STATE OF VERMONT
PUBLIC SERVICE BOARD

Request for Proposal and Comment for	)	
Implementing temporary sound-level	)	June 27, 2016
Standards for wind generation projects	)	

Dear Public Service Board,

Vermonters for a Clean Environment (VCE) appreciates this opportunity to recommend new sound-level standards and methodology for protecting neighbors from wind generation noise. These comments are respectfully offered for our members whose interests are directly affected by this noise.

VCE has been closely engaged with neighbors for proposed, constructed, operating, and withdrawn wind projects in Vermont since April, 2009. We have learned from first-hand experiences of people living with industrial wind energy generation machines on top of mountains near their homes, and been educated by ethical acousticians who have been developing good science surrounding this open air noise source. The PSB has the opportunity to learn from experience and change the sound-level standards and methodology to protect public health, quality of life, and wellbeing.

VCE's recommendations for sound standards and methodology for wind generation projects are presented by noise control expert Stephen Ambrose with support from Robert Rand and Rick James on the following page. Following our formal recommendations, VCE presents a narrative discussion of the issues involved in regulating wind turbine noise.

We wish to thank the Vermont legislature and governor for providing this opportunity to update the sound-level standards to be more protective of public health.

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Tel: 207-892-6691 **S.E. Ambrose & Associates** Email; seaa@myfairpoint.net
15 Great Falls Road, Windham, ME 04062
Acoustics, Environmental Sound & Industrial Noise

Date: June 21, 2016
Ref: Proposed Noise Regulation Recommendation

Preface: The Vermont Legislature and Public Service Board understand that the 45 dBA (LAeq1hr) noise limit does not protect public health, safety and wellbeing. Therefore, a lower noise limit for wind turbines is warranted with direct connections to the human response at night.

Applicability: All noise generated by industrial wind turbines located in rural and remote environments. These noise limits are applicable at all property lines or 500-ft from the residence, whichever is closer.

Intent: The noise limits are to preserve quality of life, peace and tranquility, and protect natural environments from excessive noise(s) by limiting the noise level increase and objectionable sound quality. This regulation does not address infrasound.

Ambient: This Regulation establishes 30 dBA as the nighttime sound level baseline for design purposes, in lieu of measurements. The 30 dBA baseline noise level excludes "wind on microphone" contamination, warm weather contributions from natural sounds (insects and tree frogs) and traffic. It is also understood that rural and remote area sound levels can be up to 15 dB quieter than the baseline (30 dBA).

Limits: Wind turbine projects shall not produce outdoor noise levels greater than 35 dBA (LAeq10min), 50 dBC (LCeq10min), and indoors 30 dBA (LAeq10min). The indoor test requires; 1) all house noise devices and systems off, 2) presence of one-measurer and one- witness, if required. This test is applicable for windows open or closed.

Predictions: The project owner and consultants are responsible for predicting wind turbine noise levels using un-weighted sound power level octave bands. Noise predictions shall include wind turbine measurement uncertainty of at least +2 dB, prediction noise model uncertainty of +3 dB, 0 dB for both ground and vegetation attenuation, and +3 dB for high wind shear conditions.

Compliance: Noise measurements are the financial responsibility of the project owner and shall be independently performed by a qualified professional when directed by the Vermont PSB or Town officials. Compliance noise measurements shall not exceed outdoor noise levels of 35 dBA (LAeq10min), 50 dBC (LCeq10min), and 30 dBA (LAeq10min) indoors (windows open or closed). Noise measurements shall prevail over noise model predictions.

Measurements: Locations shall be away from roads or other localized sound sources including short-duration (such as traffic) and seasonal events All noise measurements shall exclude "wind on microphone", tree/leaf rustle, flowing water, and natural sounds such as birds, tree frogs, and insects. Natural sounds are excluded from measurements or calculations when dBA is derived from frequency bands lower than 1250 Hz.

References: *This noise regulation requires that all acoustic terminology, noise predictions and sound measurements shall comply with recognized international standards (ANSI, IEC & ISO*) including:

1. ANSI/ASA S3/SC1.100-2014 (ANSI/ASA S12.100-2014) Methods to Define and Measure the Residual Sound in Protected Natural and Quiet Residential Areas
2. ANSI/ASA S12.9-2013/Part3 Quantities and Procedures for Description and Measurement of Environmental Sound-Part 3: Short-term Measurements with an Observer Present
3. ANSI-ASA_S12.62 (ISO9613-2) Acoustics-Attenuation of sound during propagation outdoors - Part 2: General Method of Calculation

B. Introduction

At the time the Public Service Board (PSB or "the Board") last heard testimony on a wind energy project in 2011, no big wind turbines had been erected in Vermont. Only one of the three current Board members was a member of the PSB when the Board heard testimony on wind turbine noise in East Haven, Sheffield, Deerfield, Georgia Mountain and Lowell.

Until Nov. 2011, the biggest wind turbines in Vermont were eleven 197 foot tall Zond machines each with a nameplate capacity of 600 kW, erected in 1996 in Searsburg.

Now, Sheffield hosts sixteen 420 foot tall 2.5 MW wind turbines, the Lowell Mountain range has twenty-one 459 foot tall 3+ MW wind turbines, and Georgia Mountain has four 440 foot tall 2.5 MW wind turbines.
531 structures are within 2 miles of these three operating projects.[1]

Wind energy generation projects have been proposed and withdrawn on Glebe Mountain, Northfield Ridge, Herrick Mountain range, Pittsford Ridge, in Derby Line, and the Northeast Kingdom towns of Newark, Brighton, and the Unified Towns and Gores.
3218 structures are within 2 miles of these six withdrawn projects.[2]

Industrial wind energy generation projects are currently proposed for Windham, Grafton, Swanton, Irasburg, Holland, with more, bigger wind turbines nearing construction in Searsburg and Readsboro.
1360 structures are within 2 miles of these five actively proposed projects.[3]

With thousands of Vermonters threatened with living within the impact zone (now a/k/a "sacrifice zone") of new industrial wind turbines, the legislature and governor have recognized there is a need to review and improve the sound-level standards and methodology the Board has relied on in the past to assure that the standards and methodology going forward are protective of public health, do not create a nuisance that harms Vermonters' quality of life and assures neighbors' peaceful enjoyment of their properties, protects property values, and are enforceable.

VCE is pleased to offer comments that will lead to a lower and more protective sound-level standard with better methodology for compliance and enforcement for wind generation projects going forward.

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[1] Sheffield 137 + Lowell 104 + Georgia Mountain 290 = 531 structures within 2 miles of operating projects

[2] Glebe Mountain 627 + Northfield Ridge 856 + Herrick Mountain range 552 + Pittsford Ridge 437 + Derby Line 510 and the Northeast Kingdom towns of Newark, Brighton, and the Unified Towns and Gores 236 = 3218 structures within 2 miles of withdrawn projects

[3] Windham & Grafton 366 + Swanton 568 + Irasburg 106 + Holland 171 + Deerfield Wind 149 = 1360 structures within 2 miles of planned future projects

C. Background

The PSB has taken testimony on industrial wind turbine noise on projects proposed for East Haven, Sheffield, Deerfield, Lowell and Georgia Mountain. The PSB denied the East Haven project.

In 2006, the Department of Public Service (DPS) recommended the wind turbine sound standard should be 30 dBA LMax interior and 45 dBA LMax exterior.

The Current Standard. Sheffield, Deerfield, Georgia Mountain and Lowell Wind all received CPGs that set roughly the same sound standard of 30 dBA Leq (1 hr.) interior and 45 dBA Leq (1 hr.) exterior. The 15 dBA difference between interior and exterior was partly based on the applicants' experts assertions that a home attenuates 15 dBA from outside to inside, with windows open and windows closed. Their assertions have been proven to be wrong.

Low Frequency Noise. In the Lowell case, the PSB also required monitoring for Low Frequency Noise (LFN), but did not set a standard for LFN. The Board accepted the testimony of the petitioner's expert witness who offered the opinion that "All modern large wind turbines use an upwind design that has eliminated low frequency "thump" associated with very high infrasound and low-frequency harmonics caused by blade-tower interaction." Their opinion that this low frequency "thump" has been eliminated has been proven to be wrong.

Infrasound. On the issue of infrasound, in the Lowell case the PSB found that "the Petitioners have demonstrated wind turbines are not likely to emit audible or perceivable infrasound." Infrasound is not audible but is perceivable.

NRO. The PSB required NRO (Noise Reduction Operations) mode for the Lowell wind turbines. The Final Order and CPG says, "we require that the noise monitoring plan for the proposed project include monitoring during the operation of the NRO mode and the reporting of instances when the NRO mode is triggered."[4]

Complaints Unresolved. The industrial wind turbine project in Sheffield began operating in Nov. 2011. Adjoining property owner Paul Brouha filed his first complaint about the noise with the PSB on Dec. 24, 2011. He is still waiting for a resolution to that and subsequent complaints. Green Mountain Power (GMP) began operating the Lowell wind project around Nov. 2012 and it became fully operational at the end of December 2012. Almost as soon as it began operating, dozens of neighbors filed complaints about the noise. Georgia Mountain Wind became operational Dec. 31, 2012. Neighbors of all three industrial wind projects complained numerous times throughout 2013. No neighbor complaint about wind turbine noise has been resolved. With the exceptions noted below, neighbors have given up complaining to the PSB, asking "Why bother?"

[4] http://psb.vermont.gov/sites/psb/files/orders/2011/7628FinalOrder%20CPG%20Attachment%20A-2.pdf, p. 99

Docket #8167 Sound Standard Investigation. At the end of 2013 in response to wind turbine neighbor noise complaints, the PSB opened Docket #8167, Sound Standard Investigation. The first deadline was Dec. 31, 2013 for submitting comments on the scope and other aspects of the investigation. VCE submitted comments[5] which included excerpts from testimony previously submitted to the PSB in Lowell Wind Docket #7628. We herewith incorporate VCE's comments and the full testimony and exhibits of Rick James, Les Blomberg, and Dr. Teddi Lovko in our comments on this temporary sound-level standard rule.[6]

In May, 2014, VCE attempted to help citizens put on a presentation (at the request of the citizens) for the second workshop in Docket #8167 to hear from neighbors.[7] The PSB cancelled the presentation a few hours before the workshop was to begin. Many of those who spoke at the workshop claiming there are no wind turbine noise issues were recruited by the wind companies and had an economic interest in wind energy which they did not disclose. Restricting neighbors to three minutes of oral comments created an impossible situation. Further, the Board never followed up on any submissions and most of the materials submitted in the neighbor's workshop have not been posted on the Board's docket page. The PSB should have respected wind turbine neighbors at the second sound standard investigation workshop rather than disrespect the very people who are being harmed. The Board heard from neighbors from all three operating wind projects producing noise creating serious harm. The Board has not acted on Docket #8167 since the third workshop in July 2014.

PSB Active Dockets on Wind Turbine Noise Complaints. The Board currently has three dockets with needed enforcement/investigations regarding wind turbine noise: Dockets #8653 (Sheffield), 8734 (Georgia Mountain), and 8613 (Georgia Mountain). In addition, in response to finding that GMP violated the CPG's noise standard in Lowell Wind Docket #7628, the PSB agreed that DPS would engage a firm to do continuous sound monitoring which has recently resulted in data submissions to the PSB for May[8] and June[9] 2015.

These investigation enforcement dockets provide billable hours for attorneys[10] and experts,[11] and no benefit to neighbors forced to pay lawyers or participate *pro se* without

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[5] http://psb.vermont.gov/sites/psb/files/docketsandprojects/electric/majorpendingproceedings/VCE.pdf, See Attachment B, beginning on p. 16 of VCE's comments.
[6] http://psb.vermont.gov/docketandprojects/electric/7628/nonpetitionerprefiledtest
[7] Video of 2nd PSB #8167 workshop for neighbors https://youtu.be/aj8Lv6OT1tw
[8] Acentech May 2015 http://vce.org/7628%20-%202016.04.20%20-%20DPS~Acentech%20May%202015%20Monitoring%20Summary%20(scanned).pdf
[9] Acentech June 2015http://vce.org/7628%20-%202016.05.20%20%20-%20DPS~Acentech%20June%202015%20Monitoring%20Summary%20(scanned).pdf
[10] RSG http://vce.org/2016-06-03%20GMCW%20Ltr%20to%20PSB%20re%20DPS%20Comments%20&%20Recommendations.pdf
[11] Aercoustic http://vce.org/8613%20-%202016.05.20%20-%20DPS%20Recs%20re%20GMCW%20Sound%20Modeling.pdf

legal counsel. Neighbors must take time off work, attempt to write legal filings and spend money for copies and mailings and to travel to Montpelier for hearings, placing yet more burdens on already-burdened wind turbine neighbors who see no potential for relief through the Board's enforcement/investigation dockets or actions by the DPS.

Bigger Turbines Planned Closer to Homes. The noise standards the PSB has previously established for wind generation projects have resulted in substantial health problems and numerous unresolved complaints from neighbors going back in some cases more than four years. Iberdrola, David Blittersdorf of AllEarth Renewables/VERA, and Travis Belisle of Swanton Wind are all actively developing applications for new wind turbine projects. All of these projects involve larger wind turbines closer to homes than the PSB has previously approved.

Wind turbine noise poses an imminent peril to public health, welfare and safety and does rise to the status of emergency because so many more Vermonters are facing the same noise pollution and health problems that are so evident based on visits to neighborhoods with existing operating wind turbines both in Vermont and around the world. Neighbors of future wind turbine projects have listened to testimony of neighbors of existing wind turbines[12] and have learned first-hand that the PSB's prior standards and methodology have failed to adequately protect the neighbors.

D. 30 interior/45 exterior dBA Leq (1 hour) Standard Not Protecting Public Health

Former GMP Lowell Mountain Wind neighbor Shirley Nelson kept an extensive diary[13] while living 4500 feet from the nearest Vestas 3+ MW v112 wind turbines. The diary dates from Jan. 2013 when the wind turbines became fully operational until March 2014 when the Nelsons sold out to GMP. In the settlement agreement, GMP required a non-disclosure/gag order. The result is that the people with the most experience monitoring wind turbine noise and bringing their results to the PSB have been disallowed from participating in the development of a more protective sound standard for wind energy facilities. The diary was submitted into the public record in Docket #8167 by Shirley Nelson's son Mike Nelson at the May 13, 2014 workshop held in Morrisville.

