

Maine DEP hourly sound level limit at MP-1 would be either 55 or 60 dBA for both daytime and nighttime hours.

- The highest hourly sound level measured at MP-1 from wind turbine operation was 55 dBA during 2nd quarterly testing (ref. 2nd Quarterly Report, 11/2/07). This meets the quiet limit of 55 dBA at MP-1 without a variance but is 4 dBA over the 2003 noise model estimate.

2nd Quarter Peer Review 7.2 and Conclusion (ref. 4): Prior ambient sound level measurements during conditions required for significant wind farm operation were not conducted in a technically satisfactory manner, as previously discussed in EnRad Consulting report, November 21, 2007. The "... typical hourly L_{Aeq} readings during periods of the May 2007 operations testing when winds were light or calm and wind turbines were not operating" are essentially the only technically satisfactory ambient measurements reported. Convincing valid ambient noise levels have only been reported in May of 2007 during calm or light wind conditions when wind or biological sounds, such as birds or frogs, haven't potentially invalidated the integrity of the data.

Initial Peer Review 6.0 (ref. 1): It is clear from Larson-Davis literature and testing of their microphones windscreen system that wind speeds above 12 mph produce microphone forces registered as sound levels that may adversely affect low level sound level measurements. Surface wind speed and direction were not measured at each ambient location, but rather several miles away at the Presque Isle Airport.

Reply:

- RSE agrees that some of the ambient sound level measurements from December 2006 were affected by wind forces acting on the windscreen and microphone. With the exception of positions MP-2 and MP-4, the wind influence was diminished due to shielding from wind by terrain and vegetation. This was confirmed during 2nd and 3rd quarterly operations testing through the use of portable meteorological stations.
- Measurements at MP-1 during 2nd quarterly testing showed non-wind farm (ambient) sound levels consistent with the highest ambient reading from December 2006 with ground level wind speeds at microphones measuring below 12 mph. Although the report is pending, third quarterly measurements at MP-1 also show non-wind farm (ambient) sound levels at or near 2006 levels with the microphone equipped with either a standard or oversized (secondary-type) foam windscreen. Due to insertion loss at higher frequency ranges, secondary windscreens have the potential to reduce and understate sound levels from natural ambient sounds from leaves, birds, and frogs. Windscreen insertion loss can also occur at low frequencies.
- The primary objective of the quarterly monitoring is to compare wind turbine sound levels with 2003 model estimates. Ambient data from 2006 is used for comparisons to wind farm sound levels and not to adjust measurements of wind farm operation. Only ambient sound levels measured in May 2007 with light or calm winds were used to adjust wind farm sound level readings. Further, ambient adjustments had a negligible effect on the highest reported wind farm sound levels at locations closest to the wind turbines (MP-1, MP-8, MP-6A, and MP-7/7A).
- Wind turbine sound levels were determined from measurements taken when turbine power output was moderate to high and wind speeds at the microphones were at or below 12 mph. To the extent practicable, this was confirmed by use of portable MET stations during 2nd and 3rd quarterly testing.

2nd Quarter Peer Review 7.2, 8.0 and Conclusion (ref. 4): The data found in Appendix IV indicates generally identical hourly L_{Aeq} and L_{A50} nighttime values (stable atmosphere). Operation noise level estimates calculated using the hourly L_{A50} introduces a statistical metric other than the hour L_{Aeq} , which breaks step with the existing regulation, and assumes a relationship with operation sound levels that has

been suggested by some data but not established under all conditions. During stable atmospheric sound measurements when hourly L_{Aeq} and L_{A50} are equivalent there is no reason to diverge from using the hourly L_{Aeq} .

Reply:

- When surface winds diminish and upper level winds remain strong to maintain wind turbine operation at or near full output, the L_{Aeq} and L_{A50} values are very close. Comparison of these statistics as well as the L_{A90} values is a key indicator of periods when wind turbine sound levels are predominant.
- There are also hourly periods when local surface winds have occasional gusts or other events that result in brief sound level excursions. In these cases, use of the L_{A50} is more suitable for representing wind turbine sound levels because the L_{Aeq} can be affected by higher sound levels from wind gusts or other events. Periods of full wind farm operation when the hourly L_{Aeq} and L_{A50} are the same indicates the suitability of the L_{A50} to represent hourly wind turbine sound levels. Therefore, the L_{A50} is more representative of overall wind turbine sound levels and its use simplifies analysis of the results.
- RSE has utilized the L_{A50} or similar statistical parameters on other projects in Maine to quantify sound levels from routine operation and exclude occasional non-development sounds. These methods and reports have been previously approved by Maine DEP.
- The use of various statistical parameters to quantify sound levels from a specific source or operation is a common acoustic engineering methodology. For example, a technical paper presented at Noise-Con 2007 compared measured sound levels from wind turbines using the 90th percentile (L_{A90}) of one-minute equivalent sound levels to quantify wind turbine sound levels for ten-minute periods.¹
- Maine DEP Chapter 375.10 Section H.4.2, Measurement of the Sound Levels Resulting from Routine Operation of the Development, states “When ambient sound levels are greater than the sound level limits, additional measurements can be used to determine the hourly sound level that results from routine operation of the development.” Examples given include use of sound level meters with pause capability to allow the operator to exclude non-development sounds. This technique is similar to use of percentile levels (e.g. L_{A50}) as both methods exclude the sound level contribution of intermittent noise events such as traffic and wind gusts.

