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June 7, 2013

Mr. Dan Courtemanch, Project Manager
Maine Department of Environmental Protection
Division of Land Resource Regulation
17 State House Station
Augusta, ME 04333-0017

Re: Independent Peer Review of the Noise Impact Study for the Bingham Wind Project

Dear Dan:

Tech Environmental, Inc. (TE) has completed an independent peer review of the acoustic impacts of the 191-MW Bingham Wind Project with regard to Maine Site Location of Development (SLOD) Regulations. The project is located in Somerset and Piscataquis Counties (Town of Bingham, Mayfield Township and Kingsbury Plantation).

The applicant is proposing to install either: (1) 62 Siemens SWT 3.0-113 3.0 MW turbines on a 95-m hub; or (2) 62 Vestas V112-3.0 3.0 MW turbines on a 94-m hub. The applicant has presented predicted sound levels for both wind turbine configurations. While no more than 62 turbines will be constructed, a total of 63 turbines were analyzed for sound impacts to allow for an alternative turbine location in the group of turbines in the Town of Bingham.

The documents I received for this review include:

- Section 1 of the SLOD Application, Bingham Wind, "Project Description," by Stantec.
- Section 5 of the SLOD Application, Bingham Wind, including the report by Bodwell EnviroAcoustics ("Bodwell") entitled "Sound Level Assessment, Bingham Wind Project," April 2003.

Review Standard

The purpose of this peer review is to determine if the acoustic studies submitted with the Application are reasonable and technically correct according to standard engineering practices and the Department Regulations on Control of Noise (06-096 CMR 375.10), referred to herein as the "Maine Noise Regulations". The nighttime sound limit at a Protected Location is 42 dBA (1-hour L_{eq}).

Sound Power Levels Assumed for the Turbines

The sound power level (L_w) on a decibel scale[1] is determined by the manufacturer through a series of prescribed field measurements using the International Standard IEC 61400-11 test method.[2] The IEC-reported sound power level for a given hub-height wind speed is an average value, meaning there is a scatter of values about the average and the actual sound power level emitted in the field may either be lower or higher. To quantify that variability in values of L_w, the IEC provides a method for assessing L_w measurement uncertainty and unit-to-unit turbine production uncertainty, combining both into a total uncertainty "K" factor (IEC Technical Specification 61400-14)[3]; the K factor has a value of 2.0 dBA for the Vestas wind turbine and 1.5 dBA for the Siemens wind turbine.

The IEC method defines the "Declared Sound Power Level" as L_w + K, and the sum represents an upper-bound sound power level that, under the stated wind speed conditions, will not be exceeded 95% of the time. The Declared Sound Power Level should be used in acoustic modeling to ensure the predicted sound pressure levels are conservative estimates and reasonably account for known uncertainties.

The applicant followed this procedure in modeling sound power levels that are the IEC reported maximum value for the Vestas V112-3.0 turbine of 106.5 dBA plus an uncertainty K factor of 2.0 dBA, and the IEC reported maximum value for the Siemens SWT 3.0-113 turbine of 107.0 dBA plus an uncertainty factor of 1.5 dBA.[4] The applicant then added a 1.0 dBA modeling uncertainty factor for the ISO 9613-2 sound propagation method[5] at an inland location, and thus a total sound power level of 109.5 dBA was modeled for both makes of turbine. The modeling uncertainty factor of 1 dBA is in the middle of the 0 to 2 dBA range for modeling uncertainty listed as a rebuttable presumption in sub-section I(7)(c)(9) of the Maine Noise Regulations.

[1] The sound power level is defined as $10*\log_{10}(W/W_o)$, where W is the sound power of the source in Watts and W_o is the reference power of 10^{-12} Watts. The sound power level (energy density) and sound pressure level (what we hear) are not the same, yet both are reported using a decibel levels scale. An acoustic model uses the sound power level of a wind turbine along with other assumptions to calculate the sound pressure level heard at a receiver located a certain distance from the wind turbine.

[2] International Electrotechnical Commission, International Standard IEC 61400-11 Edition 2.1, "Wind turbine generator systems – Part 11: Acoustic noise measurement techniques," Geneva, 2006.

[3] International Electrotechnical Commission, Technical Specification TS 61400-14,"Wind turbines – Part 14: Declaration of apparent sound power level and tonality values," Geneva, 2005.

