MM92, Standard, 93129 / T01 Napier Wind Project

Results of acoustic noise measurements according to IEC 61400-11 Edition 3.0

Senvion Canada Inc.

Report No.: 10029304-R-1-A
Date: 2019-03-08

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Task and objective:
Noise emission measurement according to IEC 61400-11 Edition 3.0 on a wind turbine of type Senvion MM92 near Napier (Ontario) in Canada.

Prepared by:	Verified by:	Approved by:
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A	2019-03-08	First issue	Annika Johannsen	Ulf Kock	Ulf Kock

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1 INTRODUCTION

DNV GL was retained by Senvion GmbH ("Senvion") on behalf of wpd Napier Wind Incorporated, required under Renewable Energy Approval ("REA") #8388-9B7N4J to conduct testing per the IEC 61400-11 Edition 3.0 test standard on one of the wind turbines, designated as T01, located in the Napier Wind Project ("Napier"). 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 T01.

GL Garrad Hassan Deutschland GmbH which is part of the Energy Renewable Advisory of DNV GL is accredited by the German DAKKS under ISO/IEC 17025 to perform testing according to the IEC 61400-11 test standard. This report is not done under the accreditation to suit the format requested by the costumer.

The results given in this report only relate to the specific turbine, weather conditions and measurement site. The results mentioned in this report can only be transferred to other turbines of the same model and technical construction with consideration of the uncertainty in the results, due to manufacturing tolerances and variation in meteorological and geographical conditions where the turbines might be installed.

2 WIND TURBINE INFORMATION

2.1 Wind Turbine Equipment Details

Equipment information specific to turbine T01 was provided by the manufacturer and is summarized in Tables 1 to 5.

Table 1 – Wind Turbine Details

Wind Turbine Details	
Manufacturer	Senvion
Model Number	MM92 100M CCV*
Turbine ID (Serial Number)	T01 (93129)

Table 2 – Operating Details

Operating Details	
Vertical or Horizontal axis wind turbine	Horizontal
Upwind or downwind rotor	Upwind
Hub height	100m
Horizontal distance from rotor centre to tower axis	3150 mm
Diameter of rotor	92.5 m
Tower type (lattice or tube)	Tabular
Passive stall, active stall, or pitch controlled turbine	Pitch
Constant or variable speed	Variable
Power curve	See Annex Figure 10.11
Rotational speed at each integer standardised wind speed	See Annex Figure 10.9
Rated power output	2.050 MW

Table 3 – Rotor Details

Rotor Details	
Presence of aerodynamic add-ons, such as vortex generators, stall strips, serrated trailing edges, etc.	Serrations
Blade type	RE 45.2
Serial number	0026 – 0028 - 0029
Number of blades	3

Table 4 – Gearbox Details

Gearbox Details	
Manufacturer	ZF Hansen
Model number	EH854A-012L
Serial number	LM0313

Table 5 – Generator Details

Generator Details	
Manufacturer	Siemens
Model number	JFRA-560SR-06A
Serial number	6014631

Information provided by Senvion is in the Manufacturers Certificate Section 10.58.

2.2 Wind Turbine Location

Turbine T01 is located in the municipality of Napier near the town of Strathroy. It is bounded to the north by Highway 402, to the east by Seed Road, to the south by Napperton Drive 39 and to the west by Kenwood Road 6. The area surrounding T01 is flat and consists primarily of farmland. The UTM coordinates of the turbine are 440074 m E and 4756817 m N.

3 METHODS

All measurements and analysis described in this report were done in accordance to our internal service instruction [2] which is based on IEC 61400-11 Ed. 3.0 Wind Turbines, Part 11: Acoustic Noise Measurement Techniques, 2012-11-07 [1].

a. Measurement procedure

According to [1] the sound power level has to be analysed for wind speeds from 0.8 to 1.3 times the wind speed at 85 % of maximum power rounded to the bin centres.

Note: A calculated power curve for the turbine was provided by the customer for purposes of converting the measured turbine power output into the standardized wind speed. This power curve is given in the annex.

b. Course of measurements

The total measurement period lasted from 2018-10-17 06:50 h until 2018-10-17 13:00 h.
During turbine operation, the measured wind speed at hub height ranged from 6.0 to 16.0 m/s.
The real electrical power output of the turbine ranged between 421 and 2112 kW.

The turbine was running continuously during the operating noise measurements. The sound pressure level was measured with a microphone on an acoustically hard board and fed into a sound level meter. The calculated A-weighted equivalent 1-second average data and the non-acoustic data were acquired by the measurement system with a sampling rate of 1 Hz. Time periods with intermittent background noise of a significant nature, e.g. passing cars, planes flying over, rain etc., were marked accordingly during the measurements and are omitted in the later evaluation. If there were random and reoccurring disturbances which could not be marked during the measurement, a later state correction by means of a comparison with the audio-recording is done.

The wind turbine generator system is sited in farmland. The surface is covered by grass/plants; therefore a typical length of 0.05 m is assumed in the following. The microphone position was chosen to minimize the effect of buildings, trees or bushes in the surrounding area of the wind turbine generator system, which might have had an influence on the measurement results. The conditions comply with free field behaviour over a reflecting plane.

During the noise measurements, the meteorological conditions given in Table 6 were prevailing.

Table 6 Prevailing meteorological conditions during the measurements

Parameter	Value
Barometric pressure at 2 m height above ground [hPa]	984 - 989
Air temperature at 2 m height above ground [°C]	4.8 - 7.8
Prevailing wind direction	WSW
Range of wind direction [°]	261 – 339
Weather conditions	Cloudy and dry

c. Measuring equipment

The measuring equipment used for the measurement is listed in the annex. The equipment is tested regularly according to the management system support function [3] which includes the requirements of the [1] to ensure a high degree of measurement accuracy as well as data security. The complete acoustic measurement system was checked before and after the measurements using an acoustic calibrator.

d. Position of microphone

The microphone was placed according to [1]. The distance from the turbine to the reference measuring point, R_0 = 144.0 m, was chosen taking local circumstances into account. The height of the microphone with respect to the bottom of the turbine foundation was h_A = 0.0 m.

e. Position of met mast

To gain results of free wind at the turbine position the met mast was located at the marked area in Figure 1. The aim is to measure the wind speed and wind direction in free-wind conditions by means of an anemometer and wind vane mounted on a 10-m met mast. The wind speed measured at the met mast is used for background noise measurements.

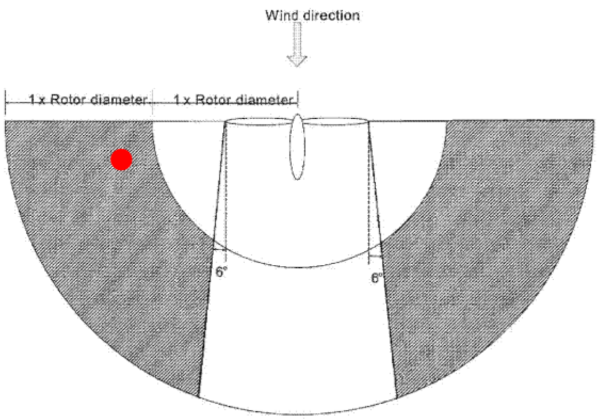

Figure 1: Position of the met mast

4 MEASUREMENT RESULTS

a. Determination of noise directivity

As no significant noise directivity was ascertained the reference noise measurement position was chosen to be directly downwind of the turbine. This position ensured that the worst-case sound propagation conditions were taken into account.

b. Sound pressure level

The microphone converts the sound pressure into a continuous analogue signal which is then fed to a sound level meter. The resulting dB value (L_{Aeq}) together with the status, the wind speed (WS) at a height of 10 m ($V_{z,m}$) and the measured power output (P_m) of the turbine, all recorded by the measurement system, is plotted against time in a graph given in the annex 10.10.

Here it can be seen at which points in time the turbine is in operation and shut down and provides an overview of the background noise in relation to the operating noise over the whole period of the measurement.

Non-normal background noises occurring in the measurement period, e.g. from aircraft or traffic, were marked during data acquisition to enable their easy omission in the evaluation to follow.

The state signal is used to differentiate between periods when the turbine is in operation and when it is stopped.

Following states have been used for evaluation in this report:

State 0: marks the data to be omitted in the evaluation,

State 1.5: depicts a stopped turbine,

State 2: depicts a turbine in operation.

Remark Nr. 1: This measurement was performed using a secondary wind shield. The attenuation effect of this wind shield was corrected by use of the measured coefficients for the secondary wind shield of type EWS-16-22 which are shown in the annex.

In order to determine the wind speed at hub height during noise measurement of the turbine the allowed range of the power curve is taken into account based of the following equation:

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

where

k is the wind speed bin number of the power curve;

P_k is the power curve value at wind speed bin k;

P_{k+1} is the power curve value above wind speed bin k;

P_{tol} is the tolerance on the power reading, in this case it is 1 % of maximum power.

All data points which exceed or are below these limitations are determined with nacelle anemometer and the wind speed from the power curve using the following relation:

$$V_{\mathrm{nac,n}} = \kappa_{nac} \cdot V_{\mathrm{nac,m}} \quad (2)$$

where

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

$V_{\mathrm{nac,m}}$ is the wind speed measured with the nacelle anemometer.

Outside the allowed range of the power curve the normalised WS at hub height is $V_{H,n} = V_{nac,n}$.

For this measurement κ_{nac} is determined to be κ_{nac} = 1.03.

For background noise measurements the wind speed is measured at height z (in this case 10 m) and multiplied by factor κ_Z factor to derive the normalized wind speed at hub height.

$$V_{\mathrm{B,n}} = \kappa_Z \cdot V_{\mathrm{Z,m}} \quad (3)$$

where

$V_{\mathrm{Z,m}}$ is the wind speed measured with an anemometer at height Z of at least 10 m;

$V_{\mathrm{B,n}}$ is the normalised wind speed at hub height.

During background noise measurements: $V_{H,n} = V_{B,n}$.

For this measurement κ_z is determined to be κ_z = 1.55.

Besides the equivalent noise level, a 1/3-octave spectrum with centre frequencies between 20 Hz and 10 kHz is calculated from the recorded WAV files and later on is used for the evaluation of the equivalent noise level $L_{Aeq,o,j}$.

$$L_{\mathrm{Aeq,o,j}} = 10 \cdot \log \sum_{i=1}^{28} 10^{\left(\frac{L_{\mathrm{Aeq,i,j}}}{10}\right)} \quad (4)$$

$$\Delta_j = L_{\mathrm{Aeq,j}} - L_{\mathrm{Aeq,o,j}} \quad (5)$$

The difference Δ_j between the noise level and the sum of the 1/3-octave band spectrum is added to each individual band $L_{\mathrm{Aeq,n,i,j}}$ in the 1/3-octave band spectrum for each measurement period j.

$$L_{\mathrm{Aeq,n,i,j}} = L_{\mathrm{Aeq,i,j}} + \Delta_j \quad (6)$$

c. Sound power level

In accordance to [1] the corrected sound pressure level for the 1/3-octave band i is the energetic difference between the total noise level and the background noise level expressed as:

$$L_{\mathrm{V,c,i,k}} = 10 \cdot \log\left(10^{0.1 \cdot L_{\mathrm{V,T,i,k}}} - 10^{0.1 \cdot L_{\mathrm{V,B,i,k}}}\right) \quad (7)$$

The corresponding sound power level $L_{WA,i,k}$ is calculated from the background corrected sound pressure level for the same 1/3-octave band as follows:

$$L_{\mathrm{WA,i,k}} = L_{\mathrm{V,c,i,k}} - 6 + 10 \cdot \lg\left(\frac{4 \cdot \pi \cdot R_1^2}{S_0}\right) \quad (8)$$

where 6 dB is the correction due to the doubled sound pressure sensed by the microphone caused by the coherent interference at the acoustically hard board.

$10 \cdot \lg\left(\frac{4 \cdot \pi \cdot R_1^2}{S_0}\right)$ corresponds to the ratio in dB of the surface area of a sphere having the radius R_1 to the reference surface area of S_0

where
S_0 = 1 m^2

$$R_1 = \sqrt{(R_0 + d)^2 + (H - h_A)^2} \tag{9}$$

The total sound power level $L_{WA,k}$ of the turbine in dB in wind speed bin k is derived by energy summing all the 1/3-octave band sound power levels:

$$L_{WA,k} = 10 \cdot \log \sum_{i=1}^{28} 10^{\left(\frac{L_{WA,i,k}}{10}\right)} \tag{10}$$

The difference between the sum of the 1/3-octave bands of the total noise and the sum of the 1/3-octave band of the background noise has to be at least 3 dB. Otherwise the result shall not be reported. If the difference is larger than 3 dB and smaller than 6 dB the result shall be marked with an asterisk.

The following results are given in the annex:

- A plot of $L_{T,c,I,k}$ and $L_{v,B,I,k}$ against wind speed;
- A plot of L_{Aeq} against power;
- A plot of rotor speed against power;
- A plot of rotor speed against wind speed;
- A plot of met mast wind speed against wind speed from power curve;
- A plot of nacelle wind speed against wind speed from power curve;
- A time plot of the measurement.
- Power Curve

For the Senvion MM92 in the present configuration the apparent sound power levels are given in Table 8.

4.1 Tonal and frequency analysis

In accordance with the international standard [1] a tonal analysis is carried out. The frequency spectrum of the noise measured on the acoustically hard board is determined on the basis of a narrow band analysis. This analysis is performed after the measurements using the recorded audio signal.

The results of the tonal analysis of the Senvion MM92 according to [1] are given in Table 8.

4.2 One-third octave analysis

The A-weighted sound spectra at all the wind speed bins are given in the annex.

4.3 Type B uncertainties

For these measurements, all the type B measurement uncertainty components as specified in Annex C of the IEC 61400-11 Ed. 3.0, are given in Table 7. For all the type B uncertainties mentioned here, a rectangular distribution of possible values is assumed for simplicity with a range described as "±a". The standard deviation for such a distribution is

$$U = \frac{a}{\sqrt{3}} \tag{11}$$

Table 7 Type B measurement uncertainty components

Uncertainty Components	Value
Calibration, U_{B1}	0.2 dB
Instruments, U_{B2}	Taken from calibration certificates
Board, U_{B3}	0.3 dB
Wind screen insertion loss, U_{B4}	Depending on the frequency
Distance and direction of microphone, U_{B5}	0.1 dB
Air absorption, U_{B6}	Usually no uncertainty assumption
Weather, U_{B7}	0.5 dB
Wind speed (measured), U_{B8} 1)	0.7 m/s
Wind speed (derived), U_{B8} 2)	0.2 m/s
Wind speed from power curve, U_{B9}	0.2 m/s

1) through nacelle anemometer or met mast
2) through power curve

5 DEVIATIONS

There are no deviations from IEC 61400-11 Ed. 3.0.

6 RESULTS

The result of this measurement is given in Table 8. For detailed results please refer to the annex.

For the measured turbine in Mode Standard (2050 kW) the relevant wind speed range according to [1] is between 7.9 m/s and 12.8 m/s.

Table 8 Summary of results at hub height

WS at hub height [m/s]	SPL $L_{WA,k}$ [dB]	Combined uncertainty in the SPL $U_{C,L,WA,k}$ [dB]	Measured rotorspeed [min^{-1}]	Tonal audibility $\Delta L_{a,k}$ [dB]	Frequency of the most prevalent tone [Hz]	Relevant tone?	Relevant tone above 0 dB?
8.0	100.6	1.2	14.2	-1.83	106	Yes	No
8.5	102.1	0.9	14.8	-	-	No	No
9.0	102.8	0.7	15.0	-	-	No	No
9.5	103.2	0.8	15.0	-1.28	600	Yes	No
10.0	103.5	0.8	15.0	-2.51 0.61	113 600	Yes Yes	No Yes
10.5	103.6	0.9	15.0	-1.52 1.72	113 599	Yes Yes	No Yes
11.0	103.4	1.1	15.0	0.53 2.14	113 599	Yes Yes	Yes Yes
11.5	103.1	1.1	15.0	2.16 1.88	113 602	Yes Yes	Yes Yes
12.0	103.4	1.3	15.0	1.02 2.06	113 599	Yes Yes	Yes Yes
12.5	103.9	1.3	15.0	0.70 3.42	112 598	Yes Yes	Yes Yes
13.0	103.8	1.3	15.0	0.13 4.84	113 598	Yes Yes	Yes Yes

Table 9 Summary of results at 10 m height

WS at 10 m height [m/s]	SPL $L_{WA,10m,k}$ [dB]	Combined uncertainty in the SPL $U_{C,L,WA,10m,k}$ [dB]
5	97.8	1.2
6	102.2	0.7
7	103.5	0.8
8	103.1	1.1
9	103.8	1.3

7 CONCLUSION

GL Garrad Hassan Deutschland GmbH supported by GL Garrad Hassan Canada Inc. undertook measurements of the acoustic noise emissions of turbine T01 of the Napier Wind Farm.

As per REA number 8388-9B7N4J the measurements and analysis of the sound power level and tonality described in this report are based on the international standard IEC 61400-11 Ed. 3.0. The analysis of the sound power level was carried out using the standardised wind speed which was derived from the calculated power curve provided by the customer (see annex).

The values of measured Tonal audibility $\Delta L_{a,k}$ [dB] shown in annex Figure 10.33 do not comply with the maximum tonal audibility values noted in the Acoustic Assessment Report. The tonal audibility also exceeds the 2017 Ontario Compliance Protocol allowable value of 3 dB. The [1] considers a tone as relevant if more than 20 % of the datasets within a BIN show a tone of same origin and their combined $\Delta L_{a,k}$ exceeds the audibility criteria of $\Delta L_{a,k}$>-3 dB.

The results of the measurement confirm that turbine T01 with serial number 93129 does not exceed the value of the maximum sound power level shown in Table B1 of the Schedule B of the REA number 8388-9B7N4J (Annex Figure 10.57) including a 0.5 dB tolerance included in the 2017 Ontario Compliance Protocol. The wind turbine generator system is considered in compliance on sound power level, when verified against the 2017 Ontario Compliance Protocol.

It is assured that this report has been drawn up impartially and with best knowledge and conscience.

8 REFERENCES

/1/ IEC 61400-11 Ed. 3.0 Wind Turbines,
Part 11: Acoustic Noise Measurement Techniques
2012-11-07

/2/ ISI-RA-MEA-4601
Noise emission measurements on wind turbines – one third octave level method
2017-03-01
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/3/ ISI-RA-MEA-2501
Calibration Programs
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9 LIST OF ABBREVIATIONS

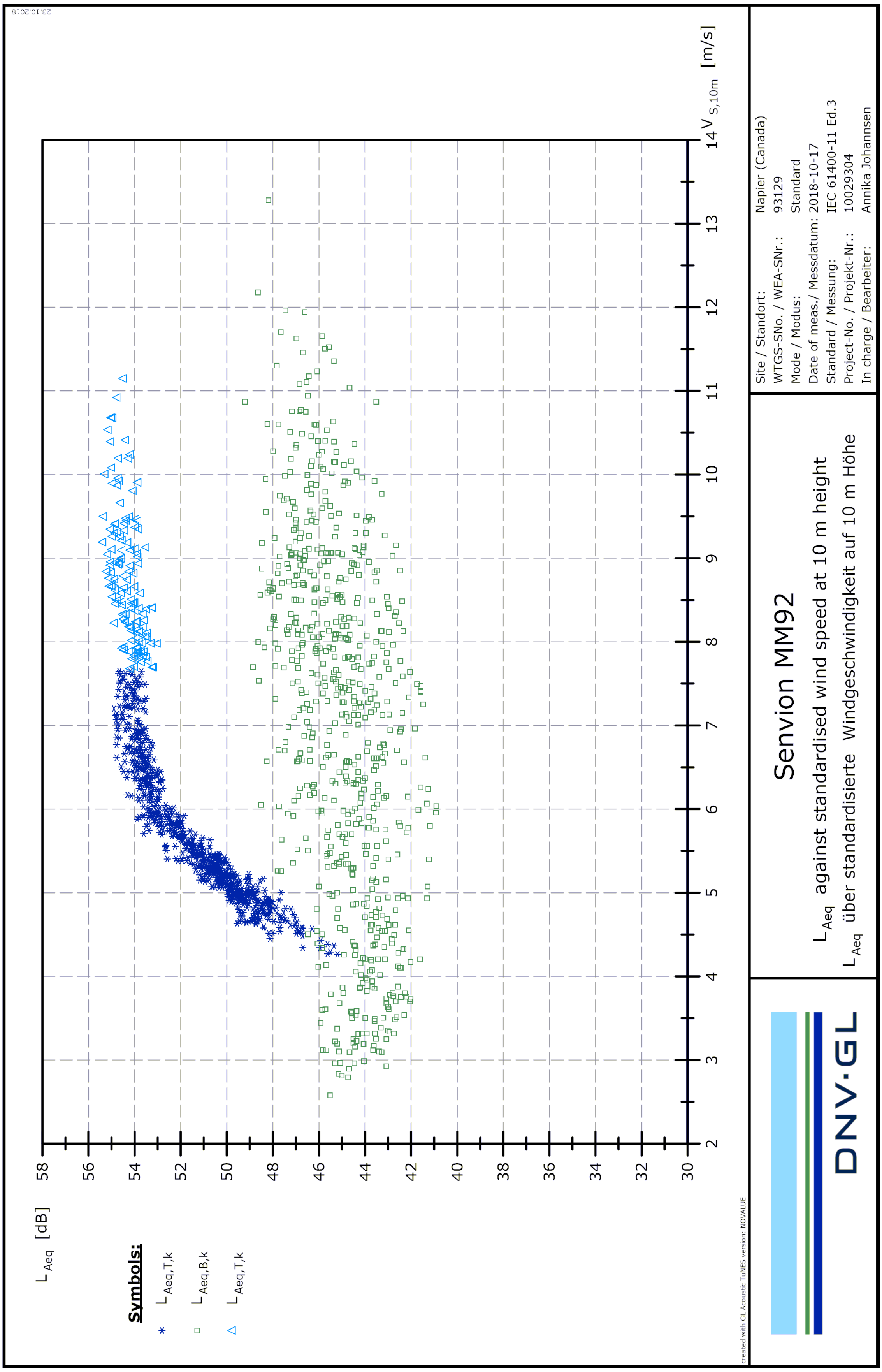
Abbreviation	Description	Unit
d	distance from rotor centre to tower axis	[m]
D	rotor diameter	[m]
H	height of rotor centre above local ground near the wind turbine	[m]
L_A or L_C	A or C-weighted sound pressure level	[dB]
L_{Aeq}	equivalent continuous A-weighted sound pressure level	[dB]
$L_{pn,j,k}$	sound pressure level of masking noise within a critical band in the 'j^{th}' spectrum at the 'k^{th}' wind speed bin	[dB]
$L_{pn,avg,j,k}$	average of analysis bandwidth sound pressure levels of masking noise in the 'j^{th}' spectra at the 'k^{th}' wind speed bin	[dB]
$L_{pt,j,k}$	sound pressure level of the tone or tones in the 'j^{th}' spectra at the 'k^{th}' wind speed bin	[dB]
$L_{WA,k}$	apparent sound power level, where k is a wind speed centre value	[dB]
log	logarithm to base 10	
P_m	measured electric power	[kW]
P_n	normalised electric power	[kW]
P_k	power curve value at wind bin k	[kW]
P_{tol}	tolerance of the power reading	[kW]
R_0	reference distance	[m]
R_1	slant distance from rotor centre to actual measurement position	[m]
S_0	reference area, $S_0 = 1\ m^2$	[m]
SPL	sound power level	[dB]
T_C	air temperature	[°C]
T_K	absolute air temperature	[K]
u_A	Uncertainty components of Type A	[dB]
u_B	Uncertainty components of Type B	[dB]
$V_{H,n}$	normalised wind speed at hub height H	[m/s]
$V_{P,n}$	normalised wind speed derived from power curve	[m/s]
V_z	wind speed at height z	[m/s]
$V_{nac,m}$	measured wind speed from nacelle anemometer	[m/s]
$V_{nac,n}$	normalised wind speed from nacelle anemometer	[m/s]
f	frequency of the tone	[Hz]
f_c	centre frequency of critical band	[Hz]
p	atmospheric pressure	[kPa]
z_0	roughness length	[m]
z_{0ref}	reference roughness length, 0.05 m	[m]
z	anemometer height	[m]
κ	Ratio between normalised wind speed and measured wind speed	[-]
$\Delta L_{tn,j,k}$	tonality of the 'j th' spectrum at 'k th' wind speed	[dB]
Φ	inclination angle	[°]
$V_{Z,m}$	is the measured wind speed with an anemometer at height Z of at least 10 m	[m/s]
$V_{B,n}$	is the normalised wind speed at hub height	[m/s]

Description of the subscripts and indexes of the formulas

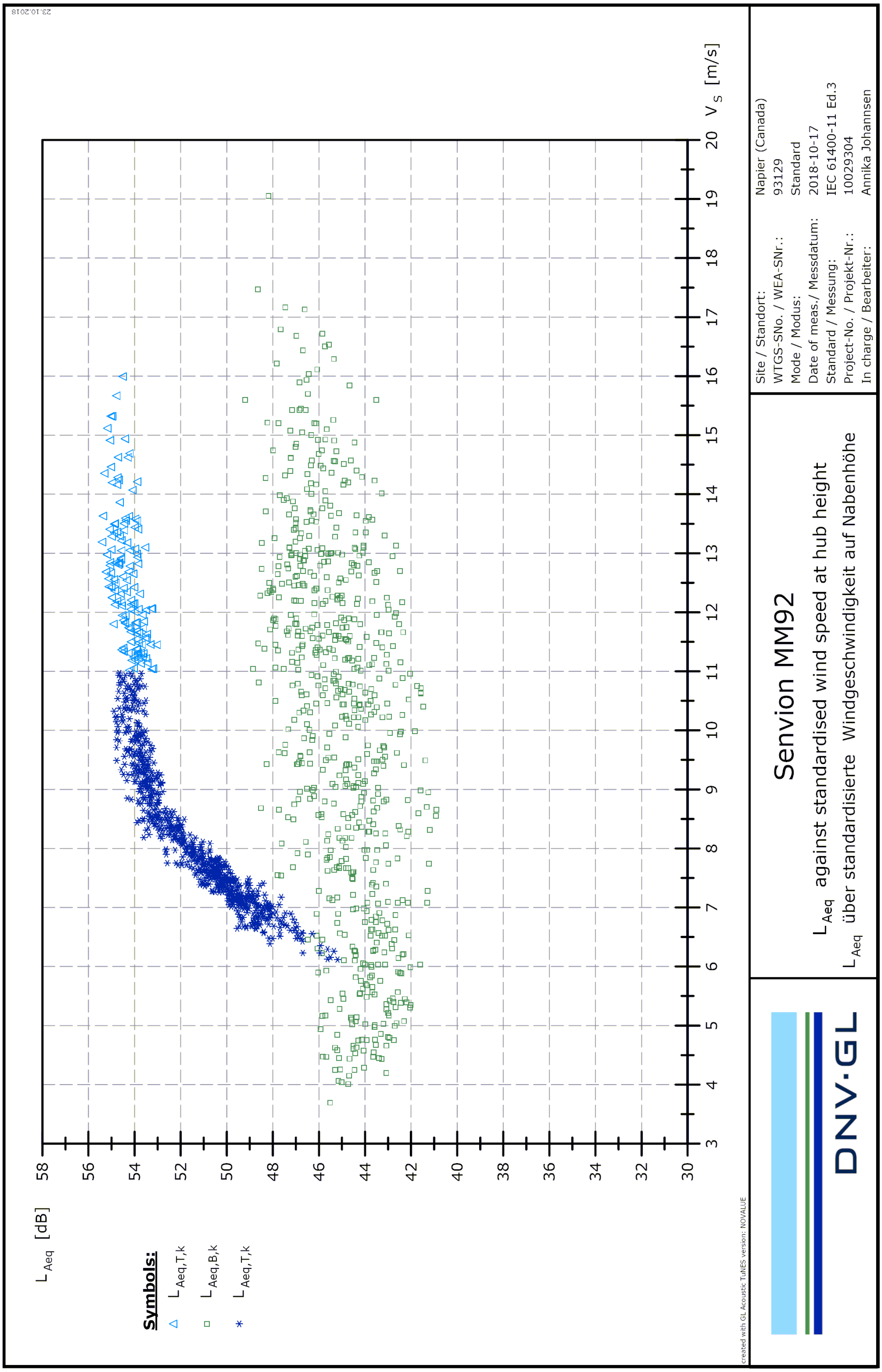
i	1/3 octave band number (e.g. i = 1 for 20 Hz centre frequency, i = 2 for 25 Hz centre frequency, ... , i = 28 for 10 kHz centre frequency)
j	10 s measurement period number (each bin should have the minimum of 10 points per bin therefore j = 1 to 10 or greater)
k	wind speed bin (i.e. k = 6 m/s bin, k = 6,5 m/s bin, k = 7 m/s bin, etc.)
V	bin centre value; of measured 1/3 octave spectrum
n	normalized spectrum
N	number of measurements in wind speed k
T	total noise
B	background noise
C	background corrected total noise

10 APPENDIX

10.1 L_{Aeq} vs. wind speed at 10 m height

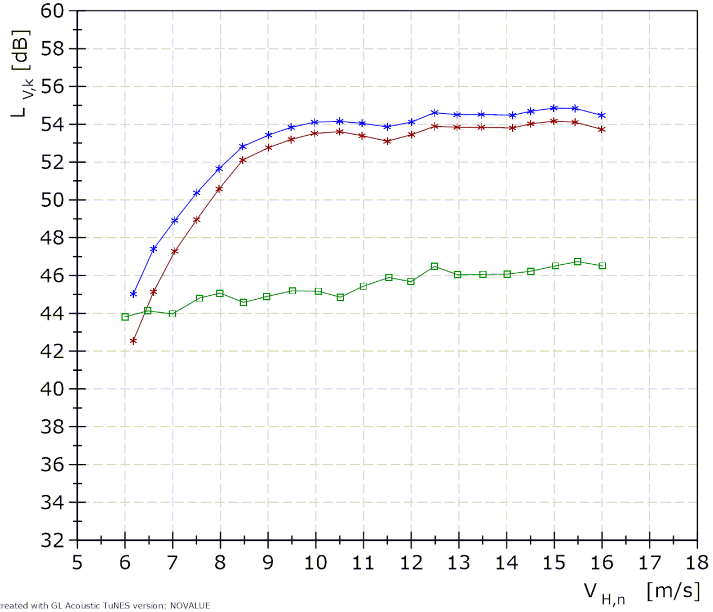


10.2 L_{Aeq} vs. wind speed at hub height



10.3 Summary of analysis input and results at hub height

H	= 100 m	d	= 3.15 m	h_A	= 0.0 m
D	= 92 m	z_0	= 0.05 m	R_0	= 144 m
k_{nac}	= 1.03	state $_{total\ noise}$			= 2
k_z	= 1.55	state $_{background\ noise}$			= 1.5
$P_{85\%}$	= 1.74 MW	$V_{P(85\%)}$ * 0.8			= 7.9 m/s
$V_{P(85\%)}$	= 9.9 m/s	$V_{P(85\%)}$ * 1.3			= 12.8 m/s



BIN [m/s]	$L_{V,T,k}$ [dB]	$L_{V,B,k}$ [dB]	$L_{V,C,k}$ [dB]	total n [no.]	backg.n [no.]	$V_{Z,k}$ [m/s]	P_k [MW]	rpm_k [U/min]	$L_{WA,k}$ [dB]	$U_{c,k}$ [dB]
6.5	47.4	44.1	**45.1**	45	28	4.53	0.54	11.9	**95.1***	2.1
7.0	48.9	44.0	**47.3**	151	25	4.88	0.66	12.6	**97.3***	1.5
7.5	50.4	44.8	**49.0**	169	24	5.23	0.81	13.4	**99.0***	1.4
8.0	51.6	45.1	**50.6**	106	25	5.58	0.97	14.2	**100.6**	1.2
8.5	52.8	44.6	**52.1**	83	33	5.93	1.16	14.8	**102.1**	0.9
9.0	53.4	44.9	**52.8**	75	34	6.27	1.38	15.0	**102.8**	0.7
9.5	53.8	45.2	**53.2**	64	38	6.62	1.58	15.0	**103.2**	0.8
10.0	54.1	45.2	**53.5**	46	25	6.97	1.77	15.0	**103.5**	0.8
10.5	54.2	44.8	**53.6**	39	42	7.32	1.90	15.0	**103.6**	0.9
11.0	54.0	45.4	**53.4**	31	44	7.67	2.00	15.0	**103.4**	1.1
11.5	53.9	45.9	**53.1**	26	51	8.02	2.06	15.1	**103.1**	1.1
12.0	54.1	45.7	**53.4**	24	36	8.36	2.06	15.0	**103.4**	1.3
12.5	54.6	46.5	**53.9**	18	42	8.71	2.06	15.0	**103.9**	1.3
13.0	54.5	46.0	**53.8**	21	43	9.06	2.06	15.0	**103.8**	1.3
13.5	54.5	46.1	**53.8**	17	27	9.41	2.06	15.0	**103.8**	1.3

23.10.2018

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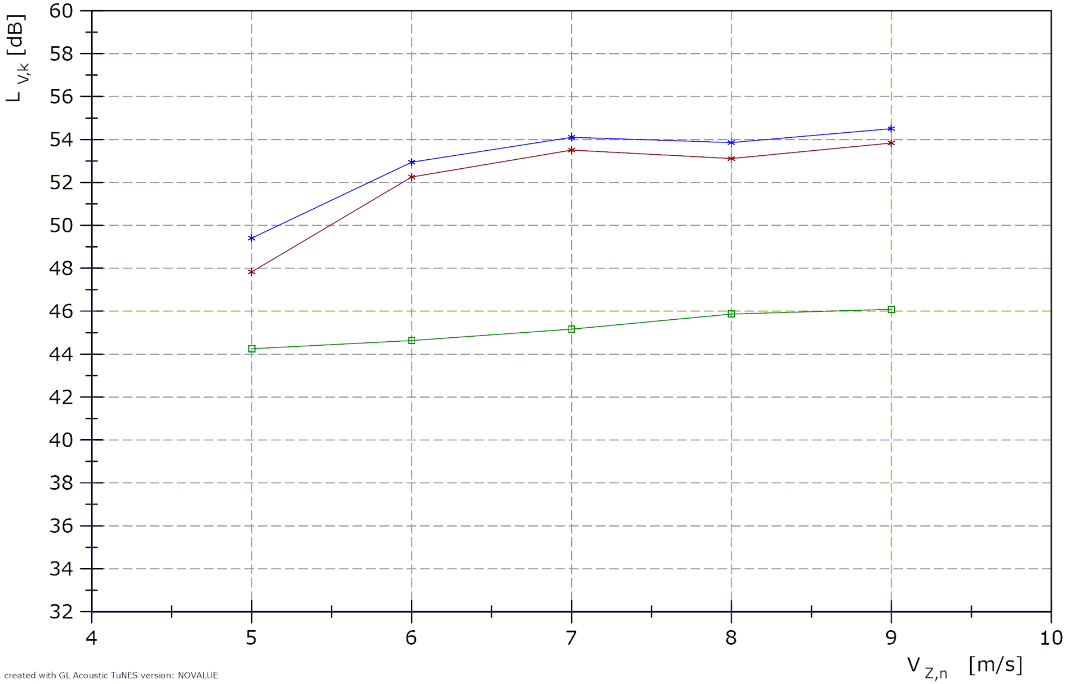
Senvion MM92

Results relating to hub height
Ergebnisse bezogen auf Nabenhöhe

Site / Standort:	Napier (Canada)
WTGS-SNo. / WEA-SNr.:	93129
Mode / Modus:	Standard
Date of meas./ Messdatum:	2018-10-17
Standard / Messung:	IEC 61400 - 11 Ed.3
Project-No. / Projekt-Nr.:	10029304
In charge / Bearbeiter:	Annika Johannsen

10.4 Summary of analysis input and results at 10m height

H	=	100 m		d	= 3.15 m		h_A	=	0.0 m
D	=	92 m		z_0	= 0.05 m		R_0	=	144 m
k_{nac}	=	1.03		k_z	= 1.55				
$P_{85\%}$	=	1.74 MW		$V_{P(85\%)}$ * 0.8 =	7.9 m/s		state $_{total\ noise}$	=	2
$V_{P(85\%)}$	=	9.9 m/s		$V_{P(85\%)}$ * 1.3 =	12.8 m/s		state $_{background\ noise}$	=	1.5



BIN [m/s]	$L_{V,T,k}$ [dB]	$L_{V,B,k}$ [dB]	$L_{V,C,k}$ [dB]	$V_{H,k}$ [m/s]	$L_{WA,k}$ [dB]	$U_{c,k}$ [dB]
5.0	49.4	44.3	**47.8**	7.17	**97.8***	1.2
6.0	52.9	44.6	**52.3**	8.61	**102.2**	0.7
7.0	54.1	45.2	**53.5**	10.04	**103.5**	0.8
8.0	53.9	45.9	**53.1**	11.48	**103.1**	1.1
9.0	54.5	46.1	**53.8**	12.91	**103.8**	1.3

23.10.2018

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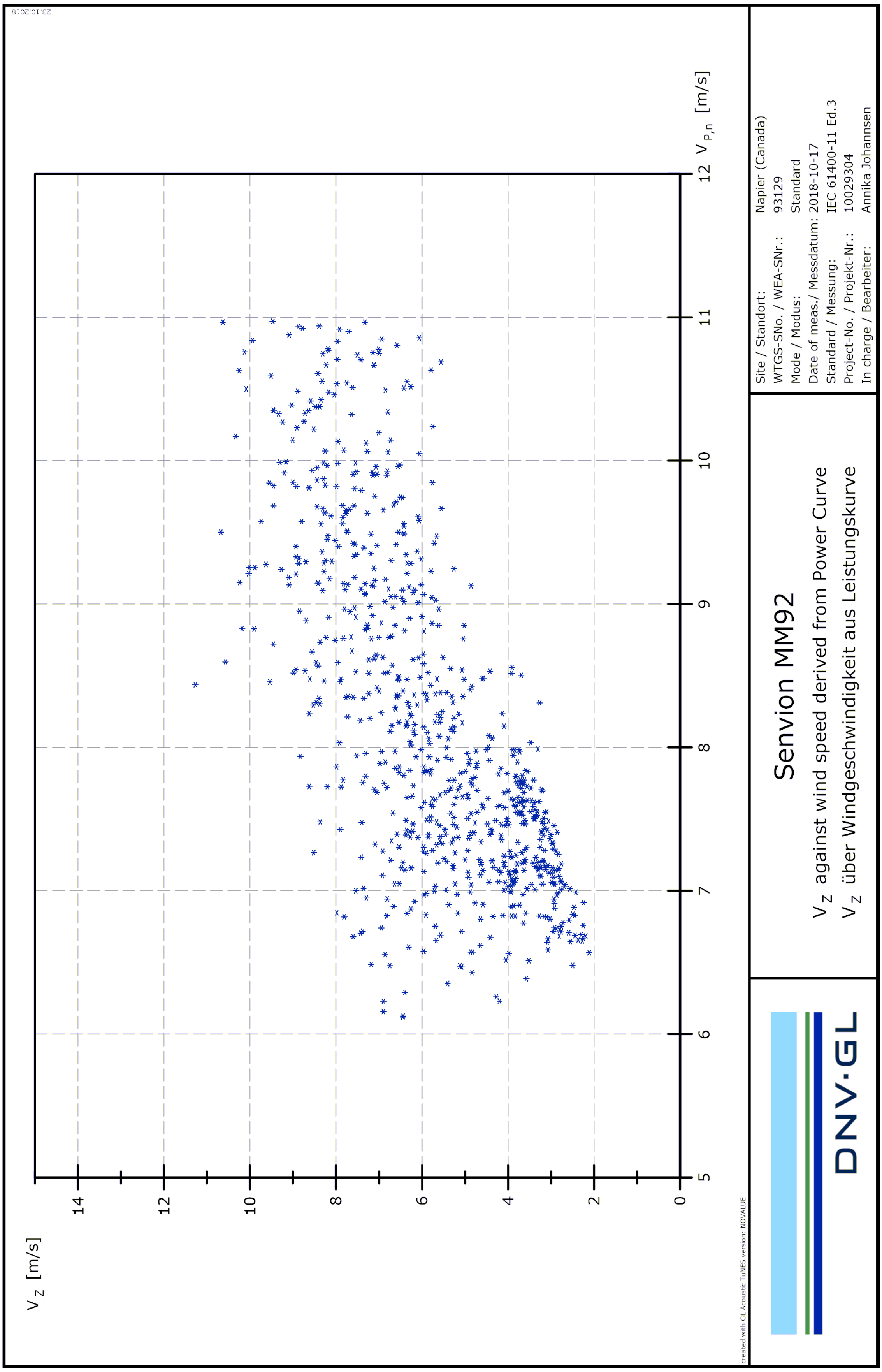
Senvion MM92

result vs. BIN (10m)

