

**STATE OF VERMONT
PUBLIC SERVICE BOARD**

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| Joint Petition of Green Mountain Power Corporation, |) | |
| Vermont Electric Cooperative, Inc., Vermont Electric |) | January 10, 2011 |
| Power Company, Inc., and Vermont Transco LLC, |) | |
| for a Certificate of Public Good, pursuant to 30 V.S.A. |) | Docket No. 7628 |
| 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. |) | |

**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**

1 Q-1. Have you previously provided testimony in this matter?
2

3 A-1. Yes.
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5

6 Q-2. What is the purpose of this testimony?
7

8 A-2. I respond to the rebuttal testimony submitted by Dr. McCunney on behalf of GMP.
9
10

11 Q-3. Have you reviewed the rebuttal testimony of Robert McCunney M.D. on behalf of Green
12 Mountain Power Corporation filed November 22, 2010?
13

14 A-3. Yes, and his discovery answers as well.
15
16

17 Q-4. Do you support the conclusions of his testimony?
18

19 A-4. No.
20
21

22 Q-5. Do you agree with Dr. McCunney's statement (A-5 and A-7) that "The risk of any direct
23 adverse health effects at levels below 45dB(A) is virtually nonexistent"?
24

25 A-5. No. It is quite clear that annoyance and sleep disturbance can occur at levels below this,
26 and Dr. McCunney himself admits to this in his discovery responses, wherein he admitted "that
27 indirect health effects from wind turbine noise (such as sleep disturbance, annoyance, stress) can
28 occur below 45dBA." Dr. McCunney thus chooses to ignore the fact that annoyance and sleep
29 disturbance are direct adverse health effects in and of themselves (WHO 2009, also see my
30 answer to Q-7 below), as well as risk factors for other diseases such as depression, hypertension,
31 cardiovascular disease, arthritis, respiratory problems, and decreased quality of life (Niemann et
32 al., 2006, also see my answer to Q-7 below). I have not seen a clear explanation from him as to
33 why he discounts the effects of annoyance and sleep disturbance.
34

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

1 Lamax inside, use of somnifacient drugs and sedatives at 40dB Lnight outside, self-reported
2 sleep disturbance and environmental insomnia at 42dB Lnight outside, and complaints at 35 dB
3 Lnight outside. The WHO 2009 report goes on to state, “adverse health effects are observed at
4 the level above 40 dB Lnight outside.”
5

6 The other reference (Miedema, 2003) is focused on the issue of noise and sleep disturbance,
7 which Dr. McCunney is choosing to ignore. In addition, Miedema states in his conclusion that
8 “currently there is not a sufficient basis for establishing exposure-response relationships for these
9 types of effects”. Nowhere does the paper give a recommendation as to what sound levels would
10 be protective of health or prevent adverse health effects. Therefore, neither of the sources he
11 cites support his assertion that adverse health effects at levels below 45dB(A) are virtually
12 nonexistent.
13
14

15 Q-6. Do you agree with Dr. McCunney (A-5) that “The Board’s approved sound standard of 45
16 dBA (exterior)(Leq)(1hr) is sufficient to protect human health and avoid sleep disturbance”? If
17 not, why is it not protective?
18

19 A-6. No I do not agree. First, I would like to point out that it is accepted in the medical field
20 that community noise, whether from wind turbines or other sources (traffic, aircraft, trains,
21 neighborhood noise), can have negative and serious impacts on people’s health. Given that fact,
22 the question is no longer “can noise from wind turbines create health problems?” Clearly they
23 can, the question is how to protect the public.
24

25 The problem with the limit of 45 dBA(exterior)(Leq)(1hr) is that it is simply too high to protect
26 people from the adverse effects of noise from wind turbines. Averaging the levels over time
27 further compounds this fact by allowing even higher sound levels to occur for periods of time.
28 Please see my prior Rebuttal testimony to the Vermont Department of Health for more on this
29 issue.
30

31 It is hard to reconcile setting a sound level of 45 dba for wind turbines when there is clear and
32 consistent evidence in the peer reviewed literature (as discussed below) that people start to suffer
33 adverse health effects, especially annoyance, at levels below this. There have been three major
34 studies looking at more than 1,500 people examining this issue (which I have summarized
35 below). These studies do not answer all the concerns regarding wind turbines and health;
36 however they provide clear and consistent evidence that the sound standard proposed by GMP
37 and standards previously used by the Public Service Board are too loud to be protective of public
38 health from wind turbine noise. The findings of these studies are important because they are
39 well designed studies and they provide the best available evidence from which to base decisions
40 regarding noise standards that would be protective of public health. Their results have also been
41 remarkably consistent, making it possible to anticipate at what sound levels noise begins to be a
42 problem.
43

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

8
9 Pedersen and Waye-2004.