Shirley Nelson's diary provides detailed insight into what it is like to live with the acoustical impacts of 459 foot tall 3+ MW wind turbines with 112 meter long blades. Mrs. Nelson documents excessive ringing in the ears, headaches, repeated sleep interruption, frustration, anger, loss of enjoyment of normal parts of life like painting and gardening, loss of comprehension to perform normal tasks like balancing a checkbook, breathing difficulty, fast heartbeat resulting in being sent to the hospital. Shirley Nelson's diary shows that neighbors do not "get used to it" as claimed by wind proponents. The diary shows that symptoms go away when away from home.

[12] Video of testimony to VT Senate Health & Welfare Committee https://youtu.be/3KtlBXyD7w4
[13] http://vce.org/ShirleyNelsonNoiseDiaries2013-2014.pdf

The Therrien Family's three-year experience living next to the Sheffield Wind turbines is well documented[14]. Because the wind turbines caused sleep disruption and health effects leading to loss of sleep by their young children and the inability of the parents to be employed while also being put on anti-depression and sleep medication by their doctors, they abandoned their home of 18 years on Dec. 22, 2014.

The first-hand reports by Vermonters are the same as people all over the world report when living too close to industrial wind turbines. Australia's Waubra Foundation has compiled excellent information about the negative health aspects of wind turbines[15] and videos with residents who are impacted[16]. A survey of Canadians[17] provides yet more insight into the negative experiences of wind turbine neighbors. According to physicians and researchers, anecdotal evidence is always a valuable first step in developing an understanding of how health is impacted.

In Nov. 2010, Dr. Teddi Lovko testified in the Lowell Wind case about the value of reviewing primary sources:

> I also attempted to read the primary source articles on wind turbines and health when available, rather than just the review papers. I also reviewed many unpublished case series, papers, surveys, and press reports that were available to me. Some of these studies represent examples of case crossover studies and are highly suggestive that wind turbines are causing the health issues described (Phillips 2010). While these nonpeer reviewed surveys and case reports may not be a basis for drawing definitive conclusions in and of themselves, they are relevant in that the spectrum of complaints and levels at which complaints occur are remarkably consistent across these reports. They represent real world examples of what would be expected from the available literature on noise and health in general and in particular with wind turbine noise and health effects. Thus they support the research that is available as being accurate.

The Society for Wind Vigilance has documented numerous studies[18] related to adverse health effects of wind turbines. In 2012, they recommended a minimum setback of 2 km from wind turbines.[19]

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[14] https://www.facebook.com/notes/victims-of-industrial-wind/the-therrien-family-story/1072673799428809

[15] http://waubrafoundation.org.au/health/

[16] http://waubrafoundation.org.au/library/section/resident-impact-videos/

[17] http://windvictimsontario.com/uploads/3/1/4/3/3143767/wind_turbine_impacts_in_ontario_11.2014.pdf

[18] http://www.windvigilance.com/

[19] https://46640c50-a-62cb3a1a-s-sites.googlegroups.com/site/windvigilancecom/Position_statement_SWV_setbacks_April_4_2012_FINAL.pdf?attachauth=ANoY7cqlNFuPW1nkSIboIYTE649B4zs9gU5QPyjaerqIszxHhMQNcG66FbZS2LS6ux-ZGzCoNA_nyRR6-qdoL55-w87cZhgo_QRqsL29qRueow_yEsj3AiKzuGV9I2RJv2PZHynTSiaZB9TeUSVXyo0r2dz3W28eyNik40Qic0G30tp6I2Z9CNXVrRUaWUZ04YOetHbxF-_70eDYERyOAL5R7jJCQz-

The mechanism by which wind turbine noise pollution impacts health is increasingly well understood. Sleep disturbance is a well-studied area that results in a host of health problems, compounded over time.[20] Low frequency noise and infrasound affect the vestibular system. People prone to seasickness are more likely to experience health effects from the lower frequencies. Dr. Alec Salt's research[21] has helped inform the understanding of the mechanisms involved in the physiological response to wind turbines. His research shows that in noisy areas, the human ear hair follicles protect people from noise. In quiet areas, the hair follicles inside the ear relax, making people more exposed to high levels of noise.

Wind turbines have been sited in some of the quietest places in Vermont where people lack protection from the more than 25 dBA increase above background noise levels that the PSB has permitted for operating industrial wind turbines. To site wind turbines in quiet areas with low ambient noise levels, a 5 dBA increase over background might be protective. Noisier areas with ambient sound levels of 40 dBA would be appropriate for wind turbine sound standards of 45 dBA.

The Nelsons used a calibrated sound meter at their former home in Lowell. Shirley Nelson's diary documents interior sound levels above 30 dBA and exterior sound levels above 45 dBA. The Nelsons took continuous one-hour readings numerous times that showed the project exceeded the 45 dBA Leq (1 hour) exterior standard. After more than a year of sleep disruption, degraded health, and loss of quality of life, the Nelsons could not live with the wind turbines as neighbors and sold the farm they had lived in for more than 40 years to GMP under duress. Their former home remains empty.

E. Studies Support Exterior Sound-Level Standard no higher than 35 dBA

Wind turbines pose unique and challenging problems for noise control experts. Typical methods of addressing noise from industrial sources like power plants involve insulating the source or insulating the receptor. Wind turbines are an open air noise source that cannot be insulated. Nearby homes may not benefit from increased insulation due to the complex acoustical characteristics of wind turbines, and even if a neighboring home could be better insulated, neighbors still have the right to have their windows open and be outside enjoying their properties without interference from a nuisance such as wind turbine noise pollution.

The type of audible noise that wind turbines produce that people find most objectionable is the rhythmic blade swish that occurs in synchronization with blade rotation, called amplitude modulation, which increases annoyance and sleep disturbance. [Rick James testimony in Lowell Wind]

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[20] Video of presentation by Dr. Stanley Shapiro, cardiologist https://youtu.be/lLy8n-sU_G0

[21] Website of Dr. Alec Salt http://oto2.wustl.edu/cochlea/wind.html

The PSB's Final Order[22] in Lowell Wind finds that pre-construction background audible noise levels were between 21 and 31 dBA based on monitoring by two different experts.

"Wind turbine sound has a number of attributes which make it different than these other commonly studied noise sources. Wind turbines are frequently placed in rural areas which often have very low background sound levels of 20-30dB." [Dr. Teddi Lovko testimony in Lowell Wind]. Dr. Lovko's testimony goes on to explain the unique qualities of wind turbine noise and the World Health Organization (WHO) 2009 report:

> Wind turbine sound often shows amplitude modulation, a pulsatile nature to the sound that has been shown to be more annoying than steady noise (Bradley 1994, Holmberg et al 1997). Wind turbines will often be as loud or louder at night than they are during the day (van den Berg 2008). Wind turbines can be a source of continuous fluctuating sound for long periods of time depending on wind conditions. This unique combination of features makes it plausible that wind turbines might have adverse health effects more frequently and at lower sound levels than the noise sources cited in the WHO 2009 report. It must also be kept in mind that the WHO 2009 Report does not make any specific references to wind turbine noise or cite any studies on wind turbine noise. Most of the studies they refer to are based on road noise, air traffic, and community noise. [Dr. Teddi Lovko testimony in Lowell Wind]

In the Lowell Wind PSB docket, Dr. Teddi Lovko provided a thorough review of studies[23] that found sleep disturbance from wind turbine noise starts to rise at about 35 dBA as measured outside the building. Sleep studies introduced by Dr. Lovko suggest that arousals can start to occur at sound levels around 35 dBA exterior, and that 35 dBA exterior or below is likely to be protective of public health.

> Two of these studies done in Sweden show levels of annoyance and sleep disturbance starting to rise at or below 35dB, with 28% showing annoyance at sound levels of 37.5-40dBA and continuing to rise as sound levels increase above 40dB(Pedersen and Persson 2004, Pedersen and Persson 2007). When looking at both studies, almost 50% of people reported annoyance at sound levels greater than 40dBA and in one of the studies 64% of those suffering annoyance also reported sleep disturbance. [Dr. Teddi Lovko testimony in Lowell Wind].

Dr. Lovko cautioned that the studies likely underestimated the impacts of wind turbine noise because the turbines were significantly smaller, placed in smaller numbers, and often in flat terrain. Studies reviewed by Dr. Lovko for the Lowell Wind case support a sound standard of 35 dBA.

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[22] http://psb.vermont.gov/sites/psb/files/orders/2011/7628FinalOrder%20CPG%20Attachment%20A-2.pdf

[23] http://psb.vermont.gov/sites/psb/files/docket/7628LowellWind/Testimony%20%26%20Exhibits/Other_Parties%27_Prefiled%26Exh/AlbanyTown/2010-11-22_Lovko_Rebuttal_Testimony%28Docket7628%29%5B1%5D.pdf

- Phipps, based on his research on wind turbines in hilly and mountainous regions in New Zealand, recommended sound levels not to exceed the background sound level (L95) by more than 5dBA, or a level of 30dBA L95, whichever is less.
- Hanning, a world renowned expert on sleep and well versed on wind turbines and health, recommends a maximum external limit of 35dBA in the absence of excessive modulation.
- Kamperman and James suggest turbine noise should not be more than 5dBA above background levels and should not exceed 35dBA within 30 meters of any occupied structure.
- New Zealand Standard 6808 provides that the evening and nighttime levels may be set at 35dB La90(10min) or 5dB above the background level, whichever is higher.
- The Dutch National Institute for Public Health and Environment recommend an outdoor Lden limit of 40dBA as the "no effect level".
- Thorne concludes that unreasonable noise occurs at noise levels above 30dBA L90 in the presence of amplitude modulation and with van den Berg states that 30dBA L95 in conditions of low wind speed with modulation restricted to 3dB would likely be protective of health and from annoyance.
- The Minnesota Department of Health paper on wind turbines and health comments that complaints rise with sound levels above 35dBA. (Minnesota Department of Health 2009).
- A summary report by the Ohio Department of Health on wind turbines suggests "that operational noise levels at these distances should be kept to levels at or below 35dBA." (Ohio Department of Health 2008).

In Lowell Wind testimony, Dr. Lovko was asked, "The Public Service Board has previously (in other dockets relating to wind turbine development) used a noise standard of 45 dBA (exterior)(Leq)(1hr). In your opinion, is this standard protective of public health?" Dr. Lovko responded:

> No, 45 dBA is too high and will not protect people from the health effects and sleep disturbance they will experience at these sound levels. These levels are higher than those recommended in the WHO 2009 report. The studies I have discussed earlier show significant sleep disturbance and annoyance at levels much lower than this. You could possibly see levels of annoyance in as many as 50% of people at these sound levels. I am not aware of any studies on wind turbines that show that these sound levels would prevent annoyance and sleep disruption. This standard is not protective of public health.

Dr. Lovko identified potential health impacts that might be expected to occur in wind turbine neighbors if the standards are set too high. The list of potential health impacts matches what neighbors of Vermont wind projects have reported since the wind turbines began operation more than three years ago.

In surrebuttal testimony Dr. Lovko responded to GMP's health expert who claimed that "The risk of any direct adverse health effects at levels below 45dB(A) is virtually nonexistent". Dr. Lovko provided more studies to support a more protective health standard than the Board had adopted in previous cases.[24] Dr. Lovko testified citing peer reviewed studies:

> It is hard to reconcile setting a sound level of 45 dba for wind turbines when there is clear and consistent evidence in the peer reviewed literature… that people start to suffer adverse health effects, especially annoyance, at levels below this...
>
> …The findings of these studies are important because they are well designed studies and they provide the best available evidence from which to base decisions regarding noise standards that would be protective of public health. Their results have also been remarkably consistent, making it possible to anticipate at what sound levels noise begins to be a problem.

The scientific studies supporting an exterior sound level of 35 dBA rather than 45 dBA for wind turbine noise were presented to the Board in direct, rebuttal and surrebuttal testimony by noise experts Rick James and Les Blomberg, and by Dr. Teddi Lovko in the Lowell Wind docket.[25]

F. Interior Standard must be no higher than 30 dBA Leq (1 hour)

S.260 Section 12(b) says, "These rules shall not allow sound levels that exceed the lowest maximum decibel levels authorized in any certificate of public good that contains limits on decibel levels issued by the Board for a wind generation facility before the effective date of this section."

The lowest maximum decibel level authorized in any CPG that contains limits on decibel levels issued by the Board for industrial wind turbines is the interior standard of 30 dBA Leq (1 hour). In this temporary rule, the Board is bound by this lowest maximum standard, or it could be lowered. The interior noise standard cannot be increased in the temporary rule.

G. Exterior Standard must be reduced from 45 dBA Leq (1 hour)

Sheffield Vermont Wind neighbor Paul Brouha hired an expert who has conducted two outside-to-inside tests at his home to determine how many decibels the home attenuates. The Board's previous 45 dBA exterior standard is in part based on the reliance of the testimony of wind turbine company noise experts (despite presentation of other conflicting expert testimony) who have provided assurances that a home will attenuate 15

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[24] http://psb.vermont.gov/sites/psb/files/docket/7628LowellWind/Testimony%20%26%20Exhibits/Other_Parties%27_Prefiled%26Exh/AlbanyTown/2011-1-10_Lovko_Surrebuttal%287628%29.pdf

[25] http://psb.vermont.gov/docketandprojects/electric/7628/nonpetitionerprefiledtest

dBA with windows open and closed.

After Mr. Brouha's first test results were submitted to the PSB, DPS hired one of the expert firms it has retained, Acentech, to conduct the outside-to-inside test at the Brouha home. Mr. Brouha had his expert conduct the same test on the same day, and the results matched and replicated the results found by in his first test. DPS submitted the Acentech report[26] to the PSB roughly 16 months after it was conducted.

Acentech's analysis of the Outdoor/Indoor Level Reduction (OILR) found the following conditions:

> "The OILR values that we determined for distant wind turbine sound are:
> • Windows fully closed – 25 dBA
> • Windows partially open – 6 dBA
> • Windows fully open – 1 dBA
>
> We obtained similar OILR values with additional measurements at different locations in the bedroom. Average data measured around the bedroom yielded the following OILR values:
> • Windows fully closed – 25 dBA
> • Windows partially open – 9 dBA
> • Windows fully open – 3 dBA

While attenuation may be up to 25 dBA with windows closed, repeated testing showed that the home attenuates only 1 – 9 dBA from outside-to-inside with windows partially to fully open. Acknowledging that EPA has allowed a 6 dBA value for attenuation of homes with windows open, an exterior standard of no more than 35 dBA is supported by the results of the inside/outside tests conducted at the Brouha home in Sutton. Full year round enjoyment of a residence requires the ability to open windows without experiencing detrimental sound.