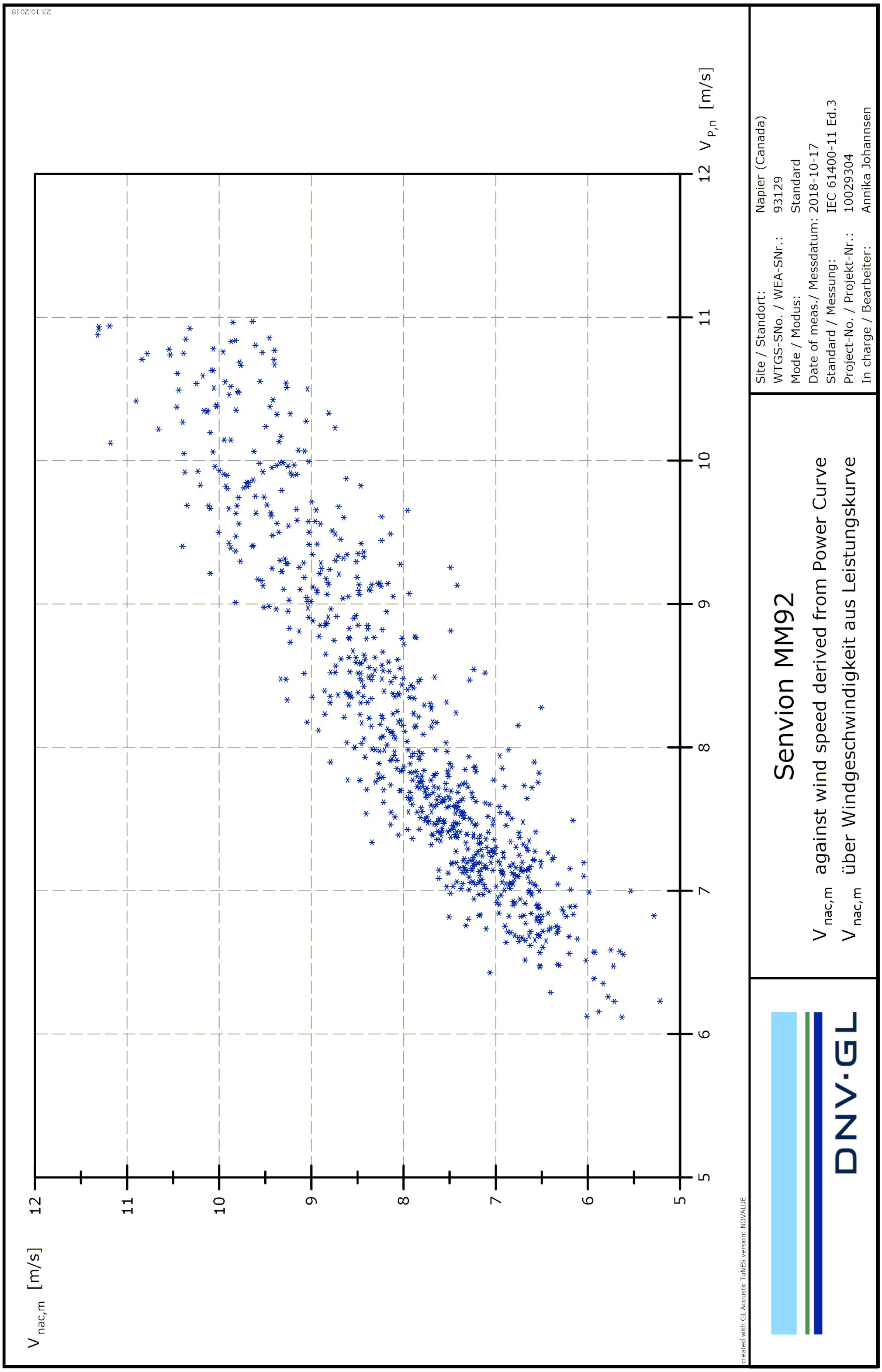
Ergebnisse pro BIN (10m)

Site / Standort:	Napier (Canada)
WTGS-SNo. / WEA-SNr.:	93129
Mode / Modus:	Standard
Date of meas./ Messdatum:	2018-10-17
Standard / Messung:	IEC 61400 - 11 Ed.3
Project-No. / Projekt-Nr.:	10029304
In charge / Bearbeiter:	Annika Johannsen

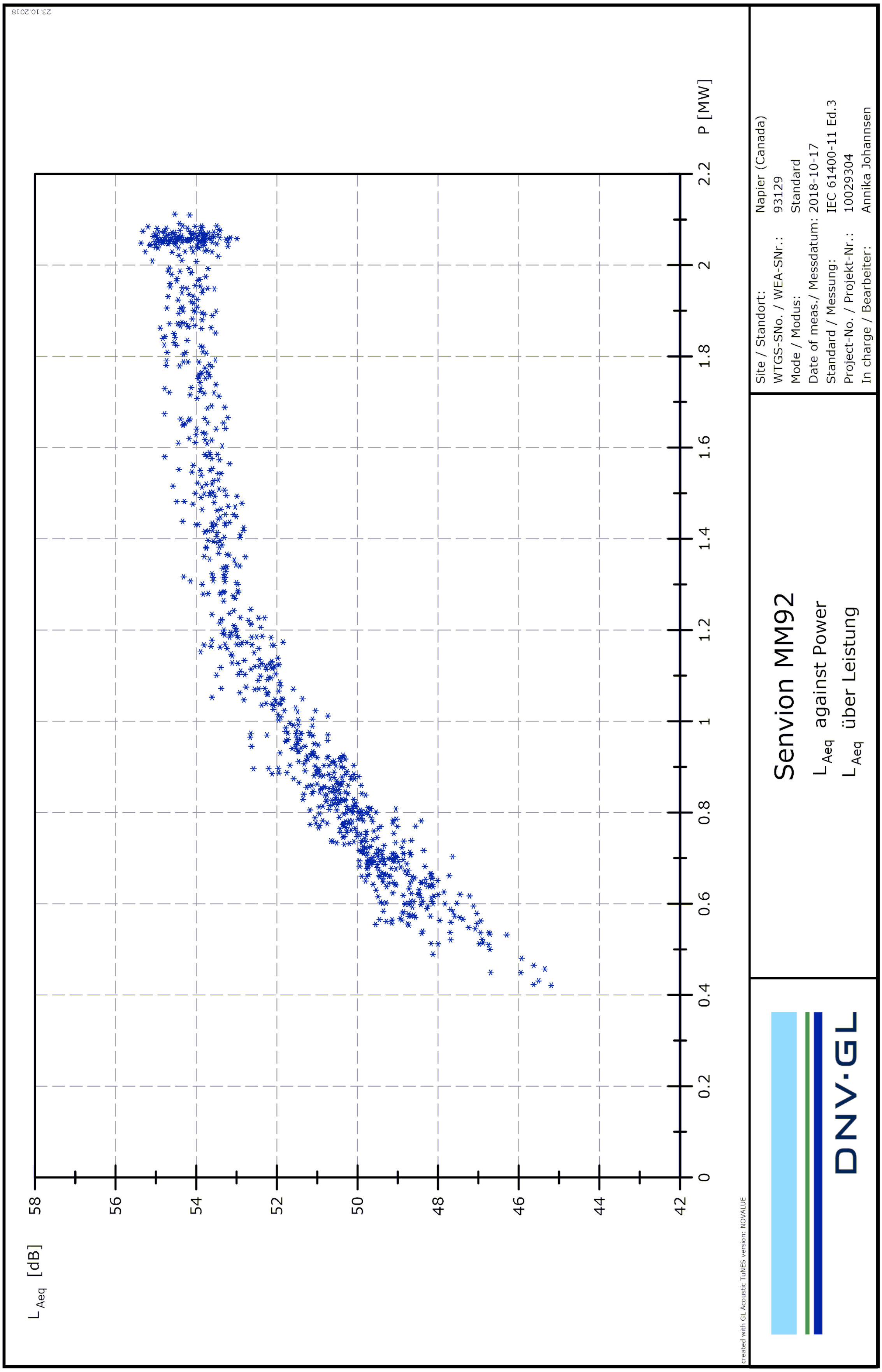
10.5 Measured wind speed from met mast vs. wind speed from power curve



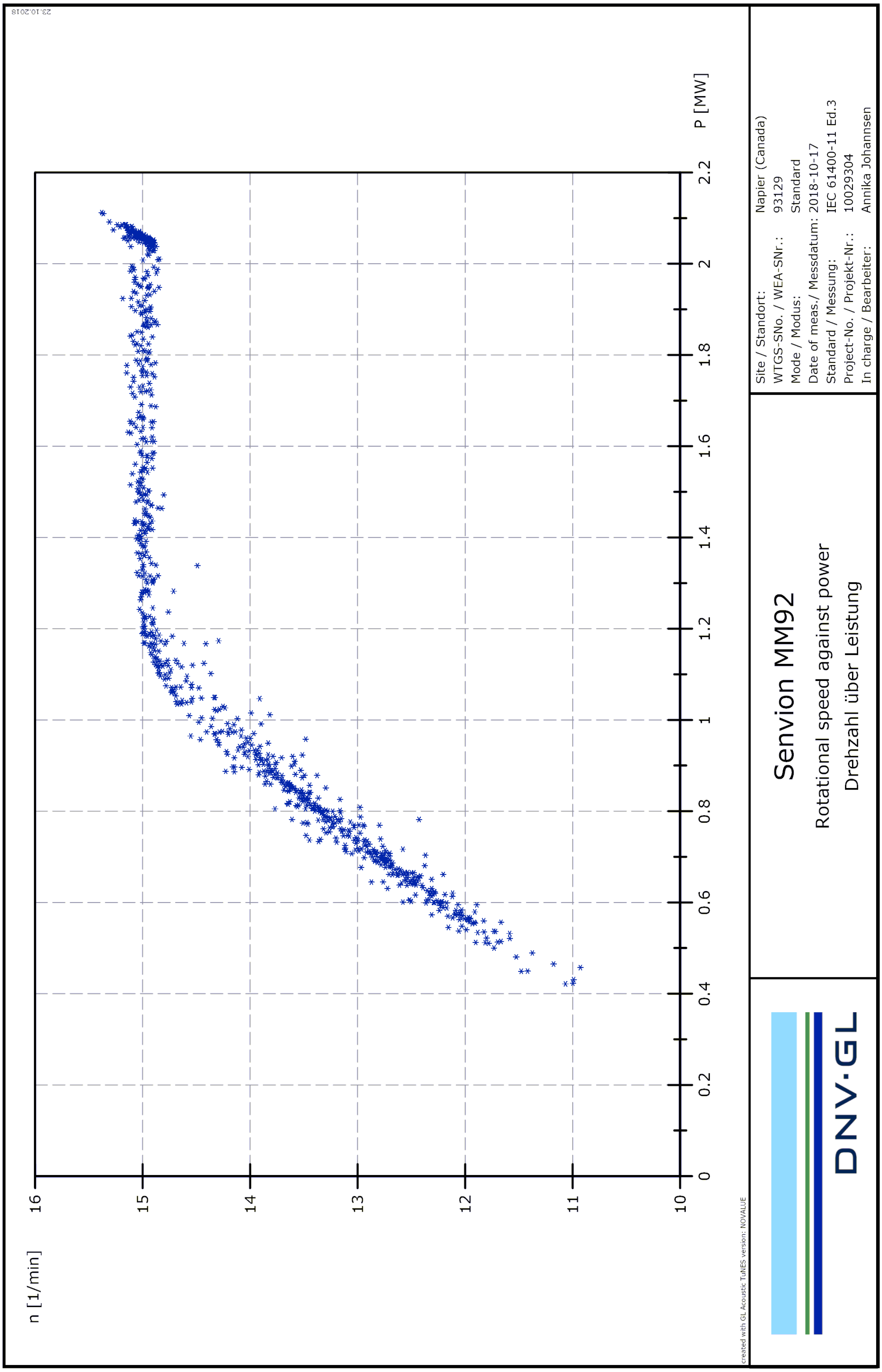
10.6 Measured wind speed from nacelle anemometer vs. wind speed from power curve



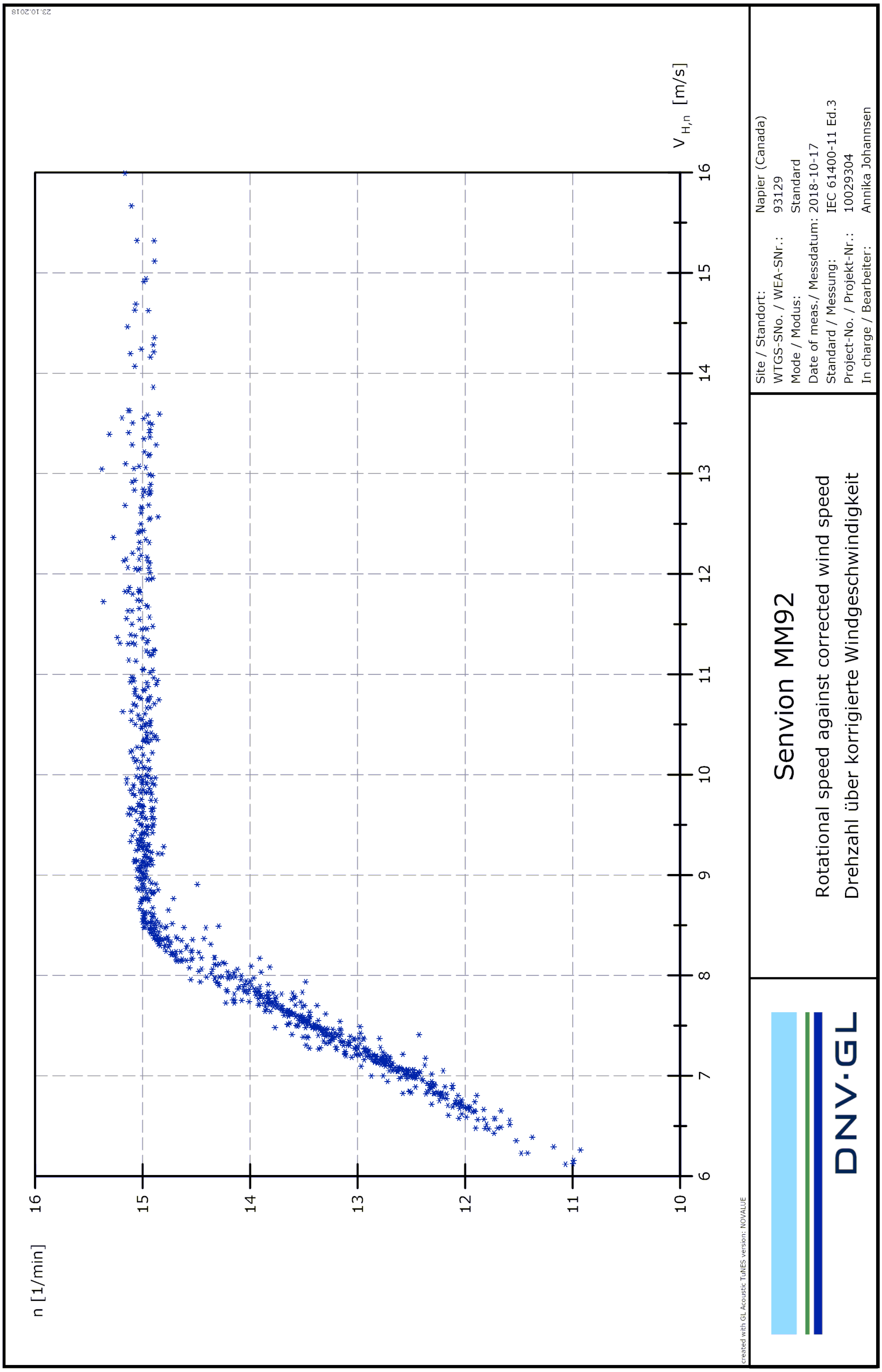
10.7 L_{Aeq} vs. active power



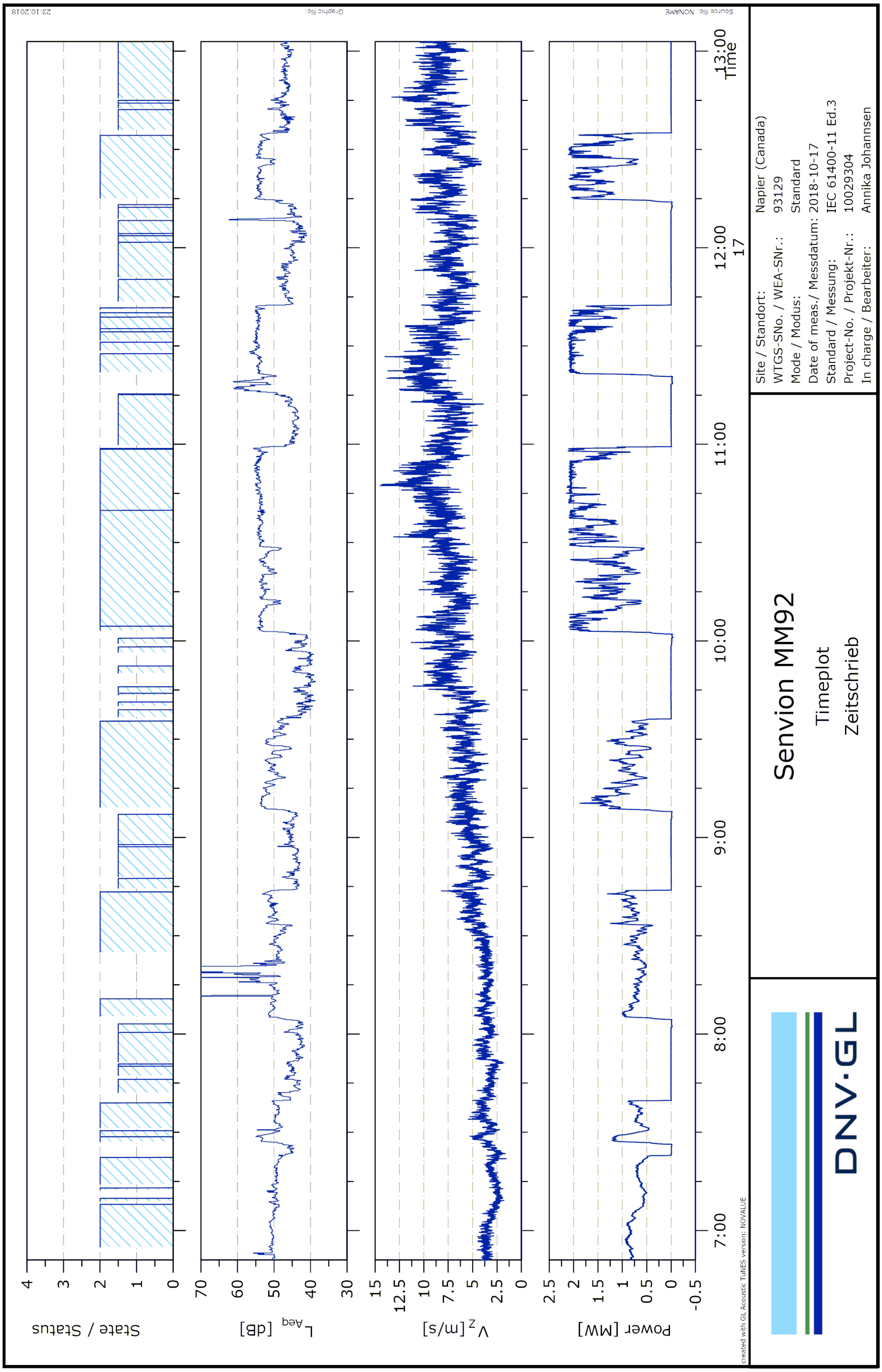
10.8 Rotor speed vs. active power



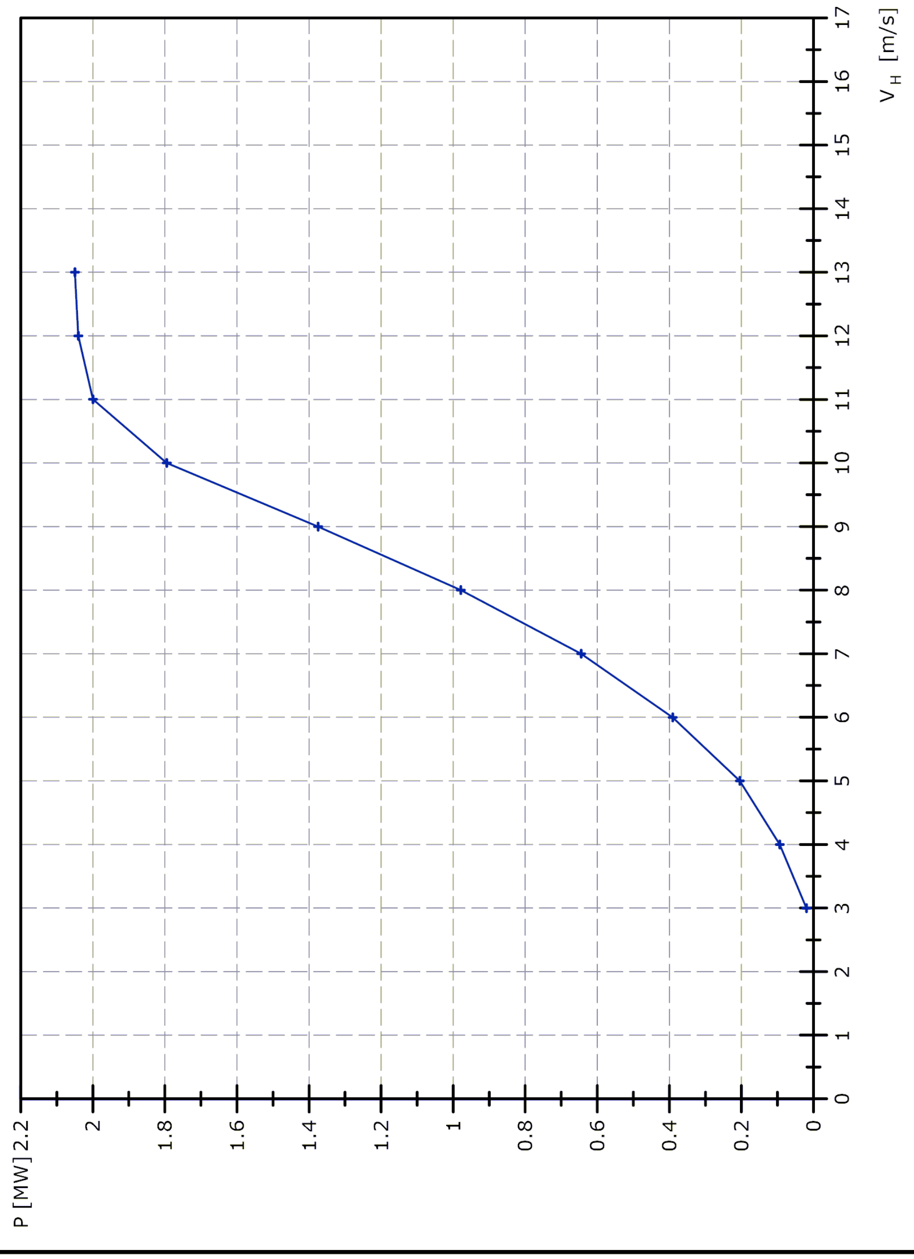
10.9 Rotor speed vs. corrected wind speed



10.10 Time plot of measurement



10.11 Power Curve



V_H [m/s]	P [MW]
3	0.020
4	0.094
5	0.205
6	0.391
7	0.645
8	0.979
9	1.375
10	1.795
11	2.000
12	2.040
13	2.050

Senvion MM92

Power curve

Leistungskurve

Site / Standort:	Napier (Canada)
WTGS-SNo. / WEA-SNr.:	93129
Mode / Modus:	Standard
Date of meas./ Messdatum:	2018-10-17
Standard / Messung:	IEC 61400-11 Ed.3
Project-No. / Projekt-Nr.:	10029304
In charge / Bearbeiter:	Annika Johannsen

Source file: NONAME Graphic file: 23.10.2018

created with GL Acoustic TuNES version: NOVALUE

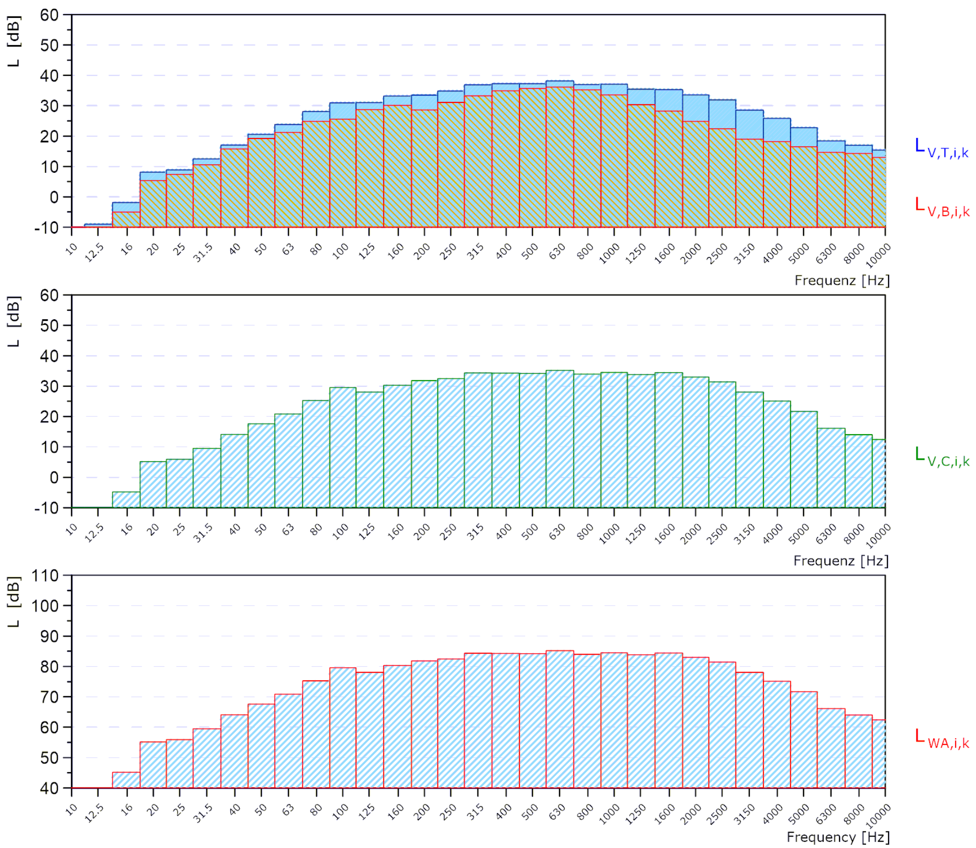
10.12 Third-octave sound power spectra at a WS of 6.5 m/s at hub height

No. of data per BIN / Anzahl der Messdaten pro BIN:
Total noise / Gesamtgeräusch = 45
Background noise / Fremdgeräusch = 28

Referencewind speed / Referenzwindgeschwindigkeit:
$WS_{BIN\ (hub\ height)}$ = 6.5 m/s
$WS_{BIN\ (10m)}$ = 4.5 m/s

Schallleistung: $L_{WA,k}$ = 95.1 dB

f [Hz]	$L_{V,T,i,k}$ [dB]	$u_{Lv,T,i,k}$ [dB]	$L_{V,B,i,k}$ [dB]	$u_{Lv,B,i,k}$ [dB]	$L_{V,C,i,k}$ [dB]	$L_{WA,i,k}$ [dB]	$u_{c,i,k}$ [dB]
10	-13.8	1.8	-18.7	1.1	-15.5	**34.5**	2.6
12.5	-9.0	1.1	-13.1	1.0	-11.1	**38.9**	1.9
16	-1.9	1.2	-5.0	1.5	-4.8	**45.2**	2.7
20	8.1	1.5	5.3	3.0	[5.1]	**[55.1]**	4.3
25	8.9	1.3	7.3	2.5	[5.9]	**[55.9]**	3.5
31.5	12.5	1.2	10.5	2.1	[9.5]	**[59.5]**	3.2
40	17.1	1.2	15.8	2.8	[14.1]	**[64.1]**	3.8
50	20.6	1.4	19.2	2.6	[17.6]	**[67.6]**	3.8
63	23.8	1.2	21.2	1.3	[20.8]	**[70.8]**	2.8
80	28.1	1.0	24.9	1.7	25.3	**75.3**	2.5
100	31.0	1.5	25.5	2.3	29.5	**79.5**	2.2
125	31.0	1.0	28.7	1.8	[28.0]	**[78.0]**	2.7
160	33.2	1.0	30.1	2.9	30.3	**80.3**	3.4
200	33.5	1.1	28.6	1.7	31.8	**81.8**	1.8
250	34.8	0.6	31.1	1.8	32.4	**82.4**	1.7
315	36.8	0.8	33.3	1.8	34.3	**84.3**	2.0
400	37.3	1.1	34.9	1.4	[34.3]	**[84.3]**	2.6
500	37.2	1.3	35.7	1.3	[34.2]	**[84.2]**	3.0
630	38.1	1.2	36.1	1.1	[35.1]	**[85.1]**	2.7
800	37.0	1.2	35.2	1.8	[34.0]	**[84.0]**	3.0
1000	37.1	1.0	33.6	1.8	34.5	**84.5**	2.3
1250	35.4	0.8	30.3	2.4	33.8	**83.8**	1.5
1600	35.3	0.7	28.3	3.0	34.4	**84.4**	1.1
2000	33.6	0.6	24.9	3.0	32.9	**82.9**	0.8
2500	31.9	0.7	22.4	2.7	31.4	**81.4**	0.9
3150	28.5	0.6	19.0	1.8	28.0	**78.0**	0.7
4000	25.9	0.8	18.1	2.0	25.1	**75.1**	1.0
5000	22.8	1.3	16.5	1.8	21.6	**71.6**	1.8
6300	18.4	1.6	14.6	1.4	16.1	**66.1**	2.9
8000	17.0	1.8	14.3	1.4	[14.0]	**[64.0]**	3.9
10000	15.4	1.8	13.0	1.3	[12.4]	**[62.4]**	3.8



23.10.2018

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Bin 6.5 Senvion MM92

one third octave analysis at hub height
Terzanalyse bezogen auf Nabenhöhe

Site / Standort:	Napier (Canada)
WTGS-SNo. / WEA-SNr.:	93129
Mode / Modus:	Standard
Date of meas./ Messdatum:	2018-10-17
Standard / Messung:	IEC 61400-11 Ed.3
Project-No. / Projekt-Nr.:	10029304
In charge / Bearbeiter:	Annika Johannsen

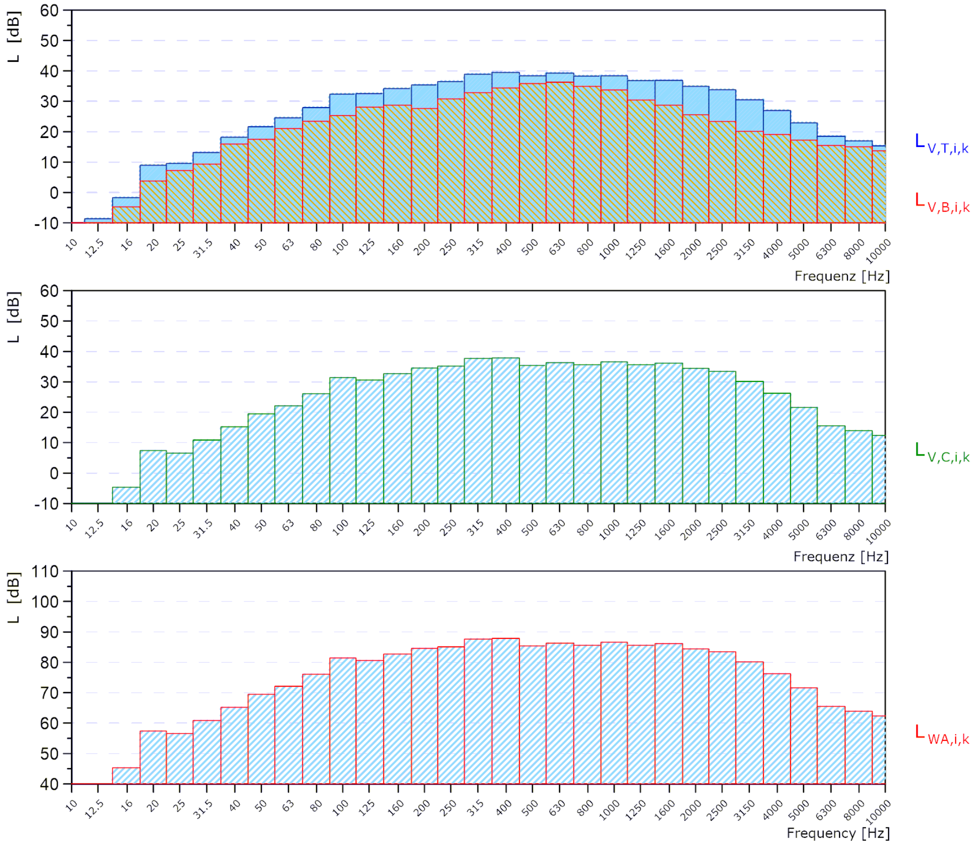
10.13 Third-octave sound power spectra at a WS of 7.0 m/s at hub height

No. of data per BIN / Anzahl der Messdaten pro BIN:
Total noise / Gesamtgeräusch = 151
Background noise / Fremdgeräusch = 25

Referencewind speed / Referenzwindgeschwindigkeit:
$WS_{BIN\ (hub\ height)}$ = 7.0 m/s
$WS_{BIN\ (10m)}$ = 4.9 m/s

Schallleistung: $L_{WA,k}$ = 97.3 dB

f [Hz]	$L_{V,T,i,k}$ [dB]	$u_{Lv,T,i,k}$ [dB]	$L_{V,B,i,k}$ [dB]	$u_{Lv,B,i,k}$ [dB]	$L_{V,C,i,k}$ [dB]	$L_{WA,i,k}$ [dB]	$u_{c,i,k}$ [dB]
10	-13.4	2.4	-18.1	1.4	-15.3	34.7	3.8
12.5	-8.6	1.7	-12.9	1.1	-10.7	39.3	2.9
16	-1.7	1.6	-4.7	1.8	[-4.7]	[45.3]	3.7
20	9.0	1.3	3.7	2.6	7.4	57.4	2.2
25	9.6	1.7	7.2	3.0	[6.6]	[56.6]	4.5
31.5	13.2	1.6	9.3	1.9	10.9	60.9	3.1
40	18.2	1.3	15.9	3.6	[15.2]	[65.2]	4.5
50	21.6	1.7	17.5	1.5	19.4	69.4	2.9
63	24.6	1.4	21.0	2.2	22.1	72.1	3.1
80	27.9	0.9	23.5	1.3	26.0	76.0	1.5
100	32.4	1.1	25.3	2.4	31.4	81.4	1.5
125	32.5	1.1	28.1	2.5	30.5	80.5	2.2
160	34.1	0.9	28.7	2.4	32.7	82.7	1.6
200	35.4	1.1	27.7	1.3	34.5	84.5	1.3
250	36.5	0.8	30.8	1.7	35.1	85.1	1.3
315	38.9	0.8	32.8	1.6	37.7	87.7	1.2
400	39.5	1.1	34.4	1.9	37.9	87.8	1.8
500	38.4	1.0	35.8	1.4	[35.4]	[85.4]	2.4
630	39.3	0.8	36.3	1.3	[36.3]	[86.3]	2.0
800	38.3	0.8	34.9	2.3	35.6	85.6	2.4
1000	38.4	0.7	33.7	2.0	36.6	86.6	1.5
1250	36.8	0.7	30.4	2.4	35.6	85.6	1.1
1600	36.9	0.6	28.7	2.7	36.1	86.1	0.8
2000	34.9	0.6	25.5	2.8	34.4	84.4	0.7
2500	33.8	0.7	23.3	2.9	33.4	83.4	0.8
3150	30.5	0.7	20.1	2.5	30.1	80.1	0.8
4000	27.0	0.7	19.1	2.8	26.2	76.2	1.0
5000	22.9	0.9	17.2	2.4	21.6	71.6	1.5
6300	18.5	1.5	15.5	2.3	[15.5]	[65.5]	3.7
8000	16.9	2.0	15.0	2.1	[13.9]	[63.9]	4.6
10000	15.3	2.0	13.6	2.1	[12.3]	[62.3]	4.5



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23.10.2018

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Bin 7 Senvion MM92

one third octave analysis at hub height
Terzanalyse bezogen auf Nabenhöhe

Site / Standort:	Napier (Canada)
WTGS-SNo. / WEA-SNr.:	93129
Mode / Modus:	Standard
Date of meas./ Messdatum:	2018-10-17
Standard / Messung:	IEC 61400-11 Ed.3
Project-No. / Projekt-Nr.:	10029304
In charge / Bearbeiter:	Annika Johannsen

10.14 Third-octave sound power spectra at a WS of 7.5 m/s at hub height

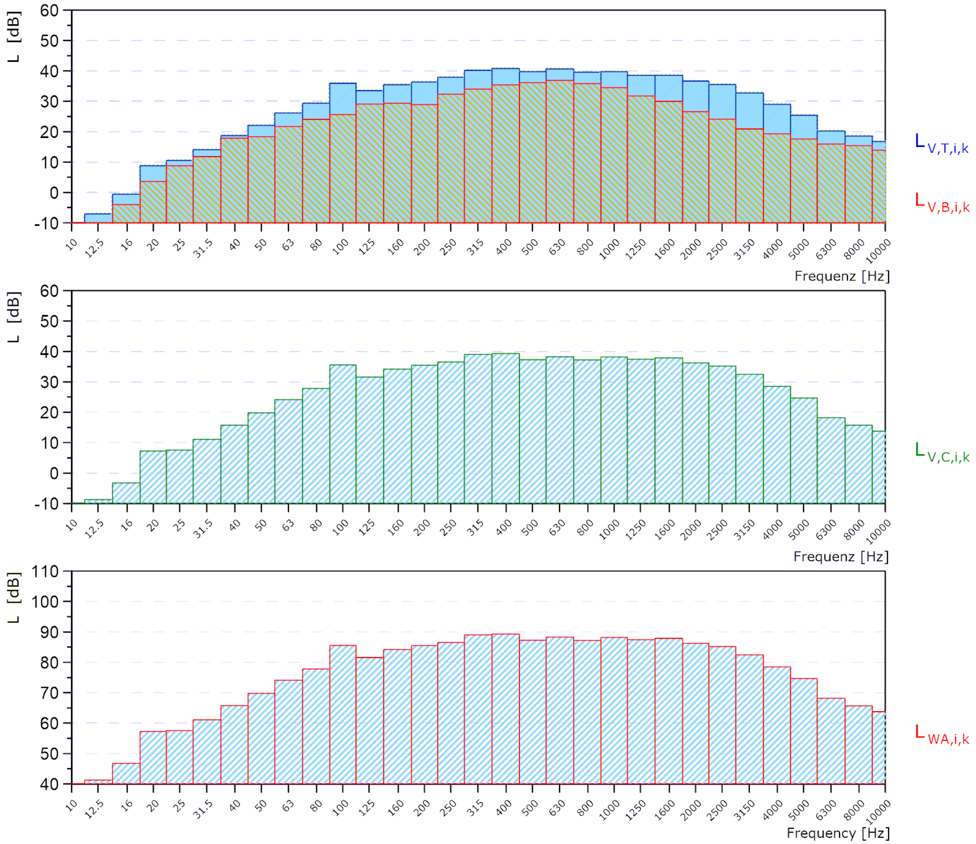
23.10.2018

No. of data per BIN / Anzahl der Messdaten pro BIN:
Total noise / Gesamtgeräusch = 169
Background noise / Fremdgeräusch = 24

Referencewind speed / Referenzwindgeschwindigkeit:
$WS_{BIN\ (hub\ height)}$ = 7.5 m/s
$WS_{BIN\ (10m)}$ = 5.2 m/s

