

September 4, 2020

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Subject: Antrim Wind Energy  
Peer Review  
Antrim Wind Farm – Post Construction Sound Monitoring—Winter 2020

Dear Ms. Monroe,

As requested, Cavanaugh Tocci has peer reviewed Acentech Report 482 “Antrim Wind Farm—Post-Construction Sound Monitoring Winter 2020” dated May 12, 2020 (“Report”). This peer review is to evaluate the Report’s methods for general compliance with post-construction measurement provisions of NH Code Admin. R. Site 301.18(e)-(h). Among aspects of the report peer reviewed are measurement methods and instrumentation used, data analysis, and the means used to arrive at their conclusion regarding compliance of Antrim Wind Energy sound with NH Code Admin. R. Site 301.14(f)(2)a sound level limits.

#### **NH Code Admin. R. Site 301.18 Provisions**

NH Code Admin. R. Site 301.18(e) Requires post-construction noise compliance monitoring. How each provision of the NH Code Admin. Rule was satisfied is as follows:

NH Code Admin. R. Site 301.18(e)(1) Adherence to the standard of ANSI/ASA S12.9-2013 Part 3, that requires short-term attended measurements to ensure transient noises are removed from the data, and measurements shall include at least one nighttime hour where turbines are operating at full sound power with winds less than 3 meters per second at the microphone

Briefly, the ANSI standard process is as follows:

- Measure sound levels with the source operating; then
- Remeasure without the source operating (this is the background sound level); then
- Logarithmically subtract the background from the measured source sound level to determine the source-only sound level, i.e. source sound level without contributions of the background.

The NH Rule requires that measurements include at least one nighttime hour where turbines are operating at full sound power with winds less than 3 meters per second at the microphone.

That was achieved. The shut down period was 30 minutes beginning at 10:30 PM, Sunday, March 8, 2020.

Site 301.18(e)(2) Unattended long-term monitoring shall also be conducted

Long-sound monitoring was completed and described in Report section 5.3 page 16. The report text "*The unattended measurements were carried out in accordance with ANSI S12.9-1992 2013 Part 2 and the NHSEC Rules.*" The NH SEC Rule does not mention a standard for unattended long-term sound measurements.

The NH SEC Rule, identifying ANSI/ASA S12.9 Part 3, pertains to short-term attended measurements. In discussing long-term measurements, the Report correctly identifies Part 2 as the appropriate standard.

Site 301.18(e)(3) requires omitting data during periods during rain or when temperatures fell below instrumentation minima. It also required the following:

- a. Microphones 1-2 m above grade and 7.5 m from reflective surfaces  
(See Report Section 5.2, p 16 paragraph 2.)
- b. Microphones must be provided with windscreens  
(See Report p 16 paragraph 2.)
- c. Microphones field calibrated before and after measurements  
(See Report Section 5.2, p 16 paragraph 2.)
- d. An anemometer close to microphones.  
(See Report Section 5.2, p 16 paragraph 3.)

All four requirements were met as described in the Report at the above-noted locations.

Site 301.18(e)(4) Monitoring shall involve measurements being made with the turbines in both operating and non-operating modes, and supervisory control and data acquisition (SCADA) system data shall be used to record hub height wind speed and turbine power output.

Precipitation and temperature were obtained from Jaffrey Airport Silver Ranch National Weather Service station. Wind farm turbine operational data reported in 10-minute intervals are the nine-turbine average hub height wind speed and direction, and the total project power generation. Wind speed, direction, and temperature were recorded by the weather station at location 5. Winds were largely from the west.

Site 301.18(e)(5) Locations shall be pre-selected where noise measurements will be taken that shall be the same locations at which predictive sound modeling study measurements were taken pursuant to subsection (c) of Rule 301.18, and the measurements shall be performed at night with winds above 4.5 meters per second at hub height and less than 3 meters per second at ground level;

Report measurement locations are the same as those used by Epsilon in “Sound Level Assessment Report—Antrim Wind Energy Project” dated June 8, 2015 prior to construction of the wind farm project. Hub height wind speed at all turbines exceeded 4.5 m/s and wind speed all microphone locations at ground level were less than 3 m/s.

