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Belle River Wind Power Project – Turbine T44 **IEC 61400-11 Edition 3.0 Measurement Report**

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Revision History

| Revision Number | Description | Date |
|-----------------|--|-------------------|
| 1 | Issued test report | 23 July 2018 |
| 2 | Revised to correct turbine model information | 21 May 2019 |
| 3 | Revised to correct turbine model | 20 September 2019 |

This report in its entirety, including appendices contains 89 pages.

Statement Qualifications and Limitations

This report was prepared by Aeroustics 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.

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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 Belle River Wind LP to conduct testing per the IEC 61400-11 test standard on one of the wind turbines, designated as T44, located in the Belle River Wind Project. The measurements were carried out in accordance with IEC 61400-11:2012, “Wind turbine generator systems – Part 11: Acoustic noise measurement techniques”. This report is specific only to turbine T44.

Aercoustics is accredited by the Standards Council of Canada under ISO/IEC 17025 to perform testing according to the IEC 61400-11 test standard.

2 Wind Turbine Information

2.1 Wind Turbine Equipment Details

Equipment information specific to turbine T44 was provided by Siemens Gamesa Renewable Energy and is summarized in Tables 1 to 5.

Table 1 - Wind Turbine Details

| Wind Turbine Details | |
|----------------------|---------------------------------|
| Manufacturer | Siemens Gamesa Renewable Energy |
| Model Number | SWT 2.473-113 |
| Turbine ID | T44 |

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 | Rev 0 |
| Rotational speed at each integer standardised wind speed | Max speed, 12.1 rpm |
| Rated power output | 2473 kW |
| Control software version | 136.1.0.1 |

Table 3 - Rotor Details

| Rotor Details | |
|--|--|
| Rotor control devices | Pitch control |
| Presence of vortex generators, stall strips, serrated trailing edges | Vortex generators and DinoTails |
| Blade type | B55 |
| Serial number | Blade A: 550256901 Blade B: 550257101 Blade C: 550256001 |
| Number of blades | 3 |

Table 4 - Gearbox Details

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

Table 5 - Generator Details

| Generator Details | |
|-------------------|------------|
| Manufacturer | Siemens |
| Model number | DD22_02 |
| Serial number | 5100219308 |

2.2 Wind Turbine Location

Turbine T44 is located in the town of Lakeshore, Ontario. Nearby roads are Lakeshore Road 131 and Trepanier Road, approximately 800 m to the west and 1,700 m to the north, respectively. The area surrounding T44 is flat and consists primarily of farmland. The UTM coordinates of the turbine are 4679766 m E and 367070 m N (Zone 17T).

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

Details regarding the acoustic measurement equipment utilized for the test is summarized in Table 6.

Table 6 – Acoustic Measurement Equipment

| Equipment | Manufacturer Name & Model | Serial Number |
|------------------------------|---------------------------|---------------|
| Data acquisition system | LMS SCADA Mobile | 22143211 |
| Microphone | B&K 4189 | 2622170 |
| Pre-amplifier for microphone | B&K 2671 | 2614901 |
| Acoustic calibrator | B&K 4231 | 2513182 |

A field calibration of the measurement chain was performed at the beginning and end of each measurement day.

3.1.2 Non-Acoustic Measurement Equipment

Non-acoustic measurement equipment includes an anemometer installed 10 m above ground level (“10 m AGL”) as well any sensing equipment utilized by the wind turbine to measure and record operational parameters. The 10 m AGL anemometer is provided by Aercoustics while the turbine sensing equipment is a part of the turbine installation.

Details regarding the non-acoustic measurement equipment utilized and controlled by Aercoustics is summarized in Table 7. Equipment used to measure turbine parameters, such as yaw angle and power output, are outside of Aercoustics’ control and are not reported here.

Table 7 – Meteorological Measurement Equipment

| Equipment | Manufacturer Name & Model | Serial Number |
|----------------------------|---------------------------|---------------|
| Weather anemometer | VAISALA WXT520 | K4250007 |
| Serial to Analog Converter | NOKEVAL 7470 | A165164 |

3.2 Measurement Setup

3.2.1 Microphone Placement

The measurement microphone was setup 156 m from the base of the turbine in a downwind position (Position 1, per IEC 61400-11), at an elevation of 0 m relative to the base of T44. The slant distance (R_1) from microphone location to rotor centre includes the distance from rotor center to tower axis ($R_1 = 189.7$ m). The microphone was placed in the centre of a circular, acoustically reflective board.

During the measurement period, data points were used only when the microphone was within 15 degrees of the downwind direction from the turbine. The microphone position relative to downwind is monitored via the turbine yaw angle provided from the turbine SCADA system (discussed further in Section 3.5).

During the test, the land surrounding the turbine was bare and tilled soil. No crops or vegetations were in the nearby area which would influence on the results of the measurement. The nearby area also did not have any reflecting surfaces (houses, barns etc.); as such the influence from reflecting surfaces is 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 Periods

Table 8 – Summary of Measurement Periods

| Date | Test Type | Start Time | Finish time |
|--------------|------------|------------|-------------|
| June 4, 2018 | Turbine ON | 12:53 pm | 1:24 pm |
| | Background | 1:29 pm | 2:16 pm |
| | Turbine ON | 2:28 pm | 3:59 pm |
| | Background | 4:01 pm | 4:41 pm |
| | Turbine ON | 4:46 pm | 6:10 pm |

3.4 Meteorological Conditions

The normalised hub height wind speed during Turbine ON periods is either derived directly using the turbine power curve and measured power output (Section 8.2.1.1 of [1]) or indirectly using the measured wind speed from the nacelle anemometer and applying a correction factor (Section 8.2.1.2 of [1]). Wind speeds during Background periods are measured using from the 10 m AGL anemometer and corrected to hub-height using a correction factor (Section 8.2.2 of [1]). The downwind direction is determined using the turbine yaw angle output, also known as the nacelle position (Section 8.3 of [1]).

Other atmospheric conditions, including ambient temperature and atmospheric pressure, are measured by the 10 m AGL anemometer during the measurement periods.

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

3.5 Turbine operational information

Turbine operational parameters – including electrical power, nacelle position (yaw angle), rotational speed, and nacelle wind speed – are acquired from the turbine controller simultaneously with the acoustic and weather measurement data using Aercoustics' data acquisition system.

4 Measurement Results

4.1 Deviations from IEC-61400-11 Edition 3.0

No deviations.

4.2 Special Notes & Considerations

Turbines T45 and T55 were parked during the test. These turbines, and their position relative to the test turbine, are shown in Figure A.01.

4.3 Analysis Methodology

The following section outlines any corrections applied to the acoustic or weather measurement data, per IEC 61400-11. Transient events, such as vehicle traffic, wildlife, or air traffic, are excluded from the measurement data set.

4.3.1 Double Windscreen Adjustment

No double wind screen was used in the measurements described in this report and therefore no adjustment for a double windscreen was applied to the measurement data.

4.3.2 Wind Speed Correction

Following the methodology described in Section 8.2 of [1] and summarized in Section 3.4 of this report, two correction factors are derived from the measurement data and used to determine the normalized hub-height wind speed in certain conditions. The first correction factor (k_{nac}) is used to correct nacelle wind speeds measured for intervals that fall outside of the allowable power curve range. The second correction factor (k_Z) is used to correct 10 m AGL wind speeds measured during Background measurement periods up to hub-height.

The k-factors for this measurement set are provided in Table 9.

Table 9 – Calculated nacelle anemometer (k_{nac}) and 10 m (k_Z) wind speed k-factor

| k_{nac} | k_Z |
|-----------|-------|
| 0.98 | 1.06 |

4.4 Type B uncertainties

Type B uncertainties were obtained through interpretation of the information provided in Annex C of [1]. A summary of Type B uncertainties is provided in Table 10, while detailed information, including uncertainties by 1/3 octave band, is provided in Appendix C.

Table 10 – 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

Average overall sound pressure levels in each wind bin for Turbine ON and Background periods are summarized in Table 11. Average sound levels and uncertainties by 1/3 octave band are provided in Appendix C. A copy of the measurement data used for analysis is provided in Appendix E.

Table 11 – 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 | |
| 7.5 | 51.4 | 40 | 38.9 | 41 | 51.2 |
| 8.0 | 51.7 | 88 | 40.8 | 37 | 51.4 |
| 8.5 | 51.6 | 193 | 40.4 | 52 | 51.3 |
| 9.0 | 51.5 | 222 | 40.0 | 57 | 51.1 |
| 9.5 | 51.5 | 129 | 40.3 | 45 | 51.1 |
| 10.0 | 51.5 | 139 | 40.7 | 29 | 51.1 |
| 10.5 | 51.4 | 115 | 41.1 | 38 | 51.0 |
| 11.0 | 51.5 | 89 | 41.5 | 27 | 51.1 |
| 11.5 | 51.7 | 61 | 41.3 | 23 | 51.3 |
| 12.0 | 51.9 | 29 | 41.1 | 10 | 51.5 |

4.6 Sound Power Level of Turbine

The calculated apparent sound power level at hub height is summarized in Table 12. Corresponding sound power levels for 10 m height wind speeds are provided in Table 13. Wind speeds at 10 m are calculated using the wind shear profile described in Section 9.4 of [1].

Sound power levels by 1/3 octave band are provided in Appendix C.

Table 12 – $L_{WA,K}$ at each integer wind speed

| Wind Speed (m/s) | Apparent L_{WA} , (dBA) | Uncertainty (dB) |
|------------------|---------------------------|------------------|
| 7.5 | 101.7 | 0.8 |
| 8.0 | 101.9 | 0.8 |
| 8.5 | 101.9 | 0.8 |
| 9.0 | 101.7 | 0.8 |
| 9.5 | 101.7 | 0.8 |
| 10.0 | 101.6 | 0.8 |
| 10.5 | 101.6 | 0.8 |
| 11 | 101.7 | 0.8 |
| 11.5 | 101.8 | 0.8 |
| 12.0 | 102.1 | 0.8 |

Table 13 – $L_{WA,10m,K}$ at each integer wind speed

| Wind Speed (m/s) | Apparent L_{WA} , (dBA) | Uncertainty (dB) |
|------------------|---------------------------|------------------|
| 5 | 101.5 | 1.0 |
| 6 | 101.8 | 0.8 |
| 7 | 101.6 | 0.8 |
| 8 | 101.8 | 0.8 |
| 9 | 101.9 | 1.4 |

Values marked with an asterisk * denote 3 to 6 dB difference between Turbine ON and Background
 Values marked with two asterisk ** denote less than 3 dB difference between Turbine ON and Background and are not reported

4.7 Tonality Analysis

The tonality analysis for turbine T44 is summarized in Table 14, while plots of narrow band spectra at each wind speed are provided in Appendix D. All ΔL_{tn} and ΔL_a values reported represent the energy average of all data points with an identified tone that fall within the same frequency of origin (Section 9.5.8 of [1]).

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 14 – 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 (%) |
|---------------------|-------------------|-----------------------------------|--|---------------------|---------------------|-----------------|
| No Reportable Tones | | | | | | |

5 Closure

Measurements and analyses per IEC 61400-11:2012 (Edition 3.0) were performed on turbine T44 of the wind farm, located in the municipality of Clarington. The test turbine was found to have a maximum apparent sound power level of 102.1 dBA and with no reportable tonal audibility.

Supplementary information to address specific local regulatory requirements are attached separately in Appendix F.

Should you have any questions or comments please contact the authors of this report.

6 References

- [1] IEC 61400-11 , *Wind Turbines - Part 11: Acoustic noise measurement techniques*, International Electrotechnical Commission, 2012.

Appendix A Site Details



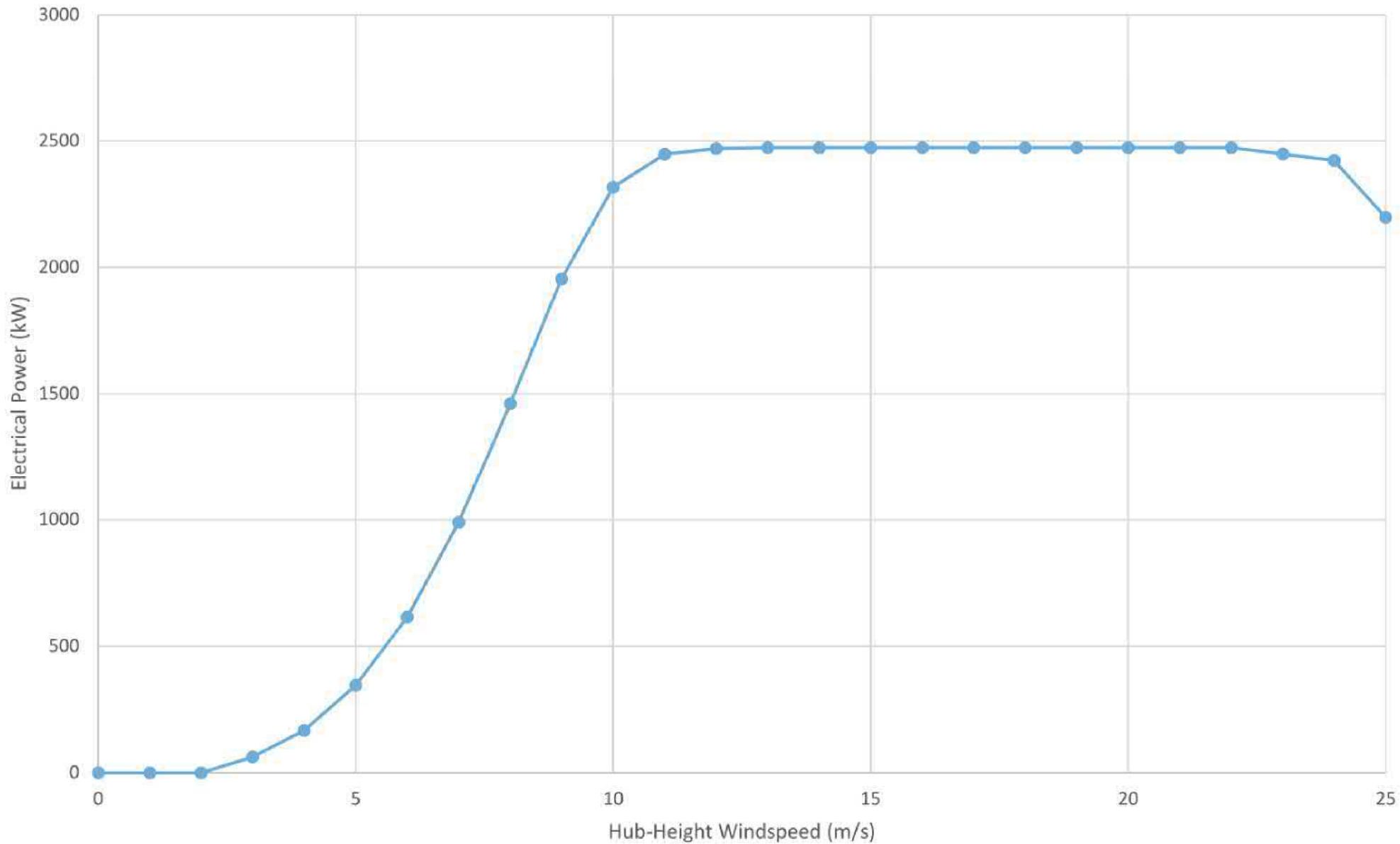
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| | Scale: NTS Drawn by: NT Reviewed by: AD Date: July 2018 Revision: 1 | Figure Title | |
| | | Site Plan | Figure A.01 |



Appendix B

Turbine Information

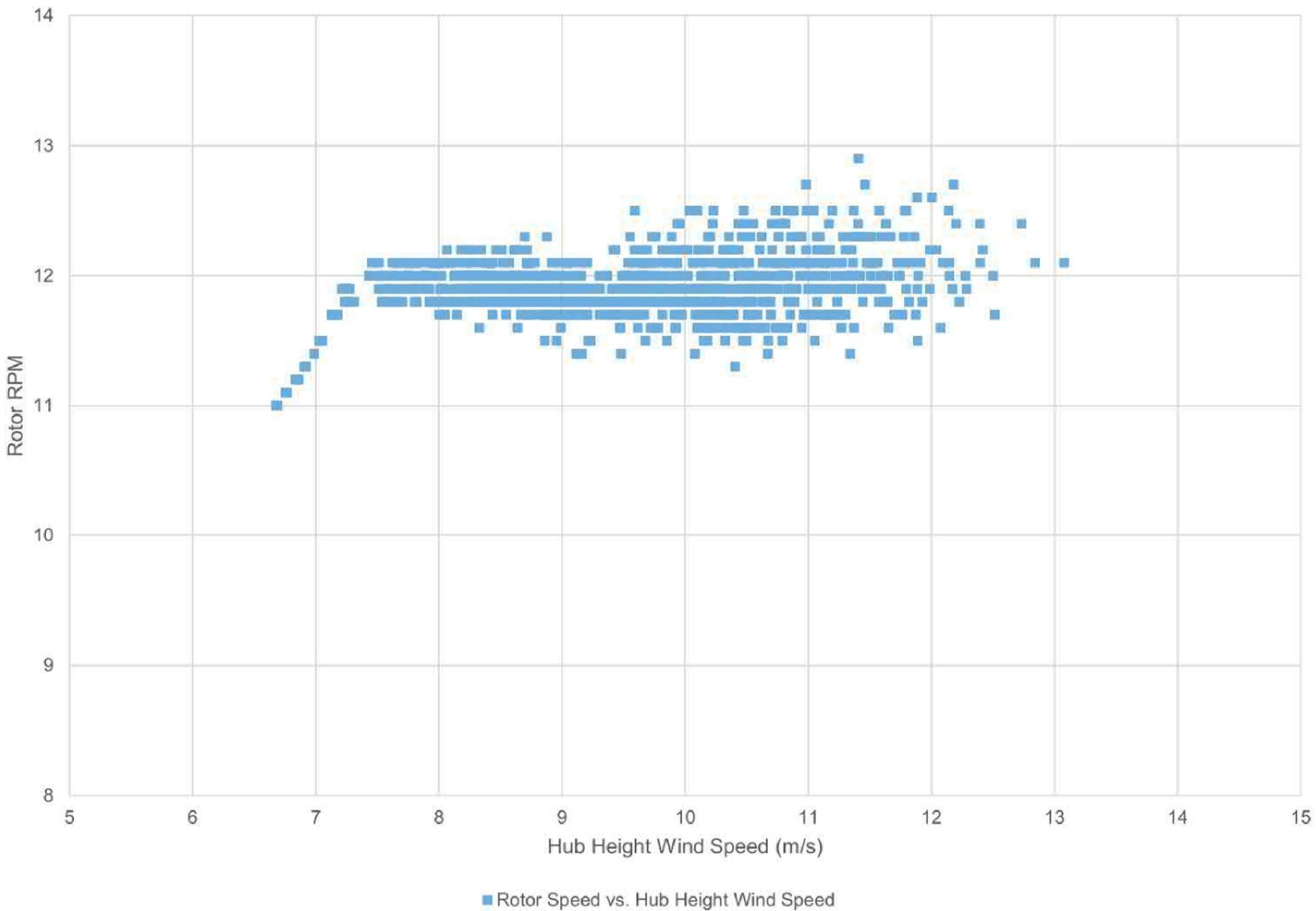
Belle River T09 - Siemens SWT-3.2-113 2.473 MW Power Curve



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Figure Title
Power Curve

Figure B.01



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Figure Title

Rotor RPM vs. Wind Speed

Figure B.02

Table B.01 Allowed range of power curve and required wind speeds

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| Power Curve & Required Wind Speeds | | |
|------------------------------------|------|-----|
| Power Curve Tolerance | 3% | |
| Acceptable range min | 4 | m/s |
| Acceptable range max | 9 | m/s |
| Min allowable range | 4 | m/s |
| Max allowable range | 9 | m/s |
| Power Output | 2473 | kW |
| 85% Power | 2102 | kW |
| Corresponding wind speed | 9.41 | m/s |
| Minimum bin | 7.5 | m/s |
| Maximum bin | 12.0 | m/s |

| Power Curve (+ value = acceptable) | | |
|------------------------------------|------------|----------------------|
| Hub Wind Speed (m/s) | Power [kW] | Slope of Power Curve |
| 0 | 0 | -148 |
| 1 | 0 | -148 |
| 2 | 0 | -85 |
| 3 | 63 | -44 |
| 4 | 167 | 31 |
| 5 | 346 | 121 |
| 6 | 615 | 227 |
| 7 | 990 | 323 |
| 8 | 1461 | 345 |
| 9 | 1954 | 215 |
| 10 | 2317 | -18 |
| 11 | 2447 | -125 |
| 12 | 2470 | -145 |
| 13 | 2473 | -148 |
| 14 | 2473 | -148 |
| 15 | 2473 | -148 |
| 16 | 2473 | -148 |
| 17 | 2473 | -148 |
| 18 | 2473 | -148 |
| 19 | 2473 | -148 |
| 20 | 2473 | -148 |
| 21 | 2473 | -148 |
| 22 | 2473 | -173 |
| 23 | 2448 | -173 |
| 24 | 2423 | -373 |
| 25 | 2198 | |

