

Bull Hill Wind Project Sound Level Assessment -- Peer Review

TOWNSHIP T 16 MD, MAINE

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Review Basis

Blue Sky East, LLC (Blue Sky) proposes to construct and operate a wind energy facility to operate 19 utility-scale wind turbines in Township T16 MD area of Hancock County, Maine. At the request of the Land Use Regulation Commission (LURC) a peer review is undertaken to determine if the noise study is reasonable and technically correct according to standard engineering practices and the Commission Regulations on Control of Noise (12 MRSA §685-B(4-B)(A)).

1.0 Introduction

The stated objective of the sound assessment is to demonstrate that the Blue Sky T16 MD Township wind project utilizing 19 Vestas V 100 turbines will meet MDEP/LURC sound level limits. Only mention is made of the Eastbrook, Maine Wind Energy Facility Ordinance. Sound levels from the construction activity, and operation of the substation and other electrical transmission facilities are briefly discussed.

The routine operation sound level estimates are compared to the Maine DEP sound level limits to demonstrate that the Blue Sky wind project will meet applicable sound level limits. The Town of Eastbrook, Maine has adopted a Wind Energy Facility Ordinance to regulate the siting, construction and operation of Wind Energy Facilities in the Town of Eastbrook, Maine. This ordinance does not directly address wind energy facility sounds received in Eastbrook from outside municipalities.

2.0 Environmental Acoustics

Informational

3.0 Project Description

The wind turbine portion of the project consists of 19 Vestas model 100 1.8 MW turbines located along Bull Hill Ridge to the north and Heifer Hill Ridge to the south. The immediate project area and closest protected locations P1, P2 and P3 are located in low elevation forest. The western end of the southern array of turbines (Heifer Hill Ridge) is approximately 600 feet east of the Eastbrook town line, 4300 feet from P1 and 3700 feet from P2. The Vestas model 100 has a total height above ground level of 476 feet. Molasses Pond year-round and seasonal dwellings lie approximately 1.9 miles and greater from the southwestern terminus of the project.

The operation of the proposed substation and O&M building (approximately 2 miles from nearest protected location) are not expected to generate significant sound levels and are thus not included in sound level estimates for the wind project facility.

Blue Sky has purchased or leased property from landowners to install and operate wind turbines at the proposed locations. Easements have been entered into with landowners

who may experience sound levels from the project that have the potential to exceed applicable sound level limits (MDEP Chap 375.10)

4.0 Vestas Wind Turbine Sound Levels

Blue sky proposes to utilize a three blade, up wind Vestas 100-1.8 MW wind turbine. Manufacturer sound power levels determined in accordance with IEC 61400 – 11 range from 94 to 105 dBA (9.3-16.6 RPM or 3-14 m/s) with an uncertainty of 2.0 dBA at full operation. Dominant frequencies range from 125-1000 Hz.

5.0 Noise Standards And Guidelines

Sound level limits were determined at protected locations and property lines based on land owner agreements and land uses. Blue Sky proposes to accept the most conservative regulation levels of 55 dBA daytime and 45 dBA nighttime. Tonal, SDRS, construction, and exempt sounds are appropriately referenced. The Eastbrook wind energy ordinance is noted but not addressed in the report (see addendum).

The reviewer notes that Chapter 375.10 (B)(1) specifies "... This regulation applies to developments located within one municipality, when the noise produced by the development is received in another municipality and, in these cases, the board will also take into consideration the municipalities quantifiable noise standards, If any."

The reviewer will provide the board with a compliance review based on the Eastbrook ordinance in a sperate addendum for consideration in this project.

6.0 Sound Assessment

6.1 Construction Sound Levels

Standard discussion

6.2 Operating Sound Levels

The wind project prediction model (ISO 9613-2) is based on CADNA/A software, with user input of the following prediction assumptions:

- individual wind turbine hub level spherical wave fronts,
- 3-D topography,
- ground surface absorption factor, $G = 0.5$ – bodies of water $G = 0$,
- atmospheric attenuation for 10°C, 70% RH,
- no attenuation due to foliage,
- all wind turbines modeled at maximum sound power output and
- under moderate downwind conditions simultaneously.

