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Antrim Wind Energy

Third Party Sound Measurement Protocol
in Response to
Post-Construction Noise Complaints

On March 17, 2017, the New Hampshire Site Evaluation Committee (NH SEC) issued a Certificate of Site and Facility to Antrim Wind Energy (AWE) to site, to construct with all associated civil and electrical infrastructure, and to operate 9 Siemens SWT-3.2-113 direct drive wind turbines capable of generating 3.2 MW each, for a total nameplate capacity of 28.8 MW. Page 9 of the Certificate contains the following condition: *"the Applicant shall retain a third-party noise expert, as approved by the Administrator of the Committee, to assist the Town of Antrim and the Administrator in taking field measurements in order to evaluate and validate noise complaints."*

This document describes a third-party sound measurement protocol to be implemented by Cavanaugh Tocci on behalf of the NH SEC and the Town of Antrim, in response to their receipt of complaints of AWE facility sound at nearby locations. Cavanaugh Tocci will complete these measurements in full cooperation with TransAlta, the AWE owner, who will provide weather and wind turbine operating information as may be needed.

Sound Level Limits

Limits on AWE sound are set forth in N.H. Admin. R., Site 301.14(f)(2)a. as follows:

> *"With respect to sound standards, the A-weighted equivalent sound levels produced by the applicant's energy facility during operations shall not exceed the greater of 45 dBA or 5 dBA above background levels, measured at the L-90 sound level, between the hours of 8:00 a.m. and 8:00 p.m. each day, and the greater of 40 dBA or 5 dBA above background levels, measured at the L-90 sound level, at all other times during each day, as measured using microphone placement at least 7.5 meters from any surface where reflections may influence measured sound pressure levels, on property that is used in whole or in part for permanent or temporary residential purposes, at a location between the nearest building on the property used for such purposes and the closest wind turbine..."*

The Certificate is also conditioned upon AWE's compliance with the terms and conditions contained in the Agreement entitled: "Agreement Between Town of Antrim New Hampshire and Antrim Wind Energy LLC, Developer/Owner of the Antrim Wind Power Project" dated March 8, 2012 ("the Agreement"). The Agreement was amended, effective January 16, 2018, and is incorporated by reference to the Certificate at Appendix V.

Paragraph 11.1 of the Agreement contains the following Residential Noise Restrictions:

> *"A-weighted equivalent sound from the Wind Farm during Operations at the exterior facades of homes shall not exceed the greater of 45 dBA or 5 dBA above background levels (measure at the L_{90} level) between the hours of 8:00AM and 8:00 PM and the greater of 40 dBA or 5 dBA above background levels (measured at the L_{90} level) at all other times each day, as measured in accordance with the SEC rules and Certificate."*

Response to Complaints

In the event of a complaint of AWE sound by a resident and determined by the NH SEC to warrant measurement, N.H. Admin. R., Site 301.18 (i) provides that:

> *Validation of noise complaints submitted to the committee shall require field sound surveys, except as determined by the administrator to be unwarranted, which field studies shall be conducted under the same meteorological conditions as occurred at the time of the alleged exceedance that is the subject of the complaint.*

A measurement protocol specifically in response to a complaint is not defined in the rules. However, Site 301.18(e) requires post-construction noise compliance monitoring and provides some details for long-term and short-term measurement of AWE sound at residential locations. The monitoring provisions are general and require some specific interpretations as discussed below.

Initial Site Visits

Cavanaugh Tocci staff, accompanied by NH SEC personnel, will make an initial, non-measurement visit to the residences of the two complainants. These visits have the primary purpose of interfacing with the residents to familiarize them with the measurement procedures, as well as where and how measurements will be made on their property generally in accordance with the provisions in N.H. Admin. R., Site 301.18 (e) for post-construction sound measurements.

Measurement scheduling

AWE will alert Cavanagh Tocci when hub-height wind speeds are predicted to be 7.0 m/s or higher during the 6:00 pm – 10:00 pm time frame that day, and when the ambient temperature at the microphone locations will exceed 15 degrees F, and when precipitation is not expected. Cavanaugh Tocci will make every effort to mobilize to conduct measurements on that day. If staff or equipment are not available, Cavanaugh Tocci will decline to measure and AWE will alert them on a subsequent day when desired conditions are again met, until measurements have been completed.

Measurements

1. ***Sound measurements (w/ background measured)*** will be performed at two complainant locations using Bruel & Kjaer 2250 (IEC Class 1) sound level meters.

    a. Meters will be tripod-mounted and fitted with windscreens, and will be calibrated prior to and after each measurement session.

    b. Microphones will be mounted 1-2 m above the grade and 7.5 m or more from buildings and other reflecting surfaces. 10-meter cables will connect the microphones to the measurement units to help isolate observer noise from the measurement.

    c. Meters will be calibrated before and after measurements using a Bruel & Kjaer Type 4231 calibrator. Calibration tone data will be recorded and included in project documentation.

d. A- and C-weighted hourly equivalent sound levels ($LA_{eq,1\text{-}hr}$ and $LC_{eq,1\text{-}hr}$) will be measured to determine whether AWE sound levels exceed the limits in the Agreement (the greater of 45 dBA or 5 dBA above background from 8:00 AM – 8:00 PM, and the greater of 40 dBA or 5 dBA above background from 8:00 PM – 8:00 AM).

e. The 1-hour measurement intervals will be comprised of 5-min subintervals ($LA_{eq,5\text{-}min}$ and $LC_{eq,5\text{-}min}$). On-site observers will note noise events that may have contaminated the data. Those 5-min samples noted as potentially contaminated may be dropped from the hourly statistics or amended using 100 ms logged data. (See 3. below). Among other 1-hour and 5-min descriptors measured will be the LAF_{90}, LAF_{10}, LCF_{90}, and the LCF_{10}. (LCF_{90} and the LCF_{10} must be computed from other measured 5-min Z-weighted 1/3 octave band data). Measurements will be performed using fast meter response.

f. To facilitate data review by the Cavanaugh Tocci, $LA_{eq,100ms}$ sound levels will be logged, and audio waveform data will be stored. These data will be used to eliminate or amend contaminated data and will not be reported.