H. Substantial Evidence Supports Applying the Precautionary Principle when determining the level of infrasound Vermonters will be exposed to

In the Lowell wind case, testimony and evidence was introduced to support including low frequency noise and infrasound values for regulatory compliance:

> Wind turbines emit large amounts of low frequency and infrasound that travels farther than higher sound frequencies and which is poorly attenuated by walls and windows and is capable of causing noise related to the vibration of these structures (Colby et al 2009, Hanning 2010, Minnesota Department of Health 2009, Roberts and Roberts 2009). [Dr. Teddi Lovko testimony in Lowell wind]

Nevertheless, in its Final Order, the Board found

[26] http://vce.org/7156%20-%202015.09.25%20-%20DPS%20Acentech%20Attenuation%20Report.pdf

> We conclude that the noise monitoring plan need not include monitoring for infrasound, sound levels below 20 Hz. The Petitioners have demonstrated wind turbines are not likely to emit audible or perceivable infrasound.

Since the issuance of the Lowell Wind CPG, numerous highly credible studies have been conducted that show conclusively that low frequency noise and infrasound are major factors in the impacts to public health and neighbors' quality of life.

An informational report summarizing the findings of the studies on low frequency noise and infrasound was compiled in July, 2015.[27] Its authors found, "With the proliferation of recent research and the rediscovery of earlier, until now largely ignored studies, infrasound and low frequency noise (LFN) can no longer be dismissed as irrelevant. This report shows why it must be given full consideration as a contributing cause of the distress of some of those people living near wind turbine installations."

> The health risk of infrasound from wind turbines has been dismissed by the wind industry as insignificant. It has maintained that since the typical loudness and frequency of wind turbine sound within a home is not audible, it cannot have any effect on human health.
>
> Noise measurements for most studies and environmental assessments have been limited to the measurement of audible sound outside homes-- using dBA weighted monitoring which is insensitive to infrasound frequencies. Some studies and environmental assessments have even relied on projected audible sound averages from computer produced models. Such observations and projections fail to take appropriate account of the distinguishing signature of the sound from a wind turbine. Unlike the more random naturally occurring sounds (such as wind or lake waves which may themselves have an infrasound component), the sound from wind turbines displays characteristics that produce a pattern that the ear and audio processing in the brain recognize.

The summary report details three studies conducted in homes surrounding wind turbines in Massachusetts, Wisconsin, and Australia.

1. The Bruce McPherson Study[28]

> "The onset of adverse health effects was swift, within twenty minutes, and persisted for some time after leaving the study area. The dBA and dBC levels and modulations did not correlate to the health effects experienced. However, the strength and modulation of the un-weighted and dBG-weighted levels increased indoors consistent with worsened health effects experienced indoors. The dBG weighted level appeared to be controlled by in-flow turbulence and exceeded physiological thresholds for response to low-frequency and infrasonic acoustic energy as theorized by Salt".

[27] http://vce.org/Infrasound-wind-turbines-4-August-2015.pdf
[28] http://randacoustics.com/wp-content/uploads/2011/12/The-Bruce-McPherson-ILFN-Study.pdf

2. The Shirley Wisconsin Study[29]

> "The four investigating firms are of the opinion that enough evidence and hypotheses have been given herein to classify LFN and infrasound as a serious issue, possibly affecting the future of the industry. It should be addressed beyond the present practice of showing that wind turbine levels are magnitudes below the threshold of hearing at low frequencies"

3. The Pacific Hydro Cape Bridgewater Study[30]

In February, 2015, Dr. Paul Schomer wrote of the Bridgewater report:

> "This study finds that these 6 people sense the operation of the turbine(s) via other pathways than hearing or seeing, and that the adverse reactions to the operations of the wind turbine(s) correlates directly with the power output of the wind turbine(s) and fairly large changes in power output. Attempts may be made to obfuscate these simple points with such arguments as it cannot be proved that infra-sound is the cause of the discomfort. But that again is a specious argument. The important point here is that something is coming from the wind turbines to affect these people and that something increases or decreases as the power output of the turbine increases or decreases. Denying infra-sound as the agent accomplishes nothing. It really does not matter what the pathway is, whether it is infra-sound or some new form of rays or electro-magnetic field coming off the turbine blades. If the turbines are the cause, then the windfarm is responsible and needs to fix it. Anyone who truly doubts the results should want to replicate this study using independent acoustical consultants at some other wind farm, such as Shirley Wisconsin, USA, where there are residents who are self-selected as being very or extremely sensitive to wind turbine acoustic emissions".

The Shirley Wisconsin study was a collaborative effort by four acousticians, including Hessler, the firm that was the sound expert for the Sheffield Vermont Wind project. The Pacific Hydro Cape Bridgewater study was commissioned by the wind company and carried out with the cooperation of the wind company. These studies represent a new, unbiased and cooperative approach that leads to results in which all parties can have confidence. The results show that the Board erred in finding in the Lowell Wind docket that "wind turbines are not likely to emit audible or perceivable infrasound."

VCE recommends a 50 dBC LCeq(10 min) standard for low frequency noise. A "safe" level of infrasound from wind turbines has not been identified. We recommend using the Precautionary Principle when determining the level of infrasound Vermonters will be exposed to.

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[29] http://windvictimsontario.com/uploads/3/1/4/3/3143767/12-12-28_number_122412-1final_as_submitted_by_clean_wisconsin_without_final_updates_by_rand.pdf

[30] http://www.pacifichydro.com.au/english/our-communities/communities/cape-bridgewater-acoustic-study-report/

I. Special circumstances -- wind turbines and sound propagation over water bodies

One proposed wind project, Swanton Wind, is next to Fairfield Pond with numerous homes surrounding it. A paper about how wind turbine noise propagates over water[31] was entered into evidence in the Lowell Wind case and found:

> This review of the work of SP and the measurements made by Boué and the above analysis makes clear that a 5 km setback of wind turbines from rural shorelines is inadequate from an acoustic perspective.

In setting a temporary rule, the PSB must establish a standard to address the special circumstance of how wind turbine noise travels over water.

J. Wildlife

The impacts to wildlife should be considered in this temporary rule. The PSB received a presentation on wildlife in Docket 8167.[32] VCE has heard anecdotal reports about changes in wildlife habits around wind projects. The most common report is that deer, bear, and moose have moved lower down, and bear don't go up over the mountain. Wind energy project owners say they see those animals on the mountains, but that does not mean they have returned to their usual patterns. The people who live around the area and are tuned into the wildlife habits say they have changed. The change in soundscape[33] may be creating an unduly adverse impact on the wildlife and is relevant to the statutory criteria the Board must use to evaluate noise from wind energy generation projects.

K. Turbines under 500 kW

Much fuss was made after the passage of S.230 about the sound standard set in the NPS 100 net-metered cases where the PSB adopted a standard of no more than 10 dBA above ambient (without testimony in either case where the standard has been used by the PSB). Wind proponents inaccurately claimed that adoption of a "no more than 10 dBA above ambient" standard would be a virtual moratorium on wind energy development. But this assertion has been shown to be false.

Massachusetts has had a noise standard of no more than 10 dBA above ambient for decades that has worked well for most types of noise. However, the standard has not stopped wind development in Mass. But even 10 dBA above ambient has not protected neighbors of industrial wind turbines from noise pollution. Neighbors of wind projects throughout Mass. are complaining,[34] without relief, just as they are in Vermont.

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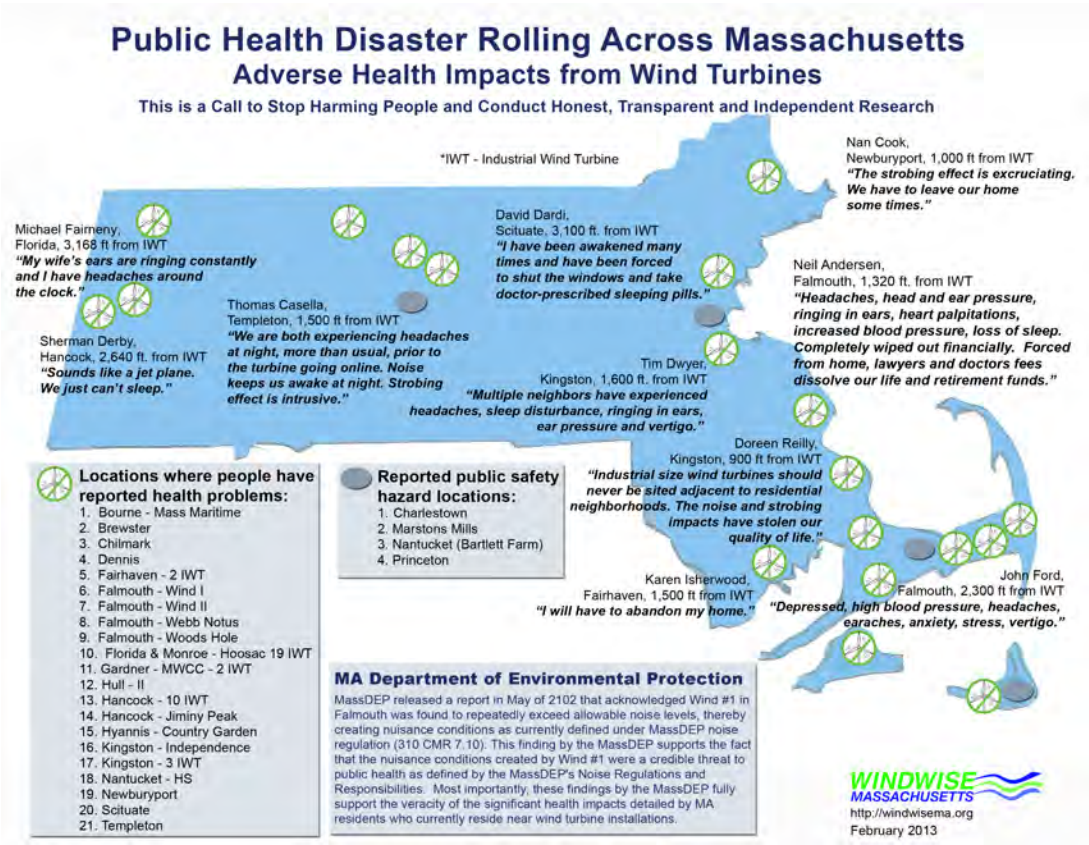
[31] http://psb.vermont.gov/sites/psb/files/docket/7628LowellWind/Testimony%20&%20Exhibits/Other_Parties'_Prefiled&Exh/AlbanyTown/Exh_ALB-RJ-2.pdf

[32] http://vce.org/Use%20of%20Ears%20and%20Auditory%20Senses%20of%20Animals-LO%20Edited.pdf

[33] Soundscape on Lowell Mountain 2011 and 2012 https://vimeo.com/73414942

[34] https://windwisema.files.wordpress.com/2013/02/health_complaints_map_ma.png



The "no more than 10 dBA above ambient" standard has failed to protect public health in Mass., just as it has failed to protect the neighbors of the Vergennes NPS 100 who have been complaining about the noise since Jan. 2012, with no relief.

Vergennes residents Brenda and Michael Mammoliti can no longer sleep in their bedroom or enjoy their back yard. They sleep in a guest room on the other side of their house from the wind turbine, no longer have a garden, and experience headaches. The Board held a technical hearing on shadow flicker and glare in Jan. 2014 after excluding noise based on testing done by GMP's expert firm RSG.[35] At the technical hearing the Board hearing officer discussed holding another site visit to again address the noise issue. To VCE's knowledge, that site visit has never been conducted and the noise issue has not been resolved.

Based on VCE's extensive experience attempting to assist the Mammolitis in getting the noise pollution from the GMP NPS 100 wind turbine in Vergennes addressed, and the equal failure of the "no more than 10 dBA above ambient" standard in Mass. to protect wind turbine neighbors, it is clear that the standard by itself is not protective of public health or quality of life. VCE recommends establishing a methodology to accompany the

[35] http://psb.vermont.gov/sites/psb/files/orders/2015/2015-03/1646%20Order%20re%20Mammoliti.pdf

"no more than 10 dBA above ambient" for 500 kW and smaller wind turbines, using the same independent approach recommended below for larger turbines.

L. Methodology

Averaging. The one-hour average adopted by the Board in prior wind cases has failed. Noise experts have found that it is almost impossible to get an hour of data without some contaminating noises.

One hour of monitoring means there is an hour for short term background sounds – vehicles driving by, wildlife next to the microphone, etc. to contaminate both the long term background and the total noise data. Contaminated data is thrown out or said to be inconclusive, leading to very expensive monitoring and enforcement issues that have not yet been resolved.

Dr. Teddi Lovko testified in the Lowell Wind case about the problems with amplitude modulation from wind turbines and how spikes in sound levels of the sort allowed by the PSB's 1-hour average standard do not support health and sleep:

> The WHO 2009 report states that "instantaneous effects such as sleep disturbance are better (correlated) with the maximum level per event LAMax" than with long term sound averages. Averaging sound levels over this long period of time would allow sound levels to rise high enough to cause health problems and sleep disruption, while still being in compliance as long as there were periods of low sound levels to average out these higher peaks. The fact that wind turbine sound often shows amplitude modulation makes it even more possible for this to occur. It has been shown that these pulses of sound can occur over a range of 5dB, meaning that the sound could spike into ranges disruptive of sleep, and yet the average sound level would suggest that the sound levels are within the prescribed limits and protective of health and sleep when in fact they are not. It does not take prolonged noise elevation to disrupt sleep and these brief peaks of noise have the potential to disrupt sleep many times during a night. If the main goal is to prevent sleep disturbance, sounds should not be averaged or would need to be averaged over very short time periods, otherwise the "peaks" of sound that are enough to disrupt sleep will be undetectable when averaged out with quieter times. If this is not done, compliance becomes uncoupled from the goal that it was set out to achieve, which is prevention of sleep disruption. [Dr. Teddi Lovko testimony in Lowell Wind].

Even the 10-minute average that VCE is willing to accept can be problematic and a better standard would be a maximum or "not to exceed" standard which is more enforceable.

Property Line Standard. The standards the Board adopted left tens of thousands of acres of land around wind facilities unprotected from the impacts of wind turbine noise. This is due in part to the absence of a comprehensive analysis of the aesthetic impacts of wind

turbine noise under Act 250 Criterion 8 during Section 248 proceedings. While the Board adopted health and safety noise criteria, aesthetic impacts resulting in nuisance occur at noise levels that are lower than those that cause health impacts, and occur at locations other than the residence. It is important, therefore, that a property line criterion be part of any interim noise standard.

