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**BEFORE THE  
PUBLIC SERVICE COMMISSION OF WISCONSIN**

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5 Application of Wisconsin Electric Power Company  
6 for a Certificate of Public Convenience and Necessity  
7 to Construct a Wind Electric Generation Facility and Docket No.6630-CE-302  
8 Associated Electric Facilities to be known as the Glacier  
9 Hills Wind Park, Located in the Towns of Randolph  
10 and Scott, Columbia County, Wisconsin

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**SURREBUTTAL TESTIMONY OF RICHARD R. JAMES  
ON BEHALF OF THE COALITION FOR WISCONSIN  
ENVIRONMENTAL STEWARDSHIP**

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16  
17 **Q. Please state your name and address.**

18 A. Richard R. James.

19 **Q. Are you the same Richard R. James who offered direct testimony in  
20 this case?**

21 A. Yes.

22 **Q. What is the purpose of your surrebuttal testimony?**

23 A. I am testifying in response to the rebuttal testimony of George Hessler,  
24 Mark Roberts, and Geoff Leventhal, filed on behalf of Wisconsin Electric  
25 Power Company.

26 **Q. Do you agree with Mr. Hessler's critique of your direct testimony?**

27 A. No, I do not.

28 **Q. How have you organized your responses to Mr. Hessler's rebuttal  
29 testimony?**

30 A. I have organized my responses into three sections: Ambient Sound  
31 Measurements, Validity of Noise Modeling, and Sleep Interference.

1           **Ambient Sound Measurements.**

2           Mr. Hessler takes issue with criticisms raised in Mr. Kamperman’s  
3           study (as summarized in my direct testimony) with respect to location of  
4           test sites and with other aspects of his 2009 testing for Glacier Hills.  
5           These criticisms were not rebutted by Mr. Hessler and remain as questions  
6           about whether the tests appropriately characterize the ambient conditions  
7           at residences in the project footprint.

8           In addition, Mr. Hessler takes umbrage at the question raised in my  
9           testimony that: “It may be that Mr. Hessler selects his test sites with the  
10          intention of biasing the test results.” This question was prefatory to the  
11          discussion of the Cape Vincent Study by Paul Schomer, Ph.D. of work by  
12          Hessler and Associates, which stated:

13                       Hessler’s BP study for the Cape Vincent Wind Power Facility  
14                       appears to have selected the noisiest sites, the noisiest time of year,  
15                       and the noisiest positions at each measurement site. Collectively,  
16                       these choices resulted in a substantial overestimate of the a-  
17                       weighted ambient sound level, 45-50 dB according to Hessler.

18           Given that Mr. Kamperman raised similar concerns about the test sites  
19           selected for Glacier Hills, it is not unreasonable to ask whether there is a  
20           similar explanation for findings at Glacier Hills.  
21           similar explanation for findings at Glacier Hills.

22           Mr. Hessler confuses the questions that were raised by  
23           observations made at Glacier Hills and the Schomer Report. Kamperman  
24           and I made no assertion about motives. Any issue Mr. Hessler has on that  
25           aspect is between his firm and Dr. Schomer.

1 Mr. Hessler refers to a paper<sup>1</sup> he presented at the 2009 Inter-Noise  
 2 Conference in Ottawa, Canada. This paper is included in my previously  
 3 filed exhibit 809. In this paper, Mr. Hessler acknowledges the concerns  
 4 about contamination of the background sound level tests by wind, insects,  
 5 short duration events that are not part of the background soundscape, etc.  
 6 He also acknowledges that background sound levels in rural communities  
 7 would be expected to be 30 dBA and below. He states:

8 The very quiet rural description range of 26 to 30 dBA is based on  
 9 a survey of acoustical consultants representing some 180 plus  
 10 years of experience. Levels in very remote wilderness areas may  
 11 be lower than the ranges shown during calm and still measurement  
 12 conditions but the ranges apply to occupied residential receptors.”