The model incorporates an uncertainty factor of + 2 dBA for equipment specification uncertainty and + 3 dBA for prediction algorithm accuracy (ISO 9613-2).

Operating sound level estimates were predicted for the three nearest protected locations indicating hourly level equivalents at or below 40 dBA. It is noted that the conservation area operating sound level estimate is approximately 20 dBA below the applicable limit of 55 dBA.

6.3. Tonal and Short Duration Repetitive Sounds

Vestas has issued a Sound Level Performance Standard that warrants the V 100 will not produce a steady tonal sound as defined by the MDEP 375.10 standard. The proposed Vestas V 100 are not expected to generate regulated tonal sounds during routine operation.

Short duration repetitive sounds are not expected to be frequently produced by the Vestas V 100. In the event that significant penalties are applied for SDRS, the project has a predicted margin of 5 dBA between routine operating sound levels and MDEP limits.

7.0 Sound Level Testing

7.1 Construction

Construction of the project as planned primarily for daylight and daytime hours. No construction sound level testing is planned.

7.2 Wind Turbine Operations

Stable atmospheric required compliance conditions are discussed. tonal and SDRS calculation methodologies are reiterated based on previous compliance reporting requirements.

8.0 Summary Of Findings

Bull Hill wind project is predicted to produce routine operating sound levels below (5 dBA or more) sound level limits based on chapter 375.10 "quiet limits -- 45 dBA nighttime/55 dBA daytime" (up to 500 feet of residence).

Conclusion - (Peer Review)

In my opinion the Bull Hill Wind Project noise assessment is reasonable and technically correct according to standard engineering practices required by LURC under 12 MRSA §685-B(4-B)(A) Regulations on Control of Noise (06-096 CMR 375.10).

The wind project prediction model based on CADNA/A software, based on the following prediction assumptions:

- individual wind turbine spherical wave fronts,
- mixed ground cover attenuation (general) and reflective water surfaces,
- atmospheric attenuation based on 10°C, 70% RH,
- no attenuation due to foliage or barriers,
- all wind turbines operating at maximum sound power output and
- all wind turbines operating under moderate downwind conditions simultaneously.

Incorporation of an uncertainty factor of + 5 dBA for maximum equipment specification uncertainty under stable atmospheric conditions and prediction methodology accuracy resulted in a reasonable prediction model.

I recommend required routine operation noise compliance measurements at a minimum of two protected locations designated in the application noise assessment as "Receiver Points" P2 and P3. These particular sites represent the southern turbine array from two directions and elevations. Please note specific recommendations (pending landowner agreement) for some locations. The reviewer notes that the northern array of turbines has no nearby protected locations.

| Receiver Point | Recommendation/s |
|----------------|--|
| P2 | Receiver point P2 is the most sensitive (39.6 dBA), and appears to have an open field nearby for potential compliance confirmation. |
| P3 | This location will require a proxy measurement point as it is largely a wetland with wooded surroundings. Aerial photos indicate that there are several potential proxy locations to confirm projected sound levels. |

Compliance should be demonstrated, based on following outlined conditions for 12, 10-minute measurement intervals per monitoring location meeting 06-096 CMR 375.10 requirements.

Background ambient monitoring may be required in the areas where extraneous sounds could potentially or do complicate routine operation compliance assessment. If required, background ambient monitoring locations and times will be determined with concurrence from the MDEP.

