E-Coustic Solutions

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Dear Mr. Abraham:

Thank you for the opportunity to respond to your request for preliminary comments on the appropriate method to assess background sound levels in rural Allegany, New York. The purpose of measuring background sound levels is to be able to predict potential impacts from noise emissions caused by a 32-turbine industrial wind farm proposed by Everpower Renewables. You have indicated that the Allegany Planning Board will be reviewing submissions from Everpower with the help of an independent consulting firm, as soon as the Board is satisfied the submissions are complete. EverPower's submissions should present the findings of their pre-construction background sound level measurements and their post-construction operational sound levels as estimated by computer modeling of the wind turbine's sound emissions' propagation into the adjacent community.

Reviewing this type of report requires an independent and thorough understanding of how wind turbines affect the potential for community annoyance, sleep disturbance, and possible health risks. There are specific differences between wind turbine sound emissions and those of other common community noise sources like roads, rail, aircraft and most industries. These differences require measurements to identify the times when the turbines are most clearly audible, which is typically when the ground level winds are calm and upper level winds are strong enough to power the wind turbine at full capacity and the man-made sounds of the community have quieted for the evening/night. This condition is typical of many summer evenings and nights so the opportunities to collect this information at night are not uncommon.

Modeling procedures for wind turbines also differ from the ones used to predict annoyance and land-use compatibility for the more common rail, road, air, and industrial sources of community noise. Wind turbines do not meet many of the requirements for accurate modeling of sound propagation under the ISO 9613-2 standard upon which all commercial modeling software's computational methods rely. The Planning Board's acoustical consultant will also need to understand the issues related to IEC 61400-11, the standard for measuring wind turbine noise under laboratory conditions. Thus, a thorough understanding of ANSI standards such as S12.9 parts 2 and 3, and S12.18; and ISO 9613-2 for sound propagation models, and IEC61400-11 for the input data to those models will be needed to adequately judge completeness, accuracy and implications of the Everpower noise study.

Limitations identified in each of the standards related to their intended use, limitations of the procedures; and conditions that could lead to higher sound emissions than the reported test results along with the theoretical limitations of the sound propagation algorithms will need to be disclosed in the report or else the reviewers will need to obtain this understanding independently. One example of this in-depth understanding is to know that the ISO 9613-2 prediction formulas and procedures are able to accurately address only the simplest of geometries between noise source and receiver. Another is that the formulas specified under ISO standards assume that the noise and receiver are under ideal weather conditions with low speed winds. Wind speeds sufficient to power wind turbines are not within the scope of the ISO standard's procedures. If the terrain is not flat, the models' ability to properly address the interactions of the terrain (as a barrier) between the source and receiver must also be carefully reviewed. Wind turbine models are not a good fit to the ISO standard's assumptions and pre-conditions used in constructing the models and computing the sound levels emitted into the adjacent properties. There is a long list of input data values that must be disclosed and reviewed for appropriateness on any particular project. If these are withheld and not disclosed in the report then the validity of the model cannot be independently verified.

Even with the above information, the model's results will not reflect the 'real world' conditions. First, the models can only consider average sound levels. They cannot, by themselves, provide any insight into the degree of fluctuating noise that will be heard outdoors on one's property, or whether the low frequency noise emissions will be a cause of problems inside adjacent homes. This later issue is especially important to know whether the wind project, when operating at night, may cause sleep disturbance.

One cannot blindly apply the results of a sound propagation model that was originally developed to predict noise levels of rail, road, and other industrial noise sources common to suburban and urban communities. Models of wind turbines on tall towers, located in rural communities, and sometimes operating under extreme weather and wind conditions have numerous opportunities for potential inaccuracy. For example:

1. Wind turbines do not operate at the low wind speeds for which the ISO based computer models assume,
2. The turbines' blades and other noise sources are located at a height that exceeds the upper limit for noise sources to be above the ground (limit is 30 meters), and
3. Because of the height, sound waves propagating from the turbine to the receiver do so at steep angles such that normal attenuation from vegetation and terrain do not occur.
4. For Wind turbine projects located in a long row along a ridge, the rate at which sound decays can be very different from what would occur if the turbines were scattered across flat terrain. If this is not accounted for in model construction serious underestimates of sound level in the community will occur. Unless the decay rates for sound from the turbines are disclosed, there will be no way to know if this and similar situations are handled properly.