13 Mr. Hessler concludes: “It is shown that  $L_{Aeq}$  is not a good metric for  
 14 quantifying levels in quiet environments, at least if the data is to be used  
 15 for noise impact studies.  $L_{A50}$  and  $L_{A90}$  are better metrics.”

| <b>Table 1 – Glacier Hills Background Sound Levels from 2009 Tests</b> |                             |                             |                             |                             |                             |                             |                             |                             |
|--|-----------------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|
|  | <b>Site 1</b>               |                             | <b>Site 2</b>               |                             | <b>Site 3</b>               |                             | <b>Site 4</b>               |                             |
| <b>2009 Study</b>  | <b><math>L_{A90}</math></b> | <b><math>L_{A50}</math></b> | <b><math>L_{A90}</math></b> | <b><math>L_{A50}</math></b> | <b><math>L_{A90}</math></b> | <b><math>L_{A50}</math></b> | <b><math>L_{A90}</math></b> | <b><math>L_{A50}</math></b> |
| <b>By:</b>   |                             |                             |                             |                             |                             |                             |                             |                             |
| <b>Hessler</b>   | 27.6                        | 30.6                        | 20.4                        | 24.4                        | 21.0                        | 23.2                        | 20.6                        | 25.2                        |
| <b>Kamperman</b>   | 20.8                        | 22.6                        | 26.0                        | 29.6                        | 21.8                        | 23.1                        | 30.9                        | 35.0                        |

16 Table 1 shows the data for these two metrics from the two 2009 studies at  
 17  
 18 Glacier Hills by Mr. Hessler and Mr. Kamperman. This table supports the

<sup>1</sup> Hessler, G., “Measuring ambient sound levels in quiet environments,” Inter-Noise 2009, Ottawa, Canada, August 23-26.



1 noise by residents living in the footprint of operating wind generators are  
2 made when wind speeds at the ground level are calm.

3 The appropriate background sound levels against which the Glacier  
4 Hills project should be judged are those reported in Table 1 above, not the  
5  $L_{A90}$  sound levels Mr. Hessler proposes to substitute under his assumption  
6 that ground level winds are required for operation of the turbines. This is  
7 explained in more detail in the reference paper submitted with my direct  
8 testimony by Mr. Clif Schneider<sup>2</sup> stating:

9 Stable conditions occurred in 67% of nights and in 30% of those  
10 nights, wind velocities represented worst-case conditions where  
11 ground level winds were less than 2 m/s and hub-height winds  
12 were greater than wind turbine cut-in speed, 4 m/s.

13  
14 There is no reason to believe that the stable weather conditions referred to  
15 for New York are any different in Wisconsin.

### 16 **Validity of Noise Modeling**

17 Mr. Hessler's faith in the estimates of wind turbine noise  
18 propagation models based on ISO 9613-2 as implemented in Cadna/A,  
19 demonstrates a lack of understanding of the limitations that the ISO  
20 9613-2 document includes in the body of the Standard. However, I stand  
21 by the statements made in my direct testimony explaining how  
22 experience shows they are not accurate.

23 Contrary to Mr. Hessler's protestations, sound propagation models  
24 are not precise instruments, and are not any better than the input data used

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<sup>2</sup> Schneider, C. "Measuring background noise with an attended, mobile survey during nights with stable atmospheric conditions" Inter-Noise 2009 Ottawa

1 to represent the noise source and accuracy of the algorithms used to  
2 represent how sound decays with increasing distance from the location of  
3 each source. Errors in models of wind turbine noise propagation located  
4 on flat terrain have been shown to have errors of 5 to 10 dB or more  
5 when studied by independent acoustical engineers (See studies by Kaliski  
6 in exhibit 809)

7 In his paper, Mr. Kaliski notes that he produced four (4) different  
8 models of a simple wind turbine layout using the various options and  
9 settings provided in Cadna/A. He then goes on to state that his “real  
10 world data” matched only one of the four models' predicted sound levels.  
11 This does not prove that the model is accurate. It only proves that Mr.  
12 Kaliski found one of his four models produced sound levels that were  
13 close to the real world measurements.