Moreover, as future residential development near turbines could expose people to noise levels the Board has found harmful, the current 30/45 dBA resident criteria does not protect the health and well-being of future residents. A 35 dBA property line criterion should be adopted immediately, until the PSB has the opportunity to fully assess the aesthetic and property line standard issue.

Over-Reliance on Industry-sponsored Experts. The Board's methodology for regulating wind turbine noise in the future must eliminate the over-reliance on industry-sponsored experts. The experience of intervenors in prior wind dockets is that the PSB ignores their expert witnesses almost entirely. This can be seen by looking at the number of citations to expert testimony in the findings of the Lowell wind case,[36] where GMP's noise expert Ken Kaliski of RSG is cited more than 20 times, while experts for the Towns and Lowell Mountains Group were cited fewer than five times. GMP's health expert Dr. McCunney's testimony was cited seven times, while the Dr. Teddi Lovko, the health expert for the Towns, was not cited at all. No reason was given by the Board for completely ignoring the well-researched testimony of peer-reviewed studies introduced into evidence by Dr. Lovko. Intervenors in the Sheffield Vermont Wind docket had the same experience with the Board's over-reliance on industry-sponsored experts while discounting or discarding the testimony sponsored by intervenors including the Town.

VCE is submitting all of Dr. Lovko's testimony into the record in this temporary rulemaking docket. It is as valid today as it was in 2010 and 2011. We offer this important testimony to show that substantial, credible expert testimony was provided to the Board but completely ignored, as well as to provide the studies that support a 35 dBA exterior standard.

Need for Pre-Construction and Post-Construction Health Surveys. Vermont's Comprehensive Energy Plan[37] contains the following recommendations:

> Strategy 2: Learn from existing wind in-state wind projects to improve the siting and review requirements and processes for future wind development.
>
> (1) The DPS, ANR, and Department of Health should continue to learn from the operation of existing wind projects to inform any future recommendations for sound, aesthetic, health, environmental, and public engagement guidelines or standards;

[36] http://psb.vermont.gov/sites/psb/files/orders/2011/7628FinalOrder%20CPG%20Attachment%20A-2.pdf

[37] https://outside.vermont.gov/sov/webservices/Shared%20Documents/2016CEP_Final.pdf

(2) The state should consider formulating requirements for health impact assessments and pre-development public engagement and mediation processes for projects that fail to meet recommended guidelines or standards.
(3) In Public Service Board proceedings related to the siting of proposed wind generation projects, the Department should advocate for adoption of sound standards that are clear, readily enforceable, and protective of public health. These standards should be based on solid science, good public policy, and best practices, and would benefit from clear companion guidance regarding monitoring and compliance protocols.

VCE supports the CEP's recommendation to conduct health impact assessments, both pre- and post-development. Examples of health impact surveys are available from the Waubra Foundation, Dr. Michael Nissenbaum, and Carmen Krogh of The Society for Wind Vigilance. The Board's temporary rule should contain a requirement for pre-application pre-construction health impacts surveys prior for all future industrial wind projects. VCE also supports the recommendation to learn from existing operations and develop sound standards that are clear, readily enforceable, and protective of public health.

Cooling Fans. All three operating wind projects have cooling fans that produce noise that was never disclosed or evaluated by the PSB in the approval process. In Sheffield, the fans are in the base of the tower. In Lowell, the fans are in the nacelle. In Georgia Mountain, the fans surround the base of the tower and are exterior to the turbines.[38] On calm, hot summer days in Lowell, Shirley Nelson monitored the fans producing 45 dBA outside her home. Future wind generation project reviews by the Board must include the fans as part of the acoustical profile to be assessed.

Need for Independent Real-Time, Attended Sound Monitoring. Power plant operators routinely pay for emissions monitoring. Wind turbines should be no exception. Monitoring must be useful, independent, and provide real time data. The monitoring the Board has previously approved has been expensive and useless to assure that public health and safety is protected.

The PSB has accepted only the testimony of industry experts, who then write the sound monitoring protocols and carry out the work on behalf of the wind company. The sole purpose of this type of monitoring is so the company can claim it is in compliance with the requirements of the CPG. The sound monitoring protocol enables the company's sound expert to decide what data to keep and what to discard. GMP's expert discarded all the data for the time periods that Shirley Nelson found were out of compliance. The PSB gave no weight whatsoever to the information carefully gathered by Shirley Nelson in real time based on what she heard. RSG's unwitnessed monitoring with misleading results was accepted by the PSB to show compliance.

[38] Video of Georgia Mountain Wind's cooling fans: https://vimeo.com/73642485

In past cases, the Board has accepted all wind companies' requests, and denied all neighbors' requests. This system has worked well for the wind companies who are able to operate their wind turbines without concern for harming neighbors.

Pre-Construction Ambient Sound Monitoring initially conducted by RSG for GMP around the Lowell Wind project showed higher background noise levels than actually exist. RSG knows how to increase background noise levels as shown by the Lowell case where monitors were placed near well-traveled roads, ATV/Snowmobile trails, and a stream. Les Blomberg of Noise Pollution Clearinghouse gathered more accurate data which was then replicated by another round of monitoring by RSG. Pre-construction monitoring must be done by independent experts who do not attempt to minimize impacts.

Post-Construction Sound Monitoring must be done in real time to enable immediate responses that will protect neighbors from harmful noise emissions. RSG and other industry noise experts have over-complicated sound monitoring and misled the Board about how to conduct it. When neighbors commented on proposed sound monitoring protocols, some requested actual interior monitoring rather than modeling. The Board never accepted anything the neighbors requested, so interior noise is evaluated through a bizarre and cumbersome process.

In the first instance, the noise monitoring protocols developed by the wind company experts and approved by the Board require the neighbor to make a phone call or send an email. The neighbor is asked to report weather conditions including wind direction and speed and temperature. The wind company is required to respond within 48 hours. The typical response to neighbor complaints is, "the project was in compliance at the time of your complaint." That ends the process for the neighbor until the next sleepless night.

If the wind company determines that the project might have been out of compliance at the time of the complaint, and if the neighbor lives within a certain distance of the wind project – a distance determined by the wind company's expert, different for each Vermont wind project – the neighbor is offered an outside-to-inside test to evaluate how much the home attenuates from outside to inside. The test involves the wind company's experts entering the neighbor's bedroom, and setting up equipment inside and outside the home. The burden of proof and the point of compliance are on the neighbor, yet there is no mechanism in place for the neighbor to get any relief.

The second phase of how the Board's approved-protocols are carried out take place in the investigation dockets. An investigation into a noise complaint is based on the data gathered during the first year or two of required monitoring. Exterior noise levels are extrapolated from that preliminary data in a process that attempts to find conditions similar to the conditions at the time the neighbor complained. If similar conditions indicate there may have been a noise violation at the time of the complaint, the neighbor is offered the outside-to-inside test conducted by the wind company's noise expert. While this may result in an eventual finding of non-compliance and a violation of the CPG, it does absolutely nothing to help neighbors sleep.

The continuous sound monitoring currently taking place at the former Nelson home in Lowell is an excellent example of how not to do it. The monitors are in the wrong place (in bushes, too close to buildings), massive amounts of data have been gathered and not immediately disclosed (data hoarding), and are only being released nearly a year later in a blizzard of graphs that are so compressed that they are impossible to analyze. More detailed data released on CD does not contain necessary Supervisory Control and Data Acquisition (SCADA) data showing turbine output. The monitoring is apparently very expensive. It is also useless.

Interior monitoring is less expensive than exterior monitoring. The challenge in this temporary rule is to establish a methodology that shifts the burden from neighbors to the wind company. The complaint-driven process the Board has enacted is not working for neighbors who are put through a long and tortured process to address even one noise complaint.

For example, a Sept. 2015 noise complaint by a neighbor of Georgia Mountain Wind is ongoing at the PSB, while the neighbor continues to experience sleep disruption. A second complaint about turbines operating under icing conditions and producing extremely loud noise levels in March 2016 resulted in a second investigation docket opened by the PSB. The incentive to complain every time the project is causing sleep interference is poor because all neighbors can expect is yet another investigation docket to be opened by the Board, with more obligations put on the neighbors to engage in the legal process, without legal counsel. Even if any of these open dockets ever results in a finding of a violation, the likely outcome allowed by statute is payment of a fine by the wind company to the General Fund, and does nothing to address the neighbor's problems with sleep disruption.

It must also be noted that attorneys representing wind developers have an incentive to underestimate the noise issues, because those same attorneys are then paid to participate in neighbor noise complaint investigations. One firm is currently representing Sheffield Vermont Wind, Georgia Mountain Wind in noise complaint investigations, and Iberdrola's Deerfield and Stiles Brook Wind in applications and compliance filings.

In developing a new methodology, the Board should utilize readily available technology to require real time monitoring at the property line with SCADA data (turbine output), weather and sound data all viewable from an independent monitor's computer screen. The Denver airport has a website (http://webtrak5.bksv.com/den3) with real time sound measurements visible from anyone's computer. There is no reason to limit the availability of this data. When neighbors are being exposed to intolerable noise levels coming from the power plant next door, the interests of public health must take precedence over the interests of the wind company.

The Board may also offer the opportunity for real time interior monitoring, with the agreement of neighbors, to assure compliance with 30 dBA which is necessary for health and sleep.

After more than four years of giving the wind companies everything they want at the expense of the health and quality of life of many neighbors, the Board must shift the balance in favor of protecting the neighbors through this temporary rule. The Board will have the opportunity to conduct a more thorough investigation of these issues through the formal rulemaking process also required by S.260. In the interim, precaution on the side of public health is warranted.

Noise Reduction Operations (NRO) Mode. The Lowell Wind project was approved based on the assurance of GMP's sound expert Ken Kaliski of RSG that NRO mode would work to bring the project into compliance. Based on the testimony about NRO mode, neighbors believed it would be adjusted to maximize benefits. Instead, the PSB accepted the same statements in every report identifying which turbines were operating in NRO mode and which ones were not, but never identifying any adjustments. The half dozen turbines closest to the Nelson home were never operated in NRO mode, and despite their efforts to understand why the system was not working as anticipated based on testimony, no adjustments were ever made in NRO mode. NRO mode has failed and should not be allowed to enable the approval of a project that otherwise would not be projected to meet compliance, as was the case with Lowell Wind.

Enforcement. The LMax standard would allow for a simplified third-party transparent continuous sound monitoring that would shift the burden of enforcement from the neighbors to the State where it belongs. Any infractions of the standard should be dealt with immediately and the project should scale back or shut down until it is proven that the standard is able to be met. This enforcement must be handled by the State and should not be left to the neighbors. No standard is any good unless it is enforced. Serious fines should be levied, payable to a neighbor relief fund. Enforcement must be timely and not drag on for months and years.

VCE has asked neighbors of operating wind projects what they need. The answer is simple. "Please give us the wind turbine operator's phone number so when the turbines are too loud we can call and ask them to turn them down or turn them off." We recommend the PSB adopt a Sound-Level Standard and Methodology that requires the wind company to provide the direct phone number to the wind turbine operator. When the neighbor calls, the wind turbine operator should note all relevant conditions including weather, power output and sound levels, and report that information to the Board and the designated independent monitor immediately. Over time, the information collected through this process will help develop a better understanding of the conditions that result in neighbor complaints. It will also provide immediate relief to neighbors, and shift the burden and expense from the neighbors to the wind company.

M. Deerfield Wind

Though it is not an operating project and is not impacted by the temporary rule and is also not a future project that has yet to receive a CPG, as we argued in the public

comment filed in April, 2016,[39] VCE believes the Board, as the sole protector of public health for energy projects, has an obligation to conduct a technical hearing on noise prior to allowing Iberdrola to begin construction of the 30 MW project that received its CPG in 2009.

The Board relied on the same expert witness used in Lowell Wind and Georgia Mountain Wind. That expert's work has resulted in numerous noise problems and unresolved noise complaints to the Board. His opinion that infrasound is not an issue is wrong, as demonstrated by numerous studies. The Board is charged with protecting public health and must update its review of the noise issue for the people of Searsburg and Readsboro prior to allowing Iberdrola to put more Vermonters at what is now a known risk based on the failure to protect public health at operating wind projects in Vermont using the same sound standards and expert witness testimony the Board relied on for the Deerfield Wind CPG.

Conclusion

For all the reasons discussed in the preceding pages, VCE is recommending the temporary adoption of sound standards for wind generation projects that will be more protective of public health than the PSB has been using in the past. We recommend a 30 dBA interior standard and a 35 dBA exterior standard, averaged at most over 10 minutes for compliance purposes, and continuous sound monitoring to assure compliance. Our complete recommendations are contained on page 2 of this document.

Dated Danby, Vermont this 27th day of June, 2016.

By:

Annette Smith, Executive Director
Vermonters for a Clean Environment, Inc.
789 Baker Brook Road
Danby, VT 05739
(802) 446-2094
vce@vce.org

[39] http://vce.org/VCE_7250_DeerfieldWind_042716.pdf

STATE OF VERMONT
PUBLIC SERVICE BOARD

Joint Petition of Green Mountain Power Corporation, Vermont Electric Cooperative, Inc., Vermont Electric Power Company, Inc., and Vermont Transco LLC, for a Certificate of Public Good, pursuant to 30 V.S.A. Section 248, for authority to construct up to a 63 MW wind electric generation facility and associated facilities on Lowell Mountain in Lowell, Vermont, and the installation or upgrade of approximately 16.9 miles of transmission line and associated substations in Lowell, Westfield and Jay, Vermont.	)	November 22, 2010 Docket No. 7628

PREFILED REBUTTAL TESTIMONY OF DR. T. RAY LOVKO M.D. ON BEHALF OF ALBANY, VERMONT

Summary: The purpose of Dr. Lovko"s testimony is to highlight the shortcomings of the report (Exhibit DPS-WEI-2) submitted as part of the pre-filed testimony of the Vermont Department of Health on behalf of the Vermont Department of Public Service, and to list some of the issues that were not addressed by the VDH report.

PREFILED REBUTTAL TESTIMONY OF DR. T. RAY LOVKO M.D.
ON BEHALF OF ALBANY, VERMONT

Q-1 Please state your name, current position, employer and business address.

A-1 T.(Teddi) Ray Lovko M.D. I currently work as a board certified physician in Internal Medicine at Family Medicine in Rutland, Vermont and as a Hospitalist at Rutland Regional Medical Center in Rutland, Vermont.