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

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

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

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

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

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

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

21
22 Other points to consider in this study:

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

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

27 -85% of people could hear the wind turbines even at levels as low as 35-37.5dB.

28
29 As you can see, based on this study the noise standards proposed by GMP and previously used
30 by the Public Service Board could result in as much as 50% of the people living in the vicinity
31 suffering from annoyance as well as significant levels of sleep disturbance and its adverse health
32 effects.

33
34 Pedersen and Waye-2007.

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

1 The following levels of annoyance were noted with regard to sound levels (dBA outside):

2 -At <37.5dBA-3-4% were annoyed

3 -At 37.5-40dBA-6% were annoyed

4 -At >40dBA-15% were annoyed

5

6 Other points to consider in this study:

7 -Noise annoyance was associated with reduced sleep quality and negative emotions. 36% of
8 those who were annoyed by wind turbine noise reported their sleep was disturbed by noise.

9 -The authors state “annoyance is an adverse health effect”. (See my answer to Q-5 in this
10 testimony)

11

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

15

16 Pedersen et al-2009.

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

22

23 The following levels of annoyance were noted with regard to sound levels (dBA):

24 -At 30-35 dBA-7% were rather or very annoyed with an additional 10% slightly annoyed.

25 -At 35-40 dBA-18% were rather or very annoyed with an additional 20% slightly annoyed.

26 -At 40-45 dBA-18% were rather or very annoyed with an additional 23% slightly annoyed.

27

28 Other points to consider in this study:

29 -Of those who expressed annoyance to wind turbine noise 92% were annoyed by sound at least
30 once a week.

31

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

38

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

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

3
4
5 Q-7. Dr. McCunney seems to ignore the negative health impacts of annoyance and sleep
6 disturbance which are clearly documented to occur at sound levels lower than the level of 45
7 db(A), a level for which he states health effects would be “virtually non-existent”. Is this
8 approach generally accepted by the research community and by the literature on noise and
9 health?

10
11 A-7. No. Even Dr. McCunney in his discovery testimony admits “that indirect health effects
12 from wind turbine noise (such as sleep disturbance, annoyance, stress) can occur below 45dBA”.
13 For reasons that remain unclear he has decided not to consider these adverse health effects. His
14 approach goes against the view of numerous regulatory agencies, acoustic experts and experts in
15 the medical field who consider annoyance and sleep disturbance as problems in and of
16 themselves as well as being mediators leading to other health problems such as cardiovascular
17 disease, depression, decreased health related quality of life. I am including an extensive but not
18 exhaustive sample of expert viewpoints on these issues. Please note that full references for these
19 are provided below following my testimony.

20
21 Health and regulatory agencies pronouncing annoyance and or sleep disturbance as a health
22 issue:

23
24 -WHO, 1999, 2009. Acknowledges that annoyance and sleep disturbance are adverse health
25 effects.

26 -Environmental Protection Agency. “Though for some, the persistent and escalating sources of
27 sound can often be considered an annoyance. This ‘annoyance’ can have major consequences,
28 primarily to one’s overall health”.

29 -Gohlke et al. 2008. (Work for NIH) “Even seemingly clean sources of energy can have
30 implications on human health. Wind energy will undoubtedly create noise, which increases
31 stress, which in turn increases the risk of cardiovascular disease and cancer”.

32 -Vermont Department of Health. “However, there is sufficient evidence of secondary health
33 effects from sleep disturbance due to excessive sound at night (from wind turbines). The
34 potential adverse health effects that can result for sleep disturbance include increased heart rate,
35 sleep state changes and awakening, insomnia, fatigue, accidents, reduced performance,
36 cardiovascular illness and depression and other mental illness”.

37 -UK National Health Service. “The acknowledgement that some people exposed to wind turbine
38 noise suffer annoyance suggests that monitoring and maximum permitted levels need to be
39 considered carefully in areas where turbines are planned.” (Horner et al., 2010).