14 Cadna/A has so many tweaks and options that there is no way its  
15 use can be calibrated unless numerous independent studies are done. For  
16 the example in Mr. Kaliski's paper and in Mr. Hessler's claim that these  
17 studies confirm the model's accuracy, it is my opinion that any such  
18 "matching" of model to real world results are more likely a case of seeking  
19 the set of Cadna/A variables that support the conclusion than it is any sign  
20 that models are accurate.

21 It should be expected that errors of 5 dBA or higher would be  
22 found in models of more complex terrain such as is found in the  
23 community near Glacier Hills' footprint even if the follow up study was

1 done by independent experts and the models' assumptions for the state of  
2 turbine power generation, wind speed and direction are carefully matched.  
3 The fact that Mr. Hessler finds no such errors when he checks his own  
4 models proves nothing about model accuracy. This is not independent  
5 validation.

6 There are independently validated models that are accepted as  
7 being accurate enough for planning purposes used by the Federal Highway  
8 Administration and the Federal Aviation Administration. Those models  
9 have undergone much development for specific noise sources and have  
10 been independently validated by experts not involved in creating the  
11 models.

12 When errors in models are identified by projects that do follow the  
13 models' predictions, the models are revised or cautions for the  
14 circumstances that lead to those errors are available. This is not true for  
15 wind turbine project models. Each wind project model is unique and  
16 validation attempts to date have been flawed by poor protocols and  
17 documentation.

### 18 **Sleep Interference**

19 Mr. Hessler asserts that the World Health Organization's most  
20 recent documents and criteria on nighttime noise and health support his  
21 position that sound levels above 40 dBA ( $L_{\text{night-outside}}$ ) are acceptable. He  
22 states: "The final document from WHO<sup>3</sup> states in a crystal clear manner in

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<sup>3</sup> World Health Organization 2009, Night Noise Guidelines For Europe, ISBN 978 92 890 4173 7

1 the Abstract and the report body that an “outside level of 40 dBA should  
2 be the target of the Night Noise Guidelines for Europe (NNG) to protect  
3 the public ...” This is an incomplete representation of the 2007 and 2009  
4 WHO statements. The 2007 document states:

5 "L<sub>night,outside</sub> 30 dB is the ultimate target of Night Noise  
6 Guideline (NNG) to protect the public, including the most  
7 vulnerable groups such as children, the chronically ill and the  
8 elderly, from the adverse health effects of night noise."  
9

10 The 2009 document states:

11  
12 The LOAEL of night noise, 40 dB  $L_{\text{night,outside}}$ , can be considered a  
13 health-based limit value of the night noise guidelines (NNG)  
14 necessary to protect the public, including most of the vulnerable  
15 groups such as children, the chronically ill and the elderly, from  
16 the adverse health effects of night noise.  
17

18 There is no conflict between the 2007 and 2009 documents; just a different  
19 goal. On the one hand, the 2007 WHO guidelines set 30 dBA as the target  
20 to protect the public, while on the other hand,, the 2009 WHO guidelines  
21 state that 40 dBA should be considered as the health-based limit value.  
22 Limit values are “limits,” not “targets.” A value of 40 dBA is a not-to-  
23 exceed-without-risk-of-harm limit.

24 The two documents confirm that WHO’s post-2000 research shows  
25 that if the  $L_{\text{night-outside}}$  is 30 dBA or lower, the environment can be  
26 considered as safe and healthful for sleep. When the  $L_{\text{night-outside}}$  is 40 dBA  
27 or higher, the data is sufficient to establish that adverse health effects will  
28 be experienced by the vulnerable groups. Mr. Hessler’s confusion over  
29 what these values represent is apparent when he draws his conclusion  
30 (above) that WHO’s 2009 document sets 40 dBA as the target one should

1 try for. A level of 30 dBA is reasonable in light of the current nighttime  
2 background sound levels of less than 30 dBA ( $L_{A90}$ ). A level of 40 dBA  
3 or higher would clearly put the public's health and well being at risk.