Schallleistung: $L_{WA,k}$ = 99.0 dB

f [Hz]	$L_{V,T,i,k}$ [dB]	$u_{Lv,T,i,k}$ [dB]	$L_{V,B,i,k}$ [dB]	$u_{Lv,B,i,k}$ [dB]	$L_{V,C,i,k}$ [dB]	$L_{WA,i,k}$ [dB]	$u_{c,i,k}$ [dB]
10	-11.2	3.5	-16.8	2.1	-12.6	**37.4**	4.9
12.5	-7.0	2.7	-12.0	1.6	-8.7	**41.3**	4.0
16	-0.6	2.0	-3.9	1.9	-3.3	**46.7**	4.0
20	8.8	1.4	3.6	1.9	7.2	**57.2**	2.2
25	10.5	1.9	8.8	2.8	[7.5]	**[57.5]**	4.8
31.5	14.0	1.8	11.8	2.8	[11.0]	**[61.0]**	4.6
40	18.7	1.6	17.9	4.1	[15.7]	**[65.7]**	5.2
50	22.1	1.7	18.3	1.5	19.8	**69.8**	3.0
63	26.1	1.8	21.7	1.9	24.1	**74.1**	3.0
80	29.3	1.4	24.0	1.8	27.8	**77.8**	2.2
100	35.9	1.7	25.6	1.7	35.5	**85.5**	1.9
125	33.5	1.1	29.0	1.9	31.6	**81.6**	2.0
160	35.4	0.9	29.3	2.1	34.2	**84.2**	1.4
200	36.3	0.9	28.9	1.9	35.5	**85.5**	1.2
250	37.9	0.9	32.3	2.0	36.5	**86.5**	1.5
315	40.2	0.8	34.0	2.1	39.0	**88.9**	1.2
400	40.8	1.0	35.4	2.2	39.3	**89.3**	1.6
500	39.7	1.0	36.1	1.5	37.2	**87.2**	2.1
630	40.6	0.9	36.8	1.6	38.2	**88.2**	1.9
800	39.6	0.9	35.8	2.0	37.2	**87.2**	2.1
1000	39.7	0.8	34.4	1.6	38.2	**88.1**	1.3
1250	38.5	0.7	31.8	1.8	37.4	**87.4**	1.0
1600	38.5	0.6	30.0	1.8	37.8	**87.8**	0.7
2000	36.6	0.6	26.6	1.7	36.2	**86.2**	0.6
2500	35.5	0.7	24.1	1.6	35.2	**85.2**	0.8
3150	32.7	0.9	20.9	1.9	32.4	**82.4**	1.0
4000	29.0	1.1	19.3	2.0	28.5	**78.5**	1.3
5000	25.4	1.8	17.6	2.1	24.6	**74.6**	2.2
6300	20.2	1.9	15.9	2.0	18.2	**68.2**	3.3
8000	18.6	2.6	15.4	1.9	15.7	**65.7**	5.4
10000	16.8	2.6	13.9	1.8	[13.8]	**[63.8]**	5.5



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Bin 7.5 Senvion MM92

one third octave analysis at hub height
Terzanalyse bezogen auf Nabenhöhe

Site / Standort:	Napier (Canada)
WTGS-SNo. / WEA-SNr.:	93129
Mode / Modus:	Standard
Date of meas./ Messdatum:	2018-10-17
Standard / Messung:	IEC 61400-11 Ed.3
Project-No. / Projekt-Nr.:	10029304
In charge / Bearbeiter:	Annika Johannsen

10.15 Third-octave sound power spectra at a WS of 8.0 m/s at hub height

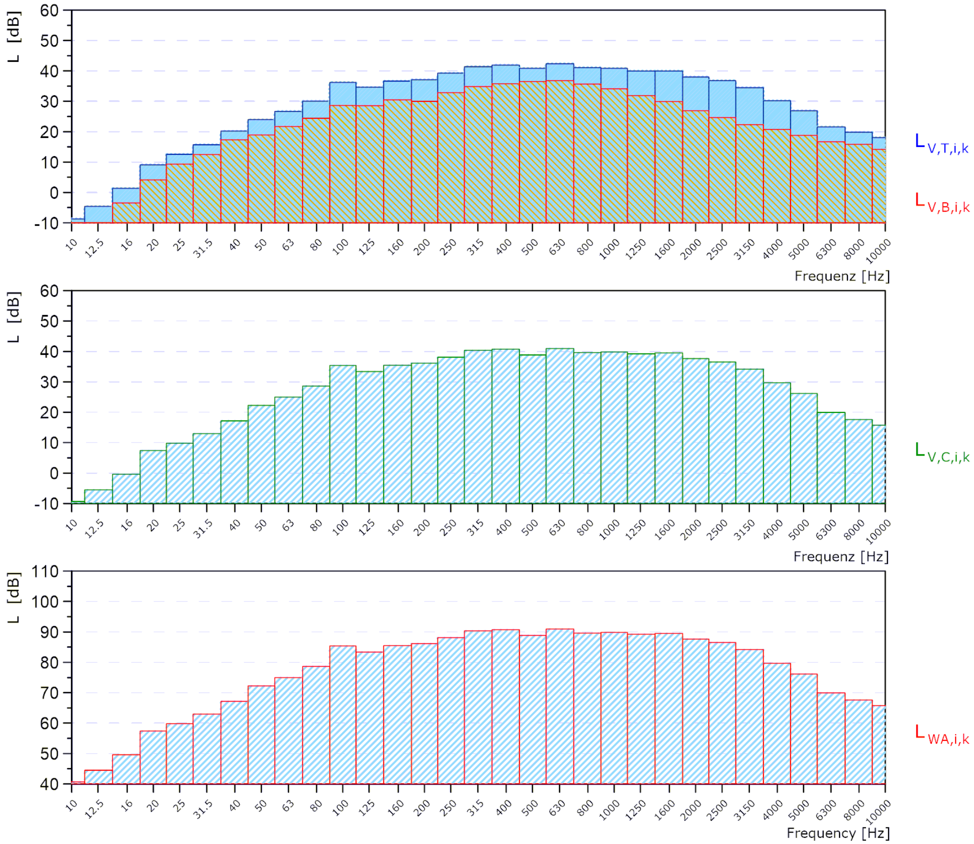
23.10.2018

No. of data per BIN / Anzahl der Messdaten pro BIN:
Total noise / Gesamtgeräusch = 106
Background noise / Fremdgeräusch = 25

Referencewind speed / Referenzwindgeschwindigkeit:
$WS_{BIN\ (hub\ height)}$ = 8.0 m/s
$WS_{BIN\ (10m)}$ = 5.6 m/s

Schallleistung: $L_{WA,k}$ = 100.6 dB

f [Hz]	$L_{V,T,i,k}$ [dB]	$u_{Lv,T,i,k}$ [dB]	$L_{V,B,i,k}$ [dB]	$u_{Lv,B,i,k}$ [dB]	$L_{V,C,i,k}$ [dB]	$L_{WA,i,k}$ [dB]	$u_{c,i,k}$ [dB]
10	-8.7	2.7	-17.0	1.6	-9.4	**40.6**	3.2
12.5	-4.6	2.6	-11.8	1.2	-5.5	**44.5**	3.2
16	1.4	2.2	-3.4	1.7	-0.4	**49.6**	3.5
20	9.1	1.6	4.2	2.4	7.4	**57.4**	2.6
25	12.6	1.9	9.3	4.0	9.8	**59.8**	5.1
31.5	15.7	2.1	12.4	3.1	13.0	**63.0**	4.8
40	20.2	1.9	17.3	3.6	[17.2]	**[67.2]**	5.2
50	23.9	2.1	18.9	2.0	22.3	**72.3**	3.2
63	26.7	1.6	21.7	1.4	25.0	**75.0**	2.4
80	30.0	1.4	24.4	1.9	28.6	**78.6**	2.0
100	36.2	1.3	28.6	3.9	35.3	**85.3**	1.8
125	34.6	1.1	28.6	1.6	33.3	**83.3**	1.6
160	36.7	0.9	30.5	3.0	35.5	**85.5**	1.5
200	37.1	0.9	30.0	2.4	36.2	**86.2**	1.2
250	39.2	1.0	32.8	2.0	38.1	**88.1**	1.5
315	41.4	0.9	34.9	2.1	40.3	**90.3**	1.3
400	41.9	0.8	35.7	1.8	40.7	**90.7**	1.2
500	40.8	0.6	36.5	1.7	38.9	**88.9**	1.4
630	42.4	0.9	36.8	1.5	41.0	**91.0**	1.4
800	41.1	0.8	35.6	1.6	39.6	**89.6**	1.3
1000	40.9	0.7	34.1	1.5	39.8	**89.8**	1.0
1250	40.0	0.7	31.9	1.9	39.2	**89.2**	0.9
1600	39.9	0.6	29.9	1.7	39.5	**89.5**	0.7
2000	38.0	0.6	26.9	1.7	37.7	**87.6**	0.6
2500	36.8	0.7	24.6	1.7	36.5	**86.5**	0.7
3150	34.5	0.9	22.3	3.0	34.2	**84.2**	1.0
4000	30.2	1.0	20.8	3.1	29.7	**79.7**	1.2
5000	26.9	1.9	18.8	2.9	26.1	**76.1**	2.3
6300	21.6	1.9	16.7	2.7	19.9	**69.9**	3.1
8000	19.8	2.6	15.8	2.5	17.6	**67.6**	4.6
10000	18.0	2.7	14.2	2.3	15.7	**65.7**	4.8



created with GL Acoustic TuNES version: NOVALUE

DNV·GL

Bin 8 Senvion MM92

one third octave analysis at hub height

Terzanalyse bezogen auf Nabenhöhe

Site / Standort:	Napier (Canada)
WTGS-SNo. / WEA-SNr.:	93129
Mode / Modus:	Standard
Date of meas./ Messdatum:	2018-10-17
Standard / Messung:	IEC 61400-11 Ed.3
Project-No. / Projekt-Nr.:	10029304
In charge / Bearbeiter:	Annika Johannsen

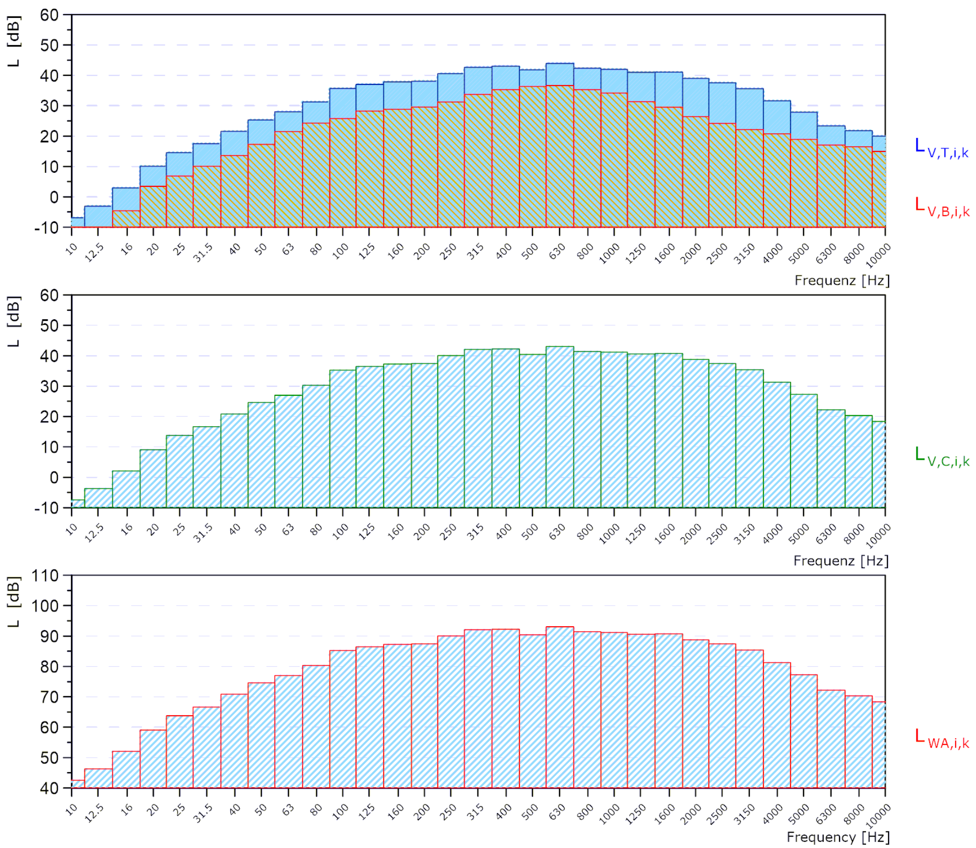
10.16 Third-octave sound power spectra at a WS of 8.5 m/s at hub height

No. of data per BIN / Anzahl der Messdaten pro BIN:
Total noise / Gesamtgeräusch = 83
Background noise / Fremdgeräusch = 33

Referencewind speed / Referenzwindgeschwindigkeit:
$WS_{BIN\ (hub\ height)}$ = 8.5 m/s
$WS_{BIN\ (10m)}$ = 5.9 m/s

Schallleistung: $L_{WA,k}$ = 102.1 dB

f [Hz]	$L_{V,T,i,k}$ [dB]	$u_{Lv,T,i,k}$ [dB]	$L_{V,B,i,k}$ [dB]	$u_{Lv,B,i,k}$ [dB]	$L_{V,C,i,k}$ [dB]	$L_{WA,i,k}$ [dB]	$u_{c,i,k}$ [dB]
10	-6.9	2.4	-16.2	2.2	-7.5	**42.5**	2.8
12.5	-3.0	2.3	-11.5	1.8	-3.7	**46.3**	2.7
16	2.9	2.1	-4.6	1.8	2.1	**52.1**	2.5
20	10.1	1.5	3.4	2.0	9.0	**59.0**	2.0
25	14.6	1.6	6.8	2.5	13.8	**63.8**	2.0
31.5	17.5	1.6	10.0	2.1	16.6	**66.6**	2.0
40	21.6	1.4	13.6	1.9	20.8	**70.8**	1.7
50	25.3	1.5	17.3	1.5	24.6	**74.6**	1.8
63	28.0	1.3	21.5	3.1	27.0	**77.0**	1.9
80	31.2	1.1	24.2	2.7	30.3	**80.3**	1.6
100	35.7	0.9	25.8	2.6	35.2	**85.2**	1.1
125	37.0	1.2	28.3	2.7	36.4	**86.4**	1.5
160	37.8	0.8	28.8	2.5	37.2	**87.2**	0.9
200	38.1	0.9	29.6	2.9	37.4	**87.4**	1.1
250	40.6	0.8	31.2	2.5	40.0	**90.0**	0.9
315	42.6	0.7	33.7	2.7	42.0	**92.0**	0.9
400	43.0	0.7	35.3	2.8	42.2	**92.2**	1.1
500	41.8	0.7	36.3	2.6	40.4	**90.4**	1.4
630	43.9	0.5	36.7	2.3	43.0	**93.0**	0.8
800	42.3	0.5	35.3	2.5	41.4	**91.4**	0.9
1000	42.0	0.4	34.2	2.4	41.2	**91.2**	0.7
1250	41.0	0.4	31.3	2.6	40.5	**90.5**	0.6
1600	41.0	0.3	29.5	2.7	40.7	**90.7**	0.4
2000	39.0	0.3	26.4	2.6	38.7	**88.7**	0.4
2500	37.6	0.4	24.2	2.6	37.4	**87.4**	0.5
3150	35.6	0.5	22.1	2.9	35.4	**85.4**	0.5
4000	31.6	0.9	20.7	3.1	31.2	**81.2**	1.0
5000	27.9	1.5	18.9	3.0	27.3	**77.3**	1.8
6300	23.3	1.8	17.0	2.9	22.2	**72.2**	2.6
8000	21.8	2.4	16.4	2.9	20.3	**70.3**	3.7
10000	20.0	2.6	15.0	2.9	18.4	**68.4**	3.9



created with GL Acoustic TuNES version: NOVALUE

23.10.2018

Bin 8.5 Senvion MM92

one third octave analysis at hub height

Terzanalyse bezogen auf Nabenhöhe

Site / Standort:	Napier (Canada)
WTGS-SNo. / WEA-SNr.:	93129
Mode / Modus:	Standard
Date of meas./ Messdatum:	2018-10-17
Standard / Messung:	IEC 61400-11 Ed.3
Project-No. / Projekt-Nr.:	10029304
In charge / Bearbeiter:	Annika Johannsen

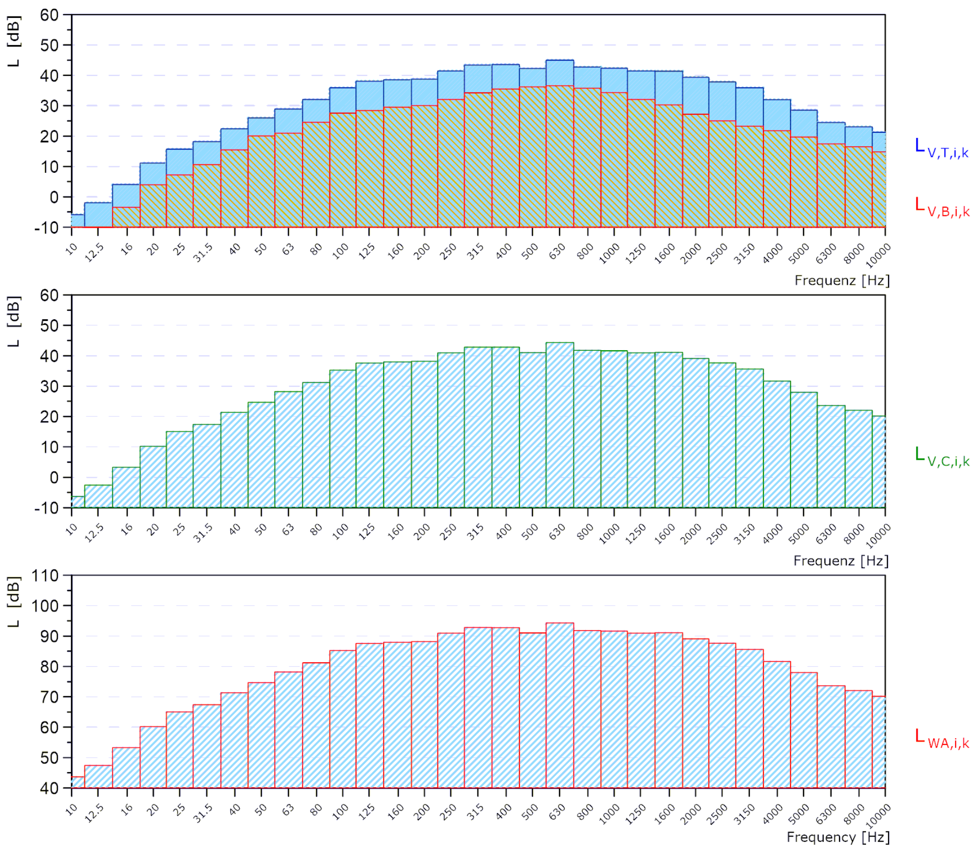
10.17 Third-octave sound power spectra at a WS of 9.0 m/s at hub height

No. of data per BIN / Anzahl der Messdaten pro BIN:
Total noise / Gesamtgeräusch = 75
Background noise / Fremdgeräusch = 34

Referencewind speed / Referenzwindgeschwindigkeit:
$WS_{BIN\ (hub\ height)}$ = 9.0 m/s
$WS_{BIN\ (10m)}$ = 6.3 m/s

Schallleistung: $L_{WA,k}$ = 102.8 dB

f [Hz]	$L_{V,T,i,k}$ [dB]	$u_{Lv,T,i,k}$ [dB]	$L_{V,B,i,k}$ [dB]	$u_{Lv,B,i,k}$ [dB]	$L_{V,C,i,k}$ [dB]	$L_{WA,i,k}$ [dB]	$u_{c,i,k}$ [dB]
10	-5.8	1.6	-15.0	2.7	-6.4	**43.6**	1.9
12.5	-1.9	1.9	-10.2	2.3	-2.6	**47.4**	2.2
16	4.1	1.8	-3.5	2.0	3.2	**53.2**	2.2
20	11.1	1.4	4.0	1.7	10.2	**60.2**	1.8
25	15.7	1.4	7.2	2.4	15.0	**65.0**	1.7
31.5	18.2	1.4	10.6	2.1	17.4	**67.3**	1.8
40	22.4	1.4	15.4	2.8	21.4	**71.4**	1.9
50	26.0	1.4	20.0	3.3	24.7	**74.7**	2.2
63	28.9	1.4	21.0	1.6	28.2	**78.2**	1.7
80	32.0	1.3	24.6	2.6	31.2	**81.2**	1.6
100	35.9	0.9	27.5	4.2	35.3	**85.2**	1.3
125	38.1	0.8	28.4	2.0	37.6	**87.6**	0.9
160	38.5	0.8	29.5	2.6	37.9	**87.9**	1.0
200	38.8	0.8	30.0	2.9	38.2	**88.2**	1.0
250	41.5	0.7	32.1	2.3	40.9	**90.9**	0.9
315	43.4	0.7	34.2	2.2	42.8	**92.8**	0.8
400	43.5	0.5	35.5	2.1	42.8	**92.8**	0.7
500	42.2	0.5	36.2	2.2	41.0	**91.0**	1.0
630	45.0	0.5	36.6	1.7	44.3	**94.3**	0.7
800	42.7	0.6	35.7	1.8	41.8	**91.8**	0.8
1000	42.3	0.4	34.3	1.4	41.6	**91.6**	0.6
1250	41.4	0.4	32.1	1.5	40.9	**90.9**	0.5
1600	41.4	0.3	30.3	1.9	41.1	**91.0**	0.4
2000	39.3	0.4	27.2	1.7	39.1	**89.1**	0.4
2500	37.8	0.4	25.0	1.9	37.6	**87.6**	0.5
3150	35.9	0.5	23.3	2.5	35.6	**85.6**	0.5
4000	32.0	0.7	21.8	2.4	31.6	**81.6**	0.9
5000	28.5	1.6	19.7	2.2	27.9	**77.9**	1.8
6300	24.5	2.1	17.4	2.0	23.6	**73.6**	2.6
8000	23.1	2.4	16.5	1.9	22.0	**72.0**	3.2
10000	21.2	2.5	14.8	1.8	20.1	**70.1**	3.2



created with GL Acoustic TuNES version: NOVALUE

23.10.2018

DNV·GL

Bin 9 Senvion MM92

one third octave analysis at hub height

Terzanalyse bezogen auf Nabenhöhe

Site / Standort:	Napier (Canada)
WTGS-SNo. / WEA-SNr.:	93129
Mode / Modus:	Standard
Date of meas./ Messdatum:	2018-10-17
Standard / Messung:	IEC 61400-11 Ed.3
Project-No. / Projekt-Nr.:	10029304
In charge / Bearbeiter:	Annika Johannsen

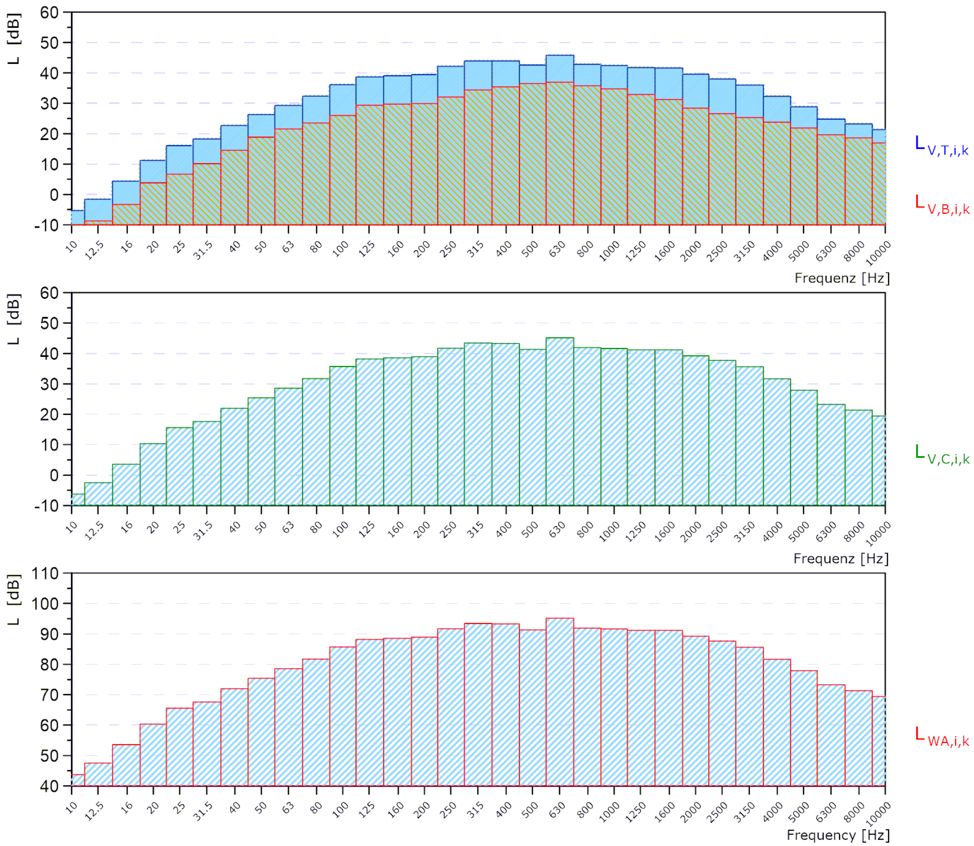
10.18 Third-octave sound power spectra at a WS of 9.5 m/s at hub height

No. of data per BIN / Anzahl der Messdaten pro BIN:
Total noise / Gesamtgeräusch = 64
Background noise / Fremdgeräusch = 38

Referencewind speed / Referenzwindgeschwindigkeit:
$WS_{BIN\ (hub\ height)}$ = 9.5 m/s
$WS_{BIN\ (10m)}$ = 6.6 m/s

Schallleistung: $L_{WA,k}$ = 103.2 dB

f [Hz]	$L_{V,T,i,k}$ [dB]	$u_{Lv,T,i,k}$ [dB]	$L_{V,B,i,k}$ [dB]	$u_{Lv,B,i,k}$ [dB]	$L_{V,C,i,k}$ [dB]	$L_{WA,i,k}$ [dB]	$u_{c,i,k}$ [dB]
10	-5.3	2.3	-12.1	4.6	-6.3	**43.7**	3.1
12.5	-1.6	2.1	-8.7	3.6	-2.5	**47.5**	2.8
16	4.4	2.0	-3.3	2.5	3.5	**53.5**	2.5
20	11.2	1.7	3.8	2.3	10.3	**60.3**	2.1
25	16.1	1.5	6.7	2.1	15.5	**65.5**	1.7
31.5	18.3	1.7	10.1	2.4	17.6	**67.6**	2.0
40	22.7	1.5	14.6	2.7	22.0	**72.0**	1.9
50	26.2	1.5	18.8	2.6	25.4	**75.4**	2.0
63	29.3	1.4	21.6	2.3	28.5	**78.5**	1.7
80	32.3	1.3	23.5	1.4	31.7	**81.7**	1.5
100	36.1	0.8	26.0	2.7	35.7	**85.7**	0.9
125	38.7	0.9	29.3	2.7	38.1	**88.1**	1.1
160	39.1	0.8	29.8	2.6	38.5	**88.5**	1.0
200	39.4	0.8	29.9	2.5	38.9	**88.9**	1.0
250	42.2	0.8	32.1	2.2	41.7	**91.7**	0.9
315	43.9	0.7	34.4	2.3	43.4	**93.4**	0.8
400	43.9	0.5	35.4	2.2	43.3	**93.3**	0.7
500	42.5	0.4	36.5	2.2	41.3	**91.3**	0.9
630	45.8	0.8	37.0	2.1	45.2	**95.2**	1.0
800	42.8	0.6	35.7	2.1	41.9	**91.9**	0.9
1000	42.5	0.5	34.8	2.1	41.6	**91.6**	0.7
1250	41.8	0.5	32.9	2.6	41.2	**91.1**	0.7
1600	41.6	0.4	31.2	2.8	41.2	**91.2**	0.5
2000	39.6	0.4	28.4	2.9	39.2	**89.2**	0.5
2500	38.0	0.4	26.6	3.1	37.7	**87.7**	0.5
3150	36.0	0.5	25.3	3.8	35.6	**85.6**	0.6
4000	32.3	0.7	23.8	3.7	31.6	**81.6**	1.1
5000	28.8	1.5	21.8	3.7	27.9	**77.9**	2.1
6300	24.8	2.1	19.6	3.7	23.2	**73.2**	3.5
8000	23.2	2.8	18.6	3.6	21.3	**71.3**	4.7
10000	21.3	2.9	17.0	3.7	19.4	**69.4**	5.1



23.10.2018

created with GL Acoustic TuNES version: NOVALUE

DNV·GL

Bin 9.5 Senvion MM92

one third octave analysis at hub height

Terzanalyse bezogen auf Nabenhöhe

Site / Standort:	Napier (Canada)
WTGS-SNo. / WEA-SNr.:	93129
Mode / Modus:	Standard
Date of meas./ Messdatum:	2018-10-17
Standard / Messung:	IEC 61400-11 Ed.3
Project-No. / Projekt-Nr.:	10029304
In charge / Bearbeiter:	Annika Johannsen

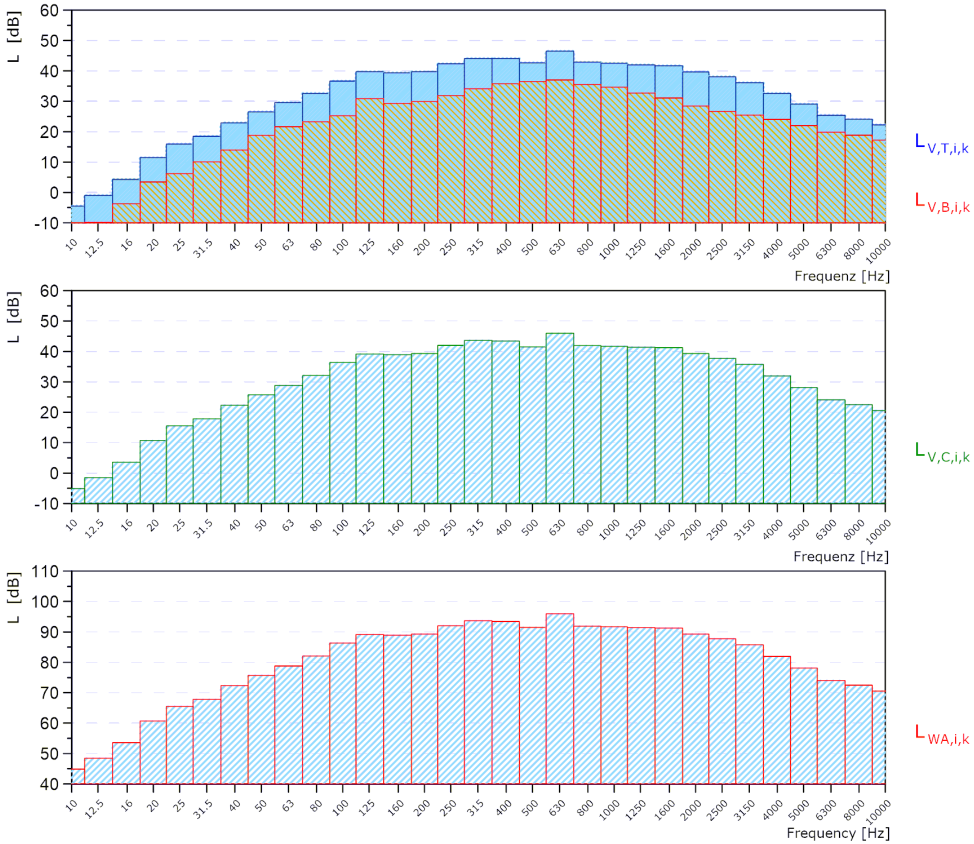
10.19 Third-octave sound power spectra at a WS of 10.0 m/s at hub height

No. of data per BIN / Anzahl der Messdaten pro BIN:
Total noise / Gesamtgeräusch = 46
Background noise / Fremdgeräusch = 25

Referencewind speed / Referenzwindgeschwindigkeit:
$WS_{BIN\ (hub\ height)}$ = 10.0 m/s
$WS_{BIN\ (10m)}$ = 7.0 m/s

Schallleistung: $L_{WA,k}$ = 103.5 dB

f [Hz]	$L_{V,T,i,k}$ [dB]	$u_{Lv,T,i,k}$ [dB]	$L_{V,B,i,k}$ [dB]	$u_{Lv,B,i,k}$ [dB]	$L_{V,C,i,k}$ [dB]	$L_{WA,i,k}$ [dB]	$u_{c,i,k}$ [dB]
10	-4.5	2.1	-12.8	3.0	-5.2	**44.8**	2.5
12.5	-0.9	2.0	-9.8	2.0	-1.6	**48.4**	2.3
16	4.3	1.6	-3.7	1.6	3.6	**53.6**	1.9
20	11.5	1.4	3.5	1.8	10.7	**60.7**	1.7
25	15.9	1.2	6.2	1.8	15.5	**65.5**	1.4
31.5	18.5	1.5	10.0	2.5	17.8	**67.8**	1.8
40	22.9	1.6	14.0	2.2	22.3	**72.3**	1.8
50	26.5	1.5	18.8	2.3	25.7	**75.7**	1.8
63	29.6	1.4	21.7	2.1	28.8	**78.8**	1.7
80	32.6	1.2	23.3	1.2	32.0	**82.0**	1.3
100	36.7	0.9	25.3	1.9	36.4	**86.3**	1.0
125	39.7	0.9	30.8	3.7	39.1	**89.1**	1.2
160	39.4	0.8	29.3	2.1	38.9	**88.9**	1.0
200	39.7	0.9	29.9	2.2	39.3	**89.3**	1.0
250	42.3	0.8	31.8	1.8	41.9	**91.9**	0.9
315	44.1	0.7	34.1	1.8	43.6	**93.6**	0.8
400	44.1	0.5	35.7	2.0	43.4	**93.4**	0.7
500	42.6	0.5	36.5	2.3	41.4	**91.4**	1.0
630	46.5	0.9	37.0	1.9	46.0	**96.0**	1.0
800	42.8	0.6	35.5	1.6	41.9	**91.9**	0.8
1000	42.5	0.4	34.6	1.6	41.7	**91.7**	0.6
1250	42.0	0.4	32.7	1.7	41.4	**91.4**	0.5
1600	41.7	0.4	31.1	2.1	41.3	**91.3**	0.5
2000	39.6	0.4	28.4	2.0	39.3	**89.3**	0.5
2500	38.1	0.5	26.7	2.2	37.7	**87.7**	0.5
3150	36.1	0.6	25.5	2.9	35.7	**85.7**	0.7
4000	32.6	0.8	24.0	3.0	32.0	**82.0**	1.1
5000	29.0	1.3	22.0	3.0	28.1	**78.1**	1.8
6300	25.4	2.2	19.8	3.0	24.0	**74.0**	3.2
8000	24.1	2.7	18.9	3.1	22.5	**72.5**	4.2
10000	22.2	2.9	17.2	3.1	20.6	**70.5**	4.4



23.10.2018

created with GL Acoustic TuNES version: NOVALUE

DNV·GL

Bin 10 Senvion MM92

one third octave analysis at hub height

Terzanalyse bezogen auf Nabenhöhe

Site / Standort:	Napier (Canada)
WTGS-SNo. / WEA-SNr.:	93129
Mode / Modus:	Standard
Date of meas./ Messdatum:	2018-10-17
Standard / Messung:	IEC 61400-11 Ed.3
Project-No. / Projekt-Nr.:	10029304
In charge / Bearbeiter:	Annika Johannsen

10.20 Third-octave sound power spectra at a WS of 10.5 m/s at hub height

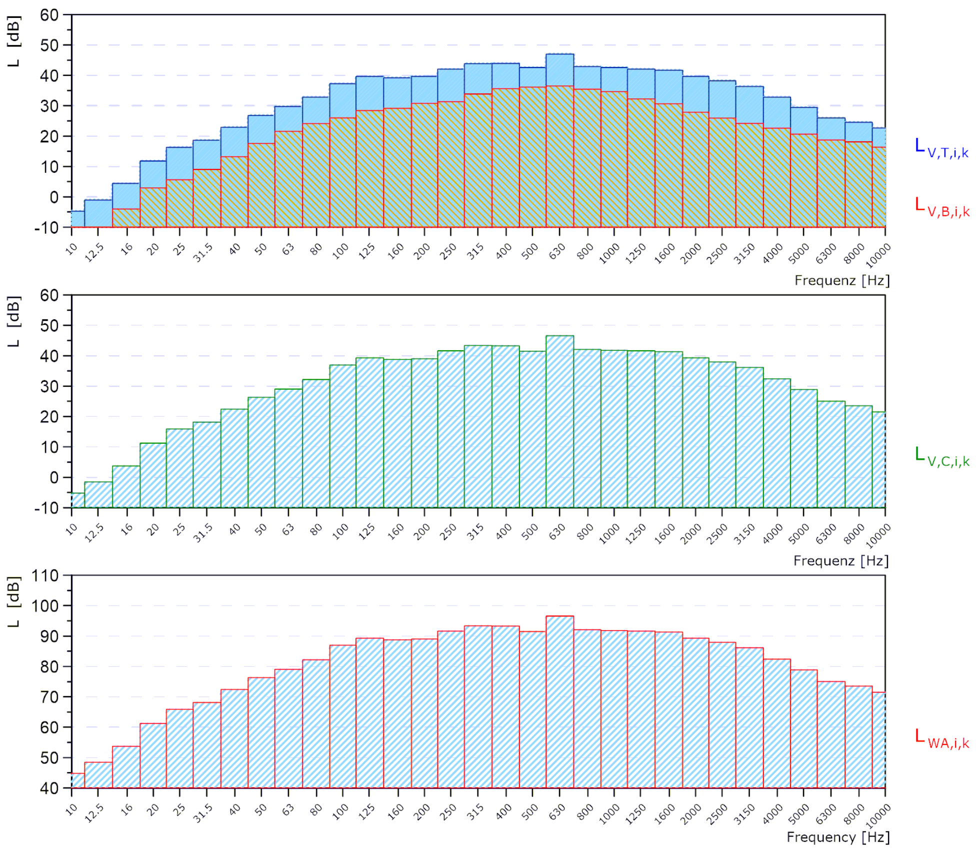
23.10.2018

No. of data per BIN / Anzahl der Messdaten pro BIN:
Total noise / Gesamtgeräusch = 39
Background noise / Fremdgeräusch = 42

Referencewind speed / Referenzwindgeschwindigkeit:
$WS_{BIN\ (hub\ height)}$ = 10.5 m/s
$WS_{BIN\ (10m)}$ = 7.3 m/s

Schallleistung: $L_{WA,k}$ = 103.6 dB

f [Hz]	$L_{V,T,i,k}$ [dB]	$u_{Lv,T,i,k}$ [dB]	$L_{V,B,i,k}$ [dB]	$u_{Lv,B,i,k}$ [dB]	$L_{V,C,i,k}$ [dB]	$L_{WA,i,k}$ [dB]	$u_{c,i,k}$ [dB]
10	-4.7	2.3	-14.3	2.6	-5.2	**44.8**	2.6
12.5	-1.0	2.1	-10.5	2.0	-1.5	**48.5**	2.4
16	4.4	1.9	-4.0	1.5	3.7	**53.7**	2.2
20	11.8	1.7	2.9	1.2	11.2	**61.2**	2.0
25	16.3	1.5	5.7	1.4	15.9	**65.9**	1.6
31.5	18.6	2.0	9.0	1.3	18.1	**68.1**	2.3
40	22.9	1.7	13.2	1.5	22.4	**72.4**	1.9
50	26.8	1.7	17.6	2.0	26.3	**76.3**	1.9
63	29.7	1.6	21.6	2.7	29.0	**79.0**	1.9
80	32.8	1.4	24.1	2.4	32.2	**82.2**	1.7
100	37.3	1.0	26.0	3.4	36.9	**86.9**	1.1
125	39.6	1.2	28.4	2.2	39.3	**89.3**	1.3
160	39.2	0.8	29.2	2.6	38.8	**88.8**	1.0
200	39.6	1.0	30.8	3.6	39.0	**89.0**	1.3
250	42.0	0.9	31.3	2.1	41.6	**91.6**	1.0
315	43.8	0.8	33.9	2.0	43.4	**93.4**	0.9
400	43.9	0.5	35.6	2.3	43.2	**93.2**	0.7
500	42.6	0.4	36.1	2.4	41.4	**91.4**	0.9
630	47.0	0.8	36.5	2.0	46.6	**96.6**	0.9
800	42.9	0.6	35.4	2.0	42.0	**92.0**	0.8
1000	42.5	0.5	34.6	2.1	41.8	**91.8**	0.7
1250	42.1	0.5	32.2	2.2	41.6	**91.6**	0.6
1600	41.7	0.4	30.6	2.4	41.3	**91.3**	0.5
2000	39.6	0.4	27.9	2.3	39.3	**89.3**	0.5
2500	38.2	0.5	25.9	2.4	38.0	**88.0**	0.6
3150	36.4	0.6	24.2	2.3	36.1	**86.1**	0.7
4000	32.8	0.8	22.6	2.3	32.4	**82.4**	1.0
5000	29.5	1.4	20.7	2.4	28.8	**78.8**	1.7
6300	26.0	2.1	18.7	2.5	25.1	**75.1**	2.6
8000	24.6	2.4	18.1	2.7	23.5	**73.5**	3.2
10000	22.6	2.3	16.4	2.8	21.5	**71.5**	3.2



created with GL Acoustic TuNES version: NOVALUE

DNV·GL

Bin 10.5 Senvion MM92

one third octave analysis at hub height

Terzanalyse bezogen auf Nabenhöhe

Site / Standort:	Napier (Canada)
WTGS-SNo. / WEA-SNr.:	93129
Mode / Modus:	Standard
Date of meas./ Messdatum:	2018-10-17
Standard / Messung:	IEC 61400-11 Ed.3
Project-No. / Projekt-Nr.:	10029304
In charge / Bearbeiter:	Annika Johannsen

