110	9.69	0	10.14	10.34	
778	0	2199	10.57	0	10.39	10.59	
779	0	2046	9.39	0	10.52	10.73	
780	0	2183	10.20	0	10.25	10.45	
781	0	1833	8.73	1	8.73	8.23	1.06
782	0	1657	8.36	1	8.36	9.17	0.91
783	0	1515	8.07	1	8.07	8.07	1.00
784	0	1710	8.47	1	8.47	9.20	0.92
785	0	1395	7.82	1	7.82	8.44	0.93
786	0	1320	7.66	1	7.66	7.55	1.02
787	0	1690	8.43	1	8.43	7.91	1.07
788	0	1850	8.76	1	8.76	9.41	0.93
789	0	1946	8.97	1	8.97	9.08	0.99
790	0	1786	8.63	1	8.63	8.12	1.06
791	0	1420	7.87	1	7.87	8.74	0.90
792	0	1375	7.78	1	7.78	7.61	1.02

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)	$V_{P,n}/V_{nac,m}$
793	0	1326	7.68	1	7.68	7.94	0.97
794	0	1318	7.66	1	7.66	7.78	0.98
795	0	1412	7.85	1	7.85	8.55	0.92
796	0	1340	7.71	1	7.71	7.75	0.99
797	0	1287	7.60	1	7.60	6.64	1.14
798	0	1225	7.47	1	7.47	8.16	0.92
799	0	1511	8.06	1	8.06	8.94	0.90
800	0	1496	8.03	1	8.03	9.14	0.88
801	0	1548	8.14	1	8.14	8.36	0.97
802	0	1442	7.91	1	7.91	7.76	1.02
803	0	1456	7.94	1	7.94	9.22	0.86
804	0	1575	8.19	1	8.19	8.71	0.94
805	0	1595	8.23	1	8.23	8.97	0.92
806	0	2182	10.18	0	10.17	10.37	
807	0	2336		0	10.77	10.98	
808	0	2280		0	10.88	11.09	
809	0	2226		0	11.23	11.45	
810	0	2172	9.99	0	10.78	10.99	
811	0	2110	9.69	0	9.46	9.64	
812	0	2233		0	10.35	10.55	
813	0	2273		0	10.86	11.07	
814	0	2247		0	10.52	10.72	
815	0	2255		0	11.16	11.38	
816	0	2214	10.93	0	9.93	10.12	
817	0	2210	10.84	0	9.49	9.67	
818	0	2162	9.94	0	10.25	10.45	
819	0	2101	9.65	0		9.41	
820	0	2219	11.38	0	10.14	10.34	
821	0	2347		0	10.78	10.99	
822	0	2189	10.32	0	9.82	10.01	
823	0	2197	10.52	0	11.62	11.85	
824	0	2268		0	11.06	11.28	
825	0	2259		0	11.21	11.43	
826	0	2243		0	11.52	11.75	
827	0	2215	10.96	0	10.93	11.15	
828	0	2150	9.88	0	10.46	10.67	
829	0	2205	10.71	0	11.43	11.66	
830	0	2200	10.59	0	11.32	11.55	
831	0	2243		0	10.66	10.87	
832	0	2204	10.69	0	9.85	10.05	
833	0	2217	11.04	0	10.28	10.48	
834	0	2076	9.53	0	9.40	9.59	
835	0	1985	9.10	1	9.10	9.07	1.00
836	0	2086	9.58	0	9.36	9.55	
837	0	1964	9.00	1	9.00	9.61	0.94
838	0	2204	10.70	0	9.60	9.79	
839	0	2246		0	10.63	10.83	
840	0	2228		0	9.74	9.93	
841	0	2281		0	10.47	10.67	
842	0	2254		0	9.68	9.87	
843	0	2067	9.49	0	9.26	9.44	
844	0	2010	9.22	1	9.22	8.98	1.03
845	0	1945	8.96	1	8.96	10.03	0.89
846	0	1949	8.97	1	8.97	10.23	0.88
847	0	2058	9.45	0	9.46	9.65	
848	0	2236		0	10.53	10.73	
849	0	2260		0	9.65	9.84	
850	0	2218	11.14	0	9.90	10.09	
851	0	2131	9.79	0	9.32	9.50	
852	0	1966	9.01	1	9.01	10.30	0.87
853	0	1984	9.10	1	9.10	9.34	0.97
854	0	1871	8.81	1	8.81	8.82	1.00
855	0	2075	9.53	0		9.16	
856	0	2198	10.55	0	10.16	10.36	
857	0	2322		0	10.42	10.63	
858	0	2274		0	10.01	10.21	
859	0	2226		0	10.38	10.59	
860	0	2233		0	10.98	11.19	
861	0	2263		0	10.65	10.85	
862	0	2228		0	11.15	11.37	
863	0	2187	10.29	0	11.38	11.61	
864	0	2199	10.56	0	10.98	11.19	
865	0	2200	10.59	0	11.32	11.55	
866	0	2233		0	10.98	11.20	
867	0	2220	11.70	0	11.10	11.32	
868	0	2170	9.98	0	10.46	10.66	
869	0	2186	10.27	0	10.14	10.33	
870	0	2271		0	9.92	10.11	
871	0	2233		0	10.19	10.39	
872	0	2221	11.92	0	11.10	11.32	
873	0	2173	9.99	0	10.27	10.48	
874	0	2189	10.33	0	10.55	10.76	
875	0	2246		0	10.28	10.48	
876	0	2195	10.48	0	10.40	10.61	
877	0	2011	9.23	1	9.23	9.79	0.94
878	0	1849	8.76	1	8.76	9.30	0.94
879	0	1903	8.87	1	8.87	9.19	0.97
880	0	2003	9.19	1	9.19	9.15	1.00

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)	$V_{P,n}/V_{nac,m}$
881	0	2034	9.34	0	9.37	9.55	
882	0	2045	9.39	0	10.04	10.24	
883	0	1993	9.14	1	9.14	10.03	0.91
884	0	1895	8.86	1	8.86	9.38	0.94
885	0	2105	9.67	0	9.81	10.00	
886	0	2139	9.83	0	9.32	9.50	
887	0	2066	9.49	0	10.69	10.90	
888	0	1799	8.66	1	8.66	9.75	0.89
889	0	1839	8.74	1	8.74	9.10	0.96
890	0	2259		0	10.47	10.67	
891	0	2299		0	10.86	11.07	
892	0	2299		0	11.21	11.43	
893	0	2291		0	11.40	11.62	
894	0	2236		0	11.77	12.00	
895	0	2174	10.00	0	9.68	9.87	
896	0	2153	9.90	0	10.37	10.57	
897	0	2220	11.69	0	11.17	11.39	
898	0	2175	10.00	0	9.32	9.50	
899	0	2228		0	9.44	9.63	
900	0	2169	9.97	0		8.79	
901	0	2281		0	9.78	9.97	
902	0	2241		0	10.94	11.15	
903	0	2226		0	10.80	11.01	
904	0	2192	10.40	0	10.31	10.51	
905	0	2236		0	10.85	11.06	
906	0	2234		0	11.22	11.44	
907	0	2274		0	10.48	10.68	
908	0	2252		0	10.71	10.92	
909	0	2209	10.82	0	10.41	10.61	
910	0	2175	10.01	0	10.25	10.46	
911	0	1996	9.16	1	9.16	10.26	0.89
912	0	1718	8.49	1	8.49	10.05	0.84
913	0	1770	8.60	1	8.60	9.25	0.93
914	0	2095	9.62	0	9.28	9.46	
915	0	1916	8.90	1	8.90	9.71	0.92
916	0	1789	8.64	1	8.64	9.32	0.93
917	0	2020	9.27	0	9.61	9.80	
918	0	1873	8.81	1	8.81	8.97	0.98
919	0	2037	9.35	0		9.09	
920	0	2266		0	9.33	9.52	
921	0	2251		0	9.43	9.62	
922	0	1989	9.12	1	9.12	9.17	1.00
923	0	2149	9.88	0	9.42	9.61	
924	0	2252		0	10.02	10.22	
925	0	2223		0	10.24	10.44	
926	0	2223		0	9.29	9.48	
927	0	2280		0	10.95	11.17	
928	0	2263		0	10.82	11.03	
929	0	2262		0	10.41	10.61	
930	0	2240		0	10.67	10.87	
931	0	2288		0	11.30	11.52	
932	0	2188	10.30	0	10.13	10.33	
933	0	2140	9.84	0	9.62	9.80	
934	0	2170	9.97	0	10.11	10.31	
935	0	2206	10.73	0	11.08	11.30	
936	0	2200	10.60	0	9.99	10.18	
937	0	2203	10.66	0	10.07	10.27	
938	0	2293		0	11.16	11.38	
939	0	2290		0	10.90	11.11	
940	0	2286		0	11.25	11.47	
941	0	2222		0	11.34	11.56	
942	0	2157	9.92	0	10.56	10.76	
943	0	2279		0	12.06	12.30	
944	0	2253		0	11.78	12.01	
945	0	2260		0	12.23	12.47	
946	0	2258		0	12.30	12.54	
947	0	2202	10.64	0	11.66	11.89	
948	0	2127	9.77	0	11.58	11.81	
949	0	2154	9.90	0	10.03	10.22	
950	0	2215	10.96	0	10.66	10.87	
951	0	2220	11.77	0	10.07	10.26	
952	0	2214	10.93	0	10.44	10.65	
953	0	2167	9.96	0	10.18	10.38	
954	0	2210	10.84	0	9.97	10.16	
955	0	2095	9.62	0	10.35	10.55	
956	0	2277		0	10.47	10.67	
957	0	2308		0	11.28	11.50	
958	0	2276		0	11.18	11.40	
959	0	2209	10.81	0	11.44	11.66	
960	0	2181	10.15	0	10.68	10.88	
961	0	1944	8.96	1	8.96	9.49	0.94
962	0	1889	8.85	1	8.85	9.09	0.97
963	0	2257		0	9.27	9.45	
964	0	2342		0	11.66	11.89	
965	0	2264		0	10.29	10.49	
966	0	2271		0	11.42	11.64	
967	0	2218	11.33	0	11.98	12.22	
968	0	2233		0	12.22	12.46	

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)	$V_{P,n}/V_{nac,m}$
969	0	2209	10.81	0	12.03	12.27	
970	0	2178	10.08	0	10.80	11.02	
971	0	2164	9.95	0	10.20	10.40	
972	0	2183	10.18	0	9.48	9.67	
973	0	2275		0	11.01	11.23	
974	0	2247		0	11.23	11.45	
975	0	2189	10.33	0	10.88	11.09	
976	0	2121	9.75	0	9.90	10.10	
977	0	1883	8.83	1	8.83	9.05	0.98
978	0	2168	9.97	0	9.88	10.07	
979	0	2291		0	10.03	10.23	
980	0	2114	9.71	0	10.08	10.27	
981	0	1931	8.93	1	8.93	9.97	0.90
982	0	2253		0	9.85	10.05	
983	0	2219	11.48	0	9.70	9.89	
984	0	2275		0	10.38	10.59	
985	0	2290		0	11.64	11.87	
986	0	2253		0	10.56	10.76	
987	0	2217	11.03	0	10.87	11.08	
988	0	2158	9.92	0	10.45	10.65	
989	0	2108	9.68	0	9.86	10.05	
990	0	2108	9.68	0	9.90	10.09	
991	0	2266		0	10.57	10.77	
992	0	2234		0	9.40	9.58	
993	0	2178	10.06	0	9.80	9.99	
994	0	2045	9.38	0		9.41	
995	0	1988	9.02	1	9.02	9.45	0.96
996	0	1929	8.93	1	8.93	9.67	0.92
997	0	2247		0	10.75	10.96	
998	0	2315		0	10.45	10.66	
999	0	2292		0	10.20	10.40	
1000	0	2201	10.62	0	10.43	10.64	
1001	0	2153	9.90	0	10.50	10.70	
1002	0	2177	10.05	0	10.23	10.43	
1003	0	2226		0	10.47	10.67	
1004	0	2229		0	10.19	10.39	
1005	0	2257		0	10.39	10.60	
1006	0	2174	10.00	0	9.66	9.85	
1007	0	2268		0	10.67	10.88	
1008	0	2308		0	11.10	11.31	
1009	1	2220	11.70	0		10.19	
1010	1	2180	10.13	0		9.61	
1011	1	2236		0		10.55	
1012	1	2243		0		10.27	
1013	1	2263		0		11.61	
1014	0	2184	10.21	0	10.43	10.64	
1015	0	2212	10.89	0	10.59	10.79	
1016	0	2219	11.38	0	9.83	10.02	
1017	0	2179	10.11	0	10.26	10.46	
1018	0	1566	8.17	1	8.17	8.79	0.93
1019	0	1637	8.32	1	8.32	8.00	1.04
1020	0	2089	9.59	0		8.55	
1021	0	2177	10.04	0	9.36	9.55	

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.CP244.R4)

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 = 1.4710

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		2087	9.58	0	9.52	4.99	
2		1860	8.79	1	8.79	4.21	2.09
3		1906	8.88	1	8.88	4.01	2.21
4		1922	8.91	1	8.91	4.60	1.94
5		1825	8.71	1	8.71	4.98	1.75
6		1575	8.19	1	8.19	4.80	1.71
7		1354	7.73	1	7.73	5.04	1.53
8		1674	8.40	1	8.40	5.44	1.54
9		1839	8.74	1	8.74	6.20	1.41
10		2035	9.34	0		5.23	
11		2128	9.78	0		6.50	
12		2039	9.36	0		5.48	
13		1977	9.06	1	9.06	5.40	1.68
14		1831	8.72	1	8.72	6.65	1.31
15		1752	8.56	1	8.56	6.31	1.36
16		1602	8.25	1	8.25	6.10	1.35
17		1565	8.17	1	8.17	5.55	1.47
18		1422	7.87	1	7.87	4.67	1.69
19		1428	7.89	1	7.89	4.91	1.61
20		1584	8.21	1	8.21	3.20	2.56
21		1513	8.06	1	8.06	4.69	1.72
22		1276	7.57	1	7.57	4.86	1.56
23		1284	7.59	1	7.59	3.80	2.00
24		1580	8.20	1	8.20	3.68	2.23
25		1879	8.83	1	8.83	4.28	2.06
26		1739	8.53	1	8.53	4.21	2.03
27		1824	8.71	1	8.71	5.88	1.48
28		2138	9.83	0	9.46	6.26	
29		2197	10.52	0	10.14	6.30	
30		2076	9.53	0	9.39	5.90	
31		1980	9.08	1	9.08	4.83	1.88
32		1807	8.68	1	8.68	4.51	1.92
33		1391	7.81	1	7.81	5.78	1.35
34		1540	8.12	1	8.12	6.56	1.24
35		2164	9.95	0	10.06	7.47	
36		2154	9.90	0	9.29	5.87	
37		2024	9.29	0		5.50	
38		1967	9.02	1	9.02	6.56	1.38
39		1806	8.67	1	8.67	7.11	1.22
40		1786	8.63	1	8.63	6.85	1.26
41		1706	8.47	1	8.47	5.57	1.52
42		1646	8.34	1	8.34	8.14	1.02
43		1978	9.07	1	9.07	7.55	1.20
44		1738	8.53	1	8.53	5.87	1.45
45		1430	7.89	1	7.89	5.02	1.57
46		1835	8.73	1	8.73	5.70	1.53
47	1	136	3.67	1		8.69	
48	1	0	2.00	1		8.00	
49	1	0	2.00	1		5.98	
50	1	0	2.00	1		4.96	
51	1	0	2.00	1		6.95	
52	1	0	2.00	1		6.82	
53		1466	7.97	1	7.97	4.32	1.85
54		1763	8.58	1	8.58	6.38	1.35
55		1329	7.68	1	7.68	5.70	1.35
56		1202	7.42	1	7.42	5.11	1.45
57		1372	7.77	1	7.77	4.96	1.57
58		1638	8.32	1	8.32	4.02	2.07
59		1566	8.17	1	8.17	5.11	1.60
60		1421	7.87	1	7.87	4.86	1.62
61		1382	7.79	1	7.79	3.47	2.24
62		1346	7.72	1	7.72	3.88	1.99
63		1524	8.09	1	8.09	4.70	1.72
64		1601	8.25	1	8.25	6.76	1.22
65		1300	7.62	1	7.62	6.78	1.12
66		1040	7.09	1	7.09	6.68	1.06
67		931	6.82	1	6.82	6.47	1.05
68		994	6.99	1	6.99	5.88	1.19
69		1072	7.15	1	7.15	5.79	1.24
70		1175	7.37	1	7.37	5.75	1.28
71		1187	7.39	1	7.39	6.84	1.08
72		1201	7.42	1	7.42	6.58	1.13
73		1176	7.37	1	7.37	6.18	1.19
74		1231	7.48	1	7.48	5.35	1.40
75		1366	7.76	1	7.76	4.81	1.61
76		1384	7.80	1	7.80	7.55	1.03
77		1502	8.04	1	8.04	7.46	1.08
78		1618	8.28	1	8.28	7.21	1.15
79		1594	8.23	1	8.23	7.30	1.13
80		1374	7.78	1	7.78	7.99	0.97
81		1162	7.34	1	7.34	6.17	1.19
82		1111	7.23	1	7.23	8.04	0.90
83		1215	7.45	1	7.45	9.37	0.79
84		2024	9.29	0	9.55	9.37	
85		2152	9.89	0		8.18	
86		2063	9.47	0		8.03	
87		2168	9.97	0		6.57	
88		2215	10.96	0		6.88	
89		2135	9.81	0	9.73	6.30	
90		2112	9.70	0	9.40	5.22	
91		2233		0	9.54	5.69	
92		2254		0	9.35	6.92	
93		2196	10.50	0		5.64	
94		2147	9.87	0	10.38	6.04	
95		2026	9.30	0		6.45	
96		2063	9.47	0		5.27	
97		1956	8.98	1	8.98	4.10	2.19
98		1939	8.95	1	8.95	4.78	1.87
99		1868	8.80	1	8.80	4.99	1.77
100		1520	8.08	1	8.08	5.53	1.46
101		1504	8.04	1	8.04	5.49	1.47
102		1671	8.39	1	8.39	4.39	1.91
103		1501	8.04	1	8.04	3.53	2.27
104		1571	8.18	1	8.18	4.34	1.88
105		1732	8.52	1	8.52	3.72	2.29
106		1397	7.82	1	7.82	3.88	2.02
107		1219	7.46	1	7.46	4.98	1.50
108		1079	7.17	1	7.17	6.47	1.11
109		931	6.83	1	6.83	4.78	1.43
110		852	6.62	1	6.62	4.71	1.40
111		846	6.60	1	6.60	3.53	1.87
112		1009	7.02	1	7.02	4.22	1.66
113		1133	7.28	1	7.28	5.01	1.45
114		1028	7.06	1	7.06	4.04	1.75
115		839	6.58	1	6.58	4.61	1.43
116		719	6.26	1	6.26	6.50	0.96
117		678	6.15	1	6.15	5.16	1.19
118		622	6.00	1	6.00	5.92	1.01
119		603	5.94	1	5.94	5.89	1.01
120		611	5.97	1	5.97	6.48	0.92
121		637	6.05	1	6.05	7.19	0.84
122		921	6.80	1	6.80	6.43	1.06
123		1441	7.91	1	7.91	5.24	1.51
124		1467	7.97	1	7.97	4.25	1.87
125		1373	7.77	1	7.77	4.01	1.94
126		1550	8.14	1	8.14	5.24	1.55
127		1332	7.69	1	7.69	3.42	2.25
128		1218	7.45	1	7.45	4.07	1.83
129		1068	7.15	1	7.15	5.11	1.40
130	1	1395	7.82	1		4.83	
131	1	2267		0		4.76	
132		2255		0	10.55	4.08	
133		2137	9.82	0	9.38	4.45	
134		2087	9.59	0	9.36	6.04	
135		1934	8.94	1	8.94	5.11	1.75
136		1984	9.10	1	9.10	6.86	1.33
137		1996	9.16	1	9.16	5.73	1.60
138		2093	9.61	0		4.61	
139		2228		0		7.83	
140		2257		0	9.61	6.22	
141		2144	9.85	0	9.83	5.24	
142		2064	9.48	0	10.03	5.96	
143		1825	8.71	1	8.71	7.43	1.17
144		1680	8.41	1	8.41	7.73	1.09
145		2212	10.88	0	9.30	6.22	
146		2175	10.00	0		8.07	
147		2147	9.87	0		5.53	
148		2253		0	10.85	6.57	
149		2252		0	10.19	6.97	
150		2214	10.92	0	9.88	7.80	
151		1882	8.83	1	8.83	7.04	1.25
152		1998	7.83	1	7.83	6.47	1.21
153		1733	8.52	1	8.52	7.70	1.11
154		1926	8.92	1	8.92	7.53	1.19
155		1873	8.81	1	8.81	7.87	1.12
156		1991	9.13	1	9.13	6.52	1.40
157		1889	8.85	1	8.85	6.81	1.30
158		1979	9.08	1	9.08	5.91	1.54
159		2215	10.95	0	9.74	6.83	
160		2181	10.15	0	9.93	7.49	
161		2004	9.19	1	9.19	6.65	1.38
162		1989	9.12	1	9.12	5.02	1.82
163		1942	8.96	1	8.96	5.30	1.69
164		1763	8.58	1	8.58	7.54	1.14
165		1781	8.62	1	8.62	5.91	1.46
166		1572	8.19	1	8.19	5.79	1.41
167		1417	7.86	1	7.86	5.54	1.42
168		1485	8.00	1	8.00	5.67	1.41
169		1498	8.03	1	8.03	6.47	1.24
170		1523	8.08	1	8.08	5.34	1.51
171		1316	7.66	1	7.66	6.86	1.12
172		1226	7.47	1	7.47	5.82	1.28
173		1146	7.31	1	7.31	4.11	1.78
174		1046	7.10	1	7.10	4.48	1.59
175		1176	7.37	1	7.37	4.72	1.56
176		1711	8.47	1	8.47	4.20	2.02
177		2136	9.82	0	10.06	4.63	
178		2198	10.56	0	10.03	5.56	
179		2145	9.86	0	9.96	4.72	
180		2113	9.71	0	9.50	7.56	
181		1874	8.81	1	8.81	6.34	1.39
182		1641	8.33	1	8.33	4.62	1.80
183		1395	7.82	1	7.82	4.36	1.80
184		1300	7.62	1	7.62	5.99	1.27
185		1772	8.60	1	8.60	5.73	1.50
186		1308	7.64	1	7.64	5.58	1.37
187		1062	7.13	1	7.13	5.72	1.25
188		1006	7.02	1	7.02	5.56	1.26
189		904	6.75	1	6.75	5.84	1.16
190		704	6.22	1	6.22	4.83	1.29
191		598	5.92	1	5.92	6.32	0.94
192		520	5.63	1	5.63	6.29	0.90
193		492	5.53	1	5.53	5.84	0.95
194		623	6.01	1	6.01	5.20	1.16
195		719	6.26	1	6.26	4.68	1.34
196		677	6.15	1	6.15	4.80	1.28
197		828	6.55	1	6.55	4.70	1.39
198		782	6.43	1	6.43	5.07	1.27
199		709	6.24	1	6.24	7.53	0.83
200		1019	7.05	1	7.05	8.17	0.86
201		1523	8.08	1	8.08	7.69	1.05
202		1772	8.60	1	8.60	9.17	0.94
203		2010	9.22	1	9.22	6.99	1.32
204		1905	8.88	1	8.88	6.40	1.39
205		1712	8.48	1	8.48	6.59	1.29
206		1780	8.62	1	8.62	8.13	1.06
207		1758	8.57	1	8.57	7.21	1.19
208		1450	7.93	1	7.93	7.68	1.03
209		1412	7.85	1	7.85	9.42	0.83
210		1445	7.92	1	7.92	7.88	1.01
211		1483	8.00	1	8.00	5.98	1.34
212		1299	7.62	1	7.62	6.10	1.25
213		1430	7.89	1	7.89	5.35	1.47
214		1426	7.88	1	7.88	5.30	1.49
215		1776	8.61	1	8.61	5.97	1.44
216		1681	8.41	1	8.41	7.22	1.17
217		1675	8.40	1	8.40	8.48	0.99
218		1999	9.17	1	9.17	8.14	1.13
219		2158	9.92	0	10.62	9.10	
220		1576	8.19	1	8.19	7.57	1.08
221		1946	8.96	1	8.96	8.18	1.10
222		2030	9.32	0		7.98	
223		1910	8.89	1	8.89	7.56	1.18
224		1566	8.17	1	8.17	7.15	1.14
225		1746	8.55	1	8.55	6.00	1.42
226		1392	7.81	1	7.81	6.55	1.19
227		1238	7.50	1	7.50	6.99	1.07
228		1045	7.10	1	7.10	5.88	1.21
229		781	6.43	1	6.43	5.35	1.20
230		617	5.99	1	5.99	4.84	1.24
231		686	6.18	1	6.18	4.87	1.27
232		1070	7.15	1	7.15	5.14	1.39
233		1557	8.15	1	8.15	4.75	1.72
234		1380	7.79	1	7.79	4.28	1.82
235		1251	7.52	1	7.52	5.08	1.48
236		1148	7.31	1	7.31	5.63	1.30
237		1144	7.30	1	7.30	6.07	1.20
238		1465	7.96	1	7.96	8.59	0.93
239		1869	8.80	1	8.80	7.08	1.24
240		1742	8.54	1	8.54	6.02	1.42
241		1326	7.68	1	7.68	7.09	1.08
242		1163	7.34	1	7.34	7.24	1.01
243		1360	7.75	1	7.75	6.83	1.13
244		1545	8.13	1	8.13	5.44	1.49
245		1855	8.77	1	8.77	5.11	1.72
246		1585	8.21	1	8.21	5.58	1.47
247		1670	8.39	1	8.39	5.30	1.58
248		1780	8.62	1	8.62	5.59	1.54
249		2152	9.89	0	9.33	7.27	
250		1861	8.79	1	8.79	7.24	1.21
251		1701	8.45	1	8.45	6.51	1.30
252		1444	7.92	1	7.92	6.42	1.23
253		1244	7.51	1	7.51	7.46	1.01
254		891	6.72	1	6.72	6.44	1.04
255		611	5.97	1	5.97	5.35	1.11
256		629	6.02	1	6.02	6.15	0.98
257		945	6.86	1	6.86	8.18	0.84
258		1530	8.10	1	8.10	8.15	0.99
259		2147	9.87	0	9.78	6.77	
260		2198	10.55	0	9.96	8.70	
261		2223		0	11.28	6.98	
262		2255		0	10.44	6.79	
263		2245		0	10.83	6.93	
264		2167	9.96	0	10.19	6.06	