Appendix C Apparent Sound Power Level

Table C.03 Type B measurement uncertainty summary

Project: Belle River Wind Power Project- Turbine T44 - IEC 61400-11 Measurement

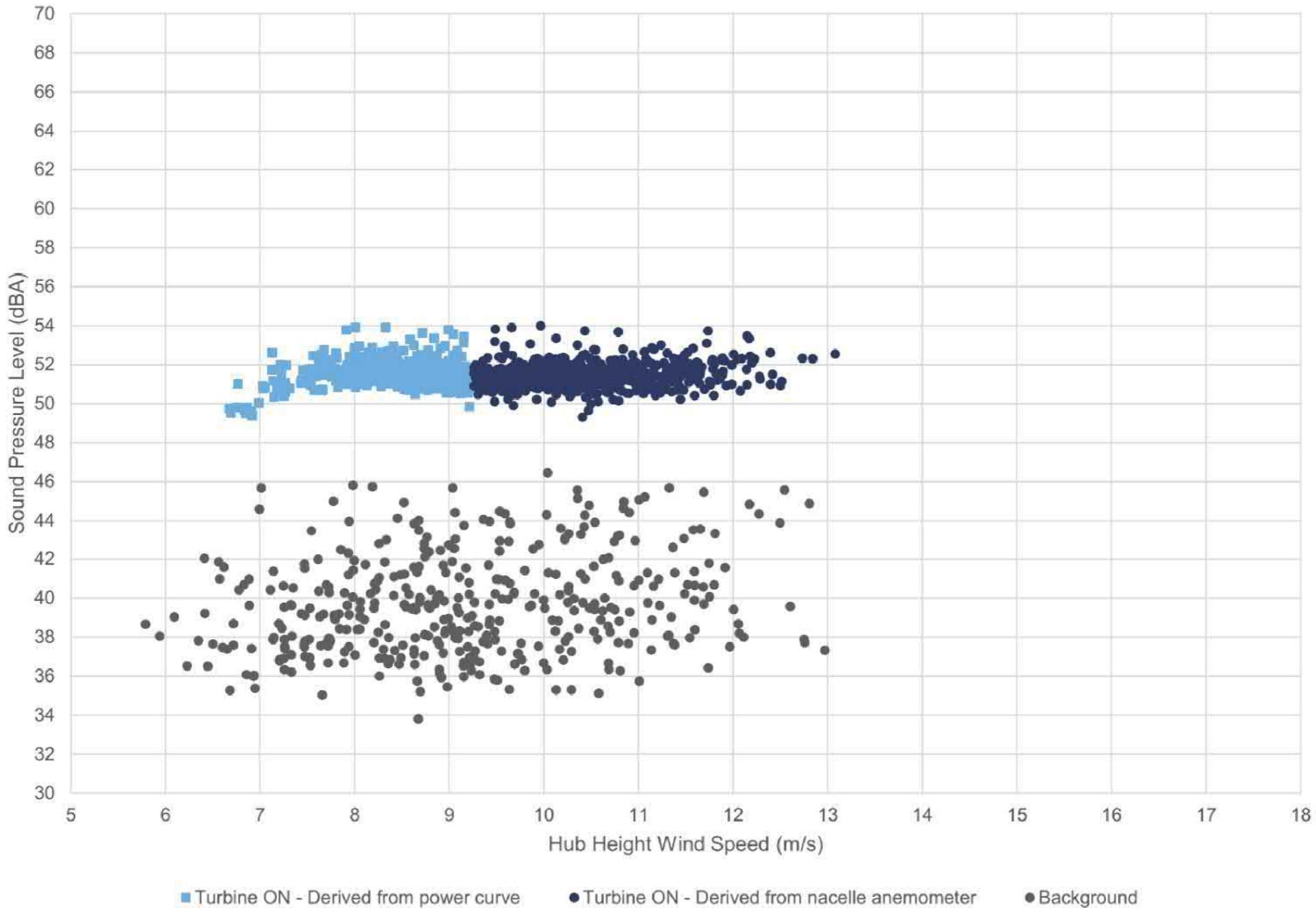
Report ID: 17095.01.T44.RP1

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| 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 | 2 dB |
| 25 | 0.8 dB | 1.6 dB |
| 31.5 | 0.5 dB | 1.1 dB |
| 40 | 0.5 dB | 1.5 dB |
| 50 | 0.5 dB | 1.1 dB |
| 63 | 0.5 dB | 0.9 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 | 0.8 dB |
| 1250 | 0.3 dB | 0.8 dB |
| 1600 | 0.3 dB | 0.8 dB |
| 2000 | 0.3 dB | 0.7 dB |
| 2500 | 0.5 dB | 0.8 dB |
| 3150 | 0.5 dB | 1.1 dB |
| 4000 | 0.5 dB | 1.1 dB |
| 5000 | 0.5 dB | 1 dB |
| 6300 | 0.5 dB | 1.1 dB |
| 8000 | 0.5 dB | 1.4 dB |
| 10000 | 1.3 dB | 1.7 dB |

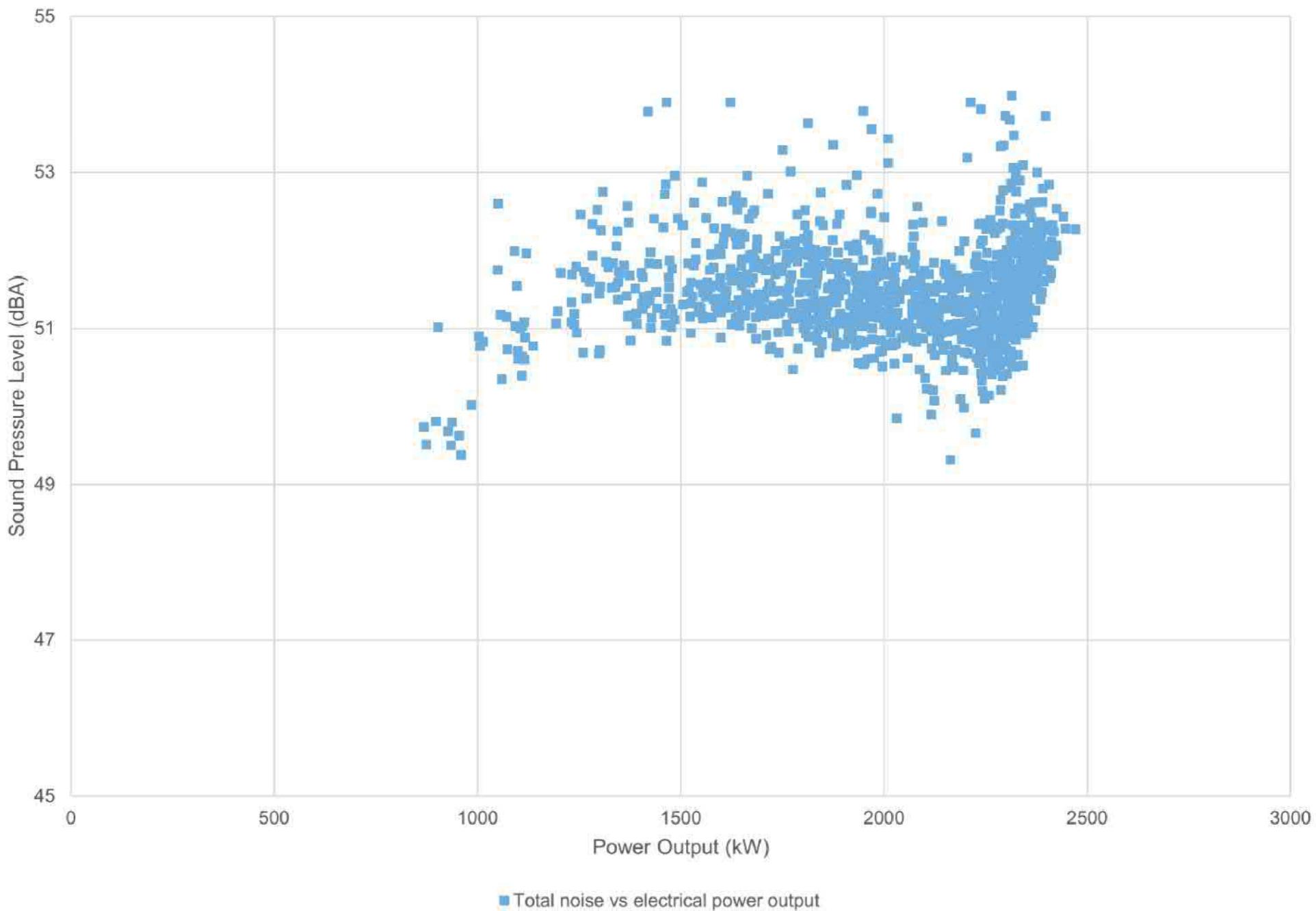


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Figure Title
 Plot of overall measurement data pairs at Position 1 (Turbine ON & Background)

Figure C.01



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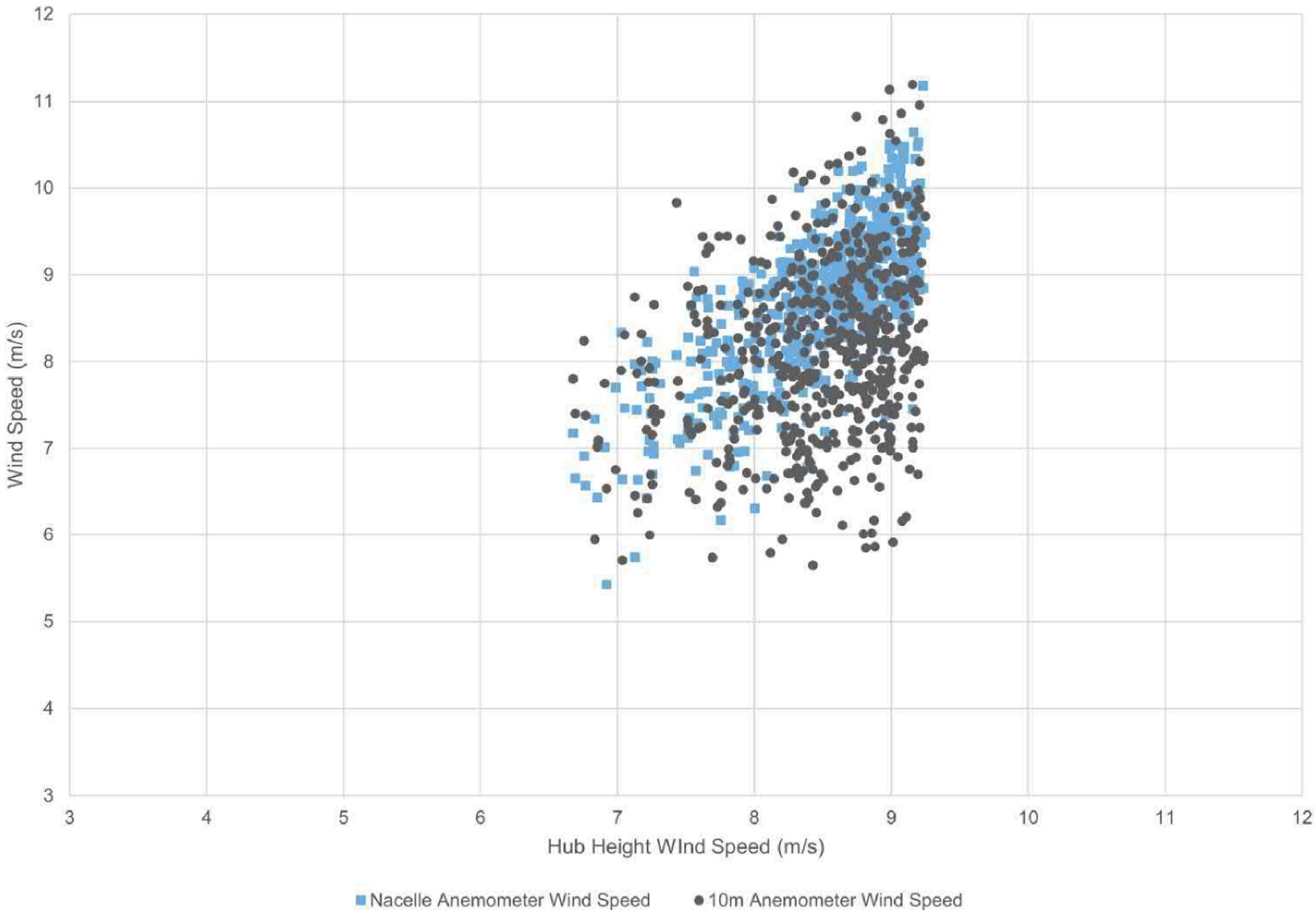
Project Name

Belle River Wind Power Project - IEC 61400-11 Edition 3.0 - Turbine T44

Figure Title

Plot of measured total noise vs. electrical power output

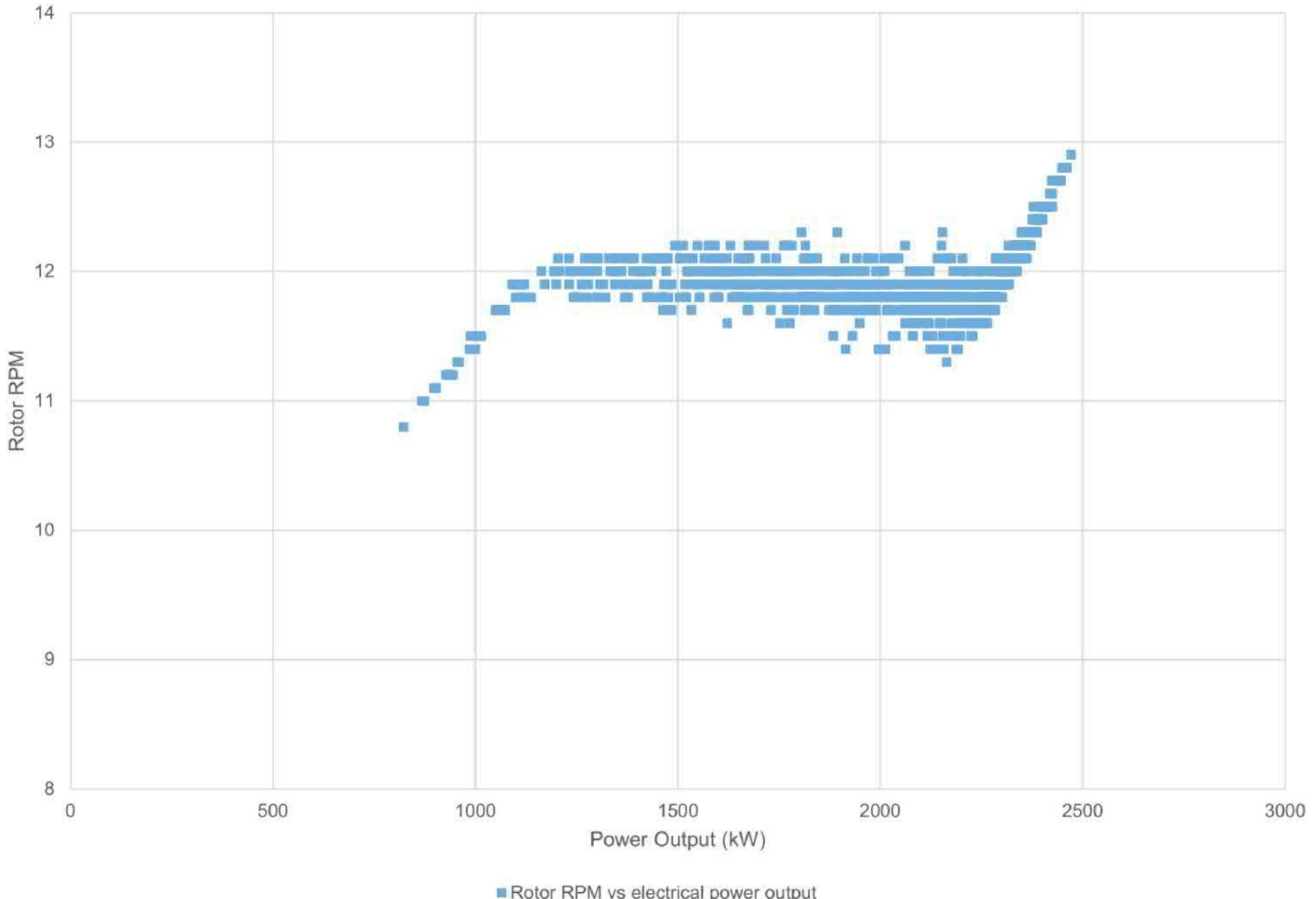
Figure C.02



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 Scale: NTS
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 Reviewed by: AD
 Date: July 2018
 Revision: 1

Project Name
 Belle River Wind Power Project - IEC 61400-11 Edition 3.0 - Turbine T44
Figure Title
 Plot of power curve relative to nacelle anemometer and 10 m anemometer

Figure C.03



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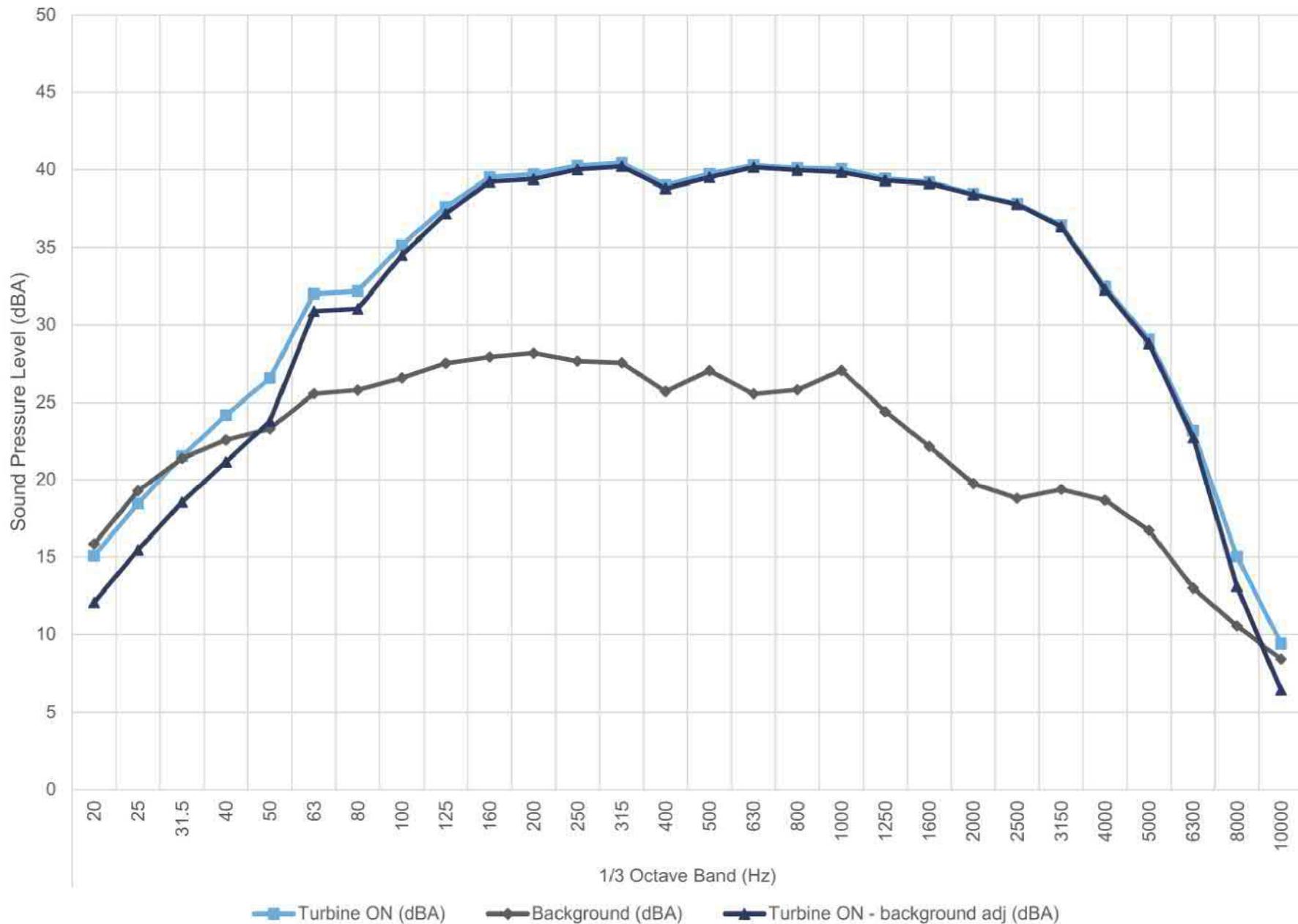
Belle River Wind Power Project - IEC 61400-11 Edition 3.0 - Turbine T44