Q-2 Please state your qualifications to provide testimony in this matter?

A-2 My curriculum vitae is included as ALB-TL-1. I spent one year of post graduate training in the Ecology and Evolutionary Biology program at Indiana University. I graduated from the University of Virginia Medical School in 1995. While in graduate school I did research on sex ratios in *C. elegans* (unpublished data) and in medical school conducted studies on *Legionella micdadei* and antibiotic susceptibilities (unpublished data). I did my residency training at Dartmouth Hitchcock Medical Center in Internal Medicine. Since that time I have been working as a physician in Internal Medicine in Rutland, Vermont.

I became involved in looking at the issue of health effects of wind turbines after being approached by another physician who was concerned about the effects that these installations might have on people in Rutland County. Since that time I have read extensively on these issues, attended several forums on wind turbine noise and health and helped organize an educational conference at Rutland Regional Medical Center on wind turbines and health.

Q-3 Have you ever testified before the Vermont Public Service Board?

A-3 No.

Q-4 Do you have any specific expertise on wind turbines or the potential health impacts experienced by people living in proximity to wind turbines?

A-4 As a physician in Internal Medicine I am called upon to treat a large number of health issues. As part of my training and job requirements I have to review scientific and medical literature on a regular basis to make sure I stay abreast of new diseases, treatments and public

health related issues. I also have to be able to interpret these studies and apply them to real world situations. It is these same skills that I have put to work reviewing the scientific and medical literature about wind turbines and their effects on health.

Q-5 Have you reviewed the report entitled "Potential Impact on the Public"s Health from Sound Associated with Wind Turbine Facilities", dated October 15, 2010, prepared by staff at the Vermont Department of Health and submitted in this matter as Exhibit DPS-WEI-2 (hereinafter the "VDH Report")?

A-5 Yes.

Q-6 Have you reviewed the papers and other sources cited by the VDH Report?

A-6 Yes, I have reviewed the papers they cite in their report. I have also read many other reports in the acoustic literature, health literature, other health experts" testimony on the issue, lay press reports, and I have reviewed a number of non-peer reviewed surveys and unpublished papers, and had personal communications with other experts in the field.

Q-7 Do you support the conclusions of the VDH Report?

A-7 I do in part. I agree with the VDH Report that there is evidence of adverse health effects and sleep disturbance related to nighttime sound levels from wind turbines.

However, my review of the literature and available evidence does not support their recommendation that limiting nighttime sound levels from wind turbines to 40dB as measured at the exterior facade of the dwelling averaged over 12 months will be protective of public health.

There is also not enough available evidence to support their conclusion "that there is no direct health effect from sound associated with wind turbine facilities" or to rule out other ways in which wind turbines may be having adverse health effects on people.

Q-8 In what way is the recommendation "that nighttime sound levels from wind turbines be limited 40 decibels or less, as measured at the exterior facade of the dwelling and averaged over

12 months of exposure" not sufficient to protect the public health?

A-8 There is well accepted evidence in the medical literature that shows noise can cause adverse health effects on people, including hypertension, heart disease, hormonal stress reactions, and sleep disturbance, as well as many other problems (WHO 2009). The WHO 2009 Report on nighttime noise gives a good overview of the mechanisms and effects of noise on health. It is believed that many of these effects arise as a result of sleep disturbance, although there are other pathways by which sound can also have adverse health effects on an individual both directly and indirectly (WHO 2009).

The recommendation in the VDH Report regarding sound levels is taken from the WHO 2009 Report which was based on studies of various noise sources and their effects on health. The WHO 2009 paper, while an excellent general overview on nighttime noise and health issues, is a general guideline and will not be equally applicable to all situations as the paper itself acknowledges. For example, the paper says that lower sound level limits will need to be provided for noise sources with high levels of low frequency sounds (such as wind turbines) as these sources are more likely to create health problems. Lower sound limits will also be required when sounds are not continuous (i.e. fluctuate like wind turbine noise) and in areas where background sound levels are low (such as rural areas like Lowell/Albany) (WHO 1999). It must also be kept in mind that the WHO 2009 Report does not make any specific references to wind turbine noise or cite any studies on wind turbine noise. Most of the studies they refer to are based on road noise, air traffic, and community noise.

Wind turbine sound has a number of attributes which make it different than these other commonly studied noise sources. Wind turbines are frequently placed in rural areas which often have very low background sound levels of 20-30dB. Wind turbines emit large amounts of low frequency and infrasound that travels farther than higher sound frequencies and which is poorly attenuated by walls and windows and is capable of causing noise related to the vibration of these structures (Colby et al 2009, Hanning 2010, Minnesota Department of Health 2009, Roberts and Roberts 2009). Wind turbine sound often shows amplitude modulation, a pulsatile nature to the sound that has been shown to be more annoying than steady noise (Bradley 1994, Holmberg et al

1997). Wind turbines will often be as loud or louder at night than they are during the day (van den Berg 2008). Wind turbines can be a source of continuous fluctuating sound for long periods of time depending on wind conditions. This unique combination of features makes it plausible that wind turbines might have adverse health effects more frequently and at lower sound levels than the noise sources cited in the WHO 2009 report.

Indeed the literature on this topic does show annoyance (an adverse health effect in its own right according to the WHO 2009 Report) and sleep disturbance from wind turbines at lower sound levels than for most other noise sources. Two of these studies done in Sweden show levels of annoyance and sleep disturbance starting to rise at or below 35dB, with 28% showing annoyance at sound levels of 37.5-40dBA and continuing to rise as sound levels increase above 40dB(Pedersen and Persson 2004, Pedersen and Persson 2007). When looking at both studies, almost 50% of people reported annoyance at sound levels greater than 40dBA and in one of the studies 64% of those suffering annoyance also reported sleep disturbance. People living in rural areas also tended to suffer more annoyance from wind turbines, as did those living in „complex" or hilly terrain (Pedersen and Persson 2007). Another study from the Netherlands showed wind turbine noise to be "more annoying than transportation noise or industrial noise at comparable levels, possibly due to specific sound properties such as a „swishing" quality, temporal variability and lack of nighttime abatement" (Pedersen et al 2009) This same study showed18% of people annoyed at 35-40dBA and evidence of sleep disturbance. Given these studies that indicate adverse health effects correlating with sound levels as low as 35dB from wind turbines, the recommendation of 40dB in the VDH Report is too high to be protective of health.

The WHO 2009 report relied on by VDH in fact specifically makes the point that 40dB is a threshold level of noise, and that once noise exceeds that level you are likely to have an adverse impact on public health. This does not even take into account the unique sound characteristics of wind turbines, as discussed above, and therefore, a noise limit must be set for this project that takes into the nature of wind turbine noise, the low existing background levels, and the WHO findings which suggest that even a 35dBA limit may result in annoyance and sleep disturbance.

Another problem with the recommendations in the VDH Report is the fact that they are recommending that sound levels be averaged over a period of 12 months. The WHO 2009 report states that "instantaneous effects such as sleep disturbance are better (correlated) with the maximum level per event LAMax" than with long term sound averages. Averaging sound levels over this long period of time would allow sound levels to rise high enough to cause health problems and sleep disruption, while still being in compliance as long as there were periods of low sound levels to average out these higher peaks. The fact that wind turbine sound often shows amplitude modulation makes it even more possible for this to occur. It has been shown that these pulses of sound can occur over a range of 5dB, meaning that the sound could spike into ranges disruptive of sleep, and yet the average sound level would suggest that the sound levels are within the prescribed limits and protective of health and sleep when in fact they are not. It does not take prolonged noise elevation to disrupt sleep and these brief peaks of noise have the potential to disrupt sleep many times during a night. If the main goal is to prevent sleep disturbance, sounds should not be averaged or would need to be averaged over very short time periods, otherwise the „peaks" of sound that are enough to disrupt sleep will be undetectable when averaged out with quieter times. If this is not done, compliance becomes uncoupled from the goal that it was set out to achieve, which is prevention of sleep disruption.

The literature indicates that the recommendation in the VDH Report of a 40dB standard is too high and the 12 month average is too long to protect public health. Both of these factors would mean that people would be likely to suffer adverse health effects and sleep disruption from wind turbine noise, and therefore in my opinion the VDH recommendations would not be protective of public health.

Q-9 Please explain how you researched the issue of health impacts related to turbine noise, and compare your review to the review conducted by VDH.

A-9 I undertook a review of the published literature on wind turbines and noise as well as reading review papers on the issue by other experts, much like VDH. Unlike the VDH report, I also attempted to read the primary source articles on wind turbines and health when available, rather than just the review papers. I also reviewed many unpublished case series, papers,

surveys, and press reports that were available to me. Some of these studies represent examples of case crossover studies and are highly suggestive that wind turbines are causing the health issues described (Phillips 2010). While these nonpeer reviewed surveys and case reports may not be a basis for drawing definitive conclusions in and of themselves, they are relevant in that the spectrum of complaints and levels at which complaints occur are remarkably consistent across these reports. They represent real world examples of what would be expected from the available literature on noise and health in general and in particular with wind turbine noise and health effects. Thus they support the research that is available as being accurate.

Q-10 What sound level does the literature you have reviewed suggest would be protective of public health?

A-10 The available studies do not provide a definitive answer as to what the exact sound levels and distances need to be to be protective of the public health. The ideal studies to show exactly at what distances and sound levels people"s health will not be affected have not been done. Furthermore, even if those studies were available they would not be applicable to every location, type of wind turbine and circumstance that would arise and would still require interpretation as to how to apply them to any given situation. Therefore we must use the best evidence available to try and meet the needs of protecting the public health, and must also err on the side of caution as this is still an emerging scientific issue.

If using 40dB as a threshold for nighttime sound levels is a general guideline for protecting health (pursuant to WHO 2009), it follows that for a sound source such as wind turbines, which cause annoyance and sleep disturbance at lower levels than most noise sources (due to amplitude modulation, low frequency noise and their locations in quiet rural settings) that the 40dB recommendation will be too high and a lower level will be required.

The best available studies on wind turbines show that the levels of self reported annoyance and sleep disturbance start to rise at about 35dB as measured outside the building. The studies from Sweden and the Netherlands referenced above have some important limitations and may underrepresent the problems we might see with current wind turbine proposals in Vermont. It is

important when looking at these studies to remember that the Swedish studies were done looking at wind turbines which are significantly smaller than the sizes of most current wind turbines, were placed in smaller numbers per array, and often on flat terrain. The study from the Netherlands also did not closely match conditions in Vermont. Current wind turbine proposals in Vermont are likely to show even higher levels of annoyance and sleep disruption as evidence suggest that sound levels and annoyance are likely to be worse as turbines get larger (more noise), there are more turbines in an area (more noise), and when they are placed on hills or ridgelines (more noise which carries farther).

When looking at the Pedersen studies it is also important to take into account, as Dr. Christopher Hanning points out (Hanning 2010), that these events are self reported and that unrecalled arousals from sound events are likely much higher, and thus sleep disturbance is likely much worse than is being reported. These arousals can occur at sound levels around 35dB exterior and are not generally recalled, but do show adverse changes in heart rate and blood pressure each time they occur. Given that sleep research suggests arousals can start to occur at sound levels around 35dBA (Hanning 2010) and current studies show a marked rise in annoyance and sleep disturbance at sound levels greater than 35dBA, 35 dB exterior or below is likely to be protective of public health.

Below are some recommendations from other health and sound experts that I have relied on, who support similar sound levels as noted in Hanning‟s 2010 paper. Hanning‟s paper *Wind Turbine Noise, Sleep and Health* is submitted as ALB-RJ-4.

-Phipps, based on his research on wind turbines in hilly and mountainous regions in New Zealand, recommended sound levels not to exceed the background sound level (L95) by more than 5dBA, or a level of 30dBA L95, whichever is less (Hanning 2010).

-Hanning, a world renowned expert on sleep and well versed on wind turbines and health, recommends a maximum external limit of 35dBA in the absence of excessive modulation (Hanning 2010)

-Kamperman and James suggest turbine noise should not be more than 5dBA above background levels and should not exceed 35dBA within 30 meters of any occupied structure. (Hanning 2010).

-New Zealand Standard 6808 provides that the evening and nighttime levels may be set at 35dB La90(10min) or 5dB above the background level, whichever is higher. (Hanning 2010).

-The Dutch National Institute for Public Health and Environment recommend an outdoor Lden limit of 40dBA as the "no effect level" (Hanning 2010).

-Thorne concludes that unreasonable noise occurs at noise levels above 30dBA L90 in the presence of amplitude modulation and with van den Berg states that 30dBA L95 in conditions of low wind speed with modulation restricted to 3dB would likely be protective of health and from annoyance. (Hanning 2010).

-The Minnesota Department of Health paper on wind turbines and health comments that complaints rise with sound levels above 35dBA. (Minnesota Department of Health 2009).

-A summary report by the Ohio Department of Health on wind turbines suggests "that operational noise levels at these distances should be kept to levels at or below 35dBA." (Ohio Department of Health 2008).

Q-11 Are there studies or papers that you are aware of that were not reviewed as part of the VDH Report that you think should have been included?

A-11 There is a growing body of data showing health complaints from people living near turbines. Much of this data is unpublished, self reported or in the lay press. While these reports reinforce the fact that people living near wind turbines are suffering from a large number of complaints, they do not tell us at what sound levels or distances these effects would be mitigated. A very important review of wind turbines and health by Dr. Christopher Hanning, a sleep expert, is important to read as it gives an excellent and thorough review of what we know about wind

turbine sound and health. As mentioned, it is has been submitted with the rebuttal testimony of Rick James as ALB-RJ-4. It is an excellent complement to the WHO 2009 paper in that it looks specifically at the data on wind turbines and sleep, which was not covered in the WHO reports. It helps to illustrate clearly how and why the sound limits proposed by the VDH are too high and not protective of health.

Additionally, an unpublished case control study by Dr. Michael Nissenbaum on wind turbines and health effects in Mars Hill, Maine is important to review. The study closely mimics conditions in Vermont (due to similarities in topography and ridgeline turbine placement) and thereby gives us a look at what kind of effects we might expect to see here. It is also one of the only studies to use a control group to compare the health of those near turbines (within 3500 feet) with those far away (3 miles). While this study does not define a safe sound level, it suggests that those within 3500 feet may suffer rates of sleep disturbance up to 82%, decreased quality of life in 95%, increased rates of use of prescription medications, headaches, stress, and depression (Nissenbaum 2010). This study emphasizes how important it is that sound levels be set at proper levels, as the adverse health effects can be very significant – however it must be noted that the Mars Hill project consisted of smaller 1.5 MW turbines, and therefore the effects of the current proposed project may be even greater due to increased noise levels from the larger turbines.