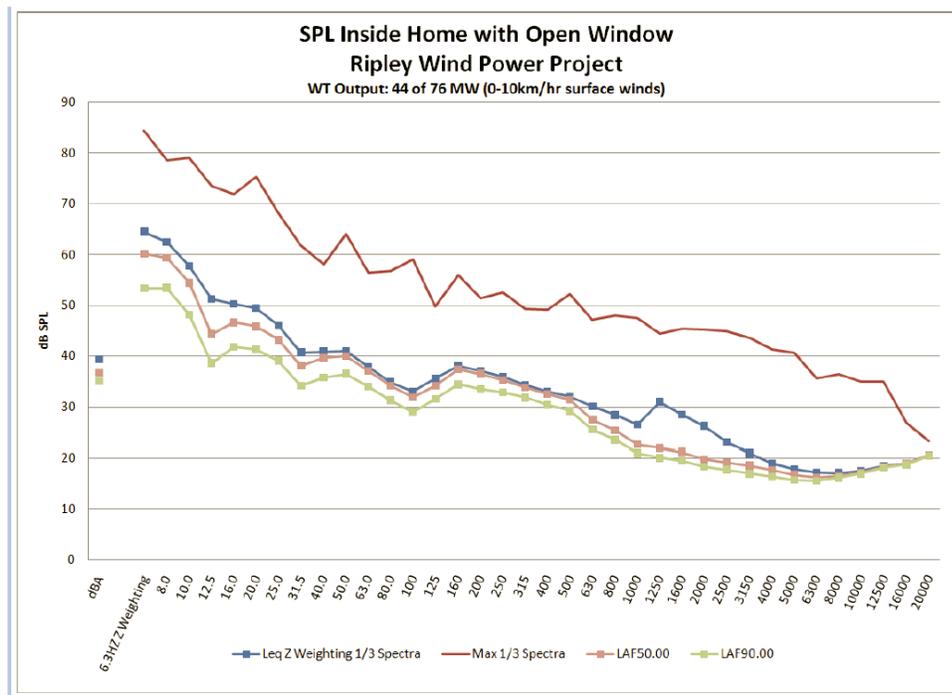
4 Mr. Hessler's contention that the criteria should be even higher  
5 than 40 dBA is based on his incorrect assumption that wind turbines do  
6 not produce significant low frequency sound, and thus will not be an  
7 indoor noise problem. Given the information showing that low frequency  
8 sounds are the dominant form of sound emitted by wind turbines (as stated  
9 in my direct testimony), it seems unusual that Mr. Hessler would  
10 reintroduce his opinion that the walls of a home would be effective in  
11 reducing the low frequency rumble that is experienced inside homes,  
12 especially evident at night when the bedroom is quiet.

13 The subject of low frequency noise is addressed on pages 9-12 of  
14 the Kamperman-James "How to... Guide," which is included in exhibit  
15 809. Low frequency noise was also highlighted in the 1990 NASA  
16 study<sup>4</sup> by Hubbard and Shepherd (See: Noise Exposure Inside  
17 Buildings, page 35-39) to the effect that low frequency turbine sounds can  
18 resonate inside a home leading to even higher levels of low frequency  
19 sound inside the home than outside. Mr. Hessler's focus on only dBA  
20 values, which do not include the low frequency sounds, discredits Mr.  
21 Hessler's contrary argument.

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<sup>4</sup> Hubbard, H. H., Shepherd, K. P. "Wind Turbine Acoustics," NASA Technical Paper 3057  
DOE/NASA/20320-77 (1990)

1 Mr. Hessler also comments on the need to limit low frequency  
 2 sound to levels of 60 to 65 dBC is a valid upper limit. The criteria  
 3 proposed in the Kamperman-James paper uses Mr. Hessler's paper on that  
 4 topic as a source for its not-to-exceed limits. However, the reports of  
 5 adverse health effects, especially those of the type described for Wind  
 6 Turbine Syndrome also occur during the daytime when sleep disturbance  
 7 is not an issue. Tests I have taken inside the homes of people reporting  
 8 such effects found low frequency sound pressure levels exceeding 60 dB  
 9 in the 6.3 Hz 1/3 Octave Band. The graph below illustrates this situation.