Figure Title

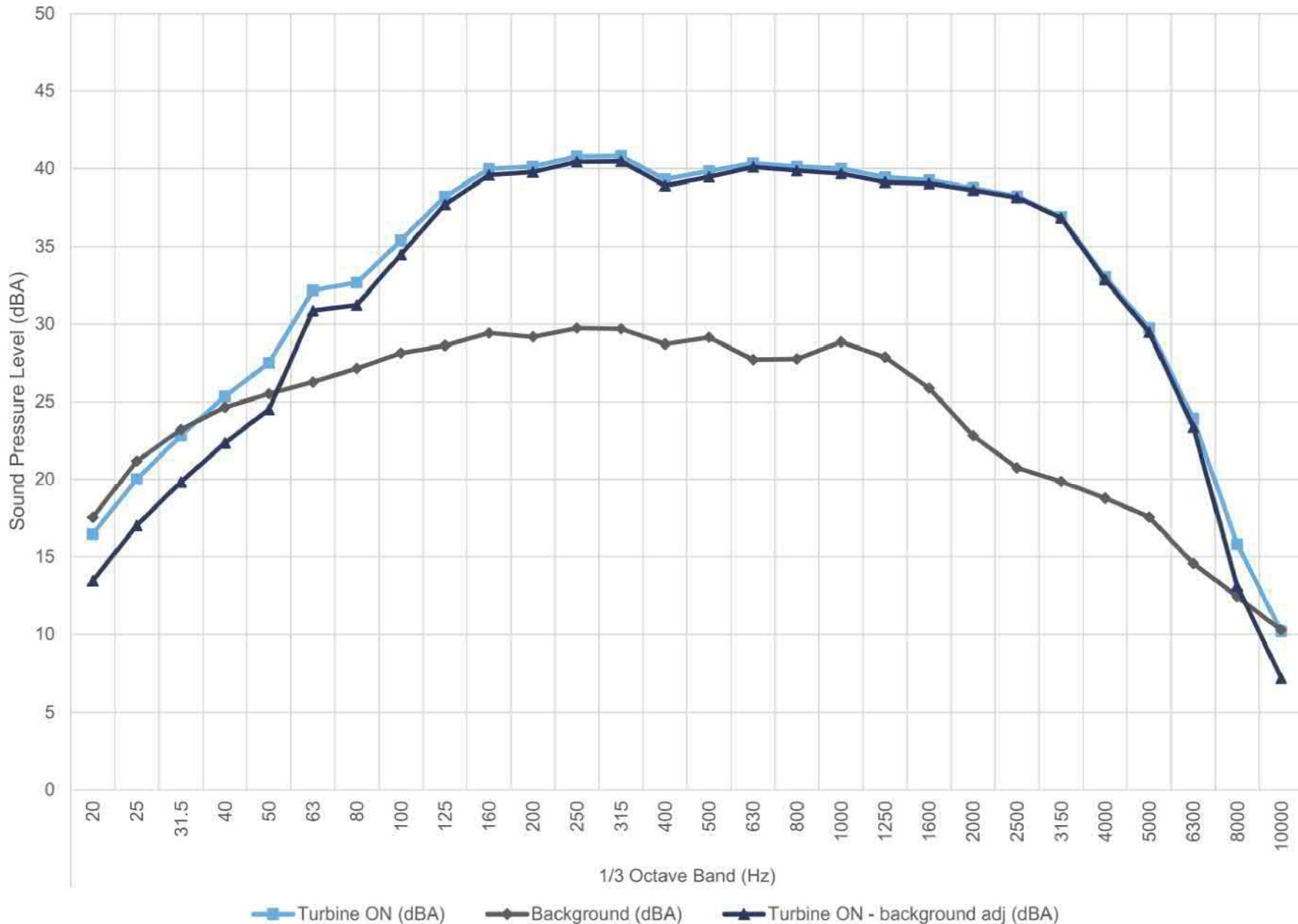
Plot of rotor RPM vs. electrical power output