[4] The IEC sound power levels L_w are confirmed by manufacturer documents in Appendices XI and XII of the Bodwell report. I note that Bodwell analyzed the louder of two versions of the SWT-3.0-113 turbine offered by Siemens.

[5] International Organization for Standardization, Standard ISO 9613-2, "Acoustics – Attenuation of sound during propagation outdoors, Part 2: General method of calculation," Table 5.

Conservatism of the Combined Uncertainty Factor

Our review of the sound test reports for the Stetson I and II wind energy facilities, where wind turbines are located on ridge top settings similar to Bingham Wind, reveal use of the IEC reported sound power level plus uncertainty K factor and adding 1 dBA for modeling uncertainty is a conservative modeling approach for assessing wind turbine acoustic impacts.[6] Thus, Bodwell's combined uncertainty factors are appropriate and should accurately predict turbine sound levels.

Acoustic Model and Assumptions

Sound levels from the wind turbines were predicted using the Cadna\A acoustic model, the International Standard ISO 9613-2 sound propagation method, and a conservative ground absorption factor of G=0.5 that represents winter frozen-ground conditions. Water bodies were modeled as reflective surfaces (G=0.0). Bodwell used proper analytical tools for evaluating sound impacts. While the ISO method provides estimates of accuracy for source heights up to 30 m and the Bingham Wind turbines are higher at 94 to 95 m, this acoustic modeling approach has been found to be accurate for utility wind turbine sounds on several past projects with similar hub heights.

The project is located in a mountainous, forested area with scattered residential properties to the southeast and southwest of the ridge lines along which the project is proposed. The two closest Protected Locations (Receivers B6 and B2) are approximately 4,675 feet and 6,250 feet, respectively, from the nearest wind turbine. The 42 dBA nighttime limit in the Maine Noise Regulations applies at these Protected Locations. A total of six discrete receivers were used in the model, one of which has a sound easement with a nighttime limit of 51 dBA established through private contract (Receiver B1). A decibel contour map was generated for Bingham Wind to allow verification of predicted sound levels at other residential locations.

The Bodwell report discusses the Foss Pond Permanent Conservation Area (FPPCA), abutting the northwest end of the project, and argues that FPPCA is not a regulated Protected Location under the Maine Noise Regulations (Bodwell report, page 20). Even if it were to be classified as a Protected Location, since no living or sleeping quarters are within the FPPCA, the sound limit of 55 dBA would apply day and night, per the Maine Noise Regulations.

The acoustic modeling results are conservative due to the following assumptions:

1. All wind turbines were assumed to be operating simultaneously and at the design wind speed, corresponding to maximum sound power.

2. All wind turbine sound power levels correspond to the IEC 61400-11 maximum sound power level plus a combined uncertainty factor of 2.5 to 3.0 dBA.

[6] Tech Environmental, Inc., "Independent Peer Review of the Sound Level Assessment for the Oakfield Wind Project," September 1, 2011.

3. The acoustic model assumed the most favorable conditions for sound propagation, corresponding to a ground-based temperature inversion, such as might occur on a calm, clear night, or during a downwind condition with a moderate wind speed.

4. No attenuation from trees or other vegetation was assumed.

5. Winter frozen ground conditions were assumed for minimal ground absorption (G=0.5), with sound reflection assumed (G=0.0) for all water bodies.

6. Excess attenuation from wind shadow effects and daytime air turbulence were ignored.

Acoustic Modeling Results

With this conservative modeling approach, the applicant predicted maximum sound levels and the results are documented in Table 6-1 and Figure 6-1 of the Bodwell report. The maximum predicted sound level at any Protected Location (500 feet from a non-participating residence) for either turbine configuration is 39.6 dBA at Receiver B2, which is in Kingsbury Plantation southeast of the ridge line. The second-highest predicted sound level at a Protected Location for either turbine configuration is 37.6 dBA at Receiver B6, which is in Mayfield Township on Mayfield Pond southeast of the ridge line. These maximum levels comply with the daytime (55 dBA) and nighttime (42 dBA) limits in the Maine Noise Regulations. The maximum predicted sound level at any project boundary is less than 55 dBA and in compliance with the 75 dBA property boundary limit in the Maine Noise Regulations.