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		2047	9.39	0	9.98	6.60	
266		2041	9.37	0	9.73	5.93	
267		1869	8.80	1	8.80	5.94	1.48
268		2069	9.50	0	9.45	7.13	
269		2151	9.89	0		6.32	
270		1918	8.91	1	8.91	6.52	1.37
271		1985	9.10	1	9.10	5.99	1.52
272		2108	9.68	0		6.51	
273		2001	9.18	1	9.18	4.86	1.89
274		1851	8.77	1	8.77	4.82	1.82
275		1969	9.03	1	9.03	3.92	2.30
276		2020	9.27	0		4.80	
277		1948	8.97	1	8.97	6.12	1.46
278		2108	9.68	0	9.30	6.71	
279		1973	9.05	1	9.05	5.64	1.61
280		1743	8.54	1	8.54	5.54	1.54
281		1771	8.60	1	8.60	4.89	1.76
282		1398	7.82	1	7.82	4.90	1.60
283		1193	7.40	1	7.40	5.53	1.34
284		1140	7.29	1	7.29	4.52	1.61
285		1334	7.69	1	7.69	4.33	1.78
286		1610	8.26	1	8.26	3.99	2.07
287		1363	7.75	1	7.75	5.75	1.35
288		1123	7.26	1	7.26	5.31	1.37
289		1681	8.41	1	8.41	5.73	1.47
290		2177	10.05	0	9.79	5.08	
291		1998	9.16	1	9.16	5.25	1.75
292		2280		0	10.14	9.61	
293		2280		0	10.90	9.13	
294		2152	9.89	0	10.53	9.60	
295		2209	10.81	0	9.84	9.06	
296		2225		0	10.39	8.72	
297		2209	10.80	0	9.92	7.61	
298		2206	10.74	0	10.04	8.08	
299		2257		0	10.29	7.82	
300		2259		0	10.51	6.51	
301		2235		0	10.18	6.60	
302		2214	10.92	0	10.71	6.55	
303		2185	10.23	0	11.27	7.23	
304		2187	10.28	0	9.98	6.59	
305		2188	10.32	0	9.36	6.25	
306		2176	10.02	0		5.75	
307		2182	10.17	0		7.74	
308		1941	8.95	1	8.95	7.24	1.24
309		1912	8.89	1	8.89	4.75	1.87
310		1804	8.67	1	8.67	6.16	1.41
311		1788	8.63	1	8.63	6.78	1.27
312		1933	8.94	1	8.94	7.23	1.24
313		2131	9.79	0	9.50	4.94	
314		2226		0	10.26	4.54	
315		2266		0	10.20	6.47	
316		2104	9.67	0		6.58	
317		1666	8.38	1	8.38	6.02	1.39
318		2088	9.59	0		6.41	
319		2279		0	9.55	6.09	
320		2236		0	10.33	4.58	
321		2094	9.62	0		4.14	
322		2067	9.49	0	10.22	4.49	
323		2232		0	10.07	4.30	
324		1989	9.12	1	9.12	4.50	2.03
325		1741	8.54	1	8.54	5.40	1.58
326		1395	7.82	1	7.82	7.46	1.05
327		1328	7.68	1	7.68	7.49	1.03
328		1637	8.32	1	8.32	7.77	1.07
329		2054	9.43	0	10.34	6.66	
330		2274		0	10.50	7.52	
331		2276		0	10.08	7.14	
332		2197	10.53	0	9.87	7.12	
333		1624	8.29	1	8.29	5.52	1.50
334		1666	8.38	1	8.38	6.64	1.26
335		2068	9.50	0		7.55	
336		2235		0		7.50	
337		2236		0	9.98	7.58	
338		2311		0	10.77	6.30	
339		2283		0	11.79	8.29	
340		2179	10.10	0	10.60	7.57	
341		2070	9.50	0	9.64	6.33	
342		2191	10.37	0	10.53	5.59	
343		2261		0	11.36	6.43	
344		2240		0	10.28	5.57	
345		2221	11.95	0	10.38	5.90	
346		2248		0	10.66	7.57	
347		2156	9.91	0	10.67	6.19	
348		2177	10.05	0	10.06	6.25	
349		2237		0	10.82	5.64	
350		2286		0	11.38	5.96	
351		2258		0	12.14	7.02	
352		2211	10.86	0	10.91	6.24	
353		2183	10.19	0	10.00	9.45	
354		2222		0	10.93	6.99	
355		2214	10.93	0	10.27	6.54	
356		2229		0	9.92	8.31	
357		2197	10.52	0	9.96	7.42	
358		2213	10.90	0	10.42	7.20	
359		2192	10.40	0	9.95	7.43	
360		2187	10.29	0	10.52	7.04	
361		2233		0	9.56	8.02	
362		2223		0	9.47	8.92	
363		2182	10.16	0	9.54	7.43	
364		2182	10.16	0	9.83	6.53	
365		2113	9.71	0	9.36	5.12	
366		2060	9.46	0		4.56	
367		1749	8.55	1	8.55	5.40	1.59
368		1599	8.24	1	8.24	4.97	1.66
369		1747	8.55	1	8.55	5.69	1.50
370		1839	8.74	1	8.74	5.43	1.61
371		1907	8.88	1	8.88	6.37	1.40
372		1939	8.95	1	8.95	5.37	1.67
373		1976	9.06	1	9.06	5.29	1.71
374		1663	8.38	1	8.38	4.00	2.09
375		1703	8.46	1	8.46	4.59	1.84
376		1486	8.01	1	8.01	7.63	1.05
377		1446	7.92	1	7.92	6.20	1.28
378		1386	7.80	1	7.80	7.01	1.11
379		1350	7.73	1	7.73	8.83	0.87
380		1126	7.27	1	7.27	5.62	1.29
381		1113	7.24	1	7.24	4.75	1.52
382		1588	8.22	1	8.22	5.47	1.50
383		1845	8.75	1	8.75	5.19	1.69
384		1800	8.66	1	8.66	4.49	1.93
385		1511	8.06	1	8.06	4.55	1.77
386		1284	7.59	1	7.59	4.33	1.75
387		1218	7.45	1	7.45	5.07	1.47
388		1112	7.24	1	7.24	4.93	1.47
389		984	6.97	1	6.97	4.18	1.67
390		964	6.91	1	6.91	3.40	2.03
391		1157	7.33	1	7.33	6.12	1.20
392		1319	7.66	1	7.66	6.21	1.23
393		1330	7.69	1	7.69	5.76	1.34
394		2149	9.88	0	9.30	6.83	
395		2285		0	10.30	6.49	
396		2260		0	10.29	5.82	
397		2135	9.81	0	9.87	7.32	
398		2150	9.88	0	9.30	6.53	
399		2140	9.83	0		7.01	
400		2239		0		8.92	
401		2320		0	10.42	6.87	
402		2298		0	11.12	5.89	
403		2240		0	11.65	6.63	
404		2238		0	11.37	7.23	
405		2226		0	12.29	6.89	
406		2233		0	11.60	7.06	
407		2210	10.83	0	11.72	5.80	
408		2198	10.54	0	11.52	5.81	
409		2184	10.20	0	10.99	6.16	
410		2131	9.79	0	9.82	6.05	
411		2215	10.96	0	11.08	7.56	
412		2229		0	10.45	5.83	
413		2249		0	10.90	5.63	
414		2221		0	10.46	5.32	
415		2230		0	10.74	6.39	
416		2213	10.89	0	10.69	8.20	
417		2181	10.15	0	10.92	6.53	
418		2084	9.57	0	9.40	6.08	
419		1921	8.91	1	8.91	7.71	1.16
420		1842	8.75	1	8.75	5.70	1.53
421		1678	8.41	1	8.41	5.92	1.42
422		1466	7.97	1	7.97	5.59	1.43
423		1503	8.04	1	8.04	4.94	1.63
424		1931	8.93	1	8.93	4.60	1.94
425		2068	9.50	0	9.55	5.23	
426		2215	10.95	0	9.39	5.63	
427		2297		0	10.71	5.25	
428		2334		0	10.69	5.70	
429		2272		0	11.25	6.72	
430		2205	10.72	0	11.44	6.63	
431		2173	9.99	0	9.75	5.96	
432		2177	10.06	0	9.94	6.62	
433		2203	10.67	0	11.21	8.48	
434		2246		0	10.55	8.34	
435		2242		0	10.70	8.40	
436		2222		0	9.93	7.20	
437		2120	9.74	0		8.43	
438		2101	9.65	0		6.59	
439		1892	8.85	1	8.85	6.41	1.38
440		1956	8.98	1	8.98	6.38	1.41
441		1544	8.13	1	8.13	4.87	1.67
442		1469	7.97	1	7.97	6.57	1.21
443		1906	8.88	1	8.88	7.36	1.21
444		1821	8.70	1	8.70	6.79	1.28
445		1638	8.32	1	8.32	7.51	1.11
446		1733	8.52	1	8.52	6.41	1.33
447		1902	8.87	1	8.87	5.70	1.56
448		1792	8.64	1	8.64	6.50	1.33
449		1648	8.34	1	8.34	6.80	1.23
450		1944	8.96	1	8.96	7.74	1.16
451		2190	10.37	0		6.12	
452		2002	9.19	1	9.19	5.90	1.56
453		1906	8.88	1	8.88	6.04	1.47
454		1536	8.11	1	8.11	4.39	1.85
455		1466	7.97	1	7.97	5.37	1.48
456		1976	9.06	1	9.06	5.65	1.60
457		2013	9.23	1	9.23	6.70	1.38
458		2202	10.63	0	10.20	7.01	
459		2265		0	9.94	5.22	
460		2265		0	9.51	6.38	
461		2221	11.97	0	10.16	6.39	
462		2219	11.50	0	10.44	5.64	
463		2177	10.04	0	10.01	7.84	
464		2161	9.94	0	9.27	6.83	
465		1930	8.93	1	8.93	5.69	1.57
466		2223		0	9.94	5.25	
467		2230		0		5.98	
468		1916	8.90	1	8.90	5.52	1.61
469		1868	8.80	1	8.80	4.86	1.81
470		2138	9.82	0	9.75	5.22	
471		2097	9.63	0	9.83	4.60	
472		1737	8.53	1	8.53	4.34	1.97
473	1	1654	8.36	1		4.34	
474		1882	8.83	1	8.83	5.06	1.74
475		2025	9.29	0		5.85	
476		1778	8.61	1	8.61	5.20	1.66
477		1467	7.97	1	7.97	6.26	1.27
478		2116	9.72	0	9.59	5.11	
479		2262		0	10.03	5.16	
480		2226		0	10.08	5.93	
481		2208	10.79	0		5.01	
482		2267		0	10.69	5.33	
483		2244		0	10.04	6.91	
484		2209	10.82	0	11.30	6.02	
485		2271		0	11.70	6.01	
486		2261		0	10.93	8.29	
487		2246		0	10.67	7.15	
488		2214	10.93	0	10.46	8.40	
489		2212	10.87	0	10.53	7.49	
490		2217	10.99	0	10.53	6.90	
491		2186	10.25	0	10.40	6.26	
492		2159	9.92	0	10.47	5.19	
493		2197	10.53	0	10.71	6.82	
494		2056	9.44	0		6.15	
495		2022	9.28	0		5.28	
496		1943	8.96	1	8.96	5.06	1.77
497		1747	8.55	1	8.55	4.99	1.71
498		1740	8.53	1	8.53	6.55	1.30
499		2136	9.82	0	9.65	7.25	
500		2117	9.73	0	9.33	7.35	
501		2213	10.90	0	9.82	6.20	
502		2249		0	10.06	5.72	
503		2260		0	9.34	7.74	
504		2258		0	9.52	7.09	
505		2205	10.72	0	10.43	6.94	
506		2231		0	10.38	6.91	
507		2247		0	10.04	6.75	
508		2262		0	10.11	6.86	
509		2241		0	10.93	6.51	
510		2224		0	10.53	8.04	
511		2257		0	10.89	7.85	
512		2261		0	11.09	6.51	
513		2159	9.93	0	10.43	6.20	
514		2157	9.92	0	10.58	6.27	
515		2123	9.76	0	10.08	7.30	
516		2121	9.74	0	9.82	7.72	
517		2225		0	10.16	6.54	
518		2218	11.35	0	10.34	7.31	
519		2252		0	10.58	7.14	
520		2215	10.95	0	10.22	6.49	
521		2059	9.45	0	10.17	6.08	
522		1635	8.32	1	8.32	6.34	1.31
523		1886	8.84	1	8.84	4.60	1.92
524		1963	9.00	1	9.00	4.75	1.89
525		1982	9.09	1	9.09	5.21	1.74
526		2022	9.28	0	11.13	6.75	
527		2034	9.33	0	10.03	5.54	
528		1750	8.56	1	8.56	6.47	1.32

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)	10m Anemometer Wind Speed, $V_{z,m}$ (m/s)	$V_{P,n}/V_{Z,m}$
529		1551	8.14	1	8.14	7.91	1.03
530		1726	8.51	1	8.51	8.46	1.01
531		1829	8.72	1	8.72	6.38	1.37
532		2159	9.92	0	9.98	6.70	
533		1839	8.74	1	8.74	6.71	1.30
534		1566	8.17	1	8.17	6.97	1.17
535		1831	8.72	1	8.72	5.83	1.50
536		1826	8.71	1	8.71	6.46	1.35
537		2132	9.80	0	9.80	5.62	
538		2144	9.86	0		5.63	
539		1990	9.13	1	9.13	5.79	1.58
540		2281		0	9.76	5.07	
541		2303		0	10.58	5.43	
542		2294		0	10.91	6.05	
543		2227		0	10.67	6.67	
544		2192	10.40	0	10.06	8.21	
545		2195	10.49	0	10.62	8.23	
546		2259		0	11.40	7.29	
547		2251		0	10.80	8.05	
548		2130	9.79	0	10.61	7.45	
549		2173	9.99	0	10.36	5.39	
550		2277		0	10.64	4.34	
551		2253		0	10.12	5.37	
552		2210	10.83	0	10.84	5.25	
553		2231		0	10.16	5.27	
554		2275		0	11.74	7.36	
555		2224		0	10.46	6.11	
556		2123	9.76	0	9.58	7.54	
557		2152	9.89	0	10.11	6.02	
558		2172	9.99	0	10.32	5.88	
559		2246		0	9.83	4.83	
560		2267		0	9.95	5.26	
561		2228		0	9.56	7.37	
562		2171	9.98	0	9.50	8.08	
563		2210	10.83	0	10.62	8.04	
564		2234		0	10.01	7.11	
565		2202	10.64	0	9.73	6.56	
566		1926	8.92	1	8.92	6.77	1.32
567		2133	9.80	0	9.46	5.74	
568		2113	9.71	0	9.54	5.91	
569		2118	9.73	0	10.21	5.89	
570		1927	8.92	1	8.92	4.46	2.00
571	1	1718	8.49	1		5.52	
572	1	1637	8.32	1		5.23	
573		2176	10.03	0		5.07	
574		2301		0	10.07	6.25	
575		2279		0	11.53	5.33	
576		2256		0	10.59	5.91	
577		2210	10.83	0	11.23	5.97	
578		2179	10.08	0	10.81	6.98	
579		2200	10.59	0	10.60	6.60	
580		2228		0	9.88	5.58	
581	1	1147	7.31	1		6.82	
582		2174	10.00	0	10.92	6.95	
583		2190	10.36	0	10.78	7.45	
584		2237		0	10.87	6.66	
585		2229		0	10.49	6.13	
586		2021	9.27	0	9.30	4.49	
587		1998	9.16	1	9.16	4.78	1.92
588		2033	9.33	0	9.96	5.74	
589		1997	9.16	1	9.16	5.18	1.77
590		1774	8.61	1	8.61	4.75	1.81
591		1685	8.42	1	8.42	4.72	1.78
592		1684	8.42	1	8.42	5.56	1.51
593		1518	8.07	1	8.07	4.87	1.66
594		2127	9.78	0	9.31	4.96	
595		2283		0	10.17	3.93	
596		2010	9.22	1	9.22	5.29	1.74
597		2223		0	9.93	5.72	
598		1907	8.88	1	8.88	7.67	1.16
599		1771	8.60	1	8.60	5.58	1.54
600		1723	8.50	1	8.50	4.88	1.74
601		1772	8.60	1	8.60	6.36	1.35
602		1578	8.20	1	8.20	6.51	1.26
603		1586	8.21	1	8.21	6.54	1.26
604		1520	8.08	1	8.08	5.88	1.37
605		1679	8.41	1	8.41	6.45	1.30
606		1571	8.18	1	8.18	6.76	1.21
607		1411	7.85	1	7.85	6.88	1.14
608		1509	8.05	1	8.05	5.43	1.48
609		1728	8.51	1	8.51	4.63	1.84
610		2130	9.79	0		6.12	
611		2314		0	10.24	5.27	
612		2374		0	10.52	8.07	
613		2313		0	12.72	7.68	
614		2206	10.74	0	11.26	6.96	
615		2245		0	10.99	7.85	
616		2241		0	10.77	8.27	