Q-12 In your opinion, does the Petitioner's failure to address infrasound mean that they have not fully characterized the potential health effects of this project?

A-12 Yes. I think there is preliminary evidence to suggest that infrasound may have more physiological effects than was previously appreciated. There are number of studies in animals and some in humans to suggest that these sounds may have effects that were previously unappreciated (Pierpoint 2010). It will take more research to determine what clinical significance these may have in the long term, however by not addressing this issue, the Petitioner has not fully characterized the potential health impacts of the project.

Q-13 The Public Service Board has previously (in other dockets relating to wind turbine development) used a noise standard of 45 dBA (exterior)(Leq)(1hr). In your opinion, is this

standard protective of public health?

A-13 No. 45 dBA is too high and will not protect people from the health effects and sleep disturbance they will experience at these sound levels. These levels are higher than those recommended in the WHO 2009 report. The studies I have discussed earlier show significant sleep disturbance and annoyance at levels much lower than this. You could possibly see levels of annoyance in as many as 50% of people at these sound levels. I am not aware of any studies on wind turbines that show that these sound levels would prevent annoyance and sleep disruption. This standard is not protective of public health.

Q-14 The Petitioner has requested that the Public Service Board impose a noise standard of 45 dBA (exterior)(Leq)(8hr). In your opinion, would this standard be protective of public health?

A-14 No. This request is even more problematic than 45dBA (exterior)(Leq)(1hr) discussed previously. The 45dBA standard is too high since, as mentioned previously, we see sleep disturbance starting at levels as low as 35dBA. This recommendation simply ignores the updated recommendations of the WHO 2009 paper on lower sound levels. It is also important to note that the WHO 1999 report states that "if the noise is not continuous, sleep disturbance correlates best with LAMax" and that "this is particularly true if the background level is low." I am not aware of any studies on wind turbines that show that these sound levels would prevent annoyance and sleep disruption.

Also as discussed previously, the longer the time period over which one averages the sound levels, the easier it becomes to be in compliance with the noise standard while having sound levels present which would be harmful to sleep and health. This standard would therefore not be protective to the public health, as it would allow for noise to exceed 45dB – which the WHO report clearly found to be problematic – for up to several hours during the night, leading to sleep disturbance and health impacts, yet the standard would not be violated. This is simply not protective of public health, and such a standard is not supported by the relevant literature.

Q-15 The Petitioner's expert, Mr. Kaliski, testified that "the sound levels from the turbines will not rise to a level that… [would] pose quality of life concerns with respect to sleep

disturbance…." Do you agree?

A-15 No. The best data available on wind turbines shows that annoyance and sleep disturbance start at levels as low as 35dB. His statement also goes against the updated WHO 2009 recommendations with regards to what safe sound levels should be. I do not think his expertise qualifies him to make that statement and the evidence does not support it.

Q-16 What noise standard do you believe the Board should employ, based on your review of the applicable literature?

A-16 I believe that the evidence suggests that nighttime sound levels should be a maximum of 35 dBA as measured at the exterior facade of the dwelling in order to be protective of public health and to avoid sleep disturbance and the health effects that go along with it. Any levels higher than this will in all likelihood subject a not insignificant percentage of people to sleep disturbance and adverse health effects. This recommendation supposes accurate sound modeling and monitoring.

I would also caution that even a maximum exterior sound level of 35 dBA may not be protective in all cases, as there are studies showing sleep arousals and disturbance at or below this level. Additionally, people"s sensitivities to noise can vary, not all the complaints related to wind turbines are likely to be related exclusively to sound levels and sleep disruption, current studies are limited in scope and time, and the effects of infrasound are still being explored. I urge the Board to err on the side of caution when setting levels that are intended to be protective of human health.

Q-17 If a less protective noise standard is used for this project, what are some of the potential health impacts that neighboring residents may experience?

A-17 You would expect to see sleep disturbance, which is a health problem in and of itself but which also can lead to cardiovascular illness, depression, elevated heart rates, changes in stress hormones, impaired glucose tolerance, increased use of prescription medications (for sleep, depression, hypertension), depression, hypertension, weight gain, headaches, tinnitus, decreased attention, accidents, and decreased school performance. These and other effects have been

documented in numerous studies on noise and many have also been shown with respect to wind turbines in particular (Colby et al 2009, Hanning 2010, Nissenbaum 2010, Pierpoint 2010, WHO 2009).

Q-18 Does this conclude your testimony?

A-18 Yes, and I have provided a list of my references below for the Board‟s review.

References

- Bradley, J.S. "Annoyance caused by constant-amplitude and amplitude-modulated sounds containing rumble". Noise Control Engineering Journal. 1994; 42 (6): 203-208.
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- Pierpoint, N. *Wind Turbine Syndrome and the Brain*, November 2010. http://www.windturbinesyndrome.com/img/WTSbrain-color.pdf

- Roberts, Mark and Jennifer Roberts. *Evaluation of the Scientific Literature on the Health Effects Associated with Wind Turbines and Low Frequency Sound*, Report to Wisconsin Public Service Commission, October 2009.

- Van den Berg et al. *Project WINDFARMperception: Visual and acoustic impact of wind turbine farms on residents*. Final report, FP6-2005-Science-and-Society-20, Specific Support Action project no. 044628. June 3, 2008.

- Vermont Department of Health, *Potential Impact on the Public's Health from Sound Associated with Wind Turbine Facilities*, October 15, 2010.

- World Health Organization, *Guidelines for Community Noise*. Geneva, 1999.

- World Health Organization, *Night Noise Guidelines for Europe*, Geneva, 2009.

STATE OF VERMONT
PUBLIC SERVICE BOARD

Joint Petition of Green Mountain Power Corporation, Vermont Electric Cooperative, Inc., Vermont Electric Power Company, Inc., and Vermont Transco LLC, for a Certificate of Public Good, pursuant to 30 V.S.A. Section 248, for authority to construct up to a 63 MW wind electric generation facility and associated facilities on Lowell Mountain in Lowell, Vermont, and the installation or upgrade of approximately 16.9 miles of transmission line and associated substations in Lowell, Westfield and Jay, Vermont.	)	January 10, 2011 Docket No. 7628

SURREBUTTAL TESTIMONY OF DR. LOVKO ON BEHALF OF ALBANY, VERMONT

Summary: Dr. Lovko responds to the prefiled rebuttal testimony of Dr. McCunney.

SURREBUTTAL TESTIMONY OF DR. LOVKO
ON BEHALF OF ALBANY, VERMONT

Q-1. Have you previously provided testimony in this matter?

A-1. Yes.

Q-2. What is the purpose of this testimony?

A-2. I respond to the rebuttal testimony submitted by Dr. McCunney on behalf of GMP.

Q-3. Have you reviewed the rebuttal testimony of Robert McCunney M.D. on behalf of Green Mountain Power Corporation filed November 22, 2010?

A-3. Yes, and his discovery answers as well.

Q-4. Do you support the conclusions of his testimony?

A-4. No.

Q-5. Do you agree with Dr. McCunney"s statement (A-5 and A-7) that "The risk of any direct adverse health effects at levels below 45dB(A) is virtually nonexistent"?

A-5. No. It is quite clear that annoyance and sleep disturbance can occur at levels below this, and Dr. McCunney himself admits to this in his discovery responses, wherein he admitted "that indirect health effects from wind turbine noise (such as sleep disturbance, annoyance, stress) can occur below 45dBA." Dr. McCunney thus chooses to ignore the fact that annoyance and sleep disturbance are direct adverse health effects in and of themselves (WHO 2009, also see my answer to Q-7 below), as well as risk factors for other diseases such as depression, hypertension, cardiovascular disease, arthritis, respiratory problems, and decreased quality of life (Niemann et al., 2006, also see my answer to Q-7 below). I have not seen a clear explanation from him as to why he discounts the effects of annoyance and sleep disturbance.

It is also unclear from his testimony why he has chosen 45dB(A) as acceptable and safe. He gives two references in his discovery answers to support that noise level - Miedema (2003) and the WHO Europe 2009 report. The WHO 2009 report to which he refers does not support his statement that "adverse health effects at levels below 45dB(A) [are] virtually nonexistent". Even a cursory look at the main tables from this paper shows sleep disturbance starting at 35 dB

Lamax inside, use of somnifacient drugs and sedatives at 40dB Lnight outside, self-reported sleep disturbance and environmental insomnia at 42dB Lnight outside, and complaints at 35 dB Lnight outside. The WHO 2009 report goes on to state, "adverse health effects are observed at the level above 40 dB Lnight outside."

The other reference (Miedema, 2003) is focused on the issue of noise and sleep disturbance, which Dr. McCunney is choosing to ignore. In addition, Miedema states in his conclusion that "currently there is not a sufficient basis for establishing exposure-response relationships for these types of effects". Nowhere does the paper give a recommendation as to what sound levels would be protective of health or prevent adverse health effects. Therefore, neither of the sources he cites support his assertion that adverse health effects at levels below 45dB(A) are virtually nonexistent.

Q-6. Do you agree with Dr. McCunney (A-5) that "The Board's approved sound standard of 45 dBA (exterior)(Leq)(1hr) is sufficient to protect human health and avoid sleep disturbance"? If not, why is it not protective?

A-6. No I do not agree. First, I would like to point out that it is accepted in the medical field that community noise, whether from wind turbines or other sources (traffic, aircraft, trains, neighborhood noise), can have negative and serious impacts on people's health. Given that fact, the question is no longer "can noise from wind turbines create health problems?" Clearly they can, the question is how to protect the public.

The problem with the limit of 45 dBA(exterior)(Leq)(1hr) is that it is simply too high to protect people from the adverse effects of noise from wind turbines. Averaging the levels over time further compounds this fact by allowing even higher sound levels to occur for periods of time. Please see my prior Rebuttal testimony to the Vermont Department of Health for more on this issue.

It is hard to reconcile setting a sound level of 45 dba for wind turbines when there is clear and consistent evidence in the peer reviewed literature (as discussed below) that people start to suffer adverse health effects, especially annoyance, at levels below this. There have been three major studies looking at more than 1,500 people examining this issue (which I have summarized below). These studies do not answer all the concerns regarding wind turbines and health; however they provide clear and consistent evidence that the sound standard proposed by GMP and standards previously used by the Public Service Board are too loud to be protective of public health from wind turbine noise. The findings of these studies are important because they are well designed studies and they provide the best available evidence from which to base decisions regarding noise standards that would be protective of public health. Their results have also been remarkably consistent, making it possible to anticipate at what sound levels noise begins to be a problem.

One thing to keep in mind while I review these studies is that they may very well underestimate effects in Vermont. These studies looked at smaller wind turbines than those being currently proposed in Vermont. Most of the sites evaluated in these studies had fewer turbines in a given area than this current proposal. Many of the sites in the studies were on flatter, less varied terrain and those that were in hilly or rocky terrain tended to show higher rates of annoyance. Therefore these studies provide a conservative view of the potential impacts of wind turbine noise on the health of the public for the proposed project.

Pedersen and Waye-2004.

The goal of this study was to evaluate the prevalence of annoyance due to wind turbine noise and to study dose-response relationships of noise and annoyance. A significant relationship was found between noise levels and annoyance. People were annoyed by sound from wind turbines at lower levels and the rates of annoyance increased more rapidly than for other sources of community noise.

The following levels of annoyance were noted with regard to sound levels:

-At 30-32.5 dBA outside the building: 0% were annoyed

-At 32.5-35.0: 18% were rather or very annoyed with an additional 17% slightly annoyed

-At 35.0-37.5: 12% were rather or very annoyed with an additional 26% slightly annoyed

-At 37.5-40.0: 28% were rather or very annoyed with an additional 23% slightly annoyed

-At >40.0: 44% were rather or very annoyed with an additional 12% slightly annoyed

Other points to consider in this study:

-Of those who noticed the wind turbine noise 25% were disturbed daily or almost daily and an additional 17% were annoyed once or twice a week, suggesting that it is not a minor or infrequent occurrence.

-At levels >35dBA 16% stated that they were disturbed in their sleep by wind turbine noise.

-85% of people could hear the wind turbines even at levels as low as 35-37.5dB.

As you can see, based on this study the noise standards proposed by GMP and previously used by the Public Service Board could result in as much as 50% of the people living in the vicinity suffering from annoyance as well as significant levels of sleep disturbance and its adverse health effects.

Pedersen and Waye-2007.

This is a similar study to their 2004 paper, in which they again looked at annoyance and wind turbine noise and also tried to ascertain if terrain has a significant impact as well. They found that living in a rural area increased the risk for annoyance and a rural area with hilly or rocky terrain increased the risk for annoyance even further. They also found that annoyance was associated with lowered sleep quality and negative emotions. They conclude that "there is a need to take the unique environment into account when planning a new wind farm so that adverse health effects are avoided."

The following levels of annoyance were noted with regard to sound levels (dBA outside):
-At <37.5dBA-3-4% were annoyed
-At 37.5-40dBA-6% were annoyed
-At >40dBA-15% were annoyed

Other points to consider in this study:
-Noise annoyance was associated with reduced sleep quality and negative emotions. 36% of those who were annoyed by wind turbine noise reported their sleep was disturbed by noise.
-The authors state "annoyance is an adverse health effect". (See my answer to Q-5 in this testimony)

This study again shows that at ~35dBA or slightly higher you begin to see an increase in negative health impacts from wind turbine noise. Therefore according to this study, the noise standard previously used by the Board would be insufficient to protect public health.

Pedersen et al-2009.
For this study, the authors collected data with the purpose of trying to come up with a dose-response relationship of noise and annoyance with the goal being to find levels which would avoid adverse health effects. As in both prior studies, the levels of annoyance increased with increasing sound levels. Again it was shown that wind turbine noise was more annoying than comparable sound levels from other noise sources.

The following levels of annoyance were noted with regard to sound levels (dBA):
-At 30-35 dBA-7% were rather or very annoyed with an additional 10% slightly annoyed.
-At 35-40 dBA-18% were rather or very annoyed with an additional 20% slightly annoyed.
-At 40-45 dBA-18% were rather or very annoyed with an additional 23% slightly annoyed.

Other points to consider in this study:
-Of those who expressed annoyance to wind turbine noise 92% were annoyed by sound at least once a week.

