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Attention: Michael Fairneny
Subject: Hoosac Wind Sound Level Monitoring, report dated June 2013
Prepared by Resource Systems Group, Inc. for New England Wind, LLC

Dear Mr. Fairneny:

Per your request, I reviewed "Hoosac Wind Sound Level Monitoring, June 2013", a report prepared under the direction of Kenneth Kaliski, P.E. of RSG, Inc. for a 28.5MW industrial wind turbine facility operated by New England Wind, LLC, in Hoosac and Florida, Massachusetts.

In my professional opinion, the RSG report of June 2013 demonstrates the following:

1. The operating facility probably exceeds the Massachusetts State noise limits in 310 CMR 7.10. The reported range of increase was up to 10 dB. Uncorrected contamination of background levels during the RSG testing obscures the full range of increase over background which was not properly identified.

2. The operating facility produced tones as defined by the Mass DEP in 310 CMR 7.10.

The RSG report was found to be misleading in its methods and conclusions as the following points suggest 1) the facility could be more strongly exceeding the Mass DEP regulations than measured during the RSG testing, and 2) questions arise on report content.

3. The power data strongly indicate that the facility was operated *below rated output* (see this letter's Appendix 1). One might have assumed that RSG would have required and documented that the facility was operated according to standard power curves. However this does not seem to have been done. Since wind turbine noise level increases with power output, it appears quite likely that the test did not acquire the highest sound levels from the Hoosac facility.

4. Each wind turbine make and model has a distinctive "signature". The GE 1.5sle normally exhibits a gearing tone in the 160 Hz one-third octave band. Yet the tonal section in the RSG report shows that tones were found in the 100-125 Hz one-third octave bands. The lowered frequency data suggest that the turbines were running below normal rotation speed.

5. The facility is required to meet Mass DEP tone regulations. The report concluded that the facility creates tonal noise per Mass DEP at multiple times and locations. It then attempted to disqualify its own findings by confounding the conclusions with discussions of ANSI S12.9 (RSG report conclusion 11). No satisfactory explanation is given. The owner is obligated to meet the law. As registered engineers and INCE members, the authors are obligated to observe existing law. Especially, the tone analysis method reviewed at length and advocated by RSG was found to be less protective, with higher thresholds than State law. Why did RSG attempt to weaken protections for neighbors?

6. In Section 4, the report states that "Determining the “ambient” sound levels without wind turbine sound in the vicinity of a wind power project can be challenging." This is misleading. It is entirely possible; multiple parties have accomplished this, including personnel in the Mass DEP. The tests are conducted when winds at the microphone and in trees are light or absent (to avoid wind on microphone and to exclude noise from wind in trees), and the wind turbines are turning at power. The turbines are then turned off, the ambient background measured, and turbines are turned back on.

This method is straightforward. Under higher wind shears, ambient winds can be low or absent in trees and on the ground when winds are strong aloft at hub height several hundred feet higher. This condition can be and has been forecast. At five other wind facilities in Massachusetts, the ambient background was measured at 27-29 dBA (see Attachment 2).

Microphone placement under trees by RSG should be considered inappropriate and leading to contamination by wind noise in nearby vegetation, skewing background sound levels up. Insect and frog noise was not excluded from sound measurements although there are well-known and accepted one-third octave band analysis procedures for doing this. Noises apparently contaminated "background" levels measured in the high 30s, 40s, and even 50s dB(A) and were not identified nor corrected.

RSG inappropriately compared the background only (non-turbine) Lmax and L90. Not only does this serve to mislead the reader, the *range* of sound levels in the ambient background has no meaning for assessing compliance with the Mass DEP; only the background L90 matters.

7. The owner was fully aware of and participated with RSG during the noise measurements. At other wind turbine sites where the owner was aware of noise measurements, it was found that power was dropped during the tests. The data furnished by RSG for Hoosac show significant drops in power output and apparent reduced frequency rotation during testing. Why did RSG not ensure standard power curves were used during testing?

8. RSG was clearly aware in 2009 of the low frequency annoyance potential of large industrial wind turbines (see Attachment 3). However, rather than perform assessments of low frequency impacts and amplitude modulations, which would be of real value to all interested parties, they apparently spent considerable time on theoretical "modeling" of long term average noise levels of the wind facility at Hoosac. Yet, they failed to recognize or reconcile the lower power output during the testing. In effect, their model-to-operating comparisons confirm their noise model under-predicts facility noise levels, as it was equated to lower power output. Was that their intent?

9. RSG complained at length about various technical difficulties they experienced during the testing. Many were related to unattended monitoring. Yet the Mass DEP attended measurement protocols have been used without complaint by DEP and noise control engineering consultants for decades; they work. RSG actually advocated for unattended monitoring; which 1) defies common sense, and, 2) begs the question: why did RSG use so much of the report making complaints and urgings to modify the State protocols with unsatisfactory changes?

