

July 16, 2012

Connecticut Siting Council
Ten Franklin Square
New Britain, CT 06051

Subject: CONNECTICUT SITING COUNCIL DRAFT WIND REGULATIONS

At the request of FairWindCT, Inc., we submit our professional opinions for the review of the proposed Connecticut Siting Council Draft Wind Regulations dated 12 April 2012. We present and discuss specific sections in the proposed regulations pertaining to wind turbine noise. Industrial noises are regulated by governmental agencies in order to protect citizens from exposure to excessive noise and adverse public health and well-being impacts.

We understand that the proposed regulations are being created in accordance with *Public Act No. 11-245, An Act Requiring The Adoption Of Regulations For The Siting Of Wind Projects*.

"Section 1. (NEW) (Effective July 1, 2011) (a) On or before July 1, 2012, the Connecticut Siting Council, in consultation with the Department of Public Utility Control and the Department of Environmental Protection, shall adopt regulations, in accordance with the provisions of chapter 54 of the general statutes, concerning the siting of wind turbines. Such regulations shall include, but not be limited to, (1) a consideration of (A) setbacks, including considerations of tower height and distance from neighboring properties; (B) flicker; (C) a requirement for the developer to decommission the facility at the end of its useful life; (D) different requirements for projects of different sizes; (E) ice throw; (F) blade shear; (G) noise; and (H) impact on natural resources; and (2) a requirement for a public hearing for wind turbine projects. "

Industrial wind turbine noise has proven to be a source of public complaints for non-urban neighbors living up to a mile away. This is especially true in locations where wind speeds can be calm to light at ground level and strong at the turbine blade heights, and/or wind directions differ from low to high elevation. The change in wind speed and/or angle with increased elevation is called "shear". Changes in topographical elevation produce "turbulence". Shear and turbulence are strong in New England, but mild at manufacturer test locations where winds are steady and there are small changes in wind speed with increased elevation.

Comment 1: Wind shear and turbulence consideration is omitted.

Reference: Sec. 16-50j-2a. Definitions (starting page 1).

We did not find consideration for wind shear and turbulence. Manufacturer test data is obtained with wind turbines operating under smooth wind flow conditions with low wind shear (as required by the IEC 61400-11 standard). However wind shear and turbulence is significant in New England and more prevalent at night when most people are trying to sleep. Wind turbine blades may be less efficient under high wind shear and turbulent air conditions; more noise is emitted. Computer prediction noise models that use low wind shear values in lieu of more representative higher values will under-predict sound levels by 5 to 8 dB, which has been confirmed by actual measurements. The proposed regulations should include a design safety margin for of 5 to 8 dB for proposed facilities.

Comment 2: Low frequency noise consideration is omitted.

Reference: Sec. 16-50j-2a. Definitions (starting page 1).

We did not find consideration for low frequency noise. Wind turbine manufacturer test data is obtained and published with A-weighting (as required by the IEC 61400-11 standard). This is very misleading since A-weighting filters out low frequency noise contributions and excludes infrasonic energy. Data published by wind turbine manufacturers discounts the significance of low frequencies and infrasonic energy. Un-weighted (linear or “dBZ”) field measurements have confirmed that most of the acoustic energy produced by wind turbines is low frequency and infrasonic (below 200 Hz).

Low frequencies are a well-documented common complaint for wind turbine noise; i.e., it sounds like “a jet plane that never lands”. This is especially true indoors, where the higher frequencies are blocked and the longer wavelengths of low-frequency and infrasonic energy pass easily through the through exterior walls and roof into the home. The predominance of low frequencies inside homes is a leading cause for complaints.

The proposed regulations should include mandatory considerations for wind turbine low frequency noise by requiring the inclusion of a maximum low frequency limit for proposed facilities. A maximum of 55 dBC, outdoors at night (measured using the broadband “dBC” filter found on professional sound level meters) has a growing consensus by environmental acoustic and public health professionals.

The recently enacted Danish indoors low-frequency wind turbine standard evaluates low frequency impacts by summing A-weighted $1/3^{\text{rd}}$ octave band frequencies only from 10 to 160 Hz. Research in Denmark had some startling findings that clearly show the deficiency for relying on the dBA scale. This is due to the low-frequency filtering of the dBA. The dBA levels often associated with “refrigerators”, or traffic noise, are not useful to assessing for community reaction to wind turbine low frequency noise because human annoyance ramps up quickly at low frequencies. Indoors adverse reactions to wind turbine low frequency noise occur and increase very quickly above 20 dBA (10-160 Hz). At 25 dBA (10-160 Hz) low frequency noise was found to be very annoying (sleep disturbed), and at 30 dBA (10-160 Hz) low frequency noise was deemed intolerable for most people.