40 -Health Canada. Acknowledges “That there are peer-reviewed scientific articles indicating that
41 wind turbines may have an adverse impact on human health” and acknowledges the health
42 consequences of stress and considers it (stress) a risk factor for heart disease, worsening diabetes,
43 bowel diseases, herpes and affects on the immune system.

1 -Ontario Ministry of Health and Long Term Care. Acknowledge wind turbines may cause
2 annoyance, stress and sleep disturbance. (King, 2009).

3 -Environmental Expert Council of Germany - Severe annoyance persistent over prolonged
4 periods of time is to be regarded as causing distress. (Ising, 2004).

5
6 AWEA 2009 paper (Colby *et al.*, 2009) and coauthor comments¹:

7
8 -Colby *et al.*, 2009 (AWEA Paper). “[A]ny sound that is chronically annoying, including very
9 soft sounds, may, for some people, create chronic stress, which can in turn lead to other health
10 problems”.

11 -Colby, David. “We’re not denying that there are people annoyed and that maybe some of them
12 are getting stressed out enough about being annoyed that they’re getting sick”. (Society for Wind
13 Vigilance, 2010 - from radio interview).

14 -Leventhall, Geoff. “Annoyance brings feelings of disturbance, aggravation, dissatisfaction,
15 concern, bother, displeasure, harassment, irritation, nuisance, vexation, exasperation, discomfort,
16 uneasiness, distress, hate etc...” “The claim that their ‘lives have been ruined’ by the (low
17 frequency) noise is not an exaggeration...”(Leventhall, 2004).

18 “[T]here was no doubt people living near the turbines suffered a range of symptoms, including
19 abnormal heart beats, sleep disturbance, headaches, tinnitus, nausea, visual blurring, panic
20 attacks and general irritability....it’s ruining their lives-and its genuine....” (Countryside News,
21 2010)

22
23 Views of experts in the field of noise and annoyance:

24
25 -Dratva *et al.* 2010. Recent evidence of an inverse relationship between noise annoyance and
26 health-related quality of life (showing that annoyance is negatively impacting people’s health).
27 They further state that “Noise annoyance expresses the degree of dissatisfaction and disturbance
28 with regard to noise exposure and can be seen as a pathway to the development of health effects
29 as well as a health effect by its own”.

30 -Hoeger *et al.*, 2002. “The annoyance-reaction is one of the central variables in noise research”.

31 -Hume, 2010. “In present times, noise disturbed sleep is a cause of considerable annoyance with
32 potential health and well being effects.” “There have been suggestions in the literature that
33 annoyance is the mediating factor between noise exposure and CVD (cardiovascular disease)...”

34 -Niemann *et al.*, 2006. “The results of the LARES study - with regard to criteria for causal
35 relations - confirmed, on an epidemiological level, an increased health risk from chronic noise
36 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.

1 risk for cardiovascular symptoms, but also with risks for respiratory symptoms like bronchitis as
2 well as arthritis and migraine.”
3 -Phillips, 2010. “Most all accepted definitions of individual or public health include
4 psychological health as part of the consideration, and usually refer to an overall state of well
5 being rather than just an absence of particular diagnosed pathology”. “‘(A)nnoyance’ in this
6 case includes serious physical and psychological symptoms”.
7 -Schreckenberget al, 2010. “Health related quality of life was associated with aircraft noise
8 annoyance...” Annoyance had negative impact on health related quality of life.
9 -Shepherd et al, 2010. “Noise, defined at the psychological level of description as an unwanted
10 sound, is increasingly being targeted as an environmental factor negatively impacting health. In
11 some contexts noise can elicit annoyance or disrupt sleep in a manner detrimental to health”.
12 “There is general agreement in the literature that annoyance and sleep disruptions are likely
13 mediators of noise-induced health deficits”. Their study on airport noise further showed
14 decreased health related quality of life with increasing levels of annoyance.
15

16 It is important to understand that annoyance and sleep disturbance adversely impact health and
17 quality of life in and of themselves. The viewpoints above show that this view is not fringe or
18 out of the mainstream, but rather is widely accepted by many noise and health professionals. It
19 is unsettling that the wind industry sponsored paper Dr. McCunney coauthored (Colby et al,
20 2009) states “It is important to note that although annoyance may be a frustrating experience for
21 people, it is not considered an adverse health effect or disease of any kind.” They provide no
22 references to support or justify this statement. Current views on noise and health suggest that
23 annoyance and sleep disturbance, and the hormonal reactions that accompany them (increased
24 autonomic activity, increased cortisol levels), contribute to other health effects such as
25 hypertension, cardiovascular disease, depression, migraines, decreased quality of life, arthritis
26 and respiratory problems. (Shepherd et al, 2010, Niemann et al, 2006). The Board must
27 therefore not accept Dr. McCunney’s unsupported and erroneous assertions regarding the
28 potential health impacts associated with wind turbine noise.
29
30