Figure C.04

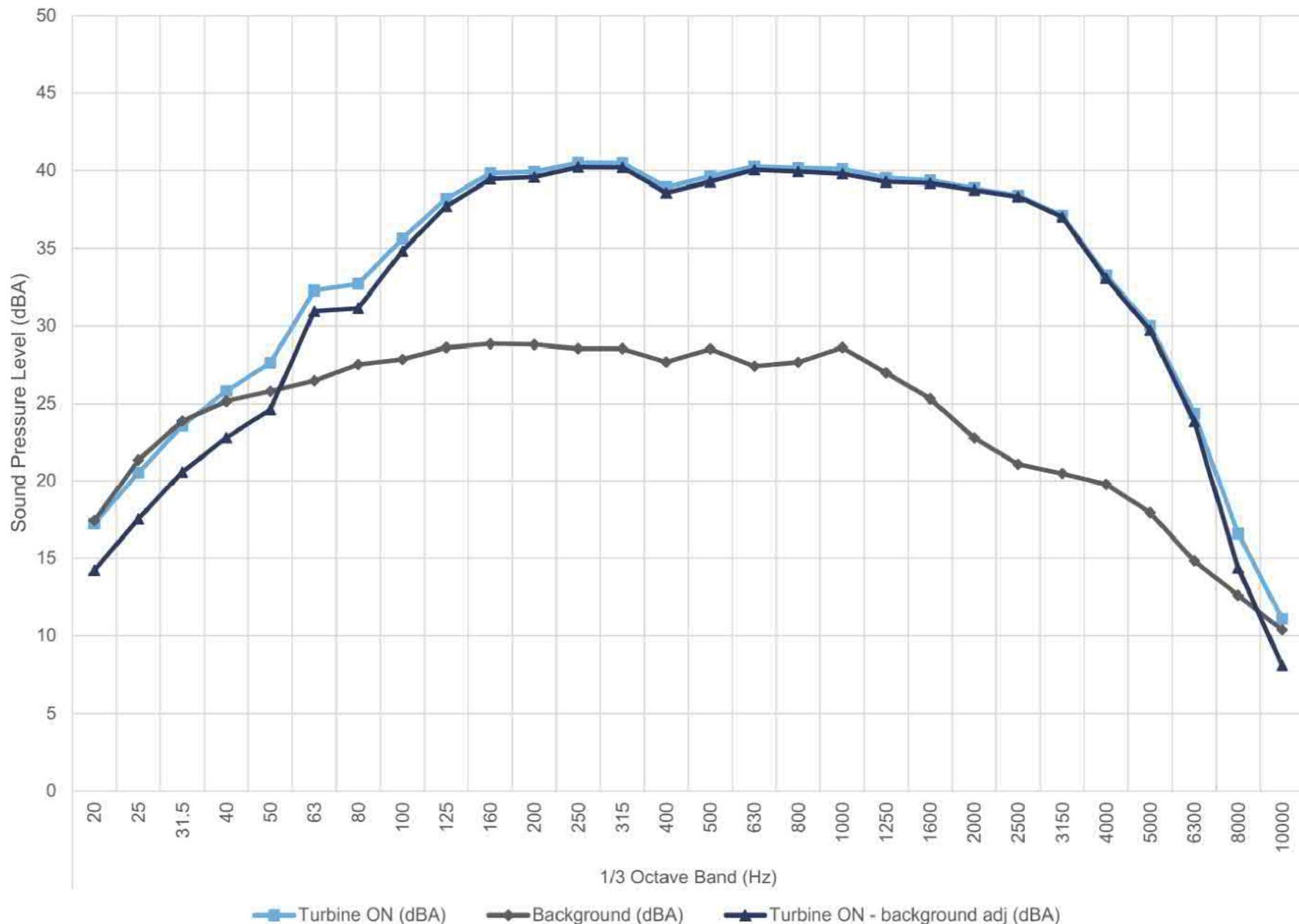
7.5 m/s - Hub Height



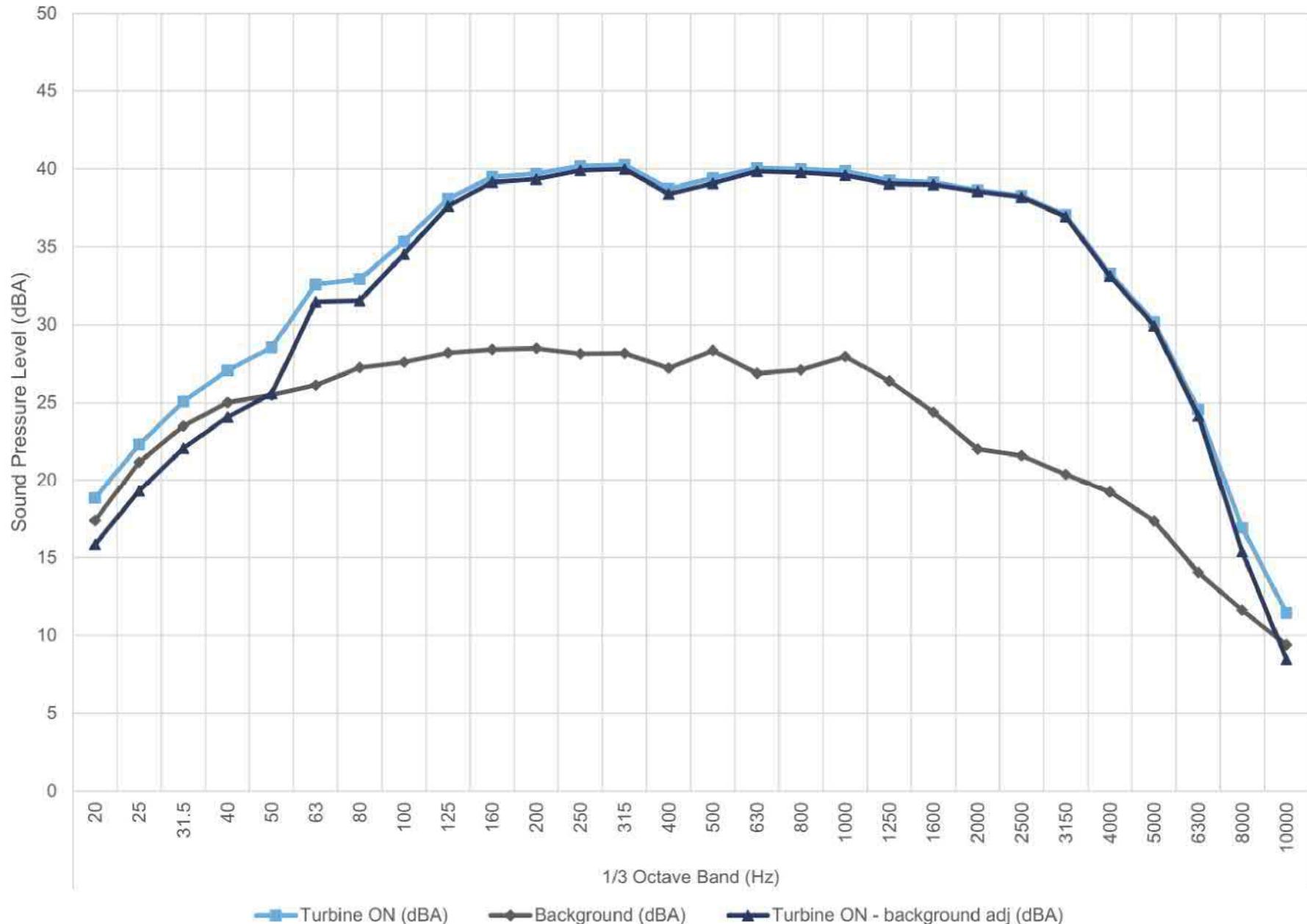
8.0 m/s - Hub Height



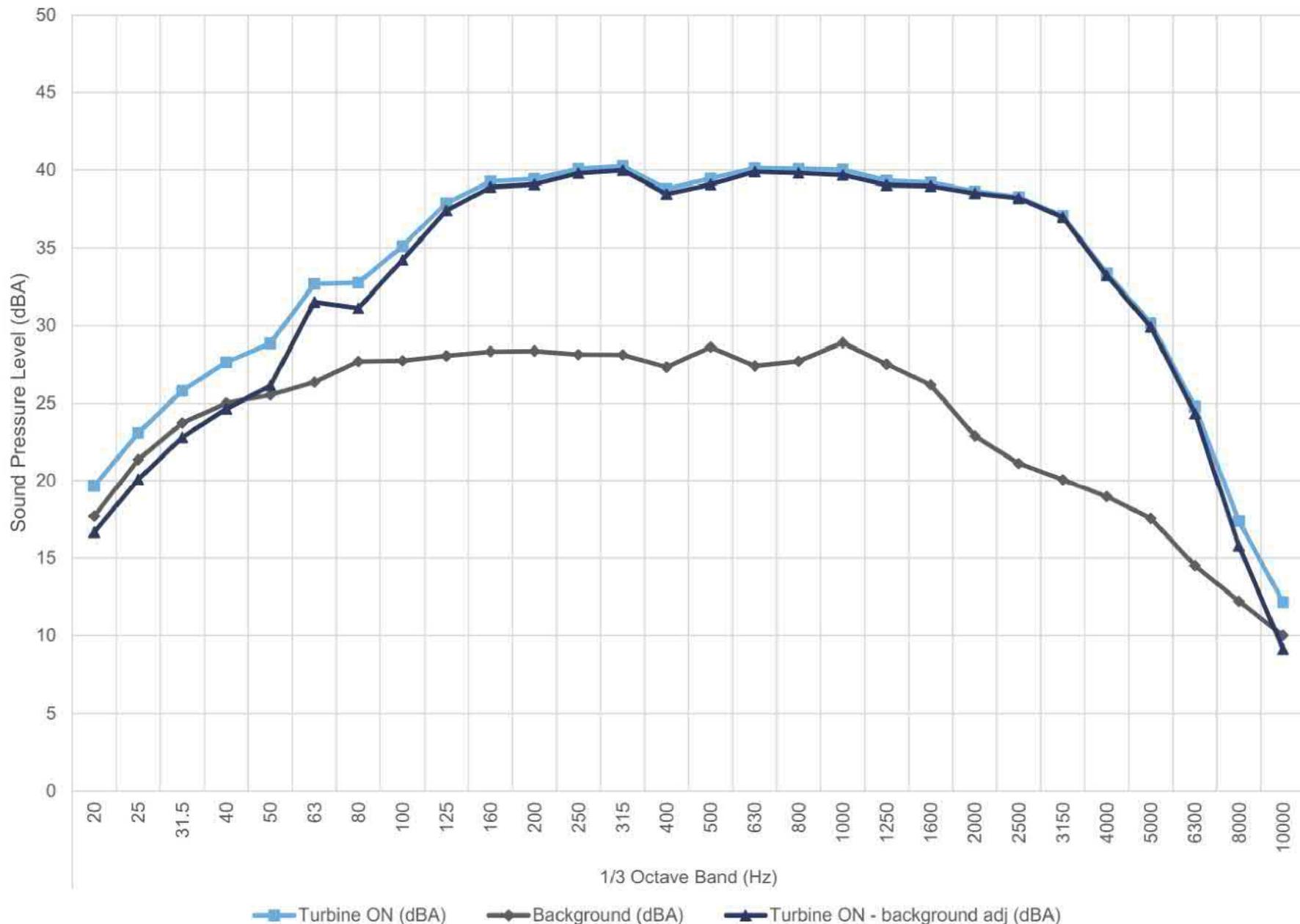
8.5 m/s - Hub Height

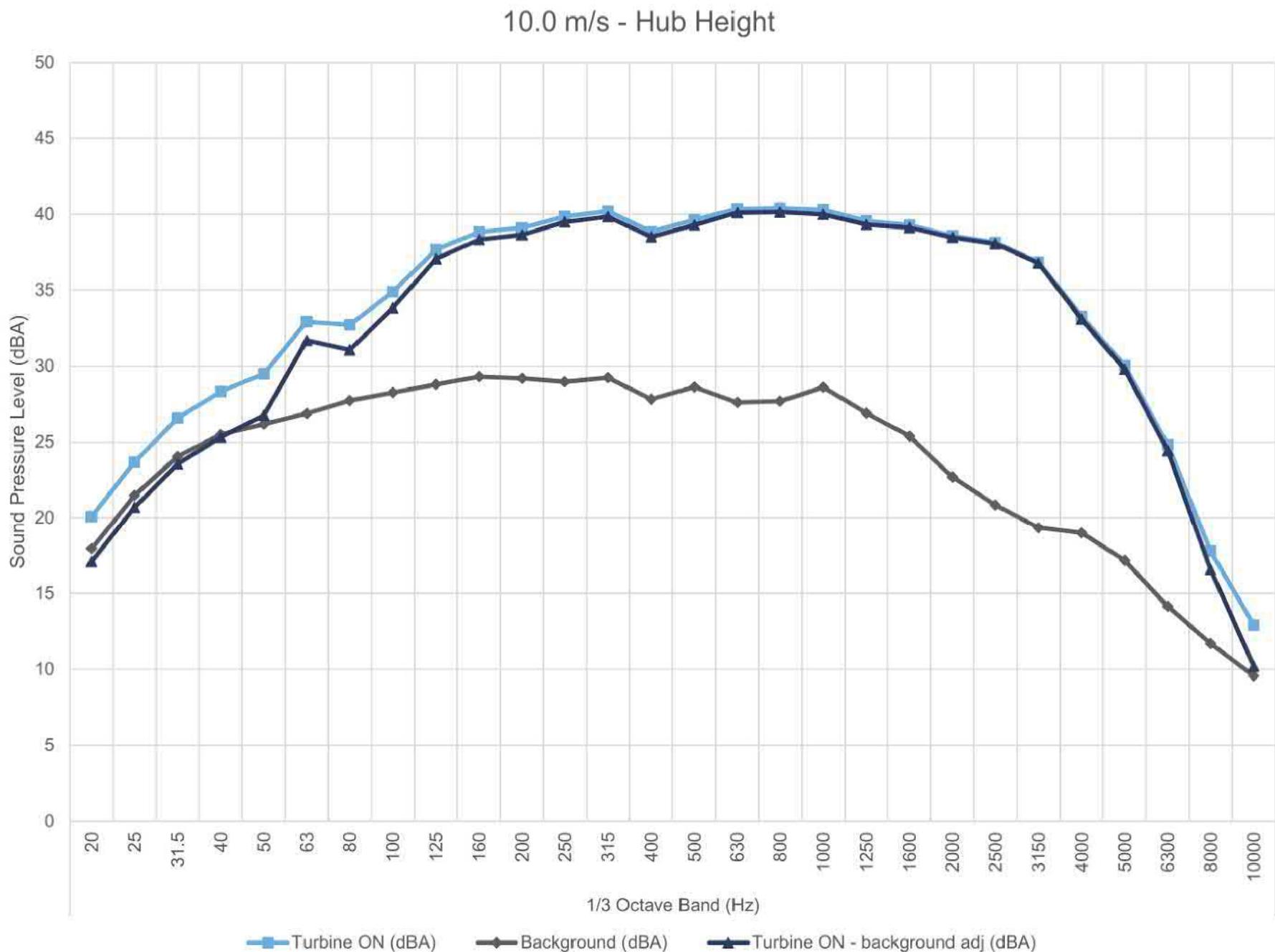


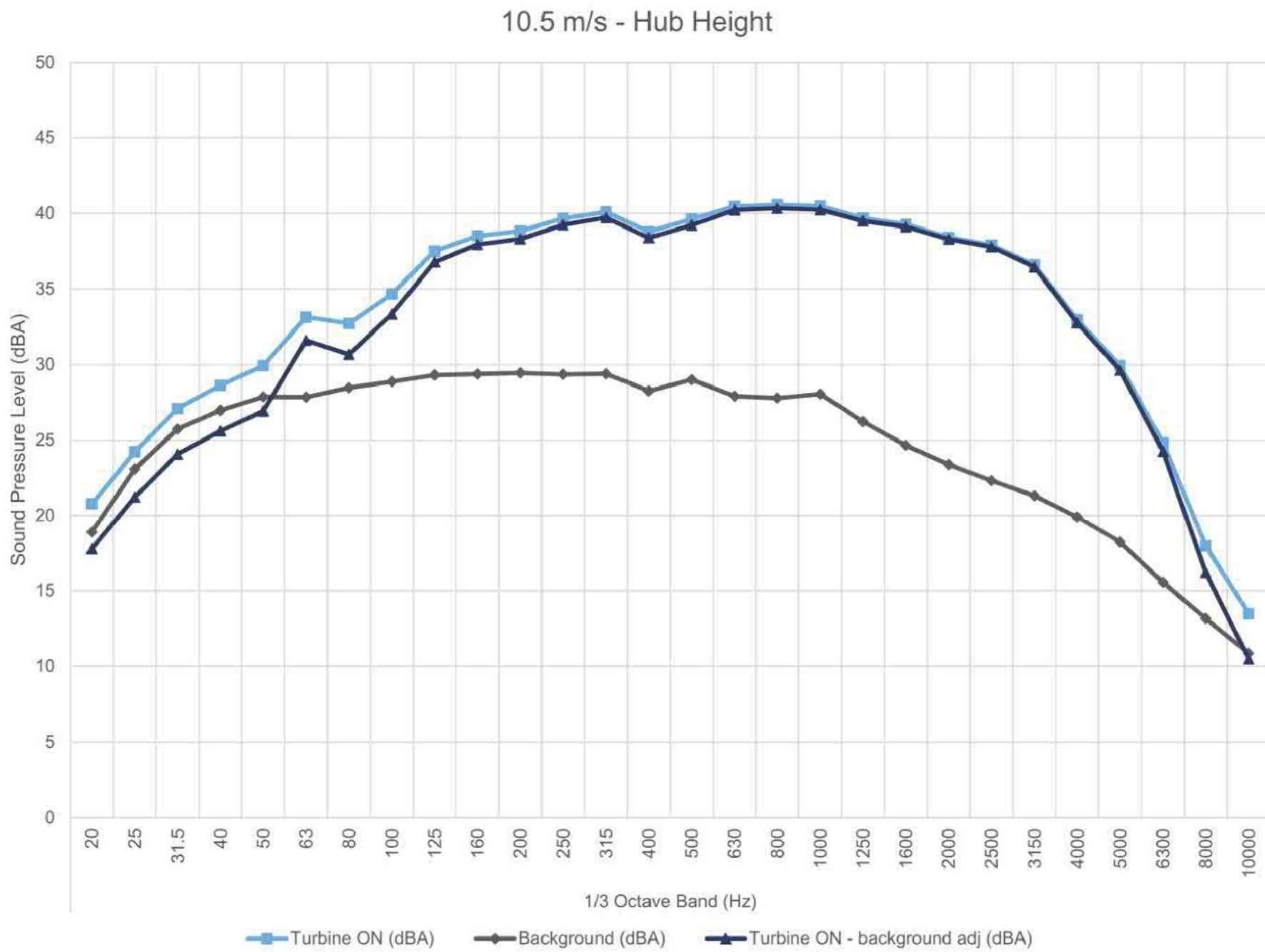
9.0 m/s - Hub Height

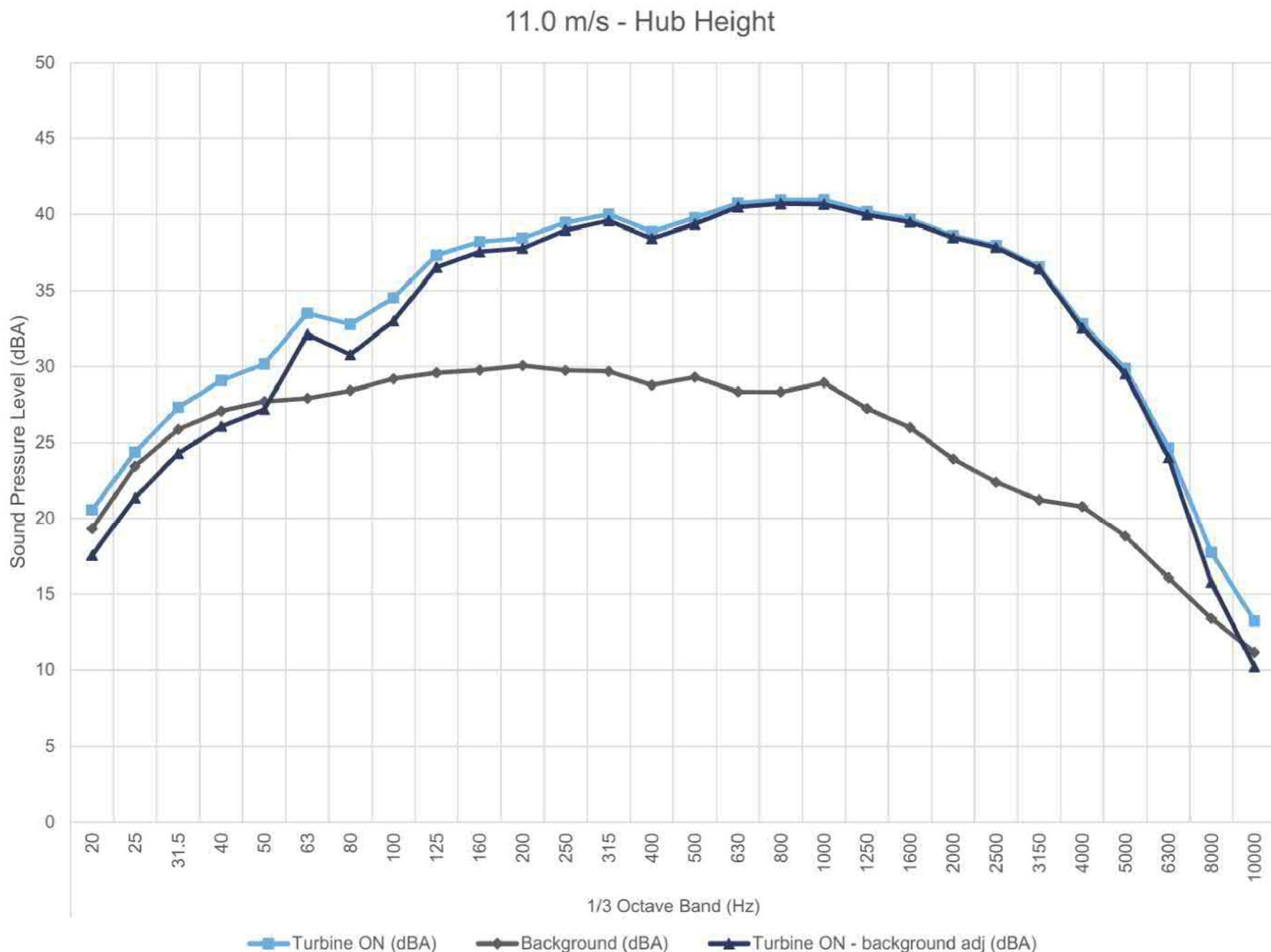


9.5 m/s - Hub Height

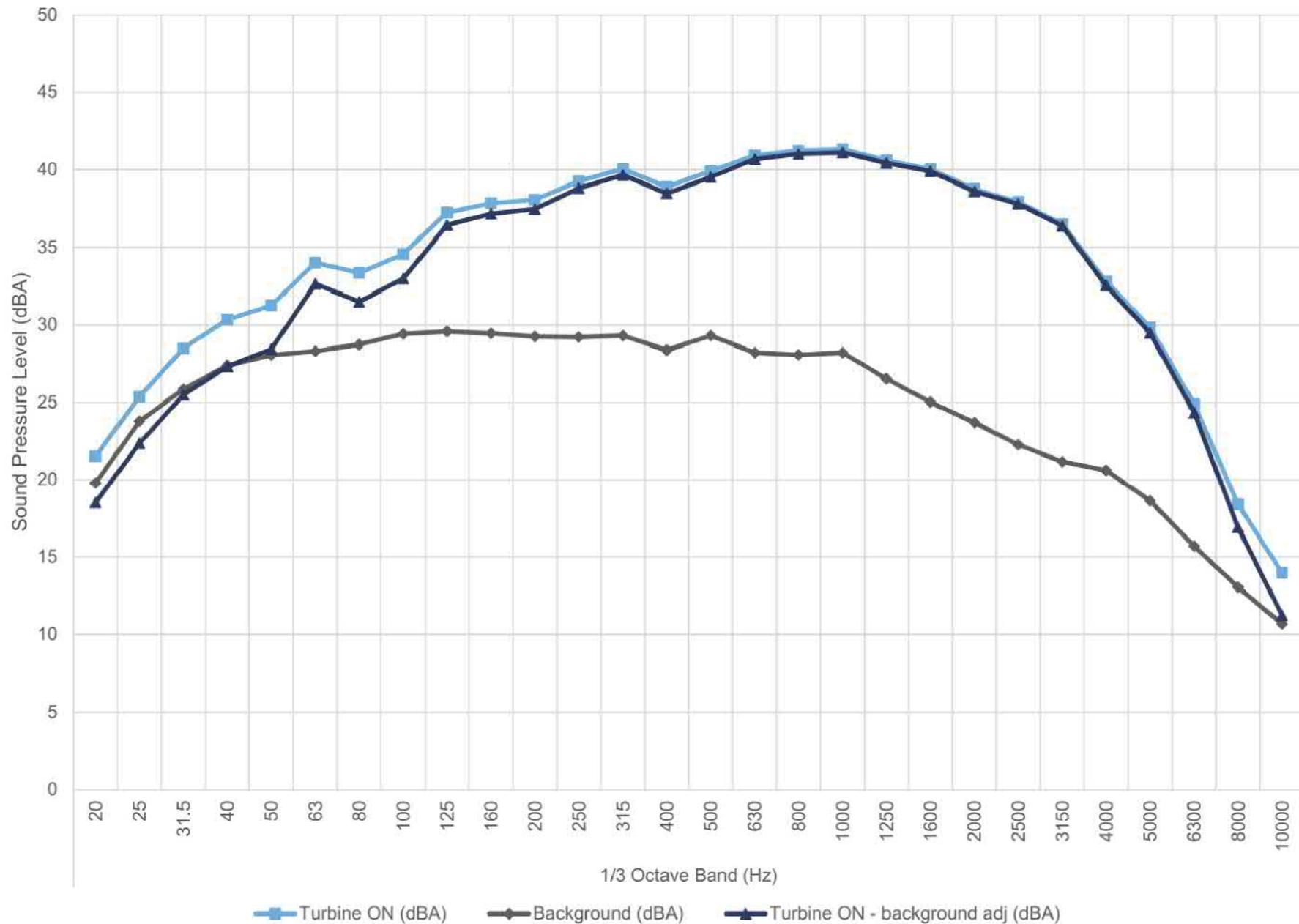


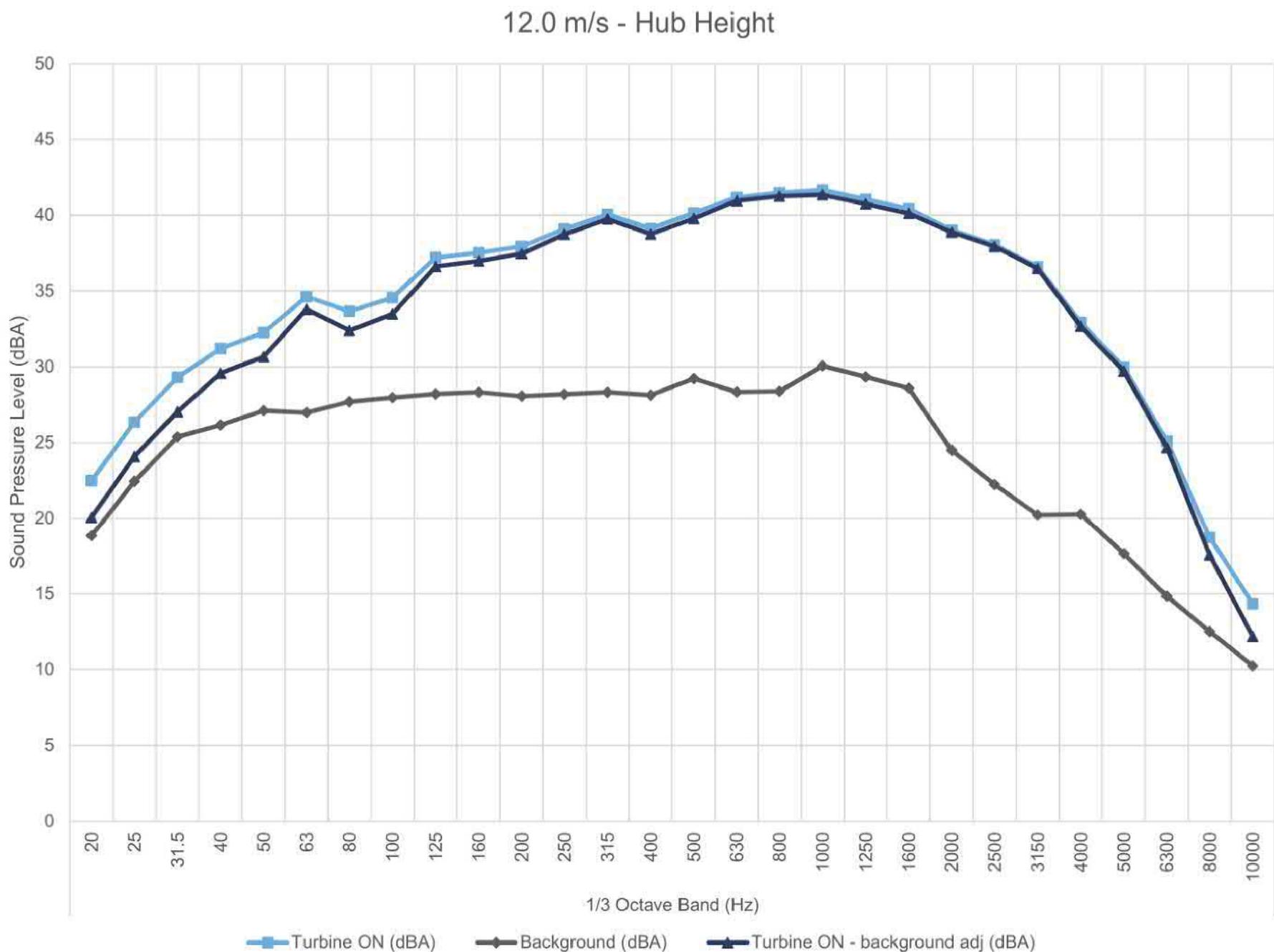






11.5 m/s - Hub Height

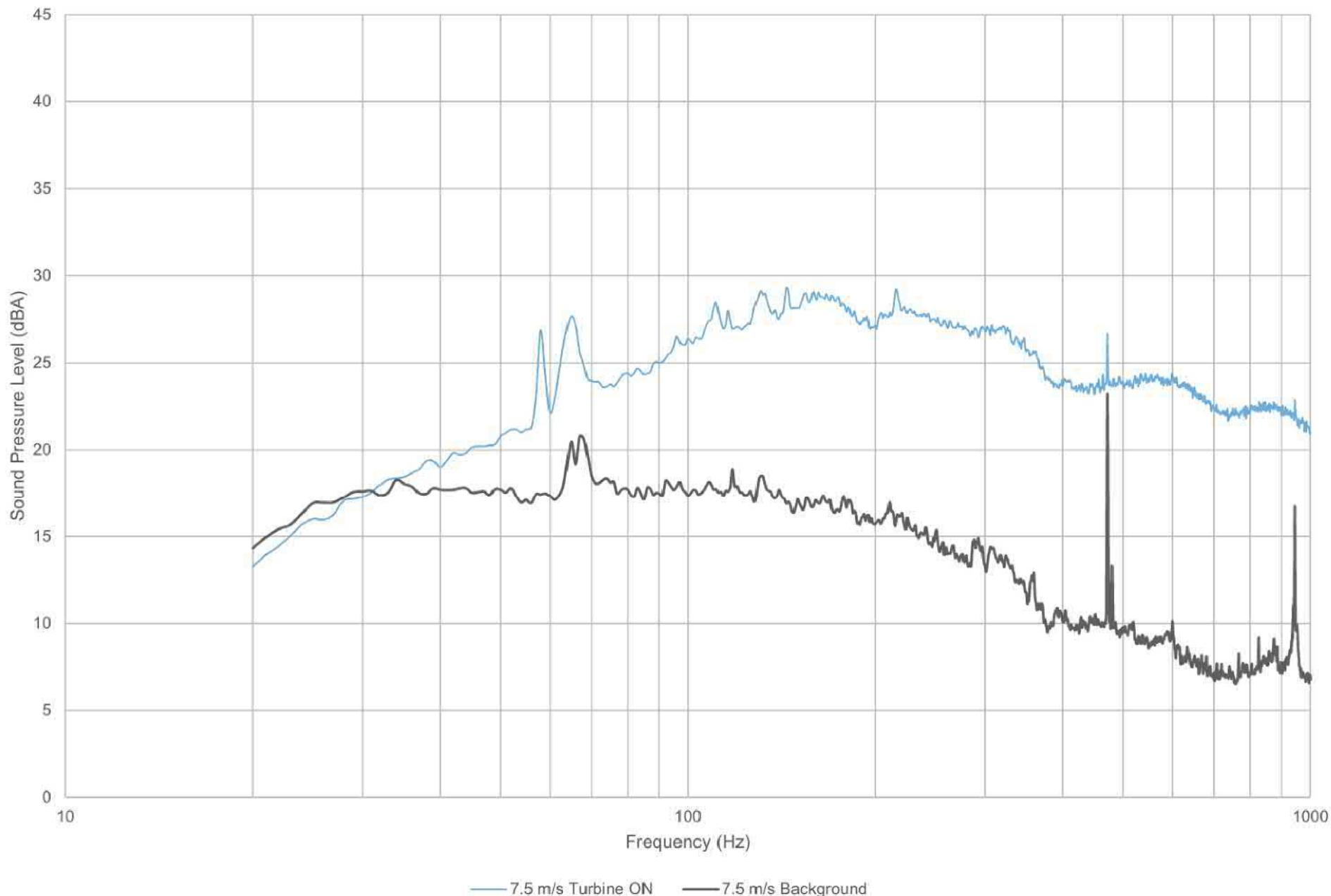




Appendix D

Tonality Assessment

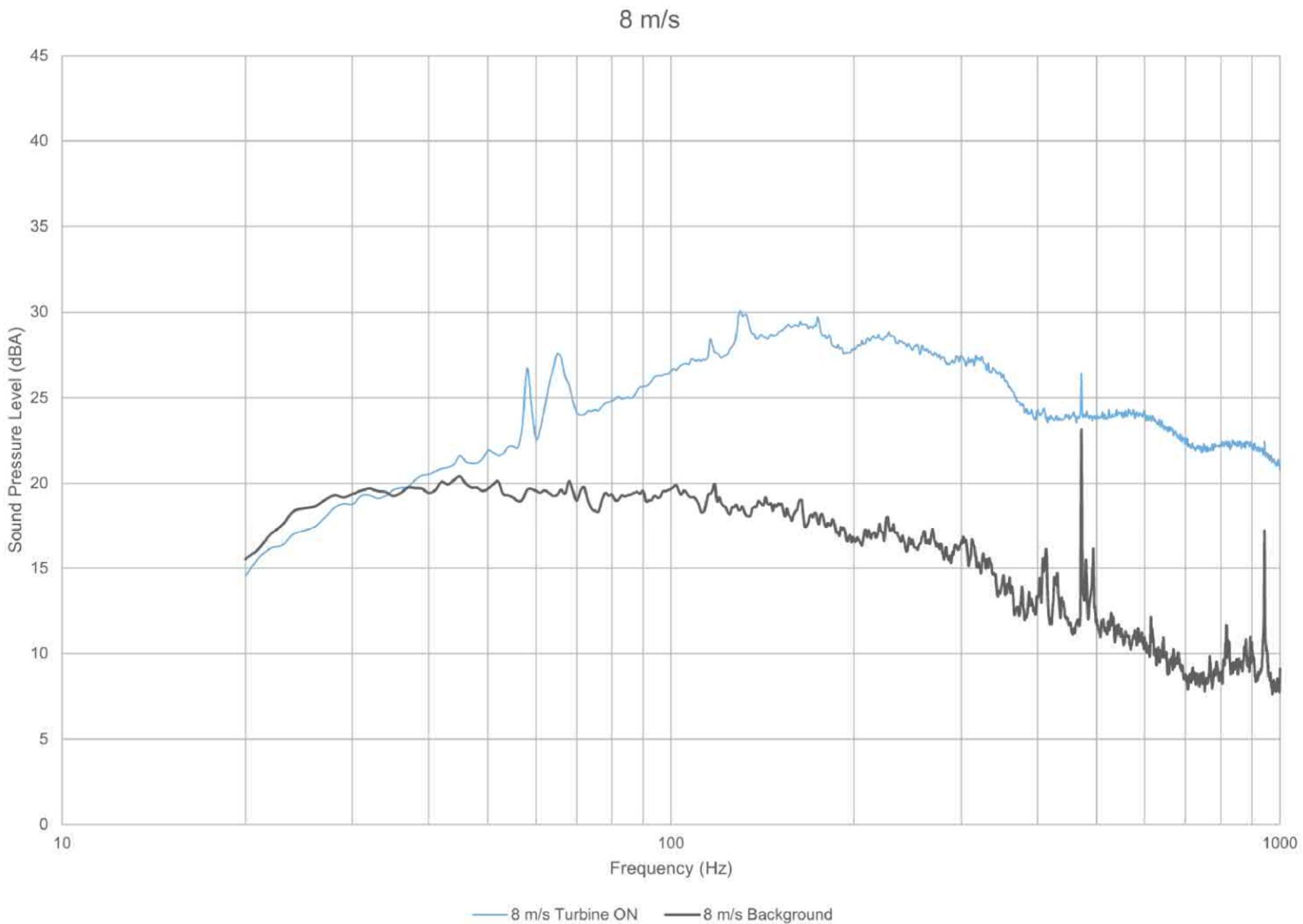
7.5 m/s



17095.01.T44.RP1
Scale: NTS
Drawn by: NT
Reviewed by: AD
Date: July 2018
Revision: 1