Comment 3. Proposed requirements are too lax to protect neighbors from excessive noise and adverse public health and well-being impacts. As written these requirements would result in widespread complaints and strong adverse community reactions. These findings are supported by the long-standing, industry-recognized and accepted community noise assessment methodologies published by USEPA dating back to the 1970's.

Reference: 6 (b) Noise. (1) Requirements (page 14).

(b) Noise.

(1) Requirements. Noise levels generated by the operation of each of the proposed wind turbines and any alternative wind turbines at the proposed site and any alternative sites shall comply with the Department of Energy and Environmental Protection Noise Control Regulations under Sections 22a-69-1 to 22a-69-7, inclusive, of the Regulations of Connecticut State Agencies, as amended. In accordance with the Noise Control Regulations, the proposed site and any alternative sites shall be categorized as Class C industrial emitters and noise level measurements shall be taken at the property lines. A copy of any variance or partial variance from the provisions of the Noise Control Regulations granted by the Department of Energy and Environmental Protection under Section 22a-69-7.1 of the Regulations of Connecticut State Agencies, as amended, shall be submitted to the Council with the application or petition.

(2) Waiver of Requirements. The required maximum noise levels generated by the operation of each of the proposed wind turbines and any alternative wind turbines at the proposed site and any alternative sites may be waived:

(A) by submission to the Council of a written agreement between the applicant or petitioner and property owner stating that consent is granted to allow excess day-time or night-time noise levels, or both, but in no case shall noise levels be greater than **day-time levels of 61 dBA** from the proposed wind turbines and any alternative wind turbines of the proposed site and any alternative sites at any occupied residential receptor and in no case greater than **night-time levels of 51 dBA** from the proposed wind turbines and any alternative wind turbines of the proposed site and any alternative sites at any occupied residential receptor; or

(B) by a vote of the Council to waive the noise level requirements upon a showing of good cause, which includes, but is not limited to, abutting parcels with non-buildable configurations, abutting parcels with intervening topographical barriers and abutting parcels subject to development restrictions.

Regulations should be enacted for the purpose to protect the public. Noise limits need to be based on scientific studies backed by research of community response to noise. The proposed draft wind regulations allow for wind turbines to produce noise levels significantly louder than the existing low background sound levels in rural and quiet residential areas, causing an adverse public response.

Adverse community reactions to excessive noise levels include; annoyance (irritation, aggravation, bother, anger, provocation), sleep disturbance, health and well-being problems. Wind turbines have shown to include additional complaints relating to dizziness, vertigo, nausea, lethargy, and cognitive difficulties.

Communities in New England have experienced strong appeals to regulatory boards to stop the noise, followed by legal action when wind turbines are placed too close to residential areas. Complaints are most prevalent in quiet residential environments especially during the night. There is strong evidence that the adverse community reaction intensifies when the outdoor wind turbine noise levels louder than 40 dBA.

It has been shown that it is possible to predict a community reaction to a proposed wind turbine facility based on the background noise levels prior to the wind turbine application process. The USEPA (1974 "Levels Document") established correlations that are now a long-standing, vetted and well understood prediction methodology. The "ordinal response" method predicts a range of community reaction responses based on the noise level increase over background produced by a noise source for existing and proposed wind turbine facilities. This prediction methodology is summarized in Figure 1 below for wind turbines located in quiet environments, less than 30 dBA nighttime.

Figure 1. USEPA Community Noise Reaction (CNR) levels normalized to Leq for wind turbines in quiet rural areas.