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		2257		0	10.97	8.79	
618		2206	10.75	0	10.69	7.19	
619		2245		0	10.37	7.28	
620		2222		0	10.48	7.29	
621		2207	10.76	0	11.06	5.19	
622		2117	9.72	0	10.32	5.30	
623		1798	8.66	1	8.66	7.17	1.21
624		1962	9.00	1	9.00	6.81	1.32
625	0	1814	8.69	1	8.69	6.04	1.44
626	0	2009	9.21	1	9.21	5.69	1.62
627	0	2363		0	11.45	7.05	
628	0	2323		0	11.49	6.70	
629	0	2293		0	10.70	5.61	
630	0	2284		0	12.09	6.63	
631	0	2235		0	12.23	8.32	
632	0	2258		0	12.56	6.37	
633	0	2268		0	12.11	7.07	
634	0	2238		0	11.11	8.85	
635	0	2217	11.11	0	12.07	8.23	
636	0	2244		0	11.22	7.29	
637	0	2242		0	11.76	7.26	
638	0	2219	11.52	0	11.85	8.23	
639	0	2205	10.71	0	11.87	8.63	
640	0	2205	10.72	0	11.49	7.44	
641	0	2163	9.94	0	10.56	6.11	
642	0	2200	10.59	0	11.04	5.84	
643	0	2207	10.76	0	11.11	6.57	
644	0	2175	10.00	0	10.94	5.75	
645	0	1843	8.75	1	8.75	7.23	1.21
646	0	1978	9.07	1	9.07	8.60	1.05
647	0	2267		0		9.44	
648	0	2331		0	11.12	10.35	
649	0	2316		0	11.27	6.81	
650	0	2279		0	10.84	6.83	
651	0	2259		0	11.62	6.41	
652	0	2275		0	12.76	5.64	
653	0	2249		0	12.62	7.72	
654	0	2247		0	12.87	6.67	
655	0	2215	10.95	0	12.39	7.33	
656	0	2213	10.91	0	11.36	9.01	
657	0	2216	10.97	0	12.05	7.25	
658	0	2259		0	12.41	7.57	
659	0	2208	10.79	0	11.18	6.70	
660	0	2174	10.00	0	10.67	7.64	
661	0	1899	8.87	1	8.87	6.53	1.36
662	0	2029	9.31	0		6.80	
663	0	2299		0	10.65	8.01	
664	0	2284		0	11.53	7.12	
665	0	2281		0	10.66	6.33	
666	0	2276		0	10.66	8.36	
667	0	2254		0	10.69	6.56	
668	0	2159	9.92	0	10.32	7.07	
669	0	2201	10.62	0	9.91	8.17	
670	0	2181	10.14	0	10.07	7.34	
671	0	2182	10.16	0	10.02	6.70	
672	0	2200	10.59	0	9.56	7.00	
673	0	2250		0	10.10	7.15	
674	0	2243		0	9.98	6.80	
675	0	2298		0	11.13	7.96	
676	0	2306		0	11.42	5.53	
677	0	2220	11.73	0	10.98	6.10	
678	0	2212	10.89	0	10.93	8.19	
679	0	2231		0	10.13	8.36	
680	0	2233		0	10.94	8.41	
681	0	2272		0	11.52	9.64	
682	0	2251		0	12.42	7.90	
683	0	2214	10.92	0	12.13	8.74	
684	0	2199	10.56	0	11.65	7.61	
685	0	2217	11.05	0	11.24	6.01	
686	0	2249		0	12.15	5.91	
687	0	2226		0	12.07	5.23	
688	0	2215	10.94	0	11.06	7.19	
689	0	2197	10.53	0	11.21	7.14	
690	0	2254		0	12.70	6.20	
691	0	2240		0	11.46	7.73	
692	0	2158	9.92	0	11.80	4.84	
693	0	2167	9.96	0	10.87	6.65	
694	0	2208	10.79	0	10.96	7.72	
695	0	2212	10.88	0	9.99	7.98	
696	0	2064	9.47	0	9.84	7.16	
697	0	2225		0	10.82	7.00	
698	0	2200	10.59	0	9.35	5.90	
699	0	2190	10.35	0	10.45	6.70	
700	0	2256		0	9.96	5.88	
701	0	2235		0	10.39	4.03	
702	0	2304		0	10.07	7.82	
703	0	2304		0	10.75	7.01	
704	0	2275		0	11.92	7.89	

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	2263		0	11.94	7.06	
706	0	2202	10.65	0	12.51	7.19	
707	0	2189	10.34	0	11.84	5.81	
708	0	2072	9.52	0	11.37	5.62	
709	0	1745	8.55	1	8.55	6.05	1.41
710	0	1981	9.08	1	9.08	6.54	1.39
711	0	2088	9.59	0	9.50	5.91	
712	0	2249		0		7.04	
713	0	2199	10.57	0	9.94	8.78	
714	0	2215	10.95	0	9.47	6.61	
715	0	2287		0	9.78	7.22	
716	0	2302		0	11.32	8.43	
717	0	2244		0	11.31	8.37	
718	0	2205	10.72	0	11.07	7.76	
719	0	2246		0	10.22	6.59	
720	0	2238		0	10.36	6.11	
721	0	2185	10.25	0	10.27	5.47	
722	0	2152	9.89	0	10.62	5.89	
723	0	2123	9.75	0	9.73	6.83	
724	0	2170	9.98	0	10.34	7.36	
725	0	2269		0	10.54	6.70	
726	0	2293		0	10.93	6.25	
727	0	2250		0	10.21	5.80	
728	0	2182	10.17	0	9.93	5.63	
729	0	2141	9.84	0	10.32	5.80	
730	0	2251		0	10.65	5.84	
731	0	2231		0	10.06	7.43	
732	0	2098	9.64	0		6.48	
733	0	1862	8.79	1	8.79	6.01	1.46
734	0	2236		0	10.45	5.47	
735	0	2292		0	10.27	6.04	
736	0	2296		0	10.58	5.70	
737	0	2259		0	11.10	5.47	
738	0	2209	10.80	0	11.13	7.16	
739	0	2198	10.54	0	11.33	8.49	
740	0	2212	10.89	0	10.49	7.59	
741	0	2203	10.66	0	10.20	9.16	
742	0	2201	10.61	0	10.32	9.85	
743	0	2206	10.73	0	10.48	8.00	
744	0	2193	10.43	0	10.88	6.47	
745	0	2221	11.96	0	10.13	5.14	
746	0	2240		0	11.67	4.87	
747	0	2206	10.74	0	10.17	5.72	
748	0	2201	10.62	0	10.30	6.01	
749	0	2193	10.42	0	10.05	6.56	
750	0	2263		0	10.28	7.05	
751	0	2266		0	11.36	6.22	
752	0	2238		0	10.83	5.77	
753	0	2198	10.55	0	9.95	6.24	
754	0	2137	9.82	0	10.12	6.03	
755	0	2207	10.76	0	9.76	7.04	
756	0	2224		0	10.26	6.60	
757	0	2032	9.33	0	9.78	5.92	
758	0	2020	9.27	0		5.80	
759	0	2228		0		6.48	
760	0	2306		0	11.35	5.42	
761	0	2319		0	10.96	5.23	
762	0	2238		0	11.71	5.68	
763	0	2174	10.00	0	10.80	5.79	
764	0	2140	9.84	0	10.58	5.31	
765	0	2217	11.00	0	10.77	6.29	
766	0	2213	10.91	0	9.84	6.59	
767	0	2180	10.12	0	10.21	5.89	
768	0	2232		0	9.62	6.01	
769	0	2195	10.48	0	10.23	4.32	
770	0	2102	9.65	0	10.17	4.49	
771	0	1914	8.90	1	8.90	5.12	1.74
772	1	1801	8.66	1		4.67	
773	1	1750	8.56	1		4.07	
774	0	1880	8.83	1	8.83	5.28	1.67
775	0	1886	8.84	1	8.84	6.74	1.31
776	0	1940	8.95	1	8.95	6.77	1.32
777	0	2110	9.69	0	10.14	6.17	
778	0	2199	10.57	0	10.39	6.02	
779	0	2046	9.39	0	10.52	6.23	
780	0	2183	10.20	0	10.25	5.25	
781	0	1833	8.73	1	8.73	5.59	1.56
782	0	1657	8.36	1	8.36	5.25	1.59
783	0	1515	8.07	1	8.07	5.18	1.56
784	0	1710	8.47	1	8.47	3.92	2.16
785	0	1395	7.82	1	7.82	3.62	2.16
786	0	1320	7.66	1	7.66	3.63	2.11
787	0	1690	8.43	1	8.43	3.88	2.17
788	0	1850	8.76	1	8.76	4.35	2.02
789	0	1946	8.97	1	8.97	4.23	2.12
790	0	1786	8.63	1	8.63	4.00	2.16
791	0	1420	7.87	1	7.87	3.94	2.00
792	0	1375	7.78	1	7.78	5.19	1.50

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)	$V_{p,n}/V_{z,m}$
793	0	1326	7.68	1	7.68	5.55	1.38
794	0	1318	7.66	1	7.66	4.75	1.61
795	0	1412	7.85	1	7.85	4.66	1.69
796	0	1340	7.71	1	7.71	5.32	1.45
797	0	1287	7.60	1	7.60	5.10	1.49
798	0	1225	7.47	1	7.47	4.04	1.85
799	0	1511	8.06	1	8.06	3.02	2.67
800	0	1496	8.03	1	8.03	4.17	1.92
801	0	1548	8.14	1	8.14	4.82	1.69
802	0	1442	7.91	1	7.91	5.64	1.40
803	0	1456	7.94	1	7.94	4.63	1.72
804	0	1575	8.19	1	8.19	5.48	1.49
805	0	1595	8.23	1	8.23	4.79	1.72
806	0	2182	10.18	0	10.17	4.95	
807	0	2336		0	10.77	5.81	
808	0	2280		0	10.88	5.14	
809	0	2226		0	11.23	6.19	
810	0	2172	9.99	0	10.78	5.78	
811	0	2110	9.69	0	9.46	5.84	
812	0	2233		0	10.35	6.28	
813	0	2273		0	10.86	4.52	
814	0	2247		0	10.52	7.05	
815	0	2255		0	11.16	6.76	
816	0	2214	10.93	0	9.93	5.90	
817	0	2210	10.84	0	9.49	5.77	
818	0	2162	9.94	0	10.25	4.67	
819	0	2101	9.65	0		5.44	
820	0	2219	11.38	0	10.14	7.68	
821	0	2347		0	10.78	8.29	
822	0	2189	10.32	0	9.82	6.25	
823	0	2197	10.52	0	11.62	5.67	
824	0	2268		0	11.06	6.49	
825	0	2259		0	11.21	7.09	
826	0	2243		0	11.52	7.53	
827	0	2215	10.96	0	10.93	7.61	
828	0	2150	9.88	0	10.46	7.42	
829	0	2205	10.71	0	11.43	7.06	
830	0	2200	10.59	0	11.32	7.89	
831	0	2243		0	10.66	7.15	
832	0	2204	10.69	0	9.85	5.65	
833	0	2217	11.04	0	10.28	4.71	
834	0	2076	9.53	0	9.40	6.69	
835	0	1985	9.10	1	9.10	8.53	1.07
836	0	2086	9.58	0	9.36	7.77	
837	0	1964	9.00	1	9.00	6.39	1.41
838	0	2204	10.70	0	9.60	5.53	
839	0	2246		0	10.63	5.88	
840	0	2228		0	9.74	6.38	
841	0	2281		0	10.47	6.08	
842	0	2254		0	9.68	7.01	
843	0	2067	9.49	0	9.26	8.04	
844	0	2010	9.22	1	9.22	6.25	1.48
845	0	1945	8.96	1	8.96	5.74	1.56
846	0	1949	8.97	1	8.97	4.99	1.80
847	0	2058	9.45	0	9.46	5.09	
848	0	2236		0	10.53	6.47	
849	0	2260		0	9.65	6.09	
850	0	2218	11.14	0	9.90	6.25	
851	0	2131	9.79	0	9.32	5.52	
852	0	1966	9.01	1	9.01	4.75	1.90
853	0	1984	9.10	1	9.10	6.43	1.42
854	0	1871	8.81	1	8.81	5.97	1.48
855	0	2075	9.53	0		5.65	
856	0	2198	10.55	0	10.16	7.42	
857	0	2322		0	10.42	5.78	
858	0	2274		0	10.01	6.28	
859	0	2226		0	10.38	6.34	
860	0	2233		0	10.98	5.27	
861	0	2263		0	10.65	4.53	
862	0	2228		0	11.15	4.85	
863	0	2187	10.29	0	11.38	4.23	
864	0	2199	10.56	0	10.98	5.02	
865	0	2200	10.59	0	11.32	7.17	
866	0	2233		0	10.98	6.69	
867	0	2220	11.70	0	11.10	6.60	
868	0	2170	9.98	0	10.46	8.11	
869	0	2186	10.27	0	10.14	7.08	
870	0	2271		0	9.92	7.77	
871	0	2233		0	10.19	6.41	
872	0	2221	11.92	0	11.10	6.60	
873	0	2173	9.99	0	10.27	7.04	
874	0	2189	10.33	0	10.55	5.75	
875	0	2246		0	10.28	5.19	
876	0	2195	10.48	0	10.40	5.98	
877	0	2011	9.23	1	9.23	5.35	1.73
878	0	1849	8.76	1	8.76	4.61	1.90
879	0	1903	8.87	1	8.87	6.22	1.43
880	0	2003	9.19	1	9.19	6.32	1.45

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)	$V_{p,n}/V_{z,m}$
881	0	2034	9.34	0	9.37	6.28	
882	0	2045	9.39	0	10.04	5.63	
883	0	1993	9.14	1	9.14	5.54	1.65
884	0	1895	8.86	1	8.86	5.23	1.69
885	0	2105	9.67	0	9.81	5.25	
886	0	2139	9.83	0	9.32	4.41	
887	0	2066	9.49	0	10.69	6.47	
888	0	1799	8.66	1	8.66	6.87	1.26
889	0	1839	8.74	1	8.74	5.95	1.47
890	0	2259		0	10.47	6.02	
891	0	2299		0	10.86	5.85	
892	0	2299		0	11.21	6.24	
893	0	2291		0	11.40	6.49	
894	0	2236		0	11.77	6.65	
895	0	2174	10.00	0	9.68	7.92	
896	0	2153	9.90	0	10.37	6.64	
897	0	2220	11.69	0	11.17	6.78	
898	0	2175	10.00	0	9.32	6.51	
899	0	2228		0	9.44	6.41	
900	0	2169	9.97	0		5.14	
901	0	2281		0	9.78	7.41	
902	0	2241		0	10.94	7.34	
903	0	2226		0	10.80	5.66	
904	0	2192	10.40	0	10.31	5.83	
905	0	2236		0	10.85	6.70	
906	0	2234		0	11.22	6.25	
907	0	2274		0	10.48	5.75	
908	0	2252		0	10.71	5.42	
909	0	2209	10.82	0	10.41	6.60	
910	0	2175	10.01	0	10.25	6.83	
911	0	1996	9.16	1	9.16	5.32	1.72
912	0	1718	8.49	1	8.49	5.47	1.55
913	0	1770	8.60	1	8.60	7.76	1.11
914	0	2095	9.62	0	9.28	6.11	
915	0	1916	8.90	1	8.90	4.79	1.86
916	0	1789	8.64	1	8.64	4.88	1.77
917	0	2020	9.27	0	9.61	5.22	
918	0	1873	8.81	1	8.81	6.02	1.46
919	0	2037	9.35	0		6.31	
920	0	2266		0	9.33	6.19	
921	0	2251		0	9.43	6.08	
922	0	1989	9.12	1	9.12	5.46	1.67
923	0	2149	9.88	0	9.42	4.54	
924	0	2252		0	10.02	5.13	
925	0	2223		0	10.24	4.17	
926	0	2223		0	9.29	4.58	
927	0	2280		0	10.95	5.56	
928	0	2263		0	10.82	7.84	
929	0	2262		0	10.41	6.93	
930	0	2240		0	10.67	6.53	
931	0	2288		0	11.30	6.31	
932	0	2188	10.30	0	10.13	7.19	
933	0	2140	9.84	0	9.62	6.77	
934	0	2170	9.97	0	10.11	5.53	
935	0	2206	10.73	0	11.08	6.07	
936	0	2200	10.60	0	9.99	5.71	
937	0	2203	10.66	0	10.07	5.93	
938	0	2293		0	11.16	5.35	
939	0	2290		0	10.90	4.65	
940	0	2286		0	11.25	6.11	
941	0	2222		0	11.34	5.30	
942	0	2157	9.92	0	10.56	5.44	
943	0	2279		0	12.06	6.91	
944	0	2253		0	11.78	7.08	
945	0	2260		0	12.23	6.52	
946	0	2258		0	12.30	6.11	
947	0	2202	10.64	0	11.66	8.19	
948	0	2127	9.77	0	11.58	9.68	
949	0	2154	9.90	0	10.03	8.34	
950	0	2215	10.96	0	10.66	8.25	
951	0	2220	11.77	0	10.07	6.62	
952	0	2214	10.93	0	10.44	6.42	
953	0	2167	9.96	0	10.18	5.65	
954	0	2210	10.84	0	9.97	6.13	
955	0	2095	9.62	0	10.35	6.86	
956	0	2277		0	10.47	7.15	
957	0	2308		0	11.28	5.85	
958	0	2276		0	11.18	5.17	
959	0	2209	10.81	0	11.44	5.02	
960	0	2181	10.15	0	10.68	7.19	
961	0	1944	8.96	1	8.96	8.93	1.00
962	0	1889	8.85	1	8.85	6.37	1.39
963	0	2257		0	9.27	6.34	
964	0	2342		0	11.66	7.47	
965	0	2264		0	10.29	5.87	
966	0	2271		0	11.42	7.89	
967	0	2218	11.33	0	11.98	7.95	
968	0	2233		0	12.22	6.88	

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)	$V_{p,n}/V_{z,m}$
969	0	2209	10.81	0	12.03	4.74	
970	0	2178	10.08	0	10.80	5.34	
971	0	2164	9.95	0	10.20	7.51	
972	0	2183	10.18	0	9.48	7.08	
973	0	2275		0	11.01	6.48	
974	0	2247		0	11.23	5.50	
975	0	2189	10.33	0	10.88	4.77	
976	0	2121	9.75	0	9.90	5.69	
977	0	1883	8.83	1	8.83	5.82	1.52
978	0	2168	9.97	0	9.88	5.95	
979	0	2291		0	10.03	7.84	
980	0	2114	9.71	0	10.08	6.86	
981	0	1931	8.93	1	8.93	6.59	1.36
982	0	2253		0	9.85	5.46	
983	0	2219	11.48	0	9.70	6.32	
984	0	2275		0	10.38	6.98	
985	0	2290		0	11.64	7.45	
986	0	2253		0	10.56	7.40	
987	0	2217	11.03	0	10.87	6.96	
988	0	2158	9.92	0	10.45	8.42	
989	0	2108	9.68	0	9.86	7.89	
990	0	2108	9.68	0	9.90	6.15	
991	0	2266		0	10.57	6.00	
992	0	2234		0	9.40	5.91	
993	0	2178	10.06	0	9.80	5.81	
994	0	2045	9.38	0		6.33	
995	0	1968	9.02	1	9.02	6.24	1.44
996	0	1929	8.93	1	8.93	6.43	1.39
997	0	2247		0	10.75	5.87	
998	0	2315		0	10.45	6.37	
999	0	2292		0	10.20	7.15	
1000	0	2201	10.62	0	10.43	6.37	
1001	0	2153	9.90	0	10.50	4.97	
1002	0	2177	10.05	0	10.23	7.97	
1003	0	2226		0	10.47	6.78	
1004	0	2229		0	10.19	5.17	
1005	0	2257		0	10.39	5.79	
1006	0	2174	10.00	0	9.66	5.38	
1007	0	2268		0	10.67	6.70	
1008	0	2308		0	11.10	7.45	
1009	1	2220	11.70	0		7.52	
1010	1	2180	10.13	0		7.67	
1011	1	2236		0		7.56	
1012	1	2243		0		7.46	
1013	1	2263		0		6.55	
1014	0	2184	10.21	0	10.43	7.64	
1015	0	2212	10.89	0	10.59	8.28	
1016	0	2219	11.38	0	9.83	6.51	
1017	0	2179	10.11	0	10.26	5.45	
1018	0	1566	8.17	1	8.17	5.26	1.55
1019	0	1637	8.32	1	8.32	4.39	1.89
1020	0	2089	9.59	0		4.59	
1021	0	2177	10.04	0	9.36	4.13	

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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.T244.R4) for data points collected during Turbine ON measurements [Data point #1 and #2]

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 #2

Average Active Power measured for Data Point #2 (x) = 1860 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 =	8	m/s
x_0 =	1483	kW
y_1 =	9	m/s
x_1 =	1963	kW
x =	1860	kW
y =	8.79	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} =	0.9808	
$V_{nac,m}$ =	9.71	m/s
$V_{nac,n}$ =	9.52	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	-44.42
1	0	-44.42
2	0	21.58
3	66	60.58
4	171	134.58
5	350	225.58
6	620	332.58
7	997	441.58
8	1483	435.58
9	1963	167.58
10	2175	-2.42
11	2217	-40.42
12	2221	-44.42
13	2221	-44.42
14	2221	-44.42
15	2221	-44.42
16	2221	-44.42
17	2221	-44.42
18	2221	-44.42
19	2221	-44.42
20	2221	-44.42
21	2221	-44.42
22	2221	-44.42
23	2221	-44.42
24	2221	-44.42
25	2221	

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	2	m/s
Max allowable range	9	m/s
Power Output	2221	kW
85% Power	1887.85	kW
Corresponding wind speed	8.84	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	0.9808	
k_Z	1.4710	

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Calibration Certificates

West Caldwell Calibration Laboratories Inc.