Project Name
Belle River Wind Power Project - IEC 61400-11 Edition 3.0 - Turbine T44
Figure Title
Plot of narrow band spectra - Turbine ON vs. Background at 7.5 m/s

Figure D.01



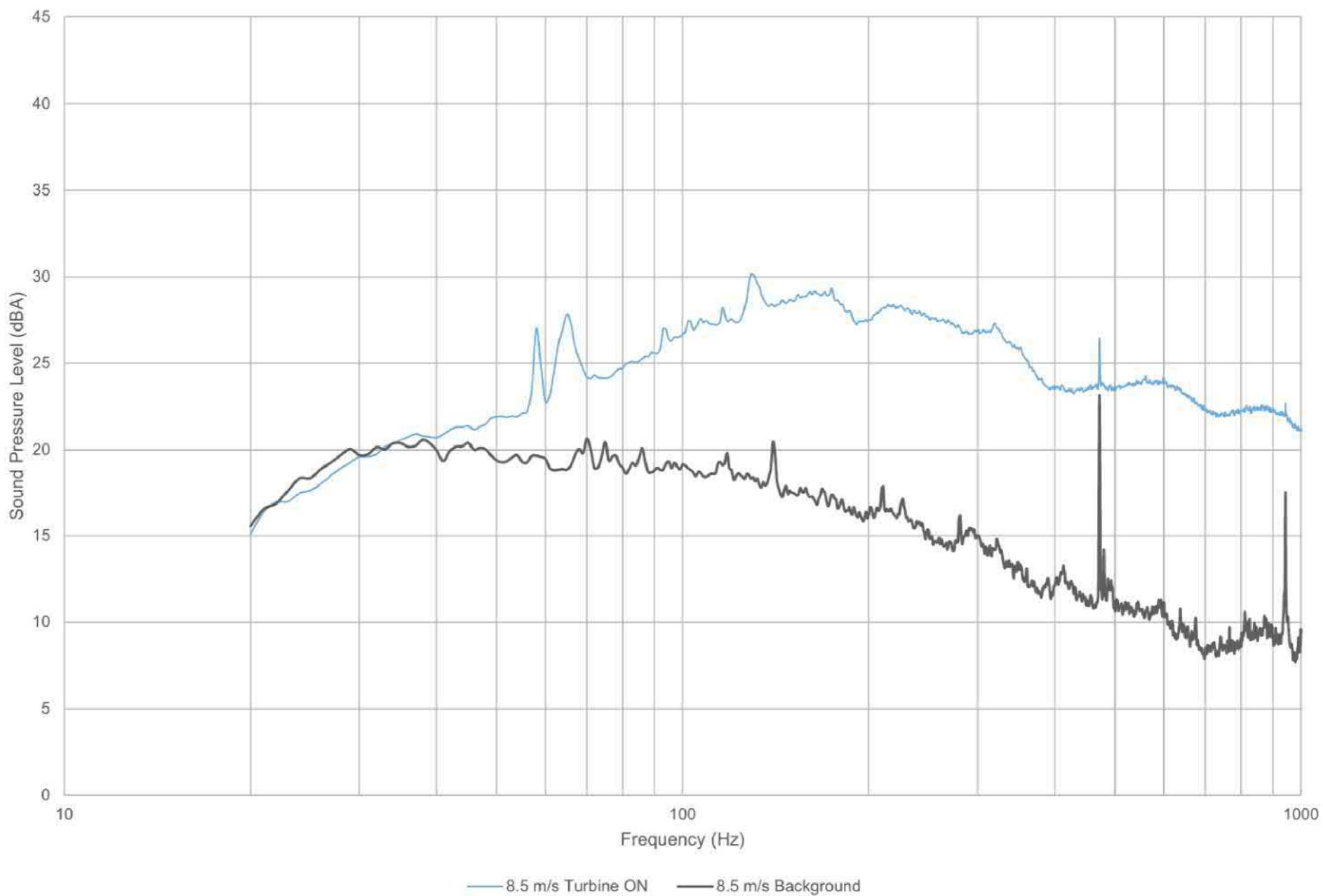
17095.01.T44.RP1
 Scale: NTS
 Drawn by: NT
 Reviewed by: AD
 Date: July 2018
 Revision: 1

Project Name
 Belle River Wind Power Project - IEC 61400-11 Edition 3.0 - Turbine T44

Figure Title
 Plot of narrow band spectra - Turbine ON vs. Background at 8 m/s

Figure D.02

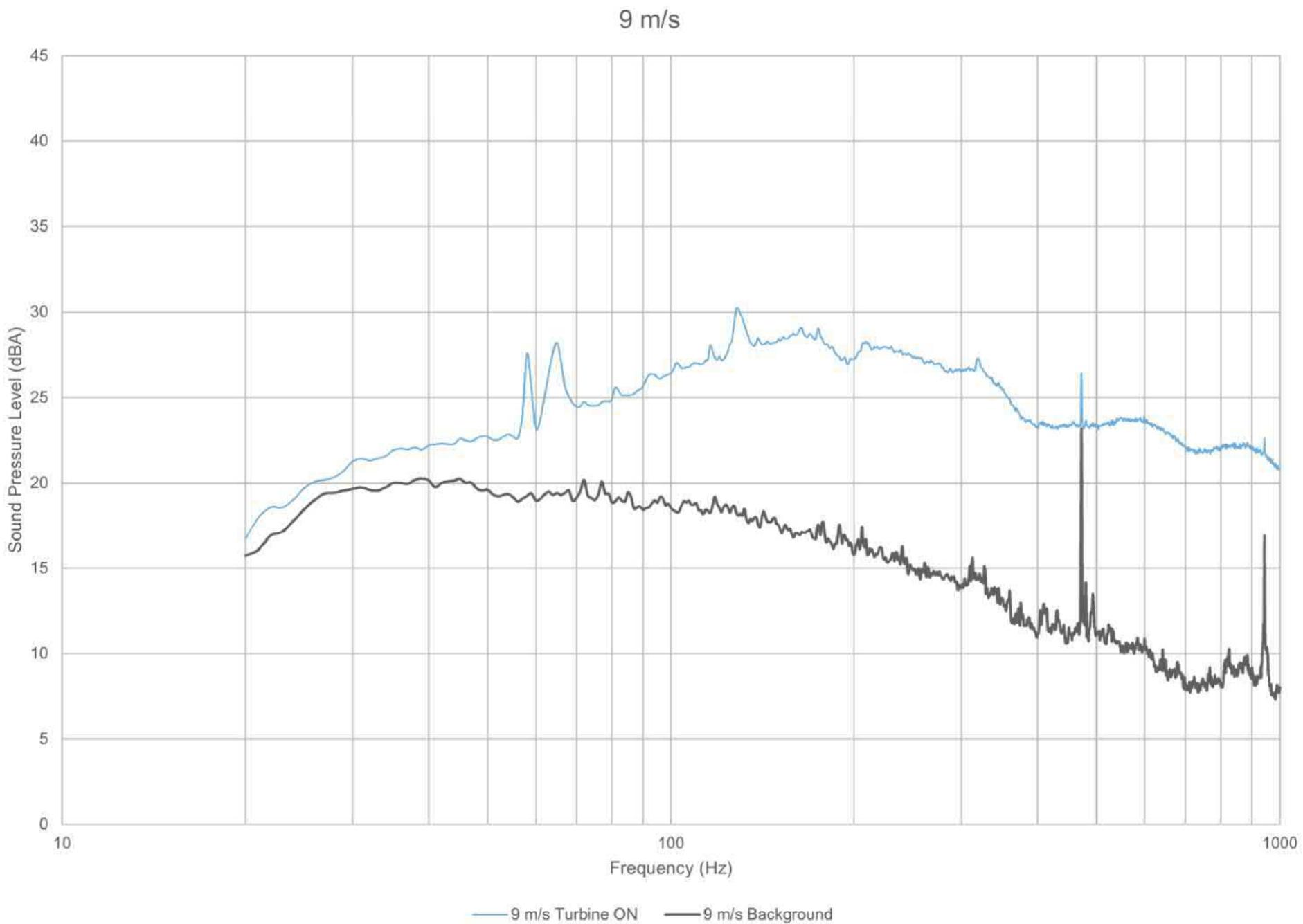
8.5 m/s



17095.01.T44.RP1
Scale: NTS
Drawn by: NT
Reviewed by: AD
Date: July 2018
Revision: 1

Project Name
Belle River Wind Power Project - IEC 61400-11 Edition 3.0 - Turbine T44
Figure Title
Plot of narrow band spectra - Turbine ON vs. Background at 8.5 m/s

Figure D.03

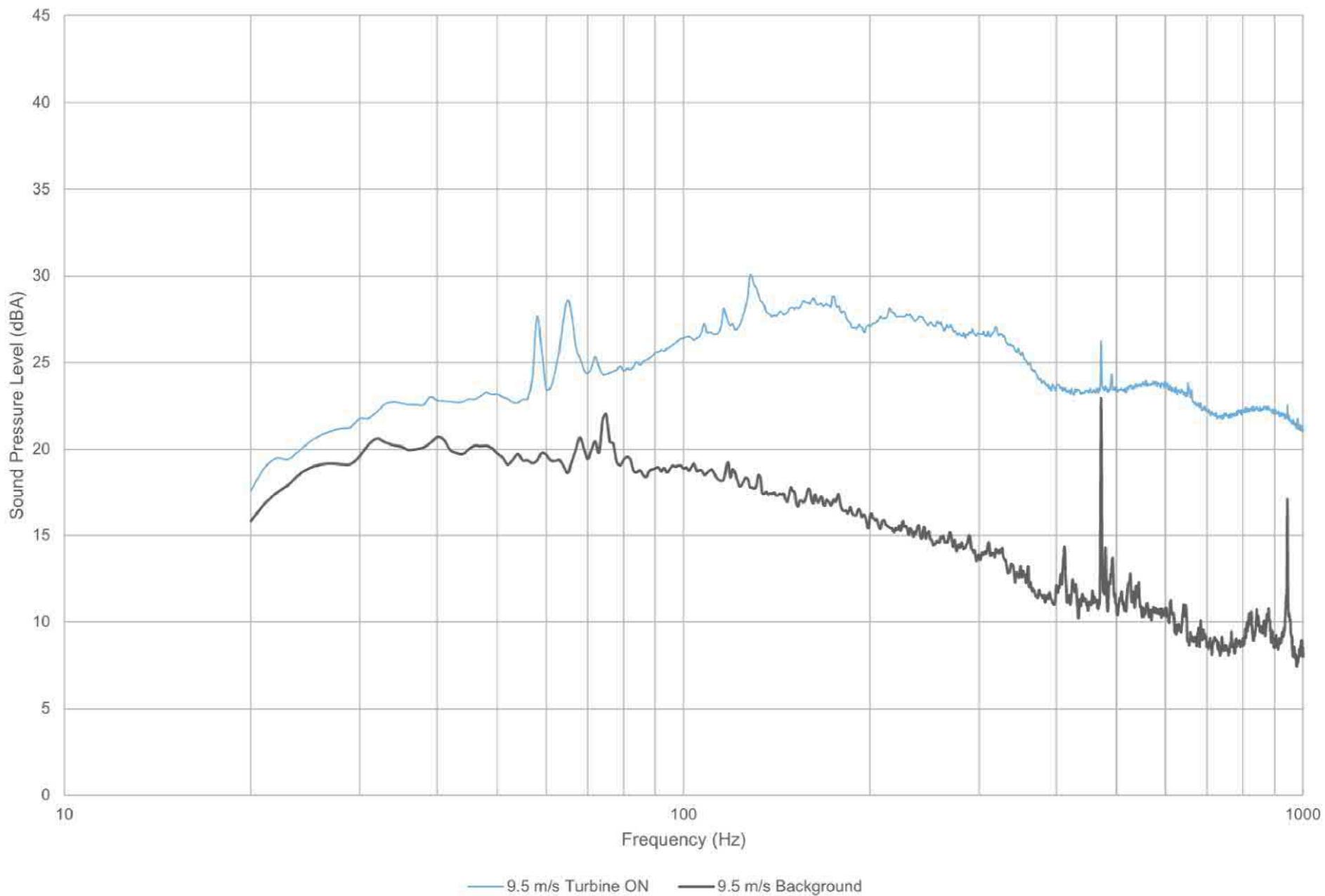


17095.01.T44.RP1
 Scale: NTS
 Drawn by: NT
 Reviewed by: AD
 Date: July 2018
 Revision: 1

Project Name
 Belle River Wind Power Project - IEC 61400-11 Edition 3.0 - Turbine T44
Figure Title
 Plot of narrow band spectra - Turbine ON vs. Background at 9 m/s

Figure D.04

9.5 m/s

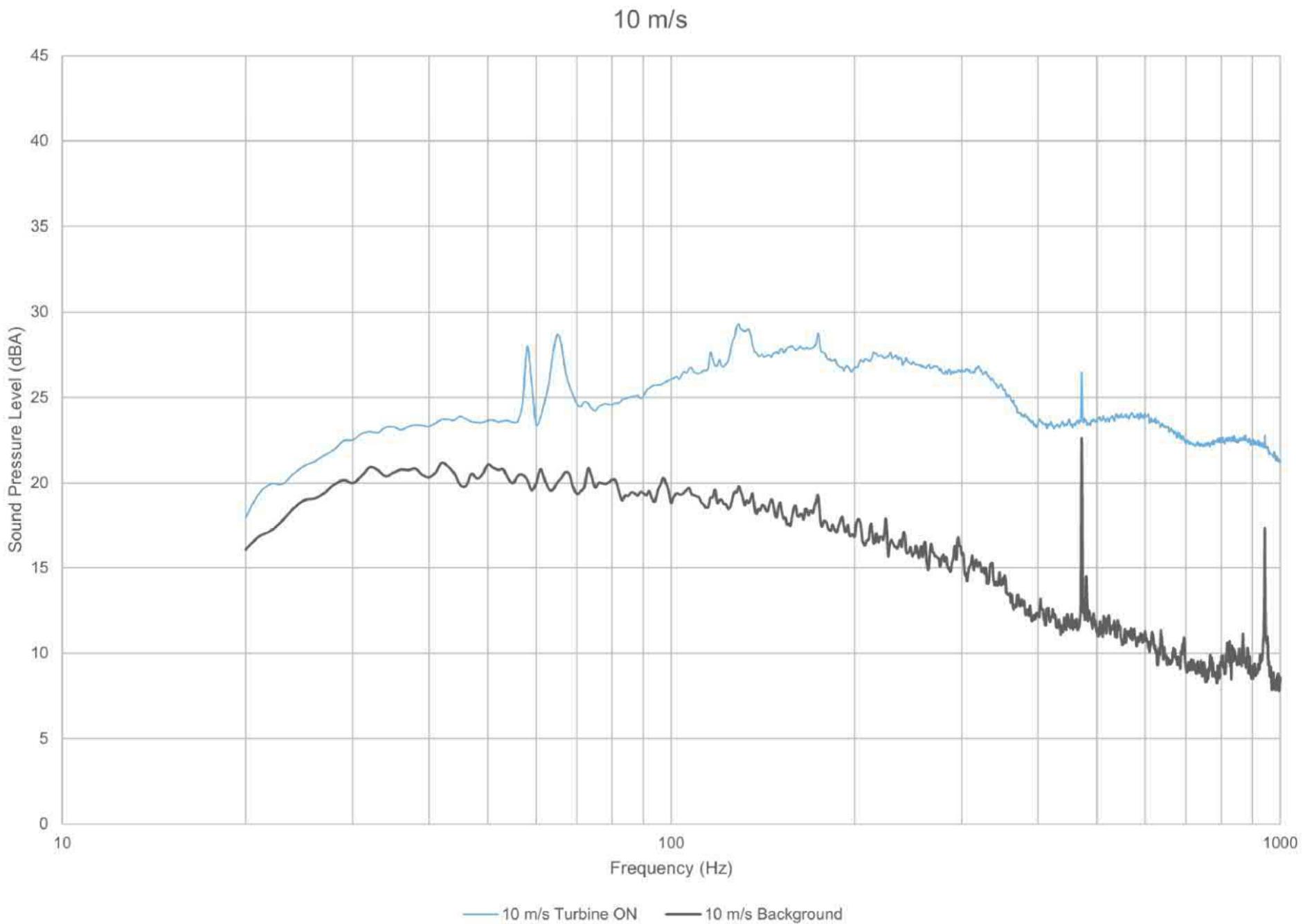


17095.01.T44.RP1
Scale: NTS
Drawn by: NT
Reviewed by: AD
Date: July 2018
Revision: 1

Project Name
Belle River Wind Power Project - IEC 61400-11 Edition 3.0 - Turbine T44

Figure Title
Plot of narrow band spectra - Turbine ON vs. Background at 9.5 m/s

Figure D.05



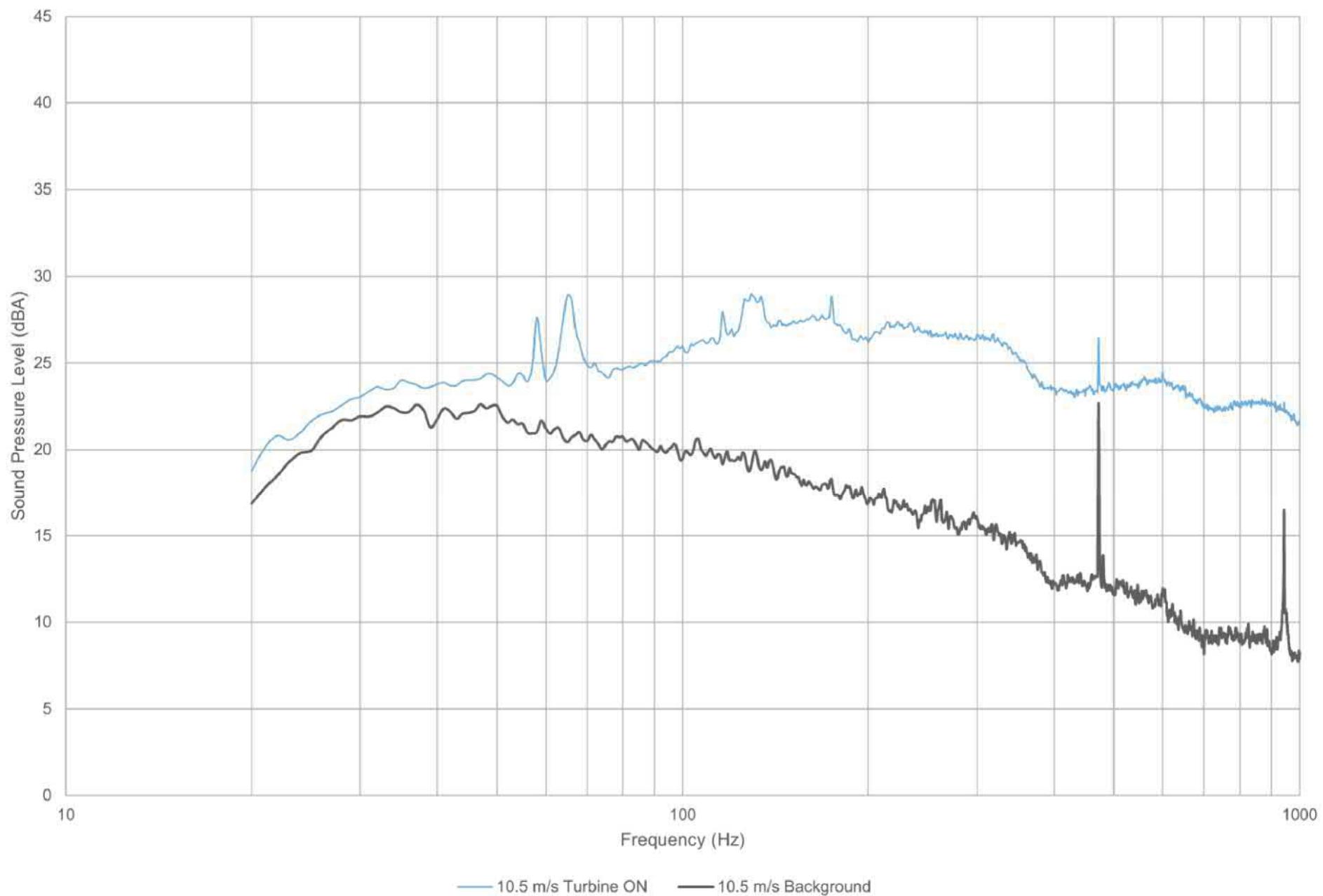
17095.01.T44.RP1
 Scale: NTS
 Drawn by: NT
 Reviewed by: AD
 Date: July 2018
 Revision: 1