- a. Compliance will be demonstrated when the required operating/test conditions have been met for twelve 10-minute measurement intervals at each monitoring location.
- b. Measurements will be obtained during weather conditions when wind turbine sound is most clearly noticeable, i.e. when the measurement location is downwind of the development and maximum surface wind speeds ≤ 6 mph with concurrent turbine hub-elevation wind speeds sufficient to generate the maximum continuous rated sound power from the five nearest wind turbines to the measurement location. Measurement intervals affected by increased biological activities, leaf rustling, traffic, high water flow or other extraneous ambient noise sources that affect the ability to demonstrate compliance will be excluded from

reported data. A downwind location is defined as within 45° of the direction between a specific measurement location and the acoustic center of the five nearest wind turbines.

c. Sensitive receiver sound monitoring locations should be positioned to most closely reflect the representative protected locations for purposes of demonstrating compliance with applicable sound level limits, subject to permission from the respective property owner(s). Selection of monitoring locations should require concurrence from MDEP.

d. Meteorological measurements of wind speed and direction should be collected using anemometers at a 10-meter height above ground at the center of large unobstructed areas and generally correlated with sound level measurement locations. Results should be reported, based on 1-second integration intervals, and be reported synchronously with hub level and sound level measurements at 10 minute intervals. The wind speed average and maximum should be reported from surface stations. MDEP concurrence on meteorological site selection is required.

e. Sound level parameters reported for each 10-minute measurement period, should include A-weighted equivalent sound level, 10/90% exceedance levels and ten 1-minute 1/3 octave band linear equivalent sound levels (dB). Short duration repetitive events should be characterized by event duration and amplitude. Amplitude is defined as the peak event amplitude minus the average minima sound levels immediately before and after the event, as measured at an interval of 50 ms or less, A-weighted and fast time response, i.e. 125 ms. For each 10-minute measurement period short duration repetitive sound events should be reported by percentage of 50 ms or less intervals for each observed amplitude integer above 4 dBA. Reported measurement results should be confirmed to be free of extraneous noise in the respective measurement intervals to the extent possible and in accordance with (b).

f. Compliance data collected in accordance with the assessment methods outlined above for representative locations selected in accordance with this protocol will be submitted to the Department for review and approval prior to the end of the first year of facility operation. Reported and unreported compliance data for each location will be submitted to the Department at the earliest possible opportunity after the commencement of operation, with consideration for the required weather, operations, and seasonal constraints.

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Addendum

This addendum to the applicant's noise assessment review addresses the sound limits pursuant to the Maine Wind Energy Facility Ordinance Town of Eastbrook, Maine for the siting, construction and operation of Wind Energy Facilities in the Town of Eastbrook, Maine. The reviewer provides this information for the commission to "take into consideration" the neighboring municipal quantifiable sound ordinance (Chapter 375 (10)(B)(1)). No inference should be concluded regarding the reviewer's opinion regarding ordinance applicability to the Bull Hill Project.

The noise assessment as submitted by Blue Sky East, LLC (Blue Sky) will be re-evaluated in this addendum beginning in section 5 (**Noise Standards and Guidelines**).

Eastbrook Wind Energy Facility Ordinance (Ordinance)

Section 3.0. Purpose.

The purpose of this ordinance is to regulate the siting, construction and operation of Wind Energy Facilities in the Town of Eastbrook, Maine in order to protect the public health, safety and welfare.

Subsection 20.1 Noise Standards

The applicant shall notify the Planning Board at least 30 days prior to conducting the study (post construction) and the town may observe all field work and shall be given an opportunity to review the study's methodology and results. A second study must be performed during the same period in the second year and at least every three years thereafter.

The project boundary hourly sound level limit of 75 dBA Leq₍₁₎ was satisfactorily demonstrated in the LURC application noise assessment.

Ordinance sound level limits at 660 feet from protected locations are compared with estimated project sound levels in Table 1.