Certificate of Calibration

for

MICROPHONE UNIT

Manufactured by:	BRUEL & KJAER
Model No:	4189-A-021
Serial No:	2622169
Calibration Recall No:	28016

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

Felix Christopher (QA Mgr.)

Calibration Date: 05-Sep-17

Certificate No: 28016 - 1

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

ISO/IEC 17025:2005

ACCREDITED

Calibration Lab. Cert. # 1533.01

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 Microphone Unit

Model No.: 4189-A-021 Serial No.: 2622169
Mic. Model No.: 4189 Serial No.: 2625417
Preamp. Model No.: 2671 Serial No.: 2614900
Company: Aercoustics Engineering LTD. I. D. No.: XXXX

Calibration results:

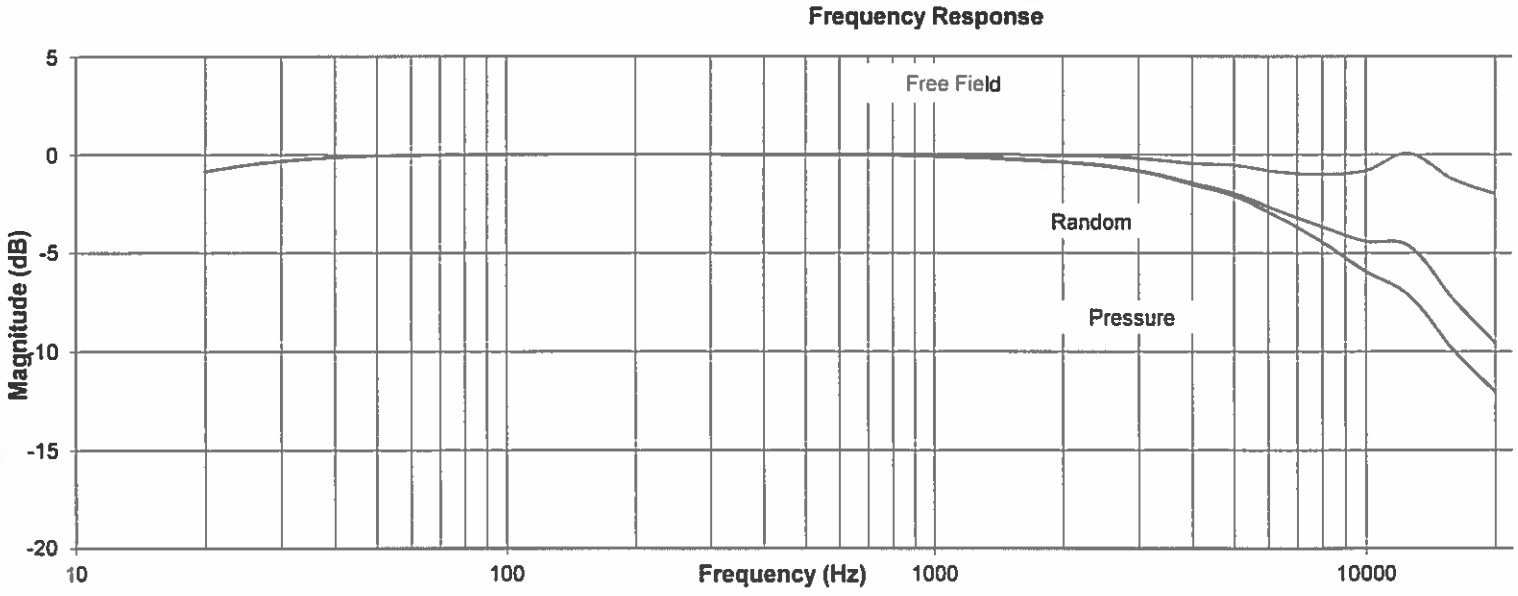
Before & after data same: ...X...

Combined Sensitivity @	250	Hz	and pressure of	98.432	kPa	
(Sens. with mic. and preamp.)	0	Volts Polarization voltage (External):				
	-26.54	dB re.1V/Pascal				
	47.10	mV/Pascal				
	0.54	Ko (- dB re 50 mV/Pascal)				
Sensitivity:	Pass					
Freq. Response:	Pass					
All tests:	Pass					

Ambient Temperature:	21.8	°C
Ambient Humidity:	56.4	% RH
Ambient Pressure:	98.432	kPa
Calibration Date:	5-Sep-2017	
Calibration Due:	5-Sep-2018	
Report Number:	28016	-1
Control Number:	28016	

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.: 2622169**
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	-0.85	-0.85	-0.85
25.12	-0.51	-0.51	-0.51
31.62	-0.28	-0.28	-0.28
39.81	-0.14	-0.14	-0.14
50.12	-0.06	-0.06	-0.06
63.10	-0.02	-0.02	-0.02
79.43	-0.01	-0.01	-0.01
100.00	0.00	0.00	0.00
125.89	0.00	0.00	0.00
158.49	0.00	0.00	0.00
199.53	0.01	0.01	0.01
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	0.01	-0.02
794.33	-0.05	0.02	-0.05
1000.00	-0.09	0.01	-0.11
1258.93	-0.14	0.01	-0.17
1584.89	-0.23	-0.01	-0.29
1995.26	-0.39	-0.06	-0.39
2511.89	-0.59	-0.11	-0.55
3162.28	-0.94	-0.23	-0.91
3981.07	-1.51	-0.45	-1.42
5011.87	-2.11	-0.53	-1.97
6309.57	-3.15	-0.87	-2.83
7943.28	-4.38	-1.00	-3.63
10000.00	-5.92	-0.80	-4.39
12589.25	-7.13	0.07	-4.62
15848.93	-9.80	-1.21	-7.22
19952.62	-12.02	-1.97	-9.54

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: 5-Sep-2017 **Tested by: James Zhu**

Calibrated on WCCL system type 9700

Rev. 7.0 Jan. 24, 2014 Doc. # 1038 P4189A021B&K

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

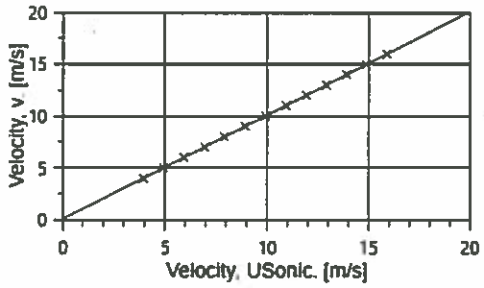
Certificate number: 17.US1.10370 **Date of issue:** November 16, 2017
Type: Vaisala Weather Transmitter, WXT520 **Serial number:** G4420002
Manufacturer: Vaisala, Oyj, Pl 26, FIN-00421 Helsinki, Finland
Client: Aercoustics Engineering Ltd., 1004 Middlegate RD, Suite 1100, S.Tower, Mississauga, ON L4Y 1M4, Canada

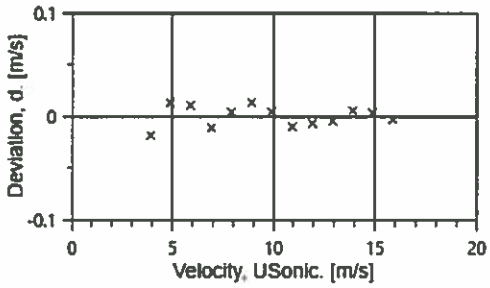
Anemometer received: November 15, 2017 **Anemometer calibrated:** November 15, 2017
Calibrated by: MEJ **Procedure:** MEASNET, IEC 61400-12-1:2017 Annex F
Certificate prepared by: EJF **Approved by:** Calibration engineer, EJF

Calibration equation obtained: $v\,[m/s] = 1.00118 \cdot f\,[m/s] + 0.06286$

Standard uncertainty, slope: 0.00077 **Standard uncertainty, offset:** 0.13048
Covariance: -0.0000059 $(m/s)^2/m/s$ **Coefficient of correlation:** $\rho = 0.999997$
Absolute maximum deviation: -0.019 m/s at 3.969 m/s
Barometric pressure: 1011.5 hPa **Relative humidity:** 21.9%

Succession	Velocity pressure, q. [Pa]	Temperature in wind tunnel [°C]	Temperature in 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	9.39	22.0	26.0	3.969	3.9200	-0.019	0.024
4	14.85	22.0	26.0	4.992	4.9103	0.013	0.025
6	21.38	22.0	26.0	5.990	5.9100	0.011	0.027
8	29.13	22.1	26.0	6.993	6.9333	-0.011	0.029
10	38.09	22.1	26.0	7.996	7.9200	0.004	0.032
12	48.35	22.1	26.0	9.010	8.9233	0.013	0.035
13-last	59.50	22.1	26.0	9.996	9.9172	0.004	0.038
11	72.14	22.0	26.0	11.006	10.9400	-0.010	0.041
9	85.76	22.0	26.0	12.000	11.9300	-0.007	0.044
7	100.55	22.0	26.0	12.993	12.9200	-0.005	0.047
5	116.73	22.0	26.0	14.000	13.9150	0.006	0.050
3	133.56	22.0	26.0	14.974	14.8900	0.004	0.053
1-first	152.12	21.9	26.0	15.979	15.9000	-0.003	0.057





AC-1746

EQUIPMENT USED

Serial Number	Description
Njord1	Wind tunnel, blockage factor = 1.0035
2254	Control cup anemometer
-	Mounting tube, D = 19 mm
TT003	Summit Electronics, 1XPT100, 0-10V Output, wind tunnel temp.
TP001	PR Electronics 5102, 0-10V Output, differential pressure box temp.
DP004	Setra Model 239, 0-1inWC, differential pressure transducer
HY002	Dwyer RHP-2D20, 0-10V Output, humidity transmitter
BP001	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.

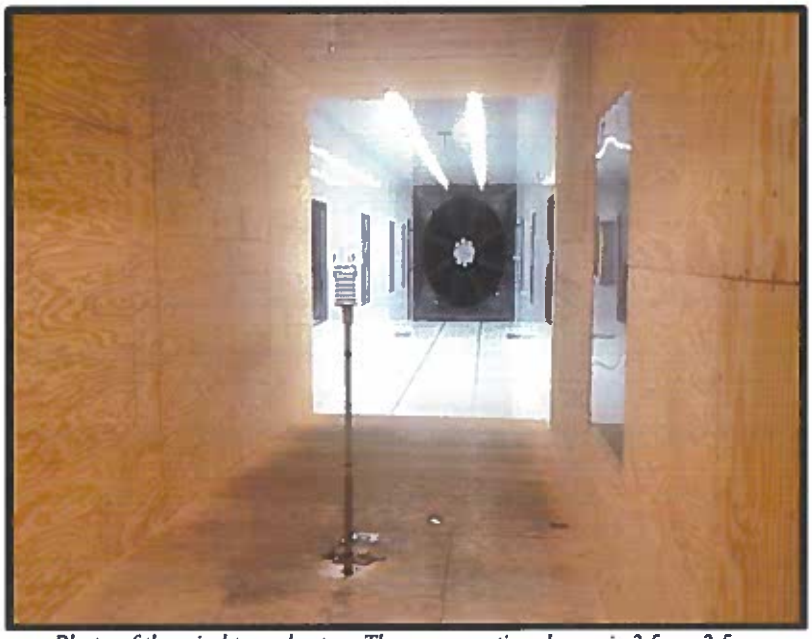


Photo of the wind tunnel setup. The cross-sectional area is 2.5m x 2.5m.

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.

COMMENTS

This sensor was calibrated at 0° for this certificate.

Certificate number: 17.US1.10370

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

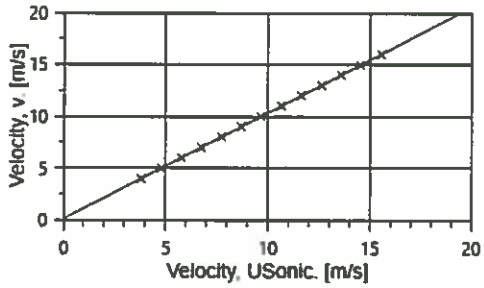
Certificate number: 17.US1.10369 **Date of issue:** November 16, 2017
Type: Vaisala Weather Transmitter, WXT520 **Serial number:** G4420002
Manufacturer: Vaisala, Oyj, Pl 26, FIN-00421 Helsinki, Finland
Client: Aercoustics Engineering Ltd., 1004 Middlegate RD, Suite 1100, S.Tower, Mississauga, ON L4Y 1M4, Canada

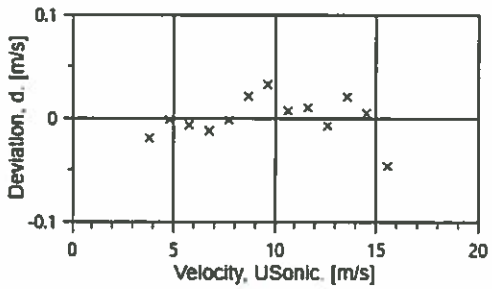
Anemometer received: November 15, 2017 **Anemometer calibrated:** November 15, 2017
Calibrated by: MEJ **Procedure:** MEASNET, IEC 61400-12-1:2017 Annex F
Certificate prepared by: EJF **Approved by:** Calibration engineer, EJF

Calibration equation obtained: v [m/s] = 1.02399 · f [m/s] + 0.09265

Standard uncertainty, slope: 0.00156 **Standard uncertainty, offset:** 0.17838
Covariance: -0.0000247 (m/s)²/m/s **Coefficient of correlation:** ρ = 0.999987
Absolute maximum deviation: -0.046 m/s at 15.979 m/s
Barometric pressure: 1011.1 hPa **Relative humidity:** 22.0%

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	9.41	22.0	26.0	3.975	3.8100	-0.019	0.024
4	14.86	22.0	26.0	4.996	4.7897	-0.002	0.025
6	21.40	22.1	26.0	5.994	5.7700	-0.007	0.027
8	29.14	22.1	26.0	6.996	6.7533	-0.012	0.029
10	38.16	22.1	26.0	8.006	7.7300	-0.002	0.032
12	48.35	22.1	26.0	9.012	8.6900	0.021	0.035
13-last	59.54	22.1	26.0	10.001	9.6448	0.032	0.038
11	72.13	22.1	26.0	11.009	10.6533	0.007	0.041
9	85.87	22.1	26.0	12.012	11.6300	0.010	0.044
7	100.56	22.1	26.0	12.998	12.6100	-0.008	0.047
5	116.94	22.0	26.0	14.015	13.5767	0.020	0.050
3	133.53	22.0	26.0	14.976	14.5300	0.005	0.053
1-first	152.03	22.0	26.0	15.979	15.5600	-0.046	0.057





AC-1746

EQUIPMENT USED

Serial Number	Description
Njord1	Wind tunnel, blockage factor = 1.0035
2254	Control cup anemometer
-	Mounting tube, D = 19 mm
TT003	Summit Electronics, 1XPT100, 0-10V Output, wind tunnel temp.
TP001	PR Electronics 5102, 0-10V Output, differential pressure box temp.
DP004	Setra Model 239, 0-1inWC, differential pressure transducer
HY002	Dwyer RHP-2D20, 0-10V Output, humidity transmitter
BP001	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.

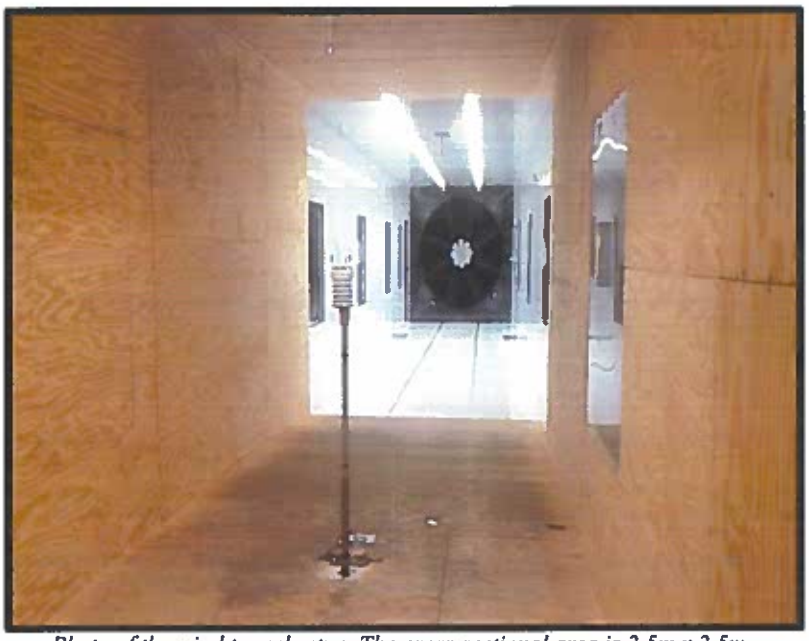


Photo of the wind tunnel setup. The cross-sectional area is 2.5m x 2.5m.

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.

COMMENTS

This sensor was calibrated at 90° for this certificate.

Certificate number: 17.US1.10369

West Caldwell Calibration Laboratories Inc.

Certificate of Calibration

for

ACOUSTICAL CALIBRATOR

Manufactured by:	BRUEL & KJAER
Model No:	4231
Serial No:	3012378
Calibration Recall No:	28460

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. 4231 BRUE

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

Within (X)

tolerance of the indicated specification. See attached Report of Calibration.
The information supplied relates to the calibrated item listed above.
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

Felix Christopher (QA Mgr.)

Calibration Date: 30-Jan-18

Certificate No: 28460 - 1

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.: 3012378**
Company: Aercoustics Engineering Ltd. **ID No.: XXXX**

Calibration results:

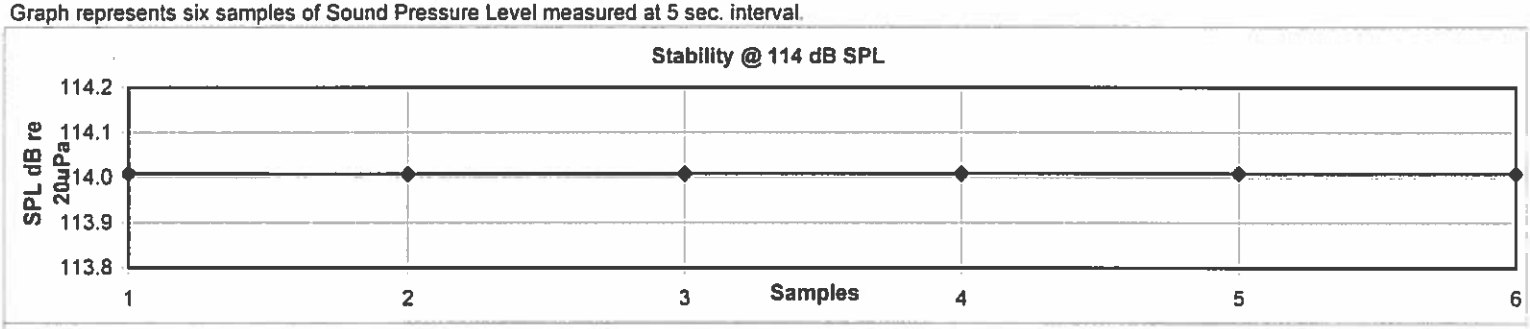
Before data: ..... **After data:** .....
Before & after data same: ...X...
Sound Pressure Level at 1000.0 Hz and pressure of 1013 hPa (mbar)
was 114.01 dB re 20 µPa
(Calibrator tested with ½" adaptor UC 0210)
IEC 1094-4 Type WS 2 P Microphone was used for measurement.

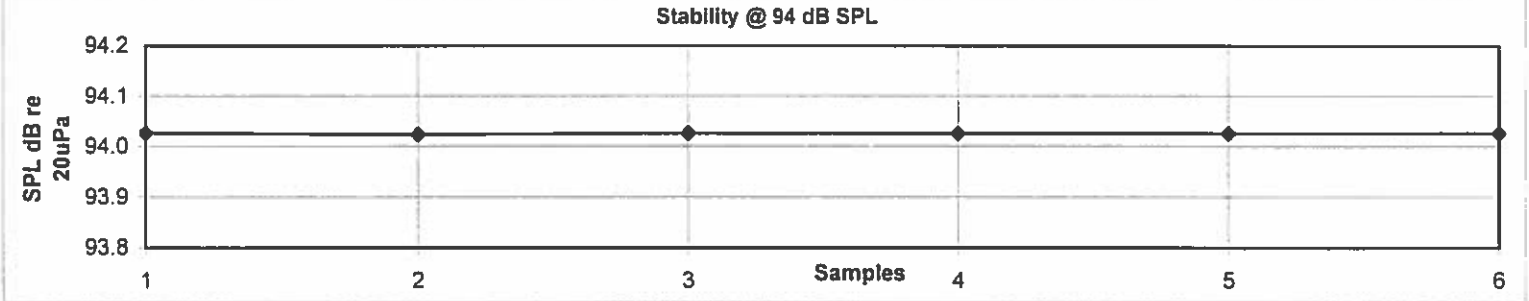
	114 dB	94 dB
Sound Pressure Level:	Pass	Pass
Frequency:	Pass	Pass
Distortion:	Pass	Pass
Stability:	Pass	Pass
All tested parameters:		Pass

Laboratory Environment:		
Ambient Temperature:	22.0	°C
Ambient Humidity:	30.9	% RH
Ambient Pressure:	99.768	kPa
Calibration Date:	30-Jan-2018	
Calibration Due:	30-Jan-2019	
Report Number:	28460 -1	
Control Number:	28460	

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: 822/275722-14
The expanded uncertainty of calibration: 0.11 dB at 95% confidence level with a coverage factor of k=2.