Tonal Sounds

While no 1/3-octave band data are presented in the application for either make of turbine, Bodwell reports (page 23) the manufacturers have guaranteed that the turbines emits no "tonal sound" as defined in the Maine Noise Regulations. Post-construction sound monitoring will confirm this fact.

Short Duration Repetitive Sound (SDRS)

The definition of SDRS in the section of the Maine Noise Regulations that pertains to Wind Energy Developments is an impulse sound that is 5 dBA or greater "on the fast meter response above the sound level observed immediately before and after the event." Typically this modulation of the turbine mid-frequency sound (the audible "swish-swish") has an amplitude range of 2 to 6 dBA. The 5-dBA penalty for SDRS is applied to each 10-minute period in which more than five SDRS events occur.

The Bodwell Report examines the likelihood for SDRS at Bingham Wind and estimates SDRS will add no more than a penalty of 1.7 dBA to measured 10-minute-average L_{eq} sound levels during a compliance test. Whereas the projected maximum sound level at a Protected Location (39.6 dBA) is 2.4 dBA below the 42-dBA nighttime limit, SDRS is not expected to cause the project to exceed the nighttime sound limit. Sound compliance testing, including SDRS effects, will be done after project completion.

Construction Noise

Construction of the Bingham Wind Project will produce sound levels similar to those generated during roadway construction, and much of the heavy equipment is similar. Daytime construction activity is not subject to the limits in the Maine Noise Regulations. Any nighttime construction activity will need to comply with the nighttime limit in the Maine Noise Regulations.

Post-Construction Sound Level Testing

To ensure that the sound level predictions submitted by the applicant are accurate, and to ensure compliance with the Maine Noise Regulations, including the provisions regarding SDRS and tonal sound, the Department should require limited post-construction sound monitoring for the project, following the general test methodology used in other recent wind energy Land Use Permits.

Whereas Noise Reduced Operation (NRO) is not used to achieve compliance, a single compliance test in the first year of operation is sufficient. Testing should be done in two areas, corresponding to where the maximum sound levels are projected for Protected Locations: 1) Receiver B2 in Kingsbury Plantation; and 2) Receivers B5 or B4 on Mayfield Pond in Mayfield Township.

I note that the compliance testing requirements in Section I of the Maine Noise Regulations, "Sound Level Standards for Wind Energy Developments" do not specify how many 10-minute test periods must occur in the day or night, only that 12 such valid test periods must be presented in the compliance test report. I recommend that any permit the Department may issue for Bingham Wind require that at least 6 of the 12 test periods used in the compliance test report represent the nighttime period (7 p.m. through 7 a.m.) during which the sound level limit is 42 dBA and during which wind shear and SDRS conditions are more likely.

Summary

A peer review was done of the report by Bodwell, "Sound Level Assessment, Bingham Wind Project" dated April 2013. The results confirm: the turbine maximum sound power level with a conservative uncertainty factor was used in the analysis; the acoustic model and its assumptions are appropriate; the sound receiver locations are appropriate; the decibel contour maps adequately cover the potential impact area; and the Department Regulations on Control of Noise (06-096 CMR 375.10) have been properly interpreted and applied for the Bingham Wind Project. Bodwell's model estimates are conservative and tend to overstate actual turbine sound levels. No additional studies and/or monitoring requirements are warranted.

For the reasons stated above, I conclude that the acoustic studies submitted with the SLOD Application are reasonable and technically correct according to standard engineering practices and the Department Regulations on Control of Noise (06-096 CMR 375.10).

Recommendations

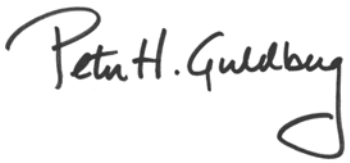
I recommend that any permit the Department may issue for the Bingham Wind Project require a single compliance test in the first year of operation at two locations: Receiver B2 and Receiver B5/B4.

I also recommend that at least 6 of the 12 test periods used in the compliance test report represent the nighttime period (7 p.m. through 7 a.m.) during which the sound level limit is 42 dBA, and that the compliance test report include a complete presentation of the data and calculations for the SDRS analysis.

Thank you for the opportunity to provide an independent peer review of the Bingham Wind Project Noise Impact Study.

Sincerely yours,

TECH ENVIRONMENTAL, INC.



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Managing Principal
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