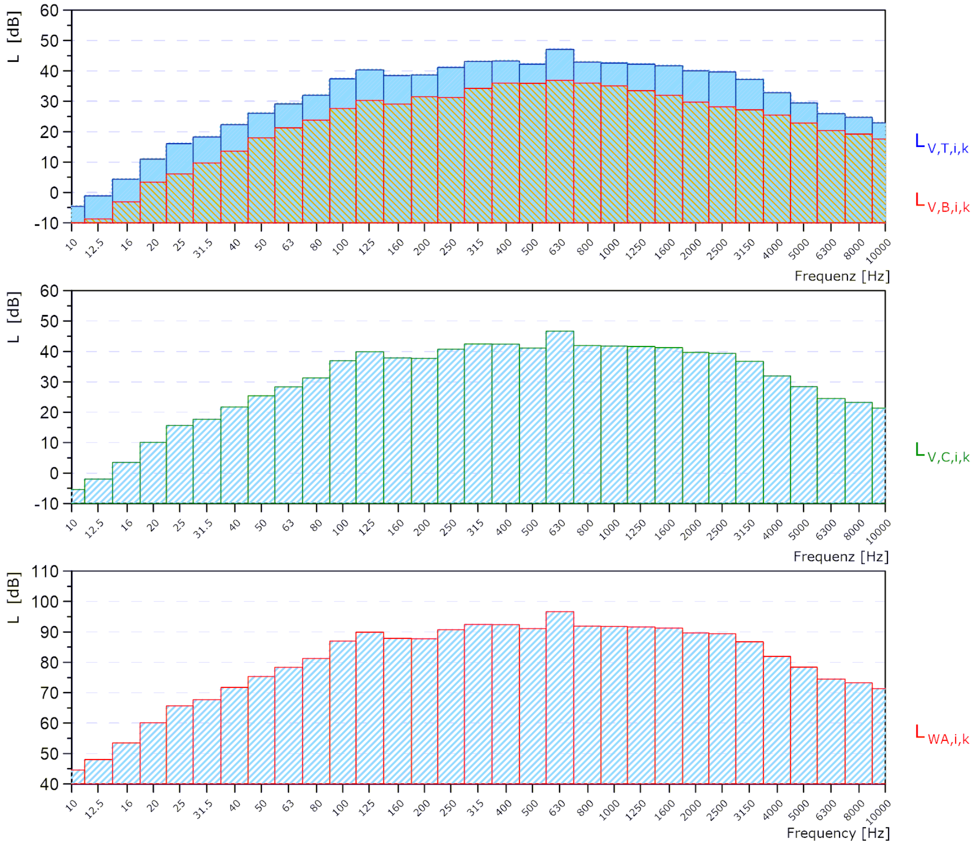
10.21 Third-octave sound power spectra at a WS of 11.0 m/s at hub height

No. of data per BIN / Anzahl der Messdaten pro BIN:
Total noise / Gesamtgeräusch = 31
Background noise / Fremdgeräusch = 44

Referencewind speed / Referenzwindgeschwindigkeit:
$WS_{BIN\ (hub\ height)}$ = 11.0 m/s
$WS_{BIN\ (10m)}$ = 7.7 m/s

Schallleistung: $L_{WA,k}$ = 103.4 dB

f [Hz]	$L_{V,T,i,k}$ [dB]	$u_{Lv,T,i,k}$ [dB]	$L_{V,B,i,k}$ [dB]	$u_{Lv,B,i,k}$ [dB]	$L_{V,C,i,k}$ [dB]	$L_{WA,i,k}$ [dB]	$u_{c,i,k}$ [dB]
10	-4.6	2.0	-12.2	3.9	-5.4	**44.6**	2.5
12.5	-1.1	1.7	-8.7	3.3	-2.0	**48.0**	2.2
16	4.3	1.6	-3.1	2.3	3.5	**53.5**	2.0
20	10.9	1.4	3.4	1.6	10.1	**60.1**	1.8
25	16.1	1.5	6.1	1.9	15.6	**65.6**	1.7
31.5	18.3	1.9	9.7	1.8	17.6	**67.6**	2.2
40	22.3	1.7	13.6	1.9	21.7	**71.7**	1.9
50	26.1	1.8	17.9	2.2	25.4	**75.4**	2.2
63	29.1	1.5	21.3	2.4	28.3	**78.3**	1.9
80	32.0	1.4	23.8	1.8	31.3	**81.3**	1.7
100	37.4	1.2	27.6	4.2	36.9	**86.9**	1.4
125	40.3	1.5	30.3	3.9	39.9	**89.9**	1.7
160	38.4	1.1	29.1	2.0	37.9	**87.9**	1.2
200	38.6	1.3	31.5	3.6	37.7	**87.7**	1.8
250	41.2	1.3	31.2	1.6	40.7	**90.7**	1.4
315	43.1	1.2	34.2	2.0	42.5	**92.5**	1.4
400	43.2	0.9	35.9	2.6	42.3	**92.3**	1.2
500	42.2	0.6	35.9	2.3	41.0	**91.0**	1.0
630	47.1	0.9	36.9	2.2	46.6	**96.6**	1.0
800	42.9	0.5	36.0	2.3	41.9	**91.9**	0.9
1000	42.6	0.5	35.1	2.4	41.8	**91.8**	0.8
1250	42.2	0.5	33.5	3.0	41.6	**91.6**	0.8
1600	41.7	0.4	32.0	3.4	41.2	**91.2**	0.6
2000	40.1	0.8	29.7	3.7	39.6	**89.6**	0.9
2500	39.7	1.6	28.2	4.1	39.3	**89.3**	1.7
3150	37.2	1.1	27.2	4.3	36.7	**86.7**	1.3
4000	32.8	0.9	25.4	4.1	31.9	**81.9**	1.4
5000	29.5	1.3	22.8	3.6	28.4	**78.4**	2.0
6300	25.9	2.0	20.3	3.4	24.5	**74.5**	3.1
8000	24.7	2.6	19.3	3.4	23.2	**73.2**	3.9
10000	22.9	2.6	17.6	3.5	21.4	**71.3**	4.0



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23.10.2018

DNV·GL

Bin 11 Senvion MM92

one third octave analysis at hub height

Terzanalyse bezogen auf Nabenhöhe

Site / Standort:	Napier (Canada)
WTGS-SNo. / WEA-SNr.:	93129
Mode / Modus:	Standard
Date of meas./ Messdatum:	2018-10-17
Standard / Messung:	IEC 61400-11 Ed.3
Project-No. / Projekt-Nr.:	10029304
In charge / Bearbeiter:	Annika Johannsen

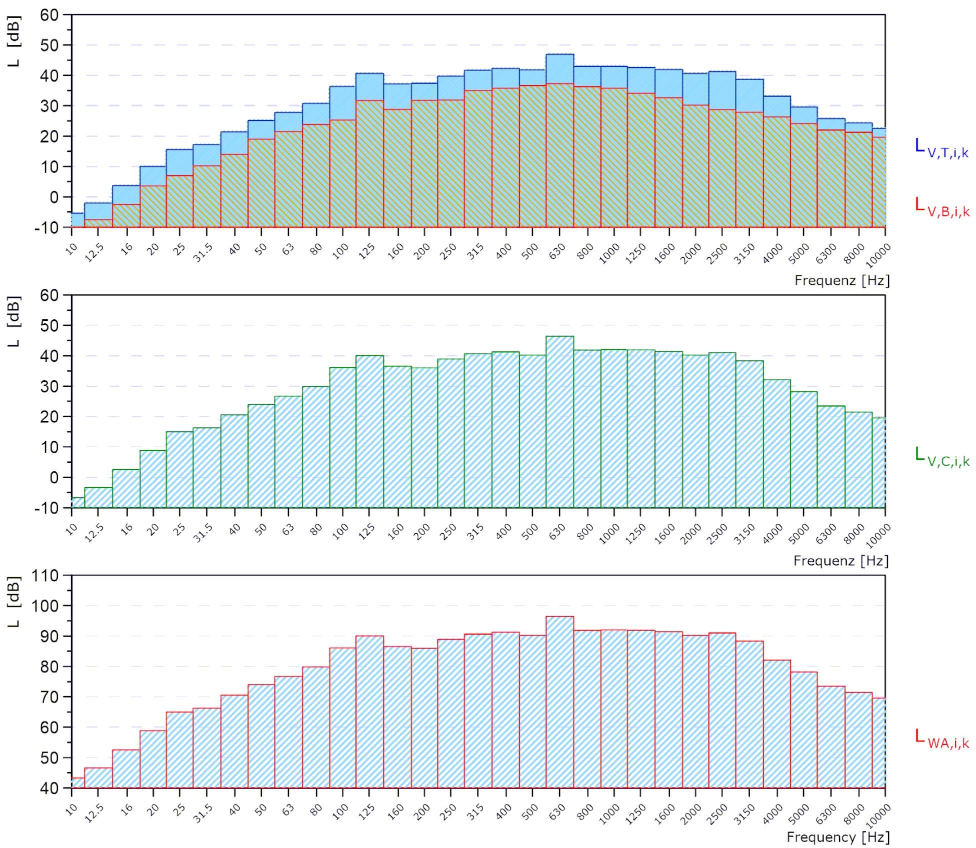
10.22 Third-octave sound power spectra at a WS of 11.5 m/s at hub height

No. of data per BIN / Anzahl der Messdaten pro BIN:
Total noise / Gesamtgeräusch = 26
Background noise / Fremdgeräusch = 51

Referencewind speed / Referenzwindgeschwindigkeit:
$WS_{BIN\ (hub\ height)}$ = 11.5 m/s
$WS_{BIN\ (10m)}$ = 8.0 m/s

Schallleistung: $L_{WA,k}$ = 103.1 dB

f [Hz]	$L_{V,T,i,k}$ [dB]	$u_{Lv,T,i,k}$ [dB]	$L_{V,B,i,k}$ [dB]	$u_{Lv,B,i,k}$ [dB]	$L_{V,C,i,k}$ [dB]	$L_{WA,i,k}$ [dB]	$u_{c,i,k}$ [dB]
10	-5.4	2.4	-11.2	3.8	-6.7	**43.3**	3.5
12.5	-2.0	1.9	-7.5	3.2	-3.4	**46.6**	3.0
16	3.7	1.6	-2.5	2.1	2.5	**52.5**	2.2
20	10.0	1.0	3.7	1.6	8.8	**58.8**	1.5
25	15.6	1.4	7.0	2.3	14.9	**64.9**	1.7
31.5	17.2	1.6	10.2	2.0	16.2	**66.2**	2.0
40	21.4	1.4	13.9	2.1	20.5	**70.5**	1.8
50	25.1	1.2	19.0	2.6	23.9	**73.9**	1.8
63	27.8	1.2	21.5	2.1	26.7	**76.6**	1.7
80	30.8	1.3	23.8	1.7	29.8	**79.8**	1.6
100	36.4	1.3	25.3	1.9	36.0	**86.0**	1.4
125	40.6	1.4	31.7	4.6	40.0	**90.0**	1.7
160	37.2	0.7	28.8	1.5	36.5	**86.5**	0.9
200	37.4	1.5	31.8	2.9	36.0	**86.0**	2.3
250	39.7	0.9	31.9	1.5	38.9	**88.9**	1.1
315	41.7	0.8	35.0	1.9	40.6	**90.6**	1.2
400	42.3	0.7	35.7	1.6	41.2	**91.2**	1.0
500	41.8	0.5	36.6	2.0	40.2	**90.2**	1.1
630	46.9	1.1	37.3	1.6	46.4	**96.4**	1.2
800	42.9	0.4	36.3	1.7	41.9	**91.9**	0.7
1000	42.9	0.4	35.8	2.0	42.0	**92.0**	0.7
1250	42.5	0.5	34.1	2.2	41.9	**91.9**	0.7
1600	41.9	0.5	32.6	2.5	41.4	**91.4**	0.6
2000	40.6	0.9	30.2	2.8	40.2	**90.2**	1.0
2500	41.2	1.7	28.7	3.3	41.0	**91.0**	1.8
3150	38.7	1.3	27.9	3.6	38.3	**88.3**	1.4
4000	33.1	1.0	26.3	3.6	32.1	**82.1**	1.6
5000	29.6	1.5	24.1	3.6	28.2	**78.2**	2.5
6300	25.8	2.3	22.0	3.7	23.4	**73.4**	4.8
8000	24.3	2.8	21.2	3.9	21.4	**71.4**	6.7
10000	22.5	3.0	19.6	4.1	[19.5]	**[69.5]**	7.3



created with GL Acoustic TuNES version: NOVALUE

23.10.2018

DNV·GL

Bin 11.5 Senvion MM92

one third octave analysis at hub height

Terzanalyse bezogen auf Nabenhöhe

Site / Standort:	Napier (Canada)
WTGS-SNo. / WEA-SNr.:	93129
Mode / Modus:	Standard
Date of meas./ Messdatum:	2018-10-17
Standard / Messung:	IEC 61400-11 Ed.3
Project-No. / Projekt-Nr.:	10029304
In charge / Bearbeiter:	Annika Johannsen

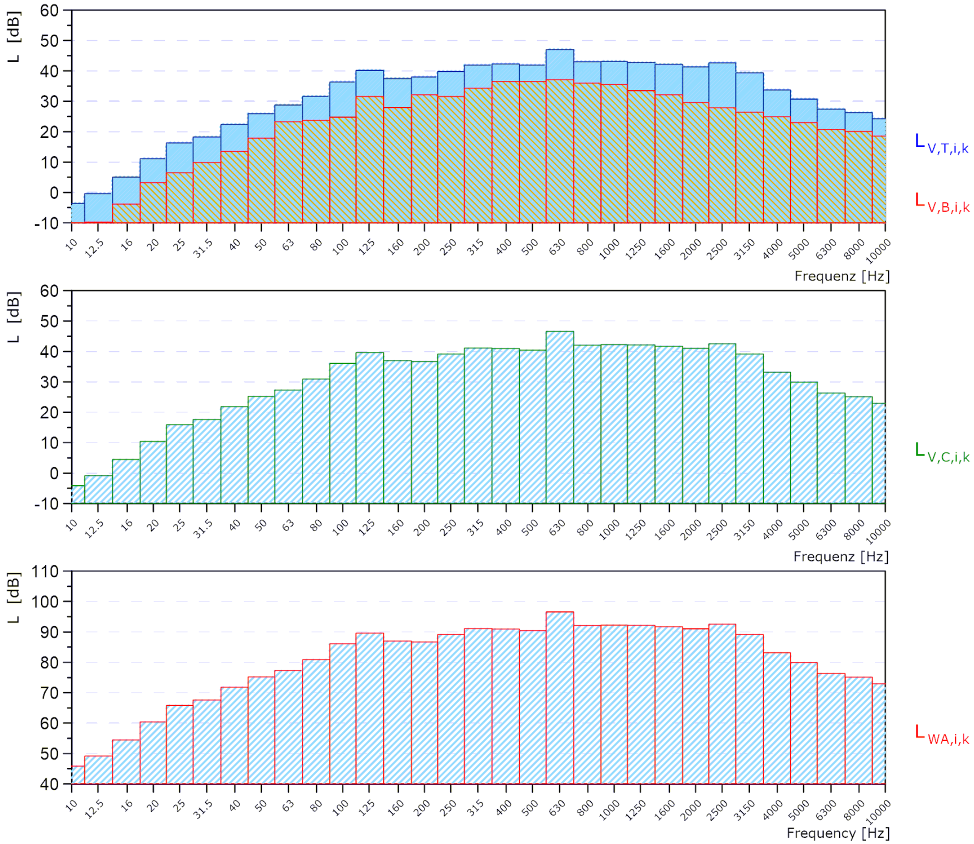
10.23 Third-octave sound power spectra at a WS of 12.0 m/s at hub height

No. of data per BIN / Anzahl der Messdaten pro BIN:
Total noise / Gesamtgeräusch = 24
Background noise / Fremdgeräusch = 36

Referencewind speed / Referenzwindgeschwindigkeit:
$WS_{BIN\ (hub\ height)}$ = 12.0 m/s
$WS_{BIN\ (10m)}$ = 8.4 m/s

Schallleistung: $L_{WA,k}$ = 103.4 dB

f [Hz]	$L_{V,T,i,k}$ [dB]	$u_{Lv,T,i,k}$ [dB]	$L_{V,B,i,k}$ [dB]	$u_{Lv,B,i,k}$ [dB]	$L_{V,C,i,k}$ [dB]	$L_{WA,i,k}$ [dB]	$u_{c,i,k}$ [dB]
10	-3.6	3.1	-12.6	3.0	-4.2	**45.8**	3.6
12.5	-0.4	2.9	-9.7	2.3	-0.9	**49.1**	3.3
16	5.1	2.9	-3.8	1.5	4.5	**54.5**	3.3
20	11.2	2.0	3.2	1.4	10.4	**60.4**	2.4
25	16.3	1.8	6.5	1.9	15.8	**65.8**	2.1
31.5	18.2	2.4	9.8	1.9	17.6	**67.6**	2.8
40	22.4	2.3	13.5	1.7	21.8	**71.8**	2.6
50	25.9	2.2	17.9	2.1	25.2	**75.2**	2.7
63	28.7	1.9	23.3	3.8	27.3	**77.3**	3.1
80	31.6	1.8	23.8	2.0	30.9	**80.9**	2.1
100	36.4	1.3	24.8	1.9	36.1	**86.1**	1.4
125	40.2	1.6	31.5	4.7	39.6	**89.6**	2.0
160	37.5	1.1	27.9	1.3	36.9	**86.9**	1.2
200	38.0	1.8	32.1	4.0	36.7	**86.6**	2.9
250	39.8	1.0	31.5	2.1	39.1	**89.1**	1.3
315	41.9	1.1	34.3	2.1	41.1	**91.1**	1.4
400	42.3	0.8	36.5	2.7	40.9	**90.9**	1.4
500	41.9	0.6	36.5	2.5	40.4	**90.4**	1.3
630	47.0	1.2	37.1	1.7	46.5	**96.5**	1.4
800	43.0	0.4	36.0	1.5	42.1	**92.1**	0.6
1000	43.1	0.3	35.5	2.0	42.2	**92.2**	0.6
1250	42.7	0.5	33.5	2.1	42.1	**92.1**	0.6
1600	42.2	0.5	32.2	2.4	41.7	**91.7**	0.7
2000	41.3	1.2	29.6	2.5	41.0	**91.0**	1.3
2500	42.7	2.2	27.9	2.9	42.5	**92.5**	2.3
3150	39.3	1.6	26.4	2.8	39.1	**89.1**	1.7
4000	33.7	1.2	24.9	2.8	33.1	**83.1**	1.4
5000	30.7	1.7	23.0	3.0	29.9	**79.9**	2.1
6300	27.4	2.5	20.8	3.0	26.3	**76.3**	3.3
8000	26.3	3.1	20.1	3.3	25.1	**75.1**	4.2
10000	24.3	3.3	18.6	3.5	22.9	**72.9**	4.6



created with GL Acoustic TuNES version: NOVALUE

23.10.2018

DNV·GL

Bin 12 Senvion MM92

one third octave analysis at hub height
Terzanalyse bezogen auf Nabenhöhe

Site / Standort:	Napier (Canada)
WTGS-SNo. / WEA-SNr.:	93129
Mode / Modus:	Standard
Date of meas./ Messdatum:	2018-10-17
Standard / Messung:	IEC 61400-11 Ed.3
Project-No. / Projekt-Nr.:	10029304
In charge / Bearbeiter:	Annika Johannsen

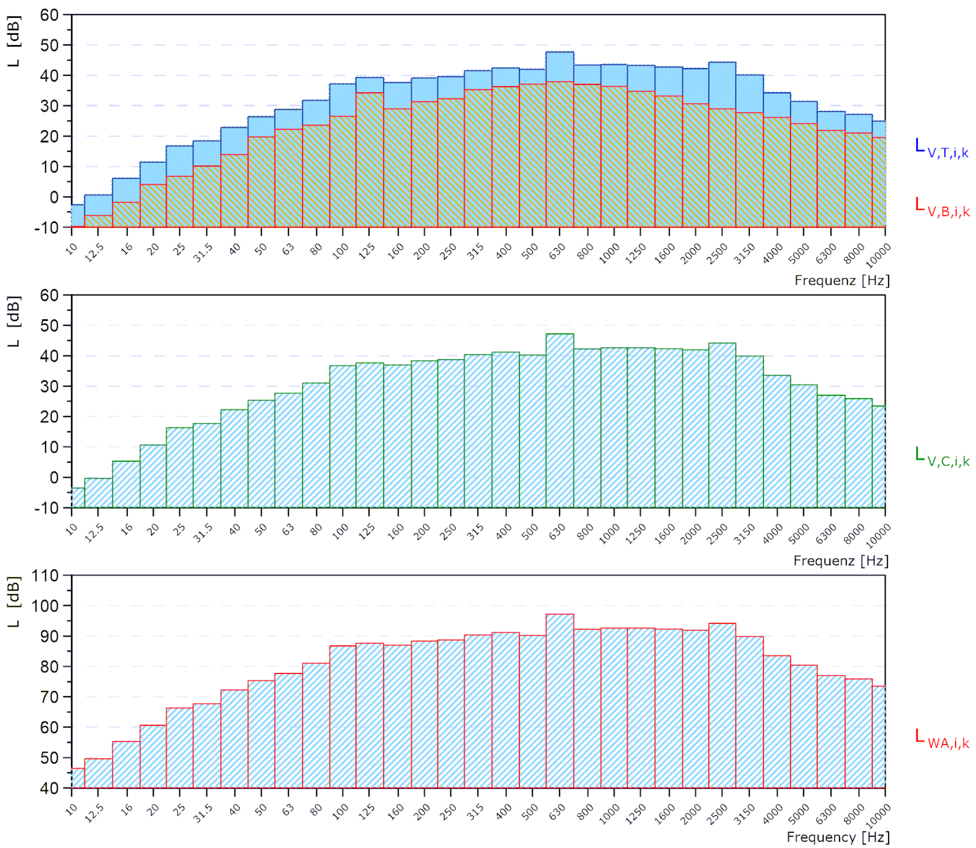
10.24 Third-octave sound power spectra at a WS of 12.5 m/s at hub height

No. of data per BIN / Anzahl der Messdaten pro BIN:
Total noise / Gesamtgeräusch = 18
Background noise / Fremdgeräusch = 42

Referencewind speed / Referenzwindgeschwindigkeit:
$WS_{BIN\ (hub\ height)}$ = 12.5 m/s
$WS_{BIN\ (10m)}$ = 8.7 m/s

Schallleistung: $L_{WA,k}$ = 103.9 dB

f [Hz]	$L_{V,T,i,k}$ [dB]	$u_{Lv,T,i,k}$ [dB]	$L_{V,B,i,k}$ [dB]	$u_{Lv,B,i,k}$ [dB]	$L_{V,C,i,k}$ [dB]	$L_{WA,i,k}$ [dB]	$u_{c,i,k}$ [dB]
10	-2.6	3.6	-9.7	5.0	-3.6	**46.4**	4.6
12.5	0.6	3.7	-6.1	4.7	-0.5	**49.5**	4.9
16	6.1	2.7	-1.8	3.2	5.3	**55.3**	3.3
20	11.5	2.4	4.1	2.3	10.6	**60.6**	3.0
25	16.8	1.7	6.8	2.0	16.3	**66.3**	1.9
31.5	18.4	2.3	10.2	1.9	17.7	**67.7**	2.8
40	22.9	2.3	13.9	1.6	22.3	**72.3**	2.7
50	26.4	2.3	19.8	3.4	25.3	**75.3**	3.1
63	28.7	1.9	22.2	2.7	27.6	**77.6**	2.5
80	31.8	1.7	23.6	1.6	31.0	**81.0**	2.1
100	37.1	1.6	26.5	3.1	36.7	**86.7**	1.7
125	39.3	0.7	34.2	5.6	37.6	**87.6**	2.8
160	37.6	1.2	29.0	1.4	36.9	**86.9**	1.4
200	39.1	2.9	31.3	3.0	38.3	**88.3**	3.5
250	39.6	0.7	32.3	1.7	38.7	**88.7**	1.0
315	41.5	0.7	35.3	2.1	40.3	**90.3**	1.1
400	42.4	0.9	36.2	1.8	41.2	**91.2**	1.3
500	41.9	0.6	37.1	1.6	40.2	**90.2**	1.2
630	47.7	0.9	37.9	1.6	47.2	**97.2**	1.1
800	43.4	0.5	37.0	2.0	42.2	**92.2**	0.9
1000	43.5	0.4	36.4	2.2	42.6	**92.6**	0.7
1250	43.2	0.5	34.7	2.6	42.6	**92.6**	0.7
1600	42.8	0.5	33.2	2.8	42.3	**92.2**	0.7
2000	42.2	1.1	30.7	3.0	41.9	**91.9**	1.2
2500	44.3	1.9	29.0	3.3	44.2	**94.2**	1.9
3150	40.1	1.1	27.7	3.7	39.8	**89.8**	1.2
4000	34.2	1.0	26.2	3.7	33.5	**83.5**	1.4
5000	31.4	1.5	24.1	3.8	30.5	**80.5**	2.0
6300	28.1	2.5	21.9	3.9	26.9	**76.9**	3.5
8000	27.1	3.3	21.0	4.2	25.9	**75.9**	4.6
10000	24.9	3.3	19.5	4.4	23.4	**73.4**	5.0



23.10.2018

created with GL Acoustic TuNES version: NOVALUE

DNV·GL

Bin 12.5 Senvion MM92

one third octave analysis at hub height
Terzanalyse bezogen auf Nabenhöhe

Site / Standort:	Napier (Canada)
WTGS-SNo. / WEA-SNr.:	93129
Mode / Modus:	Standard
Date of meas./ Messdatum:	2018-10-17
Standard / Messung:	IEC 61400-11 Ed.3
Project-No. / Projekt-Nr.:	10029304
In charge / Bearbeiter:	Annika Johannsen

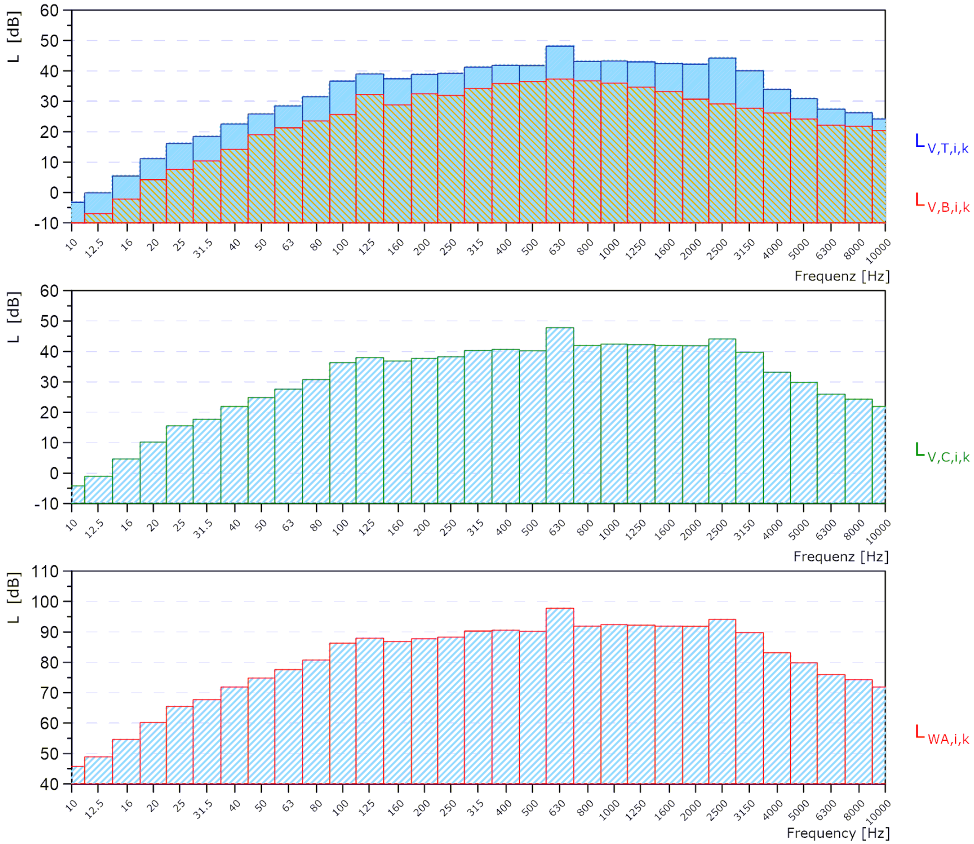
10.25 Third-octave sound power spectra at a WS of 13.0 m/s at hub height

No. of data per BIN / Anzahl der Messdaten pro BIN:
Total noise / Gesamtgeräusch = 21
Background noise / Fremdgeräusch = 43

Referencewind speed / Referenzwindgeschwindigkeit:
$WS_{BIN\ (hub\ height)}$ = 13.0 m/s
$WS_{BIN\ (10m)}$ = 9.1 m/s

Schallleistung: $L_{WA,k}$ = 103.8 dB

f [Hz]	$L_{V,T,i,k}$ [dB]	$u_{Lv,T,i,k}$ [dB]	$L_{V,B,i,k}$ [dB]	$u_{Lv,B,i,k}$ [dB]	$L_{V,C,i,k}$ [dB]	$L_{WA,i,k}$ [dB]	$u_{c,i,k}$ [dB]
10	-3.3	2.1	-10.0	3.7	-4.3	**45.7**	2.9
12.5	-0.1	1.8	-7.0	3.0	-1.1	**48.9**	2.4
16	5.4	1.5	-2.1	2.0	4.6	**54.6**	1.9
20	11.2	1.0	4.2	1.8	10.2	**60.2**	1.3
25	16.2	1.2	7.6	2.2	15.5	**65.5**	1.4
31.5	18.4	1.4	10.3	1.9	17.6	**67.6**	1.7
40	22.5	1.3	14.2	2.0	21.8	**71.8**	1.6
50	25.8	1.2	19.0	2.8	24.8	**74.8**	1.6
63	28.5	1.0	21.3	2.0	27.6	**77.6**	1.3
80	31.5	1.0	23.5	1.4	30.7	**80.7**	1.2
100	36.6	1.3	25.6	2.6	36.2	**86.2**	1.5
125	39.0	0.9	32.2	4.2	37.9	**87.9**	1.6
160	37.4	0.9	28.8	1.5	36.8	**86.8**	1.1
200	38.8	2.9	32.4	3.6	37.7	**87.7**	4.0
250	39.2	0.6	31.9	1.6	38.2	**88.2**	0.8
315	41.2	0.8	34.2	1.3	40.3	**90.3**	1.0
400	41.8	0.7	35.8	1.5	40.6	**90.6**	1.0
500	41.7	0.8	36.5	1.6	40.2	**90.2**	1.3
630	48.1	1.5	37.3	1.5	47.8	**97.8**	1.6
800	43.1	0.3	36.7	1.6	41.9	**91.9**	0.6
1000	43.3	0.4	36.0	1.6	42.4	**92.4**	0.6
1250	42.9	0.4	34.6	1.9	42.2	**92.2**	0.5
1600	42.5	0.4	33.2	2.1	41.9	**91.9**	0.6
2000	42.2	1.1	30.7	2.3	41.8	**91.8**	1.2
2500	44.2	1.9	29.1	2.8	44.1	**94.1**	2.0
3150	40.0	1.2	27.7	2.8	39.7	**89.7**	1.3
4000	33.9	1.0	26.2	2.9	33.1	**83.1**	1.3
5000	30.9	1.5	24.2	3.1	29.8	**79.8**	2.1
6300	27.4	2.4	22.2	3.4	25.9	**75.9**	3.7
8000	26.2	2.9	21.8	4.0	24.3	**74.3**	5.0
10000	24.2	2.9	20.3	4.3	21.9	**71.9**	5.8



23.10.2018

created with GL Acoustic TuNES version: NOVALUE

DNV·GL

Bin 13 Senvion MM92

one third octave analysis at hub height
Terzanalyse bezogen auf Nabenhöhe

Site / Standort:	Napier (Canada)
WTGS-SNo. / WEA-SNr.:	93129
Mode / Modus:	Standard
Date of meas./ Messdatum:	2018-10-17
Standard / Messung:	IEC 61400-11 Ed.3
Project-No. / Projekt-Nr.:	10029304
In charge / Bearbeiter:	Annika Johannsen

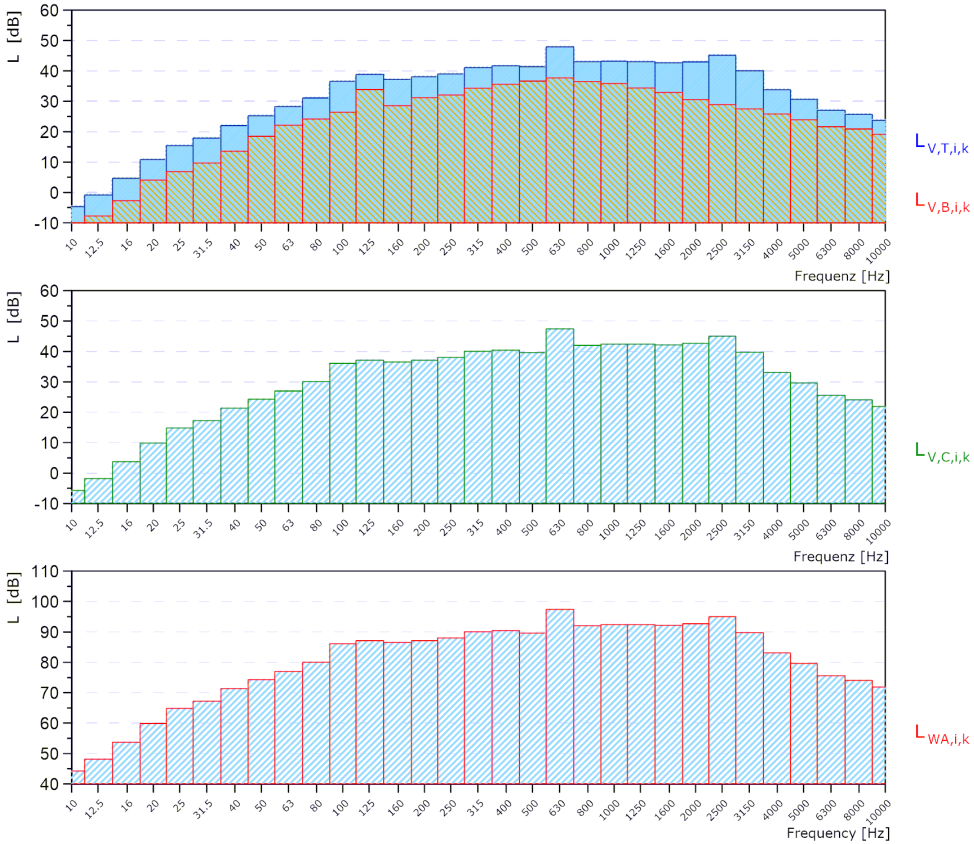
10.26 Third-octave sound power spectra at a WS of 13.5 m/s at hub height

No. of data per BIN / Anzahl der Messdaten pro BIN:
Total noise / Gesamtgeräusch = 17
Background noise / Fremdgeräusch = 26

Referencewind speed / Referenzwindgeschwindigkeit:
$WS_{BIN\ (hub\ height)}$ = 13.5 m/s
$WS_{BIN\ (10m)}$ = 9.4 m/s

Schallleistung: $L_{WA,k}$ = 103.8 dB

f [Hz]	$L_{V,T,i,k}$ [dB]	$u_{Lv,T,i,k}$ [dB]	$L_{V,B,i,k}$ [dB]	$u_{Lv,B,i,k}$ [dB]	$L_{V,C,i,k}$ [dB]	$L_{WA,i,k}$ [dB]	$u_{c,i,k}$ [dB]
10	-4.6	1.8	-10.9	4.2	-5.8	**44.2**	2.6
12.5	-0.8	1.5	-7.7	3.3	-1.8	**48.2**	2.1
16	4.6	1.7	-2.7	1.9	3.7	**53.7**	2.2
20	10.9	1.6	4.1	1.9	9.8	**59.8**	2.1
25	15.4	1.2	6.8	1.6	14.8	**64.8**	1.4
31.5	17.9	1.6	9.7	1.6	17.2	**67.2**	1.9
40	22.0	1.6	13.6	1.7	21.4	**71.4**	1.9
50	25.3	1.6	18.5	2.2	24.2	**74.2**	2.1
63	28.2	1.4	22.1	2.6	27.0	**77.0**	2.1
80	31.1	1.3	24.2	1.8	30.1	**80.1**	1.8
100	36.5	1.3	26.4	3.1	36.1	**86.1**	1.5
125	38.8	1.0	33.9	4.7	37.1	**87.1**	2.7
160	37.1	1.1	28.6	1.4	36.5	**86.5**	1.3
200	38.1	2.6	31.2	3.0	37.1	**87.1**	3.4
250	39.0	0.8	32.1	1.9	38.0	**88.0**	1.1
315	41.1	0.8	34.3	1.7	40.0	**90.0**	1.1
400	41.6	0.8	35.6	1.9	40.4	**90.4**	1.3
500	41.3	0.7	36.6	1.7	39.6	**89.6**	1.3
630	47.9	1.2	37.7	1.6	47.4	**97.4**	1.3
800	43.1	0.4	36.5	1.4	42.0	**92.0**	0.6
1000	43.2	0.3	35.8	1.5	42.3	**92.3**	0.5
1250	43.0	0.5	34.4	2.0	42.4	**92.4**	0.7
1600	42.6	0.6	32.9	2.2	42.1	**92.1**	0.7
2000	42.9	1.2	30.5	2.5	42.7	**92.7**	1.3
2500	45.1	1.8	28.9	3.0	45.0	**95.0**	1.9
3150	40.0	1.1	27.5	3.2	39.7	**89.7**	1.1
4000	33.8	0.8	25.8	3.1	33.0	**83.0**	1.1
5000	30.6	1.2	23.9	3.2	29.6	**79.6**	1.7
6300	27.0	2.1	21.7	3.4	25.5	**75.5**	3.2
8000	25.7	2.7	20.8	3.7	24.0	**74.0**	4.4
10000	23.7	2.8	19.1	3.8	21.9	**71.9**	4.7



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DNV·GL

Bin 13.5 Senvion MM92

one third octave analysis at hub height
Terzanalyse bezogen auf Nabenhöhe

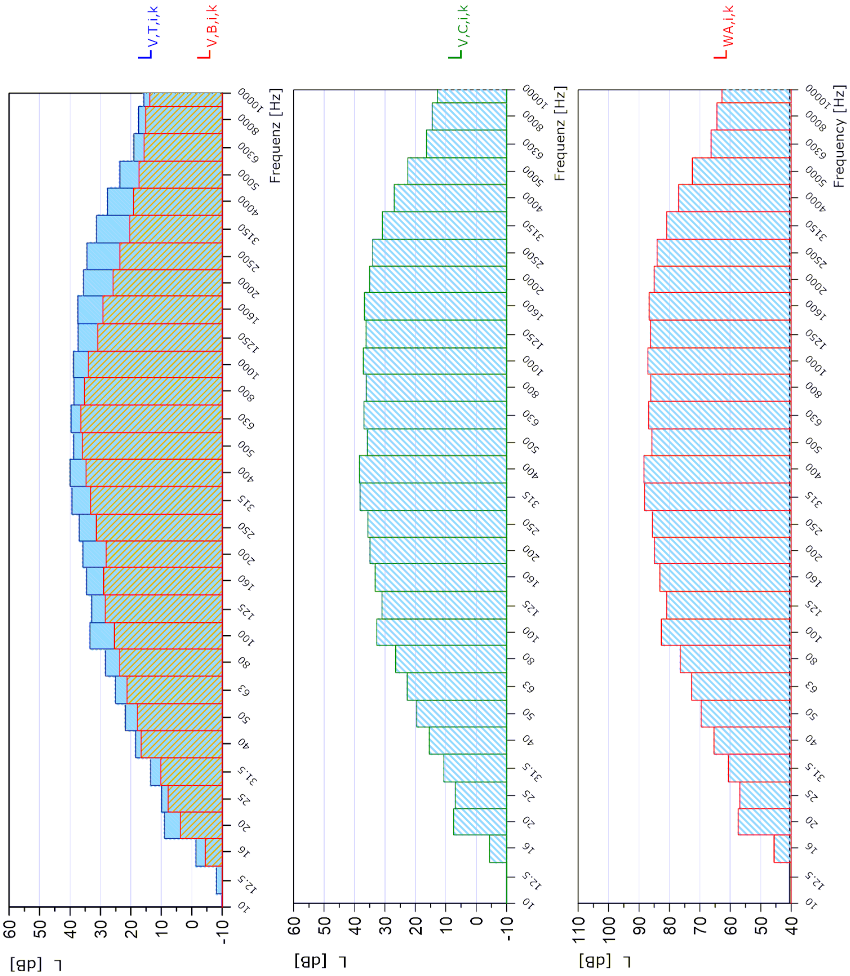
Site / Standort:	Napier (Canada)
WTGS-SNo. / WEA-SNr.:	93129
Mode / Modus:	Standard
Date of meas./ Messdatum:	2018-10-17
Standard / Messung:	IEC 61400-11 Ed.3
Project-No. / Projekt-Nr.:	10029304
In charge / Bearbeiter:	Annika Johannsen