31 Q-8. Dr McCunney states (A-5) that “Noise levels associated with sleep disturbances tend to be
32 higher than 45 dB(A)”. Is this an accurate statement?
33

34 A-8. No. While it is obviously true that the louder the noise the more likely it is to create sleep
35 disturbances, it is clear that noise levels below 45dBA can disrupt sleep. The WHO 2009 report
36 clearly states that disruptions in sleep with increased sleep motility begin at levels as low as 32
37 dBA, and at 35 dBA you begin to see evidence of electroencephalogram (EEG) awakenings. A
38 study by Maschke done in 1995 showed increasing stress hormone levels of cortisol and
39 adrenaline from nighttime air traffic with maximum sound levels of 55 dBA and mean testing
40 levels of 30dBA (Ising, 2004). A study by Basner showed that awakenings occurred at levels as
41 low as 33dBA and increased heart rates and vasoconstriction occurred at levels well below
42 45dBA (Griefahn et al. 2008).
43

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

8
9 Current models about how sound affects sleep and contributes to other adverse health problems
10 suggest that even these seemingly minor changes in sleep may be one of the pathways that noise
11 contributes to other problems such as hypertension and cardiovascular problems. (WHO 2009).
12 These disturbances are associated with elevations in blood pressure and heart rate when they
13 occur and over long periods of time may contribute to cardiovascular disease. Ising (2004)
14 further states "that for reasons of medical prevention it is necessary principally to avoid noise-
15 induced impairments [of sleep] even when below the arousal threshold".

16
17
18 Q-9. Dr. McCunney makes a point of emphasizing that personal characteristics as opposed to
19 sound level are 'primarily' associated with annoyance, and states that "annoyance, however, is
20 not a pathological condition, per se...." Do you agree with these statements?

21
22 A-9. Not entirely. Dr McCunney seems to choose his words very carefully with a very narrow
23 meaning so that his statements have some truth but fail to accurately depict the situation.

24
25 Let me explain further. Dr. McCunney makes a point of saying that "some people may be
26 annoyed at the presence of sound from wind turbines, or its fluctuating nature, depending
27 primarily on personal characteristics," as opposed to the intensity of the sound. This statement is
28 true in some situations, but it is important to understand that annoyance is also very much
29 dependent on noise levels even when personal characteristics are having an effect (see answer to
30 Q-6 of this testimony). While personal characteristics determine which noises and at what levels
31 a particular sound may become annoying to an individual, it is also true that almost any sound
32 will be annoying if loud enough. Therefore, just because the noise level at which people
33 experience annoyance is highly variable does not in any way make their annoyance and
34 associated symptoms any less real or worthy of consideration.

35
36 The fact that personal characteristics have a large impact on which sound and at what sound level
37 annoyance becomes a factor is not unique to wind turbines. This fact is virtually universal in
38 noise research and has been shown with essentially all noise sources studied (the most studied
39 are traffic, air, train, and neighborhood noise) (Marquis-Favre et al, 2005, Miedema and Vos,
40 2003, Shepherd et al, 2010). Annoyance from other noise sources is not discounted or
41 discredited because of this fact and neither should annoyance related to noise from wind
42 turbines.

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

8
9 It is abundantly clear, and not surprising, that in the noise literature, how someone reacts to a
10 sound is dependent on a number of personal factors (Leventhall, 2004, Miedema and Vos, 2003).
11 The strongest predictor of annoyance to sound is whether or not a person is ‘noise sensitive’.
12 This is a term well documented in the sound literature to describe that some people tend to be
13 less tolerant of noise and become annoyed at levels that many do not have a problem with (Job,
14 1988, Marquis-Favre et al, 2005). This quality has been shown to be a consistent trait which
15 does not change over time and is considered a stable personality trait that an individual has little
16 to no control over (Miedema and Vos, 2003, Shepherd et al, 2010). Noise sensitivity even shows
17 some evidence of heritability (Miedema and Vos, 2003, Shepherd et al, 2010). It has also been
18 shown that noise sensitive individuals have stronger physiological responses to noise exposures,
19 showing higher heart rates and higher rates of sleep disturbance when exposed to noise
20 (Miedema and Vos, 2003). These physiological changes are markers for increased autonomic
21 activity or stress-type reactions which may make these individuals at higher risk for
22 cardiovascular problems related to noise in the long term.