Graph represents six samples of Sound Pressure Level measured at 5 sec. 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: 30-Jan-2018

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.: 3012378**
Company: Aercoustics Engineering Ltd.

All tested parameters: Pass

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

Sample	1	114.01 dB re 20 µPa	94.03 dB re 20 µPa	
	2	114.01	94.02	
	3	114.01	94.03	
	4	114.01	94.03	
	5	114.01	94.03	
	6	114.01	94.03	
	Average	**114.01** Spec. 114dB ± 0.2dB	**94.03**	Spec. 94 dB ± 0.2 dB

Frequency measured (Three samples at 30 sec. Interval)

Sample	1	999.99 Hz	1000.00 Hz	
	2	999.99	999.99	
	3	999.99	1000.00	
	Average	**999.99**	**1000.00**	Spec. 1000 Hz ±0.1%

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

Distortion measured	-54.9 dB	-53.8 dB	Spec. ≤-40 dB

Instruments used for calibration:			Date of Cal.	Traceability No.	Re-cal. Due Date
Brüel & Kjær	4231	S/N 2308998	1-Aug-2017	822/275722-14	1-Aug-2018
Brüel & Kjær	4134	S/N 854464	1-Aug-2017	822/275722-14	1-Aug-2018
Brüel & Kjær	2669	S/N 2148476	1-Aug-2017	683/281764-14	1-Aug-2018
HP	34401A	S/N US360980	1-Aug-2017	,205342	1-Aug-2018
Brüel & Kjær	2636	S/N 1323964	1-Aug-2017	822/275722-14	1-Aug-2018
HP	33120A	S/N US360458	1-Aug-2017	,205342	1-Aug-2018

Cal. Date: 30-Jan-2018 **Tested by: James Zhu**

Calibrated on WCCL system type 9700

TRANSCAT CANADA
Trust in every measure

CERTIFICATE OF CALIBRATION

Customer: AEROCOUSTICS ENGINEERING LTD
1004 MIDDLEGATE ROAD
SUITE 1100
MISSISSAUGA, ON L4Y 1M4
PO Number: TR2018.02.14

SCC Accredited LAB — LAB Accrédité CCN
SCC Lab No 827

CLAS NRC·CNRC CLAS CLAS 2016-02

ilac-MRA

Certificate/SO Number: 33-Q0W0C-20-1 Revision 0

Manufacturer: Nokeval
Model Number: 7470
Description: Serial to Analog Converter
Serial Number: A159784
ID: NONE

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

Calibration Date: Feb 20, 2018
Due Date: Feb 20, 2020

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. Any measurements on an accredited calibration not covered by that Lab's Scope of Accreditation are listed in the notes section of the certificate. 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 QAC-P01-000 Revision 1.0, the customer's Purchase Order and/or Quality Agreement requirements, ISO 9001:2008, ANSI/NCSL Z540.1-1994 (R2002). Complete records of work performed are maintained by Transcat and are available for inspection. Laboratory standards used in the performance of this calibration are listed below.

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 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 upon written request 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. 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. Recorded calibration data is valid at the time of calibration within the stated uncertainties at the environmental conditions noted. The determination of compliance to the specification is specific to the model/serial no./ID no. referenced above based on the tolerances shown; these tolerances are either the original equipment manufacturers (OEM's) warranted specifications or the client's requested specifications. 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).

TRANSCAT CANADA
Trust in every measure

CERTIFICATE OF CALIBRATION

Customer: AEROCOUSTICS ENGINEERING LTD
1004 MIDDLEGATE ROAD
SUITE 1100
MISSISSAUGA, ON L4Y 1M4
PO Number: TR2018.02.14

SCC Accredited LAB — LAB Accrédité CCN — SCC Lab No 827
CLAS CLAS 2016-02
ilac-MRA

Certificate/SO Number: 33-Q0W0C-20-1 Revision 0

As Found/As Left Data

Description	Setpoints	Accuracy	Low Limit	High Limit	As Found / As Left	OOT	Cal Process Uncertainty (k=2; ±)	Measurement Uncertainty (k=2; ±)	Units	TUR
DC Current % Source - 4-20mA Ch #1										
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	7.995 mA		2.7e-004	1.9e-003	mA	59.3 : 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	19.998 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	7.999 mA		2.7e-004	1.9e-003	mA	59.3 : 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	16.002 mA		1.3e-003	2.3e-003	mA	12.3 : 1
	100%	±(0.1% Span)	19.984	20.016	19.999 mA		1.4e-003	2.3e-003	mA	11.4 : 1
DC Current % Source - 4-20mA Ch #3										
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		2.7e-004	1.9e-003	mA	59.3 : 1
	50%	±(0.1% Span)	11.984	12.016	11.996 mA		1.1e-003	2.2e-003	mA	14.5 : 1
	75%	±(0.1% Span)	15.984	16.016	16.002 mA		1.3e-003	2.3e-003	mA	12.3 : 1
	100%	±(0.1% Span)	19.984	20.016	20.002 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	3.997 mA		1.6e-004	1.9e-003	mA	100.0 : 1
	25%	±(0.1% Span)	7.984	8.016	7.995 mA		2.7e-004	1.9e-003	mA	59.3 : 1
	50%	±(0.1% Span)	11.984	12.016	11.999 mA		1.1e-003	2.2e-003	mA	14.5 : 1
	75%	±(0.1% Span)	15.984	16.016	15.997 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

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PO Number: TR2018.02.14

SCC Accredited LAB — LAB Accrédité CCN
SCC Lab No 827

CLAS ARC·CNRC CLAS CLAS 2016-02

ilac-MRA

Certificate/SO Number: 33-Q0W0C-20-1 Revision 0

As Found/As Left Data

Description	Setpoints	Accuracy	Low Limit	High Limit	As Found / As Left	OOT	Cal Process Uncertainty (k=2; ±)	Measurement Uncertainty (k=2; ±)	Units	TUR
DC Current % Source - 0-20mA Ch #1										
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	4.997 mA		1.9e-004	2.3e-003	mA	100.0 : 1
	50%	±(0.1% Span)	9.980	10.020	9.997 mA		3.2e-004	2.3e-003	mA	62.5 : 1
	75%	±(0.1% Span)	14.980	15.020	14.998 mA		1.2e-003	2.6e-003	mA	16.7 : 1
	100%	±(0.1% Span)	19.980	20.020	19.998 mA		1.4e-003	2.7e-003	mA	14.3 : 1
DC Current % Source - 0-20mA Ch #2										
0 - 20mA	0%	±(0.1% Span)	-0.020	0.020	0.002 mA		9.2e-007	2.3e-003	mA	100.0 : 1
	25%	±(0.1% Span)	4.980	5.020	4.996 mA		1.9e-004	2.3e-003	mA	100.0 : 1
	50%	±(0.1% Span)	9.980	10.020	10.000 mA		3.2e-004	2.3e-003	mA	62.5 : 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	19.999 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	0.001 mA		9.2e-007	2.3e-003	mA	100.0 : 1
	25%	±(0.1% Span)	4.980	5.020	4.996 mA		1.9e-004	2.3e-003	mA	100.0 : 1
	50%	±(0.1% Span)	9.980	10.020	9.996 mA		3.2e-004	2.3e-003	mA	62.5 : 1
	75%	±(0.1% Span)	14.980	15.020	14.996 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	0.001 mA		9.2e-007	2.3e-003	mA	100.0 : 1
	25%	±(0.1% Span)	4.980	5.020	4.992 mA		1.9e-004	2.3e-003	mA	100.0 : 1
	50%	±(0.1% Span)	9.980	10.020	9.997 mA		3.2e-004	2.3e-003	mA	62.5 : 1
	75%	±(0.1% Span)	14.980	15.020	14.996 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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Description	Setpoints	Accuracy	Low Limit	High Limit	As Found / As Left	OOT	Cal Process Uncertainty (k=2; ±)	Measurement Uncertainty (k=2; ±)	Units	TUR
DC Voltage % Source - 0-5V Ch#1										
0 -5V	0%	±(0.1% Span)	-0.0050	0.0050	0.0009 V		5.0e-007	5.8e-004	V	100.0 : 1
	20%	±(0.1% Span)	0.9950	1.0050	1.0010 V		5.5e-006	5.8e-004	V	100.0 : 1
	40%	±(0.1% Span)	1.9950	2.0050	2.0001 V		1.1e-005	5.8e-004	V	100.0 : 1
	60%	±(0.1% Span)	2.9950	3.0050	2.9984 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	4.9988 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	0.0002 V		5.0e-007	5.8e-004	V	100.0 : 1
	20%	±(0.1% Span)	0.9950	1.0050	1.0000 V		5.5e-006	5.8e-004	V	100.0 : 1
	40%	±(0.1% Span)	1.9950	2.0050	2.0010 V		1.1e-005	5.8e-004	V	100.0 : 1
	60%	±(0.1% Span)	2.9950	3.0050	2.9990 V		1.6e-005	5.8e-004	V	100.0 : 1
	80%	±(0.1% Span)	3.9950	4.0050	3.9980 V		2.1e-005	5.8e-004	V	100.0 : 1
	100%	±(0.1% Span)	4.9950	5.0050	5.0000 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	0.0001 V		5.0e-007	5.8e-004	V	100.0 : 1
	20%	±(0.1% Span)	0.9950	1.0050	0.9995 V		5.5e-006	5.8e-004	V	100.0 : 1
	40%	±(0.1% Span)	1.9950	2.0050	1.9991 V		1.1e-005	5.8e-004	V	100.0 : 1
	60%	±(0.1% Span)	2.9950	3.0050	2.9982 V		1.6e-005	5.8e-004	V	100.0 : 1
	80%	±(0.1% Span)	3.9950	4.0050	4.0008 V		2.1e-005	5.8e-004	V	100.0 : 1
	100%	±(0.1% Span)	4.9950	5.0050	5.0015 V		2.6e-005	5.8e-004	V	100.0 : 1

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As Found/As Left Data

Description	Setpoints	Accuracy	Low Limit	High Limit	As Found / As Left	OOT	Cal Process Uncertainty (k=2; ±)	Measurement Uncertainty (k=2; ±)	Units	TUR
DC Voltage % Source - 0-5V Ch#4										
0 -5V	0%	±(0.1% Span)	-0.0050	0.0050	0.0001 V		5.0e-007	5.8e-004	V	100.0 : 1
	20%	±(0.1% Span)	0.9950	1.0050	1.0006 V		5.5e-006	5.8e-004	V	100.0 : 1
	40%	±(0.1% Span)	1.9950	2.0050	1.9991 V		1.1e-005	5.8e-004	V	100.0 : 1
	60%	±(0.1% Span)	2.9950	3.0050	2.9999 V		1.6e-005	5.8e-004	V	100.0 : 1
	80%	±(0.1% Span)	3.9950	4.0050	3.9984 V		2.1e-005	5.8e-004	V	100.0 : 1
	100%	±(0.1% Span)	4.9950	5.0050	4.9996 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		5.0e-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	7.997 V		4.1e-005	1.2e-003	V	100.0 : 1
	100%	±(0.1% Span)	9.990	10.010	9.997 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	0.002 V		5.0e-007	1.2e-003	V	100.0 : 1
	20%	±(0.1% Span)	1.990	2.010	2.001 V		1.1e-005	1.2e-003	V	100.0 : 1
	40%	±(0.1% Span)	3.990	4.010	3.998 V		2.1e-005	1.2e-003	V	100.0 : 1
	60%	±(0.1% Span)	5.990	6.010	5.998 V		3.1e-005	1.2e-003	V	100.0 : 1
	80%	±(0.1% Span)	7.990	8.010	7.998 V		4.1e-005	1.2e-003	V	100.0 : 1
	100%	±(0.1% Span)	9.990	10.010	9.997 V		5.2e-005	1.2e-003	V	100.0 : 1

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As Found/As Left Data

Description	Setpoints	Accuracy	Low Limit	High Limit	As Found / As Left	OOT	Cal Process Uncertainty (k=2; ±)	Measurement Uncertainty (k=2; ±)	Units	TUR
DC Voltage % Source - 0-10V Ch#3										
0 - 10V	0%	±(0.1% Span)	-0.010	0.010	0.000 V		5.0e-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	7.999 V		4.1e-005	1.2e-003	V	100.0 : 1
	100%	±(0.1% Span)	9.990	10.010	9.998 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		5.0e-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	3.998 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	8.000 V		4.1e-005	1.2e-003	V	100.0 : 1
	100%	±(0.1% Span)	9.990	10.010	9.998 V		5.2e-005	1.2e-003	V	100.0 : 1

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Traceable Standards

Asset	Manufacturer	Model Number	Description	Cal Date	Due Date	Traceability Number	Use
N0150	Fluke Corporation	5700A	Calibrator	23-Jun-17	31-May-18	5-&N0150-14-1	AF
N0436	Agilent Technologies	3458A Opt 002	Digital Multimeter, 8.5 Digit	19-Apr-17	30-Apr-18	5-&N0436-14-1	AF/AL

The use of the standard is defined as: AF - used for as-found readings, AL - used for as-left readings.

Environmental Data

Temperature	Relative Humidity	Temp / RH Asset
71.35°F /21.86°C	33.50%	N0457

Calibrated At:
4043 Carling Avenue
Ottawa, ON K2K 2A4

Facility Responsible:
4043 Carling Avenue
Ottawa, ON K2K 2A4
800-828-1470

Calibrated By:
Electronically Signed By:
Mark King

Mark King	Feb 20, 2018
Calibration Technician	15:08:17 -05:00

Reviewed By:
Electronically Signed By:
Francis Kane

Francis Kane	Feb 20, 2018
Lab Manager	15:24:41 -05:00

Unit Barcode: 901B0150195

Date Received: February 15, 2018
Service Level : R9

Customer Number: 9-322110-000

ISO17025

As Found RECALIBRATION CERTIFICATE

Sales Region:	Canada
Account:	Aercoustics Engineering Ltd
Instrument:	LMS SCADAS
Manufacturer:	Siemens Industry Software B.V.
Type:	SCR05
Serial number(s):	53103922
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 23.4°C and a relative humidity of 47%.
Calibration date:	October 24, 2017
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, October 25, 2017

Calibration performed by:

Wilfred Nolles

Certificate approved by:

Frank Lemmens

The Raad voor Accreditatie is one of the signatories of the Multilateral Agreement of the European Cooperation for Accreditation (EA) for the mutual recognition of calibration certificates.

Siemens Industry Software B.V.
Weidehek 53
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The Netherlands
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Table of contents

Siemens Industry Software B.V.
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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	201702735.00	July 21, 2017
Calibration software	NA	2.10.0001	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)			0053103922			
	XSIDA BT GPS (0)		2009501008	2	0	
	VC8_E (1)		2010788002	0	0	
	VC8_E (2)		2010788018	0	0	
	XSII CF CN (3)		2012144006	10	0	
	PS12-2 MOB (4)		2010622010	12	11	

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4 VC8_E_h0s0

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	-0.014 mV, -0.006%
0,1,x,1	-0.017 mV, -0.007%
0,1,x,2	-0.013 mV, -0.006%
0,1,x,3	-0.014 mV, -0.006%
0,1,x,4	-0.015 mV, -0.007%
0,1,x,5	-0.015 mV, -0.007%
0,1,x,6	-0.015 mV, -0.007%
0,1,x,7	-0.019 mV, -0.008%
0,2,x,0	-0.020 mV, -0.009%
0,2,x,1	-0.020 mV, -0.009%
0,2,x,2	-0.012 mV, -0.005%
0,2,x,3	-0.016 mV, -0.007%
0,2,x,4	-0.018 mV, -0.008%
0,2,x,5	-0.016 mV, -0.007%
0,2,x,6	-0.014 mV, -0.006%
0,2,x,7	-0.013 mV, -0.006%

AdcBw 102400Hz, Range 1V Alternating voltage 316mV < IR <= 1V Spec: <= ±0.100% Uncertainty: 140µV	
Chan	Value
0,1,x,0	-0.008 mV, -0.001%
0,1,x,1	-0.012 mV, -0.002%
0,1,x,2	-0.003 mV, -0.000%
0,1,x,3	-0.002 mV, -0.000%
0,1,x,4	-0.010 mV, -0.001%
0,1,x,5	-0.010 mV, -0.001%
0,1,x,6	-0.009 mV, -0.001%
0,1,x,7	-0.018 mV, -0.002%
0,2,x,0	-0.017 mV, -0.002%
0,2,x,1	-0.019 mV, -0.003%
0,2,x,2	0.003 mV, 0.000%
0,2,x,3	-0.009 mV, -0.001%
0,2,x,4	-0.017 mV, -0.002%
0,2,x,5	-0.005 mV, -0.001%
0,2,x,6	-0.001 mV, -0.000%
0,2,x,7	-0.005 mV, -0.001%

AdcBw 102400Hz, Range 3.16V Alternating voltage 1V < IR <= 3.16V Spec: <= ±0.100% Uncertainty: 370µV	
Chan	Value
0,1,x,0	0.058 mV, 0.003%
0,1,x,1	0.044 mV, 0.002%
0,1,x,2	0.066 mV, 0.003%
0,1,x,3	0.071 mV, 0.003%
0,1,x,4	0.041 mV, 0.002%
0,1,x,5	0.051 mV, 0.002%
0,1,x,6	0.049 mV, 0.002%
0,1,x,7	-0.002 mV, -0.000%
0,2,x,0	0.016 mV, 0.001%
0,2,x,1	0.011 mV, 0.000%
0,2,x,2	0.081 mV, 0.004%
0,2,x,3	0.040 mV, 0.002%
0,2,x,4	0.019 mV, 0.001%
0,2,x,5	0.062 mV, 0.003%
0,2,x,6	0.077 mV, 0.003%
0,2,x,7	0.068 mV, 0.003%

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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	0.175 mV, 0.004%
0,1,x,1	0.145 mV, 0.004%
0,1,x,2	0.186 mV, 0.005%
0,1,x,3	0.189 mV, 0.005%
0,1,x,4	0.143 mV, 0.004%
0,1,x,5	0.154 mV, 0.004%
0,1,x,6	0.151 mV, 0.004%
0,1,x,7	0.095 mV, 0.002%
0,2,x,0	0.109 mV, 0.003%
0,2,x,1	0.085 mV, 0.002%
0,2,x,2	0.221 mV, 0.006%
0,2,x,3	0.155 mV, 0.004%
0,2,x,4	0.117 mV, 0.003%
0,2,x,5	0.160 mV, 0.004%
0,2,x,6	0.201 mV, 0.005%
0,2,x,7	0.189 mV, 0.005%

AdcBw 102400Hz, Range 316pC
Alternating charge IR <= 316pC
Spec: <= ±0.100%
Uncertainty: 3.0pC

Chan	Value
0,1,x,0	0.006 pC, 0.003%
0,1,x,1	0.003 pC, 0.001%
0,1,x,2	0.006 pC, 0.003%
0,1,x,3	0.003 pC, 0.001%
0,1,x,4	0.005 pC, 0.002%
0,1,x,5	0.005 pC, 0.002%
0,1,x,6	0.004 pC, 0.002%
0,1,x,7	-0.003 pC, -0.001%
0,2,x,0	-0.001 pC, -0.001%
0,2,x,1	-0.001 pC, -0.000%
0,2,x,2	0.010 pC, 0.004%
0,2,x,3	0.002 pC, 0.001%
0,2,x,4	-0.000 pC, -0.000%
0,2,x,5	0.004 pC, 0.002%
0,2,x,6	0.007 pC, 0.003%
0,2,x,7	0.006 pC, 0.003%

AdcBw 102400Hz, Range 1nC
Alternating charge 316pC < IR <= 1nC
Spec: <= ±0.100%
Uncertainty: 9.2pC

Chan	Value
0,1,x,0	0.026 pC, 0.004%
0,1,x,1	0.022 pC, 0.003%
0,1,x,2	0.029 pC, 0.004%
0,1,x,3	0.020 pC, 0.003%
0,1,x,4	0.022 pC, 0.003%
0,1,x,5	0.023 pC, 0.003%
0,1,x,6	0.022 pC, 0.003%
0,1,x,7	0.002 pC, 0.000%
0,2,x,0	0.014 pC, 0.002%
0,2,x,1	0.011 pC, 0.001%
0,2,x,2	0.039 pC, 0.006%
0,2,x,3	0.018 pC, 0.003%
0,2,x,4	0.011 pC, 0.002%
0,2,x,5	0.030 pC, 0.004%
0,2,x,6	0.032 pC, 0.005%
0,2,x,7	0.023 pC, 0.003%

AdcBw 102400Hz, Range 3.16nC
Alternating charge 1nC < IR <= 3.16nC
Spec: <= ±0.100%
Uncertainty: 30pC

Chan	Value
0,1,x,0	0.098 pC, 0.004%
0,1,x,1	0.084 pC, 0.004%
0,1,x,2	0.102 pC, 0.005%
0,1,x,3	0.074 pC, 0.003%
0,1,x,4	0.081 pC, 0.004%
0,1,x,5	0.087 pC, 0.004%
0,1,x,6	0.084 pC, 0.004%
0,1,x,7	-0.004 pC, -0.000%
0,2,x,0	0.053 pC, 0.002%
0,2,x,1	0.045 pC, 0.002%
0,2,x,2	0.122 pC, 0.005%
0,2,x,3	0.065 pC, 0.003%
0,2,x,4	0.044 pC, 0.002%
0,2,x,5	0.108 pC, 0.005%
0,2,x,6	0.117 pC, 0.005%
0,2,x,7	0.094 pC, 0.004%