Site 301.18(e)(6) All sound measurements during post-construction monitoring shall be taken at 0.125-second intervals measuring both fast response and Leq metrics

Sound level descriptors (L10, L90, LEQ) were recorded in 10 minutes using the meter’s fast time response, which analyzes the data with a 0.125 second time constant. Descriptors and 1/3 octave band sound levels were measured and recorded every 0.100 second, though these data were not reported as doing so would not be practical in a paper report.

Site 301.18(e)(7) Post-construction monitoring surveys shall be conducted once within 3 months of commissioning and once during each season thereafter for the first year, provided that:

- a. Additional surveys shall be conducted at the request of the committee or the administrator.
- b. Adjustments to this schedule shall be permitted, subject to review by the committee or the administrator.

This statement did not require a response in the Report.

Site 301.18(f) Post-construction sound monitoring reports shall include a map or diagram clearly showing the following:

- (1) Layout of the project area, including topography, project boundary lines, and property lines;
- (2) Locations of the sound measurement points; and
- (3) Distance between any sound measurement point and the nearest wind turbine.

Report Figure 1-1 shows the project boundary, turbine and measurement locations, and topography on a USGS map. The map is scalable to determine distances between points on the map.

Site 301.18(g) For each sound measurement period during post-construction monitoring, reports shall include each of the following measurements:

- (1) LAEQ, LA10, and LA90
- (2) LCEQ, LC10, and LC90

The listed data have been provided in ranges Table 6.3 and in Appendix B.

Site 301.18(h) Noise emissions shall be free of audible tones, and if the presence of a pure tone frequency is detected, a 5 dB penalty shall be added to the measured dBA sound level.

On Report section 5.7, page 16, it is stated that no audible pure tones were determined to exist based on ANSI S12.9 part 4, Annex C using 1/3 octave band data. One-third octave band data were not included in the Report and would be impractical to include.

### **NH Code Admin. R. Site 301.14(f)(2)a Compliance**

ANSI/ASA S12.9-2013 Part 3 provides the basic method to be followed for determining the source-only sound level when measured in the environment with other non-source sounds contributing to measured sound levels. The following are several of the provisions of ANSI/ASA S12.9-2013 Part 3 pertinent to the measurement and evaluation of AWE wind turbine-only sound levels.

ANSI/ASA S12.9-2013 Part 3 §6.9 Correction for background sound contains several provisions for removing background sound from measurements to determine the source-only sound level at a location. The following identifies those provisions applicable to the measurements conducted by Acentech. Not all Standard procedures exactly as described are directly practical.

ANSI/ASA S12.9-2013 Part 3 §6.9(b) directs that background sound levels are to be removed from source measured sound level in frequency bands, and that LAeq and LCEq values should be recalculated from band limited data rather than removing background equivalent sound levels from source measured A- and C-weighted equivalent sound levels.

The Report analysis outline is briefly as follows:

- Identify qualifying hours when sound levels were measured and when six criteria were met. Four are provided in the Rule, two are from ANSI S12.9 Part 3 and ANSI S12.18. These criteria are provided on Section 6.2 page 19 of the Report.
- As wind turbine sound is characteristically steady, its predominance when other transient sounds are present is signified using the ANSI S12.9 Part 3 §6.5(b)(1)(first bullet) provision that when maximum and minimum sound levels differ by not more than 3 dB during a five-minute period that the sound measured is substantially that of the steady source. The Report infers minimum and maximum sound levels as being LAF90 and LAF10 respectively. At some locations, the 3 dB difference was widened to 4 dB and greater.
- Background sound levels during unplanned hourly shutdowns were corrected to remove transient sounds produce by vehicles passing on Route 9.
- Subtracting planned and unplanned background shut down periods from sound levels measured during qualifying hours revealed wind turbine-only sound levels at each location.
- The Report appears to use A- and C-weighted sound levels for direct computation to remove background and arrive at source-only A- and C-weight sound levels. The Standard recommends that A- and C-weighted source-only sound levels be computed form band-limited sound levels, not directly from A- and C-weighed values.