10  
 11 The slope of the spectrum increases as frequency decreases. Thus,  
 12 the sound pressure levels in the infrasound region below 10 Hz may be  
 13 higher yet. These measured levels are consistent with the sound emission

1 spectrum of wind turbines. Although wind may play some role in raising  
2 the sound pressure level in the lower frequency, the wind turbines are by  
3 themselves significant contributors that should not be ignored by  
4 continued use of A-weighting to measure and display wind turbine sound  
5 data.

6 Adverse health effects are being reported that may be linked to  
7 vestibular and balance functions. Whether these are a result of the simple  
8 average sound pressure level or whether some other characteristic of the  
9 acoustic energy such as the dynamic modulation of the sound in these  
10 lower frequencies is responsible is not known. Following the  
11 precautionary principle, the K-J criteria proposed that in communities  
12 without significant man-made sources of low frequency sound to mask the  
13 ILFN sounds from the turbines that there also be limits to any increases in  
14 over-all ILFN. Thus, the recommendation for applying a second  
15 limitation for ILFN using the criteria of  $L_{Ceq} = L_{C90} + 5$  for additional  
16 sound from wind turbines.

17 **Q. Does this complete your response to the rebuttal testimony of George**  
18 **Hessler?**

19 A. Yes.

20 **Q. What is your response to the rebuttal testimony of Mark Roberts?**

21 A. Dr. Roberts describes what he believes to be deficiencies in the work of  
22 Dr. Nina Pierpont. This position may be more understandable when one  
23 considers that epidemiological studies rely on exposed populations with

1 adverse health effects. In this case the focus should be on preventing  
2 adverse health effects in the exposed population, not permitting it.

3           What is lost in Dr. Roberts's arguments is that Dr. Pierpont's work  
4 is the first step in bringing attention to the adverse health effects reported  
5 by people living near wind turbines. Today, there is no base of exposed  
6 population that would permit a study of the type Dr. Roberts would like to  
7 have conducted. Dr. Roberts claims an extensive knowledge of how such  
8 studies should be done in his field, but fails to acknowledge that studies of  
9 the type conducted by Dr. Pierpont are common and accepted in the  
10 medical community.

11           For example, the use of case studies and self-reported adverse  
12 health effects are the medical community's first line of defense against  
13 unexpected interactions between prescription drugs. There are reports in  
14 the news that this or that new drug has unanticipated side effects for a  
15 small portion of the people to whom it was prescribed. These are based on  
16 studies of the type conducted by Dr. Pierpont and others for wind turbine  
17 related health issues.

18           It is not clear which version of Dr. Pierpont's study Dr. Roberts  
19 reviewed. The study will not be available to the public in published form  
20 until November 6th, 2009, at the earliest. Since the second draft was  
21 released on the Internet in winter 2009, the study has changed  
22 significantly. Yet, no other complete copies have been made available.  
23 The references that I used in my direct testimony were taken from a

1 small excerpt of the galley draft made available to a limited audience  
2 for the purpose of addressing Dr. Pierpont's concerns about papers  
3 published by others that claimed there were no adverse health effects.  
4 Dr. Pierpont's forthcoming study has been extensively and favorably  
5 peer-reviewed by some of the top experts in the fields of otolaryngology  
6 and otology.

7 **Q. What is your response to the rebuttal testimony of Geoff Leventhall?**

8 A. Dr. Leventhall states that "infrasound from wind turbines is of no  
9 consequence." Dr. Leventhall incorrectly lumps infrasound and low  
10 frequency noise together. They are two distinct noise categories. This is  
11 surprising since even Dr Leventhall's own earlier work is concerned with  
12 the mitigation of low frequency noise because it has been acknowledged  
13 to be disruptive to human activities.

14 Dr. Leventhall testifies that "any effect from wind turbine noise, or  
15 any other low level of noise, which might be produced within the body is  
16 'lost' in the existing background noise and vibration." Human beings have  
17 adapted to disregard normal bodily noises. It is , therefore, seriously  
18 wrong of Dr. Leventhall to compare external, imposed, and unnatural  
19 fluctuating sounds with pressure levels of 40 -70 decibels to physiologic  
20 noises within the body.