23
24 It has also been shown that noise sensitivity can lower annoyance thresholds by up to 10 dBA.
25 (Marquis-Favre et al, 2005, Miedema and Vos, 2003, Shepherd et al, 2010). Further, it is
26 important to note that this is not a rare phenomenon but has been estimated to occur in as many
27 as 50% of individuals in some studies (Pedersen, 2004, Shepherd et al, 2010). The reason I am
28 discussing ‘noise sensitivity’ is to give an example of the fact that how someone reacts to sound
29 is not something they have much control over, but is an inherent trait, much like people have
30 different thresholds or reactions to painful stimuli.

31
32 It is important when considering annoyance to remember that sound levels, in addition to
33 ‘personal characteristics,’ play an important part of when and if an individual will become
34 annoyed (Miedema and Vos, 2003, Pedersen, 2004, Pedersen, 2007, Pedersen, 2009). The peer
35 reviewed papers on wind turbines and annoyance that I discussed earlier clearly show that
36 annoyance increases with sound levels. Thus annoyance is not simply a complaint made by
37 people who do not like wind turbines. If noise levels were not important, you would not see the
38 correlation of increasing annoyance with increasing noise levels so consistently and at such
39 similar sound levels in all three major studies on wind turbines (see answer 6 in this testimony).
40 The wind industry would like you to believe that annoyance is simply a result of the fact that
41 people do not like wind turbines and has nothing to do with the noise created by wind turbines.
42 As I have discussed above, the evidence does not support this. This wind industry view also fails

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

3
4 As for annoyance ‘not being a pathological condition per se’, it is difficult to know what Dr.
5 McCunney precisely means. As I have shown in my earlier answers, annoyance is a health issue
6 in its own right. It is not a diagnosable disease in the world of medicine because it is a symptom
7 and a risk factor for disease and not a diagnosis in and of itself. Dr. McCunney admits in his
8 discovery responses that annoyance is a symptom, which is why it is “not a pathological
9 condition” and “not a recognized diagnosis”. Current views on annoyance suggest it is a risk
10 factor for many of the other health effects noise can create over the long-term by disturbing sleep
11 and increasing stress and stress hormone levels (Shepherd et al, 2010, Niemann et al, 2006). Dr.
12 McCunney further admitted in his discovery responses that “annoyance from noise may have an
13 adverse effect on people’s health and well being,” and that “annoyance from wind turbine noise
14 may cause recognized medical disorders, such as through sleep deprivation,” seemingly
15 contradicting the fact that he does not consider annoyance relevant to health.

16
17 Contrary to Dr. McCunney’s statements in his testimony, annoyance from noise is clearly a
18 public health issue and ultimately in his discovery testimony he admits as much. Some
19 researchers are now suggesting that noise annoyance might be more closely related to noise
20 related health effects than objective measures (such as sound levels). Annoyance captures the
21 interaction of the sound level with the effects on an individual and is likely a mediator in many
22 of the health effects we see from noise exposure via increased autonomic stimulation and stress
23 reactions (Dratva et al, 2010, Shepherd et al, 2010, Hume, 2010).

24
25 If the Public Service Board and Green Mountain Power wish to protect the public health they
26 will need to protect the public from sound levels which may create annoyance. The standard
27 previously used by the Board will not accomplish this, and it is my opinion that a 35dBA
28 standard is necessary to protect public health.

29
30
31 Q-10. Dr. McCunney states that “Exceedances of the WHO guideline values do not necessarily
32 imply significant noise impact and indeed, it may be that significant impacts do not occur until
33 much higher degrees of noise exposure are reached.” Do you agree with this statement?