Recommendations

-- The operating data during the test appear to be below standard power curves and should be reviewed independently. Supervisory Control And Data Acquisition (SCADA) data should be furnished for independent analytical review, for the test periods covered in the report as well as at least five days each side of the test period, including, for each turbine, at 10-minute intervals.

a. Power output, kw.
b. Wind speed at hub, m/s.
c. Wind speed at ground, as available, m/s.
d. Rotational speed, rpm.
e. Yaw error, turbine generator to actual wind direction, degrees.
f. If turbine off, error code or status to clarify reason turbine off.

These data should be provided in csv/excel format. Additionally, recordings made during tonal noise should be furnished with calibration and time information for independent review.

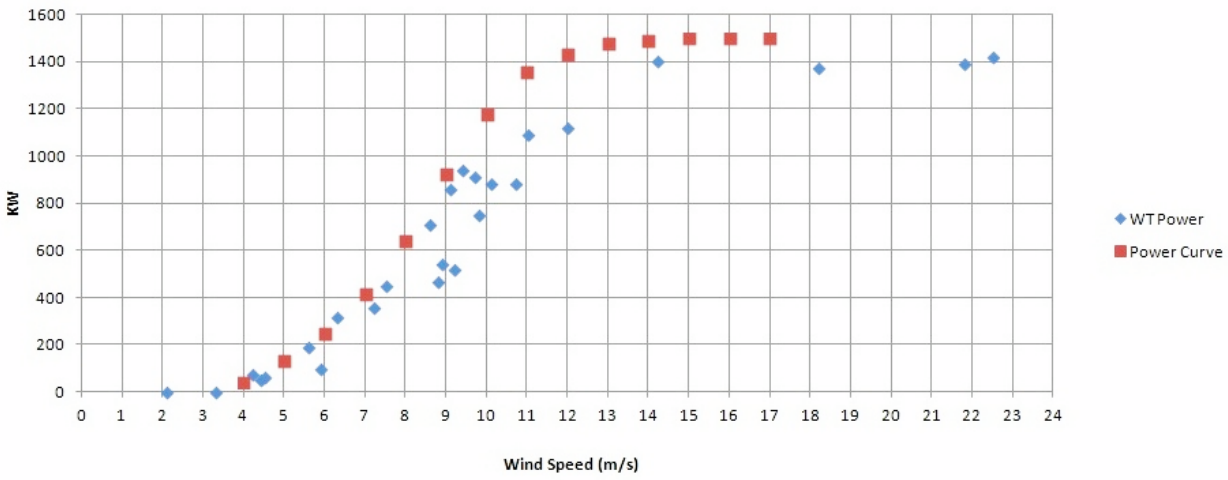
-- Attended testing should be conducted by other independent investigators. 1) RSG was clear in their report that they had problems conducting this type of survey and find it challenging. 2) They were unable to establish the normally occurring quiet background in the area, substituting uncorrected and contaminated background levels in the high 30s, 40s and 50s dB(A) which are much higher than background levels found at five other wind turbine sites in Massachusetts. 3) They advocated weakened tonal assessments compared to State law. 4) They did not address the reduced power output during testing.

Thank you for your consideration of these findings. Please contact me if you have any questions.

Sincerely Yours,

Attachment 1. Power output below rated power curve. Data compiled from RSG report by Chris Kapsambelis. Posted at http://windwisema.org/hoosac-wind-turbine-sound-monitoring/.

Power/Noise discrepancy



This graph shows blue diamonds highlighting values from the Hoosac noise testing report (plotted from the table on the left below) to represent the power output during testing. The red boxes come from the published power curve of the GE 1.5 sle wind turbine. The expected power output related to wind speed is shown in the table on the right below.

Power Curve	
Wind Speed	Power
4	43
5	131
6	250
7	416
8	640
9	924
10	1181
11	1359
12	1436
13	1481
14	1494
15	1500
16	1500
17	1500

In comparing the recorded power output to the published power curve data, it is clear that the wind turbines were not operating normally. The power output was as much as 33% less than normal which would mean that the sound power level was also substantially reduced.

This casts a shadow on the integrity of the sound study and needs a plausible explanation.

BS/AS	WD	Wind Speed	WT Power	Date
BS	257	14.2	1406	4/3/2013 13:20
AS	257	18.2	1378	4/3/2013 13:20
BS	274	22.5	1421	4/3/2013 22:00
AS	272	21.8	1393	4/3/2013 22:00
BS	262	7.2	360	4/4/2013 10:30
AS	271	7.5	454	4/4/2013 10:30
BS	275	12	1123	4/5/2013 23:43
AS	297	11	1097	4/5/2013 23:43
BS	284	4.2	80	4/8/2013 14:15
AS	276	2.1	0	4/8/2013 14:15
BS	258	5.6	192	4/10/2013 13:35
AS	275	6.3	319	4/10/2013 13:35
BS	311	4.4	55	4/11/2013 7:33
AS	7	3.3	0	4/11/2013 7:33
BS	121	5.9	102	4/15/2013 17:00
AS	143	4.5	66	4/15/2013 17:00
BS	298	9.8	751	4/17/2013 7:21
AS	297	8.9	548	4/17/2013 7:21
BS	101	8.6	712	4/18/2013 2:04
AS	101	9.1	862	4/18/2013 2:04
BS	132	9.4	945	4/18/2013 11:00
AS	141	9.7	913	4/18/2013 11:00
BS	84	9.2	521	4/22/2013 7:00
AS	88	8.8	469	4/22/2013 7:00
BS	117	10.7	888	4/22/2013 13:00
AS	115	10.1	887	4/22/2013 13:00