Project Name
 Belle River Wind Power Project - IEC 61400-11 Edition 3.0 - Turbine T44

Figure Title
 Plot of narrow band spectra - Turbine ON vs. Background at 10 m/s

Figure D.06

10.5 m/s

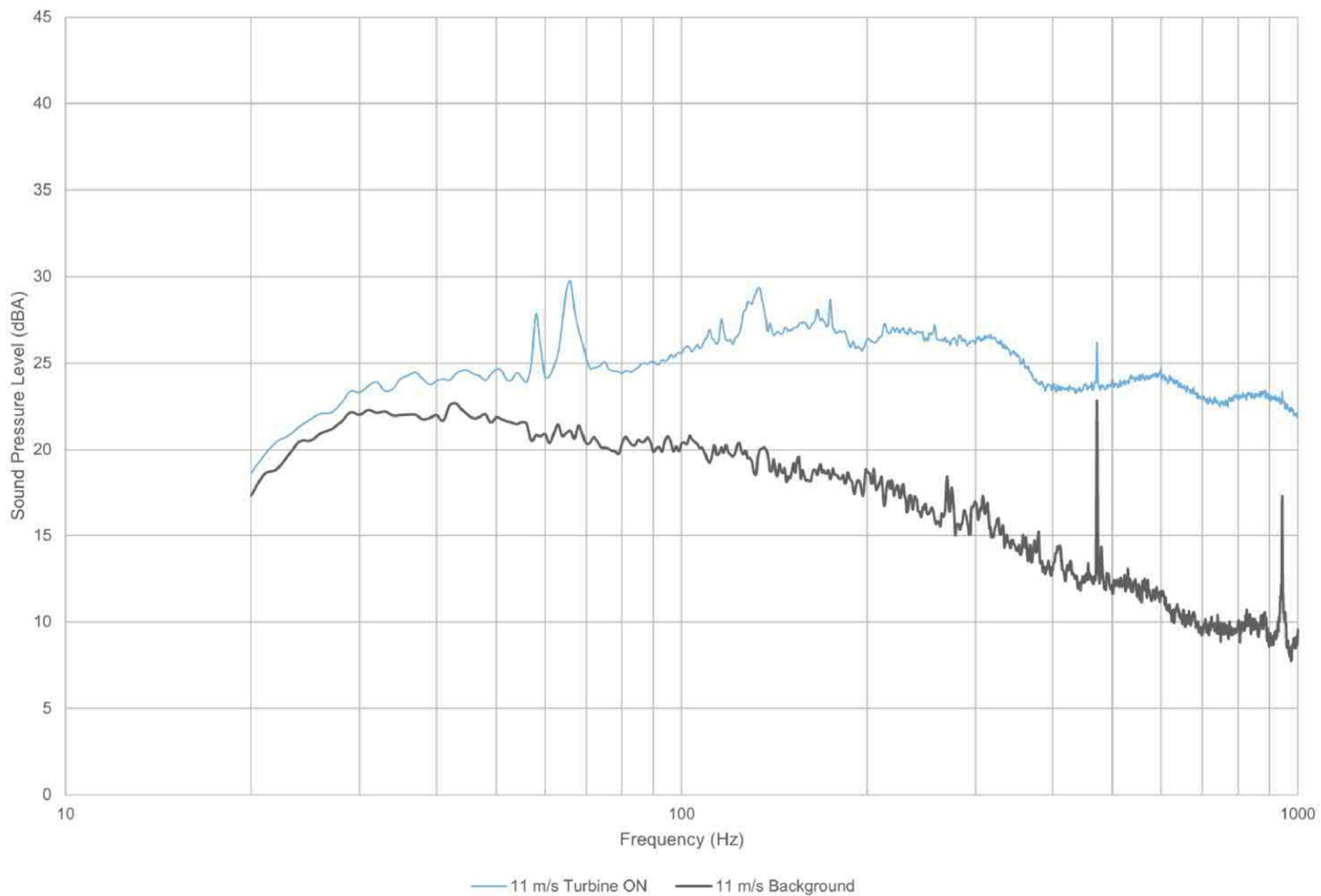


17095.01.T44.RP1
Scale: NTS
Drawn by: NT
Reviewed by: AD
Date: July 2018
Revision: 1

Project Name
Belle River Wind Power Project - IEC 61400-11 Edition 3.0 - Turbine T44
Figure Title
Plot of narrow band spectra - Turbine ON vs. Background at 10.5 m/s

Figure D.07

11 m/s



17095.01.T44.RP1
Scale: NTS
Drawn by: NT
Reviewed by: AD
Date: July 2018
Revision: 1

Project Name

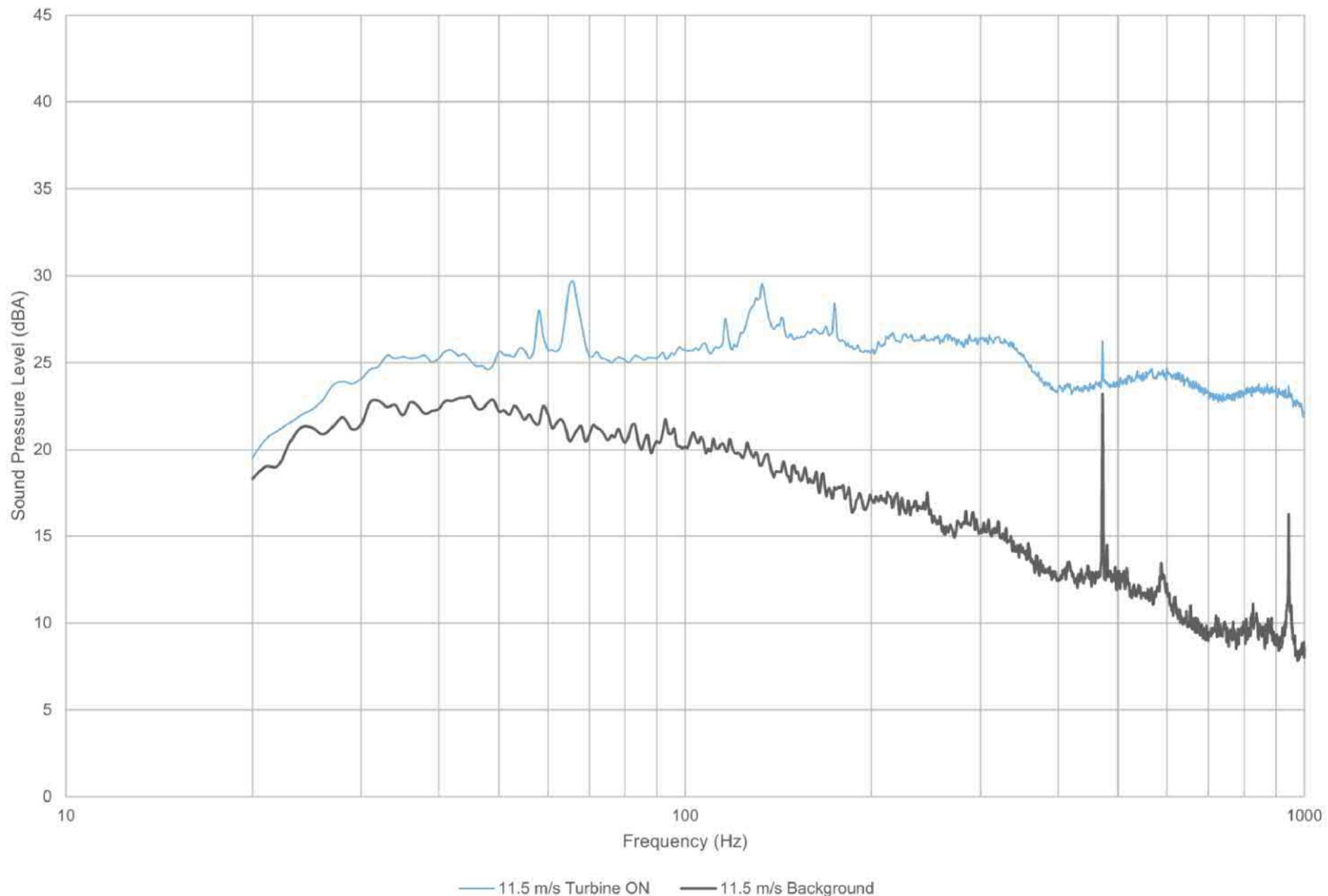
Belle River Wind Power Project - IEC 61400-11 Edition 3.0 - Turbine T44

Figure Title

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

Figure D.08

11.5 m/s



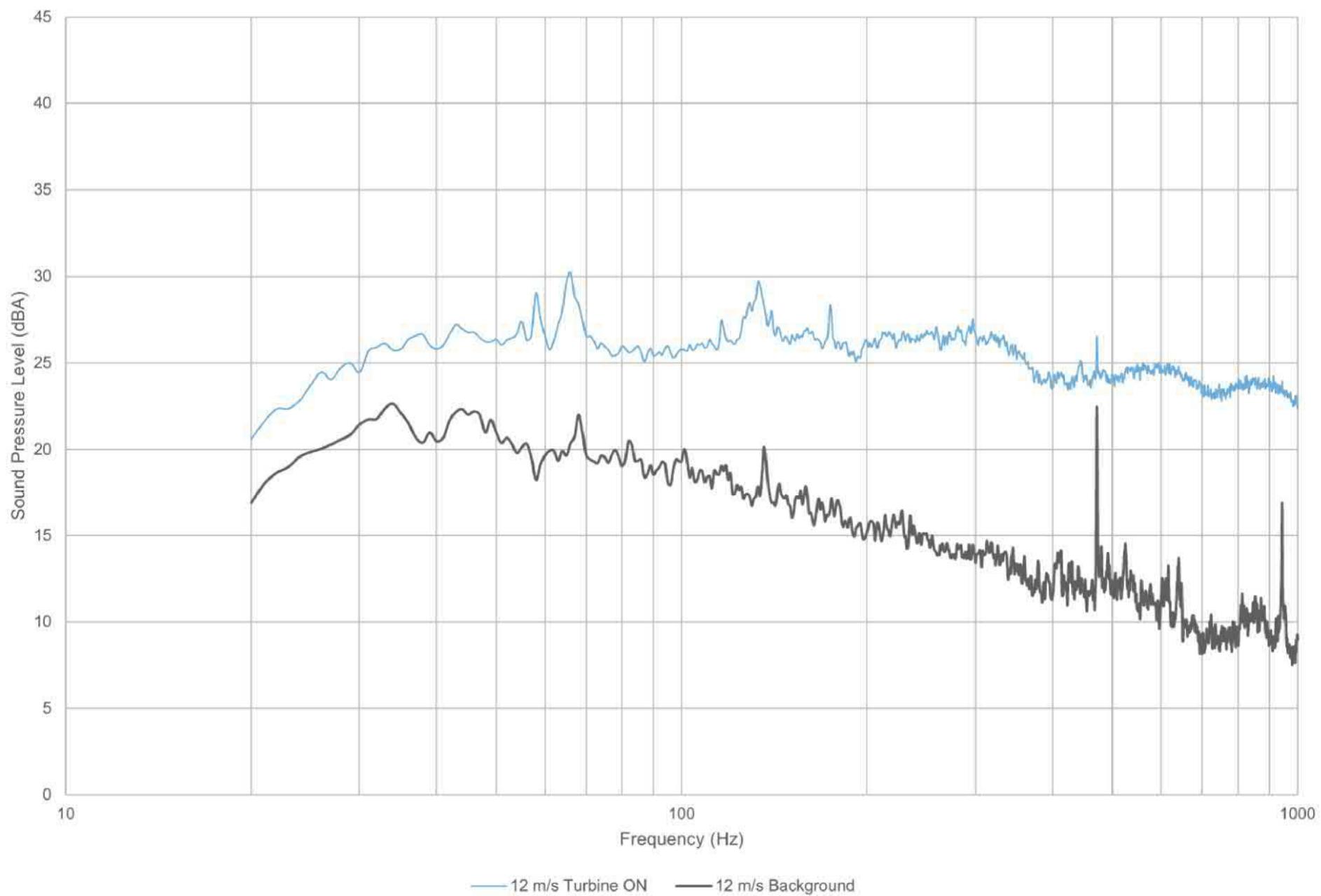
17095.01.T44.RP1
Scale: NTS
Drawn by: NT
Reviewed by: AD
Date: July 2018
Revision: 1

Project Name
Belle River Wind Power Project - IEC 61400-11 Edition 3.0 - Turbine T44

Figure Title
Plot of narrow band spectra - Turbine ON vs. Background at 11.5 m/s

Figure D.09

12 m/s



17095.01.T44.RP1
Scale: NTS
Drawn by: NT
Reviewed by: AD
Date: July 2018
Revision: 1

Project Name

Belle River Wind Power Project - IEC 61400-11 Edition 3.0 - Turbine T44

Figure Title

Plot of narrow band spectra - Turbine ON vs. Background at 12 m/s

Figure D.10

Appendix E Measurement Data

Table E.02 Measurement data - Background

Project: Belle River Wind Power Project - Turbine T44 - IEC 61400-11 Measurement
Report ID: 17095.01.T44.RP1

Page 3 of 3

Created on: 7/5/2018

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

| Data Point # | Standardized Wind Speed | LAeq | Rotor RPM | 10m Anemometer Wind Speed (m/s) | Air Temperature (°C) | Pressure (kPa) | Relative Humidity (%) |
|--------------|-------------------------|------|-----------|---------------------------------|----------------------|----------------|-----------------------|
| 499 | 10.2 | 36.8 | 0.2 | 9.7 | 21 | 9835.6 | 35 |
| 500 | 11.1 | 38.9 | 0.3 | 10.5 | 21 | 9835.6 | 36 |
| 501 | 11.1 | 39.8 | 0.2 | 10.5 | 21 | 9835.6 | 36 |
| 502 | | 0.1 | 9.8 | | 21 | 9835.9 | 36 |
| 503 | 9.1 | 39.5 | 0.1 | 8.6 | 21 | 9835.7 | 36 |
| 504 | 8.6 | 38.0 | 0.2 | 8.2 | 21 | 9835.5 | 36 |
| 505 | 9.3 | 38.5 | 0.3 | 8.8 | 21 | 9829.6 | 36 |
| 506 | 9.2 | 37.5 | 0.0 | 8.7 | 21 | 9822.9 | 35 |
| 507 | 9.1 | 37.3 | -0.2 | 8.6 | 21 | 9822.9 | 35 |
| 508 | | 0.0 | 7.0 | | 21 | 9823.0 | 35 |
| 509 | 9.3 | 37.1 | 0.3 | 8.8 | 21 | 9823.1 | 35 |
| 510 | 10.2 | 43.1 | 0.3 | 9.7 | 21 | 9824.0 | 36 |
| 511 | 9.4 | 44.1 | 0.4 | 8.9 | 21 | 9824.0 | 36 |
| 512 | 9.2 | 36.9 | -0.1 | 8.7 | 21 | 9822.4 | 36 |
| 513 | 8.5 | 36.6 | 0.0 | 8.0 | 21 | 9823.1 | 36 |
| 514 | 7.3 | 37.1 | 0.0 | 6.9 | 21 | 9823.0 | 36 |
| 515 | 9.7 | 37.2 | 0.0 | 9.2 | 21 | 9822.9 | 36 |
| 516 | 10.1 | 35.3 | 0.2 | 9.6 | 21 | 9823.2 | 36 |

***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 (%) |
|--------------|-------------------------|------|-----------|---------------------------------|----------------------|----------------|-----------------------|
| 582 | | | | | | | |
| 583 | | | | | | | |
| 584 | | | | | | | |
| 585 | | | | | | | |
| 586 | | | | | | | |
| 587 | | | | | | | |
| 588 | | | | | | | |
| 589 | | | | | | | |
| 590 | | | | | | | |
| 591 | | | | | | | |
| 592 | | | | | | | |
| 593 | | | | | | | |
| 594 | | | | | | | |
| 595 | | | | | | | |
| 596 | | | | | | | |
| 597 | | | | | | | |
| 598 | | | | | | | |
| 599 | | | | | | | |

***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 (%) |
|--------------|-------------------------|------|-----------|---------------------------------|----------------------|----------------|-----------------------|
| 685 | | | | | | | |
| 686 | | | | | | | |
| 687 | | | | | | | |
| 688 | | | | | | | |
| 689 | | | | | | | |
| 670 | | | | | | | |
| 671 | | | | | | | |
| 672 | | | | | | | |
| 673 | | | | | | | |
| 674 | | | | | | | |
| 675 | | | | | | | |
| 676 | | | | | | | |
| 677 | | | | | | | |
| 678 | | | | | | | |
| 679 | | | | | | | |
| 680 | | | | | | | |
| 681 | | | | | | | |
| 682 | | | | | | | |

Appendix F

Supplementary Information for the Regulator

Appendix F.01 Calibration Certificates



ISO 17025

As Left RECALIBRATION CERTIFICATE

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

Breda, August 17, 2016

Calibration performed by:

H. Dam

Certificate approved by:

M.C.A.G. Damen

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.

Reproduction of the complete certificate is allowed. Parts of the certificate may only be reproduced with written approval of the calibration laboratory.

This certificate is issued provided that neither Siemens Industry Software B.V. nor the Raad voor Accreditatie assumes any liability.

Certificate number: 22143211-20160817-1

Page: 1 of 16

West Caldwell Calibration Laboratories Inc.

Certificate of Calibration

for

MICROPHONE UNIT

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

Submitted By:

Customer:
Company: Aercoustics Engineering LTD
Address:

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

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

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

Within (X)

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

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

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

Approved by: 

Calibration Date: 20-Sep-17

Felix Christopher (QA Mgr.)

Certificate No: 28047 - 1

QA Doc. #1051 Rev. 2.0 10/1/01

Certificate Page 1 of 1

ISO/IEC 17025:2005


uncompromised calibration
1575 State Route 96, Victor, NY 14564, U.S.A.



Calibration Lab. Cert. # 1533.01

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



Calibration Lab. Cert. # 1533.01

REPORT OF CALIBRATION

for

Brüel & Kjær Microphone Unit

Model No.: 4189-A-021

Serial No.: 2622170

Mic. Model No.: 4189

Serial No.: 2625197

Preamp. Model No.: 2671

Serial No.: 2614901

Company: Aercoustics Engineering LTD

I. D. No.: XXXX

Calibration results:

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

Ambient Temperature: 21.6 °C

Combined Sensitivity @ 250 Hz and pressure of 99.456 kPa
 (Sens. with mic. and preamp.) 0 Volts Polarization voltage (External):
 -26.69 dB re 1V/Pascal
 46.31 mV/Pascal
 0.69 Ko (- dB re 50 mV/Pascal)
 Sensitivity: Pass
 Freq. Response: Pass
 All tests: Pass

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

The above listed instrument meets or exceeds the tested manufacturer's specifications.