21 Dr. Leventhall testifies that "higher frequency noise from wind  
22 turbines, if it is audible, can cause disturbance to some residents, but this  
23 effect is no different from that of noise from another source." On the

1 contrary, wind turbine noise, by virtue of its constant presence (over  
2 hours or days), dynamic modulation of ILFN and audible frequencies, and  
3 frequent nocturnal exacerbation, is unlike other sources of community and  
4 industrial noise. Moreover, other sources of industrial noise are regulated  
5 in manners suitable to their nature. Given the demonstrated increased  
6 annoyance of turbine noise, and contribution of nighttime annoyance to  
7 sleep disturbance, regulations must be specially formulated to address  
8 their unique qualities and potentials for annoyance.

9 **Q. Do you have any comments on Dr. Leventhal's discussion of the work**  
10 **of Dr. Inger and Dr. Mulvihill?**

11 A. Yes. Dr. Leventhal correctly notes that Dr. Inger's research does not  
12 establish a link between ILFN and cellular response. The conclusion that  
13 research into mechanotransduction response supports a link to ILFN was  
14 drawn by Dr. Mulvihill based on her prior experience and on the research  
15 reported in peer-reviewed studies. Dr. Leventhal dismisses these studies  
16 as not meeting his standards or his understanding of this hypothesis for the  
17 causal link between ILFN and adverse health effects.

18 Dr. Leventhal contacted Dr. Inger about Dr. Mulvihill's linkage  
19 reported in the direct testimony and Dr. Inger responded that his work  
20 was neutral on this topic. Dr. Mulvihill contacted Dr. Inger in response  
21 to Dr. Leventhal's rebuttal. The following is Dr. Inger's email response  
22 to Dr. Mulvihill (provided to me by Dr. Mulvihill):

1 From: **Ingber, Donald** <[Donald.Ingber@childrens.harvard.edu](mailto:Donald.Ingber@childrens.harvard.edu)>  
2 Date: Fri, Oct 23, 2009 at 9:54 AM  
3 Subject: Re: Wind turbine controversy  
4 To: Eileen Mulvihill <[mulvier@gmail.com](mailto:mulvier@gmail.com)>  
5 E/ Prof. Leventhall did not indicate that he would be using this for  
6 formal testimony, but I also was not aware you or others were  
7 referring to my work without first inquiring about the details.  
8 In any case, that quote of mine is accurate, HOWEVER, I also  
9 wrote him:  
10 "You can quote me as long as you do not make me seem to say  
11 there is no way that low frequency vibration can influence cells  
12 directly, because there probably is an effect; I just can't tell  
13 whether that effect is negative, positive or null physiologically  
14 without controlled experiments."  
15 Feel free to use this quote, AS LONG AS you emphasize the need  
16 for controlled experiments to explore potential health dangers.  
17 Best,  
18 Don  
19 It is clear that Dr. Ingber remains open to the possibility of the  
20 causal link in spite of Dr. Leventhall's assertion that no such link exists.  
21 **Q. Do you have any comments regarding Dr. Leventhall's discussion of**  
22 **VAD ?**

1 A. Yes. There are others who support Dr. Mulvihill's conclusion about  
2 cellular level processes accounting for some of the reported adverse health  
3 effects. Dr. Leventhall not only dismisses the work of Dr. Pierpont, he  
4 also dismisses the work of the VAD Team headed by Dr. Nuno Branco,  
5 which has been investigating the linkage between ILFN and pathology for  
6 over 28 years in Portugal. The VAD Team's research has been published  
7 in peer-reviewed journals and also presented at conferences, yet Dr.  
8 Leventhall dismisses their conclusions regarding this causal hypothesis.  
9 While it may be true that many of their studies involved higher levels of  
10 ILFN than may be routinely present in homes near operating wind utilities,  
11 there is also research that shows effects at levels more typical of wind  
12 turbine noise.