AdcBw 102400Hz, Range 10nC
Alternating charge 3.16nC < IR <= 10nC
Spec: <= ±0.100%
Uncertainty: 96pC

Chan	Value
0,1,x,0	0.252 pC, 0.006%
0,1,x,1	0.220 pC, 0.006%
0,1,x,2	0.257 pC, 0.006%
0,1,x,3	0.195 pC, 0.005%
0,1,x,4	0.223 pC, 0.006%
0,1,x,5	0.219 pC, 0.005%
0,1,x,6	0.220 pC, 0.006%
0,1,x,7	0.103 pC, 0.003%
0,2,x,0	0.185 pC, 0.005%
0,2,x,1	0.165 pC, 0.004%
0,2,x,2	0.295 pC, 0.007%
0,2,x,3	0.208 pC, 0.005%
0,2,x,4	0.172 pC, 0.004%
0,2,x,5	0.250 pC, 0.006%
0,2,x,6	0.272 pC, 0.007%
0,2,x,7	0.237 pC, 0.006%

AdcBw 51200Hz, Range 0.316V
Alternating voltage 100mV < IR <= 316mV
Spec: <= ±0.100%
Uncertainty: 72µV

Chan	Value
0,1,x,0	0.021 mV, 0.009%
0,1,x,1	0.018 mV, 0.008%
0,1,x,2	0.021 mV, 0.009%
0,1,x,3	0.022 mV, 0.010%
0,1,x,4	0.020 mV, 0.009%
0,1,x,5	0.021 mV, 0.009%
0,1,x,6	0.019 mV, 0.009%
0,1,x,7	0.015 mV, 0.007%
0,2,x,0	0.013 mV, 0.006%
0,2,x,1	0.014 mV, 0.006%
0,2,x,2	0.024 mV, 0.011%
0,2,x,3	0.018 mV, 0.008%
0,2,x,4	0.017 mV, 0.007%
0,2,x,5	0.017 mV, 0.008%
0,2,x,6	0.022 mV, 0.010%
0,2,x,7	0.022 mV, 0.010%

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AdcBw 51200Hz, Range 1V Alternating voltage 316mV < IR <= 1V Spec: <= ±0.100% Uncertainty: 140µV	
Chan	Value
0,1,x,0	0.069 mV, 0.010%
0,1,x,1	0.064 mV, 0.009%
0,1,x,2	0.073 mV, 0.010%
0,1,x,3	0.076 mV, 0.011%
0,1,x,4	0.066 mV, 0.009%
0,1,x,5	0.069 mV, 0.010%
0,1,x,6	0.066 mV, 0.009%
0,1,x,7	0.056 mV, 0.008%
0,2,x,0	0.057 mV, 0.008%
0,2,x,1	0.053 mV, 0.007%
0,2,x,2	0.082 mV, 0.012%
0,2,x,3	0.066 mV, 0.009%
0,2,x,4	0.059 mV, 0.008%
0,2,x,5	0.070 mV, 0.010%
0,2,x,6	0.076 mV, 0.011%
0,2,x,7	0.072 mV, 0.010%

AdcBw 51200Hz, Range 10V Alternating voltage 3.16V < IR <= 10V Spec: <= ±0.100% Uncertainty: 640µV	
Chan	Value
0,1,x,0	0.392 mV, 0.010%
0,1,x,1	0.355 mV, 0.009%
0,1,x,2	0.399 mV, 0.010%
0,1,x,3	0.411 mV, 0.010%
0,1,x,4	0.359 mV, 0.009%
0,1,x,5	0.367 mV, 0.009%
0,1,x,6	0.362 mV, 0.009%
0,1,x,7	0.303 mV, 0.008%
0,2,x,0	0.320 mV, 0.008%
0,2,x,1	0.289 mV, 0.007%
0,2,x,2	0.450 mV, 0.011%
0,2,x,3	0.373 mV, 0.009%
0,2,x,4	0.337 mV, 0.008%
0,2,x,5	0.376 mV, 0.009%
0,2,x,6	0.428 mV, 0.011%
0,2,x,7	0.406 mV, 0.010%

AdcBw 51200Hz, Range 1nC Alternating charge 316pC < IR <= 1nC Spec: <= ±0.100% Uncertainty: 9.2pC	
Chan	Value
0,1,x,0	0.043 pC, 0.006%
0,1,x,1	0.038 pC, 0.005%
0,1,x,2	0.045 pC, 0.006%
0,1,x,3	0.038 pC, 0.005%
0,1,x,4	0.040 pC, 0.006%
0,1,x,5	0.040 pC, 0.006%
0,1,x,6	0.038 pC, 0.005%
0,1,x,7	0.019 pC, 0.003%
0,2,x,0	0.031 pC, 0.004%
0,2,x,1	0.025 pC, 0.004%
0,2,x,2	0.055 pC, 0.008%
0,2,x,3	0.035 pC, 0.005%
0,2,x,4	0.028 pC, 0.004%
0,2,x,5	0.045 pC, 0.006%
0,2,x,6	0.049 pC, 0.007%
0,2,x,7	0.041 pC, 0.006%

AdcBw 51200Hz, Range 3.16V Alternating voltage 1V < IR <= 3.16V Spec: <= ±0.100% Uncertainty: 370µV	
Chan	Value
0,1,x,0	0.221 mV, 0.010%
0,1,x,1	0.203 mV, 0.009%
0,1,x,2	0.228 mV, 0.010%
0,1,x,3	0.242 mV, 0.011%
0,1,x,4	0.203 mV, 0.009%
0,1,x,5	0.215 mV, 0.010%
0,1,x,6	0.209 mV, 0.009%
0,1,x,7	0.154 mV, 0.007%
0,2,x,0	0.171 mV, 0.008%
0,2,x,1	0.164 mV, 0.007%
0,2,x,2	0.250 mV, 0.011%
0,2,x,3	0.201 mV, 0.009%
0,2,x,4	0.179 mV, 0.008%
0,2,x,5	0.225 mV, 0.010%
0,2,x,6	0.248 mV, 0.011%
0,2,x,7	0.235 mV, 0.011%

AdcBw 51200Hz, Range 316pC Alternating charge IR <= 316pC Spec: <= ±0.100% Uncertainty: 3.0pC	
Chan	Value
0,1,x,0	0.013 pC, 0.006%
0,1,x,1	0.009 pC, 0.004%
0,1,x,2	0.012 pC, 0.005%
0,1,x,3	0.009 pC, 0.004%
0,1,x,4	0.011 pC, 0.005%
0,1,x,5	0.011 pC, 0.005%
0,1,x,6	0.010 pC, 0.005%
0,1,x,7	0.003 pC, 0.001%
0,2,x,0	0.004 pC, 0.002%
0,2,x,1	0.004 pC, 0.002%
0,2,x,2	0.016 pC, 0.007%
0,2,x,3	0.007 pC, 0.003%
0,2,x,4	0.006 pC, 0.003%
0,2,x,5	0.008 pC, 0.004%
0,2,x,6	0.012 pC, 0.006%
0,2,x,7	0.013 pC, 0.006%

AdcBw 51200Hz, Range 3.16nC Alternating charge 1nC < IR <= 3.16nC Spec: <= ±0.100% Uncertainty: 30pC	
Chan	Value
0,1,x,0	0.137 pC, 0.006%
0,1,x,1	0.114 pC, 0.005%
0,1,x,2	0.134 pC, 0.006%
0,1,x,3	0.116 pC, 0.005%
0,1,x,4	0.117 pC, 0.005%
0,1,x,5	0.119 pC, 0.005%
0,1,x,6	0.116 pC, 0.005%
0,1,x,7	0.030 pC, 0.001%
0,2,x,0	0.083 pC, 0.004%
0,2,x,1	0.071 pC, 0.003%
0,2,x,2	0.158 pC, 0.007%
0,2,x,3	0.099 pC, 0.004%
0,2,x,4	0.076 pC, 0.003%
0,2,x,5	0.139 pC, 0.006%
0,2,x,6	0.156 pC, 0.007%
0,2,x,7	0.136 pC, 0.006%

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AdcBw 51200Hz, Range 10nC
Alternating charge 3.16nC < IR <= 10nC
Spec: <= ±0.100%
Uncertainty: 96pC

Chan	Value
0,1,x,0	0.255 pC, 0.006%
0,1,x,1	0.219 pC, 0.005%
0,1,x,2	0.252 pC, 0.006%
0,1,x,3	0.199 pC, 0.005%
0,1,x,4	0.221 pC, 0.006%
0,1,x,5	0.218 pC, 0.005%
0,1,x,6	0.216 pC, 0.005%
0,1,x,7	0.099 pC, 0.002%
0,2,x,0	0.181 pC, 0.005%
0,2,x,1	0.144 pC, 0.004%
0,2,x,2	0.298 pC, 0.007%
0,2,x,3	0.205 pC, 0.005%
0,2,x,4	0.169 pC, 0.004%
0,2,x,5	0.240 pC, 0.006%
0,2,x,6	0.275 pC, 0.007%
0,2,x,7	0.242 pC, 0.006%

AdcBw 25600Hz, Range 1V
Alternating voltage 316mV < IR <= 1V
Spec: <= ±0.100%
Uncertainty: 140µV

Chan	Value
0,1,x,0	0.081 mV, 0.011%
0,1,x,1	0.075 mV, 0.011%
0,1,x,2	0.084 mV, 0.012%
0,1,x,3	0.089 mV, 0.013%
0,1,x,4	0.079 mV, 0.011%
0,1,x,5	0.081 mV, 0.011%
0,1,x,6	0.077 mV, 0.011%
0,1,x,7	0.068 mV, 0.010%
0,2,x,0	0.068 mV, 0.010%
0,2,x,1	0.063 mV, 0.009%
0,2,x,2	0.095 mV, 0.013%
0,2,x,3	0.078 mV, 0.011%
0,2,x,4	0.071 mV, 0.010%
0,2,x,5	0.082 mV, 0.012%
0,2,x,6	0.089 mV, 0.013%
0,2,x,7	0.084 mV, 0.012%

AdcBw 25600Hz, Range 10V
Alternating voltage 3.16V < IR <= 10V
Spec: <= ±0.100%
Uncertainty: 640µV

Chan	Value
0,1,x,0	0.456 mV, 0.011%
0,1,x,1	0.425 mV, 0.011%
0,1,x,2	0.464 mV, 0.012%
0,1,x,3	0.478 mV, 0.012%
0,1,x,4	0.424 mV, 0.011%
0,1,x,5	0.441 mV, 0.011%
0,1,x,6	0.426 mV, 0.011%
0,1,x,7	0.364 mV, 0.009%
0,2,x,0	0.376 mV, 0.009%
0,2,x,1	0.345 mV, 0.009%
0,2,x,2	0.517 mV, 0.013%
0,2,x,3	0.437 mV, 0.011%
0,2,x,4	0.398 mV, 0.010%
0,2,x,5	0.432 mV, 0.011%
0,2,x,6	0.496 mV, 0.012%
0,2,x,7	0.471 mV, 0.012%

AdcBw 25600Hz, Range 0.316V
Alternating voltage 100mV < IR <= 316mV
Spec: <= ±0.100%
Uncertainty: 72µV

Chan	Value
0,1,x,0	0.025 mV, 0.011%
0,1,x,1	0.021 mV, 0.009%
0,1,x,2	0.025 mV, 0.011%
0,1,x,3	0.026 mV, 0.011%
0,1,x,4	0.023 mV, 0.010%
0,1,x,5	0.024 mV, 0.011%
0,1,x,6	0.023 mV, 0.010%
0,1,x,7	0.018 mV, 0.008%
0,2,x,0	0.017 mV, 0.008%
0,2,x,1	0.017 mV, 0.008%
0,2,x,2	0.029 mV, 0.013%
0,2,x,3	0.022 mV, 0.010%
0,2,x,4	0.020 mV, 0.009%
0,2,x,5	0.020 mV, 0.009%
0,2,x,6	0.026 mV, 0.012%
0,2,x,7	0.027 mV, 0.012%

AdcBw 25600Hz, Range 3.16V
Alternating voltage 1V < IR <= 3.16V
Spec: <= ±0.100%
Uncertainty: 370µV

Chan	Value
0,1,x,0	0.255 mV, 0.011%
0,1,x,1	0.226 mV, 0.010%
0,1,x,2	0.256 mV, 0.011%
0,1,x,3	0.275 mV, 0.012%
0,1,x,4	0.236 mV, 0.011%
0,1,x,5	0.241 mV, 0.011%
0,1,x,6	0.236 mV, 0.011%
0,1,x,7	0.179 mV, 0.008%
0,2,x,0	0.197 mV, 0.009%
0,2,x,1	0.188 mV, 0.008%
0,2,x,2	0.281 mV, 0.013%
0,2,x,3	0.230 mV, 0.010%
0,2,x,4	0.208 mV, 0.009%
0,2,x,5	0.250 mV, 0.011%
0,2,x,6	0.281 mV, 0.013%
0,2,x,7	0.267 mV, 0.012%

AdcBw 25600Hz, Range 316pC
Alternating charge IR <= 316pC
Spec: <= ±0.100%
Uncertainty: 3.0pC

Chan	Value
0,1,x,0	0.013 pC, 0.006%
0,1,x,1	0.009 pC, 0.004%
0,1,x,2	0.012 pC, 0.005%
0,1,x,3	0.010 pC, 0.004%
0,1,x,4	0.012 pC, 0.005%
0,1,x,5	0.011 pC, 0.005%
0,1,x,6	0.010 pC, 0.005%
0,1,x,7	0.003 pC, 0.001%
0,2,x,0	0.004 pC, 0.002%
0,2,x,1	0.004 pC, 0.002%
0,2,x,2	0.015 pC, 0.007%
0,2,x,3	0.007 pC, 0.003%
0,2,x,4	0.006 pC, 0.003%
0,2,x,5	0.008 pC, 0.003%
0,2,x,6	0.012 pC, 0.005%
0,2,x,7	0.013 pC, 0.006%

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AdcBw 25600Hz, Range 1nC Alternating charge 316pC < IR <= 1nC Spec: <= ±0.100% Uncertainty: 9.2pC	
Chan	Value
0,1,x,0	0.040 pC, 0.006%
0,1,x,1	0.033 pC, 0.005%
0,1,x,2	0.040 pC, 0.006%
0,1,x,3	0.034 pC, 0.005%
0,1,x,4	0.037 pC, 0.005%
0,1,x,5	0.035 pC, 0.005%
0,1,x,6	0.033 pC, 0.005%
0,1,x,7	0.015 pC, 0.002%
0,2,x,0	0.026 pC, 0.004%
0,2,x,1	0.020 pC, 0.003%
0,2,x,2	0.049 pC, 0.007%
0,2,x,3	0.030 pC, 0.004%
0,2,x,4	0.022 pC, 0.003%
0,2,x,5	0.040 pC, 0.006%
0,2,x,6	0.043 pC, 0.006%
0,2,x,7	0.038 pC, 0.005%

AdcBw 25600Hz, Range 3.16nC Alternating charge 1nC < IR <= 3.16nC Spec: <= ±0.100% Uncertainty: 30pC	
Chan	Value
0,1,x,0	0.151 pC, 0.007%
0,1,x,1	0.118 pC, 0.005%
0,1,x,2	0.145 pC, 0.006%
0,1,x,3	0.127 pC, 0.006%
0,1,x,4	0.130 pC, 0.006%
0,1,x,5	0.125 pC, 0.006%
0,1,x,6	0.126 pC, 0.006%
0,1,x,7	0.037 pC, 0.002%
0,2,x,0	0.092 pC, 0.004%
0,2,x,1	0.077 pC, 0.003%
0,2,x,2	0.164 pC, 0.007%
0,2,x,3	0.107 pC, 0.005%
0,2,x,4	0.085 pC, 0.004%
0,2,x,5	0.147 pC, 0.007%
0,2,x,6	0.166 pC, 0.007%
0,2,x,7	0.148 pC, 0.007%

AdcBw 25600Hz, Range 10nC Alternating charge 3.16nC < IR <= 10nC Spec: <= ±0.100% Uncertainty: 96pC	
Chan	Value
0,1,x,0	0.275 pC, 0.007%
0,1,x,1	0.238 pC, 0.006%
0,1,x,2	0.267 pC, 0.007%
0,1,x,3	0.221 pC, 0.006%
0,1,x,4	0.239 pC, 0.006%
0,1,x,5	0.239 pC, 0.006%
0,1,x,6	0.230 pC, 0.006%
0,1,x,7	0.115 pC, 0.003%
0,2,x,0	0.195 pC, 0.005%
0,2,x,1	0.146 pC, 0.004%
0,2,x,2	0.314 pC, 0.008%
0,2,x,3	0.224 pC, 0.006%
0,2,x,4	0.184 pC, 0.005%
0,2,x,5	0.245 pC, 0.006%
0,2,x,6	0.294 pC, 0.007%
0,2,x,7	0.264 pC, 0.007%

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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	0.027 mV
0,1,x,1	-0.005 mV
0,1,x,2	-0.015 mV
0,1,x,3	0.001 mV
0,1,x,4	0.003 mV
0,1,x,5	-0.005 mV
0,1,x,6	-0.007 mV
0,1,x,7	0.032 mV
0,2,x,0	0.003 mV
0,2,x,1	0.026 mV
0,2,x,2	-0.010 mV
0,2,x,3	0.009 mV
0,2,x,4	-0.006 mV
0,2,x,5	0.013 mV
0,2,x,6	0.001 mV
0,2,x,7	0.002 mV

AdcBw 102400Hz, Range 3.16V Direct voltage 1V < IR <= 3.16V Spec: <= ±3.160 mV Uncertainty: 8µV	
Chan	Value
0,1,x,0	-0.012 mV
0,1,x,1	0.019 mV
0,1,x,2	-0.058 mV
0,1,x,3	-0.022 mV
0,1,x,4	-0.058 mV
0,1,x,5	-0.086 mV
0,1,x,6	-0.069 mV
0,1,x,7	-0.006 mV
0,2,x,0	0.012 mV
0,2,x,1	-0.000 mV
0,2,x,2	-0.019 mV
0,2,x,3	-0.020 mV
0,2,x,4	-0.022 mV
0,2,x,5	-0.003 mV
0,2,x,6	-0.004 mV
0,2,x,7	-0.044 mV

AdcBw 51200Hz, Range 0.316V Direct voltage IR <= 316mV Spec: <= ±0.316 mV Uncertainty: 4.8µV	
Chan	Value
0,1,x,0	0.026 mV
0,1,x,1	-0.007 mV
0,1,x,2	-0.016 mV
0,1,x,3	-0.000 mV
0,1,x,4	-0.001 mV
0,1,x,5	-0.006 mV
0,1,x,6	-0.004 mV
0,1,x,7	0.028 mV
0,2,x,0	0.003 mV
0,2,x,1	0.026 mV
0,2,x,2	-0.011 mV
0,2,x,3	0.009 mV
0,2,x,4	-0.004 mV
0,2,x,5	0.015 mV
0,2,x,6	-0.006 mV
0,2,x,7	-0.001 mV

AdcBw 51200Hz, Range 3.16V Direct voltage 1V < IR <= 3.16V Spec: <= ±3.160 mV Uncertainty: 8µV	
Chan	Value
0,1,x,0	-0.001 mV
0,1,x,1	0.014 mV
0,1,x,2	-0.045 mV
0,1,x,3	-0.019 mV
0,1,x,4	-0.049 mV
0,1,x,5	-0.078 mV
0,1,x,6	-0.067 mV
0,1,x,7	-0.001 mV
0,2,x,0	0.017 mV
0,2,x,1	0.006 mV
0,2,x,2	-0.020 mV
0,2,x,3	-0.007 mV
0,2,x,4	-0.015 mV
0,2,x,5	0.001 mV
0,2,x,6	-0.018 mV
0,2,x,7	-0.045 mV

AdcBw 102400Hz, Range 1V Direct voltage 316mV < IR <= 1V Spec: <= ±1.000 mV Uncertainty: 5.2µV	
Chan	Value
0,1,x,0	0.019 mV
0,1,x,1	-0.003 mV
0,1,x,2	-0.026 mV
0,1,x,3	-0.005 mV
0,1,x,4	-0.013 mV
0,1,x,5	-0.021 mV
0,1,x,6	-0.024 mV
0,1,x,7	0.024 mV
0,2,x,0	0.005 mV
0,2,x,1	0.022 mV
0,2,x,2	-0.015 mV
0,2,x,3	0.004 mV
0,2,x,4	-0.010 mV
0,2,x,5	0.009 mV
0,2,x,6	-0.002 mV
0,2,x,7	-0.006 mV

AdcBw 102400Hz, Range 10V Direct voltage 3.16V < IR <= 10V Spec: <= ±10.000 mV Uncertainty: 21µV	
Chan	Value
0,1,x,0	-0.083 mV
0,1,x,1	0.081 mV
0,1,x,2	-0.138 mV
0,1,x,3	-0.074 mV
0,1,x,4	-0.187 mV
0,1,x,5	-0.284 mV
0,1,x,6	-0.234 mV
0,1,x,7	-0.080 mV
0,2,x,0	0.036 mV
0,2,x,1	-0.047 mV
0,2,x,2	-0.030 mV
0,2,x,3	-0.063 mV
0,2,x,4	-0.059 mV
0,2,x,5	-0.028 mV
0,2,x,6	-0.022 mV
0,2,x,7	-0.147 mV