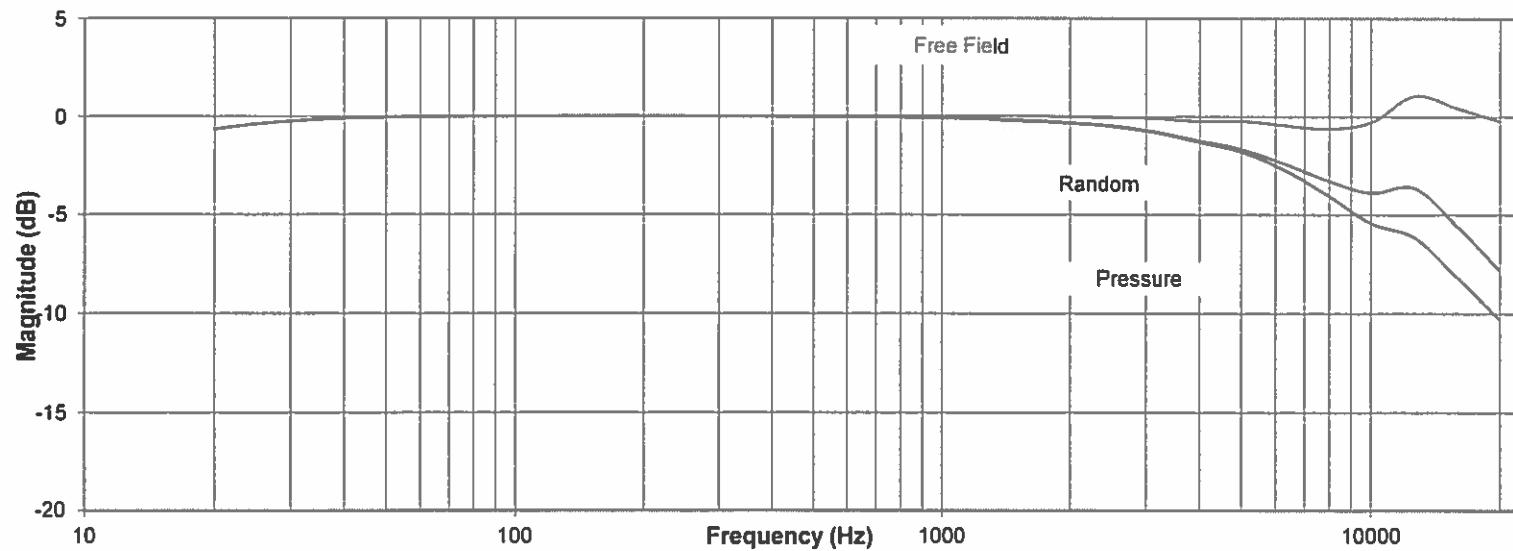
The IEC 651:1979 & 1993 Type 1 specification passed.

This Calibration is traceable through NIST test numbers: 683/284413-14

The expanded uncertainty of calibration: 0.079dB at 95% confidence level with a coverage factor of k=2.

The pressure response recorded with electroacoustic method.

Frequency Response



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

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

West Caldwell Calibration Laboratories Inc.

1575 State Route 96, Victor NY 14564

Tel. (585) 586-3900 FAX (585) 586-4327

Calibration Data Record

for

Model No.: 4189-A-021

Brüel & Kjær Microphone Unit

Company: Aeroustics Engineering LTD

Serial No.: 2622170

I. D. No.: XXXX

Frequency Response (Reference = 0 dB @ 250Hz)

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

Freq. response: Expanded Uncertainty (dB) with coverage factor K = 2

20 to 63Hz 0.1dB, 63 to 12.5kHz 0.094dB, 12.5k to 16kHz 0.10dB, 16k to 20kHz 0.5dB.

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

Cal. Date: 20-Sep-2017

Tested by: James Zhu

Calibrated on WCCL system type 9700

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

West Caldwell Calibration Laboratories Inc.

Certificate of Calibration

for

ACOUSTICAL CALIBRATOR

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

Submitted By:

Customer:

Company: Aeroustics 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.

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: 

Calibration Date: 25-Jul-17

Felix Christopher (QA Mgr.)

Certificate No: 27880 - 2

QA Doc. #1051 Rev. 2.0 10/1/01

Certificate Page 1 of 1

ISO/IEC 17025:2005

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



Calibration Lab. Cert. # 1533.01

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

ISO/IEC 17025: 2005



Calibration Lab. Cert. # 1533.01

REPORT OF CALIBRATION

for

Brüel & Kjær Acoustical Calibrator
 Company: Aercoustics Engineering LTD

Model No.: 4231

 Serial No.: 2513182
 ID No.: XXXX

Calibration results:

Before data: After data:

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

Sound Pressure Level at 1000.0 Hz and pressure of 1013 hPa (mbar)
 was 113.99 dB re 20 μ Pa

(Calibrator tested with $\frac{1}{2}$ " adaptor UC 0210)

IEC 1094-4 Type WS 2 P Microphone was used for measurement.

Sound Pressure Level: 114dB 94dB

Frequency: Pass Pass

Distortion: Pass Pass

Stability: Pass Pass

All tested parameters: Pass

Laboratory Environment:

Ambient Temperature: 22.6 °C

Ambient Humidity: 54.8 % RH

Ambient Pressure: 99.611 kPa

Calibration Date: 25-Jul-2017

Calibration Due: 25-Jul-2019

Report Number: 27880 -2

Control Number: 27880

The above listed instrument meets or exceeds the tested manufacturer's specifications

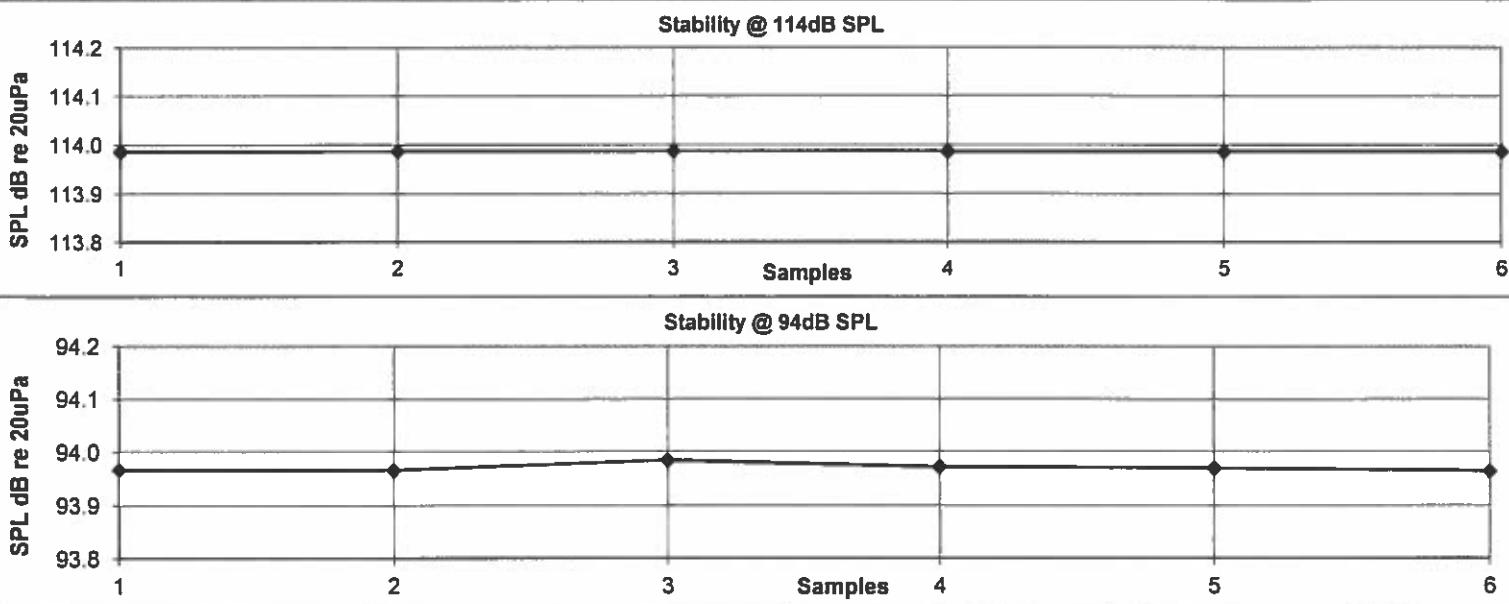
The IEC 942:1988 Class 1 specifications, passed.

The ANSI S1.4-1984 specifications, passed.

This Calibration is traceable through NIST test numbers: 683/284413-14

The expanded uncertainty of calibration: 0.09dB at 95% confidence level with a coverage factor of k=2.

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



The above listed instrument was checked using calibration procedure documented in West Caldwell

Calibration Laboratories Inc. procedure :

Rev. 7.0 Jan. 24, 2014 Doc. # 1038 4231B&K

Calibration was performed by West Caldwell Calibration Laboratories Inc. under Operating Procedures

intended to implement the requirements of ISO10012-1, IEC Guide 25, ANSI/NCSL Z540-1, (MIL-STD-45662A) and ISO 9001:2008, ISO 17025

Cal. Date: 25-Jul-2017

Measurements performed by:

Calibrated on WCCL system type 9700

James Zhu

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Rev. 7.0 Jan. 24, 2014 Doc. # 1038 4231B&K

West Caldwell Calibration Laboratories Inc.

1575 State Route 96, Victor NY 14564
 Tel. (585) 586-3900 FAX (585) 586-4327

Calibration Data Record

Brüel & Kjær Acoustical Calibrator
 Company: Aercoustics Engineering LTD

for
 Model No.: 4231

Serial No.: 2513182

All tested parameters: Pass

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

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

Frequency measured (Three samples at 30 sec. Interval)

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

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

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

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

Cal. Date: 25-Jul-2017

Tested by: James Zhu

Calibrated on WCCL system type 9700

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Rev. 7.0 Jan. 24, 2014 Doc. # 1038 4231B&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: 16.US2.13242

Date of Issue: November 1, 2016

Type: Vaisala Weather Transmitter, WXT520

Serial number: K4250007.0Deg

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

Client: Aercoustics Engineering Ltd., 1004 Middlegate RD, Suite 1100, S.Tower, Mississauga, ON L4Y 1M4

Anemometer received: October 28, 2016

Anemometer calibrated: 12:26 November 1, 2016

Calibrated by: cjf

Procedure: MEASNET, IEC 61400-12-1:2005(E) Annex F

Certificate prepared by: ejf

Approved by: Calibration engineer, rds

Calibration equation obtained: $v [m/s] = 1.02488 \cdot f [m/s] + 0.20659$

Standard uncertainty, slope: 0.00515

Standard uncertainty, offset: 0.26065

Covariance: -0.0002755 (m/s)²/ m/s

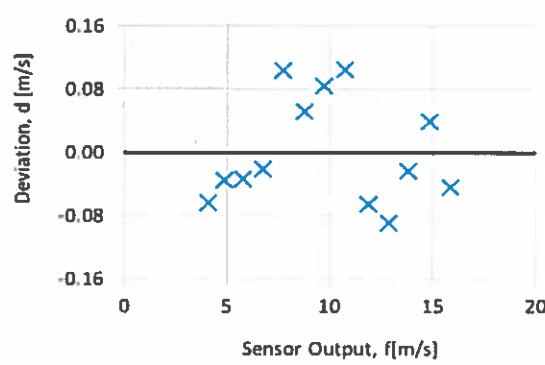
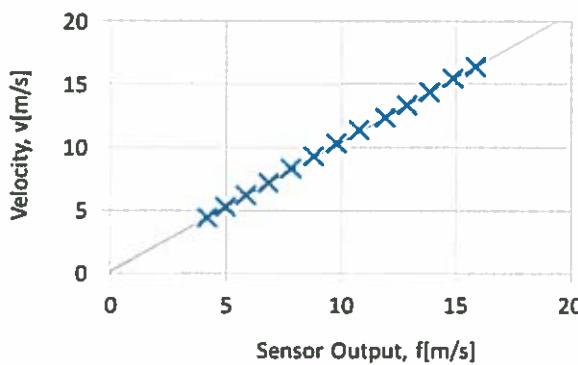
Coefficient of correlation: $\rho = 0.999854$

Absolute maximum deviation: 0.104 m/s at 11.380 m/s

Barometric pressure: 1011.4 hPa

Relative humidity: 24.4%

| 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 | 10.30 | 23.9 | 26.8 | 4.415 | 4.1690 | -0.065 | 0.024 |
| 4 | 14.60 | 24.0 | 26.8 | 5.259 | 4.9655 | -0.036 | 0.025 |
| 6 | 20.25 | 24.0 | 26.8 | 6.170 | 5.8517 | -0.034 | 0.027 |
| 8 | 27.59 | 24.0 | 26.8 | 7.189 | 6.8345 | -0.022 | 0.029 |
| 10 | 36.37 | 24.0 | 26.8 | 8.304 | 7.8000 | 0.103 | 0.032 |
| 12 | 46.01 | 23.9 | 26.8 | 9.312 | 8.8345 | 0.051 | 0.035 |
| 13-last | 56.51 | 23.9 | 26.8 | 10.327 | 9.7931 | 0.084 | 0.038 |
| 11 | 69.14 | 23.9 | 26.8 | 11.380 | 10.8000 | 0.104 | 0.042 |
| 9 | 83.91 | 24.0 | 26.8 | 12.372 | 11.9345 | -0.066 | 0.045 |
| 7 | 98.08 | 24.0 | 26.8 | 13.324 | 12.8862 | -0.089 | 0.048 |
| 5 | 114.02 | 24.0 | 26.8 | 14.379 | 13.8517 | -0.024 | 0.052 |
| 3 | 131.07 | 23.9 | 26.8 | 15.498 | 14.8828 | 0.038 | 0.055 |
| 1-first | 149.22 | 23.9 | 26.8 | 16.423 | 15.8655 | -0.044 | 0.058 |



AC-1746



EQUIPMENT USED

| Serial Number | Description |
|---------------|---|
| Njord 2 | Wind tunnel, blockage factor = 1.004 |
| 13924 | Control cup anemometer |
| - | Mounting tube, D = 30 mm |
| TT001 | Summit RT-AUI, wind tunnel |
| TP001 | Summit RT-AUI, differential pressure box |
| DP007 | Setra Model 239 pressure transducer |
| HY003 | Dwyer Instruments RHP-2D20 humidity transmitter |
| BP003 | Setra Model 278 barometer |
| PL3 | Pitot tube |
| XB001 | Computer Board. 16 bit A/D data acquisition board |
| 66GSPS1 | PC dedicated to data acquisition |

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



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

UNCERTAINTIES

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

Certificate number: 16.US2.13242



SOH Wind Engineering LLC

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Tel 802.316.4368 • Fax 802.735.9106 • www.sohwind.com

CERTIFICATE FOR CALIBRATION OF SONIC ANEMOMETER

Certificate number: 16.US2.13243

Date of issue: November 1, 2016

Type: Vaisala Weather Transmitter, WXT520

Serial number: K4250007.90deg

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

Client: Aercoustics Engineering Ltd., 1004 Middlegate RD, Suite 1100, S.Tower, Mississauga, ON L4Y 1M4

Anemometer received: October 28, 2016

Anemometer calibrated: 12:55 November 1, 2016

Calibrated by: ejf

Procedure: MEASNET, IEC 61400-12-1:2005(E) Annex F

Certificate prepared by: ejf

Approved by: Calibration engineer, rds

Calibration equation obtained: $v [m/s] = 1.03019 \cdot f [m/s] + 0.33373$

Standard uncertainty, slope: 0.00815

Standard uncertainty, offset: 0.25263

Covariance: -0.0006847 (m/s)² / m/s

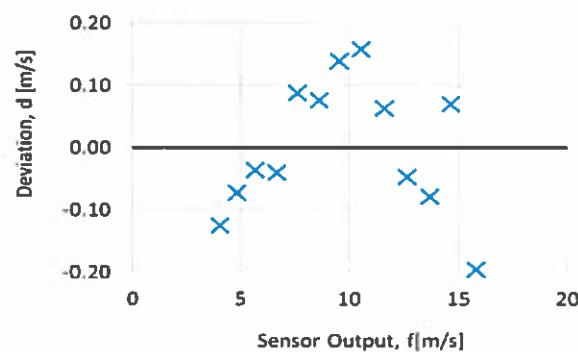
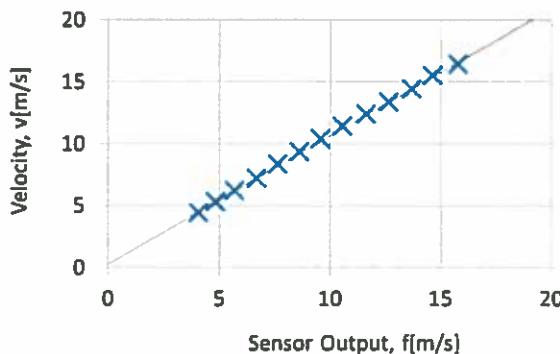
Coefficient of correlation: $\rho = 0.999635$

Absolute maximum deviation: 0.195 m/s at 16.423 m/s

Barometric pressure: 1010.8 hPa

Relative humidity: 24.4%

| 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 | 10.27 | 23.9 | 26.8 | 4.415 | 4.0828 | -0.125 | 0.024 |
| 4 | 14.54 | 24.0 | 26.8 | 5.259 | 4.8517 | -0.072 | 0.025 |
| 6 | 20.18 | 24.0 | 26.8 | 6.170 | 5.7000 | -0.036 | 0.027 |
| 8 | 27.60 | 24.0 | 26.8 | 7.189 | 6.6931 | -0.040 | 0.029 |
| 10 | 36.22 | 24.0 | 26.8 | 8.304 | 7.6517 | 0.088 | 0.032 |
| 12 | 45.89 | 24.0 | 26.8 | 9.312 | 8.6414 | 0.076 | 0.035 |
| 13-last | 56.62 | 23.9 | 26.8 | 10.327 | 9.5655 | 0.139 | 0.038 |
| 11 | 68.84 | 24.0 | 26.8 | 11.380 | 10.5690 | 0.158 | 0.041 |
| 9 | 83.82 | 24.0 | 26.8 | 12.372 | 11.6241 | 0.063 | 0.045 |
| 7 | 97.78 | 24.0 | 26.8 | 13.324 | 12.6552 | -0.047 | 0.048 |
| 5 | 113.96 | 24.0 | 26.8 | 14.379 | 13.7103 | -0.079 | 0.052 |
| 3 | 130.87 | 23.9 | 26.8 | 15.498 | 14.6517 | 0.070 | 0.055 |
| 1-first | 149.36 | 23.9 | 26.8 | 16.423 | 15.8069 | -0.195 | 0.058 |



AC-1746



EQUIPMENT USED

| Serial Number | Description |
|---------------|---|
| Njord 2 | Wind tunnel, blockage factor = 1.004 |
| 13924 | Control cup anemometer |
| - | Mounting tube, D = 30 mm |
| TT001 | Summit RT-AUI, wind tunnel |
| TP001 | Summit RT-AUI, differential pressure box |
| DP007 | Setra Model 239 pressure transducer |
| HY003 | Dwyer Instruments RHP-2D20 humidity transmitter |
| BP003 | Setra Model 278 barometer |
| PL3 | Pitot tube |
| XB001 | Computer Board, 16 bit A/D data acquisition board |
| 66GSPS1 | PC dedicated to data acquisition |

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



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

UNCERTAINTIES

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

Certificate number: 16.US2.13243



Trust in every measure

Customer: AEROCOUSTICS ENGINEERING LTD

1004 MIDDLEGATE ROAD

SUITE 1100

MISSISSAUGA, ON L4Y 1M4

PO Number: 2017.01.12C



Certificate/SO Number: 33-Q0M0D-20-1 Revision 0

Manufacturer: Nukeval

Model Number: 7470

Description: Serial to Analog Converter

Serial Number: A165164

ID: NONE

As-Found: In Tolerance

As-Left: In Tolerance

Calibration Date: Feb 02, 2017

Due Date: Feb 02, 2019

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

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

Transcat calibrations, as applicable, are performed in compliance with the requirements of the Transcat Quality Manual Revision I, ISO 9001:2008, ANSI/NCSL Z540.1-1994 (R2002), and ISO 10012:2003. When specified contractually, the requirements of ISO TS 16949:2009, 10CFR21, 10CFR50 App. B and ASME NQA-1:2012 are also covered. Complete records of work performed are maintained by Transcat and are available for inspection. Laboratory standards used in the performance of this calibration are shown on the Supplemental Report.

