July 24, 2014

Maria Eggett, Project Manager
Division of Land Use Regulation
Maine DEP
17 State House Station
Augusta, ME 04333

Re: Independent Peer Review of the Supplement and Addendum to the Sound Assessment for the Hancock Wind Project

Dear Maria:

Tech Environmental, Inc. (TE) provided a peer review of acoustic impacts for the 55-MW Hancock Wind Project in a letter report to the Department dated March 8, 2013. This report provides an independent peer review of two documents in Section 5 of the Combined Application Amendment for Hancock Wind, with regard to Maine Site Location of Development (SLOD) Regulations:

- Report by Bodwell EnviroAcoustics LLC, "Supplement to Sound Level Assessment, Hancock Wind Project," June 2014 (the "Supplement Report").

- Report by Bodwell EnviroAcoustics LLC, "Addendum to Sound Level Assessment, Hancock Wind Project," June 2014 (the "Addendum Report").

In the Supplement Report, the acoustic effects of a third turbine layout are presented; the third turbine alternative consists of 17 Vestas V117 (3.3-MW) wind turbines on 116.5 meter towers. The original Sound Level Assessment from January 2013 (the "Bodwell Report") examined two layouts of 18 turbine each (Vestas V112 or Siemens ST113 turbines). The new layout of 17 turbines eliminates T05 in T22MD, which is the turbine closest to Spectacle Pond.

<u>Addendum Report</u>

The Addendum Report corrects turbine location errors in the original Bodwell Report. The net effect of correcting those geographical errors is to change the predicted sound levels by only 0.1 dBA at a single receptor, Receptor H3. Whereas all corrected sound levels for the first two turbine layouts still comply with all regulatory sound limits, the conclusions of our March 8, 2013 review report stand: the acoustic studies submitted with the SLOD Application for the Vestas V112 and Siemens ST113 turbine layouts are reasonable and technically correct according to standard engineering practices and they comply with the Department Regulations on Control of Noise (06-096 CMR 375.10).

Review Standard for the Supplement Report

The purpose of this peer review is to determine if the Supplement Report submitted with the Combined Application Amendment for Hancock Wind is reasonable and technically correct according to standard engineering practices and if it complies with 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}).

The Eastbrook Wind Energy Facility Ordinance sets a slightly lower nighttime sound limit of 40 dBA for Protected Locations within Eastbrook. Whereas the nearest Protected Location in Eastbrook is 3.5 miles from the closest turbine in the Hancock Wind Project, and hemispherical wave spreading alone will reduce sound from the Hancock Wind Project to below 25 dBA at that receiver, there is no need for the Department to consider the Eastbrook Ordinance in its review of the this project. The applicant nonetheless provided a cumulative impact analysis for the combined Hancock and Bull Hill Wind Projects.

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 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 V117 turbine of 107.0 dBA plus an uncertainty K factor of 2.0 dBA. The applicant then added a 1.0 dBA modeling uncertainty factor for the ISO 9613-2 sound propagation

[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.

method[4] at an inland location, and thus a total sound power level of 110.0 dBA was modeled. 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.

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 Hancock 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.[5] Thus, Bodwell EnviroAcoustics'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 with G=0.0. Standard values for temperature and relative humidity (as they affect air absorption) were employed. These are the proper tools for accurately evaluating sound impacts. While the ISO method provides estimates of accuracy for source heights up to 30 m and the Hancock Wind V117 turbines are higher at 116.5 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 method is judged to be accurate for the Hancock Wind Project.

The project is located in an area of commercial forestland with rural residential and seasonal transient properties such as hunting camps and lakeside cottages. The majority of residential properties in the vicinity of the project are located to the west in the Town of Osborn along the eastern shore of Spectacle Pond. The three closest Protected Locations are two residences on Spectacle Pond (Receptors H1 and H2), which are 3,552 feet and 3,693 feet from the nearest turbine in the V117 layout, respectively, and a residence to the north of the project on Rocky Pond in T22 (Receptor H3), which is 4,749 feet from the nearest turbine in the V117 layout. A decibel contour map was generated for Hancock Wind to allow verification of predicted sound levels at other residential locations. The compliance assessment did not include recreational cabins as these transient dwellings are not considered to be Protected Locations in 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.