34
35 A-10. No. Again Dr. McCunney makes a statement that is technically true but only tells part of
36 the story and thus is ultimately misleading. It is true that not everyone will be adversely
37 impacted at sound levels even above the WHO 2009 guidelines. This will depend on both the
38 features of the individual and the qualities and levels of the sound. It is also quite likely that
39 some individuals will be harmed at or above these levels. In fact it is possible that people will
40 suffer impacts at levels below the WHO guidelines in certain situations, such as has been shown
41 with noise from wind turbines (see my answer to Q-6 above). The WHO 2009 guidelines state
42 that “adverse health effects are observed at the level of 40dBLnight outside, such as self-reported
43 sleep disturbance, environmental insomnia, and increased use of somnifacient drugs and

1 sedatives”. So while some individuals may not be harmed at higher sound levels, others almost
2 certainly will and it is also quite possible to see problems at lower sound levels. Wind turbines
3 have been shown to cause sleep problems and annoyance at levels well below 40 dB(A) and thus
4 wind turbines appear to be more likely to cause problems at lower sound levels than they are to
5 be ‘safe’ at higher levels as Dr. McCunney suggests.
6
7

8 Q-11. In Answer 8 of Dr. McCunney’s testimony he refers to the Hayes McKenzie partnership
9 report using it to show that only 5 of 126 UK wind turbine facilities reported low frequency
10 noise problems and that the most common cause of complaint was audible modulation. Are you
11 familiar with this report and does it adequately describe the nature, scope, and extent of noise
12 issues related to turbines?
13

14 A-11. I am familiar with the report and I was surprised to see Dr McCunney refer to it as it is a
15 government report that was not peer reviewed and has been widely criticized in how it was
16 conducted and for the conclusions it reached. A Freedom of Information Act request unearthed
17 that the results of this study were altered for political reasons and that how the list of turbine sites
18 with noise complaints was tallied was flawed and it is clear that their methods likely
19 underestimated the number of problems. Despite this, in their original draft the authors still
20 concluded that current sound standards were not adequate to protect public health and
21 recommended more stringent sound limits. This recommendation was struck from the final
22 report for political reasons. This report has serious methodological flaws and ethical issues and
23 cannot be taken at face value. I would not rely on it to draw any specific conclusions. For a
24 summary of the problems related to this study I refer you to Hanning, 2010 and Renewable
25 Energy Foundation, 2009 (Freedom of Information Act findings).
26
27

28 Q-12. Dr. McCunney refers to a Texas study from 2010 (page 8 of his testimony) that shows
29 “infrasound is inaudible to even the most sensitive people 305 meters away” and “low frequency
30 sound above 40Hz may be audible depending on background sound levels”. Is this finding
31 important?
32

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

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

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

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

2
3 Further, noise sensitive individuals exposed to low frequency noise are more impacted by low
4 frequency noise than broadband noise (Shepherd et al, 2010). It has also been shown that
5 annoyance from low frequency sound tends to be greater than that from higher frequency noise
6 at the same A-weighted level (Leventhall, 2004 referring to Persson study).

7
8 Leventhall (2004) also makes the point that “conventional methods of assessing annoyance,
9 typically based on A-weighted equivalent level, are inadequate for low frequency noise and lead
10 to incorrect decisions by regulatory authorities”.

11
12 As I stated in my earlier testimony the amplitude modulation of wind turbines makes them more
13 likely to create problems with annoyance. This also holds true for low frequency sounds where
14 fluctuations and temporal variations of low frequency noise are correlated with annoyance.
15 Fluctuating noises tend to be more annoying than predicted by their average sound levels.
16 Levels close to threshold can cause annoyance if there is also fluctuation (Leventhall, 2004).

17
18 Reading Leventhall’s (2004) review, it is striking how many of the features that he ascribes to
19 low frequency sound annoyance are seen with the complaints associated with wind turbine noise.
20 Since low frequency sounds from wind turbines can be audible at times and many of the
21 symptoms people complain of are similar to complaints from people suffering from low
22 frequency sound annoyance this is an area worthy of further investigation.