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

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

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



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SUITE 1100

MISSISSAUGA, ON L4Y 1M4

PO Number: 2017.01.12C

Certificate/SO Number: 33-Q0M0D-20-1 Revision 0

As Found/As Left Data

| Description | Setpoints | Accuracy | Low Limit | High Limit | As Found / As Left | O Cal Process Uncertainty (k=2; \pm) | T O Uncertainty (k=2; \pm) | Measurement Uncertainty (k=2; \pm) | Units | TUR |
|------------------------------------|-----------|---------------------------|-----------|------------|--------------------|--|--|---|-----------|-----|
| DC Current % Source - 4-20mA Ch #1 | | | | | | | | | | |
| 4 - 20mA | 0% | $\pm(0.1\% \text{ Span})$ | 3.984 | 4.016 | 4.002 mA | 1.6e-004 | 1.9e-003 | mA | 100.0 : 1 | |
| | 25% | $\pm(0.1\% \text{ Span})$ | 7.984 | 8.016 | 8.003 mA | 2.7e-004 | 1.9e-003 | mA | 59.3 : 1 | |
| | 50% | $\pm(0.1\% \text{ Span})$ | 11.984 | 12.016 | 12.000 mA | 1.1e-003 | 2.2e-003 | mA | 14.5 : 1 | |
| | 75% | $\pm(0.1\% \text{ Span})$ | 15.984 | 16.016 | 16.001 mA | 1.3e-003 | 2.3e-003 | mA | 12.3 : 1 | |
| | 100% | $\pm(0.1\% \text{ Span})$ | 19.984 | 20.016 | 20.001 mA | 1.4e-003 | 2.3e-003 | mA | 11.4 : 1 | |
| DC Current % Source - 4-20mA Ch #2 | | | | | | | | | | |
| 4 - 20mA | 0% | $\pm(0.1\% \text{ Span})$ | 3.984 | 4.016 | 4.004 mA | 1.6e-004 | 1.9e-003 | mA | 100.0 : 1 | |
| | 25% | $\pm(0.1\% \text{ Span})$ | 7.984 | 8.016 | 7.998 mA | 2.7e-004 | 1.9e-003 | mA | 59.3 : 1 | |
| | 50% | $\pm(0.1\% \text{ Span})$ | 11.984 | 12.016 | 12.000 mA | 1.1e-003 | 2.2e-003 | mA | 14.5 : 1 | |
| | 75% | $\pm(0.1\% \text{ Span})$ | 15.984 | 16.016 | 16.001 mA | 1.3e-004 | 1.9e-003 | mA | 100.0 : 1 | |
| | 100% | $\pm(0.1\% \text{ Span})$ | 19.984 | 20.016 | 20.001 mA | 1.4e-003 | 2.3e-003 | mA | 11.4 : 1 | |
| DC Current % Source - 4-20mA Ch #3 | | | | | | | | | | |
| 4 - 20mA | 0% | $\pm(0.1\% \text{ Span})$ | 3.984 | 4.016 | 3.999 mA | 1.6e-004 | 1.9e-003 | mA | 100.0 : 1 | |
| | 25% | $\pm(0.1\% \text{ Span})$ | 7.984 | 8.016 | 8.000 mA | 2.7e-004 | 1.9e-003 | mA | 59.3 : 1 | |
| | 50% | $\pm(0.1\% \text{ Span})$ | 11.984 | 12.016 | 12.003 mA | 1.1e-003 | 2.2e-003 | mA | 14.5 : 1 | |
| | 75% | $\pm(0.1\% \text{ Span})$ | 15.984 | 16.016 | 16.004 mA | 1.3e-003 | 2.3e-003 | mA | 12.3 : 1 | |
| | 100% | $\pm(0.1\% \text{ Span})$ | 19.984 | 20.016 | 19.999 mA | 1.1e-003 | 2.2e-003 | mA | 14.5 : 1 | |
| DC Current % Source - 4-20mA Ch #4 | | | | | | | | | | |
| 4 - 20mA | 0% | $\pm(0.1\% \text{ Span})$ | 3.984 | 4.016 | 4.003 mA | 1.6e-004 | 1.9e-003 | mA | 100.0 : 1 | |
| | 25% | $\pm(0.1\% \text{ Span})$ | 7.984 | 8.016 | 8.006 mA | 2.7e-004 | 1.9e-003 | mA | 59.3 : 1 | |
| | 50% | $\pm(0.1\% \text{ Span})$ | 11.984 | 12.016 | 12.010 mA | 1.1e-003 | 2.2e-003 | mA | 14.5 : 1 | |
| | 75% | $\pm(0.1\% \text{ Span})$ | 15.984 | 16.016 | 16.007 mA | 1.3e-003 | 2.3e-003 | mA | 12.3 : 1 | |
| | 100% | $\pm(0.1\% \text{ Span})$ | 19.984 | 20.016 | 20.008 mA | 1.4e-003 | 2.3e-003 | mA | 11.4 : 1 | |



SCC Lab No 827



Trust in every measure

Customer: AEROCOUSTICS ENGINEERING LTD

1004 MIDDLEGATE ROAD

SUITE 1100

MISSISSAUGA, ON L4Y 1M4

PO Number: 2017.01.12C

Certificate/SO Number: 33-Q0M0D-20-1 Revision 0



SCC Lab No 827

As Found/As Left Data

| Description | Setpoints | Accuracy | Low Limit | High Limit | As Found / As Left | O Cal Process Uncertainty (k=2; ±) | O 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 | 5.003 mA | 1.9e-004 | 2.3e-003 | mA | 100.0 : 1 |
| | 50% | ±(0.1% Span) | 9.980 | 10.020 | 10.002 mA | 3.2e-004 | 2.3e-003 | mA | 62.5 : 1 |
| | 75% | ±(0.1% Span) | 14.980 | 15.020 | 14.999 mA | 1.2e-003 | 2.6e-003 | mA | 16.7 : 1 |
| | 100% | ±(0.1% Span) | 19.980 | 20.020 | 20.000 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 | 0.000 mA | 9.2e-007 | 2.3e-003 | mA | 100.0 : 1 |
| | 25% | ±(0.1% Span) | 4.980 | 5.020 | 4.999 mA | 1.9e-004 | 2.3e-003 | mA | 100.0 : 1 |
| | 50% | ±(0.1% Span) | 9.980 | 10.020 | 10.002 mA | 3.2e-004 | 2.3e-003 | mA | 62.5 : 1 |
| | 75% | ±(0.1% Span) | 14.980 | 15.020 | 14.999 mA | 1.3e-003 | 2.7e-003 | mA | 15.4 : 1 |
| | 100% | ±(0.1% Span) | 19.980 | 20.020 | 20.000 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 | 5.001 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 | 15.002 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 #4 | | | | | | | | | |
| 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 | 5.004 mA | 1.9e-004 | 2.3e-003 | mA | 100.0 : 1 |
| | 50% | ±(0.1% Span) | 9.980 | 10.020 | 10.006 mA | 3.2e-004 | 2.3e-003 | mA | 62.5 : 1 |
| | 75% | ±(0.1% Span) | 14.980 | 15.020 | 15.011 mA | 1.3e-003 | 2.7e-003 | mA | 15.4 : 1 |
| | 100% | ±(0.1% Span) | 19.980 | 20.020 | 20.008 mA | 1.4e-003 | 2.7e-003 | mA | 14.3 : 1 |

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Customer: AEROCOUSTICS ENGINEERING LTD

1004 MIDDLEGATE ROAD

SUITE 1100

MISSISSAUGA, ON L4Y 1M4

PO Number: 2017.01.12C



SCC Lab No 827



Certificate/SO Number: 33-Q0M0D-20-1 Revision 0

| As Found/As Left Data | | | | | | |
|---------------------------------|-----------|--------------|-----------|------------|--------------------|---|
| Description | Setpoints | Accuracy | Low Limit | High Limit | As Found / As Left | O T (k=2; ±) |
| DC Voltage % Source - 0-5V Ch#1 | | | | | | Cal Process Measurement Uncertainty (k=2; ±) |
| 0-5V | 0% | ±(0.1% Span) | -0.0050 | 0.0050 | 0.0006 V | 5.0e-007 |
| | 20% | ±(0.1% Span) | 0.9950 | 1.0050 | 0.9987 V | 5.5e-006 |
| | 40% | ±(0.1% Span) | 1.9950 | 2.0050 | 2.0004 V | 1.1e-005 |
| | 60% | ±(0.1% Span) | 2.9950 | 3.0050 | 2.9994 V | 1.6e-005 |
| | 80% | ±(0.1% Span) | 3.9950 | 4.0050 | 4.0011 V | 2.1e-005 |
| | 100% | ±(0.1% Span) | 4.9950 | 5.0050 | 5.0001 V | 2.6e-005 |
| DC Voltage % Source - 0-5V Ch#2 | | | | | | Cal Process Measurement Uncertainty (k=2; ±) |
| 0-5V | 0% | ±(0.1% Span) | -0.0050 | 0.0050 | 0.0000 V | 5.8e-007 |
| | 20% | ±(0.1% Span) | 0.9950 | 1.0050 | 1.0010 V | 5.5e-006 |
| | 40% | ±(0.1% Span) | 1.9950 | 2.0050 | 2.0000 V | 2.2e-005 |
| | 60% | ±(0.1% Span) | 2.9950 | 3.0050 | 3.0000 V | 1.6e-005 |
| | 80% | ±(0.1% Span) | 3.9950 | 4.0050 | 4.0020 V | 2.1e-005 |
| | 100% | ±(0.1% Span) | 4.9950 | 5.0050 | 5.0000 V | 2.6e-005 |
| DC Voltage % Source - 0-5V Ch#3 | | | | | | Cal Process Measurement Uncertainty (k=2; ±) |
| 0-5V | 0% | ±(0.1% Span) | -0.0050 | 0.0050 | 0.0001 V | 5.0e-007 |
| | 20% | ±(0.1% Span) | 0.9950 | 1.0050 | 1.0000 V | 5.5e-006 |
| | 40% | ±(0.1% Span) | 1.9950 | 2.0050 | 2.0005 V | 1.1e-005 |
| | 60% | ±(0.1% Span) | 2.9950 | 3.0050 | 2.9993 V | 1.6e-005 |
| | 80% | ±(0.1% Span) | 3.9950 | 4.0050 | 4.0000 V | 2.1e-005 |
| | 100% | ±(0.1% Span) | 4.9950 | 5.0050 | 5.0013 V | 2.6e-005 |

TRANSCAT
MANUFACTURING

Trust in every measure

Customer: AEROCOUSTICS ENGINEERING LTD

1004 MIDDLEGATE ROAD

SUITE 1100

MISSISSAUGA, ON L4Y 1M4

PO Number: 2017.01.12C

Certificate/SO Number: 33-Q0MOD-20-1 Revision 0



| As Found/As Left Data | | | | | | | Cal Process 0 0 Uncertainty (k=2; ±) | Measurement Uncertainty (k=2; ±) | Units | TUR |
|----------------------------------|-----------|--------------|-----------|------------|--------------------|----------|--|--|-----------|-----|
| Description | Setpoints | Accuracy | Low Limit | High Limit | As Found / As Left | T | | | | |
| DC Voltage % Source - 0-5V Ch#4 | | | | | | | | | | |
| 0 - 5V | 0% | ±(0.1% Span) | -0.0050 | 0.0050 | 0.0004 V | 5.0e-007 | 5.8e-004 | ✓ | 100.0 : 1 | |
| | 20% | ±(0.1% Span) | 0.9950 | 1.0050 | 1.0010 V | 5.5e-006 | 5.8e-004 | ✓ | 100.0 : 1 | |
| | 40% | ±(0.1% Span) | 1.9950 | 2.0050 | 2.0000 V | 1.1e-005 | 5.8e-004 | ✓ | 100.0 : 1 | |
| | 60% | ±(0.1% Span) | 2.9950 | 3.0050 | 3.0020 V | 1.6e-005 | 5.8e-004 | ✓ | 100.0 : 1 | |
| | 80% | ±(0.1% Span) | 3.9950 | 4.0050 | 4.0020 V | 2.1e-005 | 5.8e-004 | ✓ | 100.0 : 1 | |
| | 100% | ±(0.1% Span) | 4.9950 | 5.0050 | 5.0036 V | 2.6e-005 | 5.8e-004 | ✓ | 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 | ✓ | 100.0 : 1 | |
| | 20% | ±(0.1% Span) | 1.990 | 2.010 | 2.000 V | 1.1e-005 | 1.2e-003 | ✓ | 100.0 : 1 | |
| | 40% | ±(0.1% Span) | 3.990 | 4.010 | 4.001 V | 2.1e-005 | 1.2e-003 | ✓ | 100.0 : 1 | |
| | 60% | ±(0.1% Span) | 5.990 | 6.010 | 6.002 V | 3.1e-005 | 1.2e-003 | ✓ | 100.0 : 1 | |
| | 80% | ±(0.1% Span) | 7.990 | 8.010 | 7.999 V | 4.1e-005 | 1.2e-003 | ✓ | 100.0 : 1 | |
| | 100% | ±(0.1% Span) | 9.990 | 10.010 | 9.999 V | 5.2e-005 | 1.2e-003 | ✓ | 100.0 : 1 | |
| DC Voltage % Source - 0-10V Ch#2 | | | | | | | | | | |
| 0 - 10V | 0% | ±(0.1% Span) | -0.010 | 0.010 | 0.001 V | 5.0e-007 | 1.2e-003 | ✓ | 100.0 : 1 | |
| | 20% | ±(0.1% Span) | 1.990 | 2.010 | 2.000 V | 1.1e-005 | 1.2e-003 | ✓ | 100.0 : 1 | |
| | 40% | ±(0.1% Span) | 3.990 | 4.010 | 4.002 V | 2.1e-005 | 1.2e-003 | ✓ | 100.0 : 1 | |
| | 60% | ±(0.1% Span) | 5.990 | 6.010 | 6.002 V | 3.1e-005 | 1.2e-003 | ✓ | 100.0 : 1 | |
| | 80% | ±(0.1% Span) | 7.990 | 8.010 | 8.006 V | 4.1e-005 | 1.2e-003 | ✓ | 100.0 : 1 | |
| | 100% | ±(0.1% Span) | 9.990 | 10.010 | 9.999 V | 5.2e-005 | 1.2e-003 | ✓ | 100.0 : 1 | |

TRANSCAT
MANADA

Trust in every measure

Customer: AEROCOUSTICS ENGINEERING LTD

1004 MIDDLEGATE ROAD

SUITE 1100

MISSISSAUGA, ON L4Y 1M4

PO Number: 2017.01.12C

Certificate/SO Number: 33-Q0M0D-20-1 Revision 0



As Found/As Left Data

| Description | Setpoints | Accuracy | Low Limit | High Limit | As Found / As Left | O 0 T | Cal Process Uncertainty (k=2; t) | Measurement Uncertainty (k=2; t) | Units | TUR |
|----------------------------------|-----------|--------------|-----------|------------|--------------------|-------------|--|--|-----------|-----|
| DC Voltage % Source - 0-10V Ch#3 | 0% | ±(0.1% Span) | -0.010 | 0.010 | 0.001 V | 5.0e-007 | 1.2e-003 | ✓ | 100.0 : 1 | |
| | 20% | ±(0.1% Span) | 1.990 | 2.010 | 2.001 V | 1.1e-005 | 1.2e-003 | ✓ | 100.0 : 1 | |
| | 40% | ±(0.1% Span) | 3.990 | 4.010 | 4.000 V | 2.1e-005 | 1.2e-003 | ✓ | 100.0 : 1 | |
| | 60% | ±(0.1% Span) | 5.990 | 6.010 | 6.000 V | 3.1e-005 | 1.2e-003 | ✓ | 100.0 : 1 | |
| | 80% | ±(0.1% Span) | 7.990 | 8.010 | 8.001 V | 4.1e-005 | 1.2e-003 | ✓ | 100.0 : 1 | |
| | 100% | ±(0.1% Span) | 9.990 | 10.010 | 10.000 V | 5.2e-005 | 1.2e-003 | ✓ | 100.0 : 1 | |
| DC Voltage % Source - 0-10V Ch#4 | 0% | ±(0.1% Span) | -0.010 | 0.010 | 0.000 V | 5.0e-007 | 1.2e-003 | ✓ | 100.0 : 1 | |
| | 20% | ±(0.1% Span) | 1.990 | 2.010 | 2.000 V | 1.1e-005 | 1.2e-003 | ✓ | 100.0 : 1 | |
| | 40% | ±(0.1% Span) | 3.990 | 4.010 | 4.002 V | 2.1e-005 | 1.2e-003 | ✓ | 100.0 : 1 | |
| | 60% | ±(0.1% Span) | 5.990 | 6.010 | 6.003 V | 3.1e-005 | 1.2e-003 | ✓ | 100.0 : 1 | |
| | 80% | ±(0.1% Span) | 7.990 | 8.010 | 8.004 V | 4.1e-005 | 1.2e-003 | ✓ | 100.0 : 1 | |
| | 100% | ±(0.1% Span) | 9.990 | 10.010 | 10.003 V | 5.2e-005 | 1.2e-003 | ✓ | 100.0 : 1 | |

Customer: AEROCOUSTICS ENGINEERING LTD
 1004 MIDDLEGATE ROAD
 SUITE 1100
 MISSISSAUGA, ON L4Y 1M4
 PO Number: 2017.01.12C



Certificate/SO Number: 33-Q0MOD-20-1 Revision 0

Traceable Standards

| Asset | Manufacturer | Model Number | Description | Cal Date | Due Date | Traceability Number |
|-------|--------------|---------------|-----------------------|-----------|-----------|---------------------|
| N0118 | Agilent/HP | 3458A Opt 002 | Multimeter, 8.5 Digit | 22-Nov-16 | 30-Nov-17 | 5-8N0118-727-1 |

Environmental Data

| Temperature | Relative Humidity | Temp / RH Asset |
|-------------------|-------------------|-----------------|
| 69.30°F / 20.72°C | 35.30% | N0438A |

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

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

Calibrated By:
 Digitally Signed On February 02, 2017
 By Mark King

Reviewed By:
 Digitally Signed On February 02, 2017
 By Francis Kanafor

Mark King
 Calibration Technician

Robert Whitaker
 Lab Manager

Unit Barcode:

Customer Number: 9-322110-000

Date Received: January 17, 2017

Service Level: R9

Certificate - Page 7 of 7

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Appendix F.02

Summary of Measurement Results

Summary of Measurement Results

1.1 Sound Power Levels

From Table 12 of IEC test report 17095.01.T44.RP1:

| Wind Speed (m/s) | Apparent L _{WA} , (dBA) | Maximum Sound Power Level (dBA)* REA # 5663-9R9JTB |
|------------------|----------------------------------|---|
| 7.5 | 101.7 | 102.5 |
| 8.0 | 101.9 | 102.5 |
| 8.5 | 101.9 | 102.5 |
| 9.0 | 101.7 | 102.5 |
| 9.5 | 101.7 | 102.5 |
| 10.0 | 101.6 | 102.5 |
| 10.5 | 101.6 | 102.5 |
| 11 | 101.7 | 102.5 |
| 11.5 | 101.8 | 102.5 |
| 12.0 | 102.1 | 102.5 |
| 7.5 | 101.7 | 102.5 |

*Includes +0.5 dB, per Section E3.1 of the MOECC Compliance Protocol for Wind Turbine Noise

1.2 Tonal Audibility Values

From Table 14 of IEC test report 17095.01.T44.RP1:

| Wind Speed (m/s) | Frequency (Hz) | Tonal audibility, ΔL _a (dB) | Tonal Audibility from AAR* (dB) |
|---------------------|----------------|--|------------------------------------|
| No Reportable Tones | | | 3 dB |

*Belle River Wind Project Noise Impact Assessment Report (November 27, 2015)

1.3 Statement of Compliance

Based on the results in Table 12 of the IEC 61400-11 test report to which this statement is attached, the maximum apparent sound power level of the test turbine complies with the sound level in REA # 2765-A4ER2P and Section E3.1 of the MOECC Compliance Protocol for Wind Turbine Noise.

Based on the results in Table 14 of the IEC 61400-11 to which this statement is attached, the tonal audibility of the test turbine complies with the maximum tonal audibility of 3 dB as indicated in the statement from the manufacturer dated July 15, 2015, found in Appendix E of the Noise Impact Assessment Report dated November 27, 2015.

Appendix F.03 E-Audit Checklist

Appendix F.03 - (2017 Compliance Protocol Appendix F6): E-Audit checklist for IEC 61400-11:2013

Wind Energy Project – Screening Document – Acoustic Audit Report – Emission IEC61400-11:2013 Standard

Information Required in the Acoustic Audit Report – Emission

| Item # | Description | Complete? | Comment |
|--------|--|-----------|---|
| 1 | Characterization of the wind turbine Items 1 to 26; IEC61400-11:2013, Section 10.2 | ✓ | Report Section 2.1 |
| 2 | Physical environment Items 27 to 33; IEC61400-11:2013, Section 10.3, Physical Environment | ✓ | Report Section 2.2, 3.2, 4.2, Appendix A |
| 3 | Measurement instrumentation Items 34 to 39; IEC61400-11:2013, Section 10.4, Instrumentation | ✓ | Report Section 3, Appendix F.01 |
| 4 | Acoustic data Items 40 to 52; IEC61400-11:2013, Section 10.5, Acoustic Data | ✓ | Report Section 4, 3.3, Appendix C, Appendix D, |
| 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 | ✓ | Report Section 3, Appendix E |
| 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 | ✓ | Report Section 4, Appendix C |
| 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 | ✓ | Report Section 3, Appendix F, data in Excel provided separately |
| 8 | Items 68 to 72; IEC61400-11:2013, Section 10.5, Acoustic Data | ∅ | Optional information, not provided in this report |
| 9 | Non-acoustic data Items 73 to 74 are from IEC61400-11:2013, Section 10.6, Non-Acoustic Data | ∅ | Optional information, not provided in this report |

End of Report