Taken together, these studies show that adverse health effects, primarily annoyance, begin to consistently increase at levels above 35 dBA. The prior standard used by the Public Service Board, and the standard requested by GMP, allow for 45dBA, which will not be protective to many people exposed to levels higher than 35 dBA. Any guideline proposal higher than that should explain why that will be protective when the best evidence to date shows higher levels will leave a significant number of people at risk for health problems.

There are other unpublished studies of varying degrees of quality, from case crossover studies (Pierpoint, 2010), to a case control study (Nissenbaum, 2010), and numerous case reports and surveys have been conducted (Phipps et al, Gillis, 2009, Harry, 2007, Cummings, 2010, National Wind Watch, Industrial Wind Action Group), which while not providing definitive evidence in

and of themselves show that the studies I have just reviewed are supported by what is being seen elsewhere.

Q-7. Dr. McCunney seems to ignore the negative health impacts of annoyance and sleep disturbance which are clearly documented to occur at sound levels lower than the level of 45 db(A), a level for which he states health effects would be "virtually non-existent". Is this approach generally accepted by the research community and by the literature on noise and health?

A-7. No. Even Dr. McCunney in his discovery testimony admits "that indirect health effects from wind turbine noise (such as sleep disturbance, annoyance, stress) can occur below 45dBA". For reasons that remain unclear he has decided not to consider these adverse health effects. His approach goes against the view of numerous regulatory agencies, acoustic experts and experts in the medical field who consider annoyance and sleep disturbance as problems in and of themselves as well as being mediators leading to other health problems such as cardiovascular disease, depression, decreased health related quality of life. I am including an extensive but not exhaustive sample of expert viewpoints on these issues. Please note that full references for these are provided below following my testimony.

<u>Health and regulatory agencies pronouncing annoyance and or sleep disturbance as a health issue</u>:

-WHO, 1999, 2009. Acknowledges that annoyance and sleep disturbance are adverse health effects.
-Environmental Protection Agency. "Though for some, the persistent and escalating sources of sound can often be considered an annoyance. This „annoyance" can have major consequences, primarily to one"s overall health".
-Gohlke et al. 2008. (Work for NIH) "Even seemingly clean sources of energy can have implications on human health. Wind energy will undoubtedly create noise, which increases stress, which in turn increases the risk of cardiovascular disease and cancer".
-Vermont Department of Health. "However, there is sufficient evidence of secondary health effects from sleep disturbance due to excessive sound at night (from wind turbines). The potential adverse health effects that can result for sleep disturbance include increased heart rate, sleep state changes and awakening, insomnia, fatigue, accidents, reduced performance, cardiovascular illness and depression and other mental illness".
-UK National Health Service. "The acknowledgement that some people exposed to wind turbine noise suffer annoyance suggests that monitoring and maximum permitted levels need to be considered carefully in areas where turbines are planned." (Horner et al., 2010).
-Health Canada. Acknowledges "That there are peer-reviewed scientific articles indicating that wind turbines may have an adverse impact on human health" and acknowledges the health consequences of stress and considers it (stress) a risk factor for heart disease, worsening diabetes, bowel diseases, herpes and affects on the immune system.

-Ontario Ministry of Health and Long Term Care. Acknowledge wind turbines may cause annoyance, stress and sleep disturbance. (King, 2009).
-Environmental Expert Council of Germany - Severe annoyance persistent over prolonged periods of time is to be regarded as causing distress. (Ising, 2004).

AWEA 2009 paper (Colby *et al*., 2009) and coauthor comments[1]:

-Colby et al, 2009 (AWEA Paper). "[A]ny sound that is chronically annoying, including very soft sounds, may, for some people, create chronic stress, which can in turn lead to other health problems".
-Colby, David. "We're not denying that there are people annoyed and that maybe some of them are getting stressed out enough about being annoyed that they're getting sick". (Society for Wind Vigilance, 2010 - from radio interview).
-Leventhall, Geoff. "Annoyance brings feelings of disturbance, aggravation, dissatisfaction, concern, bother, displeasure, harassment, irritation, nuisance, vexation, exasperation, discomfort, uneasiness, distress, hate etc...." "The claim that their „lives have been ruined" by the (low frequency) noise is not an exaggeration...."(Leventhall, 2004).
"[T]here was no doubt people living near the turbines suffered a range of symptoms, including abnormal heart beats, sleep disturbance, headaches, tinnitus, nausea, visual blurring, panic attacks and general irritability....it's ruining their lives-and its genuine...." (Countryside News, 2010)

Views of experts in the field of noise and annoyance:

-Dratva *et al.* 2010. Recent evidence of an inverse relationship between noise annoyance and health-related quality of life (showing that annoyance is negatively impacting people's health). They further state that "Noise annoyance expresses the degree of dissatisfaction and disturbance with regard to noise exposure and can be seen as a pathway to the development of health effects as well as a health effect by its own".
-Hoeger *et al*., 2002. "The annoyance-reaction is one of the central variables in noise research".
-Hume, 2010. "In present times, noise disturbed sleep is a cause of considerable annoyance with potential health and well being effects." "There have been suggestions in the literature that annoyance is the mediating factor between noise exposure and CVD (cardiovascular disease)...."
-Niemann *et al*., 2006. "The results of the LARES study - with regard to criteria for causal relations - confirmed, on an epidemiological level, an increased health risk from chronic noise annoyance." "It has to be assumed that chronic noise annoyance is not only connected with a

[1] This is significant because Dr. McCunney has relied on the findings of the American Wind Energy Association ("AWEA") 2009 paper for his testimony, and was a member of an expert panel put together by the AWEA for that paper. As he stated in his testimony, the purpose of the panel was to address the peer-reviewed scientific literature regarding potential health implications of wind turbines. Dr. McCunney was a co-author of the comprehensive review "Wind Turbines and Health" (the "White Paper"), which was authored by the panel.

risk for cardiovascular symptoms, but also with risks for respiratory symptoms like bronchitis as well as arthritis and migraine."
-Phillips, 2010. "Most all accepted definitions of individual or public health include psychological health as part of the consideration, and usually refer to an overall state of well being rather than just an absence of particular diagnosed pathology". "„(A)nnoyance‟ in this case includes serious physical and psychological symptoms".
-Schreckenberg et al, 2010. "Health related quality of life was associated with aircraft noise annoyance...." Annoyance had negative impact on health related quality of life.
-Shepherd et al, 2010. "Noise, defined at the psychological level of description as an unwanted sound, is increasingly being targeted as an environmental factor negatively impacting health. In some contexts noise can elicit annoyance or disrupt sleep in a manner detrimental to health". "There is general agreement in the literature that annoyance and sleep disruptions are likely mediators of noise-induced health deficits". Their study on airport noise further showed decreased health related quality of life with increasing levels of annoyance.

It is important to understand that annoyance and sleep disturbance adversely impact health and quality of life in and of themselves. The viewpoints above show that this view is not fringe or out of the mainstream, but rather is widely accepted by many noise and health professionals. It is unsettling that the wind industry sponsored paper Dr. McCunney coauthored (Colby et al, 2009) states "It is important to note that although annoyance may be a frustrating experience for people, it is not considered an adverse health effect or disease of any kind." They provide no references to support or justify this statement. Current views on noise and health suggest that annoyance and sleep disturbance, and the hormonal reactions that accompany them (increased autonomic activity, increased cortisol levels), contribute to other health effects such as hypertension, cardiovascular disease, depression, migraines, decreased quality of life, arthritis and respiratory problems. (Shepherd et al, 2010, Niemann et al, 2006). The Board must therefore not accept Dr. McCunney‟s unsupported and erroneous assertions regarding the potential health impacts associated with wind turbine noise.

Q-8. Dr McCunney states (A-5) that "Noise levels associated with sleep disturbances tend to be higher than 45 dB(A)". Is this an accurate statement?

A-8. No. While it is obviously true that the louder the noise the more likely it is to create sleep disturbances, it is clear that noise levels below 45dBA can disrupt sleep. The WHO 2009 report clearly states that disruptions in sleep with increased sleep motility begin at levels as low as 32 dBA, and at 35 dBA you begin to see evidence of electroencephalogram (EEG) awakenings. A study by Maschke done in 1995 showed increasing stress hormone levels of cortisol and adrenaline from nighttime air traffic with maximum sound levels of 55 dBA and mean testing levels of 30dBA (Ising, 2004). A study by Basner showed that awakenings occurred at levels as low as 33dBA and increased heart rates and vasoconstriction occurred at levels well below 45dBA (Griefahn et al. 2008).

The scientific literature therefore shows that sound levels below 45 dBA are capable of creating sleep disturbance. The full impact of these findings on an individual‟s health is still being examined. Even though these parameters may not be associated with fully conscious awakenings, people who are experiencing them report less restful sleep, fatigue, longer reaction times, poor short-term memory, reduced motivation, distractability and decreased performance showing that they do create immediate adverse impacts. (Shepherd et al, 2010, Zaharna and Guilleminault, 2010).

Current models about how sound affects sleep and contributes to other adverse health problems suggest that even these seemingly minor changes in sleep may be one of the pathways that noise contributes to other problems such as hypertension and cardiovascular problems. (WHO 2009). These disturbances are associated with elevations in blood pressure and heart rate when they occur and over long periods of time may contribute to cardiovascular disease. Ising (2004) further states "that for reasons of medical prevention it is necessary principally to avoid noise-induced impairments [of sleep] even when below the arousal threshold".

Q-9. Dr. McCunney makes a point of emphasizing that personal characteristics as opposed to sound level are „primarily" associated with annoyance, and states that "annoyance, however, is not a pathological condition, per se...." Do you agree with these statements?

A-9. Not entirely. Dr McCunney seems to choose his words very carefully with a very narrow meaning so that his statements have some truth but fail to accurately depict the situation.

Let me explain further. Dr. McCunney makes a point of saying that "some people may be annoyed at the presence of sound from wind turbines, or its fluctuating nature, depending primarily on personal characteristics," as opposed to the intensity of the sound. This statement is true in some situations, but it is important to understand that annoyance is also very much dependent on noise levels even when personal characteristics are having an effect (see answer to Q-6 of this testimony). While personal characteristics determine which noises and at what levels a particular sound may become annoying to an individual, it is also true that almost any sound will be annoying if loud enough. Therefore, just because the noise level at which people experience annoyance is highly variable does not in any way make their annoyance and associated symptoms any less real or worthy of consideration.

The fact that personal characteristics have a large impact on which sound and at what sound level annoyance becomes a factor is not unique to wind turbines. This fact is virtually universal in noise research and has been shown with essentially all noise sources studied (the most studied are traffic, air, train, and neighborhood noise) (Marquis-Favre et al, 2005, Miedema and Vos, 2003, Shepherd et al, 2010). Annoyance from other noise sources is not discounted or discredited because of this fact and neither should annoyance related to noise from wind turbines.

In fact, „personal characteristics“ determine what effects any stimulus will have on an individual and what the effects of that stimulus will be. For example, pain thresholds vary greatly from individual to individual and even within a given individual depending on the insult. „Personal characteristics“ help to determine whether someone who smokes will end up suffering from lung cancer or not. We do not ignore someone“s pain because they experience it at levels that others might not and we do not ignore the fact that smoking is bad for someone“s health even though others who smoke suffer no health effects.

It is abundantly clear, and not surprising, that in the noise literature, how someone reacts to a sound is dependent on a number of personal factors (Leventhall, 2004, Miedema and Vos, 2003). The strongest predictor of annoyance to sound is whether or not a person is „noise sensitive“. This is a term well documented in the sound literature to describe that some people tend to be less tolerant of noise and become annoyed at levels that many do not have a problem with (Job, 1988, Marquis-Favre et al, 2005). This quality has been shown to be a consistent trait which does not change over time and is considered a stable personality trait that an individual has little to no control over (Miedema and Vos, 2003, Shepherd et al, 2010). Noise sensitivity even shows some evidence of heritability (Miedema and Vos, 2003, Shepherd et al, 2010). It has also been shown that noise sensitive individuals have stronger physiological responses to noise exposures, showing higher heart rates and higher rates of sleep disturbance when exposed to noise (Miedema and Vos, 2003). These physiological changes are markers for increased autonomic activity or stress-type reactions which may make these individuals at higher risk for cardiovascular problems related to noise in the long term.

It has also been shown that noise sensitivity can lower annoyance thresholds by up to 10 dBA. (Marquis-Favre et al, 2005, Miedema and Vos, 2003, Shepherd et al, 2010). Further, it is important to note that this is not a rare phenomenon but has been estimated to occur in as many as 50% of individuals in some studies (Pedersen, 2004, Shepherd et al, 2010). The reason I am discussing „noise sensitivity“ is to give an example of the fact that how someone reacts to sound is not something they have much control over, but is an inherent trait, much like people have different thresholds or reactions to painful stimuli.

It is important when considering annoyance to remember that sound levels, in addition to „personal characteristics,“ play an important part of when and if an individual will become annoyed (Miedema and Vos, 2003, Pedersen, 2004, Pedersen, 2007, Pedersen, 2009). The peer reviewed papers on wind turbines and annoyance that I discussed earlier clearly show that annoyance increases with sound levels. Thus annoyance is not simply a complaint made by people who do not like wind turbines. If noise levels were not important, you would not see the correlation of increasing annoyance with increasing noise levels so consistently and at such similar sound levels in all three major studies on wind turbines (see answer 6 in this testimony). The wind industry would like you to believe that annoyance is simply a result of the fact that people do not like wind turbines and has nothing to do with the noise created by wind turbines. As I have discussed above, the evidence does not support this. This wind industry view also fails

to explain why even in areas where people have clearly welcomed wind turbines, problems with annoyance have occurred (Vinalhaven, ME, Johnsburg Survey, 2009).

As for annoyance „not being a pathological condition per se", it is difficult to know what Dr. McCunney precisely means. As I have shown in my earlier answers, annoyance is a health issue in its own right. It is not a diagnosable disease in the world of medicine because it is a symptom and a risk factor for disease and not a diagnosis in and of itself. Dr. McCunney admits in his discovery responses that annoyance is a symptom, which is why it is "not a pathological condition" and "not a recognized diagnosis". Current views on annoyance suggest it is a risk factor for many of the other health effects noise can create over the long-term by disturbing sleep and increasing stress and stress hormone levels (Shepherd et al, 2010, Niemann et al, 2006). Dr. McCunney further admitted in his discovery responses that "annoyance from noise may have an adverse effect on people's health and well being," and that "annoyance from wind turbine noise may cause recognized medical disorders, such as through sleep deprivation," seemingly contradicting the fact that he does not consider annoyance relevant to health.