Table 1

| Location | Ordinance day limit dBA Leq ₍₁₎ | Ordinance night limit dBA Leq ₍₁₎ | SDRS ^d | Tonal ^e | Project estimate ^f dBA |
|-----------------------|--|--|-------------------|--------------------|-----------------------------------|
| P1 ^a @660' | 55 | 40 | No | No | 41.5 |
| P2 ^a @660' | 55 | 40 | No | No | 39.6 |
| LF ^b @2mi | 35 | 35 ^c | No | No | 28.5 |

^a Protected locations based on the ordinance and the Bull Hill Wind Project Sound Level Assessment

^b lakefront properties along Molasses Pond are assumed by the reviewer to be protected locations at distances greater than 2 miles

^c Ordinance limits at protected locations at distances greater than 2 miles (Appendix B A.1.a)

^d not expected to be problematic, but the planning board may find occurrences as particularly annoying penalizing with additional 5 dBA (Appendix B A.1.c.ii)

^e not expected to be problematic, as demonstrated by manufacture specifications, but may be penalized (Chapter 375.10 criteria) by 5 dBA added to the $Leq_{(t)}$ (Appendix B A.1.b)

^f As estimated by the reviewer employing ISO 9613-2:1996(E) assuming simultaneous operation of all wind turbines, winter frozen-ground conditions ($G = 0$), each turbine emitting the maximum sound power level guaranteed by the manufacturer for all wind speeds, including the uncertainty level (K factor) for sound measurement uncertainty and turbine production uncertainty (IEC technical specification 61400-14) (Appendix B B.f). Total sound power uncertainty is conservatively assumed at 2 dBA given the independent DELTA testing of the Vestas V90 and very limited production specifications of the V100.

In addition to footnote "d" of Table 1, Section C of the ordinance – Terms and Conditions the planning board reserves the right to require the applicant to:

- enclose equipment or operations,
- impose limits or extent of operating hours,
- require specific design technologies,
- site design,
- modes of operation, or
- traffic patterns,
- document no unreasonable disturbance of wildlife, or
- adversely affect wildlife populations, or
- lower sound level limits for the protection of wildlife resources.

The above paragraph appears to be based in part on subjective criteria that do not allow the predictions of two evaluators to necessarily arrive at the same outcomes.

The proposed project as designed does not comply with the ordinance quantifiable nighttime limit of 40 dBA for protected location P1 at 660 feet from property boundary.

Additional subjective SDRS compliance requirements cannot be anticipated at this time.

Appendix B (A.2) Construction Sound Level Limits

Ordinance nighttime (6 PM-7 AM) construction sound level limits are similar to chapter 375.10 requirements, except for the limit levels (Ordinance – 40 dBA@660 feet from the property boundary: Chapter 375.10 – 45 dBA up to 500 feet from a residence on a protected location).

Ordinance daytime construction (7 AM-6 PM) sound level limits are markedly below the chapter 375.10 limits that were repealed by 38 MRSA 484. Ordinance daytime

construction sound level limits are compared with previously held MDEP limits in Table-2 for perspective.

Table 2 Ordinance Daytime Construction Sound Level Limits Compared With Previously Held MDEP Limits

| Eastbrook Ordinance | | Repealed Chapter 375.10 | |
|-----------------------------|---------------------------------|--------------------------------|---------------------------------|
| Duration of activity | Hourly Sound Level Limit | Duration of activity | Hourly Sound Level Limit |
| >6 hours | 80 dBA | 12 hours | 87 dBA |
| | | 8 hours | 90 dBA |
| 2 to 6 hours | 85 dBA | 6 hours | 92 dBA |
| | | 4 hours | 95 dBA |
| | | 3 hours | 97 dBA |
| >1 hour but <2 hours | 95 dBA | 2 hours | 100 dBA |
| One hour or less | 105 dBA | 1 hour or less | 105 dBA |

Since daytime construction sounds are exempt from chapter 375.10 (38 MRSA 484), the applicant made no estimates of impact. Hence, the reviewer has insufficient construction information and must also follow suit. It is noted that the ordinance daytime construction sound level limits are markedly below those of the former application of chapter 375.10.

Appendix B Section D Measurement Procedures

SDRS duration and frequency of occurrence of events must be measured (D.4.2.d).

Review Conclusion

The Eastbrook ordinance parallels chapter 375.10 in many aspects. The reviewer has attempted to highlight only areas of marked exception between the two regulations.

It is the reviewer's opinion that the Eastbrook ordinance is not entirely quantifiable and provides an insufficient basis for estimating acceptable wind project design.