10.27 Third-octave sound power spectra at a WS of 5 m/s at 10 m height

Reference wind speed / Referenzwindgeschwindigkeit:
$WS_{BIN\ (hub\ height)}$ = 7.2 m/s
$WS_{BIN\ (10\ m)}$ = 5 m/s

Schallleistung: $L_{WA,k}$ = 97.8 dB

f [Hz]	$L_{V,T,i,k}$ [dB]	$u_{Lv,T,i,k}$ [dB]	$L_{V,B,i,k}$ [dB]	$u_{Lv,B,i,k}$ [dB]	$L_{V,C,i,k}$ [dB]	$L_{WA,i,k}$ [dB]	$u_{c,i,k}$ [dB]
10	-12.8	2.2	-17.6	1.2	-14.5	**35.5**	3.3
12.5	-8.2	1.6	-12.6	0.9	-10.1	**39.9**	2.5
16	-1.4	1.4	-4.4	1.4	-4.4	**45.6**	3.1
20	8.9	1.1	3.7	1.9	7.4	**57.4**	1.8
25	9.9	1.4	7.8	2.3	[6.9]	**[56.9]**	3.7
31.5	13.4	1.4	10.2	1.6	10.7	**60.7**	3.0
40	18.4	1.2	16.6	2.9	[15.4]	**[65.4]**	3.7
50	21.8	1.4	17.8	1.2	19.6	**69.6**	2.4
63	25.1	1.2	21.3	1.6	22.7	**72.7**	2.4
80	28.3	0.8	23.7	1.1	26.5	**76.5**	1.4
100	33.4	1.0	25.4	1.8	32.7	**82.7**	1.2
125	32.9	0.9	28.4	1.9	30.9	**80.9**	1.8
160	34.6	0.7	28.9	1.8	33.2	**83.2**	1.2
200	35.7	0.9	28.1	1.2	34.9	**84.9**	1.1
250	37.0	0.7	31.3	1.4	35.6	**85.6**	1.1
315	39.4	0.7	33.2	1.3	38.2	**88.2**	1.0
400	40.0	0.9	34.7	1.5	38.4	**88.4**	1.4
500	38.8	0.8	35.9	1.1	[35.8]	**[85.8]**	1.9
630	39.7	0.7	36.5	1.1	36.9	**86.9**	1.6
800	38.7	0.7	35.2	1.7	36.1	**86.1**	1.8
1000	38.8	0.6	34.0	1.5	37.1	**87.1**	1.1
1250	37.3	0.6	30.9	1.8	36.2	**86.2**	0.9
1600	37.4	0.5	29.1	2.0	36.7	**86.7**	0.7
2000	35.5	0.5	25.9	2.0	35.0	**85.0**	0.6
2500	34.4	0.6	23.6	2.1	34.0	**84.0**	0.7
3150	31.3	0.6	20.4	1.9	30.9	**80.9**	0.7
4000	27.6	0.6	19.1	2.1	27.0	**77.0**	0.8
5000	23.6	0.9	17.3	1.8	22.5	**72.5**	1.3
6300	19.0	1.3	15.6	1.7	16.4	**66.4**	2.8
8000	17.4	1.8	15.1	1.6	[14.4]	**[64.4]**	3.9
10000	15.7	1.7	13.7	1.6	[12.7]	**[62.7]**	3.8



Site / Standort: Napier (Canada)
WTGS-SNo. / WEA-SNr.: 93129
Mode / Modus: Standard
Date of meas./ Messdatum: 2018-10-17
Standard / Messung: IEC 61400-11 Ed.3
Project-No. / Projekt-Nr.: 10029304
In charge / Bearbeiter: Annika Johannsen

Bin 5 Senvion MM92

One third octave analysis at 10 m height

Terzanalyse bezogen auf 10 m Höhe

DNV·GL

created with GL Acoustic TuNES version: NOVALUE

23.10.2018

10.28 Third-octave sound power spectra at a WS of 6 m/s at 10 m height

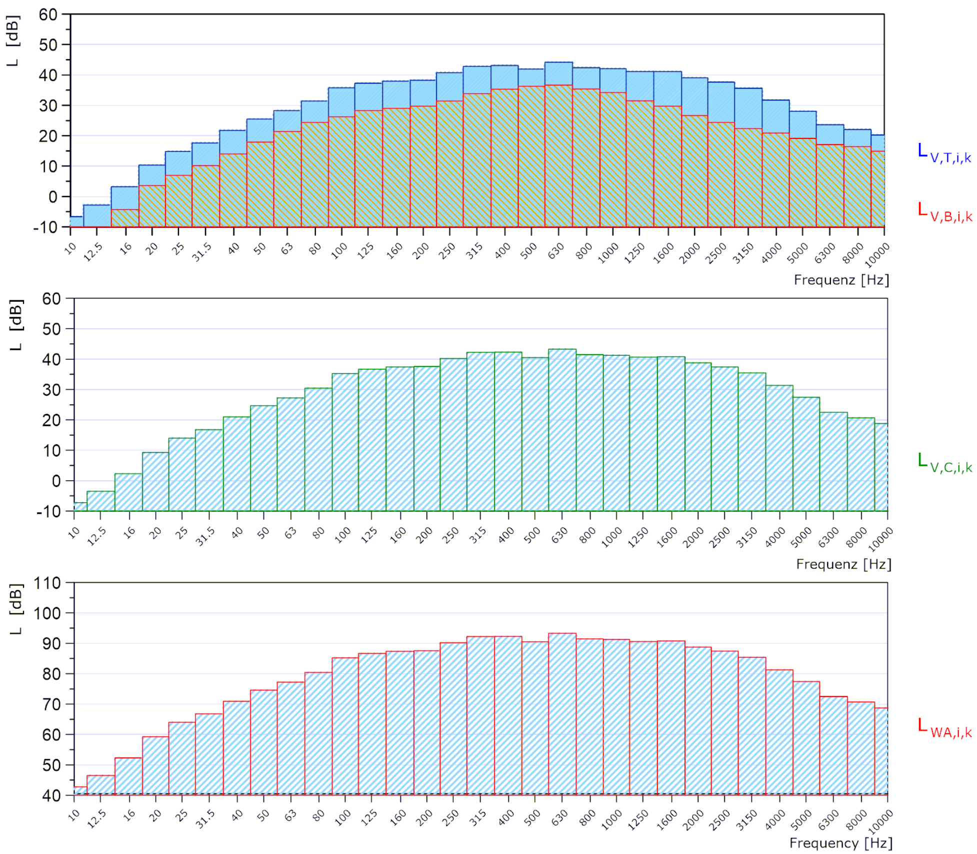
Reference wind speed / Referenzwindgeschwindigkeit:

$WS_{BIN\ (hub\ height)}$ = 8.6 m/s

$WS_{BIN\ (10\ m)}$ = 6 m/s

Schallleistung: $L_{WA,k}$ = 102.2 dB

f [Hz]	$L_{V,T,i,k}$ [dB]	$u_{Lv,T,i,k}$ [dB]	$L_{V,B,i,k}$ [dB]	$u_{Lv,B,i,k}$ [dB]	$L_{V,C,i,k}$ [dB]	$L_{WA,i,k}$ [dB]	$U_{c,i,k}$ [dB]
10	-6.7	2.0	-16.0	1.9	-7.2	**42.8**	2.2
12.5	-2.8	1.9	-11.2	1.5	-3.5	**46.5**	2.2
16	3.2	1.7	-4.3	1.5	2.3	**52.3**	2.1
20	10.3	1.2	3.6	1.6	9.3	**59.3**	1.6
25	14.8	1.3	6.9	2.0	14.0	**64.0**	1.6
31.5	17.6	1.3	10.2	1.7	16.8	**66.8**	1.6
40	21.8	1.2	14.0	1.6	20.9	**70.9**	1.5
50	25.5	1.3	17.9	1.5	24.6	**74.6**	1.6
63	28.2	1.1	21.4	2.4	27.2	**77.2**	1.5
80	31.4	1.0	24.3	2.2	30.5	**80.5**	1.3
100	35.7	0.8	26.2	2.3	35.2	**85.2**	0.9
125	37.3	1.0	28.3	2.2	36.7	**86.7**	1.2
160	38.0	0.6	29.0	2.0	37.4	**87.4**	0.8
200	38.2	0.7	29.7	2.4	37.6	**87.6**	0.9
250	40.8	0.6	31.4	2.0	40.2	**90.2**	0.8
315	42.8	0.6	33.8	2.2	42.2	**92.2**	0.7
400	43.1	0.6	35.4	2.2	42.3	**92.3**	0.8
500	41.9	0.6	36.3	2.1	40.5	**90.5**	1.1
630	44.2	0.4	36.6	1.8	43.3	**93.3**	0.7
800	42.4	0.4	35.4	2.0	41.5	**91.4**	0.7
1000	42.1	0.4	34.2	1.9	41.3	**91.3**	0.6
1250	41.1	0.4	31.5	2.0	40.6	**90.6**	0.5
1600	41.1	0.3	29.7	2.2	40.8	**90.8**	0.3
2000	39.1	0.3	26.6	2.1	38.8	**88.8**	0.3
2500	37.6	0.3	24.4	2.1	37.4	**87.4**	0.4
3150	35.7	0.4	22.4	2.4	35.4	**85.4**	0.4
4000	31.7	0.8	20.9	2.5	31.3	**81.3**	0.9
5000	28.0	1.3	19.1	2.4	27.4	**77.4**	1.5
6300	23.6	1.5	17.1	2.3	22.5	**72.5**	2.1
8000	22.1	2.0	16.4	2.3	20.7	**70.7**	2.9
10000	20.3	2.1	14.9	2.3	18.8	**68.8**	3.1



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23.10.2018

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Bin 6 Senvion MM92

One third octave analysis at 10 m height

Terzanalyse bezogen auf 10 m Höhe

Site / Standort:	Napier (Canada)
WTGS-SNo. / WEA-SNr.:	93129
Mode / Modus:	Standard
Date of meas./ Messdatum:	2018-10-17
Standard / Messung:	IEC 61400-11 Ed.3
Project-No. / Projekt-Nr.:	10029304
In charge / Bearbeiter:	Annika Johannsen

10.29 Third-octave sound power spectra at a WS of 7 m/s at 10 m height

Reference wind speed / Referenzwindgeschwindigkeit:

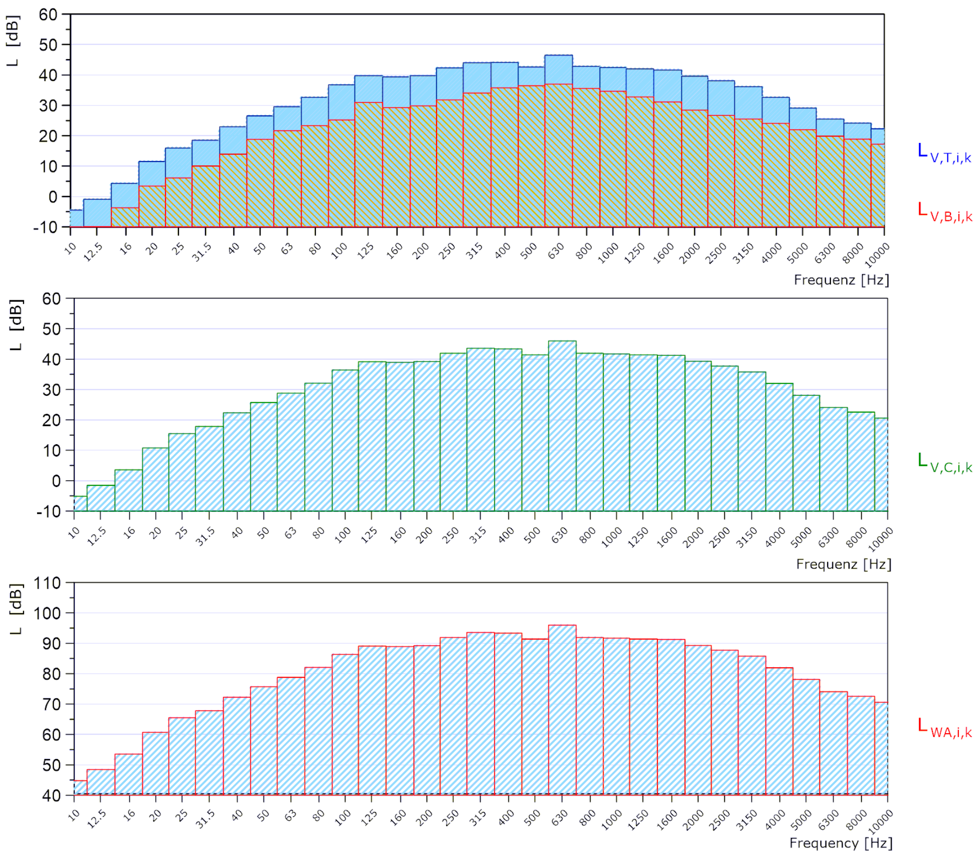
$WS_{BIN\ (hub\ height)}$ = 10.0 m/s

$WS_{BIN\ (10\ m)}$ = 7 m/s

Schallleistung: $L_{WA,k}$ = 103.5 dB

23.10.2018

f [Hz]	$L_{V,T,i,k}$ [dB]	$u_{Lv,T,i,k}$ [dB]	$L_{V,B,i,k}$ [dB]	$u_{Lv,B,i,k}$ [dB]	$L_{V,C,i,k}$ [dB]	$L_{WA,i,k}$ [dB]	$U_{c,i,k}$ [dB]
10	-4.5	1.9	-12.9	3.2	-5.2	**44.8**	2.3
12.5	-1.0	1.8	-9.9	2.2	-1.5	**48.5**	2.1
16	4.3	1.5	-3.7	1.8	3.6	**53.6**	1.8
20	11.5	1.3	3.4	1.9	10.7	**60.7**	1.6
25	16.0	1.2	6.1	1.9	15.5	**65.5**	1.3
31.5	18.5	1.4	10.0	2.7	17.8	**67.8**	1.7
40	22.9	1.5	13.9	2.3	22.3	**72.3**	1.7
50	26.5	1.4	18.8	2.5	25.7	**75.7**	1.7
63	29.6	1.3	21.7	2.3	28.8	**78.8**	1.6
80	32.6	1.1	23.3	1.3	32.1	**82.1**	1.2
100	36.7	0.8	25.2	2.1	36.4	**86.4**	0.9
125	39.7	0.8	31.0	4.0	39.1	**89.1**	1.1
160	39.4	0.8	29.2	2.3	38.9	**88.9**	0.9
200	39.7	0.8	29.9	2.4	39.3	**89.2**	0.9
250	42.3	0.8	31.8	2.0	41.9	**91.9**	0.9
315	44.0	0.7	34.0	2.0	43.6	**93.6**	0.8
400	44.1	0.5	35.7	2.2	43.4	**93.4**	0.7
500	42.6	0.4	36.5	2.5	41.4	**91.4**	1.0
630	46.5	0.8	37.0	2.1	46.0	**96.0**	0.9
800	42.8	0.5	35.5	1.8	42.0	**91.9**	0.7
1000	42.5	0.4	34.6	1.8	41.7	**91.7**	0.6
1250	42.0	0.4	32.7	1.9	41.4	**91.4**	0.5
1600	41.7	0.4	31.1	2.3	41.3	**91.3**	0.4
2000	39.6	0.4	28.4	2.2	39.3	**89.3**	0.5
2500	38.1	0.4	26.7	2.4	37.7	**87.7**	0.5
3150	36.1	0.5	25.5	3.1	35.8	**85.8**	0.7
4000	32.6	0.8	24.0	3.2	32.0	**82.0**	1.0
5000	29.1	1.2	22.0	3.2	28.1	**78.1**	1.7
6300	25.5	2.0	19.9	3.2	24.1	**74.1**	3.0
8000	24.1	2.5	18.9	3.3	22.6	**72.5**	3.9
10000	22.2	2.6	17.2	3.4	20.6	**70.6**	4.2



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Bin 7 Senvion MM92

One third octave analysis at 10 m height

Terzanalyse bezogen auf 10 m Höhe

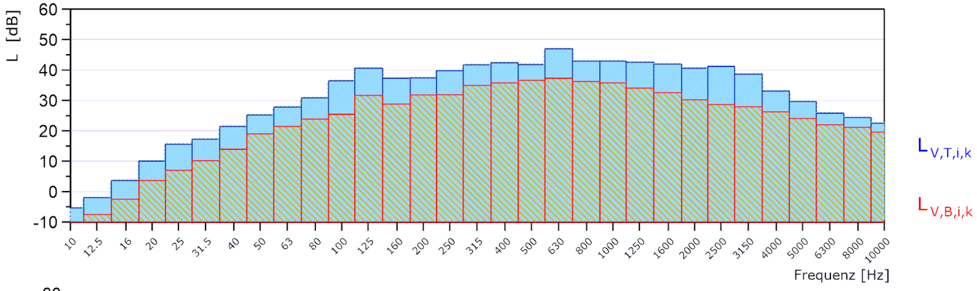
Site / Standort:	Napier (Canada)
WTGS-SNo. / WEA-SNr.:	93129
Mode / Modus:	Standard
Date of meas./ Messdatum:	2018-10-17
Standard / Messung:	IEC 61400-11 Ed.3
Project-No. / Projekt-Nr.:	10029304
In charge / Bearbeiter:	Annika Johannsen

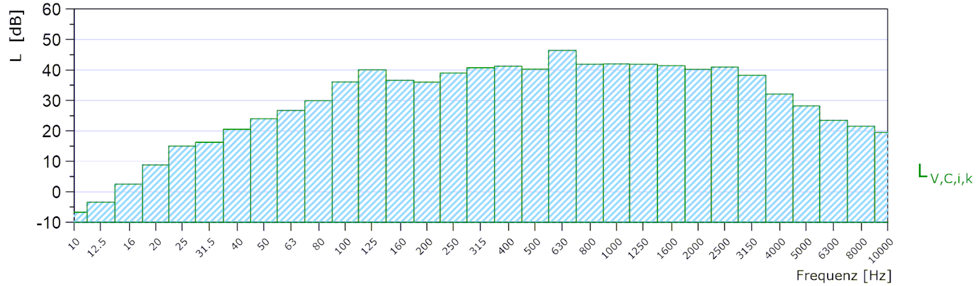
10.30 Third-octave sound power spectra at a WS of 8 m/s at 10 m height

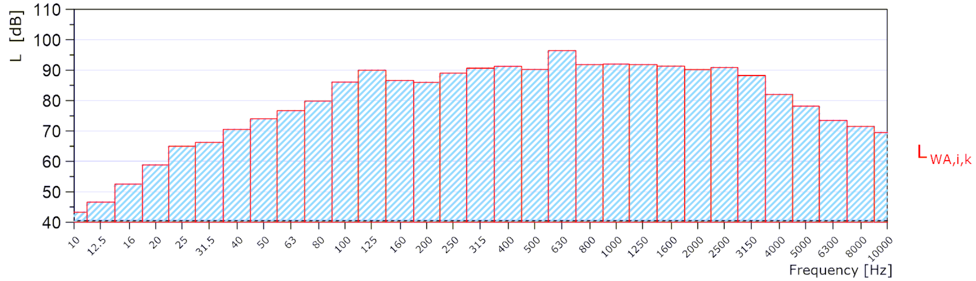
Reference wind speed / Referenzwindgeschwindigkeit:
$WS_{BIN\ (hub\ height)}$ = 11.5 m/s
$WS_{BIN\ (10\ m)}$ = 8 m/s

Schallleistung: $L_{WA,k}$ = 103.1 dB

f [Hz]	$L_{V,T,i,k}$ [dB]	$u_{Lv,T,i,k}$ [dB]	$L_{V,B,i,k}$ [dB]	$u_{Lv,B,i,k}$ [dB]	$L_{V,C,i,k}$ [dB]	$L_{WA,i,k}$ [dB]	$U_{c,i,k}$ [dB]
10	-5.4	2.3	-11.3	3.6	-6.7	**43.3**	3.4
12.5	-2.0	1.9	-7.6	3.1	-3.4	**46.6**	2.9
16	3.7	1.5	-2.6	2.0	2.5	**52.5**	2.1
20	10.0	1.0	3.6	1.5	8.9	**58.9**	1.4
25	15.6	1.4	7.0	2.2	15.0	**65.0**	1.6
31.5	17.2	1.5	10.2	1.9	16.3	**66.3**	2.0
40	21.4	1.4	13.9	2.0	20.5	**70.5**	1.8
50	25.2	1.2	19.0	2.5	24.0	**74.0**	1.7
63	27.8	1.2	21.5	2.0	26.7	**76.7**	1.7
80	30.8	1.2	23.8	1.6	29.9	**79.9**	1.6
100	36.4	1.3	25.4	1.9	36.1	**86.1**	1.4
125	40.6	1.3	31.7	4.4	40.0	**90.0**	1.7
160	37.2	0.7	28.8	1.4	36.6	**86.6**	0.9
200	37.4	1.5	31.8	2.8	36.0	**86.0**	2.3
250	39.7	0.9	31.8	1.4	39.0	**89.0**	1.1
315	41.7	0.8	35.0	1.8	40.7	**90.7**	1.1
400	42.3	0.7	35.7	1.5	41.3	**91.3**	0.9
500	41.8	0.4	36.6	1.9	40.3	**90.2**	1.0
630	46.9	1.1	37.3	1.5	46.4	**96.4**	1.2
800	42.9	0.4	36.2	1.7	41.9	**91.9**	0.6
1000	42.9	0.4	35.7	1.9	42.0	**92.0**	0.6
1250	42.5	0.5	34.1	2.1	41.9	**91.9**	0.7
1600	41.9	0.5	32.6	2.4	41.4	**91.4**	0.6
2000	40.6	0.9	30.2	2.7	40.2	**90.2**	1.0
2500	41.2	1.6	28.6	3.2	40.9	**90.9**	1.7
3150	38.6	1.2	27.9	3.5	38.2	**88.2**	1.4
4000	33.1	0.9	26.3	3.5	32.1	**82.1**	1.5
5000	29.6	1.5	24.0	3.5	28.2	**78.2**	2.4
6300	25.8	2.2	21.9	3.5	23.4	**73.4**	4.6
8000	24.3	2.8	21.1	3.7	21.5	**71.5**	6.3
10000	22.5	2.9	19.5	3.9	[19.5]	**[69.5]**	7.1







created with GL Acoustic TuNES version: NOVALUE

23.10.2018

DNV·GL

Bin 8 Senvion MM92

One third octave analysis at 10 m height

Terzanalyse bezogen auf 10 m Höhe

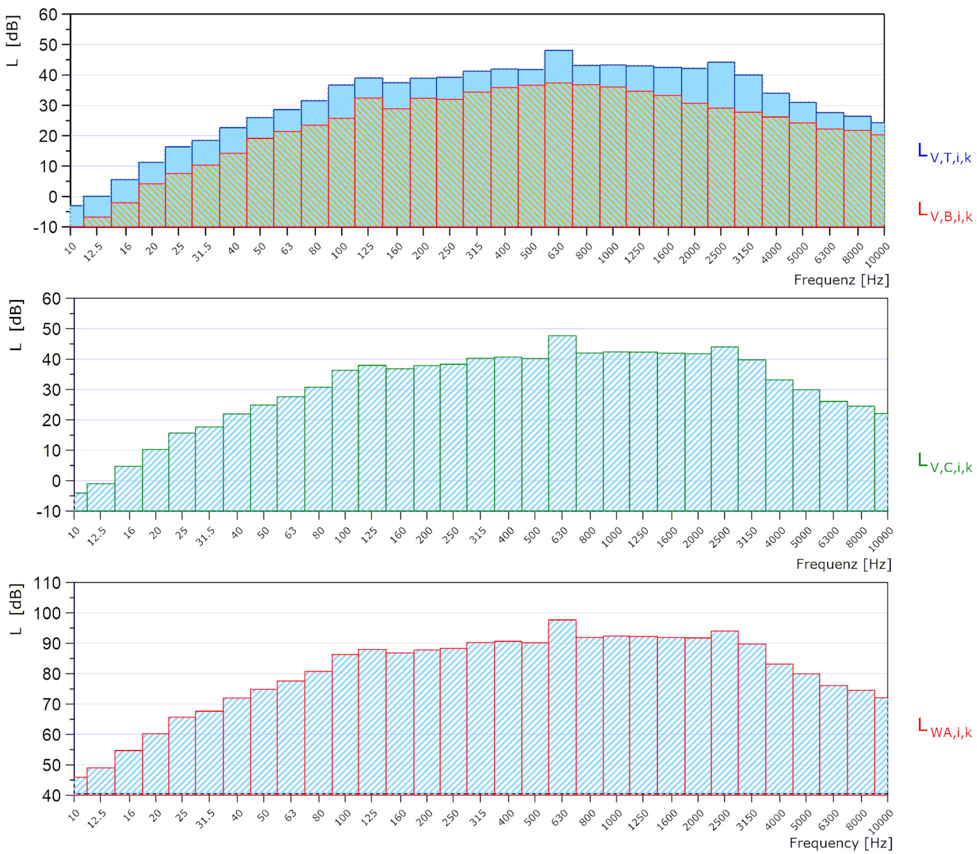
Site / Standort:	Napier (Canada)
WTGS-SNo. / WEA-SNr.:	93129
Mode / Modus:	Standard
Date of meas./ Messdatum:	2018-10-17
Standard / Messung:	IEC 61400-11 Ed.3
Project-No. / Projekt-Nr.:	10029304
In charge / Bearbeiter:	Annika Johannsen

10.31 Third-octave sound power spectra at a WS of 9 m/s at 10 m height

Reference wind speed / Referenzwindgeschwindigkeit:
$WS_{BIN\ (hub\ height)}$ = 12.9 m/s
$WS_{BIN\ (10\ m)}$ = 9 m/s

Schallleistung: $L_{WA,k}$ = 103.8 dB

f [Hz]	$L_{V,T,i,k}$ [dB]	$u_{Lv,T,i,k}$ [dB]	$L_{V,B,i,k}$ [dB]	$u_{Lv,B,i,k}$ [dB]	$L_{V,C,i,k}$ [dB]	$L_{WA,i,k}$ [dB]	$U_{c,i,k}$ [dB]
10	-3.1	2.1	-10.0	3.5	-4.1	**45.9**	2.8
12.5	0.0	1.8	-6.8	2.8	-1.0	**49.0**	2.4
16	5.5	1.5	-2.1	1.9	4.7	**54.7**	1.9
20	11.2	1.0	4.2	1.7	10.2	**60.2**	1.3
25	16.3	1.2	7.5	2.0	15.7	**65.7**	1.4
31.5	18.4	1.4	10.3	1.7	17.7	**67.7**	1.6
40	22.6	1.3	14.2	1.8	21.9	**71.9**	1.6
50	25.9	1.1	19.1	2.6	24.9	**74.9**	1.6
63	28.5	1.0	21.4	1.8	27.6	**77.6**	1.3
80	31.5	1.0	23.5	1.3	30.8	**80.8**	1.2
100	36.7	1.3	25.7	2.4	36.3	**86.3**	1.4
125	39.0	0.9	32.4	3.9	37.9	**87.9**	1.6
160	37.5	0.9	28.9	1.4	36.8	**86.8**	1.0
200	38.9	2.9	32.3	3.3	37.8	**87.8**	3.8
250	39.2	0.6	32.0	1.4	38.3	**88.3**	0.8
315	41.3	0.8	34.3	1.3	40.3	**90.3**	1.0
400	41.9	0.7	35.9	1.4	40.7	**90.7**	1.0
500	41.8	0.7	36.6	1.5	40.2	**90.2**	1.2
630	48.1	1.4	37.3	1.4	47.7	**97.7**	1.6
800	43.1	0.3	36.7	1.5	42.0	**92.0**	0.6
1000	43.3	0.3	36.0	1.5	42.4	**92.4**	0.5
1250	43.0	0.4	34.7	1.8	42.3	**92.3**	0.5
1600	42.5	0.4	33.2	1.9	41.9	**91.9**	0.5
2000	42.1	1.0	30.7	2.2	41.8	**91.8**	1.1
2500	44.2	1.9	29.1	2.6	44.0	**94.0**	1.9
3150	40.0	1.2	27.8	2.6	39.7	**89.7**	1.3
4000	34.0	1.0	26.2	2.7	33.2	**83.2**	1.3
5000	30.9	1.5	24.2	2.9	29.9	**79.9**	2.0
6300	27.5	2.3	22.2	3.2	26.1	**76.1**	3.5
8000	26.4	2.8	21.7	3.7	24.5	**74.5**	4.7
10000	24.3	2.9	20.3	4.0	22.1	**72.1**	5.4



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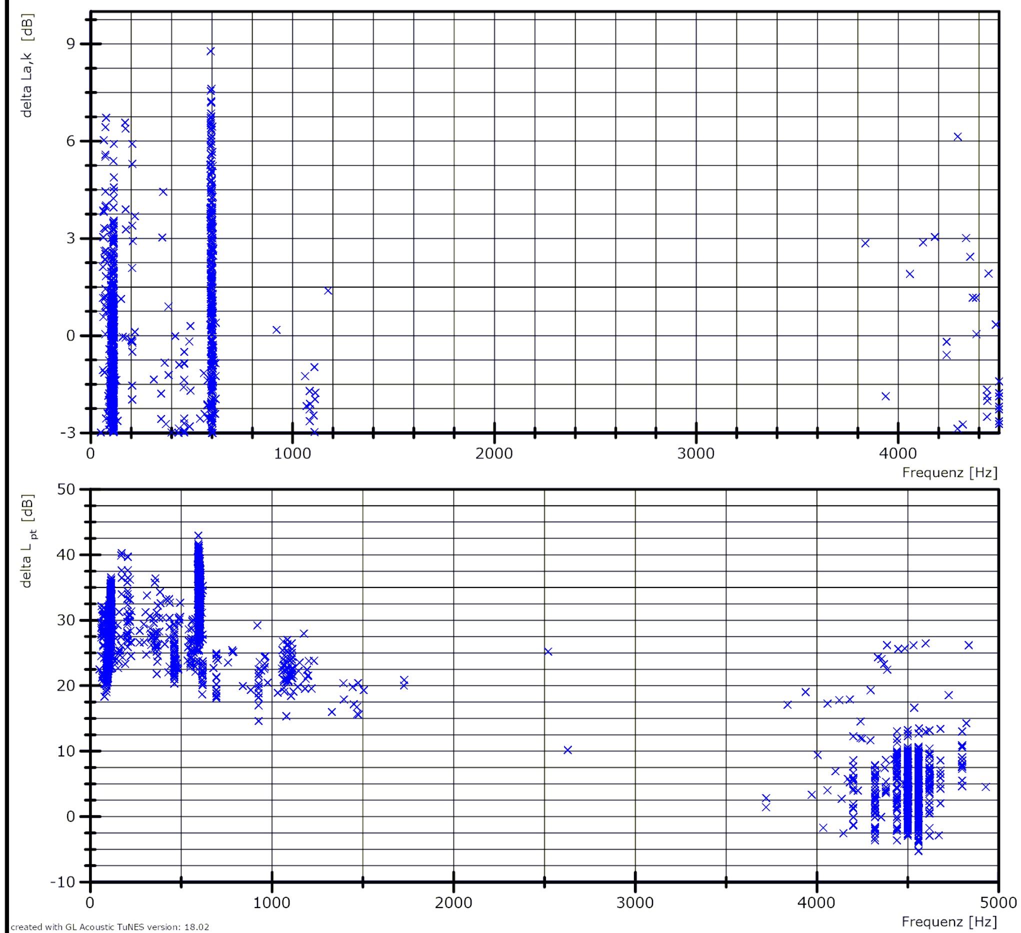
Bin 9 Senvion MM92

One third octave analysis at 10 m height

Terzanalyse bezogen auf 10 m Höhe

Site / Standort:	Napier (Canada)
WTGS-SNo. / WEA-SNr.:	93129
Mode / Modus:	Standard
Date of meas./ Messdatum:	2018-10-17
Standard / Messung:	IEC 61400-11 Ed.3
Project-No. / Projekt-Nr.:	10029304
In charge / Bearbeiter:	Annika Johannsen

10.33 Tonality analysis overview – all



WS [m/s]	tone f_T [Hz]	n all	n ident	delta $L_{a,k}$ [dB]	WS-BIN complete	tonal audibility
6.5	466	45	8	***-3.18***	Yes	No
7	96	151	71	***-3.92***	Yes	No
7.5	81	169	39	***2.06***	Yes	Yes
8	106	106	97	***-1.83***	Yes	Yes
8.5	112	83	73	***-3.64***	Yes	No
9	68	75	1	***-1.14***	Yes	No
9.5	600	64	61	***-1.28***	Yes	Yes
10	600	46	45	***0.61***	Yes	Yes
10.5	599	39	39	***1.72***	Yes	Yes
11	599	31	31	***2.14***	Yes	Yes
11.5	113	26	26	***2.16***	Yes	Yes
12	599	24	24	***2.06***	Yes	Yes
12.5	598	18	18	***3.42***	Yes	Yes
13	598	21	21	***4.84***	Yes	Yes
13.5	599	17	17	***4.62***	Yes	Yes

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Senvion MM92

Analysis of tonality

Tonhaltigkeitsanalyse

Site / Standort:	Napier (Canada)
WTGS-SNo. / WEA-SNr.:	93129
Mode / Modus:	Standard
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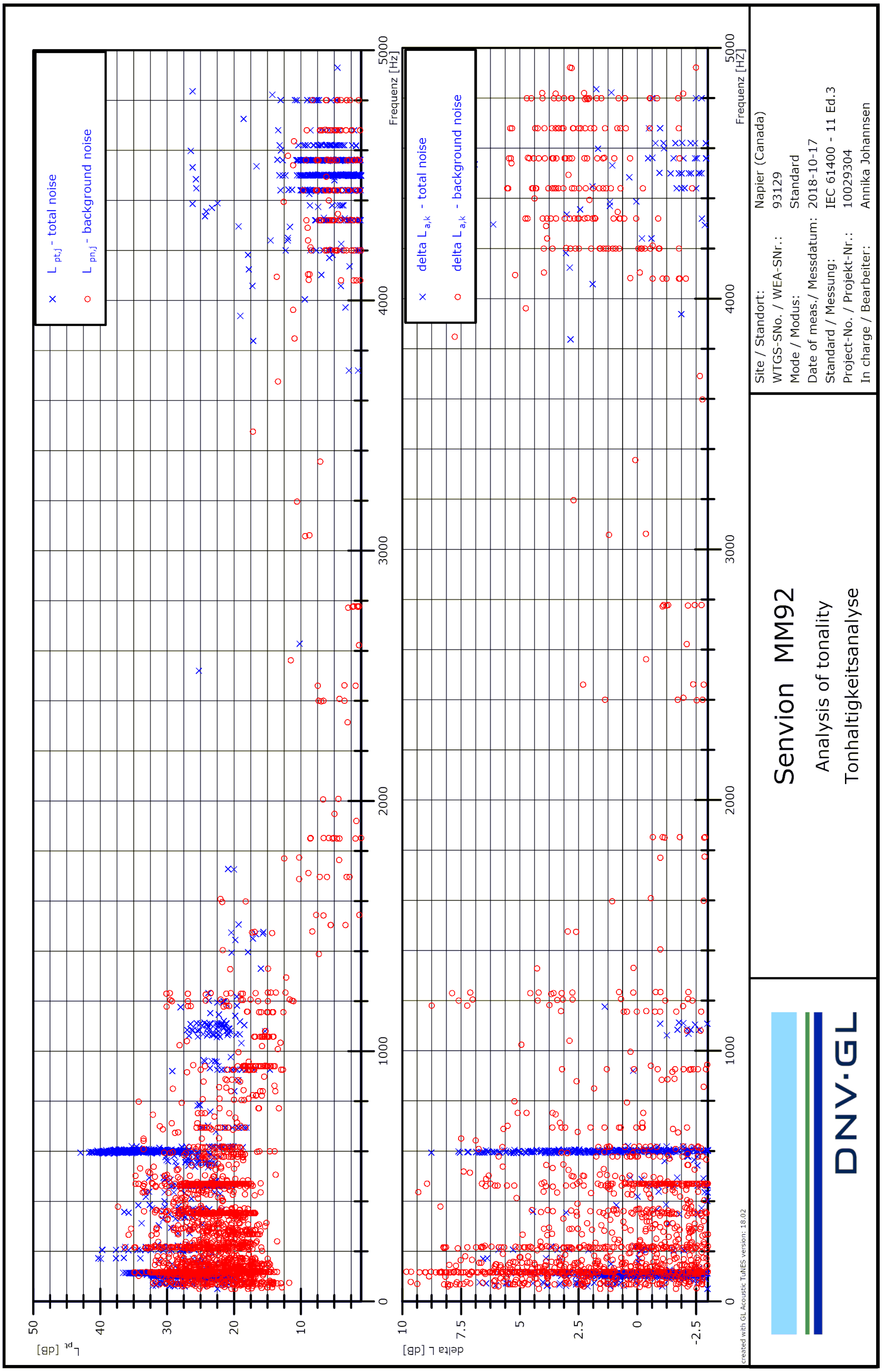
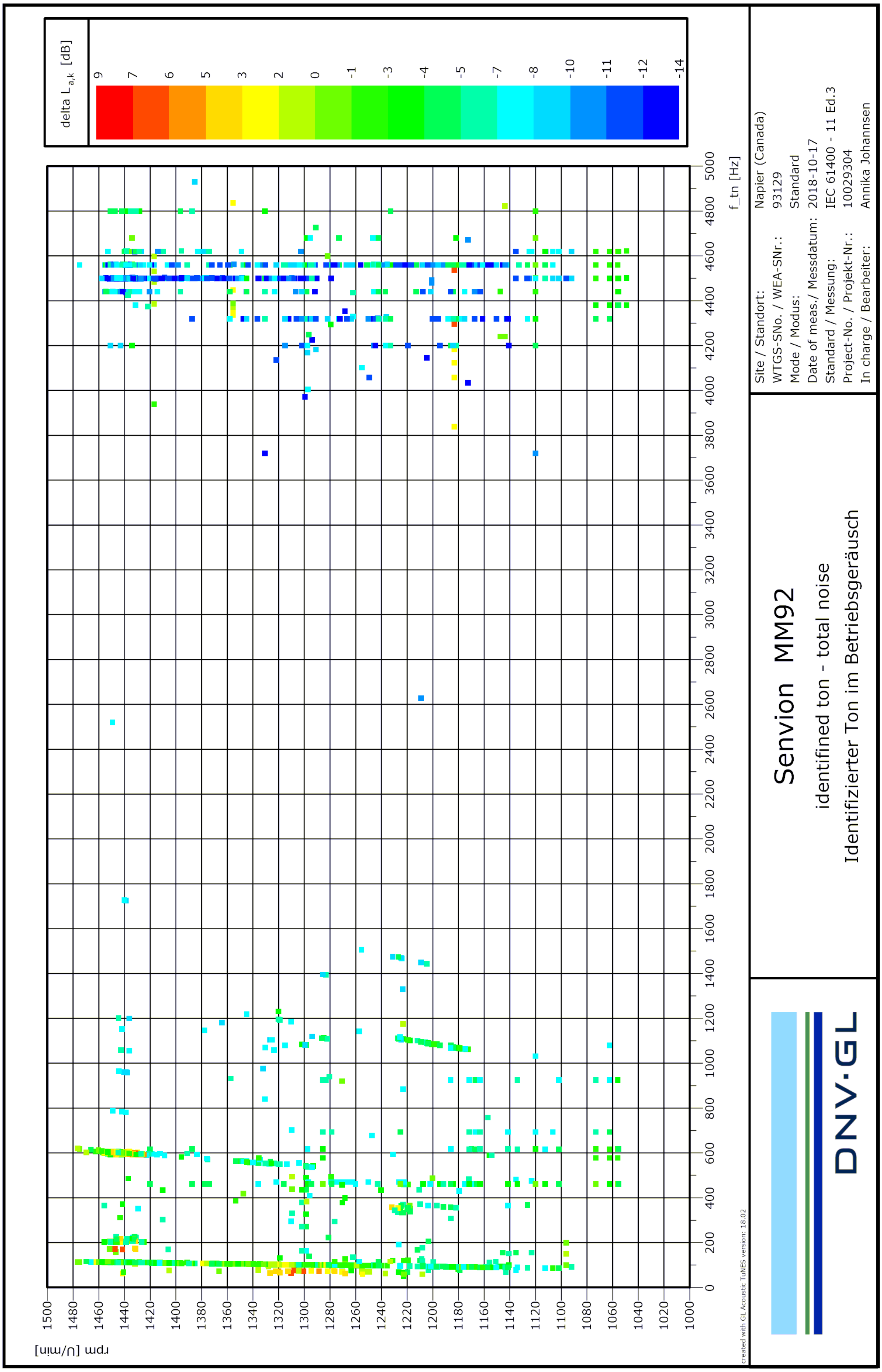
Project-No. / Projekt-Nr.:	10029304
In charge / Bearbeiter:	Annika Johannsen