23
24 It is also worthwhile to look at some of the factors that make low frequency sounds more likely
25 to cause annoyance, as the current project potentially shares some of these characteristics. For
26 example some of the factors that were correlated with complaints from low frequency sound
27 include:

28 -problems arose in quiet rural environments
29 -the noise was often close to inaudible and heard by a minority of people
30 -the noise was more audible at night
31 -the noise had a throb or rumble characteristic
32 -the noise was typically heard indoors and not outdoors
33 (Leventhall, 2004)

34
35 With regards to infrasound, Dr. McCunney has admitted in discovery that “infrasound may
36 become audible through vibration induced by airborne energy and potentially augmented by
37 resonance in homes or other structures”. Infrasound also has the potential to act on the human
38 body even at subaudible levels. A study on guinea pigs has exemplified this fact (Salt, 2010) as
39 has the fact that infrasound has been approved for therapeutic massage by the FDA (McCunney,
40 January 2010). Dr. McCunney has used this to show that infrasound is safe but it is interesting to
41 note that 1) it did require FDA approval and 2) suggests that the sound, while inaudible, is
42 presumably having some effect on the person being treated. Ultimately, what affect if any

1 infrasound is having in relation to the problems people are having with sound from wind turbines
2 is unclear, but it is an area worthy of further investigation.
3
4

5 Q-13. Dr McCunney, in referring to a paper (Salt et al, 2010) on infrasound and guinea pigs,
6 stated that “the outer hair cells are not connected to the brain” and suggests that because of
7 anatomical differences in the ear, specifically the helicotrema, that the studies on guinea pigs did
8 not pertain to humans. Is this true and what is the significance of this fact?
9

10 A-13. In personal correspondence with Dr. Salt, the author of the study Dr. McCunney refers to,
11 I am informed that Dr. McCunney’s statement is incorrect and that the outer hair cells do connect
12 to the brain via type II afferent fibers. Infrasound therefore has the potential to influence the
13 body even at levels of sound that are below the audible range. Further, I have been informed that
14 the guinea pig helicotrema has the same attenuation characteristics as in humans. (Bensen et al,
15 2004, Pamulova et al, 2006, Dancer, 1982, and Salt et al, 2009). I think it is worthwhile to point
16 out that Dr. McCunney spends a great deal of time trying to deemphasize the potential
17 implications of Dr. Salt’s study without having his facts correct.
18

19 In discussing infrasound, it is important to keep in mind that people are suffering adverse effects
20 from noise sources and in this respect wind turbines are not exempt. In fact, evidence shows
21 wind turbines being more problematic than most other noise sources. These debates about how
22 and why people are being affected do not change that fact and in some ways can be a distraction
23 from the important point that audible wind turbine noise can clearly cause problems for some
24 people. Whether infrasound and low frequency sound are contributing to this problem remains
25 unclear but does not alter the clear findings that problems are occurring from audible noise, and
26 that wind turbines do have the potential to affect public health.
27
28

29 Q-14. Dr McCunney states (Q-9) that “Sound can adversely affect sleep, but such effects are
30 highly individualized. Research has also shown that people can become habituated to sounds so
31 that they are no longer affected by the sounds.” Do you agree with this comment?
32

33 A-14. Again Dr McCunney likes to point out that ‘effects are highly individualized’ as if this
34 somehow makes the impact less true or problematic for the individual suffering from the
35 problem. As I mentioned, many ‘effects’ on people from all sorts of insults from pain, to
36 smoking to cancer can be highly individualized. This fact does nothing to lessen their
37 seriousness or the serious effects noise creates on sleep. These adverse effects on individuals
38 cannot be discounted as they are members of the public and must be accounted for when looking
39 out for the public good and public health.
40

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

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

10
11 The potential for habituation to wind turbine noise needs to be viewed cautiously for other
12 reasons as well. In the real world studies on wind turbines done in Sweden and the Netherlands,
13 all the areas studied had turbines for at least a year. If habituation had occurred it was either
14 incomplete (meaning more people were suffering initially than the results suggest because the
15 results continue to show sleep disturbance after a year) or there was no habituation. So while
16 theoretically habituation may occur on some sleep parameters, there is clear evidence that heart
17 rate and vasoconstriction responses DO NOT habituate and that in the real world there is no
18 evidence supporting habituation to noise from wind turbines.

19
20
21 Q-15. Do you agree with Dr. McCunney’s conclusions regarding annoyance in Answer 10 of his
22 testimony?

23
24 A-15. I believe his answer is incomplete and underestimates the impact that annoyance has on
25 the individual both in the short term and long term. Please see my response to question 7 in my
26 current testimony for more on that topic.