2. ***Wind Speed*** will be monitored near both microphones using a Davis Vantage VUE system. This system measures wind speed and direction, and temperature. These measurements will be used to determine whether wind speeds at the microphones are within specified operating ranges for the sound level meter and windscreen, and if not may be used to correct for microphone wind noise.

3. ***Observer monitoring*** – Cavanaugh Tocci staff will attend both meters for 2 daytime and 2 nighttime hours (6:00 PM – 10:00 PM). These hours were chosen to best address the times reported by the complainants, and to provide coverage during both daytime (8 AM – 8 PM) and nighttime hours (8 PM – 8 AM), and are consistent with the requirements for post-construction monitoring. This interval may be shifted by up to an hour earlier or later to better match wind conditions to conditions at the time of complaints as required by N.H. Admin. R., Site 301.18 (i). The observer will note any events that may have influenced sound measurements and the times at which these events occurred. Examples of such events include weather conditions, turbine operation, indigenous sounds, streams, and wind in vegetation.

4. ***Background sound measurements.*** To address the *"5 dBA above background levels"* limit of the Agreement, and to determine the contribution of background sound to measured AWE sound, some or all wind turbines may need to be shut down for a brief period of time depending on complaint measurement location. Unless otherwise agreed-to, the three turbines closest to each receptor will be shut down for 15-minute interval which will allow measurement of two 5-minute background samples. The arithmetic average of the two measured $LAF_{90,5\text{-}min}$ sound levels will be the *"background levels"* to which 5 dBA is added for the background-based limits on turbine sound. 5-minute intervals which include turbine spin-down and spin-up will be excluded from the hourly results.

   Background sound levels will be subtracted from measured levels to determine the AWE-alone sound level for compliance evaluation.

5. ***Tone assessment.*** If audible tones are observed by Cavanaugh Tocci staff during the measurement, methods of ANSI S12.9 Part 3 (2013) Annex B will be used to evaluate tonality. If AWE sound is determined to be tonal in accordance with the standard annex, measured AWE sound levels will be increased by 5 dBA as per Site 301.18(h).

6. ***Operational data.*** Wind speed and direction at hub height, as well as power generation, of the three turbines closest to each receptor will be provided by AWE in 10-minute intervals for the duration of sound monitoring.

7. ***Reporting.*** Within 15 days after the completion of each measurement session, a report evaluating compliance of AWE facility sound with applicable limits will be prepared and submitted to the NH SEC. The NH SEC will distribute the report to all other parties as appropriate. The general format of the data to be presented is exhibited in Appendix A.

Appendix A

Data Presentation Format

Location: XXX Residence, Road, Town, NH

Date Feb. xx, 2020

Pre-measurement Calibration	5:52 PM	94.0	dB @ 1000 Hz
Post-measurement Calibration	10:04 PM	94.0	dB @ 1000 Hz

Time	LAeq,1-hr	Time	LAeq,5-min	Transient?	Valid 5-min Samples	Adj LAeq,1-hr	Notes
6:00:00 PM	70	7:00:00 PM	80		80	70	
		7:05:00 PM	50		50		
		7:10:00 PM	39		39		
		7:15:00 PM	60		60		
		7:20:00 PM	51		51		
		7:25:00 PM	50		50		
		7:30:00 PM	50		50		
		7:35:00 PM	42		42		
		7:40:00 PM	57		57		
		7:45:00 PM	60	x			
		7:50:00 PM	61		61		
		7:55:00 PM	50		60		
7:00:00 PM	81	8:00:00 PM	50		50	79	
		8:05:00 PM	45		45		
		8:10:00 PM	46		46		
		8:15:00 PM	74		74		
		8:20:00 PM	57	x			
		8:25:00 PM	86	x			
		8:30:00 PM	61		61		
		8:35:00 PM	60		60		
		8:40:00 PM	61	x			
		8:45:00 PM	77		77		
		8:50:00 PM	87		87		
		8:55:00 PM	82		82		
8:00:00 PM	74	9:00:00 PM	80	x		67	
		9:05:00 PM	74		74		
		9:10:00 PM	72		72		
		9:15:00 PM	76	x			
		9:20:00 PM	30	x			
		9:25:00 PM	50	x			
		9:30:00 PM	39		39		
		9:35:00 PM	60		60		
		9:40:00 PM	51		51		
		9:45:00 PM	50		50		
		9:50:00 PM	50		50		
		9:55:00 PM	42		42		
9:00:00 PM	79	10:00:00 PM	57		57	79	
		10:05:00 PM	50		60		
		10:10:00 PM	61		61		
		10:15:00 PM	60		60		
		10:20:00 PM	50		50		
		10:25:00 PM	45		45		
		10:30:00 PM	46		46		
		10:35:00 PM	74		74		
		10:40:00 PM	87		87		
		10:45:00 PM	86		86		
		10:50:00 PM	51		61		
		10:55:00 PM	60		60		
10:00:00 PM	61	11:00:00 PM	61		61	61	