2nd Quarter Peer Review Conclusion: Sheltering sound and weather stations to minimize microphone wind interference is not always desirable. “Leaf noise”, or more generally localized intrusive noise, potential at protected locations should be carefully evaluated at monitoring position to assure appropriate protected location representation. Correct anemometer placement for accurate ground wind speeds should be 10H from an obstructing barrier, where H is the height of the barrier.

Reply:

- During 2nd and 3rd quarterly testing, portable met stations were located adjacent to sound monitoring positions in order to measure the wind speed incident on the tripod mounted microphone/windscreen system. These locations are different than if selected for purposes of determining ground or surface wind speed without obstruction where the 10H rule would apply.
- Sound level measurements are supplemented by field observations to identify periods when wind turbine sound was predominant relative to ambient sounds particularly wind forces on trees. Regional weather data from Presque Isle (Northern Maine Regional Airport) was reviewed to verify field observations related to local treetop wind conditions

¹ K. Kaliski and E. Duncan, *Propagation Modeling Parameters for Wind Turbines*, Noise-Con 2007.

- Working with W. Brown, the 3rd quarterly test protocol included locating a sound level meter and a portable met station at a new position MP-1A and adding a portable met station at position MP-2 (open, elevated field). Both locations were selected to measure surface wind conditions with minimal nearby obstruction. (Ref. e-mail correspondence between RSE, W. Brown, EnRad, and R. Clukey, Maine DEP, 12/31/07 and 1/3/08.)

2nd Quarter Peer Review Conclusion: Monitoring location MP-1 is located proximal to a hedgerow of trees that artificially increases ambient noise in the immediate area during high wind conditions. Nighttime (September 4/5, 2007) wind data (Presque Isle airport, ground level METS station, hub level measurements and RSE field observations) indicate probable stable atmospheric conditions, which provide ample windmill wind speed at higher elevations and negligible surface wind near monitoring locations.

Reply:

- This conclusion supports RSE's methodology for quantifying wind turbine sound levels using measurements taken with ample wind speed at turbine hubs and moderate to light surface winds (≤ 12 mph) near monitoring locations.
- Similar to MP-1, measurement results and observations at new position MP-1A during 3rd quarterly testing also show elevated ambient sound levels during high surface wind conditions due to wind forces acting on nearby vegetation, terrain, and more distant trees as prominent ambient sound sources. Third quarterly testing results will be reported upon completion of data reduction and analysis.
- The primary objective of quarterly testing is to determine wind farm sound levels. Only ambient readings during very light or calm winds were used to adjust measured wind farm sound levels. The effect of high surface winds on quarterly measurements would be to increase ambient sound and overstate wind turbine sound levels thereby providing conservative results for wind farm sound levels.

2nd Quarter Peer Review Conclusion: It is the opinion of the reviewer that this 2nd assessment of the project indicates, once again, substantial compliance, but requires further measurement technique refinement with additional measurements to fully demonstrate results are reasonable and technically correct to standard engineering practices and the Department Regulations on Control of Noise (06-096 CMR 375.10) with operational noise limits set forth in the Control of Noise rules and the variance given in Department Order L-21635-26-A-N/L-21365-TG-B-N, dated June 1, 2004.

Reply:

- Prior to recommendations of the initial peer review and based on results of 1st quarterly testing, RSE and UPC implemented additional instrumentation and field methods during 2nd quarterly sound level testing. In the initial peer review, W. Brown provided recommendations in support of the additions already made to the 2nd quarterly measurement protocol.
- Based on further review by W. Brown, including the 2nd quarterly sound level report, RSE and UPC worked with Maine DEP and W. Brown to implement additional refinements to measurement techniques that were implemented as part of 3rd quarterly testing. For example, RSE provided additional maps and site photographs to Maine DEP and W. Brown to establish an additional test location at MP-1A. This work was completed prior to formal issue of the 2nd Quarter Peer Review report.
- As a result, several of the recommendations contained in the 2nd Quarter Peer Review were implemented by RSE/UPC during 3rd quarterly testing (see Reply to follow). Analysis and

reporting of 3rd quarterly results is in process.

2nd Quarter Peer Review Recommendations: Relocate anemometer and sound monitoring locations at MP-1 maintaining appropriate distances (property boundary/hedgerow distance) and similar geometry with nearby wind turbines.