27
28 Dr. McCunney also states “some people *may* be annoyed at the presence of sound from wind
29 turbines....” The truth is many people *are* annoyed by wind turbine noise and this has been
30 shown consistently in the studies published to date (Pedersen 2004, 2007, 2009). There are also
31 numerous case reports and literature reports showing that the extent of this annoyance is having a
32 large impact on people’s immediate quality of life (Nissenbaum, 2010, Phipps, 2007, Gillis,
33 2009, Johnsbury Survey, Pierpoint, 2010, Harry, 2007, Hanning, 2010). There is documentation
34 of people leaving their homes or having wind companies buy their homes because their distress
35 is so high (Cummings, 2010, Pierpoint, 2010). So at least for a subset of people, this annoyance
36 is not temporary or minor but as is shown by their actions is having a profound and serious effect
37 on their lives.

38
39 Dr. McCunney states that environmental noise levels “especially beyond 45dB(A),” show
40 increasing levels of annoyance. While this fact is true it again underestimates the problems with
41 regards to wind turbines. Wind turbine studies have shown problems arising at ~35 dB(A) so I
42 am not sure how Dr McCunney would mitigate the adverse effects experienced by individuals at
43 35 dBA when he recommends a 45 dB(A) standard. 45dBA would be perceived as doubling of

1 sound level by those already suffering annoyance at 35 dB(A). This also does not take into
2 account that by using an average time limit, such as the 1-hour average used by the Public
3 Service Board in prior dockets or the 8-hour average requested by GMP, that sound levels could
4 be even higher than 45 dB(A) for considerable periods of time.
5
6

7 Q-16. Dr. McCunney refers to several ‘studies’ in Ontario, Maine, and Wisconsin with regards
8 to noise standards. Are you aware of these standards? Are they representative of accepted noise
9 levels for wind turbines?
10

11 A-16. No, I am not familiar with the ‘studies’ done in Ontario, Maine or Wisconsin that he is
12 referring to. I am however, familiar with reports from surveys and unpublished research of
13 problems in each of those areas (Nissenbaum, 2010, Gillis, 2009, Cummings, 2010). Modern
14 wind turbines are relatively new structures with unique patterns of noise. Research on noise (not
15 just from wind turbines) has convincingly shown that noise can create health problems. (WHO
16 2009). However, finding exactly what levels of noise are safe has proved challenging and has
17 varied depending on the source of noise and the study. Wind turbines are actually somewhat
18 unique compared to other noise sources in that the levels at which annoyance begins to occur
19 have been consistently ~35dBA. Despite this observation there has been no consensus on
20 acceptable sound guidelines with regards to wind turbines (see Walsh, 2010 which provides a
21 summary of standards that exist worldwide, and indicates that there is no consensus on
22 appropriate setbacks to protect public health).
23

24 The reasons for this are many. Unfortunately, the standards and guidelines implemented are
25 often not protective of health for all the reasons I have been discussing. The wind industry has
26 misrepresented the extent and nature of wind turbine noise, whether unintentionally or not, so
27 that people have been taken off guard when the turbines are not ‘as quiet as a refrigerator’.
28 Given the clear health related problems and decreased quality of life noise can create, it stands
29 that if the Public Service Board wishes to protect the public health they will need to follow the
30 precautionary principle and use the best available data with regards to wind turbines and revise
31 the prior standard previously used to a lower level. (See Pederesen, 2004, 2007, 2009).
32
33

34 Q-17. Dr. McCunney states that he is “a co-author of a recent comprehensive review of the peer
35 reviewed scientific literature respecting wind turbines and human health.” In discovery, Dr.
36 McCunney stated that this review was funded by the AWEA and CanWEA. Do you have any
37 comments regarding Dr. McCunney’s review of the literature in this field?
38

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

1 Service, 2010) and shows industry favorable bias. It should be noted that the mission of the
2 “AWEA is to promote the growth of wind power through advocacy, communication and
3 education.” (Colby et al, 2009). The AWEA’s mission is to promote the wind industry, not
4 public health.
5

6 The AWEA paper focuses on very narrow aspects of wind turbine noise and health, making a
7 somewhat false and vague distinction between ‘direct’ and ‘indirect’ health effects. They go to
8 great lengths to show that the noise is not creating direct physical harm (for example as radiation
9 might) but essentially ignore and downplay the ‘direct’ effects of sleep disturbance and
10 annoyance and the secondary health effects they may create when chronic such as cardiovascular
11 disease, depression, and immune suppression. Dr. McCunney’s participation and conclusions in
12 this report suggest an industry bias that is not supported by the best evidence available on wind
13 turbine noise and health.
14

15
16 Q-18 Does this conclude your testimony?
17

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

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