Contrary to Dr. McCunney's statements in his testimony, annoyance from noise is clearly a public health issue and ultimately in his discovery testimony he admits as much. Some researchers are now suggesting that noise annoyance might be more closely related to noise related health effects than objective measures (such as sound levels). Annoyance captures the interaction of the sound level with the effects on an individual and is likely a mediator in many of the health effects we see from noise exposure via increased autonomic stimulation and stress reactions (Dratva et al, 2010, Shepherd et al, 2010, Hume, 2010).

If the Public Service Board and Green Mountain Power wish to protect the public health they will need to protect the public from sound levels which may create annoyance. The standard previously used by the Board will not accomplish this, and it is my opinion that a 35dBA standard is necessary to protect public health.

Q-10. Dr. McCunney states that "Exceedances of the WHO guideline values do not necessarily imply significant noise impact and indeed, it may be that significant impacts do not occur until much higher degrees of noise exposure are reached." Do you agree with this statement?

A-10. No. Again Dr. McCunney makes a statement that is technically true but only tells part of the story and thus is ultimately misleading. It is true that not everyone will be adversely impacted at sound levels even above the WHO 2009 guidelines. This will depend on both the features of the individual and the qualities and levels of the sound. It is also quite likely that some individuals will be harmed at or above these levels. In fact it is possible that people will suffer impacts at levels below the WHO guidelines in certain situations, such as has been shown with noise from wind turbines (see my answer to Q-6 above). The WHO 2009 guidelines state that "adverse health effects are observed at the level of 40dBLnight outside, such as self-reported sleep disturbance, environmental insomnia, and increased use of somnifacient drugs and

sedatives". So while some individuals may not be harmed at higher sound levels, others almost certainly will and it is also quite possible to see problems at lower sound levels. Wind turbines have been shown to cause sleep problems and annoyance at levels well below 40 dB(A) and thus wind turbines appear to be more likely to cause problems at lower sound levels than they are to be „safe" at higher levels as Dr. McCunney suggests.

Q-11. In Answer 8 of Dr. McCunney"s testimony he refers to the Hayes McKenzie partnership report using it to show that only 5 of 126 UK wind turbine facilities reported low frequency noise problems and that the most common cause of complaint was audible modulation. Are you familiar with this report and does it adequately describe the nature, scope, and extent of noise issues related to turbines?

A-11. I am familiar with the report and I was surprised to see Dr McCunney refer to it as it is a government report that was not peer reviewed and has been widely criticized in how it was conducted and for the conclusions it reached. A Freedom of Information Act request unearthed that the results of this study were altered for political reasons and that how the list of turbine sites with noise complaints was tallied was flawed and it is clear that their methods likely underestimated the number of problems. Despite this, in their original draft the authors still concluded that current sound standards were not adequate to protect public health and recommended more stringent sound limits. This recommendation was struck from the final report for political reasons. This report has serious methodological flaws and ethical issues and cannot be taken at face value. I would not rely on it to draw any specific conclusions. For a summary of the problems related to this study I refer you to Hanning, 2010 and Renewable Energy Foundation, 2009 (Freedom of Information Act findings).

Q-12. Dr. McCunney refers to a Texas study from 2010 (page 8 of his testimony) that shows "infrasound is inaudible to even the most sensitive people 305 meters away" and "low frequency sound above 40Hz may be audible depending on backround sound levels". Is this finding important?

A-12. Yes. Wind turbines have been shown to emit audible low frequency sounds. Audible low frequency sound can create annoyance more readily in some people. An excellent review of low frequency sound makes the point that it "has been recognized as a special problem, particularly to sensitive people in their homes" (Leventhall, 2004). The WHO 2009 report also makes a point of emphasizing how low frequency sound deserves special attention and can create problems for people at noise levels that otherwise might not be problematic. The WHO report states that:

-"For noise with a large proportion of low frequency sounds a still lower guideline (than 30dBA) is recommended".

-"It should be noted that a large proportion of low frequency components in a noise may increase considerably the adverse effects on health".

-“The evidence on low frequency noise is sufficiently strong to warrant immediate concern”.

Further, noise sensitive individuals exposed to low frequency noise are more impacted by low frequency noise than broadband noise (Shepherd et al, 2010). It has also been shown that annoyance from low frequency sound tends to be greater than that from higher frequency noise at the same A-weighted level (Leventhall, 2004 referring to Persson study).

Leventhall (2004) also makes the point that “conventional methods of assessing annoyance, typically based on A-weighted equivalent level, are inadequate for low frequency noise and lead to incorrect decisions by regulatory authorities”.

As I stated in my earlier testimony the amplitude modulation of wind turbines makes them more likely to create problems with annoyance. This also holds true for low frequency sounds where fluctuations and temporal variations of low frequency noise are correlated with annoyance. Fluctuating noises tend to be more annoying than predicted by their average sound levels. Levels close to threshold can cause annoyance if there is also fluctuation (Leventhall, 2004).

Reading Leventhall‟s (2004) review, it is striking how many of the features that he ascribes to low frequency sound annoyance are seen with the complaints associated with wind turbine noise. Since low frequency sounds from wind turbines can be audible at times and many of the symptoms people complain of are similar to complaints from people suffering from low frequency sound annoyance this is an area worthy of further investigation.

It is also worthwhile to look at some of the factors that make low frequency sounds more likely to cause annoyance, as the current project potentially shares some of these characteristics. For example some of the factors that were correlated with complaints from low frequency sound include:
-problems arose in quiet rural environments
-the noise was often close to inaudible and heard by a minority of people
-the noise was more audible at night
-the noise had a throb or rumble characteristic
-the noise was typically heard indoors and not outdoors
(Leventhall, 2004)

With regards to infrasound, Dr. McCunney has admitted in discovery that “infrasound may become audible through vibration induced by airborne energy and potentially augmented by resonance in homes or other structures”. Infrasound also has the potential to act on the human body even at subaudible levels. A study on guinea pigs has exemplified this fact (Salt, 2010) as has the fact that infrasound has been approved for therapeutic massage by the FDA (McCunney, January 2010). Dr. McCunney has used this to show that infrasound is safe but it is interesting to note that 1) it did require FDA approval and 2) suggests that the sound, while inaudible, is presumably having some effect on the person being treated. Ultimately, what affect if any

infrasound is having in relation to the problems people are having with sound from wind turbines is unclear, but it is an area worthy of further investigation.

Q-13. Dr McCunney, in referring to a paper (Salt et al, 2010) on infrasound and guinea pigs, stated that "the outer hair cells are not connected to the brain" and suggests that because of anatomical differences in the ear, specifically the helicotroma, that the studies on guinea pigs did not pertain to humans. Is this true and what is the significance of this fact?

A-13. In personal correspondence with Dr. Salt, the author of the study Dr. McCunney refers to, I am informed that Dr. McCunney"s statement is incorrect and that the outer hair cells do connect to the brain via type II afferent fibers. Infrasound therefore has the potential to influence the body even at levels of sound that are below the audible range. Further, I have been informed that the guinea pig helicotrema has the same attenuation characteristics as in humans. (Bensen et al, 2004, Pamulova et al, 2006, Dancer, 1982, and Salt et al, 2009). I think it is worthwhile to point out that Dr. McCunney spends a great deal of time trying to deemphasize the potential implications of Dr. Salt"s study without having his facts correct.

In discussing infrasound, it is important to keep in mind that people are suffering adverse effects from noise sources and in this respect wind turbines are not exempt. In fact, evidence shows wind turbines being more problematic than most other noise sources. These debates about how and why people are being affected do not change that fact and in some ways can be a distraction from the important point that audible wind turbine noise can clearly cause problems for some people. Whether infrasound and low frequency sound are contributing to this problem remains unclear but does not alter the clear findings that problems are occurring from audible noise, and that wind turbines do have the potential to affect public health.

Q-14. Dr McCunney states (Q-9) that "Sound can adversely affect sleep, but such effects are highly individualized. Research has also shown that people can become habituated to sounds so that they are no longer affected by the sounds." Do you agree with this comment?

A-14. Again Dr McCunney likes to point out that „effects are highly individualized" as if this somehow makes the impact less true or problematic for the individual suffering from the problem. As I mentioned, many „effects" on people from all sorts of insults from pain, to smoking to cancer can be highly individualized. This fact does nothing to lessen their seriousness or the serious effects noise creates on sleep. These adverse effects on individuals cannot be discounted as they are members of the public and must be accounted for when looking out for the public good and public health.

There are some studies showing that people can become habituated to sounds with regards to some parameters of sleep but results have been inconsistent and there are studies that show no evidence of habituation (Babisch and van Kamp, 2009, Ising, 2004, Shepherd et al, 2010).

Marquis-Favre makes a point that with regards to annoyance, large amplitude fluctuations are annoying and "in fact there cannot be what is called „habituation" to this type of noise" (Marquis-Favre et al, 2005). It is also very clear that a number of effects of sound on sleep do not habituate, most significantly the autonomic changes that occur with increased heart rates and vasoconstriction (Griefahn et al. 2008). Maschke, in a 2002 study, showed permanently increased cortisol levels from nighttime noise, again arguing against habituation (Ising, 2004). These changes occur at sound levels lower than those that usually create conscious awakenings. They are important because these autonomic changes may be linked in the long term to adverse cardiovascular events such as cardiac disease and hypertension.

The potential for habituation to wind turbine noise needs to be viewed cautiously for other reasons as well. In the real world studies on wind turbines done in Sweden and the Netherlands, all the areas studied had turbines for at least a year. If habituation had occurred it was either incomplete (meaning more people were suffering initially than the results suggest because the results continue to show sleep disturbance after a year) or there was no habituation. So while theoretically habituation may occur on some sleep parameters, there is clear evidence that heart rate and vasoconstriction responses DO NOT habituate and that in the real world there is no evidence supporting habituation to noise from wind turbines.

Q-15. Do you agree with Dr. McCunney's conclusions regarding annoyance in Answer 10 of his testimony?

A-15. I believe his answer is incomplete and underestimates the impact that annoyance has on the individual both in the short term and long term. Please see my response to question 7 in my current testimony for more on that topic.

Dr. McCunney also states "some people ***may*** be annoyed at the presence of sound from wind turbines...." The truth is many people ***are*** annoyed by wind turbine noise and this has been shown consistently in the studies published to date (Pedersen 2004, 2007, 2009). There are also numerous case reports and literature reports showing that the extent of this annoyance is having a large impact on people's immediate quality of life (Nissenbaum, 2010, Phipps, 2007, Gillis, 2009, Johnsburg Survey, Pierpoint, 2010, Harry, 2007, Hanning, 2010). There is documentation of people leaving their homes or having wind companies buy their homes because their distress is so high (Cummings, 2010, Pierpoint, 2010). So at least for a subset of people, this annoyance is not temporary or minor but as is shown by their actions is having a profound and serious effect on their lives.

Dr. McCunney states that environmental noise levels "especially beyond 45dB(A)," show increasing levels of annoyance. While this fact is true it again underestimates the problems with regards to wind turbines. Wind turbine studies have shown problems arising at ~35 dB(A) so I am not sure how Dr McCunney would mitigate the adverse effects experienced by individuals at 35 dBA when he recommends a 45 dB(A) standard. 45dBA would be perceived as doubling of

sound level by those already suffering annoyance at 35 dB(A). This also does not take into account that by using an average time limit, such as the 1-hour average used by the Public Service Board in prior dockets or the 8-hour average requested by GMP, that sound levels could be even higher than 45 dB(A) for considerable periods of time.

Q-16. Dr. McCunney refers to several „studies" in Ontario, Maine, and Wisconsin with regards to noise standards. Are you aware of these standards? Are they representative of accepted noise levels for wind turbines?

A-16. No, I am not familiar with the „studies" done in Ontario, Maine or Wisconsin that he is referring to. I am however, familiar with reports from surveys and unpublished research of problems in each of those areas (Nissenbaum, 2010, Gillis, 2009, Cummings, 2010). Modern wind turbines are relatively new structures with unique patterns of noise. Research on noise (not just from wind turbines) has convincingly shown that noise can create health problems. (WHO 2009). However, finding exactly what levels of noise are safe has proved challenging and has varied depending on the source of noise and the study. Wind turbines are actually somewhat unique compared to other noise sources in that the levels at which annoyance begins to occur have been consistently ~35dBA. Despite this observation there has been no consensus on acceptable sound guidelines with regards to wind turbines (see Walsh, 2010 which provides a summary of standards that exist worldwide, and indicates that there is no consensus on appropriate setbacks to protect public health).

The reasons for this are many. Unfortunately, the standards and guidelines implemented are often not protective of health for all the reasons I have been discussing. The wind industry has misrepresented the extent and nature of wind turbine noise, whether unintentionally or not, so that people have been taken off guard when the turbines are not „as quiet as a refrigerator". Given the clear health related problems and decreased quality of life noise can create, it stands that if the Public Service Board wishes to protect the public health they will need to follow the precautionary principle and use the best available data with regards to wind turbines and revise the prior standard previously used to a lower level. (See Pederesen, 2004, 2007, 2009).

Q-17. Dr. McCunney states that he is "a co-author of a recent comprehensive review of the peer reviewed scientific literature respecting wind turbines and human health." In discovery, Dr. McCunney stated that this review was funded by the AWEA and CanWEA. Do you have any comments regarding Dr. McCunney's review of the literature in this field?

A-17. The AWEA Paper is a non-peer reviewed (even though Dr. McCunney in his discovery responses erroneously states that it is), non-published (in scientific literature at least) industry sponsored paper. It has as much credibility as one might expect of a non-peer reviewed, unpublished industry sponsored report. It has been criticized by numerous sources (Society for Wind Vigilance, 2010, Hanning, 2010, Philips, 2010, Cummings, 2010, UK National Health

Service, 2010) and shows industry favorable bias. It should be noted that the mission of the "AWEA is to promote the growth of wind power through advocacy, communication and education." (Colby et al, 2009). The AWEA's mission is to promote the wind industry, not public health.

The AWEA paper focuses on very narrow aspects of wind turbine noise and health, making a somewhat false and vague distinction between „direct" and „indirect" health effects. They go to great lengths to show that the noise is not creating direct physical harm (for example as radiation might) but essentially ignore and downplay the „direct" effects of sleep disturbance and annoyance and the secondary health effects they may create when chronic such as cardiovascular disease, depression, and immune suppression. Dr. McCunney's participation and conclusions in this report suggest an industry bias that is not supported by the best evidence available on wind turbine noise and health.

Q-18 Does this conclude your testimony?

A-18 Yes, and I have provided a list of my references below for the Board's review.

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