10.34 Tonality analysis - $\Delta L_{pn,j}$ and $\Delta L_{a,k}$ vs. frequency

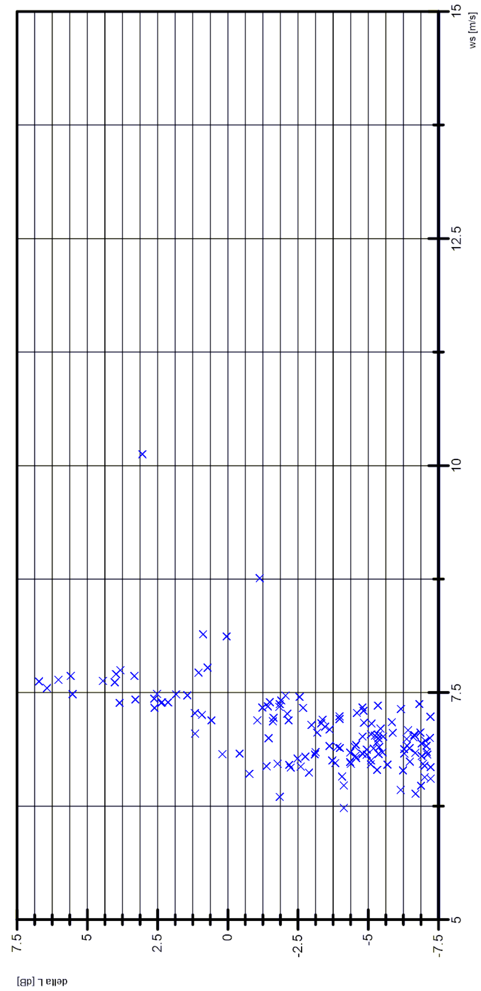


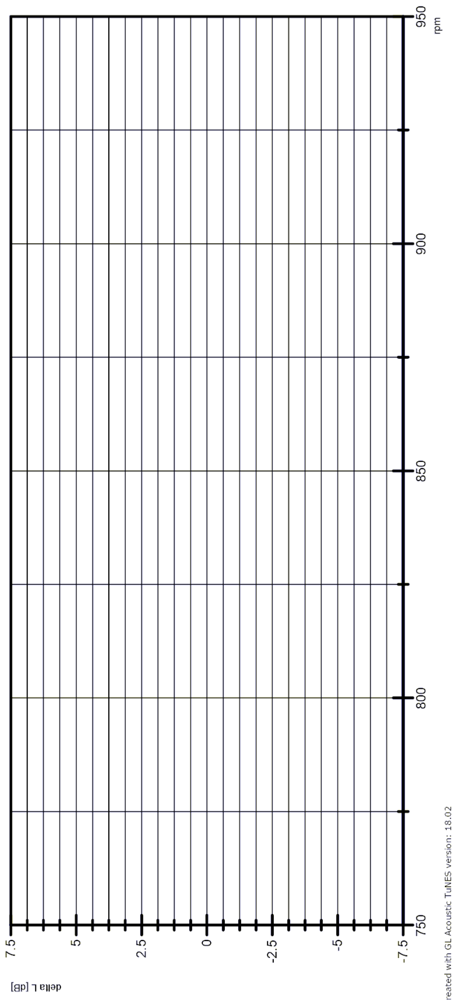
10.35 Tonality analysis - rpm vs. frequency for the identified tones in the total noise



10.36 Tonality analysis - wind bin overview (page 1)

WS [m/s]	tone f_T [Hz]	n all	n ident	delta $L_{a,k}$ [dB]	WS-BIN complete	tonal audibility
6.5	89	45	26	***-4.13***	Yes	No
7	90	151	70	***-4.08***	Yes	No
7.5	81	169	39	***2.06***	Yes	Yes
8	74	106	3	***0.56***	Yes	No
8.5		83	0		Yes	No
9	68	75	1	***-1.14***	Yes	No
9.5		64	0		Yes	No
10	62	46	1	***3.04***	Yes	No
10.5		39	0		Yes	No
11		31	0		Yes	No
11.5		26	0		Yes	No
12		24	0		Yes	No
12.5		18	0		Yes	No
13		21	0		Yes	No
13.5		17	0		Yes	No





Site / Standort:	Napier (Canada)
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Date of meas./ Messdatum:	2018-10-17
Standard / Messung:	IEC 61400 - 11 Ed.3
Project-No. / Projekt-Nr.:	10029304
In charge / Bearbeiter:	Annika Johannsen

Senvion MM92

Analysis of tonality

analysis of tonality / Tonhaltigkeitsanalyse

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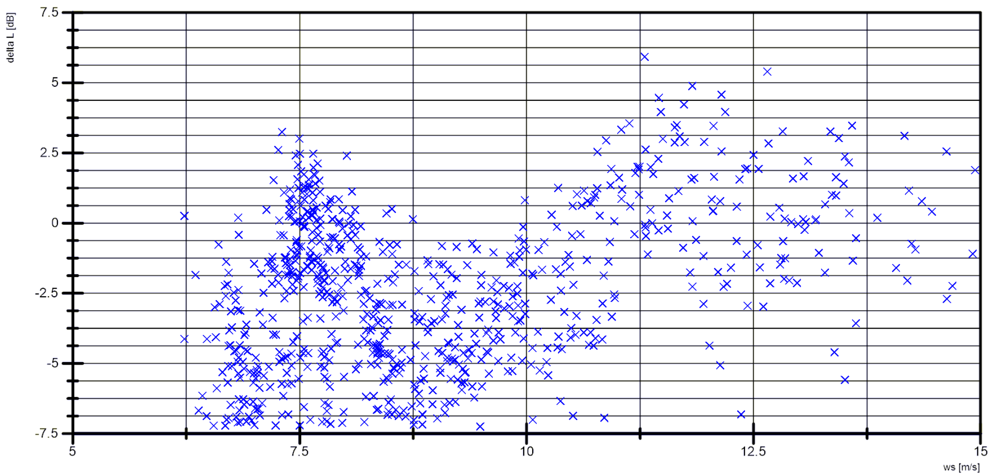
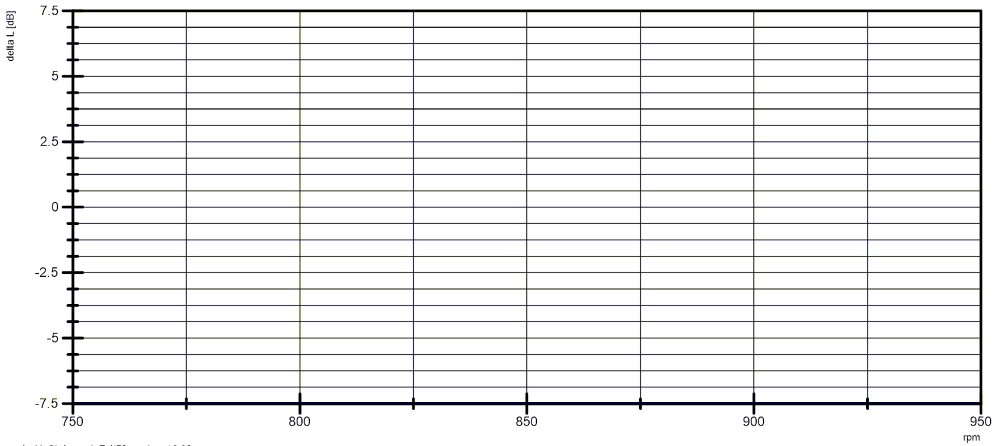
10.37 Tonality analysis - wind bin overview (page 2)





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WS [m/s]	tone f_T [Hz]	n all	n ident	delta $L_{a,k}$ [dB]	WS-BIN complete	tonal audibility
6.5	92	45	27	***-3.96***	Yes	No
7	96	151	71	***-3.92***	Yes	No
7.5	102	169	149	***-0.65***	Yes	Yes
8	106	106	97	***-1.83***	Yes	Yes
8.5	112	83	73	***-3.64***	Yes	No
9	112	75	65	***-3.86***	Yes	No
9.5	113	64	48	***-3.67***	Yes	No
10	113	46	42	***-2.51***	Yes	Yes
10.5	113	39	36	***-1.53***	Yes	Yes
11	113	31	31	***0.53***	Yes	Yes
11.5	113	26	26	***2.16***	Yes	Yes
12	113	24	24	***1.02***	Yes	Yes
12.5	112	18	18	***0.70***	Yes	Yes
13	113	21	21	***0.13***	Yes	Yes
13.5	112	17	17	***0.85***	Yes	Yes

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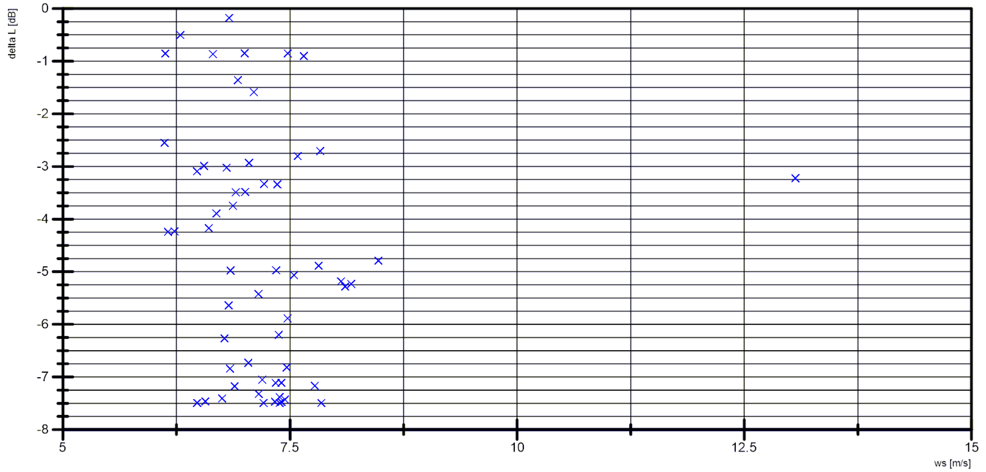
Senvion MM92

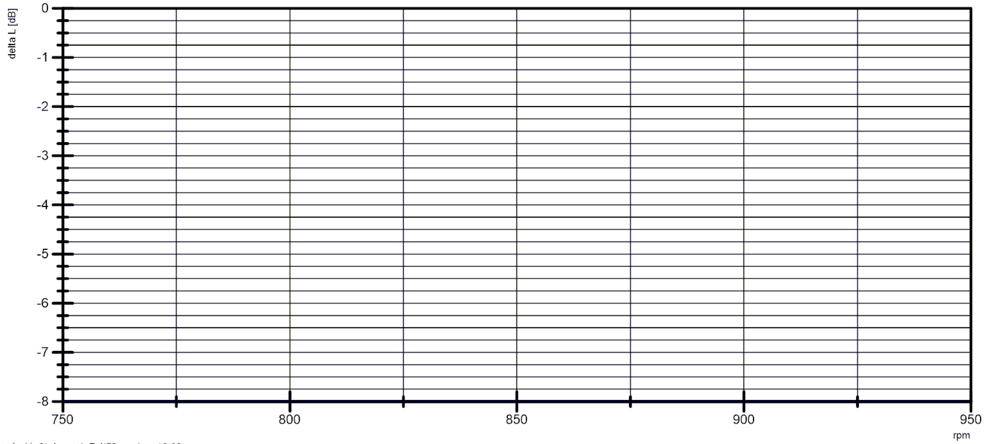
Analysis of tonality

analysis of tonality / Tonhaltigkeitsanalyse

Site / Standort:	Napier (Canada)
WTGS-SNo. / WEA-SNr.:	93129
Mode / Modus:	Standard
Date of meas./ Messdatum:	2018-10-17
Standard / Messung:	IEC 61400 - 11 Ed.3
Project-No. / Projekt-Nr.:	10029304
In charge / Bearbeiter:	Annika Johannsen

10.38 Tonality analysis - wind bin overview (page 3)





WS [m/s]	tone f_T [Hz]	n all	n ident	delta $L_{a,k}$ [dB]	WS-BIN complete	tonal audibility
6.5	466	45	8	***-3.18***	Yes	No
7	465	151	21	***-3.95***	Yes	No
7.5	466	169	16	***-4.84***	Yes	No
8	463	106	7	***-5.17***	Yes	No
8.5	462	83	1	***-4.79***	Yes	No
9		75	0		Yes	No
9.5		64	0		Yes	No
10		46	0		Yes	No
10.5		39	0		Yes	No
11		31	0		Yes	No
11.5		26	0		Yes	No
12		24	0		Yes	No
12.5		18	0		Yes	No
13	486	21	1	***-3.22***	Yes	No
13.5		17	0		Yes	No

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Senvion MM92

Analysis of tonality

analysis of tonality / Tonhaltigkeitsanalyse

Site / Standort:	Napier (Canada)
WTGS-SNo. / WEA-SNr.:	93129
Mode / Modus:	Standard
Date of meas./ Messdatum:	2018-10-17
Standard / Messung:	IEC 61400 - 11 Ed.3
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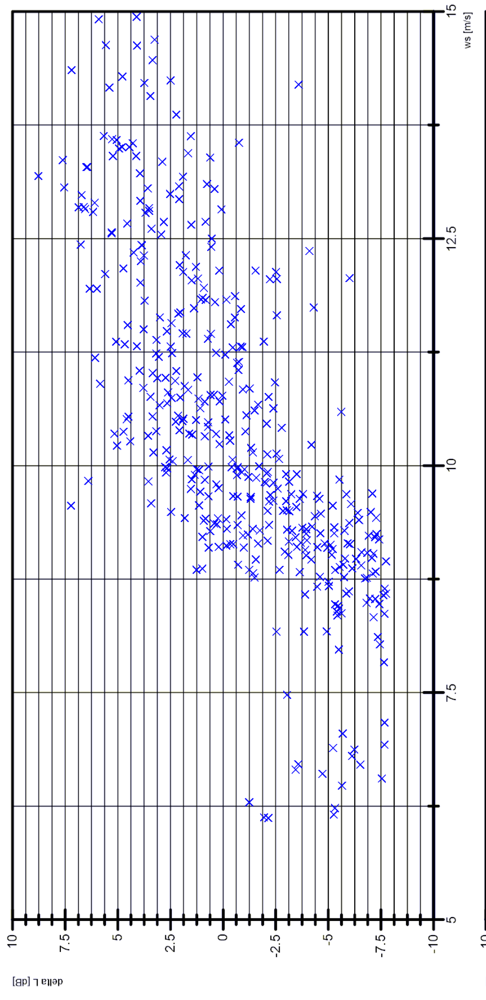
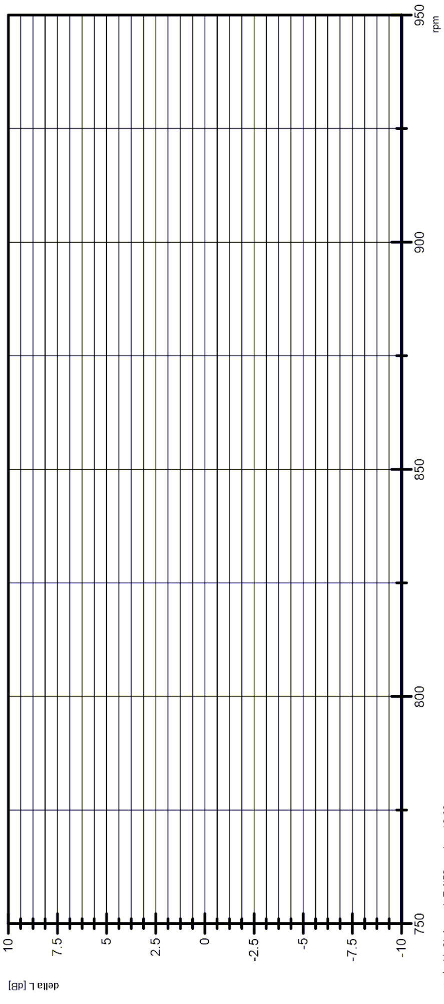
In charge / Bearbeiter:	Annika Johannsen

10.39 Tonality analysis - wind bin overview (page 4)

WS [m/s]	tone f_T [Hz]	n all	n ident	delta $L_{a,k}$ [dB]	WS-BIN complete	tonal audibility
6.5	609	45	7	-4.22	Yes	No
7	614	151	6	-6.34	Yes	No
7.5	578	169	1	-3.04	Yes	No
8	587	106	7	-5.21	Yes	No
8.5	597	83	21	-6.01	Yes	No
9	599	75	61	-3.17	Yes	No
9.5	600	64	61	-1.28	Yes	Yes
10	600	46	45	0.61	Yes	Yes
10.5	599	39	39	1.72	Yes	Yes
11	599	31	31	2.14	Yes	Yes
11.5	602	26	26	1.88	Yes	Yes
12	599	24	24	2.06	Yes	Yes
12.5	598	18	18	3.42	Yes	Yes
13	598	21	21	4.84	Yes	Yes
13.5	599	17	17	4.62	Yes	Yes





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Site / Standort: Napier (Canada)
WTGS-SNo. / WEA-SNr.: 93129
Mode / Modus: Standard
Date of meas./ Messdatum: 2018-10-17
Standard / Messung: IEC 61400 - 11 Ed.3
Project-No. / Projekt-Nr.: 10029304
In charge / Bearbeiter: Annika Johannsen

Senvion MM92

Analysis of tonality

analysis of tonality / Tonhaltigkeitsanalyse

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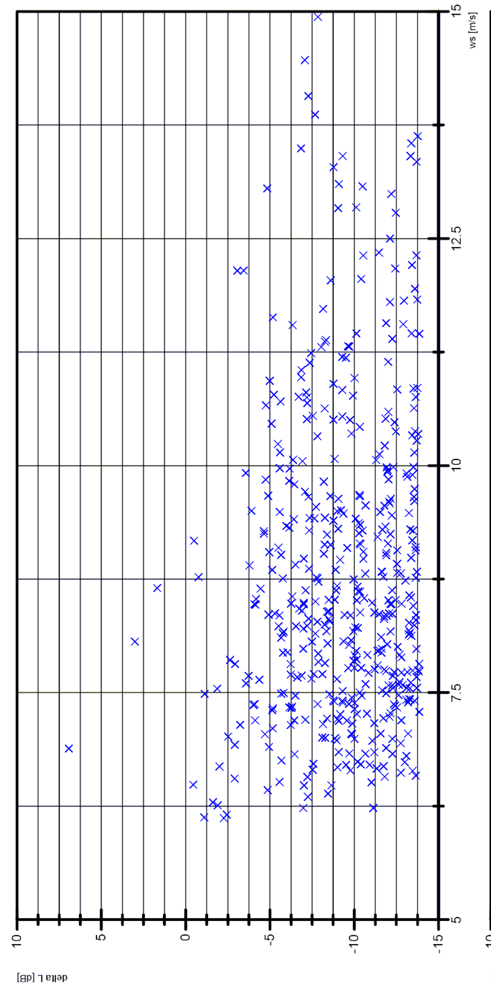
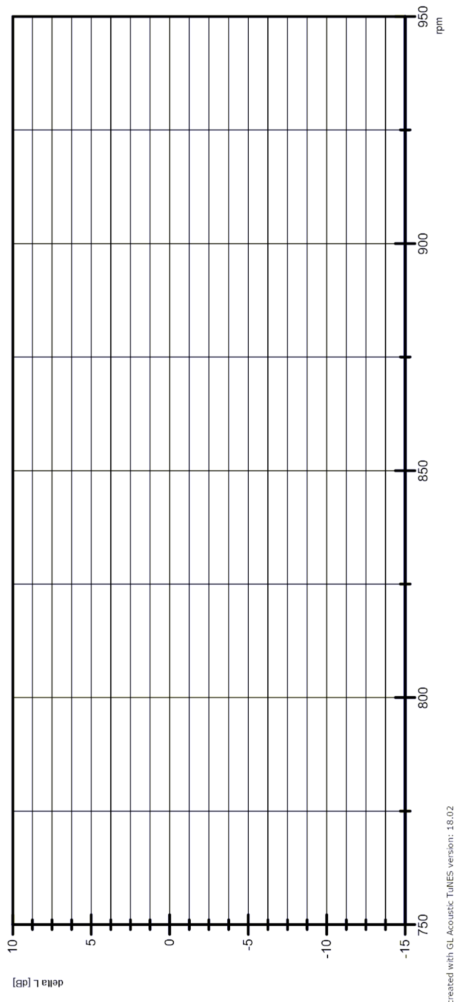
10.40 Tonality analysis - wind bin overview (page 5)

WS [m/s]	tone f_T [Hz]	n all	n ident	delta $L_{a,k}$ [dB]	WS-BIN complete	tonal audibility
6.5	4571	45	28	-6.50	Yes	No
7	4526	151	42	-5.54	Yes	No
7.5	4527	169	72	-8.38	Yes	No
8	4535	106	55	-7.68	Yes	No
8.5	4540	83	58	-7.91	Yes	No
9	4530	75	44	-7.81	Yes	No
9.5	4528	64	43	-8.76	Yes	No
10	4541	46	25	-8.19	Yes	No
10.5	4532	39	23	-8.86	Yes	No
11	4535	31	19	-8.43	Yes	No
11.5	4544	26	14	-9.11	Yes	No
12	4542	24	10	-8.31	Yes	No
12.5	4501	18	4	-11.81	Yes	No
13	4525	21	7	-9.01	Yes	No
13.5	4534	17	7	-10.44	Yes	No





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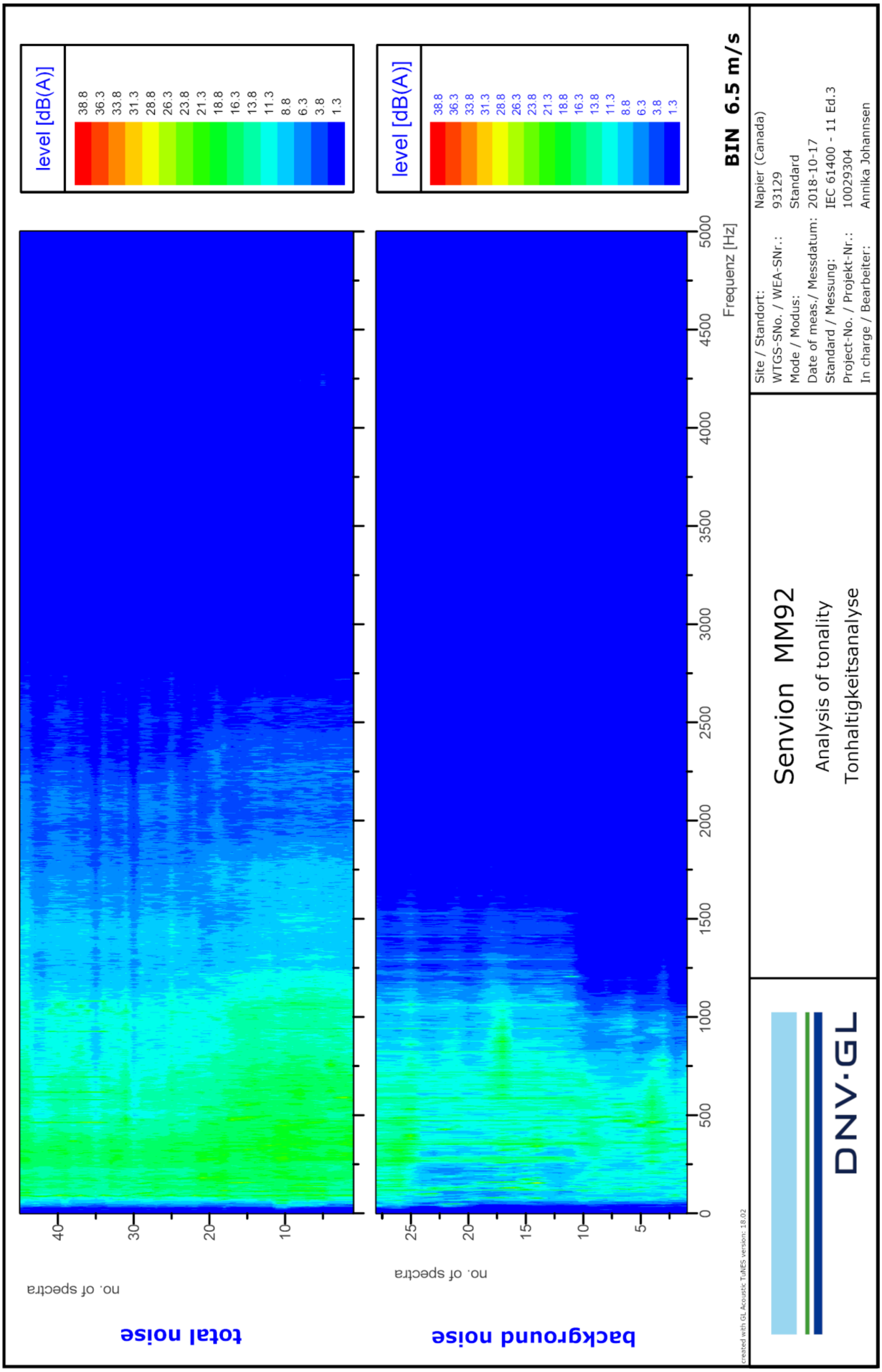
Site / Standort: Napier (Canada)
WTGS-SNo. / WEA-SNr.: 93129
Mode / Modus: Standard
Date of meas./ Messdatum: 2018-10-17
Standard / Messung: IEC 61400 - 11 Ed.3
Project-No. / Projekt-Nr.: 10029304
In charge / Bearbeiter: Annika Johannsen

Senvion MM92

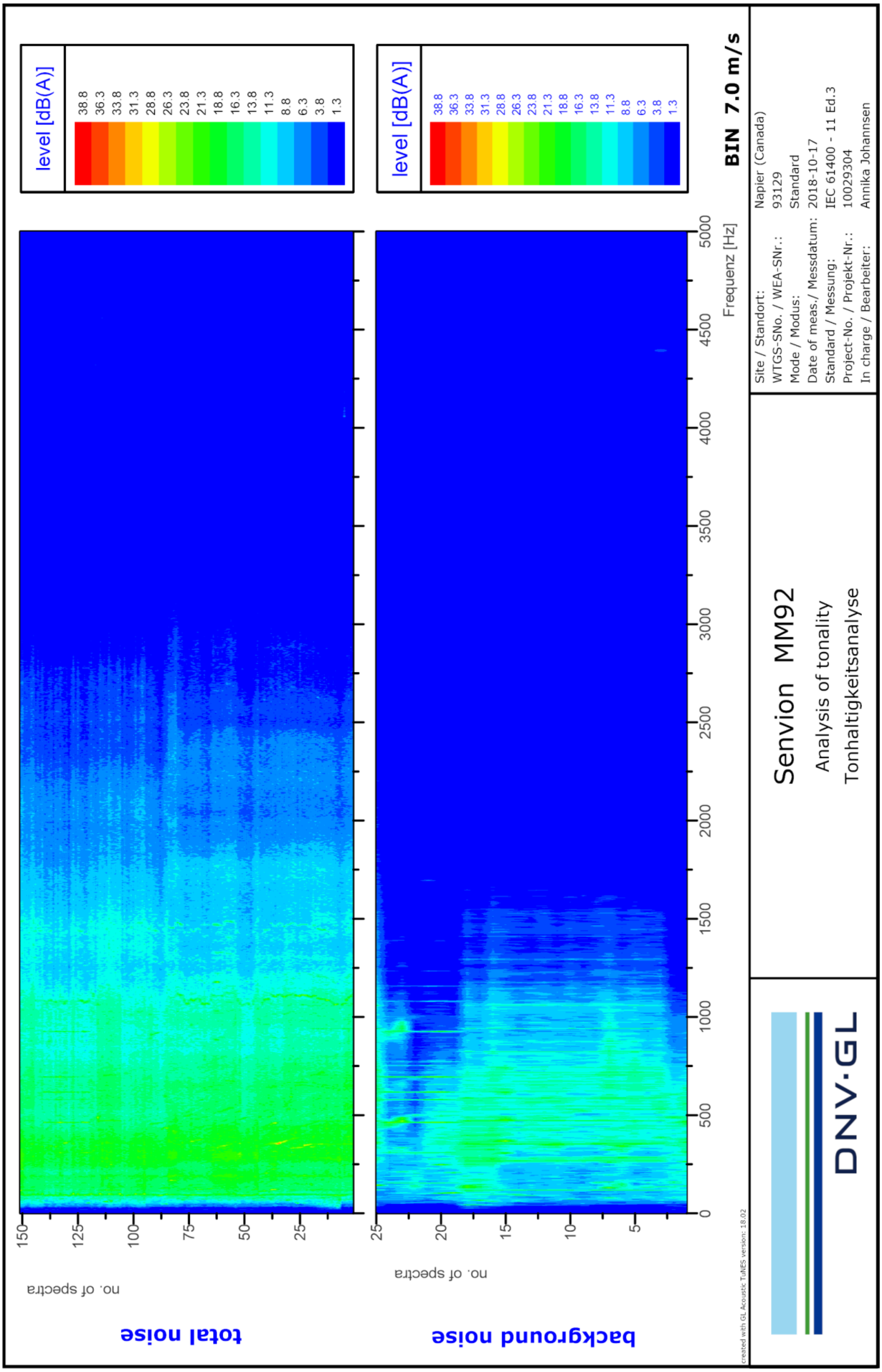
Analysis of tonality

analysis of tonality / Tonhaltigkeitsanalyse

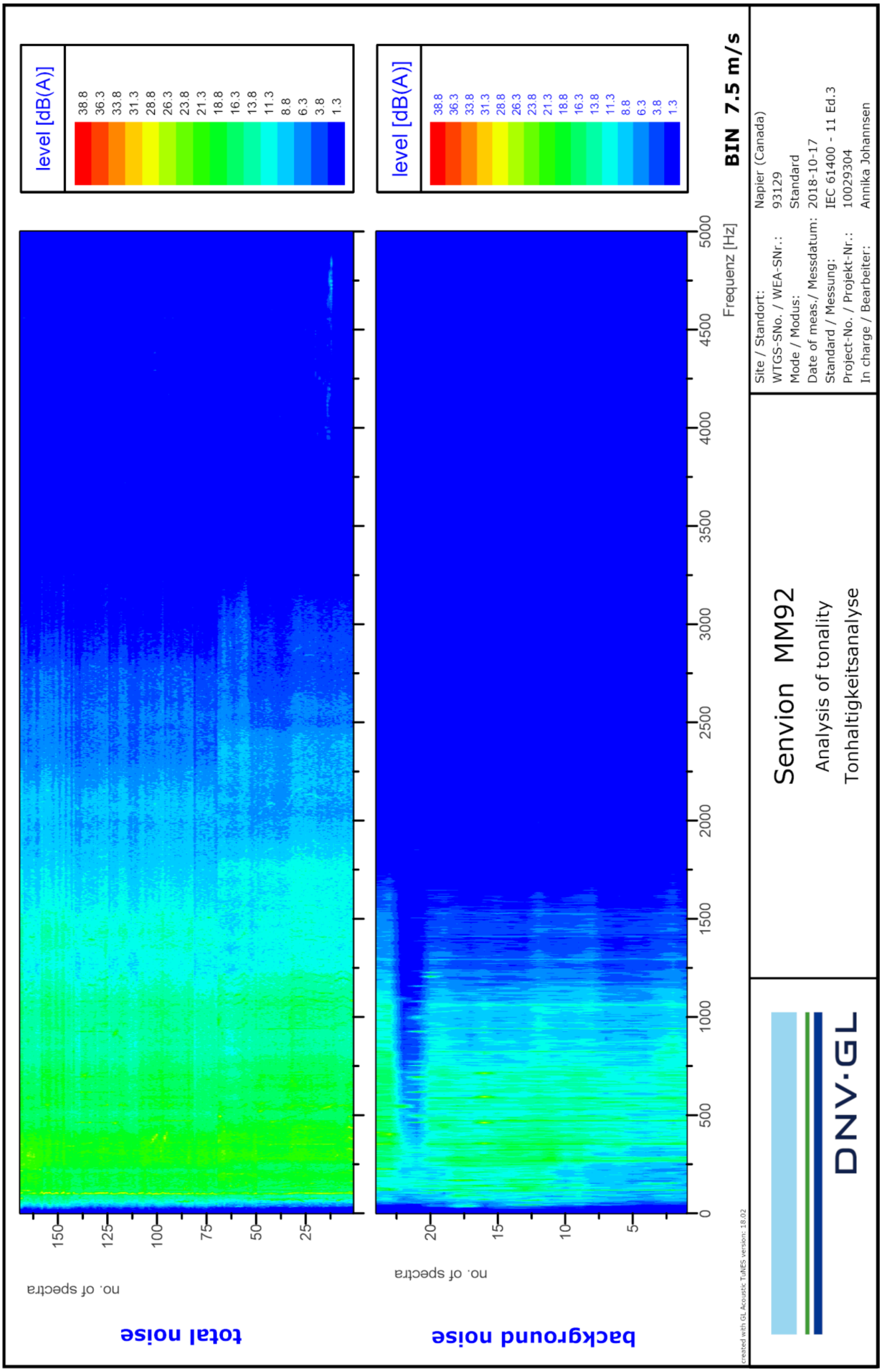
10.41 Frequency spectra of total and background noise at a WS of 6.5 m/s at hub height



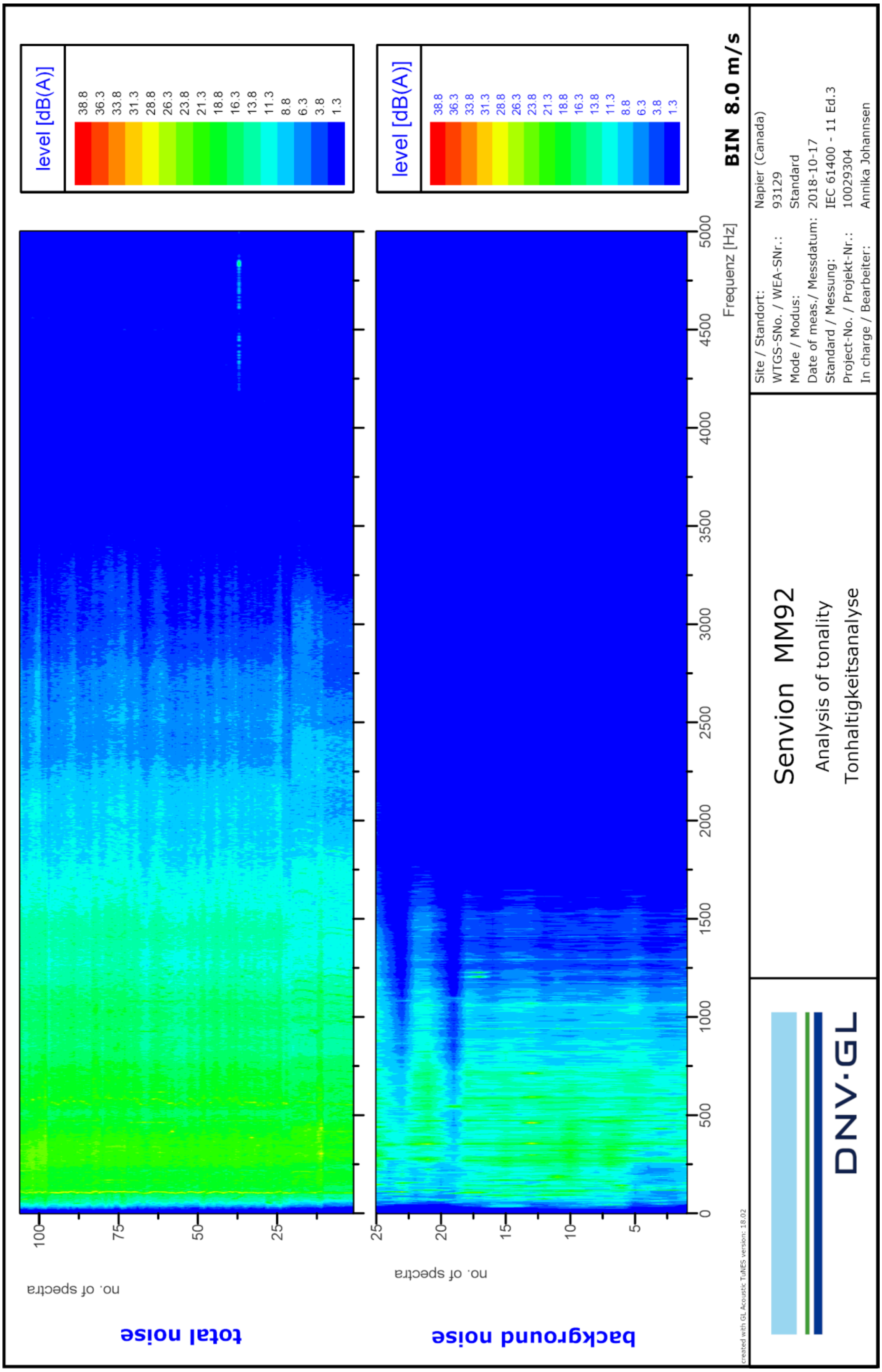
10.42 Frequency spectra of total and background noise at a WS of 7.0 m/s at hub height



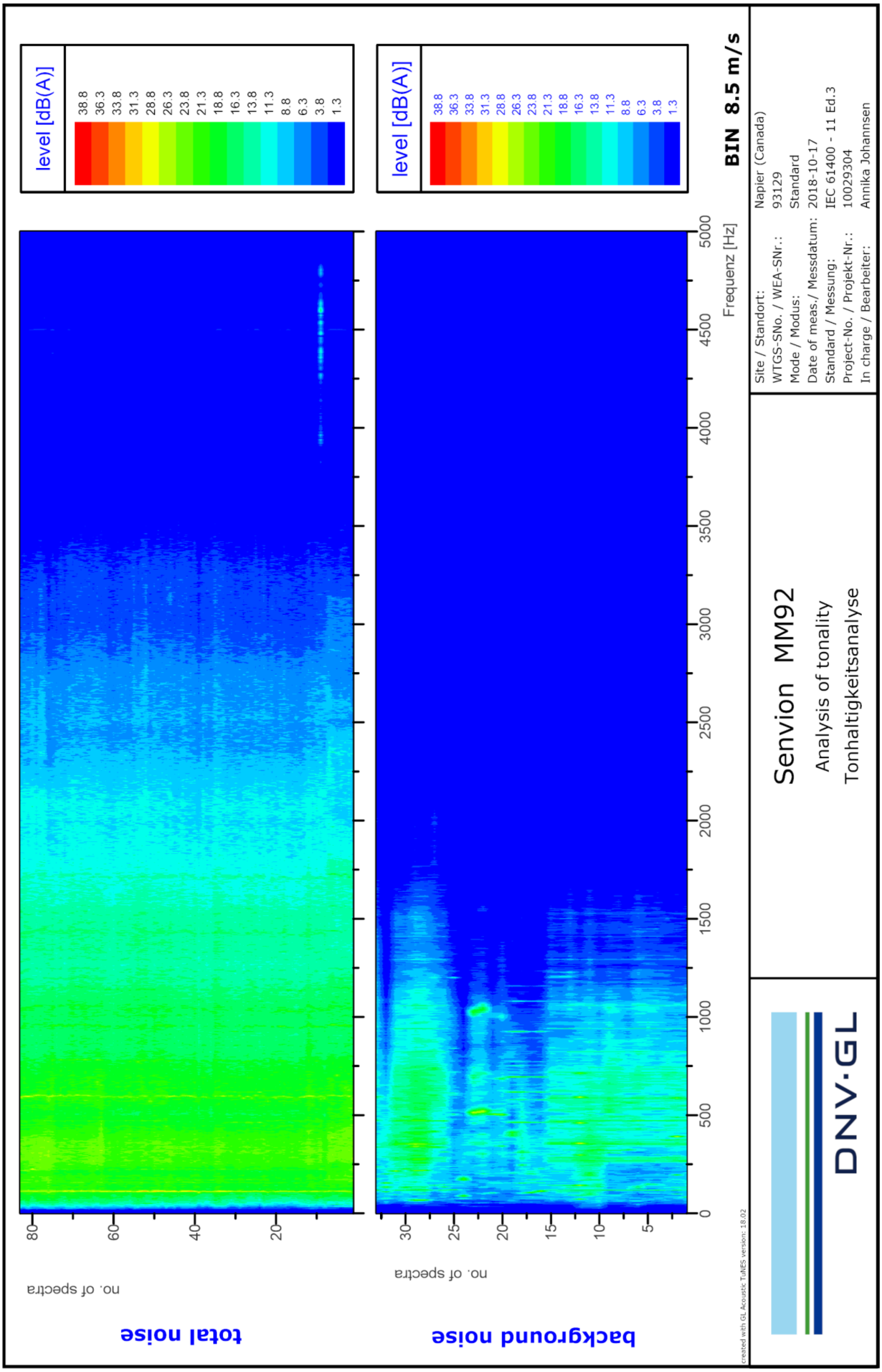
10.43 Frequency spectra of total and background noise at a WS of 7.5 m/s at hub height