Yet, given that the models are poor at replicating the way turbine sound emissions will propagate in the real world due to the poor fit between the ISO 9613-2 formulas and the way turbines are situated they are still often used in wind turbine company noise studies included in requests for permits and other necessary approvals. It is critical that those who will be reviewing the EverPower sound study understand the details of the model construction and the assumptions used in creating it. The study should also disclose all factors that could lead to higher noise levels than the model predicts to allow the reviewers to estimate the upper limit of noise impact.

I have reviewed Mr. Charles Ebbing's PowerPoint presentation given to the Planning Board on February 2, 2009. I fully support his estimate of about 25 dBA as representative of the community's nighttime background sound level. I base that support on my understanding that the Everpower project area is located in an area that would be considered rural or wilderness. I understand that this area does not bound urban areas where air, rail, and road noise set the long-term background sound levels. It is typical of rural areas 3-5 miles distant from any major artery that is heavily trafficked at night, not on flight/landing paths, not affected by industrial noise sources, and where rail and other man-made sounds are infrequent especially during late evening and nighttime hours.

I have conducted tests of background sound levels in many similar areas. Nighttime background sound levels of 25 dBA or even lower were commonly observed.

Mr. Ebbing is also correct to emphasize the common situation of stable atmospheric conditions, where calm air prevails at ground level, with little or no wind speed, but wind speeds at elevations of 100 feet or more above ground level are sufficient to operate turbines at maximum output. This condition is especially common for people who live below ridge line-sited wind turbines. People living at the foot of the ridge are often sheltered from the wind by the ridge. Under those conditions, the turbines are producing maximum sound emissions but there is no masking of wind turbine sounds in the valley because there the winds are calm and there is no 'wind' noise.

This condition, when the turbines are "clearly audible," is the one that should be used to assess whether a wind project meets the sound level criteria, not some other condition, such as, when surface winds are high and the sounds of wind interacting with objects and vegetation might provide some masking of the turbine sounds. The standards are intended to prevent complaints of noise. It would be absurd to judge the acceptability of wind turbines for conditions that represent situations when sounds in the valley are unusually high.

Generally accepted procedures for land use planning assess the new source against the quiet times of the community not the noisy times when complaints would be unlikely. Since wind turbines operate 24 hours a day, the likely complaint time would be at night, when man-made noises have stopped, the winds at the turbines on the ridges are at nominal or higher operating speeds, and the winds in the valley are shielded by the ridge or because of wind shear. Mr. George and Dave Hessler, in their paper titled: "*Baseline Environmental Sound Levels for Wind Turbine Projects*" say in the first paragraph of the Conclusion:

"Adverse impacts occur when the new noise from a project significantly exceeds the background level at sensitive receptors and becomes clearly audible.[1]"

It is puzzling that, immediately after this statement, the Hesslers continue by concluding that the time when wind turbines will be "clearly audible" is when the wind outside homes in the valley is blowing hard, e.g. at 10-20 mph, and the wind at the ridge is also high causing the turbines to operate at their maximum sound emission level.

This interpretation is contrary to the generally accepted understanding of a community's 'background sound level.' This is a defined term in acoustics. To alter its meaning to be the noisiest conditions and not the quiet conditions as generally accepted for land use planning and evaluating a community's reaction to a new noise source is truly novel. It is clearly at odds with ANSI standards and procedures for assessing background sound levels and for assessing the impact of a new noise source on a community.