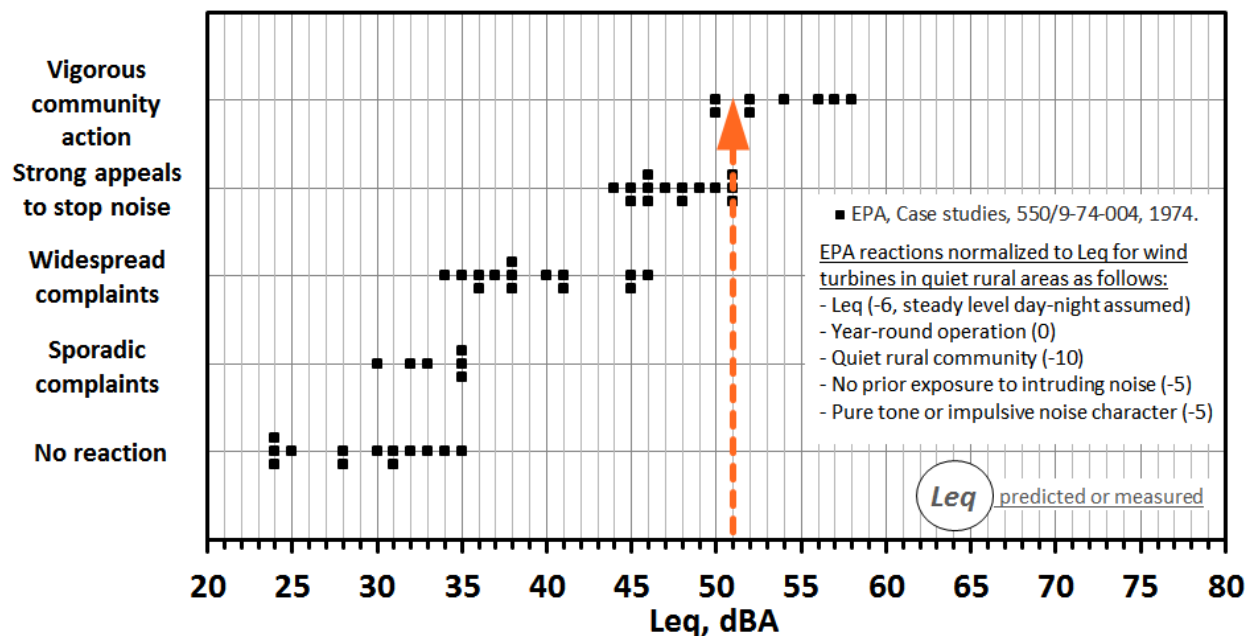


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The proposed Draft Wind Regulation noise limits for 51 dBA night produce the strongest two community noise reaction levels, "Strong appeals to stop the noise" and "Vigorous community reaction". The public is not protected by the proposed regulation.

In quiet areas, the proposed wind turbine noise limits are far too permissive for the wind turbine owner/operator and does not provide any public protection that prevents adverse

community reactions. This regulation departs from the basic requirement of Connecticut law: Protect public health and welfare. Connecticut's protection of public health is supported by the World Health Organization (WHO; the USA is a member), which recognizes that adverse health effects increase quickly above 40 dBA outdoors at night. This is supported by sufficient medical evidence for the WHO to establish 40 dBA as a maximum design limit in their 2009 report. The WHO conclusions are based on transportation noise, while research has shown that wind turbine noise is much more annoying at lower levels than transportation noise. WHO cautioned that lower limits than 40 dBA should be considered if the noise has strong low frequencies.

The proposed Draft Wind Regulations are 11 to 21 dB higher than the 2009 WHO guidelines, which will thereby cause adverse public health impacts. Connecticut should recognize the importance and significance of the WHO conclusions. These are based on three decades of medical evidence of adverse effects of noise on public health. Connecticut noise limits date back to before the WHO medical studies. It is appropriate to consider the existing Connecticut noise limits as out of date. Adopting the proposed Draft Wind Regulations as written provides no protection for public health and welfare from wind turbine noise.

Comment 4. Proposed requirements continue to allow “noise level excursions” (exceedences) allowed under the existing Connecticut law. These ‘allowances’ would intensify wind turbine noise impacts especially at night when most people are trying to sleep.

Reference: 6 (b) Noise. (1) Requirements (page 14).

(b) Noise.

(1) Requirements. Noise levels generated by the operation of each of the proposed wind turbines and any alternative wind turbines at the proposed site and any alternative sites shall comply with the Department of Energy and Environmental Protection Noise Control Regulations under Sections 22a-69-1 to 22a-69-7, inclusive, of the Regulations of Connecticut State Agencies, as amended. In accordance with the Noise Control Regulations, the proposed site and any alternative sites shall be categorized as Class C industrial emitters and noise level measurements shall be taken at the property

The existing Connecticut regulations allow a 3 to 8 dB short term increase over the proposed 61 dBA, day / 51 dBA, night "limits". In Connecticut’s “Control of Noise”, Section 22a-69-4, Measurement procedures, allowances are made:

(f) In measuring compliance with Noise Zone Standards, the following short-term noise level excursions over the noise level standards established by these Regulations shall be allowed, and measurements within these ranges of established standards shall constitute compliance therewith:

Allowable levels above standards (dBA)	Time period of such levels (minutes/hour)
3	15
6	7 ½
8	5

By requiring that maximum wind turbine sound levels comply with the Department of Energy and Environmental Protection Noise Control Regulations under Sections 22a-69-1 to 22a-69-7, the proposed wind turbine regulations in fact *allow much higher short-term noise levels* than the proposed “maximum” proposed 61 dBA, day / 51 dBA, night "limits" in Sections 5(c)(2), 6(b)(1) and 6(b)(2). Allowing higher short term noise levels of 3 to 8 dB intensifies the level of night-time sleep disturbance. The allowed “excursions” place an unreasonable hardship on residential neighbors. The excursions should be disallowed in the proposed Draft Wind Regulations.

Comment 5. Setback distances for noise must be greater than proposed for safety.

Reference: Sec. 6 (a) Setback Distances. (1) Requirements.

(a) Setback Distances.