Reply:

- As previously discussed, both a data-logging sound level meter and portable met station were placed at a new position MP-1A established with W. Brown for 3rd quarterly testing.
- Instrumentation for 3rd quarterly testing was also maintained at MP-1 to provide a comparison with MP-1A results and previous MP-1 measurements from 1st and 2nd quarterly sound testing.
- MP-1 is located along the lease boundary of the wind farm and MP-1A is located approximately 250 feet west of MP-1 on the abutting parcel of land. Both positions are more than 500 feet from the nearby residence.

2nd Quarter Peer Review Recommendations: Microphone wind interference should be controlled using secondary windscreens.

Reply:

- Subsequent to the initial peer review report and prior to 3rd quarterly testing, RSE worked with Maine DEP and W. Brown to establish procedures for the use of secondary-type windscreens for 3rd quarterly testing.
- It was generally agreed that although secondary-type windscreens may reduce wind noise across the microphone, they can also cause a reduction in measured broadband sound levels due to windscreen insertion loss. Due to the limitations of secondary-type windscreens, it is preferable to conduct sound level measurements using standard windscreens and with wind speeds not exceeding 12 mph.
- The agreed protocol was to use large foam (secondary-type) windscreens for rotational spot measurements at times when surface wind speeds are regularly over 10 mph. (ref. e-mail to Maine DEP and W. Brown, 12/14/07). Maine DEP 375.10.H.2 states that measurement periods shall be avoided when the local wind speed exceeds 12 mph and prescribes using microphone windscreens of a type recommended by the manufacturer of the sound level meter.
- Most rotational spot measurements as well as a portion of continuous measurements at MP-1 were taken using large foam windscreens. Further details concerning the use of secondary-type windscreens and comparison to standard windscreens will be provided in the 3rd quarterly test report.

2nd Quarter Peer Review Recommendations: Operation noise levels should be reported in specified metrics unless otherwise specified by the department.

Reply:

- As previously stated, the Department's regulations recognize the use of additional measurement methods to remove the contribution of ambient sounds not emitted from operation of a development.
- In many cases, the L_{A50} and L_{Aeq} readings at nearby community locations are nearly identical, and thus either metric would include the sound level contribution of wind turbines. In cases where sound events from wind forces acting on trees and terrain, or other sources such as traffic or

wildlife, affect the measured L_{Aeq} readings, the L_{A50} is more representative of wind turbine sound levels. In these cases, use of the L_{Aeq} may significantly overstate wind turbine sound levels.

2nd Quarter Peer Review Recommendations: Ambient (operation conditions) sound levels should be established (May 2007, calm periods or re-measured) to allow definitive calculation of operation hourly L_{Aeq} for comparison with department compliance conditions.

Reply:

- Sound level readings and observations at Mars Hill demonstrate that a wide range of ambient sound levels can occur under conditions suitable for operation of the wind farm at or near full power output. Measurement results during both wind farm operation and shutdowns have shown a strong relationship between ambient sound levels and local wind conditions, excluding wind effects on the microphone.
- The upper level winds driving the wind turbines can fluctuate independently of surface winds. Measurements have been taken during daytime and nighttime periods with strong winds both aloft and at surface levels. Conversely, measurement data also includes several periods, usually at night, when surface winds diminish while upper level winds increase or remain strong.
- These results indicate the difficulty of establishing a single ambient sound level for periods of high wind park operation due to fluctuating local wind conditions and other variables (wind gradients, vegetation, wildlife, etc.).
- RSE's method for adjusting operating sound levels for ambient contributions remains conservative and results in little, if any, adjustment at the nearest locations for the upper range of wind turbine sound levels. Thus, for comparing wind farm sound levels to 2003 model estimates, this method may overstate wind turbine sound levels for specific operating and weather conditions.
- For fourth quarterly testing, it may be possible to arrange brief park shutdowns during field-selected periods to measure "real-time" ambient sound levels under operating conditions.

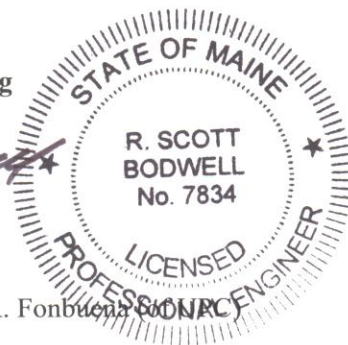
We trust that the additional information provided is responsive to findings and recommendations from Warren Brown. Review and analysis of the 3rd quarterly test results continues including the use of secondary-type windscreens, a new monitoring location, and turbine operations during periods of blade icing. Measurements under variable weather conditions and operating conditions continue to increase knowledge of the relationships between wind turbine operations, weather conditions, and seasonal changes. UPC and RSE would be happy to meet with you and Mr. Brown to discuss this information and review potential refinements to the fourth quarterly test protocol.

Please feel free to contact us if there are any further questions concerning the information presented in the Sound Level Study reports submitted to Maine DEP.

Sincerely,
Resource Systems Engineering



R. Scott Bodwell, PE
Sr. Project Engineer



cc: D. Cowan, M. Alvarez, R. Fontana, J. Conroy