Mr. D. Hessler's report for Everpower on pre-construction background noise uses this novel twist to the meaning of background sound level to substitute higher sound levels for the basis of compatibility conclusions than sound levels representing the quiet nighttime ambient. This substitution is not appropriate because using the 'worst case' wind induced noise sound level in place of the more appropriate 'quiet time' sound level gives the appearance that the wind project will be more compatible with the community than it will be in operation. There are many examples of wind developer sound studies that use this type of ruse to conclude that a wind project will be compatible or even not audible in a community when it requests a permit. Yet, those same projects cause frequent complaints of excessive noise once they start operating. The methods being applied in the EverPower study can easily lead to the same problems.

Because the methods used for the Everpower report do not follow generally accepted practices any statements about compatibility with the community should be ignored. The fact that the wind project may not be a noise 'problem' when the community is subjected to high noise from wind and weather has nothing to do with its compatibility when the community is quiet and the turbines remain in operation. The report's novel method of interpreting (or misinterpreting) the background sound level near the project area based on conditions when the turbines are the least audible (because it is already noisy outside from high winds) will always show wind turbines are more compatible with the community, compared to an interpretation based on generally accepted standards for determining background sound. Generally accepted standards dictate that background sound levels be determined under conditions when the turbines would be most clearly audible. Whether this is intentional biasing of the study in favor of the developer or not, the result is to bias the findings in favor of the developer's goals.

[1] Hessler, George F., Hessler, David M., "Baseline Environmental Sound Levels for Wind Turbine Projects" published in Sound and Vibration Magazine, pages 10-13, Nov., 2006

Mr. Hessler may respond that this method is used by many other consultants who work for wind energy developers. But, as Mahatma Gandi said: " *An error does not become truth by reason of multiplied propagation, nor does truth become error because nobody sees it*"

Mr. Ebbing is also correct to distinguish the impact of low frequency sound from A-weighted sound levels generated by wind turbines. Low frequency sound is a significant component of wind turbine noise, it more easily passes through walls to home interiors where there is an expectation of privacy and quiet, and can be expected to be higher in amplitude (louder) than sound levels from the same source measured with the meter set to apply A-weighting to the measurement data (dBA). Since Hessler's model results are not presented with octave or 1/3 octave band level of detail nor in terms of over-all dBC sound levels the dominance of the energy in the lower frequency ranges common to most modern wind turbines is not apparent to a reviewer of the report who does not already know the spectral energy distribution of a wind turbine. Thus, without this information it is not possible to know if the wind turbine's sound emissions will result in excessive low frequency energy.

Mr. George Hessler understands the role low frequency sounds can play in community complaints and has written a paper on that topic in which he recommends strict limits for low frequency sound using dBC measurements to assess whether the low frequency sounds are excessive[2]. Yet, even with that knowledge available to him, Mr. D. Hessler presents no analysis of the operational low frequency noise emissions of the EverPower wind project. Is this oversight or intentional? To dismiss low frequency sound and its potential as a community annoyance or possible public health risk using an unsupported assertion that it is not 'significant' is not science, it is public relations. Complaints from people who live near operating wind projects often involve low frequency sound issues. It would have been appropriate for Mr. D. Hessler to present an analysis to show whether the low frequency sound emissions from this project might pose problems given the understanding of the issues of low frequency sound and complaints shown in Mr. G. Hessler's paper.

Based on my experience measuring community background sound levels, such rural areas are much quieter than acoustical experts have assumed for the last 30 years. This lack of information occurred because in the U.S., almost all of the major research on community noise was conducted in the 1970s under the auspices of EPA's Office of Noise Abatement and Control. These studies focused almost exclusively on urban, suburban and industrial areas. Those areas were the primary concern because those areas where undergoing the most rapid development. In 1980 the Office of Noise Abatement and Control was defunded and no administration since has renewed funding. Thus, all government-sponsored research came to a virtual halt. By the time acoustical engineers, as a profession, realized we had no understanding of long term background sound levels in rural/wilderness areas there were no funds to conduct the research.