13 There are also recent studies showing adverse health effects  
14 associated with living near airports and highways that may be an early  
15 indication that community standards which have focused on A-weighted  
16 sound levels may have failed to protect the public from adverse health  
17 effects of low frequency sound.

18 **Q. Do you have any comments on Dr. Leventhall's discussion of**  
19 **mechanotransduction?**

20 A. Yes. Dr. Leventhall pays great attention to rebutting any link between  
21 research on the mechanotransduction process and the adverse health  
22 effects reported for exposure to ILFN, claiming that sound pressure levels  
23 are not high enough to cause any such effects from wind turbines. Yet, in

1 the VAD team's paper entitled: "*Vibro-acoustic disease: Biological effects*  
2 *of infrasound and low-frequency noise explained by Mechanotransduction*  
3 *cellular signaling*," --reproduced in exhibit 810, filed with my testimony--  
4 it is just this link that is presented as the explanation for these health  
5 effects. It is clear that the sound pressure levels reported in this paper are  
6 not significantly different in the lowest frequency bands than the sound  
7 pressure levels inside homes during the operation of wind turbines  
8 documented by me.

9 Dr. Leventhall's fallback argument seems to be that, in his opinion,  
10 sound pressure levels of low frequency sound in people's yards and homes  
11 do not exceed the threshold of perception levels for the median population.  
12 He then asserts there can be no adverse health effect without audibility.  
13 Yet the adverse health effects, other than sleep disturbance, are being  
14 reported by a small sub-set of the people living near wind turbines. Not all  
15 people living near wind turbines are claiming any adverse health effects.  
16 The adverse health effects matching the symptoms of Wind Turbine  
17 Syndrome being reported do not affect large percentages of people living  
18 near wind turbines. The fact that it is a small portion of the exposed  
19 population that report adverse health effects may be supporting evidence  
20 that it is some more vulnerable subset of people who are responding to the  
21 wind turbine acoustic energy.

22 If we use the threshold of perception for the most sensitive people  
23 then the median threshold drops by approximately 12 dB. In Dr.

1 Leventhall's article in Noise and Health (part of exhibit 809) he  
2 discusses this issue and states that for the most sensitive people the  
3 threshold may be even lower than 12 dB. This is not far from the sound  
4 pressure levels that are being reported inside homes. It should also be  
5 remembered that the 1990 NASA study reported that in-home resonance  
6 can increase the amplitude of the lower frequency acoustic emissions  
7 above the levels found outside the home.

8 **Q. Do you have anything else to add regarding exhibit 810.**

9 A. Yes. A careful reading of the section of the VAD team's paper, in section  
10 "2.2 *What you can't hear, won't hurt you,*" supports my precautionary  
11 approach to the reports of adverse health effects, not the outright dismissal  
12 that is offered by Dr. Leventhall.

13 **Q. Do you have any further comments on Dr. Leventhall's rebuttal**  
14 **testimony?**

15 A. Yes. Dr. Leventhal finds flaws in my direct testimony regarding other  
16 research papers. His testimony demonstrates more about the frame of  
17 reference in which he positions his beliefs and opinions than it does about  
18 errors in using those references. It is true that reasonable people can differ  
19 in their interpretation of such research. There are many independent  
20 experts in acoustics, medicine, and other professions who support the  
21 positions taken in my direct testimony. It is the responsibility of all  
22 professionals to use their skills to protect the public health and welfare.

1                   Some may disagree and say that we should proceed with allowing  
2                   wind turbines to be located close to homes as do those who recommend  
3                   distances of 1000 to 2000 feet. In my opinion, there should be at least a  
4                   mile and  $\frac{1}{4}$  between turbines and homes. I say this not to restrict wind  
5                   energy as a source of renewable energy, but instead as a temporary  
6                   condition until the questions of adverse health effects can be addressed in  
7                   independent research that can be used as a future guide to either continue  
8                   the large setbacks or to set new setbacks that are founded on knowledge  
9                   and not speculation.

10    **Q.    Does this complete your testimony?**

11    A.    Yes.

12