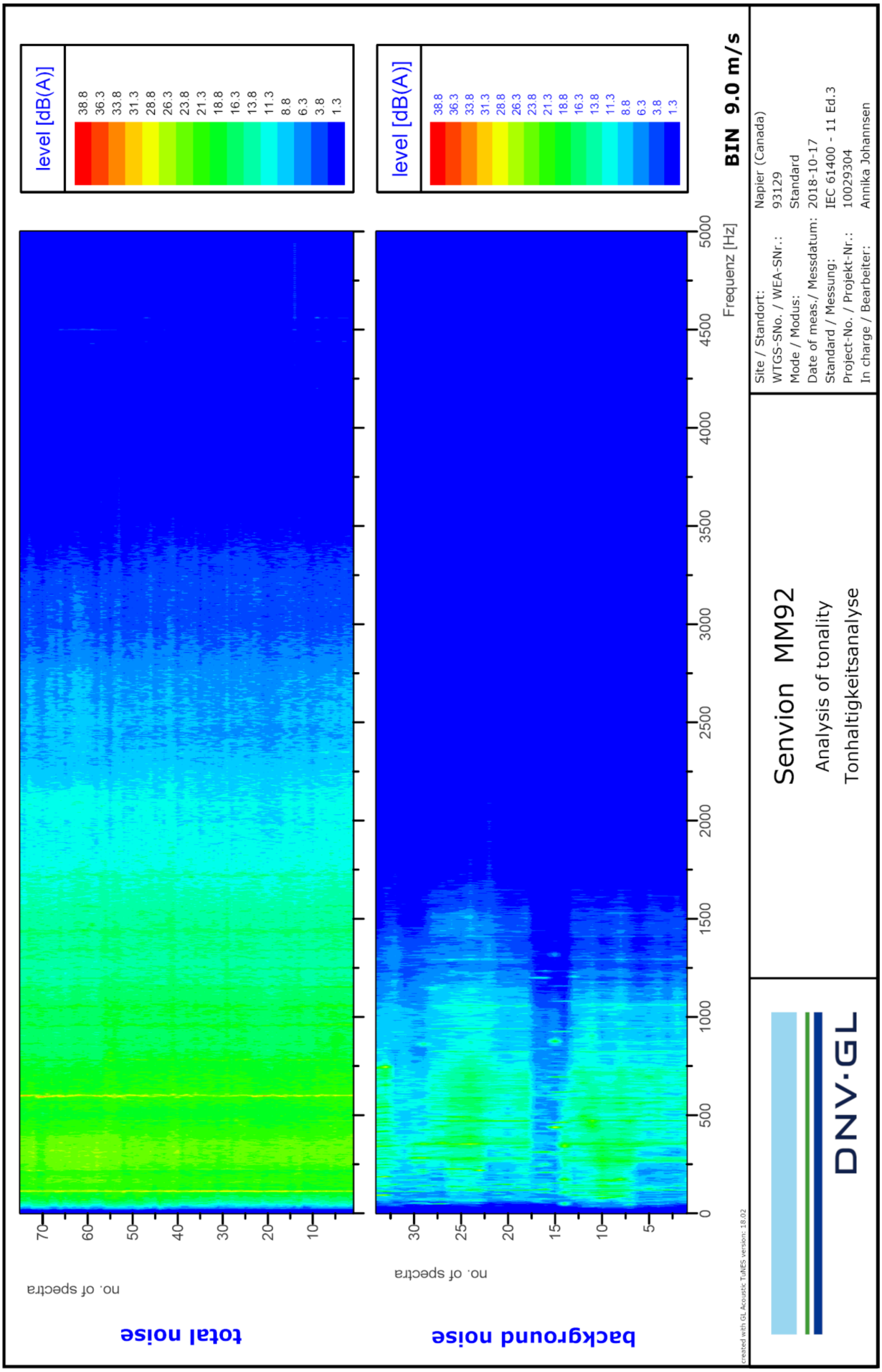
10.44 Frequency spectra of total and background noise at a WS of 8.0 m/s at hub height



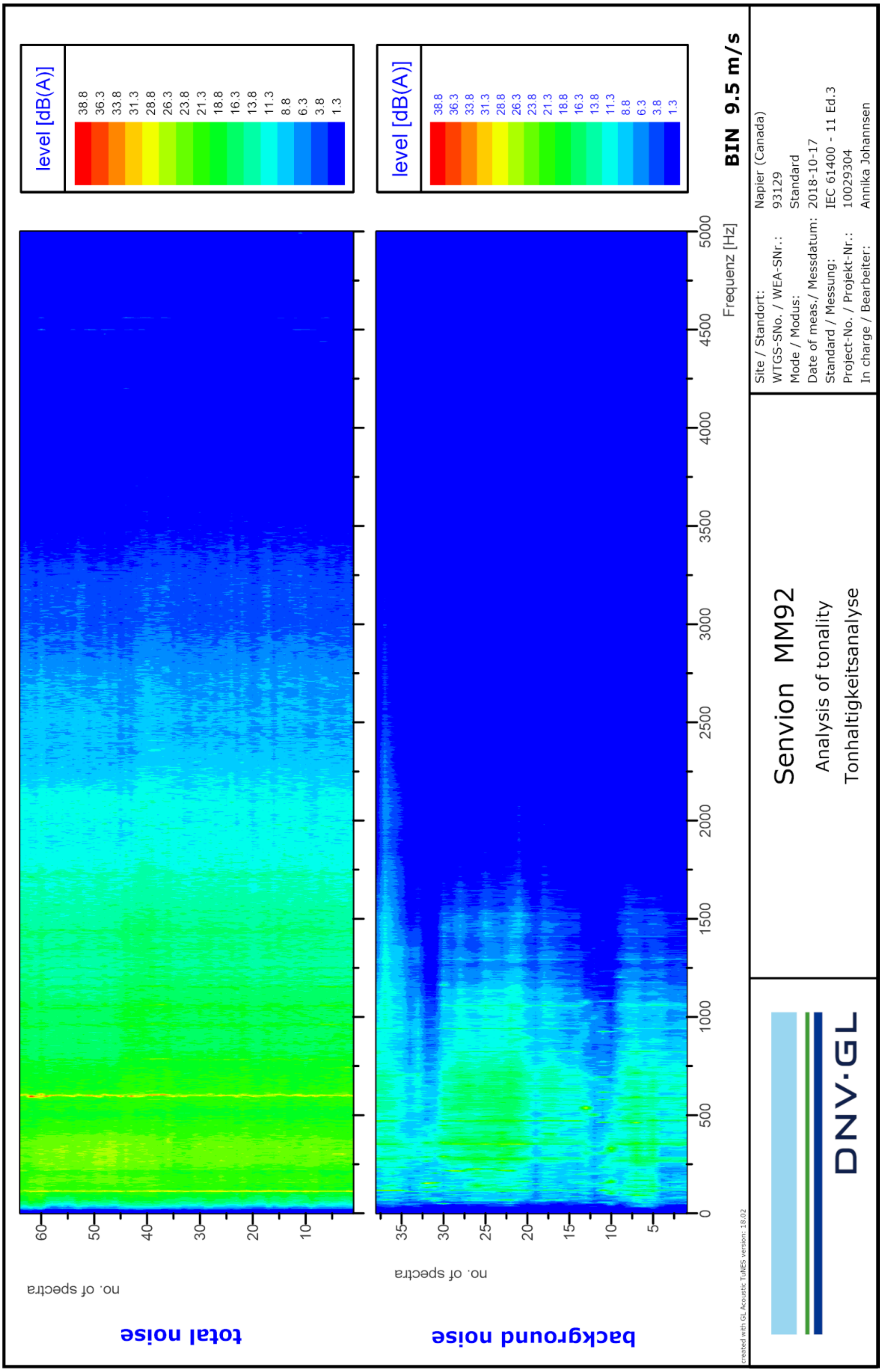
10.45 Frequency spectra of total and background noise at a WS of 8.5 m/s at hub height



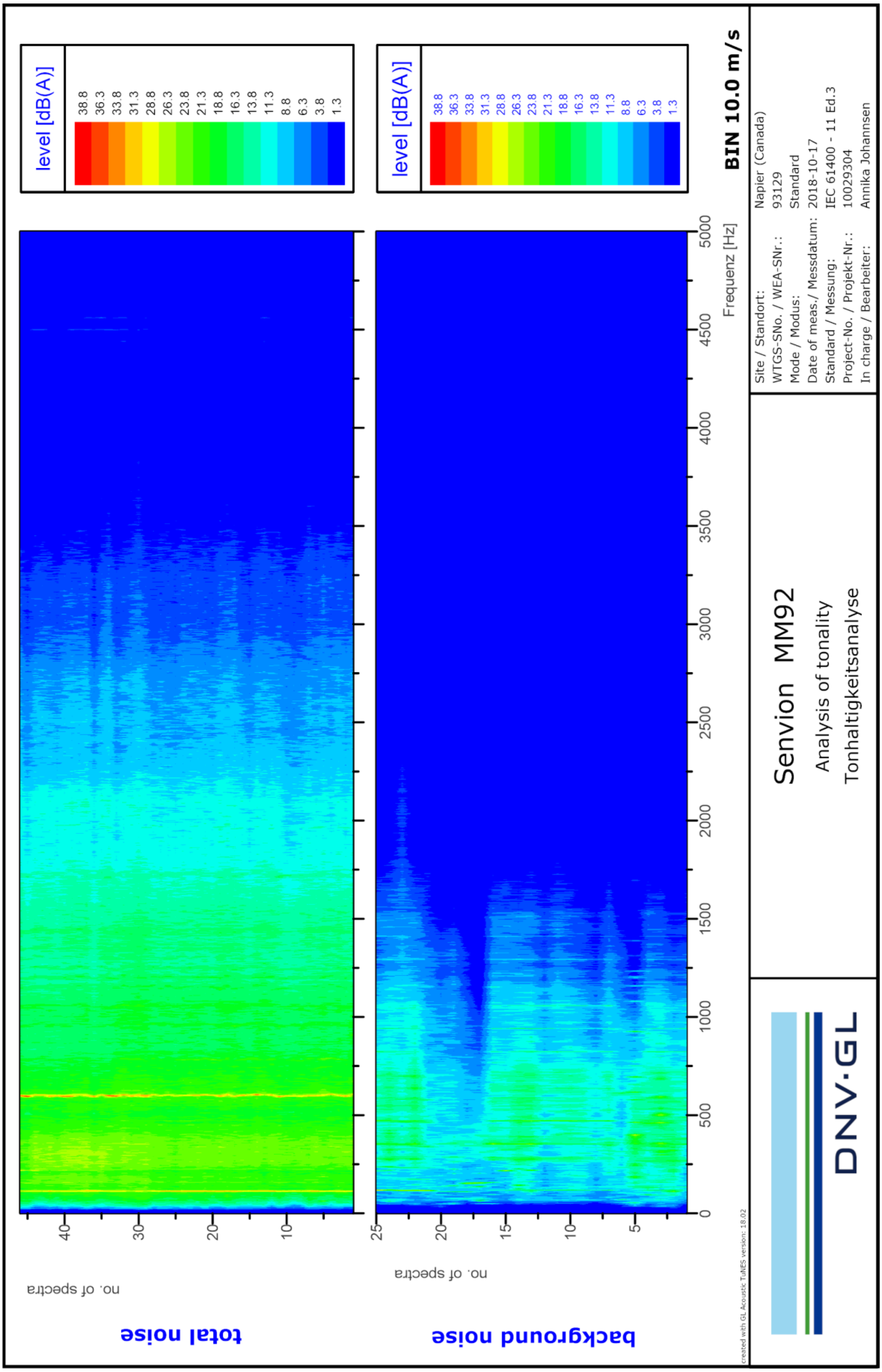
10.46 Frequency spectra of total and background noise at a WS of 9.0 m/s at hub height



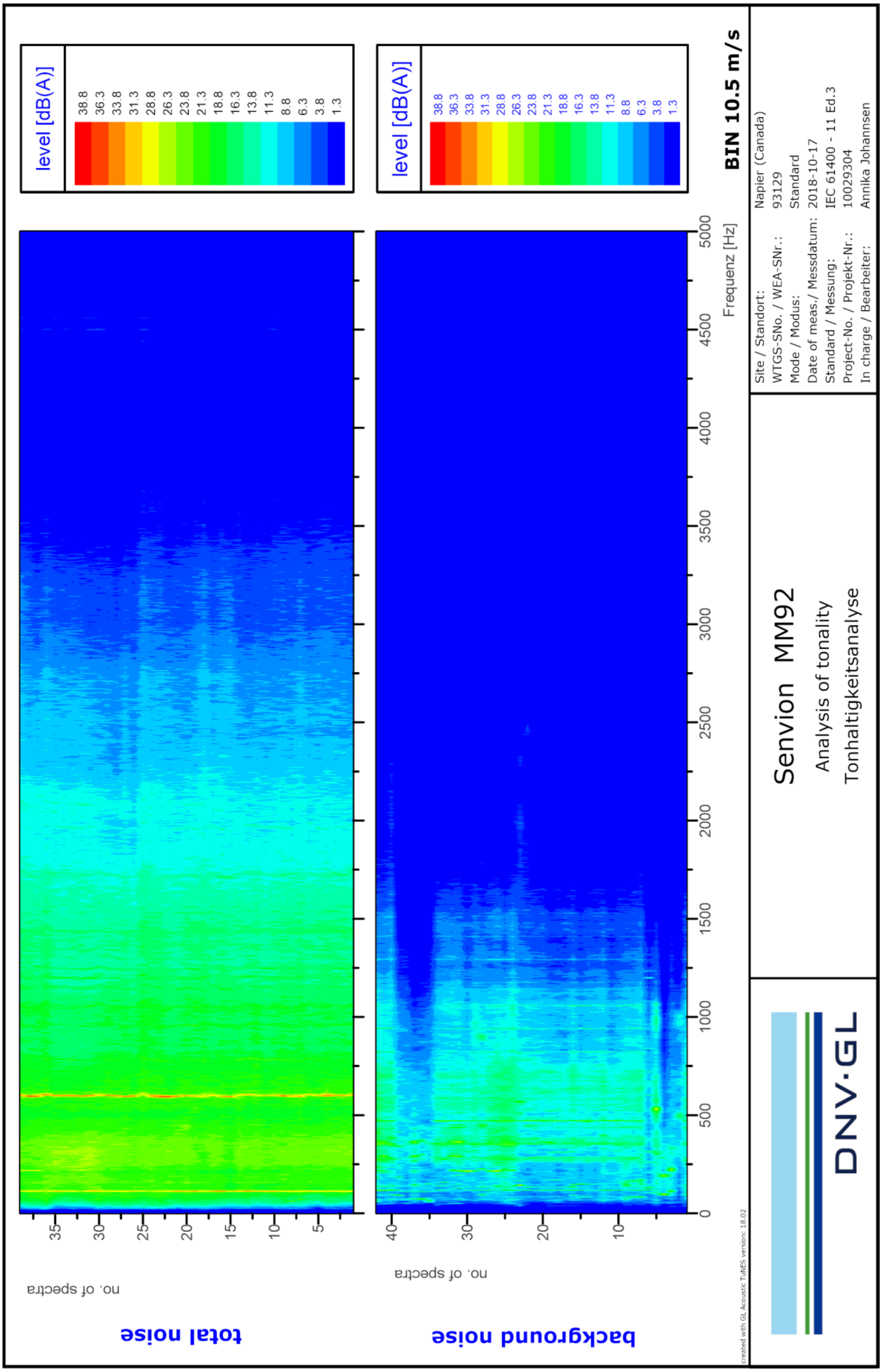
10.47 Frequency spectra of total and background noise at a WS of 9.5 m/s at hub height



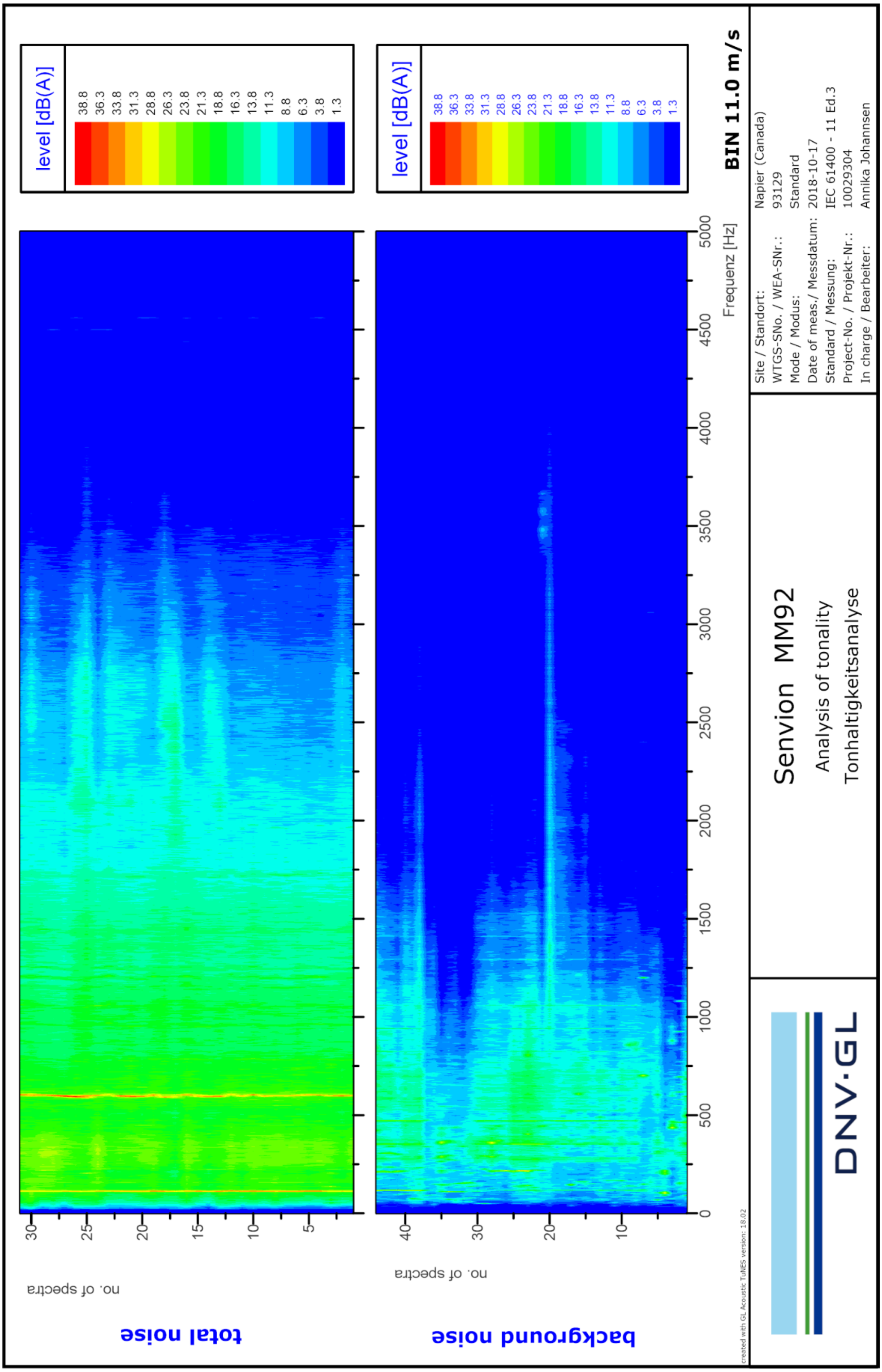
10.48 Frequency spectra of total and background noise at a WS of 10.0 m/s at hub height



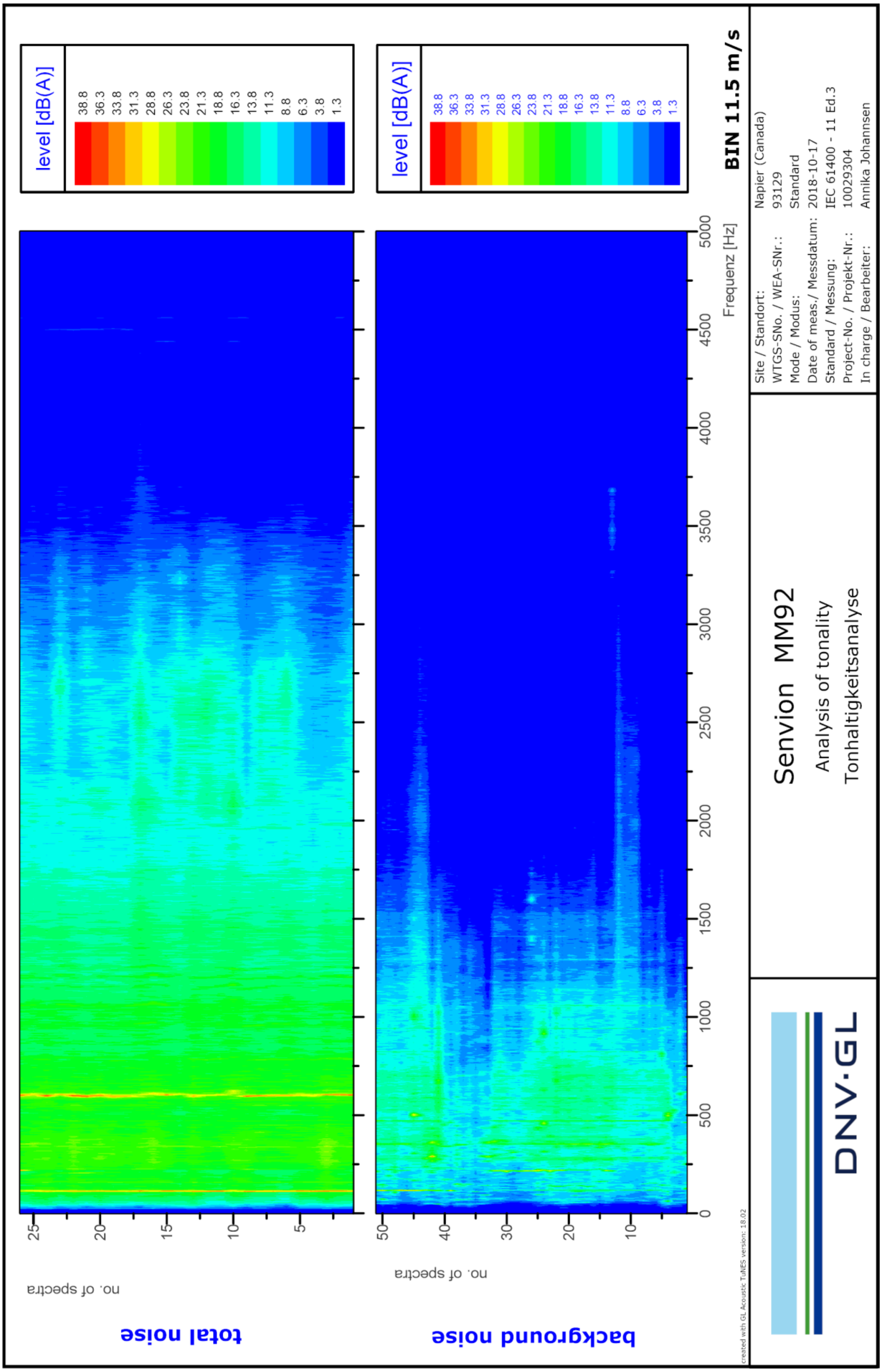
10.49 Frequency spectra of total and background noise at a WS of 10.5 m/s at hub height



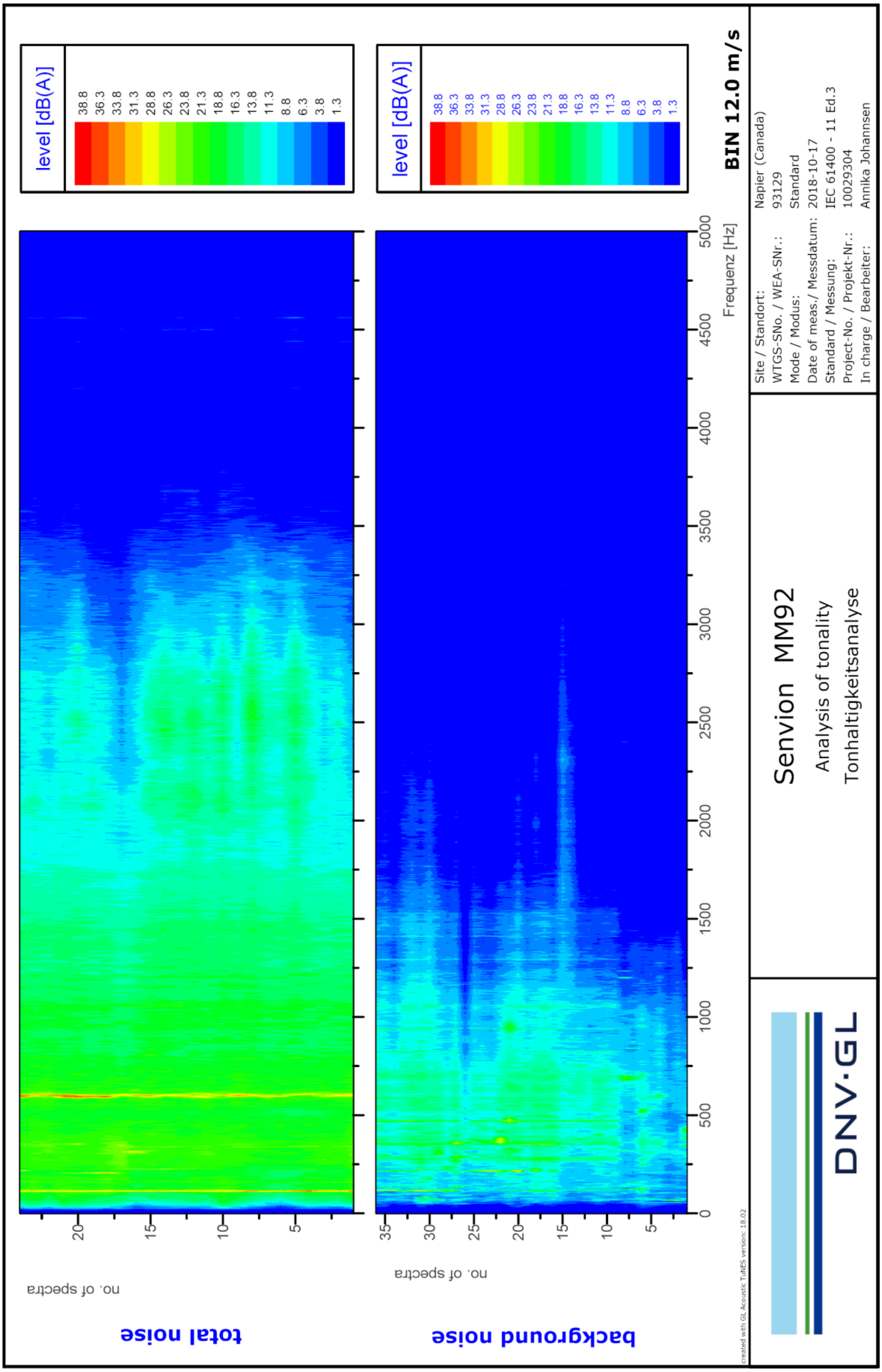
10.50 Frequency spectra of total and background noise at a WS of 11.0 m/s at hub height



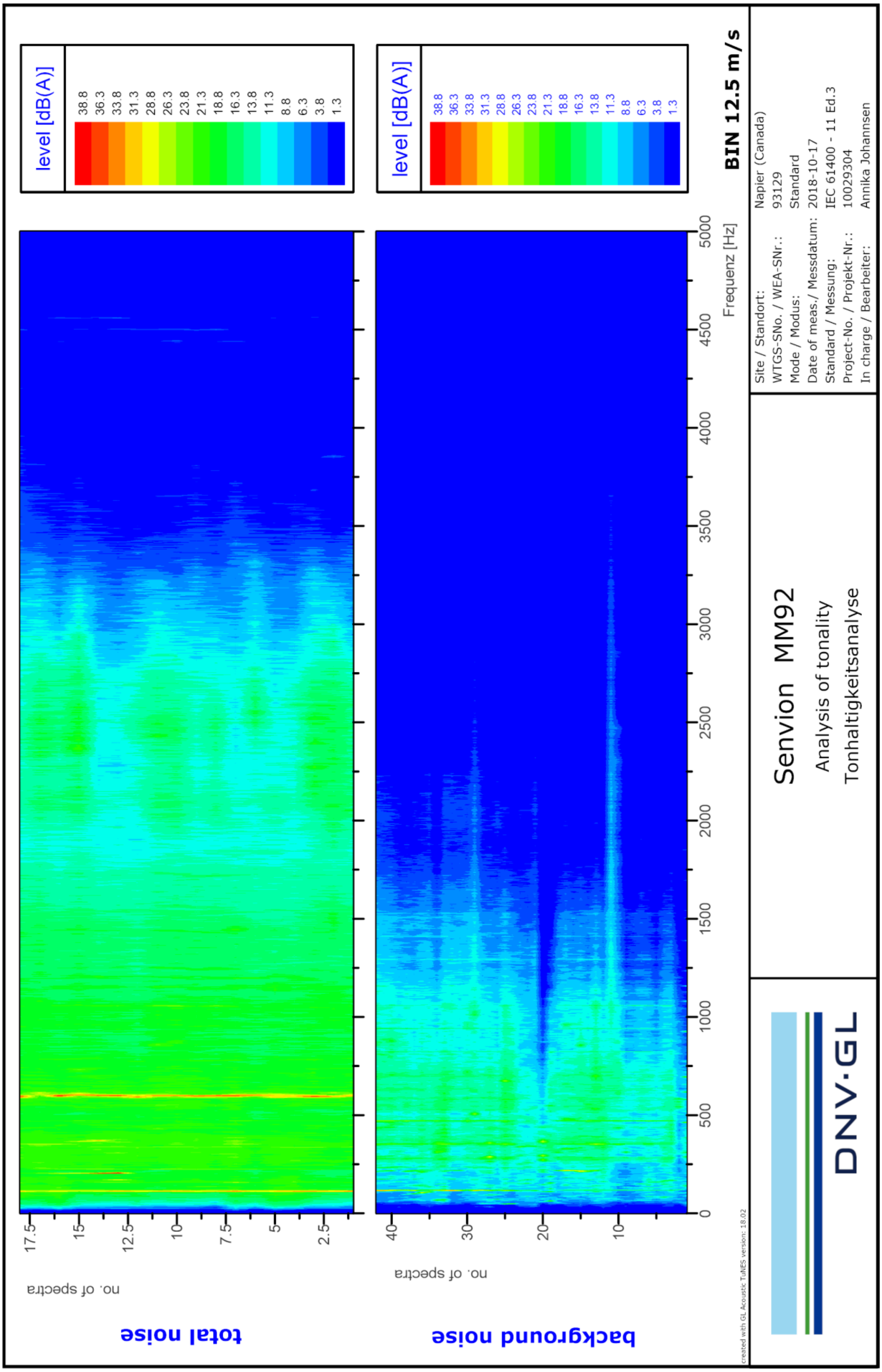
10.51 Frequency spectra of total and background noise at a WS of 11.5 m/s at hub height



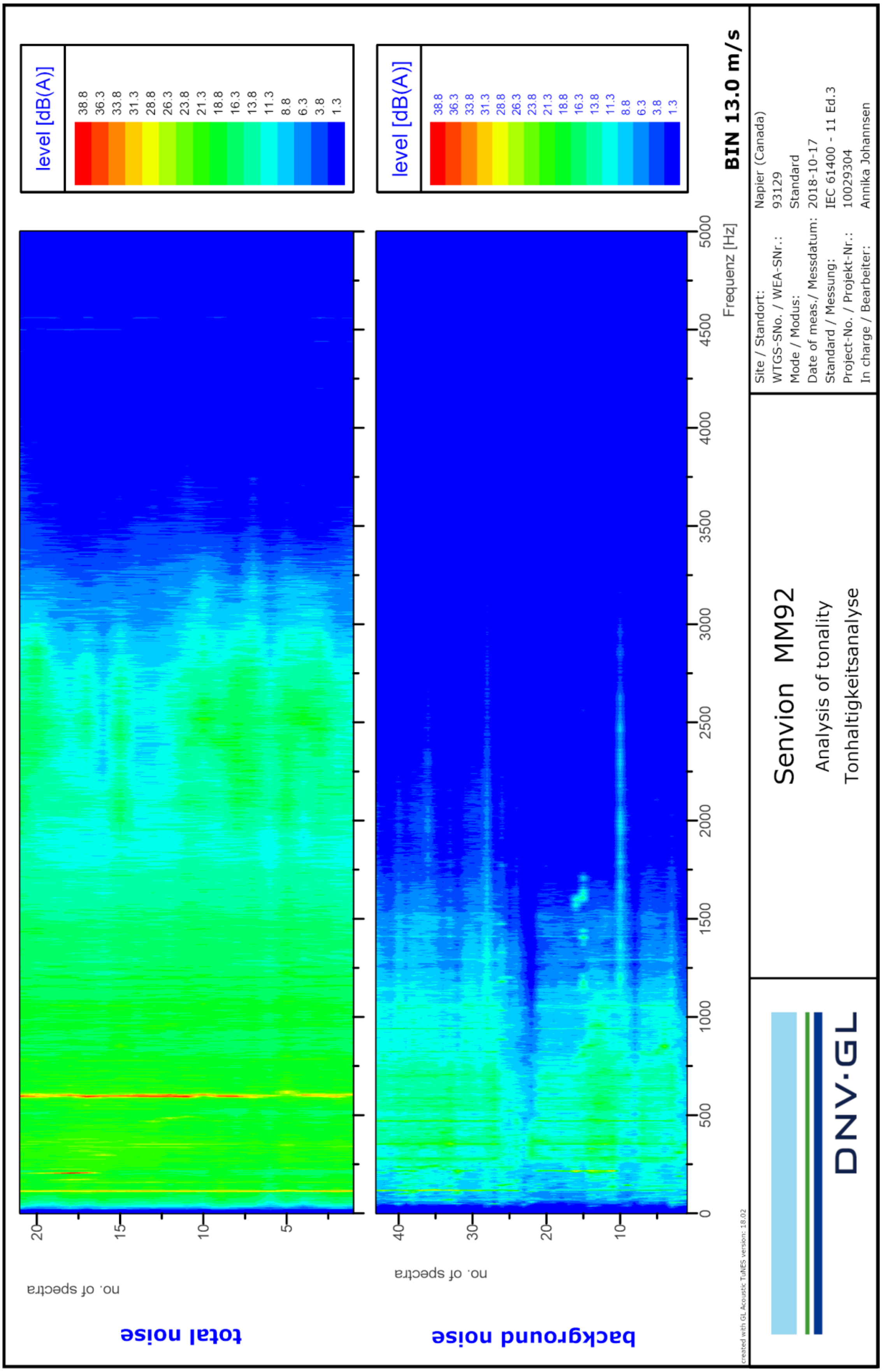
10.52 Frequency spectra of total and background noise at a WS of 12.0 m/s at hub height



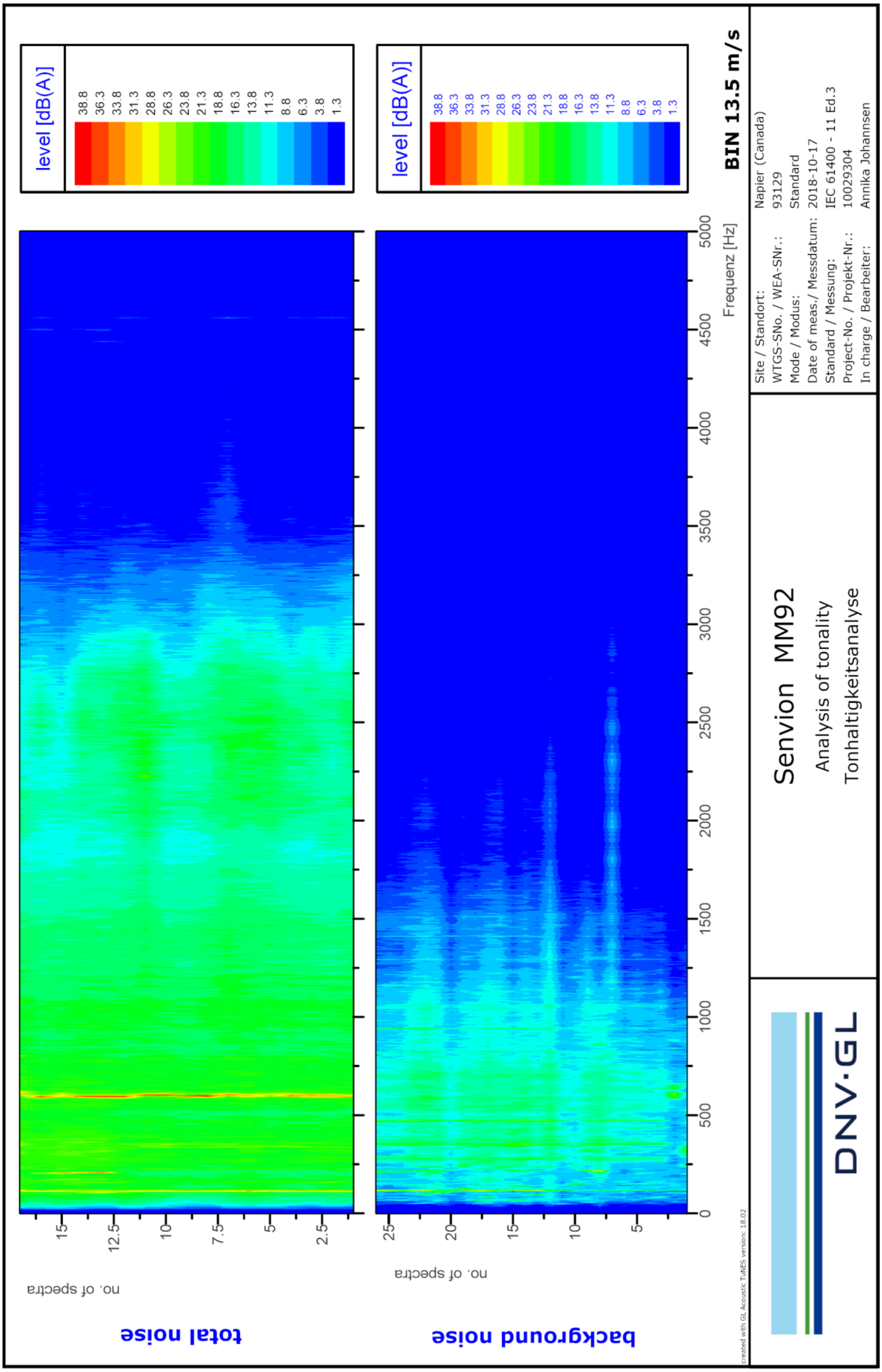
10.53 Frequency spectra of total and background noise at a WS of 12.5 m/s at hub height



10.54 Frequency spectra of total and background noise at a WS of 13.0 m/s at hub height



10.55 Frequency spectra of total and background noise at a WS of 13.5 m/s at hub height



10.56 Power curve used for the analysis

3 Elektrische Leistungskurve und Schallleistungspegel

3.1 Elektrische Leistungskurve

Werte bei einer Luftdichte von 1,225 kg/m³

Windgeschwindigkeit v [m/s]	Elektrische Leistung P [kW]	Schubbeiwert c_S [-]	Leistungsbeiwert c_P [-]
3,0	20	0,98	0,180
4,0	94	0,87	0,357
5,0	205	0,79	0,398
6,0	391	0,79	0,440
7,0	645	0,79	0,457
8,0	979	0,79	0,465
9,0	1375	0,74	0,458
10,0	1795	0,69	0,436
11,0	2000	0,54	0,365
12,0	2040	0,39	0,287
13,0	2050	0,29	0,227
14,0	2050	0,23	0,182
15,0	2050	0,19	0,148
16,0	2050	0,15	0,122
17,0	2050	0,13	0,101
18,0	2050	0,11	0,085
19,0	2050	0,09	0,073
20,0	2050	0,08	0,062
21,0	2050	0,07	0,054
22,0	2050	0,06	0,047
23,0	2050	0,06	0,041
24,0	2050	0,05	0,036

Die elektrische Leistung gilt bei reiner Wirkleistungsvorgabe.