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[2] Hessler, G. F. Jr., "Proposed criteria in residential communities for low-frequency noise emissions from industrial sources", Pages 179 to 185, Noise Control Eng. J. **52** (4), 2004 Jul–Aug

Mr. George Kamperman, PE, Bd. Cert. INCE (emeritus), who has been active in the community noise field since about 1950 and who participated directly or indirectly in many of the studies used to establish the guidelines now commonly used in community ordinances has stated in private conversations that the truly rural areas were not considered because they were not near sources like road/rail/air/industry. Developing noise criteria for the urban and suburban land-uses was the initial concern of the EPA. Once the office was defunded there was no way to fill in the gaps in our understanding of rural/wilderness land-uses.

This lack of data and the subsequent miscues created by committees who have adopted acoustical principles and rules created in the 1970s for road/rail/air/industrial noise sources for wind projects along with misdirection in marketing materials from wind advocacy groups like the trade lobbying organization American Wind Energy Association has resulted in disasters like the UPC/First Wind, Mars Hill utility in Maine. There and in other places the application of old rules for land-use planning has resulted in wind projects being "compliant" but the adjacent properties are subjected to constant sound levels over 50 dBA with high low frequency sound energy and the periodic "whoosh" of turbine blades every 1.5 seconds 24/7. This is part of a general phenomenon, where modeling by wind developers predicts low impacts, but many operating wind farms around the world, especially those using modern upwind industrial scale wind turbines located within a half mile of homes, have elicited unexpected levels of community complaints about noise.

The long-term background sound level (L_{90}) as defined and measured according to ANSI standards, is the proper starting point for assessing community response to a new noise source. My rule of thumb is that if one can hear sporadic traffic at distance of 1-2 miles at night when the air is calm and man-made sounds are not present near the listener, the L_{90} will be in the range of 25 dBA or lower. Some rural/wilderness areas I have tested have been 18 dBA and possibly lower where even the sound of distant traffic is not present.

The Acoustical Society of America is in the initial stages of establishing a new working group to review the issue of rural/wilderness long-term background sound levels and how to measure them. The measurement methods in the Kamperman and James manuscript reflect the current best understanding of how to make these measurements within the framework of current ANSI/ISO standards. I expect, based on Mr. Kamperman's relationship with Dr. Schomer, who is charged with the task, that our procedures will be part of the working group's starting point.

However, as explained above, consultants who regularly work for the wind industry use their own method. It does not meet any of the generally accepted acoustical standards and in many respects its methods are directly prohibited under the ANSI/ISO standards. For example, measuring community background sound levels when winds exceed 4.5 mph, or allowing transitory sounds such as sounds of a nearby brook to be taken into account in the measurement are both prohibited under the standards. This is because the standards require that the measurements capture only sounds that can be expected to be persistent over long periods; the standard directs that transitory sounds and wind noise be removed from the data set used to determine background sound level.

Based on my professional experience, I expect that the families living in the valley between the two ridges on which Everpower proposes to site industrial turbines in Allegany will be subjected to higher levels of annoyance, sleep disturbance and other negative impacts than would occur if the turbines were on relatively flat land. None of the computer-based acoustic models being applied for wind projects that I have reviewed to date properly address this difference. My research and that of others into the current models used by wind developers show that the attempts to make the models fit the ridge-to-valley situation can introduce errors that further under-predict the extent to which sound propagates into the valley. For this reason the models also under-predict the potential for annoyance and sleep disturbance. Computer model results need to be carefully reviewed to prevent such errors and, if needed, adjusted manually for the ridge-to-valley situation.

I have enclosed guidelines developed by myself and George Kamperman titled "Simple guidelines for siting wind turbines to prevent health risks," for your and the Planning Board's further reference.

Sincerely,

Richard R. James, INCE
For: E-Coustic Solutions

February 19, 2009

Attachment