ANSI/ASA S12.9-2013 Part 3 §7.3.3(b) With the source(s) off, measure the equivalent-continuous sound pressure level of the background sound within the hour before or within the hour after measurement of the source at the location of the source(s) measurements, with the same sound pressure level measuring instruments, and with the same instrument settings. The uncertainty factor to be used in 7.3.2 for this clause is 1.5 dB.

The report does not appear to address or to use an uncertainty factor in its computation of wind turbine-only sound levels. The uncertainty factor raises the computed source-only sound level, but not by 1.5 dB, but by some smaller amount.

### **Report Conclusion**

The report concludes that “...*turbine-only sound levels under conditions meeting maximum sound were all below the lowest sound limits for the project. This was found to be the case at all five sound monitoring locations, thereby demonstrating the project’s sound compliance.*”

### **Peer Reviewer Confirmation**

To verify in part the conclusion reached in the Report, the following brief analysis was completed on sound levels reported in Appendix B for the three hours 21:00 to 00:00, Sunday, March 8, 2020.

- During the middle hour, 22:00 to 23:00, all nine wind turbines were shut down to measure the background sound level. Instead of using the equivalent sound level, we observe that the LAF90 for this middle hour would be the lowest constant background, likely to have occurred when wind turbines were shut down.
- The LAF90 for the first and third hours would include wind turbine sound level. Use of the 90<sup>th</sup> percentile statistic eliminates transient sound levels such as that produced by traffic and wind through foliage.
- The only condition not met at all locations during these three measurements was wind direction (see Report section 6.2).
- Subtracting the middle hour LAF90, i.e. the background, from the
  - Higher of the first and third hour LAF90 provides a high estimate of wind turbine-only sound.
  - Average of the first and third hour LAF90 provides a middle estimate of wind turbine-only sound
  - Lower of the first and third hour LAF90 provides a low estimate of wind turbine-only sound

Estimated wind turbine-only sound levels using the method outlined above are presented in Peer Review Table 1 below.

	Location 1. Keene Road	Location 2. Loveren Mill Road	Location 3. Salmon Brook Road	Location 4. Reed Carr Road	Location 5. Gregg Lake Road
Max.	31.1	26.1	29.8	32.4	28.3
Ave.	27.9	22.9	28.0	30.6	26.8
Min.	n/a	n/a	25.7	28.7	25.0

Peer Review Table 1. Estimated range of wind-turbine only sound levels at five locations  
sound levels measured Sunday, 21:00 to 00:00, March 8, 2020  
Antrim Wind Energy, Antrim, NH

### Peer Review Conclusion

Acentech report “Antrim Wind Farm—Post-Construction Sound Monitoring Winter 2020” dated May 12, 2020 measurements of wind-turbine only sound levels ranged between 32 and 38 dBA depending on location and small hour-to-hour variations at each location. The methods employed by Acentech are generally consistent with those of ANSI S12.9 Part 3 and meet the requirements of the NH Code Admin. R. Site 301.18 for testing. We agree with the Report conclusion reached that “...*turbine-only sound levels under conditions meeting maximum sound were all below the lowest sound limits for the project.*”

The peer reviewed estimate of wind turbine-only sound level of 27 to 32 dBA using the LAF90 measured during the hours before and after the scheduled shut-down hour, and the LAF90 during the shutdown hour, is consistent with the ANSI S12.9 Part 3 §7.3.3(b) method for measuring source-only sound level, and concludes that wind turbine only sound levels are below the NH Code Admin. R. Site 301.14 maximum permitted nighttime sound level limit of 40 dBA, and below the daytime limit of 45 dBA.

The Report’s computation, data filtering, and analysis are necessarily complex. The Report authors might consider adding a brief outline of the data collection and computation steps used to arrive at their estimates of Antrim Wind Energy sound levels at monitoring locations. This is not to replace any part of the Report, but only to be an overview to help laymen understand the process and to appreciate how each step is needed.

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If we can provide any further information, please do not hesitate to contact me. Thank you.

Sincerely,  
CAVANAUGH TOCCI



Gregory C. Tocci, Sr. Principal Consultant