Diese Leistungskurve gilt für die Niederspannungsseite des Transformators.

10.57 Extract from REA 8388-9B7N4J; Schedule B

SCHEDULE A

Facility Description

The Facility shall consist of the construction, installation, operation, use and retiring of the following:

(a) a total of two (2) REpower MM92 wind turbine generators each rated at a maximum of 2.05 megawatts (MW) generating output capacity with a maximum total name plate capacity of 4.1 megawatts (MW), each with a hub height of 100 metres above grade, and sited at the locations shown in SCHEDULE B; and

(b) associated ancillary equipment, systems and technologies, on-site access roads, underground cabling and overhead distribution lines,

all in accordance with the Application.

SCHEDULE B
Table B1: Coordinates of the Equipment and Noise Specifications

Coordinates of the Equipment below in UTM, Z17-NAD83 projection

Source ID	Maximum Sound Power Level (dBA)	Easting (metres)	Northing (metres)	Source Description
WTG1	104.2	440,074	4,756,817	Wind Turbine REpower MM92 2.05 MW, 100 metres hub height
WTG2	104.2	441,437	4,756,769	Wind Turbine REpower MM92 2.05 MW, 100 metres hub height

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10.58 Manufacturer's certificate

Herstellerbescheinigung, Kurzfassung für akustische Nachmessungen
Manufacturer's certificate, short version for control measurements of acoustic noise

1. Allgemeine Informationen – General information	
Anlagenhersteller – turbine manufacturer:	Senvion GmbH
Spezifische Anlagenbezeichnung – specific turbine type name:	MM92 CCV
Seriennummer der vermessenden WEA – serial number of tested WT:	93129
Standort der vermessenden WEA – location of tested WT:	Napier
Koordinaten des Standortes – coordinates of turbine location:	-81.734766 / 42.9616140
Rotorachse – rotor axis:	horizontal – horizontal ☒ vertikal – vertical ☐
Nennleistung – rated power:	2050 kW
Leistungsregelung – power control:	pitch ☒ stall ☐
Nabenhöhe über Grund – hub height above ground:	100 m
Nabenhöhe über Fundamentflansch – hub height above top of foundation flange:	98 m
Nennwindgeschwindigkeit – rated wind speed:	12,5 m/s
Ein- / Abschaltwindgeschwindigkeit – cut-in / cut-out wind speed:	3,0 m/s – 24,0 m/s
2. Rotor - Rotor	
Durchmesser – rotor diameter:	92,5 m
Anzahl der Blätter – number of blades:	3
Nabenart – kind of hub:	pendelnd – teetered ☐ starr – rigid ☒
Anordnung zum Turm – position relative to tower:	Luvseitig / upwind
Drehzahlbereich/Drehzahlstufen – rotor speed range/stages of rotor speed:	7,5 – 15,0 rpm
Rotorblatteinstellwinkel – rotor blade pitch setting:	variabel (0 – 91°)
Konuswinkel – cone angel:	3,5°
Achsneigung – tilt angle:	5°
Horizontaler Abstand zwischen Rotormittelpunkt und Turmmittellinie – horizontal distance between centre of rotor and tower centre line:	3150 mm
3. Rotorblatt – Rotor blade	
Hersteller – manufacturer:	Power Blades
Typenbezeichnung – type:	RE45.2
Seriennummer der Rotorblätter – serial number of rotor blades:	0026 – 0028 - 0029
Zusatzkomponenten (z.B. strips, Vortex-Gen., Turbulatoren) – additional components (e.g. stall strips, vortex gen., trip strips):	Serrations
4. Getriebe – Gearbox	
Hersteller – manufacturer:	ZF Hansen
Typenbezeichnung – type:	EH854A-012L
Seriennummer des Getriebes – serial number of gear box:	LM0313
Ausführung – design:	Planeten-/Stirnradgetriebe Planetary/spur gearbox
Übersetzungsverhältnis – gear ratio:	1:96
5. Generator – Generator	
Hersteller – manufacturer:	Siemens
Typenbezeichnung – type:	JFRA-560SR-06A
Seriennummer des Generators – serial number of generator:	6014631
Anzahl der Generatoren – number of generators:	1
Art des Generators (z.B. synchron, asynchr.) – kind of generator (e.g. synchronous, asynchr.):	doppeltgespeist, asynchrony Asynchronous double - fed
Nennleistung(en) – rated power values(s):	2100 kW
Drehzahlbereich/Drehzahlstufen – rotor speed range/stages of rotor speed:	720 – 1400 rpm
6. Turm – Tower	
Ausführung – design:	konisch – conical
Material – material:	Stahl
Durchmesser Turmfuß – foot of the tower diameter	4,3 m
7. Betriebsführung / Regelung – Control system	
Art der Leistungsregelung – kind of power control:	Pitch
Antrieb der Leistungsregelung – actuation of power control:	Elektrisch
Hersteller der Betriebsführung / Regelung – manufacturer of control system:	Bachmann
Typenbezeichnung der Betriebsführung / Regelung – control system type:	MPC 293
Bezeichnung der verwendeten Steuerungskurve – designation of used control setup:	Standard
Bezeichnung / Messbericht der verwendeten Leistungskurve – designation of power curve report:	Standard

22-Oct-2018

Datum, Stempel und Unterschrift des Herstellers
Date, manufacturer's stamp and signature

Der Hersteller der Windenergieanlage bestätigt, dass die WEA, deren Schallemission, Leistungskurve und elektrische Eigenschaften in den Prüfberichten abgebildet sind, die o.g. Eigenschaften aufweist. – The manufacturer of the wind turbine (WT) confirms that the WT whose noise level, performance curve and power quality is measured and depicted in the test reports, shows the characteristics given above.

Senvion USA Corp.
1600 Stout St. #2000
Denver, CO 80202

10.59 Measuring equipment

Beschreibung *description*	**Fabrikat** *supplier*	**Typ** *Type*	**WT Nr./Ser.Nr.** *WT stock number/ serial number*	**letzte Kalibrierung** *last calibration*	**nächste Kalibrierung** *next calibration*
Schallpegelmesser *sound level meter*	Svantek	979	59702	Jun. 17	Jun. 19
Mikrofon *microphone*	G.R.A.S.	40AE	242494	**gemeinsame Kalibration** *common calibration*	**gemeinsame Kalibration** *common calibration*
Vorverstärker *preamp.*	Svantek	SV17	57849		
Mikrofonkabel *microphone cable*	Svantek	SC93/10	-		
Akustischer Kalibrator *acoustic calibrator*	CAL	200	5593	Mrz. 18	Mrz. 19
Primärwindschirm *primary wind shield*	Brüel & Kjær	UA 0237	-		
Sekundärwindschirm *secondary wind shield*	DNVGL	EWS 15-22	GLGH-428618-336000070		
Anemometer *anemometer*	Thies Clima	4.9200.00.000	GLGH 428616-113000306 (10160038)	Nov. 16	Nov. 18
Windrichtungsgeber *wind direction sensor*	Thies Clima	4.9200.00.000	GLGH 428616-113000306 (10160038)	Nov. 16	Nov. 18
Temperaturgeber *temperature sensors*	Thies Clima	4.9200.00.000	GLGH 428616-113000306 (10160038)		
Luftdruckgeber *pressure sensors*	Thies Clima	4.9200.00.000	GLGH 428616-113000306 (10160038)		
Feuchtesensor *humidity sensor*	Thies Clima	4.9200.00.000	GLGH 428616-113000306 (10160038)		
Niederschlagssensor *rain sensor*	Thies Clima	4.9200.00.000	GLGH 428616-113000306 (10160038)		
WEA Box	Expert	EX9017/F	GLGH-428616-323000015 (66024)	Nov. 16	Nov. 18
Laser-Entfernungsmesser *laser distance meter*	Lasertech	TruePulse 200	-		
Erfassungsrechner *data acquisition computer*	Lenovo	X230	-		
Erfassungs- und Auswertesoftware *data acquisition and analytical software*	GfS Aachen Microsoft DATALOG GmbH	DIAdem 18.0 Office 365 ProPlus Dasy-Lab 16.0			

10.60 Calibration certificate of noise level meter (page 1)

e-mail: service@sensidyne.com Tel.: +727-530-3602 ext. 781 www.sensidyne.com

SENSIDYNE
Industrial Health & Safety Instrumentation
Calibration Laboratory

1000 112th Circle North Suite 100
Saint Petersburg, FL 33716
USA

A2LA ACCREDITED
Certificate No. 3943.01

CALIBRATION CERTIFICATE

Date of issue: March 4, 2019 **Certificate No:** 260617-1 **Page:** 1/5

OBJECT OF CALIBRATION	Sound level meter type SVAN 979, number 59702, manufacturer SVANTEK with preamplifier type SV17, number 57849, manufacturer SVANTEK and microphone type 40AE, number 242494, manufacturer G.R.A.S.
APPLICANT	DNV KEMA Renewables, Inc. 1501 4th Avenue Suite 900 Seattle, WA 98101
CALIBRATION METHOD	Method described in instruction WI0102 “Calibration of Sound Level Meters”, rev -, dated 09/03/15, written on the basis of international standard EN IEC 61672-3:2006 Electroacoustics. Part 3: Periodic tests.
ENVIRONMENTAL CONDITIONS	Temperature: (24.3 ÷ 24.6) °C Ambient pressure: (1018.6 ÷ 1018.7) kPa Relative humidity: (54 ÷ 56) %
DATE OF CALIBRATION	26-06-2017
TRACEABILITY	Calibration results were referred to primary standard of sound pressure maintained in the Central Office of Measures with the application of the working standard – sound calibrator type SV 30A, No 48714, manufactured by SVANTEK.
CALIBRATION RESULTS	The results are presented on pages 2 ÷ 5 of this certificate including measurement uncertainty.
UNCERTAINTY OF MEASUREMENTS	Uncertainty of measurement has been evaluated in compliance with EA-4/02:2013. The expanded uncertainty assigned corresponds to a coverage probability of 95 % and the coverage factor *k* = 2.
CONFORMITY WITH REQUIREMENTS	On the basis of the calibration results, it has been found that sound level meter meets metrological requirements specified in the standard IEC 61672-1:2002 Electroacoustics – Sound level meters. Part 1: Specifications, for class 1.

10.61 Calibration certificate of noise level meter (page 2)

CALIBRATION CERTIFICATE issued by ACCREDITED LABORATORY #3943.01

Date of issue: March 4, 2019 **Certificate No:** 260617-1 **Page:** 2/5

CALIBRATION RESULTS Calibration results are the following:

1. Indication at the calibration check frequency

The sound level meter was calibrated in compliance with the instruction manual. During this process, the indication of this SLM was adjusted to the sound pressure level of the sound level calibrator type SV 30A, No 48714, from SVANTEK. The sound pressure level was corrected by the free-field factor.

Deviation of the acoustic pressure measurement of the A-weighted sound level using the sound calibrator type SV 30A, No 48714, from SVANTEK, was made according to the standard reference conditions: for static pressure 101.325 kPa, for temperature 23 ºC and for relative humidity 50 %, results:

(0.0 ± 0.2) dB

The deviation was determined as a difference between the measured sound level and the sound level corrected by the free-field factor appropriate to mentioned sound calibrator.

2. Self-generated noise with microphone installed

Frequency weighting	A
The highest level of self-generated noise stated in the instruction manual [dB]	12.0
Indication [dB]	26.4

3. Self-generated noise with microphone replaced by the electrical input signal device

Frequency weighting	A	C	Z
The highest expected level of self-generated noise stated in the instruction manual [dB]	11.0	10.0	16.0
Level of self-generated noise [dB]	7.4	6.8	11.1

Authorized by: Fred Lacey

10.62 Calibration certificate of noise level meter (page 3)

CALIBRATION CERTIFICATE issued by ACCREDITED LABORATORY #3943.01

Date of issue: March 4, 2019 **Certificate No:** 260617-1 **Page:** 3/5

4. Acoustical signal tests of a frequency weighting C

Frequency	Relative frequency-weighted free-field response	Design-goal frequency weighting	The deviation of frequency weighting	Extended uncertainty	Acceptable limits
Hz	dB	dB	dB	dB	dB
125.0	-0.6	-0,2	-0.4	0.3	±1.5
1000.0	0.0	0,0	0.0	0.3	±1.1
4000.0	-1.0	-0,8	-0.2	0.4	±1.6
8000.0	-2.6	-3,0	0.4	0.4	-3.1; +2.5

5. Electrical signal tests of frequency weightings

Frequency	Design-goal frequency weighting			The deviation of frequency weighting			Extended uncertainty	Acceptable limits
	A	C	Z	A	C	Z		
Hz	dB	dB	dB	dB	dB	dB	dB	dB
63	-26,2	-0,8	0,0	0.1	0.1	0.1	0,3	±1,5
125	-16,1	-0,2	0,0	0.1	0.1	0.1	0,3	±1,5
250	-8,6	0,0	0,0	-0.1	-0.1	-0.1	0,3	±1,4
500	-3,2	0,0	0,0	-0.1	0.0	0.0	0,3	±1,4
1000	0,0	0,0	0,0	0.4	0.4	0.4	0,3	±1,1
2000	1,2	-0,2	0,0	0.4	0.4	0.4	0,3	±1,6
4000	1,0	-0,8	0,0	-0.2	-0.2	-0.2	0,3	±1,6
8000	-1,1	-3,0	0,0	0.3	0.3	0.1	0,4	-3,1; +2,5
16000	-6,6	-8,5	0,0	-0.6	-0.6	-0.4	0,6	-17,0; +3,5

6. Frequency and time weightings at 1 kHz

	Sound level				Time-averaged sound level
Frequency weighting	A	A	C	Z	A
Time weighting	Fast	Slow	Fast	Fast	-
Indication [dB]	94.0	94.0	94.0	94.0	94.0
The deviation of indication from the indication of A-weighted sound level with Fast time weighting [dB]		0.0	0.0	0.0	0.0
Extended uncertainty [dB]		0.1			
Acceptable limits [dB]		±0.3	±0.4	±0.4	±0.3

Authorized by: Fred Lacey

10.63 Calibration certificate of noise level meter (page 4)

CALIBRATION CERTIFICATE issued by ACCREDITED LABORATORY #3943.01

Date of issue: March 4, 2019 **Certificate No:** 260617-1 **Page:** 4/5

7. Level linearity on the reference level range

Range: „HIGH"

Expected sound level	Indication	Level linearity error	Extended uncertainty	Acceptable limits
dB	dB	dB	dB	dB
136.0	136.0	0.0	0.2	±1.1
135.0	135.0	0.0		
134.0	134.0	-0.1		
133.0	133.0	-0.1		
132.0	132.0	-0.1		
131.0	131.0	-0.1		
130.0	130.0	-0.1		
129.0	128.9	-0.1		
124.0	123.9	-0.1		
119.0	118.9	-0.1		
114.0	114.0	0.0		
109.0	109.0	0.0		
104.0	104.0	0.0		
99.0	99.0	0.0		
94.0	93.9	-0.1		
89.0	88.9	-0.1		
84.0	83.9	-0.1		
79.0	79.0	0.0		
74.0	74.0	0.0		
69.0	69.0	0.0		
64.0	63.9	-0.1		
59.0	58.9	-0.1		
54.0	54.0	0.0		
49.0	49.0	0.0		
44.0	44.0	0.0		
39.0	39.0	0.0		
38.0	38.0	0.0		
37.0	37.0	0.0		
36.0	36.0	0.0		
35.0	35.0	0.0		
34.0	34.0	0.0		
33.0	33.0	0.0		
32.0	32.1	0.1		
31.0	31.1	0.1		
30.0	30.2	0.2		

Authorized by: Fred Lacey

10.64 Calibration certificate of noise level meter (page 5)

CALIBRATION CERTIFICATE issued by ACCREDITED LABORATORY #3943.01

Date of issue: March 4, 2019 **Certificate No:** 260617-1 **Page:** 5/5

8. Level linearity including the level range control

Level range	HIGH	LOW
Indication for the reference sound pressure level [dB]	94.0	94.0
The deviation of indication [dB]		0.0
Anticipated level that is 5 dB less than the upper limit specified in the instruction manual for level range at 1 kHz [dB]	132.0	115.0
Indication [dB]	132.0	115.0
The deviation of indication [dB]	0.0	0.0
Extended uncertainty [dB]	0.2	
Acceptable limits [dB]	±1.1	

9. Toneburst response

Measurement quantity	Time weighting	Toneburst duration	The indications in response to toneburst relative to the steady sound level	Reference toneburst response relative to the steady sound level	The deviations of the measured toneburst in responses from the corresponding reference toneburst	Extended uncertainty	Acceptable limits
		ms	dB	dB	dB	dB	dB
Time-weighted sound level	Fast	200	-1.0	-1.0	0.0	0.2	±0.8
		2	-18.0	-18.0	0.0		-1.8; +1.3
		0.25	-27.1	-27.0	-0.1		-3.3; +1.3
Time-weighted sound level	Slow	200	-7.4	-7.4	0.0		±0.8
		2	-27.0	-27.0	0.0		-1.8; +1.3
Sound exposure level	-	200	-7.0	-7.0	0.0		±0.8
		2	-27.0	-27.0	0.0		-1.8; +1.3
		0.25	-36.1	-36.0	-0.1		-3.3; +1.3

10.Peak C sound level

Numbers of cycles in test signal	Frequency of test signal	The deviation of indication	Extended uncertainty	Acceptable limits
	Hz	dB	dB	dB
One	8000	-0.7	0.2	±2.4
Positive half-cycle	500	-0.1		±1.4
Negative half-cycle	500	-0.1		

11.Overload indication

Frequency weighting A

The difference between the levels of the positive and negative one-half-cycles input signals that first cause the displays of overload indication [dB]	Extended uncertainty [dB]	Maximum value of the difference [dB]
dB	dB	dB
0.1	0.3	1.8

Authorized by: Fred Lacey

10.65 Calibration certificate of calibrator (page 1)

Calibration Certificate

Certificate Number 2018002853

Customer:
GL Garrad Hassan Canada
4100 Rue Molson Suite 100
Montreal, QC H1Y 2X4, Canada

Model Number	CAL200
Serial Number	5593
Test Results	**Pass**
Initial Condition	Adjusted
Description	Larson Davis CAL200 Acoustic Calibrator

Procedure Number	D0001.8386		
Technician	Scott Montgomery		
Calibration Date	21 Mar 2018		
Calibration Due	21 Mar 2019		
Temperature	22	°C	± 0.3 °C
Humidity	41	%RH	± 3 %RH
Static Pressure	101.3	kPa	± 1 kPa

Evaluation Method The data is aquired by the insert voltage calibration method using the reference microphone's open circuit sensitivity. Data reported in dB re 20 μPa.

Compliance Standards Compliant to Manufacturer Specifications per D0001.8190 and the following standards:
IEC 60942:2017 ANSI S1.40-2006

Issuing lab certifies that the instrument described above meets or exceeds all specifications as stated in the referenced procedure (unless otherwise noted). It has been calibrated using measurement standards traceable to the SI through the National Institute of Standards and Technology (NIST), or other national measurement institutes, and meets the requirements of ISO/IEC 17025:2005. **Test points marked with a ‡ in the uncertainties column do not fall within this laboratory's scope of accreditation.**

The quality system is registered to ISO 9001:2008.

This calibration is a direct comparison of the unit under test to the listed reference standards and did not involve any sampling plans to complete. No allowance has been made for the instability of the test device due to use, time, etc. Such allowances would be made by the customer as needed.

The uncertainties were computed in accordance with the ISO Guide to the Expression of Uncertainty in Measurement (GUM). A coverage factor of approximately 2 sigma (k=2) has been applied to the standard uncertainty to express the expanded uncertainty at approximately 95% confidence level.

Standards Used

Description	Cal Date	Cal Due	Cal Standard
Agilent 34401A DMM	09/06/2017	09/06/2018	001021
Larson Davis Model 2900 Real Time Analyzer	04/10/2017	04/10/2018	001051
Microphone Calibration System	03/07/2018	03/07/2019	005446
1/2" Preamplifier	10/05/2017	10/05/2018	006506
Larson Davis 1/2" Preamplifier 7-pin LEMO	08/08/2017	08/08/2018	006507
1/2 inch Microphone - RI - 200V	04/24/2017	04/24/2018	006510
Pressure Transducer	06/01/2017	06/01/2018	007310

Larson Davis, a division of PCB Piezotronics, Inc
1681 West 820 North
Provo, UT 84601, United States
716-684-0001

ilac-MRA ACCREDITED Cert. #3622.01

LARSON DAVIS
A PCB PIEZOTRONICS DIV.

3/21/2018 3:15:05PM

Page 1 of 3

D0001.8410 Rev A

10.66 Calibration certificate of calibrator (page 2)

Certificate Number 2018002853

Output Level

Nominal Level [dB]	Pressure [kPa]	Test Result [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
114	101.2	114.00	113.80	114.20	0.13	Pass
94	101.3	94.01	93.80	94.20	0.14	Pass

-- End of measurement results--

Frequency

Nominal Level [dB]	Pressure [kPa]	Test Result [Hz]	Lower limit [Hz]	Upper limit [Hz]	Expanded Uncertainty [Hz]	Result
94	101.3	1,000.27	990.00	1,010.00	0.20	Pass
114	101.2	1,000.26	990.00	1,010.00	0.20	Pass

-- End of measurement results--

Total Harmonic Distortion + Noise (THD+N)

Nominal Level [dB]	Pressure [kPa]	Test Result [%]	Lower limit [%]	Upper limit [%]	Expanded Uncertainty [%]	Result
94	101.3	0.39	0.00	2.00	0.25	Pass
114	101.2	0.35	0.00	2.00	0.25	Pass

-- End of measurement results--

Level Change Over Pressure

Tested at: 114 dB, 23 °C, 39 %RH

Nominal Pressure [kPa]	Pressure [kPa]	Test Result [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
101.3	101.3	0.00	-0.30	0.30	0.04 ‡	Pass
92.0	92.0	0.00	-0.30	0.30	0.04 ‡	Pass
108.0	108.0	-0.02	-0.30	0.30	0.04 ‡	Pass
83.0	83.0	-0.02	-0.30	0.30	0.04 ‡	Pass
74.0	74.1	-0.07	-0.30	0.30	0.04 ‡	Pass
65.0	65.0	-0.18	-0.30	0.30	0.04 ‡	Pass

-- End of measurement results--

Frequency Change Over Pressure

Tested at: 114 dB, 23 °C, 39 %RH

Nominal Pressure [kPa]	Pressure [kPa]	Test Result [Hz]	Lower limit [Hz]	Upper limit [Hz]	Expanded Uncertainty [Hz]	Result
108.0	108.0	0.00	-10.00	10.00	0.20 ‡	Pass
101.3	101.3	0.00	-10.00	10.00	0.20 ‡	Pass
92.0	92.0	0.00	-10.00	10.00	0.20 ‡	Pass
83.0	83.0	0.00	-10.00	10.00	0.20 ‡	Pass
74.0	74.1	-0.01	-10.00	10.00	0.20 ‡	Pass
65.0	65.0	-0.01	-10.00	10.00	0.20 ‡	Pass

-- End of measurement results--

Larson Davis, a division of PCB Piezotronics, Inc
1681 West 820 North
Provo, UT 84601, United States
716-684-0001

ilac-MRA ACCREDITED Cert #3622.01

LARSON DAVIS
A PCB PIEZOTRONICS DIV.

3/21/2018 3:15:05PM

10.67 Calibration certificate of calibrator (page 3)

Certificate Number 2018002853

Total Harmonic Distortion + Noise (THD+N) Over Pressure

Tested at: 114 dB, 23 °C, 39 %RH

Nominal Pressure [kPa]	Pressure [kPa]	Test Result [%]	Lower limit [%]	Upper limit [%]	Expanded Uncertainty [%]	Result
108.0	108.0	0.38	0.00	2.00	0.25 ‡	Pass
101.3	101.3	0.36	0.00	2.00	0.25 ‡	Pass
92.0	92.0	0.34	0.00	2.00	0.25 ‡	Pass
83.0	83.0	0.31	0.00	2.00	0.25 ‡	Pass
74.0	74.1	0.29	0.00	2.00	0.25 ‡	Pass
65.0	65.0	0.28	0.00	2.00	0.25 ‡	Pass

-- End of measurement results--

Signatory: *Scott Montgomery*

Larson Davis, a division of PCB Piezotronics, Inc
1681 West 820 North
Provo, UT 84601, United States
716-684-0001

ilac-MRA ACCREDITED Cert. #3622.01

LARSON DAVIS
A PCB PIEZOTRONICS DIV.

10.68 Calibration certificate of anemometer (page 1)

Deutsche WindGuard
Wind Tunnel Services GmbH, Varel

accredited by the / *akkreditiert durch die*

Deutsche Akkreditierungsstelle GmbH

Deutsche Akkreditierungsstelle D-K-15140-01-00

as calibration laboratory in the / *als Kalibrierlaboratorium im*

Deutschen Kalibrierdienst DKD

1624105
D-K-15140-01-00
11/2016

Calibration certificate
Kalibrierschein

Calibration mark
Kalibrierzeichen

Object *Gegenstand*	2D Sonic Anemometer
Manufacturer *Hersteller*	Thies Clima D-37083 Göttingen
Type *Typ*	4.9201.00.000
Serial number *Fabrikat/Serien-Nr.*	10160038 GLGH4286 113000306
Customer *Auftraggeber*	GL Garrad Hassan D-25709 Kaiser-Wilhelm-Koog
Order No. *Auftragsnummer*	18295
Project No. *Projektnummer*	VT160980
Number of pages *Anzahl der Seiten*	5
Date of Calibration *Datum der Kalibrierung*	07.11.2016

This calibration certificate documents the traceability to national standards, which realize the units of measurement according to the International System of Units (SI).
The DAkkS is signatory to the multilateral agreements of the European co-operation for Accreditation (EA) and of the International Laboratory Accreditation Cooperation (ILAC) for the mutual recognition of calibration certificates.
The user is obliged to have the object recalibrated at appropriate intervals.
Dieser Kalibrierschein dokumentiert die Rückführung auf nationale Normale zur Darstellung der Einheiten in Übereinstimmung mit dem Internationalen Einheitensystem (SI).
Die DAkkS ist Unterzeichner der multilateralen Übereinkommen der European co-operation for Accreditation (EA) und der International Laboratory Accreditation Cooperation (ILAC) zur gegenseitigen Anerkennung der Kalibrierscheine.
Für die Einhaltung einer angemessenen Frist zur Wiederholung der Kalibrierung ist der Benutzer verantwortlich.

Date *Datum*	Head of the calibration laboratory *Leiter des Kalibrierlaboratoriums*	Person in charge *Bearbeiter*
07.11.2016	Dipl. Phys. Dieter Westermann	Dipl.-Ing. (FH) Catharina Herold

10.69 Calibration certificate of anemometer (page 2)

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Calibration object
Kalibriergegenstand

2D Sonic Anemometer

Calibration procedure
Kalibrierverfahren

• Deutsche WindGuard Wind Tunnel Services: QM-KL-AK-VA
Based on following standards:
• MEASNET: Anemometer calibration procedure
• IEC 61400-12-1: Power performance measurements of electricity producing wind turbines
• IEC 61400-12-2: Power performance of electricity producing wind turbines based on nacelle anemometry
• ISO 3966: Measurement of fluid in closed conduits
• ISO 16622: Meteorology - Sonic anemometers/thermometers

Place of calibration
Ort der Kalibrierung

Windtunnel of Deutsche WindGuard WindTunnel Services GmbH, Varel

Test conditions
Messbedingungen

wind tunnel area	10000 cm²
anemometer frontal area	340 cm²
diameter of mounting pipe	48 mm
blockage ratio [1)]	0.034 [-]
software version	7.64

[1)] Due to the special construction of the test section no blockage correction is necessary.

Ambient conditions
Umgebungsbedingungen

air temperature	19.7 °C ± 0.1 °C
air pressure	1009.8 hPa ± 0.3 hPa
relative air humidity	49.9 % ± 2.0 %

Measurement uncertainty
Messunsicherheit

The expanded uncertainty assigned to the measurement results is obtained by multiplying the standard uncertainty by the coverage factor k = 2. It has been determined in accordance with DAkkS-DKD-3. The value of the measurand lies within the assigned range of values with a probability of 95%.
The reference flow speed measurement is traceable to the German NMI (Physikalisch-Technische Bundesanstalt) standard for flow speed. It is realized by using a PTB owned and calibrated Laser Doppler Anemometer (Standard Uncertainty 0.2 %, k=2)

Additional remarks
Zusätzliche Anmerkungen

Orientation: 0°

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10.70 Calibration certificate of anemometer (page 3)

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Calibration result
Kalibrierergebnis

Sensor speed m/s	Sensor dir deg	Tunnel speed m/s	Uncertainty (k=2) m/s
4.011	0.150	3.982	0.050
6.047	0.007	5.984	0.050
7.917	360.000	7.856	0.050
9.911	360.000	9.838	0.050
12.001	360.000	11.918	0.050
14.045	360.000	13.921	0.050
15.951	360.000	15.813	0.050
15.035	360.000	14.901	0.050
12.981	360.000	12.891	0.050
10.972	360.000	10.891	0.050
8.906	0.015	8.847	0.050
6.985	360.000	6.946	0.050
4.960	0.026	4.942	0.050

File: 1624105

Statistical analysis

Statistical analysis	Slope	0.99068 (m/s)/(m/s) ±0.00087 (m/s)/(m/s)
	Offset	0.0167 m/s ±0.009 m/s
	Standard error (Y)	0.013 m/s
	Correlation coefficient	0.999996

Remarks

The calibrated sensor complies with the demanded linearity of MEASNET

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Graphical representation of the result
Grafische Darstellung des Ergebnisses

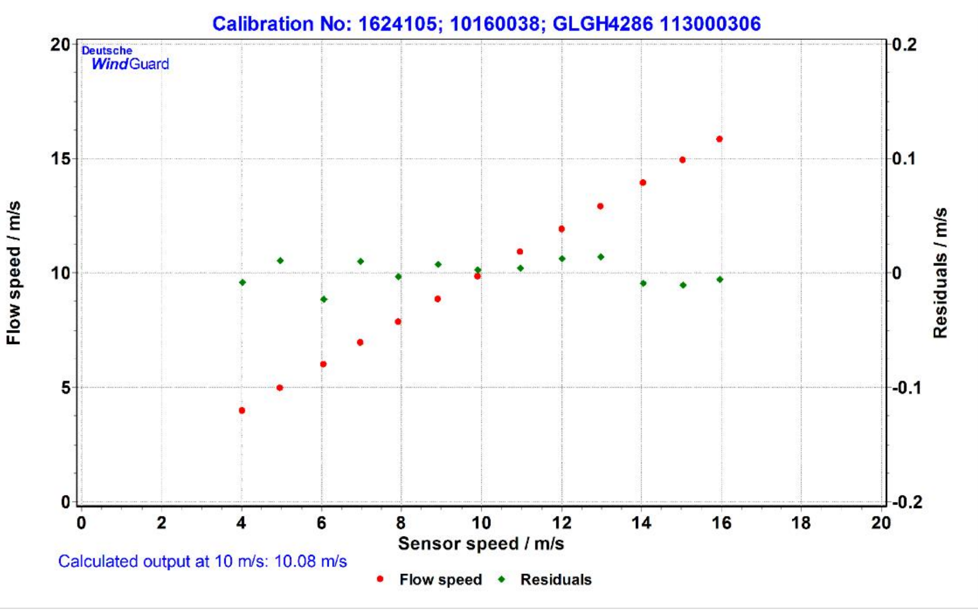
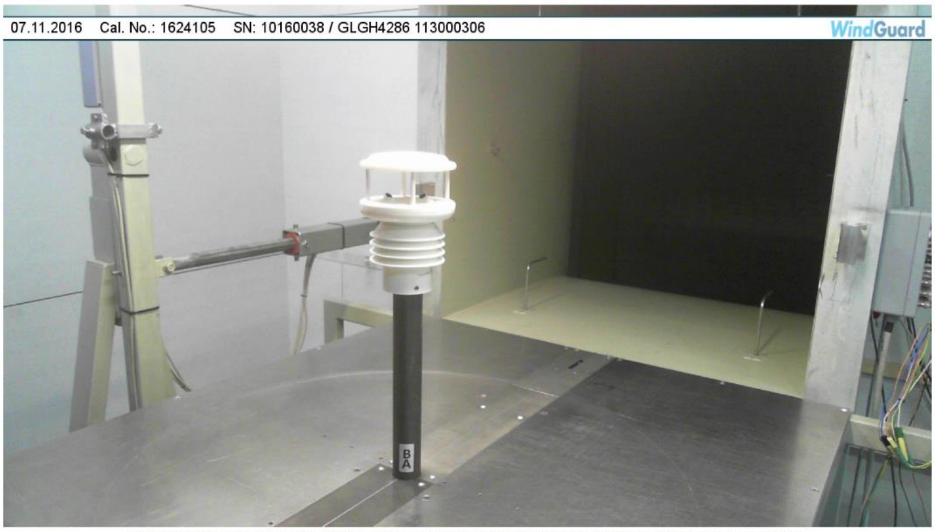


Photo of the measurement setup
Foto des Messaufbaus



Remark: The proportions of the set-up may not be true to scale due to imaging geometry.

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10.72 Calibration certificate of anemometer (page 5)

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Sensor config during calibration
Sensorkonfiguration während der Kalibrierung

!00SS00000
00AB80106
00AH00100
00AL00120
00AM00001
00AO00001
00AP00100
00AQ00100
00AR00060
00AT14060
00AV00010
00BO00000
00BP00008
00BR00096
00BT00000
00CI00000
00DM00001
00DO00001
00DT00001
00EI00000
00ET00030
00HC00010
00HH00000
00HP00010
00HS00001
00HT00001
00ID00000
00II00000
00KY00000
00MC00000
00NC00000
00OL12789
00OP00000
00OR01000
00OS00000
00PE00016
00PH00260
00PN00002
00PT00010
00PW00060
00RD00005
00RT00000
00SH00000
00SM00000
00SN10160038
00ST00001
00SV00402
00TA920100000
00TT00002
00TZ00000
000.0 000 +18.0 40 1009.2 07.11.16 17:08:28 *36

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10.73 Extract of Calibration certificate of secondary wind screen

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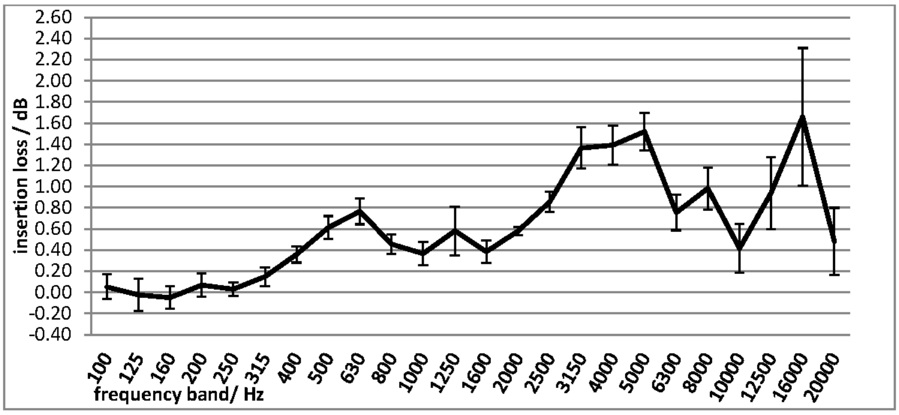
Extract of the test report GLGH 4286 11 07555 000-C-0078-A

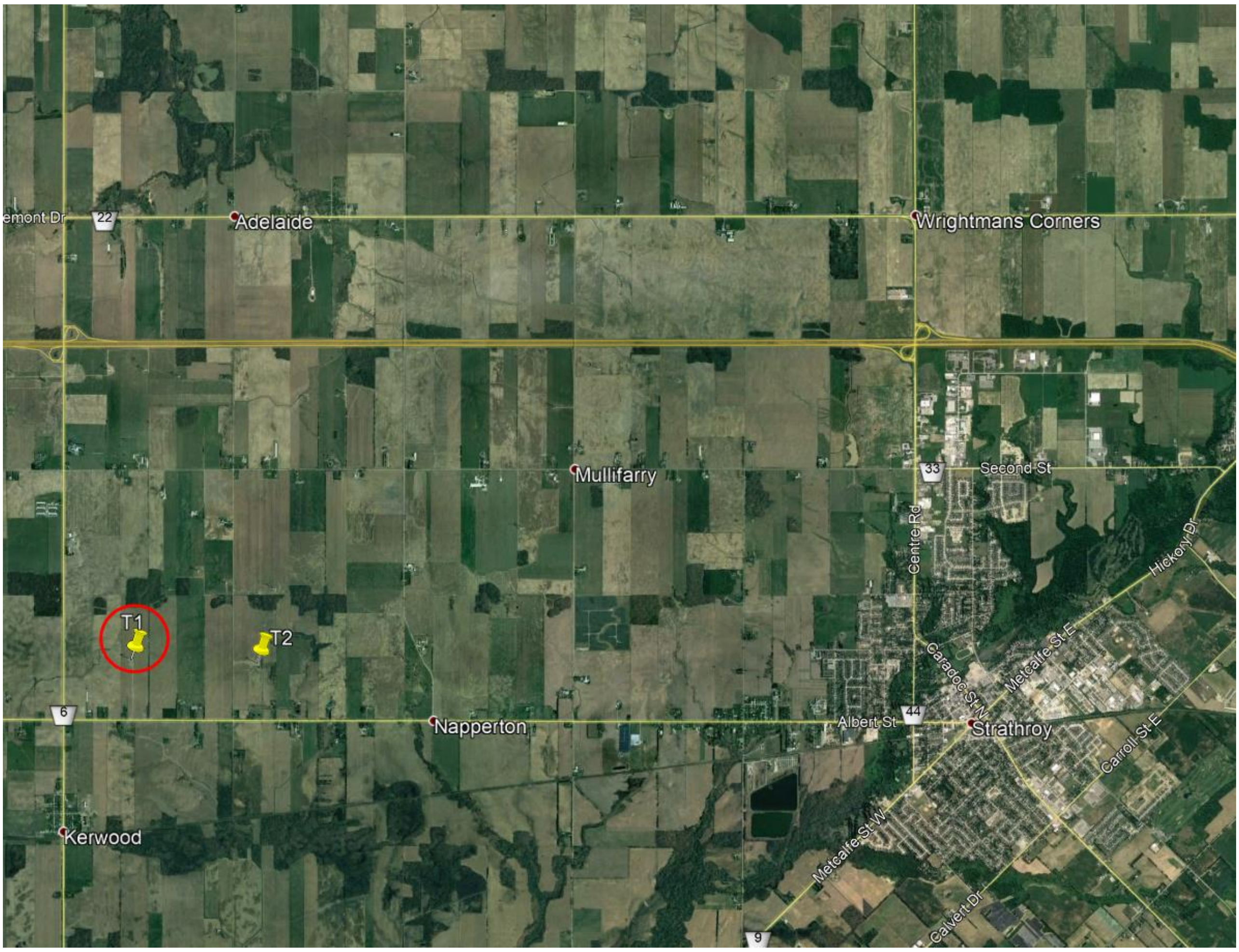


(Page 7) Figure 2: insertion loss of the secondary windscreen EWS-16-22 with optional weatherproof cover (mean and standard deviation of 12 individual measurements)

frequency	incl. weather protection	
Hz	mean	SD
100,00	0.05	0.12
125,00	-0.02	0.15
160,00	-0.05	0.11
200,00	0.07	0.11
250,00	0.03	0.07
315,00	0.15	0.09
400,00	0.36	0.08
500,00	0.61	0.11
630,00	0.77	0.12
800,00	0.45	0.09
1000,00	0.37	0.11
1250,00	0.58	0.23
1600,00	0.39	0.11
2000,00	0.58	0.04
2500,00	0.86	0.09
3150,00	1.36	0.19
4000,00	1.39	0.18
5000,00	1.52	0.17
6300,00	0.75	0.17
8000,00	0.98	0.20
10000,00	0.41	0.23
12500,00	0.94	0.34
16000,00	1.66	0.65
20000,00	0.48	0.32

(Page 8) Table 2: insertion loss of the secondary windscreen EWS-16-22 with optional weatherproof cover (mean and standard deviation of 12 individual measurements)

10.74 Position of the test site
Source: Google Earth



10.75 Photos

Photo 1: Photo from microphone and board toward the turbine

Photo 2: Photo from the wind met mast toward the turbine

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