AdcBw 51200Hz, Range 1V Direct voltage 316mV < IR <= 1V Spec: <= ±1.000 mV Uncertainty: 5.2µV	
Chan	Value
0,1,x,0	0.019 mV
0,1,x,1	0.001 mV
0,1,x,2	-0.022 mV
0,1,x,3	-0.006 mV
0,1,x,4	-0.011 mV
0,1,x,5	-0.025 mV
0,1,x,6	-0.017 mV
0,1,x,7	0.020 mV
0,2,x,0	0.005 mV
0,2,x,1	0.022 mV
0,2,x,2	-0.010 mV
0,2,x,3	0.003 mV
0,2,x,4	-0.006 mV
0,2,x,5	0.011 mV
0,2,x,6	-0.008 mV
0,2,x,7	-0.010 mV

AdcBw 51200Hz, Range 10V Direct voltage 3.16V < IR <= 10V Spec: <= ±10.000 mV Uncertainty: 21µV	
Chan	Value
0,1,x,0	-0.060 mV
0,1,x,1	0.085 mV
0,1,x,2	-0.113 mV
0,1,x,3	-0.056 mV
0,1,x,4	-0.183 mV
0,1,x,5	-0.283 mV
0,1,x,6	-0.202 mV
0,1,x,7	-0.094 mV
0,2,x,0	0.029 mV
0,2,x,1	-0.040 mV
0,2,x,2	-0.052 mV
0,2,x,3	-0.062 mV
0,2,x,4	-0.042 mV
0,2,x,5	-0.030 mV
0,2,x,6	-0.050 mV
0,2,x,7	-0.127 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	0.024 mV
0,1,x,1	-0.010 mV
0,1,x,2	-0.015 mV
0,1,x,3	0.002 mV
0,1,x,4	-0.003 mV
0,1,x,5	-0.004 mV
0,1,x,6	-0.002 mV
0,1,x,7	0.026 mV
0,2,x,0	0.002 mV
0,2,x,1	0.024 mV
0,2,x,2	-0.010 mV
0,2,x,3	0.013 mV
0,2,x,4	-0.009 mV
0,2,x,5	0.018 mV
0,2,x,6	-0.006 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	-0.003 mV
0,1,x,1	0.015 mV
0,1,x,2	-0.047 mV
0,1,x,3	-0.020 mV
0,1,x,4	-0.056 mV
0,1,x,5	-0.089 mV
0,1,x,6	-0.059 mV
0,1,x,7	-0.009 mV
0,2,x,0	0.013 mV
0,2,x,1	0.008 mV
0,2,x,2	-0.021 mV
0,2,x,3	-0.001 mV
0,2,x,4	-0.016 mV
0,2,x,5	0.006 mV
0,2,x,6	-0.023 mV
0,2,x,7	-0.037 mV

AdcBw 25600Hz, Range 1V Direct voltage 316mV < IR <= 1V Spec: <= ±1.000 mV Uncertainty: 5.2µV	
Chan	Value
0,1,x,0	0.016 mV
0,1,x,1	-0.004 mV
0,1,x,2	-0.022 mV
0,1,x,3	-0.003 mV
0,1,x,4	-0.016 mV
0,1,x,5	-0.027 mV
0,1,x,6	-0.015 mV
0,1,x,7	0.013 mV
0,2,x,0	0.003 mV
0,2,x,1	0.016 mV
0,2,x,2	-0.013 mV
0,2,x,3	0.007 mV
0,2,x,4	-0.009 mV
0,2,x,5	0.014 mV
0,2,x,6	-0.012 mV
0,2,x,7	-0.009 mV

AdcBw 25600Hz, Range 10V Direct voltage 3.16V < IR <= 10V Spec: <= ±10.000 mV Uncertainty: 21µV	
Chan	Value
0,1,x,0	-0.087 mV
0,1,x,1	0.089 mV
0,1,x,2	-0.117 mV
0,1,x,3	-0.086 mV
0,1,x,4	-0.184 mV
0,1,x,5	-0.314 mV
0,1,x,6	-0.199 mV
0,1,x,7	-0.103 mV
0,2,x,0	0.047 mV
0,2,x,1	-0.045 mV
0,2,x,2	-0.030 mV
0,2,x,3	-0.048 mV
0,2,x,4	-0.049 mV
0,2,x,5	-0.027 mV
0,2,x,6	-0.074 mV
0,2,x,7	-0.122 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	15.463 µV, -108.3dB
0,1,x,1	16.216 µV, -107.8dB
0,1,x,2	15.755 µV, -108.1dB
0,1,x,3	15.225 µV, -108.4dB
0,1,x,4	14.711 µV, -108.7dB
0,1,x,5	14.920 µV, -108.6dB
0,1,x,6	14.943 µV, -108.6dB
0,1,x,7	15.216 µV, -108.4dB
0,2,x,0	15.326 µV, -108.3dB
0,2,x,1	14.758 µV, -108.7dB
0,2,x,2	15.474 µV, -108.2dB
0,2,x,3	14.916 µV, -108.6dB
0,2,x,4	15.006 µV, -108.5dB
0,2,x,5	15.041 µV, -108.5dB
0,2,x,6	14.961 µV, -108.5dB
0,2,x,7	13.064 µV, -109.7dB

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

Chan	Value
0,1,x,0	5.055 µV, -102.9dB
0,1,x,1	5.187 µV, -102.7dB
0,1,x,2	5.123 µV, -102.8dB
0,1,x,3	4.887 µV, -103.2dB
0,1,x,4	4.559 µV, -103.8dB
0,1,x,5	4.998 µV, -103.0dB
0,1,x,6	4.860 µV, -103.3dB
0,1,x,7	4.753 µV, -103.4dB
0,2,x,0	5.607 µV, -102.0dB
0,2,x,1	5.262 µV, -102.6dB
0,2,x,2	5.492 µV, -102.2dB
0,2,x,3	5.364 µV, -102.4dB
0,2,x,4	5.143 µV, -102.8dB
0,2,x,5	4.779 µV, -103.4dB
0,2,x,6	5.199 µV, -102.7dB
0,2,x,7	5.010 µV, -103.0dB

Range 10nC
Distortion 3.16nC < IR <= 10nC
Spec: <= -94.0dB
Uncertainty: 2.6fC

Chan	Value
0,1,x,0	22.372 fC, -105.0dB
0,1,x,1	23.497 fC, -104.6dB
0,1,x,2	22.060 fC, -105.2dB
0,1,x,3	21.667 fC, -105.3dB
0,1,x,4	21.145 fC, -105.5dB
0,1,x,5	21.951 fC, -105.2dB
0,1,x,6	22.107 fC, -105.2dB
0,1,x,7	20.616 fC, -105.8dB
0,2,x,0	23.308 fC, -104.7dB
0,2,x,1	21.936 fC, -105.2dB
0,2,x,2	23.245 fC, -104.7dB
0,2,x,3	21.748 fC, -105.3dB
0,2,x,4	22.222 fC, -105.1dB
0,2,x,5	21.998 fC, -105.2dB
0,2,x,6	22.137 fC, -105.1dB
0,2,x,7	18.755 fC, -106.6dB

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

Chan	Value
0,1,x,0	6.286 µV, -111.0dB
0,1,x,1	6.977 µV, -110.1dB
0,1,x,2	6.083 µV, -111.3dB
0,1,x,3	6.354 µV, -110.9dB
0,1,x,4	4.898 µV, -113.2dB
0,1,x,5	5.632 µV, -112.0dB
0,1,x,6	5.967 µV, -111.5dB
0,1,x,7	5.691 µV, -111.9dB
0,2,x,0	6.628 µV, -110.6dB
0,2,x,1	6.170 µV, -111.2dB
0,2,x,2	7.023 µV, -110.1dB
0,2,x,3	6.048 µV, -111.4dB
0,2,x,4	5.616 µV, -112.0dB
0,2,x,5	5.120 µV, -112.8dB
0,2,x,6	5.480 µV, -112.2dB
0,2,x,7	3.963 µV, -115.0dB

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

Chan	Value
0,1,x,0	4.141 µV, -94.6dB
0,1,x,1	4.159 µV, -94.6dB
0,1,x,2	4.303 µV, -94.3dB
0,1,x,3	3.973 µV, -95.0dB
0,1,x,4	3.893 µV, -95.2dB
0,1,x,5	4.300 µV, -94.3dB
0,1,x,6	4.029 µV, -94.9dB
0,1,x,7	4.056 µV, -94.8dB
0,2,x,0	4.815 µV, -93.3dB
0,2,x,1	4.287 µV, -94.3dB
0,2,x,2	4.477 µV, -94.0dB
0,2,x,3	4.599 µV, -93.7dB
0,2,x,4	4.429 µV, -94.1dB
0,2,x,5	4.044 µV, -94.8dB
0,2,x,6	4.557 µV, -93.8dB
0,2,x,7	4.666 µV, -93.6dB

Range 3.16nC
Distortion 1nC < IR <= 3.16nC
Spec: <= -94.0dB
Uncertainty: 0.8fC

Chan	Value
0,1,x,0	13.908 fC, -104.1dB
0,1,x,1	14.496 fC, -103.8dB
0,1,x,2	13.574 fC, -104.3dB
0,1,x,3	14.048 fC, -104.0dB
0,1,x,4	12.624 fC, -105.0dB
0,1,x,5	13.264 fC, -104.5dB
0,1,x,6	13.791 fC, -104.2dB
0,1,x,7	13.398 fC, -104.4dB
0,2,x,0	13.828 fC, -104.2dB
0,2,x,1	13.506 fC, -104.4dB
0,2,x,2	14.425 fC, -103.8dB
0,2,x,3	13.000 fC, -104.7dB
0,2,x,4	13.031 fC, -104.7dB
0,2,x,5	12.827 fC, -104.8dB
0,2,x,6	12.820 fC, -104.8dB
0,2,x,7	10.623 fC, -106.5dB

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Range 1nC **Distortion 316pC < IR <= 1nC** **Spec: <= -94.0dB** **Uncertainty: 290aC**	
Chan	Value
0,1,x,0	6.812 fC, -100.3dB
0,1,x,1	7.093 fC, -100.0dB
0,1,x,2	6.824 fC, -100.3dB
0,1,x,3	6.707 fC, -100.5dB
0,1,x,4	6.411 fC, -100.9dB
0,1,x,5	6.641 fC, -100.5dB
0,1,x,6	6.677 fC, -100.5dB
0,1,x,7	6.600 fC, -100.6dB
0,2,x,0	7.276 fC, -99.8dB
0,2,x,1	6.995 fC, -100.1dB
0,2,x,2	7.245 fC, -99.8dB
0,2,x,3	6.939 fC, -100.2dB
0,2,x,4	6.855 fC, -100.3dB
0,2,x,5	6.599 fC, -100.6dB
0,2,x,6	6.852 fC, -100.3dB
0,2,x,7	6.325 fC, -101.0dB

Range 0.316nC **Distortion IR <= 316pC** **Spec: <= -90.0dB** **Uncertainty: 140aC**	
Chan	Value
0,1,x,0	4.550 fC, -93.8dB
0,1,x,1	4.642 fC, -93.6dB
0,1,x,2	4.663 fC, -93.6dB
0,1,x,3	4.465 fC, -94.0dB
0,1,x,4	4.451 fC, -94.0dB
0,1,x,5	4.555 fC, -93.8dB
0,1,x,6	4.481 fC, -94.0dB
0,1,x,7	4.482 fC, -94.0dB
0,2,x,0	5.098 fC, -92.8dB
0,2,x,1	4.867 fC, -93.2dB
0,2,x,2	4.937 fC, -93.1dB
0,2,x,3	4.895 fC, -93.2dB
0,2,x,4	4.916 fC, -93.2dB
0,2,x,5	4.712 fC, -93.5dB
0,2,x,6	4.982 fC, -93.0dB
0,2,x,7	4.756 fC, -93.4dB

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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	215.7331µVrms
0,1,x,1	216.8399µVrms
0,1,x,2	215.1143µVrms
0,1,x,3	214.9676µVrms
0,1,x,4	217.1991µVrms
0,1,x,5	219.4411µVrms
0,1,x,6	219.4025µVrms
0,1,x,7	217.0582µVrms
0,2,x,0	218.4044µVrms
0,2,x,1	220.6707µVrms
0,2,x,2	214.5613µVrms
0,2,x,3	218.7858µVrms
0,2,x,4	219.2260µVrms
0,2,x,5	220.7999µVrms
0,2,x,6	216.1602µVrms
0,2,x,7	215.5046µVrms

Range 10nC, Bw 80kHz Not in Scope Spec: < 331.0000fCrms	
Chan	Value
0,1,x,0	216.9160fCrms
0,1,x,1	217.7132fCrms
0,1,x,2	216.2103fCrms
0,1,x,3	215.2511fCrms
0,1,x,4	218.4760fCrms
0,1,x,5	220.4308fCrms
0,1,x,6	220.4813fCrms
0,1,x,7	217.5184fCrms
0,2,x,0	217.5387fCrms
0,2,x,1	220.4054fCrms
0,2,x,2	213.5679fCrms
0,2,x,3	219.7129fCrms
0,2,x,4	218.4869fCrms
0,2,x,5	218.6897fCrms
0,2,x,6	216.9374fCrms
0,2,x,7	215.5797fCrms

Range 10V, Bw 40kHz Not in Scope Spec: < 42.0000µVrms	
Chan	Value
0,1,x,0	31.0481µVrms
0,1,x,1	30.9056µVrms
0,1,x,2	30.5448µVrms
0,1,x,3	30.2800µVrms
0,1,x,4	31.1077µVrms
0,1,x,5	30.9900µVrms
0,1,x,6	31.0441µVrms
0,1,x,7	30.4306µVrms
0,2,x,0	31.1010µVrms
0,2,x,1	31.8063µVrms
0,2,x,2	30.8414µVrms
0,2,x,3	30.6689µVrms
0,2,x,4	30.4073µVrms
0,2,x,5	30.7581µVrms
0,2,x,6	30.9162µVrms
0,2,x,7	30.4965µVrms

Range 0.316V, Bw 80kHz Not in Scope Spec: < 10.5000µVrms	
Chan	Value
0,1,x,0	7.2655µVrms
0,1,x,1	7.3131µVrms
0,1,x,2	7.2502µVrms
0,1,x,3	7.2040µVrms
0,1,x,4	7.3174µVrms
0,1,x,5	7.3369µVrms
0,1,x,6	7.4118µVrms
0,1,x,7	7.2699µVrms
0,2,x,0	7.3112µVrms
0,2,x,1	7.4048µVrms
0,2,x,2	7.2379µVrms
0,2,x,3	7.2816µVrms
0,2,x,4	7.3230µVrms
0,2,x,5	7.3056µVrms
0,2,x,6	7.3281µVrms
0,2,x,7	7.2234µVrms

Range 0.316nC, Bw 80kHz Not in Scope Spec: < 12.1000fCrms	
Chan	Value
0,1,x,0	8.5676fCrms
0,1,x,1	8.4833fCrms
0,1,x,2	8.4951fCrms
0,1,x,3	8.4640fCrms
0,1,x,4	8.4615fCrms
0,1,x,5	8.3955fCrms
0,1,x,6	8.5839fCrms
0,1,x,7	8.4918fCrms
0,2,x,0	8.5019fCrms
0,2,x,1	8.6402fCrms
0,2,x,2	8.4711fCrms
0,2,x,3	8.4602fCrms
0,2,x,4	8.3771fCrms
0,2,x,5	8.4910fCrms
0,2,x,6	8.4662fCrms
0,2,x,7	8.5282fCrms

Range 0.316V, Bw 40kHz Not in Scope Spec: < 2.8000µVrms	
Chan	Value
0,1,x,0	2.0543µVrms
0,1,x,1	2.0619µVrms
0,1,x,2	2.0645µVrms
0,1,x,3	2.0559µVrms
0,1,x,4	2.0637µVrms
0,1,x,5	2.0613µVrms
0,1,x,6	2.0678µVrms
0,1,x,7	2.0544µVrms
0,2,x,0	2.0552µVrms
0,2,x,1	2.0688µVrms
0,2,x,2	2.0647µVrms
0,2,x,3	2.0561µVrms
0,2,x,4	2.0526µVrms
0,2,x,5	2.0690µVrms
0,2,x,6	2.0548µVrms
0,2,x,7	2.0533µVrms

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Range 10nC, Bw 40kHz Not in Scope Spec: < 44.5000fCrms	
Chan	Value
0,1,x,0	31.1678fCrms
0,1,x,1	30.9036fCrms
0,1,x,2	30.8610fCrms
0,1,x,3	30.6852fCrms
0,1,x,4	31.2625fCrms
0,1,x,5	31.2388fCrms
0,1,x,6	31.4626fCrms
0,1,x,7	31.2002fCrms
0,2,x,0	31.4553fCrms
0,2,x,1	32.0019fCrms
0,2,x,2	31.1568fCrms
0,2,x,3	31.0972fCrms
0,2,x,4	30.9503fCrms
0,2,x,5	31.0932fCrms
0,2,x,6	31.1749fCrms
0,2,x,7	30.8646fCrms

Range 0.316nC, Bw 40kHz Not in Scope Spec: < 5.3700fCrms	
Chan	Value
0,1,x,0	3.7320fCrms
0,1,x,1	3.6576fCrms
0,1,x,2	3.6431fCrms
0,1,x,3	3.7079fCrms
0,1,x,4	3.7499fCrms
0,1,x,5	3.6826fCrms
0,1,x,6	3.6674fCrms
0,1,x,7	3.7069fCrms
0,2,x,0	3.6692fCrms
0,2,x,1	3.6771fCrms
0,2,x,2	3.6382fCrms
0,2,x,3	3.6994fCrms
0,2,x,4	3.6884fCrms
0,2,x,5	3.6640fCrms
0,2,x,6	3.6950fCrms
0,2,x,7	3.7135fCrms

Range 10V, Bw 20kHz Noise 3.16V < IR <= 10V Spec: <= 29.000 µV Uncertainty: 3.4nV	
Chan	Value
0,1,x,0	20.707 µV
0,1,x,1	20.504 µV
0,1,x,2	20.650 µV
0,1,x,3	20.418 µV
0,1,x,4	20.924 µV
0,1,x,5	20.383 µV
0,1,x,6	20.609 µV
0,1,x,7	20.366 µV
0,2,x,0	20.884 µV
0,2,x,1	20.717 µV
0,2,x,2	21.268 µV
0,2,x,3	21.039 µV
0,2,x,4	20.563 µV
0,2,x,5	20.436 µV
0,2,x,6	20.616 µV
0,2,x,7	20.272 µV

Range 0.316V, Bw 20kHz Noise IR <= 316mV Spec: <= 1.980 µV Uncertainty: 2.0nV	
Chan	Value
0,1,x,0	1.455 µV
0,1,x,1	1.457 µV
0,1,x,2	1.454 µV
0,1,x,3	1.458 µV
0,1,x,4	1.458 µV
0,1,x,5	1.455 µV
0,1,x,6	1.460 µV
0,1,x,7	1.445 µV
0,2,x,0	1.449 µV
0,2,x,1	1.455 µV
0,2,x,2	1.458 µV
0,2,x,3	1.453 µV
0,2,x,4	1.448 µV
0,2,x,5	1.461 µV
0,2,x,6	1.455 µV
0,2,x,7	1.451 µV

Range 10nC, Bw 20kHz Noise 3.16nC < IR <= 10nC Spec: <= 30.000 fC Uncertainty: 2.8aC	
Chan	Value
0,1,x,0	20.941 fC
0,1,x,1	20.723 fC
0,1,x,2	20.792 fC
0,1,x,3	20.599 fC
0,1,x,4	21.153 fC
0,1,x,5	20.781 fC
0,1,x,6	20.846 fC
0,1,x,7	20.678 fC
0,2,x,0	20.792 fC
0,2,x,1	21.031 fC
0,2,x,2	20.986 fC
0,2,x,3	20.982 fC
0,2,x,4	20.799 fC
0,2,x,5	20.681 fC
0,2,x,6	20.689 fC
0,2,x,7	20.547 fC

Range 0.316nC, Bw 20kHz Noise IR <= 316pC Spec: <= 3.960 fC Uncertainty: 0.1aC	
Chan	Value
0,1,x,0	2.687 fC
0,1,x,1	2.665 fC
0,1,x,2	2.684 fC
0,1,x,3	2.677 fC
0,1,x,4	2.700 fC
0,1,x,5	2.667 fC
0,1,x,6	2.676 fC
0,1,x,7	2.689 fC
0,2,x,0	2.649 fC
0,2,x,1	2.666 fC
0,2,x,2	2.660 fC
0,2,x,3	2.677 fC
0,2,x,4	2.657 fC
0,2,x,5	2.631 fC
0,2,x,6	2.655 fC
0,2,x,7	2.682 fC

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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	18.0258µV
0,1,x,1	19.7598µV
0,1,x,2	21.3127µV
0,1,x,3	20.2946µV
0,1,x,4	22.8623µV
0,1,x,5	18.4378µV
0,1,x,6	21.1810µV
0,1,x,7	20.5866µV
0,2,x,0	19.7253µV
0,2,x,1	28.9388µV
0,2,x,2	20.5672µV
0,2,x,3	19.2183µV
0,2,x,4	21.2738µV
0,2,x,5	21.8250µV
0,2,x,6	20.1144µV
0,2,x,7	19.0972µV

Range 10nC, Bw 80kHz Not in Scope Spec: < 40.0000fC	
Chan	Value
0,1,x,0	20.9669fC
0,1,x,1	19.3920fC
0,1,x,2	18.9895fC
0,1,x,3	20.6996fC
0,1,x,4	21.5149fC
0,1,x,5	22.9002fC
0,1,x,6	20.1692fC
0,1,x,7	21.2094fC
0,2,x,0	28.7950fC
0,2,x,1	18.4514fC
0,2,x,2	20.5792fC
0,2,x,3	20.2400fC
0,2,x,4	20.7207fC
0,2,x,5	22.2564fC
0,2,x,6	21.3554fC
0,2,x,7	20.5170fC