(1) Requirements. Any application for a certificate for a proposed wind turbine facility and any petition for a declaratory ruling for a proposed wind turbine facility shall include setback distances from each of the proposed wind turbine locations and any alternative wind turbine locations of not less than 1.1 times the wind turbine height from all property lines at the proposed site and any alternative sites or shall comply with the wind turbine manufacturer's recommended setback distances, whichever is greater. A copy of the wind turbine manufacturer's recommended setback distances shall be included in the application or petition, if available. In its discretion, the Council may require greater setback distances based on the results of any evaluation report submitted under Section 16-50j-96 of the Regulations of Connecticut State Agencies.

A setback distance of 1.1 times the wind turbine height, or the manufacturers recommended safety setback distance, may be appropriate for mechanical failure of the turbine structure and break-away parts. The safety setback does not address noise impacts. A reasonable and appropriate setback for noise is at a minimum 10 times the turbine height. This is supported by actual in-situ noise level measurements made in the vicinity of industrial wind turbines.

Discussion

Taking the WHO 40 dBA, night-time maximum limit guideline of 40 dBA and applying the wind shear design safety factor of 5 to 8 dB reveals a more realistic and appropriate maximum nighttime noise limit of 32 to 35 dBA. These noise limits may be achievable using a minimum noise setback distance of 10 times the turbine height (tower base to maximum blade height). Wind turbines rated at up to 2 MW require a setback of approximately 1 mile which is supported by in-situ wind turbine noise measurements in quiet areas (under 30 dBA nighttime); protecting public health and welfare. Short term noise excursions, allowed by the existing Connecticut law, have been associated with sleep disturbance and should be disallowed. Low frequency noise produced by wind turbines must be limited and considered to be a critical factor for determining the viability for a proposed site to be a good acoustic neighbor.

Conclusions

In conclusion, we find that the proposed regulation is biased in favor of the wind turbine owner/operator and does not protect the nearby residential neighbors from exposure to excessive nighttime noise, adverse public health and well-being impacts. Our professional opinions and findings for the proposed Draft Wind Regulations are as follows:

1. There is a high probability to provoke strong adverse community reactions to wind turbine noise due to overly permissive noise limits and allowed excursions.
2. The regulations are unable to protect public safety, health, welfare and well-being.
3. The regulations should include a night-time wind shear design safety margin requirement.
4. The regulations should include maximum limits for low frequency noise outdoors and indoors. We strongly recommend adopting the Danish maximum indoor limit of 20 dBA assessed with field measurements of A-weighted 1/3rd octave bands from 10 to 160 Hz, and the outdoor maximum limit of 55 dBC.

Please feel free to contact us with any questions or further assistance. Thank you.

Respectfully Submitted,



Stephen E. Ambrose, INCE (Brd. Cert.)



Robert W. Rand, INCE

Background and Qualifications

Bio: Stephen Ambrose is a principal investigator with over thirty-five years of experience in industrial noise control including eighteen years in the Noise Control Group at Stone & Webster Engineering Corporation. A Member INCE since 1978, Mr. Ambrose runs a small business providing cost-effective environmental noise consulting services for industrial & commercial businesses, municipal & state governments, and private citizens.

Bio: Robert Rand is a principal investigator with over thirty years of experience in general acoustics including industrial noise control, environmental sound assessment and ten years in the Noise Control Group at Stone & Webster Engineering Corporation. A Member INCE since 1993, Mr. Rand runs a small business providing consulting, investigator and design services in acoustics. His business web site is <http://www.randacoustics.com>.

Mr. Rand has been independently investigating the noise and community reactions to large wind turbines since the spring of 2009. Joined by Mr. Ambrose in 2010, the independent investigators have measured operating sound levels versus distance at several wind turbine facilities in Maine and Massachusetts. Ambrose and Rand published three articles in the fall of 2010 on the acoustics of wind turbines and showed that the community reaction to large industrial wind turbines is predictable. The investigators have given expert testimony to towns in Maine and Massachusetts, to the State of Maine Board of Environmental Protection, and the Environmental Review Tribunal of Ontario. Mr. Rand has conducted a number of invited presentations on industrial wind turbine noise for towns in Maine and Michigan. Several of these communities have adopted specific noise ordinances to protect the health and well-being of their citizens based on the information provided.

Rand and Ambrose have measured wind turbine noise at several sites, multiple days living near wind turbines, and experienced some of the adverse health effects documented worldwide by people living near large industrial wind turbines. Rand and Ambrose are capable and qualified to evaluate large industrial wind turbine projects and regulations governing such projects.

Communities should develop wind turbine noise limits that adequately protect the public from excessive noise and adverse health impacts. There are industry accepted and recognized noise assessment procedures that can predict the potential for an adverse community response to a new noise. Adversely impacted neighbors complain about noise when there is more than a 5 dB increase over background level and if there is an objectionable sound character.