Attention is called to the data points inside the box between 8 and 12 meters/second. This is the range where the noise level is most likely to be in violation. At wind speeds less than 8 m/s the noise level is too low to overcome the 10 dB(A) above ambient limit. And above 12 m/s the sound power from the wind turbine flattens out while the wind is creating excessive ambient noise.

The study contains weather data sets for 13 monitoring periods. Each data set contains wind speed data and average turbine output power per turbine.

These data* were copied into a table used to plot power output as a function of wind speed. The field labels:

- "BS/AS" Refer to the original fields "WT + Background Before Shutdown, WT + Background After Start."
- The field "WD" refers to "**Met Tower 50 meter Wind Direction (degrees)."**
- The field "WS" refers to "**Met Tower 62 meter wind speed (m/s)."**
- The field "WT Power" refers to **"Average Turbine Output (kW per turbine). "**
- The field "Date" is taken from the title of each Weather Data table.

*The data is contained in tables 8. 10, 12, 15, 17, 20, 22, 24, 26, 29, 31, 33, and 36 titled "Weather Data."

Attachment 2. Ambient background sound level measurements made at other wind turbine sites in Massachusetts.

Ambient background sound level measurements made at other wind turbine sites in Massachusetts has found noise levels less than 30 dBA, see **Table 1** below. Save Cohasset, which is still only proposed (and in a lawsuit for potential noise impacts), all of these wind turbine facilities have created a nuisance with widespread complaints, appeals to stop the noise, and threats of legal action.

Table 1. Representative minimum L90 sound levels at wind turbine sites.

Location	Date	Context	L90, dB(A)
Cohasset	March 2012	Peer Review Noise Survey	**27**
Fairhaven	May 2013	Post-op MassDEP Test Report	**28**
Falmouth	May 2012	Post-op MassDEP Test Report	**27**
Kingston	April 2013	Independent Test Report	**29**
Scituate	April 2008	Preconstruction Report	**29**

Sources:
Ambrose, S., Rand, R., Advisory Letter – Noise, TTOR Project, Cohasset, MA, April 2012.
MassDEP, Interim Test Report, Fairhaven, MA, May 2013.
MassDEP, Attended Sampling of Sound from Wind Turbine #1, Falmouth, MA, May 2012.
NCE, Inc., O'Donnell Wind Turbines Noise Evaluation, Kingston, MA, 23 April 2013.
Guldberg, P., Acoustic Study of Three Wind Turbines, Scituate, MA, April 2008.

Attachment 3. Allegheny Ridge Wind Farm Sound Monitoring Study, RSG, May 2009.

Excerpt illustrating RSG's knowledge in 2009 of the highly annoying character of wind turbine noise. Investigations were voluntary according to the report as shown below. No similar acknowledgement or analysis was found in the RSG 2013 Hoosac report, which is also understood to be a voluntary study by the Hoosac owner to investigate noise levels.

To investigate the low frequency component of the swooshing further, a voluntary visit was made to the Batdorf residence after the on-call visit at the Reilly residence. One second equivalent sound pressure levels were around 40 dBA and 55 dBC. It was noted during the voluntary visit by the RSG representative that the low frequency component of the swooshing sound seems much louder than the sound level meter was registering and could be described as highly annoying.

To illustrate the difference between the low frequency swooshing components heard on February 16 and a more normal low frequency swooshing component, two different sound files were analyzed using a spectrogram. A spectrogram is a colored graph of the sound that was recorded that shows both the frequency and the relative level of the sound. Time is represented on the horizontal axis in seconds, frequency is represented on the vertical axis in hertz, and the relative level of the sound is represented by the color scale. Blue shades are lower levels and yellows and red shades are higher levels.

The spectrogram of a normal swooshing sound that wind turbines make is shown in Figure 28 and the spectrogram of the swooshing sound that was experienced at the Reilly residence on February 16 is shown in Figure 29. The spacing of the vertical red lines represent the beating of the swooshing sound. The lower half of the graphs represents the sound at low frequencies between 0 and 30 Hz. The upper half of the graph extends up to 200 Hz. The graphs are not calibrated to so the actual numbers on the color scale are not accurate, but it does show the relative level difference between frequencies.