Range 10V, Bw 40kHz Not in Scope Spec: < 3.0000µV	
Chan	Value
0,1,x,0	1.4346µV
0,1,x,1	1.5138µV
0,1,x,2	1.4216µV
0,1,x,3	1.6728µV
0,1,x,4	1.6711µV
0,1,x,5	1.6846µV
0,1,x,6	1.8798µV
0,1,x,7	1.9603µV
0,2,x,0	2.1265µV
0,2,x,1	1.6921µV
0,2,x,2	2.1057µV
0,2,x,3	1.8577µV
0,2,x,4	2.3854µV
0,2,x,5	1.6558µV
0,2,x,6	1.6987µV
0,2,x,7	1.4657µV

Range 10nC, Bw 40kHz Not in Scope Spec: < 3.0000fC	
Chan	Value
0,1,x,0	1.9829fC
0,1,x,1	1.5564fC
0,1,x,2	1.8120fC
0,1,x,3	1.5570fC
0,1,x,4	1.7344fC
0,1,x,5	1.7927fC
0,1,x,6	1.7502fC
0,1,x,7	1.4902fC
0,2,x,0	1.7261fC
0,2,x,1	1.4957fC
0,2,x,2	2.3281fC
0,2,x,3	1.7758fC
0,2,x,4	1.6961fC
0,2,x,5	1.6725fC
0,2,x,6	1.4451fC
0,2,x,7	1.3794fC

Range 0.316V, Bw 80kHz Not in Scope Spec: < 1.2000µV	
Chan	Value
0,1,x,0	0.6794µV
0,1,x,1	0.6306µV
0,1,x,2	0.6120µV
0,1,x,3	0.6073µV
0,1,x,4	0.6083µV
0,1,x,5	0.6841µV
0,1,x,6	0.6372µV
0,1,x,7	0.5810µV
0,2,x,0	0.6941µV
0,2,x,1	0.5971µV
0,2,x,2	0.6532µV
0,2,x,3	0.7280µV
0,2,x,4	0.6325µV
0,2,x,5	0.6444µV
0,2,x,6	0.5478µV
0,2,x,7	0.6098µV

Range 0.316nC, Bw 80kHz Not in Scope Spec: < 1.2000fC	
Chan	Value
0,1,x,0	0.6534fC
0,1,x,1	0.6345fC
0,1,x,2	0.6020fC
0,1,x,3	0.6248fC
0,1,x,4	0.6508fC
0,1,x,5	0.6198fC
0,1,x,6	0.6614fC
0,1,x,7	0.6902fC
0,2,x,0	0.6119fC
0,2,x,1	0.7955fC
0,2,x,2	0.6187fC
0,2,x,3	0.6484fC
0,2,x,4	0.6443fC
0,2,x,5	0.6474fC
0,2,x,6	0.7112fC
0,2,x,7	0.6161fC

Range 0.316V, Bw 40kHz Not in Scope Spec: < 0.1600µV	
Chan	Value
0,1,x,0	0.0773µV
0,1,x,1	0.0815µV
0,1,x,2	0.0900µV
0,1,x,3	0.0983µV
0,1,x,4	0.0994µV
0,1,x,5	0.1014µV
0,1,x,6	0.0922µV
0,1,x,7	0.0779µV
0,2,x,0	0.0935µV
0,2,x,1	0.0926µV
0,2,x,2	0.0909µV
0,2,x,3	0.0825µV
0,2,x,4	0.0827µV
0,2,x,5	0.0897µV
0,2,x,6	0.0839µV
0,2,x,7	0.0897µV

Range 0.316nC, Bw 40kHz Not in Scope Spec: < 0.3500fC	
Chan	Value
0,1,x,0	0.1643fC
0,1,x,1	0.1682fC
0,1,x,2	0.1443fC
0,1,x,3	0.1500fC
0,1,x,4	0.1397fC
0,1,x,5	0.1534fC
0,1,x,6	0.1460fC
0,1,x,7	0.1468fC
0,2,x,0	0.1486fC
0,2,x,1	0.1466fC
0,2,x,2	0.1524fC
0,2,x,3	0.1534fC
0,2,x,4	0.1955fC
0,2,x,5	0.1347fC
0,2,x,6	0.1768fC
0,2,x,7	0.1535fC

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Range 10V, Bw 20kHz
Spurious 3.16V < IR <= 10V
Spec: <= 2.300 µV
Uncertainty: 3.4nV

Chan	Value
0,1,x,0	1.311 µV
0,1,x,1	1.266 µV
0,1,x,2	1.205 µV
0,1,x,3	1.154 µV
0,1,x,4	1.059 µV
0,1,x,5	1.175 µV
0,1,x,6	1.246 µV
0,1,x,7	1.013 µV
0,2,x,0	1.261 µV
0,2,x,1	1.269 µV
0,2,x,2	1.405 µV
0,2,x,3	1.455 µV
0,2,x,4	1.040 µV
0,2,x,5	1.149 µV
0,2,x,6	1.062 µV
0,2,x,7	0.985 µV

Range 10nC, Bw 20kHz
Spurious 3.16nC < IR <= 10nC
Spec: <= 2.500 fC
Uncertainty: 2.8aC

Chan	Value
0,1,x,0	1.535 fC
0,1,x,1	1.246 fC
0,1,x,2	1.482 fC
0,1,x,3	1.294 fC
0,1,x,4	1.304 fC
0,1,x,5	1.153 fC
0,1,x,6	1.224 fC
0,1,x,7	1.217 fC
0,2,x,0	1.041 fC
0,2,x,1	1.257 fC
0,2,x,2	1.590 fC
0,2,x,3	1.604 fC
0,2,x,4	1.120 fC
0,2,x,5	1.370 fC
0,2,x,6	1.249 fC
0,2,x,7	0.983 fC

ICP
Not in Scope
Spec: < 0.2600µVp

Chan	Value
0,1,x,0	0.0886µVp
0,1,x,1	0.0906µVp
0,1,x,2	0.0735µVp
0,1,x,3	0.0781µVp
0,1,x,4	0.0803µVp
0,1,x,5	0.0924µVp
0,1,x,6	0.0681µVp
0,1,x,7	0.0688µVp
0,2,x,0	0.0877µVp
0,2,x,1	0.0697µVp
0,2,x,2	0.0656µVp
0,2,x,3	0.0615µVp
0,2,x,4	0.0737µVp
0,2,x,5	0.0776µVp
0,2,x,6	0.0709µVp
0,2,x,7	0.0665µVp

Range 0.316V, Bw 20kHz
Spurious IR <= 316mV
Spec: <= 0.130 µV
Uncertainty: 2.0nV

Chan	Value
0,1,x,0	0.072 µV
0,1,x,1	0.064 µV
0,1,x,2	0.057 µV
0,1,x,3	0.063 µV
0,1,x,4	0.058 µV
0,1,x,5	0.056 µV
0,1,x,6	0.062 µV
0,1,x,7	0.062 µV
0,2,x,0	0.062 µV
0,2,x,1	0.078 µV
0,2,x,2	0.064 µV
0,2,x,3	0.063 µV
0,2,x,4	0.063 µV
0,2,x,5	0.060 µV
0,2,x,6	0.060 µV
0,2,x,7	0.055 µV

Range 0.316nC, Bw 20kHz
Spurious IR <= 316pC
Spec: <= 0.300 fC
Uncertainty: 0.1aC

Chan	Value
0,1,x,0	0.097 fC
0,1,x,1	0.120 fC
0,1,x,2	0.097 fC
0,1,x,3	0.120 fC
0,1,x,4	0.113 fC
0,1,x,5	0.116 fC
0,1,x,6	0.099 fC
0,1,x,7	0.106 fC
0,2,x,0	0.106 fC
0,2,x,1	0.105 fC
0,2,x,2	0.139 fC
0,2,x,3	0.105 fC
0,2,x,4	0.108 fC
0,2,x,5	0.105 fC
0,2,x,6	0.122 fC
0,2,x,7	0.114 fC

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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	0.135 µV, -131.4dB
0,1,x,1	0.145 µV, -130.8dB
0,1,x,2	0.124 µV, -132.1dB
0,1,x,3	0.082 µV, -135.7dB
0,1,x,4	0.131 µV, -131.6dB
0,1,x,5	0.123 µV, -132.2dB
0,1,x,6	0.136 µV, -131.3dB
0,1,x,7	0.115 µV, -132.7dB
0,2,x,0	0.093 µV, -134.6dB
0,2,x,1	0.111 µV, -133.1dB
0,2,x,2	0.070 µV, -137.1dB
0,2,x,3	0.133 µV, -131.5dB
0,2,x,4	0.093 µV, -134.6dB
0,2,x,5	0.094 µV, -134.5dB
0,2,x,6	0.114 µV, -132.8dB
0,2,x,7	0.131 µV, -131.6dB

Range 10V, F 1K5
Crosstalk 3.16V < IR <= 10V
Spec: <= -108.0dB
Uncertainty: 1.3µV

Chan	Value
0,1,x,0	0.362 µV, -122.8dB
0,1,x,1	0.317 µV, -124.0dB
0,1,x,2	0.217 µV, -127.3dB
0,1,x,3	0.498 µV, -120.0dB
0,1,x,4	0.303 µV, -124.4dB
0,1,x,5	0.562 µV, -119.0dB
0,1,x,6	0.647 µV, -117.8dB
0,1,x,7	0.821 µV, -115.7dB
0,2,x,0	0.311 µV, -124.1dB
0,2,x,1	0.422 µV, -121.5dB
0,2,x,2	0.112 µV, -133.0dB
0,2,x,3	0.698 µV, -117.1dB
0,2,x,4	0.320 µV, -123.9dB
0,2,x,5	0.548 µV, -119.2dB
0,2,x,6	0.634 µV, -117.9dB
0,2,x,7	0.676 µV, -117.4dB

Range 0.316nC, F 1K5
Crosstalk IR <= 316pC
Spec: <= -118.0dB
Uncertainty: 68aC

Chan	Value
0,1,x,0	0.172 fC, -129.3dB
0,1,x,1	0.163 fC, -129.7dB
0,1,x,2	0.164 fC, -129.7dB
0,1,x,3	0.129 fC, -131.8dB
0,1,x,4	0.171 fC, -129.3dB
0,1,x,5	0.150 fC, -130.4dB
0,1,x,6	0.191 fC, -128.4dB
0,1,x,7	0.202 fC, -127.9dB
0,2,x,0	0.186 fC, -128.6dB
0,2,x,1	0.167 fC, -129.5dB
0,2,x,2	0.192 fC, -128.3dB
0,2,x,3	0.169 fC, -129.4dB
0,2,x,4	0.197 fC, -128.1dB
0,2,x,5	0.192 fC, -128.3dB
0,2,x,6	0.227 fC, -126.9dB
0,2,x,7	0.199 fC, -128.0dB

Range 10nC, F 1K5
Crosstalk 3.16nC < IR <= 10nC
Spec: <= -109.0dB
Uncertainty: 1.3fC

Chan	Value
0,1,x,0	0.340 fC, -123.4dB
0,1,x,1	0.214 fC, -127.4dB
0,1,x,2	0.205 fC, -127.7dB
0,1,x,3	0.947 fC, -114.5dB
0,1,x,4	0.516 fC, -119.7dB
0,1,x,5	0.474 fC, -120.5dB
0,1,x,6	0.603 fC, -118.4dB
0,1,x,7	0.800 fC, -115.9dB
0,2,x,0	0.169 fC, -129.4dB
0,2,x,1	0.174 fC, -129.2dB
0,2,x,2	0.345 fC, -123.2dB
0,2,x,3	0.389 fC, -122.2dB
0,2,x,4	0.598 fC, -118.4dB
0,2,x,5	0.603 fC, -118.4dB
0,2,x,6	0.753 fC, -116.4dB
0,2,x,7	0.568 fC, -118.9dB

Range 0.316V, F 15K
Crosstalk 100mV < IR <= 316mV
Spec: <= -107.0dB
Uncertainty: 68nV

Chan	Value
0,1,x,0	0.594 µV, -118.5dB
0,1,x,1	0.961 µV, -114.3dB
0,1,x,2	0.968 µV, -114.3dB
0,1,x,3	0.775 µV, -116.2dB
0,1,x,4	0.910 µV, -114.8dB
0,1,x,5	0.932 µV, -114.6dB
0,1,x,6	0.957 µV, -114.4dB
0,1,x,7	0.883 µV, -115.1dB
0,2,x,0	0.558 µV, -119.1dB
0,2,x,1	0.932 µV, -114.6dB
0,2,x,2	0.950 µV, -114.4dB
0,2,x,3	0.794 µV, -116.0dB
0,2,x,4	0.903 µV, -114.9dB
0,2,x,5	0.906 µV, -114.8dB
0,2,x,6	0.930 µV, -114.6dB
0,2,x,7	0.881 µV, -115.1dB

Range 10V, F 15K
Crosstalk 3.16V < IR <= 10V
Spec: <= -105.0dB
Uncertainty: 1.3µV

Chan	Value
0,1,x,0	0.913 µV, -114.8dB
0,1,x,1	1.579 µV, -110.0dB
0,1,x,2	1.585 µV, -110.0dB
0,1,x,3	1.551 µV, -110.2dB
0,1,x,4	1.325 µV, -111.5dB
0,1,x,5	1.235 µV, -112.1dB
0,1,x,6	1.372 µV, -111.2dB
0,1,x,7	0.950 µV, -114.4dB
0,2,x,0	1.090 µV, -113.2dB
0,2,x,1	1.624 µV, -109.8dB
0,2,x,2	1.598 µV, -109.9dB
0,2,x,3	1.519 µV, -110.3dB
0,2,x,4	1.196 µV, -112.4dB
0,2,x,5	1.386 µV, -111.1dB
0,2,x,6	1.298 µV, -111.7dB
0,2,x,7	1.151 µV, -112.8dB

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Range 0.316nC, F 15K Crosstalk IR <= 316pC Spec: <= -118.0dB Uncertainty: 68aC	
Chan	Value
0,1,x,0	0.230 fC, -126.7dB
0,1,x,1	0.364 fC, -122.7dB
0,1,x,2	0.247 fC, -126.1dB
0,1,x,3	0.459 fC, -120.7dB
0,1,x,4	0.323 fC, -123.8dB
0,1,x,5	0.303 fC, -124.3dB
0,1,x,6	0.301 fC, -124.4dB
0,1,x,7	0.312 fC, -124.1dB
0,2,x,0	0.238 fC, -126.5dB
0,2,x,1	0.326 fC, -123.7dB
0,2,x,2	0.242 fC, -126.3dB
0,2,x,3	0.423 fC, -121.5dB
0,2,x,4	0.324 fC, -123.8dB
0,2,x,5	0.280 fC, -125.0dB
0,2,x,6	0.302 fC, -124.4dB
0,2,x,7	0.319 fC, -123.9dB

Range 10nC, F 15K Crosstalk 3.16nC < IR <= 10nC Spec: <= -109.0dB Uncertainty: 1.3fC	
Chan	Value
0,1,x,0	0.660 fC, -117.6dB
0,1,x,1	0.964 fC, -114.3dB
0,1,x,2	0.906 fC, -114.8dB
0,1,x,3	1.260 fC, -112.0dB
0,1,x,4	0.675 fC, -117.4dB
0,1,x,5	0.737 fC, -116.6dB
0,1,x,6	0.444 fC, -121.0dB
0,1,x,7	0.080 fC, -135.9dB
0,2,x,0	0.444 fC, -121.0dB
0,2,x,1	0.961 fC, -114.3dB
0,2,x,2	1.037 fC, -113.7dB
0,2,x,3	0.910 fC, -114.8dB
0,2,x,4	0.688 fC, -117.2dB
0,2,x,5	0.843 fC, -115.5dB
0,2,x,6	0.621 fC, -118.1dB
0,2,x,7	0.560 fC, -119.0dB

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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	0.0413°
0,1,x,1	0.0274°
0,1,x,2	0.0353°
0,1,x,3	0.0212°
0,1,x,4	0.0245°
0,1,x,5	0.0413°
0,1,x,6	0.0334°
0,1,x,7	0.0399°
0,2,x,0	0.0292°
0,2,x,1	0.0265°
0,2,x,2	0.0231°
0,2,x,3	0.0408°
0,2,x,4	0.0234°
0,2,x,5	0.0340°
0,2,x,6	0.0250°
0,2,x,7	0.0249°

Range 10nC, F 9k9 Not in Scope Spec: < 0.3000°	
Chan	Value
0,1,x,0	0.0468°
0,1,x,1	0.0256°
0,1,x,2	0.0439°
0,1,x,3	0.0285°
0,1,x,4	0.0332°
0,1,x,5	0.0392°
0,1,x,6	0.0288°
0,1,x,7	0.0468°
0,2,x,0	0.0260°
0,2,x,1	0.0354°
0,2,x,2	0.0333°
0,2,x,3	0.0332°
0,2,x,4	0.0281°
0,2,x,5	0.0341°
0,2,x,6	0.0242°
0,2,x,7	0.0245°

Range 10V, F 19k9 Not in Scope Spec: < 0.4000°	
Chan	Value
0,1,x,0	0.0836°
0,1,x,1	0.0548°
0,1,x,2	0.0714°
0,1,x,3	0.0430°
0,1,x,4	0.0491°
0,1,x,5	0.0836°
0,1,x,6	0.0671°
0,1,x,7	0.0812°
0,2,x,0	0.0594°
0,2,x,1	0.0536°
0,2,x,2	0.0472°
0,2,x,3	0.0818°
0,2,x,4	0.0472°
0,2,x,5	0.0686°
0,2,x,6	0.0501°
0,2,x,7	0.0499°

Range 10nC, F 19K9 Not in Scope Spec: < 0.4000°	
Chan	Value
0,1,x,0	0.0966°
0,1,x,1	0.0514°
0,1,x,2	0.0912°
0,1,x,3	0.0586°
0,1,x,4	0.0678°
0,1,x,5	0.0787°
0,1,x,6	0.0580°
0,1,x,7	0.0966°
0,2,x,0	0.0523°
0,2,x,1	0.0734°
0,2,x,2	0.0685°
0,2,x,3	0.0669°
0,2,x,4	0.0588°
0,2,x,5	0.0685°
0,2,x,6	0.0514°
0,2,x,7	0.0519°

Range 0.316V, F 9k9 Not in Scope Spec: < 0.3000°	
Chan	Value
0,1,x,0	0.0727°
0,1,x,1	0.1025°
0,1,x,2	0.0779°
0,1,x,3	0.1260°
0,1,x,4	0.0866°
0,1,x,5	0.1115°
0,1,x,6	0.1218°
0,1,x,7	0.1409°
0,2,x,0	0.1319°
0,2,x,1	0.1048°
0,2,x,2	0.1205°
0,2,x,3	0.0966°
0,2,x,4	0.1161°
0,2,x,5	0.0868°
0,2,x,6	0.1177°
0,2,x,7	0.1409°

Range 0.316nC, F 9k9 Not in Scope Spec: < 0.3000°	
Chan	Value
0,1,x,0	0.0749°
0,1,x,1	0.0959°
0,1,x,2	0.0732°
0,1,x,3	0.1288°
0,1,x,4	0.0787°
0,1,x,5	0.1044°
0,1,x,6	0.1127°
0,1,x,7	0.1429°
0,2,x,0	0.1429°
0,2,x,1	0.1159°
0,2,x,2	0.1330°
0,2,x,3	0.1120°
0,2,x,4	0.1231°
0,2,x,5	0.0944°
0,2,x,6	0.1277°
0,2,x,7	0.1427°

Range 0.316V, F 19k9 Not in Scope Spec: < 0.6000°	
Chan	Value
0,1,x,0	0.1434°
0,1,x,1	0.2034°
0,1,x,2	0.1531°
0,1,x,3	0.2511°
0,1,x,4	0.1719°
0,1,x,5	0.2218°
0,1,x,6	0.2419°
0,1,x,7	0.2808°
0,2,x,0	0.2633°
0,2,x,1	0.2089°
0,2,x,2	0.2412°
0,2,x,3	0.1927°
0,2,x,4	0.2317°
0,2,x,5	0.1729°
0,2,x,6	0.2355°
0,2,x,7	0.2808°

Range 0.316nC, F 19K9 Not in Scope Spec: < 0.6000°	
Chan	Value
0,1,x,0	0.1527°
0,1,x,1	0.1912°
0,1,x,2	0.1500°
0,1,x,3	0.2587°
0,1,x,4	0.1582°
0,1,x,5	0.2093°
0,1,x,6	0.2242°
0,1,x,7	0.2879°
0,2,x,0	0.2876°
0,2,x,1	0.2337°
0,2,x,2	0.2669°
0,2,x,3	0.2254°
0,2,x,4	0.2471°
0,2,x,5	0.1904°
0,2,x,6	0.2580°
0,2,x,7	0.2879°

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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
0,0,x,0	0.368 mV, 0.009%
0,0,x,1	0.087 mV, 0.002%

BW 51k2 **Alternating voltage 3.16V < IR <= 10V** **Spec: <= ±0.100%** **Uncertainty: 640µV**	
Chan	Value
0,0,x,0	0.389 mV, 0.010%
0,0,x,1	0.255 mV, 0.006%

BW 102k4 **Not in Scope** **Spec: 1.00000 ±0.10%**	
Chan	Value
0,0,x,0	1.00006, 0.01%
0,0,x,1	1.00003, 0.00%

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End of Report