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

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

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

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) and a reflective surface (G=0.0) was assumed for surface 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 of the Supplement Report. Sound levels range from 36.0 to 36.5 dBA at Receptors H1 through H3. The highest predicted sound level of 36.5 dBA occurs at Receptor H3 on Rocky Pond. The acoustic modeling results demonstrate Hancock Wind complies with the daytime (55 dBA) and nighttime (42 dBA) limits in the Maine Noise Regulations. The maximum predicted sound level at any project boundary (the lease line) is far below the 75 dBA property boundary limit in the Maine Noise Regulations.

A cumulative impact analysis of the Hancock Wind and Bull Hill Wind Projects was performed and is presented in Table III-1 of the Supplement Report. The combined project sound levels range from 31.9 to 39.7 dBA at Receptors H1 through H4 and receptor P2. The analysis also demonstrates compliance with the Town of Eastbrook Ordinance sound limits at Receptors H4 and P2 where the combined sound level from both projects are well below the Eastbrook sound limits.

Tonal Sounds

An analysis of the sound power level spectrum for the Vestas V117 turbine reveals no potential for creating a “tonal sound” as defined in the Maine Noise Regulations. Thus, the 5-dBA penalty for tonal sound does not apply to this project for permitting. Compliance sound testing will need to verify this assumption.

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 original Bodwell Report provides a thoughtful analysis of the likelihood for SDRS to occur for Hancock Wind and makes a reasonable worst case assumption that the SDRS penalty may apply to one-third of the ten-minute periods that qualify as valid test periods. That level of SDRS added to the modeling results still demonstrates full compliance with all regulatory limits. SDRS is not expected to be a factor in complying with the Maine Noise Regulations.

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 Hancock 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.

Construction Noise

Construction of the Hancock 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 for the wind turbines actually installed, and to ensure compliance with the Maine Noise Regulations, including the provisions regarding SDRS and tonal sound, the Department should require post-construction sound monitoring for the project. With the exception of Receptor H3 that is 4,749 away from the nearest turbine, all nearby Protected Locations, and those closest to the turbines, are on the east shore of Spectacle Pond.

I recommend that the Department require sound compliance testing at Receptor H1 as it has the highest predicted sound level in the combined project analysis for the receptors in the Hancock Wind project area, and it is the closest Protected Location to any turbine in the Hancock Wind Project. A verification of compliance at Receptor H1 will ensure the project complies with the Maine Noise Regulations at all other Protected Locations.

Summary

A peer review was done of the Supplement Report. The results confirm: the Vestas V117 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 Hancock Wind Project. Bodwell also performed a cumulative impact analysis of the Hancock and Bull Hill Wind Projects, demonstrating compliance with both the Maine Noise Regulations and the Eastbrook Ordinance. No additional acoustic studies are required for permitting of the project.

For the reasons stated above, I conclude that the Supplement Report submitted with the Combined Application Amendment for Hancock Wind is reasonable and technically correct according to standard engineering practices and it complies with the Department Regulations on Control of Noise (06-096 CMR 375.10).

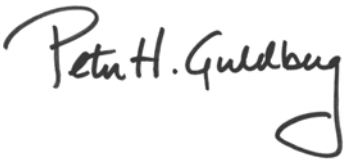
Recommendations

I recommend that any permit the Department may issue for Hancock 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 that the compliance test report include a complete presentation of the data and calculations for the SDRS analysis performed as part of the sound compliance testing for the project.

Thank you for the opportunity to provide an second independent peer review of the Hancock Wind Project application.

Sincerely yours,

TECH ENVIRONMENTAL, INC.



Peter H. Guldberg, INCE, CCM
Managing Principal
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