

BEFORE
THE OHIO POWER SITING BOARD

In the Matter of the Application of)	
Champaign Wind LLC, for a)	
Certificate to Install Electricity)	Case No. 12-0160-EL-BGN
Generating Wind Turbines in)	
Champaign County)	

MOTION FOR LEAVE TO FILE *INSTANTER*
AMENDED TESTIMONY OF DAVID M. HESSLER

Champaign Wind LLC, the Applicant, respectfully moves for leave to file *Instanter* the attached Amended Testimony of David M. Hessler. Mr. Hessler was unreachable prior to filing the testimony on October 29, 2012 as a result of the October 29, 2012 storm which hit the East Coast. Champaign Wind filed Mr. Hessler's direct testimony on October 29, 2012 and included correspondence reserving the right to amend the testimony due to the his unavailability. Accordingly, Champaign Wind requests that leave be granted and that the attached Amended Testimony of David M. Hessler be accepted for filing on the docket in this proceeding. A Memorandum in Support of this Motion is attached.

Respectfully submitted,



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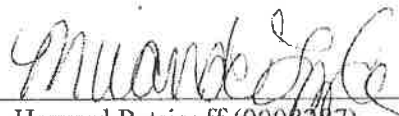
**MEMORANDUM IN SUPPORT OF MOTION FOR LEAVE TO FILE *INSTANTER*
AMENDED TESTIMONY OF DAVID M. HESSLER**

Champaign Wind LLC, the Applicant, respectfully moves for leave to file *Instanter* the attached Amended Testimony of David M. Hessler. In support of this Motion, Champaign Wind states as follows:

1. On October 29, 2012, Champaign Wind LLC filed the Direct Testimony of David M. Hessler in this matter.
2. Prior to filing that testimony, counsel for Champaign Wind LLC attempted to communicate with Mr. Hessler with respect to some additional language for Answer 16. Because Mr. Hessler resides in Virginia, and given the storm which approached the East Coast of the United States on October 29, 2012, Mr. Hessler was not available to be reached.
3. Subsequent to October 29, communication with Mr. Hessler was re-established and Mr. Hessler agreed that a change in the language in Answer 16 should be made.
4. Champaign Wind now moves to file the attached Amended Direct Testimony of David M. Hessler in order to amend the language in Answer 16. No other portion of Mr. Hessler's testimony is being amended through this filing.
5. This amendment is for the purpose of ensuring that the record is accurate; it would be preferable for Champaign Wind to be permitted to amend Mr. Hessler's testimony now rather than awaiting the hearing, at which Mr. Hessler would make the same correction.
6. No party will be prejudiced by the granting of this Motion.

WHEREFORE, Champaign Wind LLC respectfully requests that the Board grant its Motion for Leave to File *Instantly* the attached Amended Direct Testimony of David M. Hessler.

Respectfully submitted,



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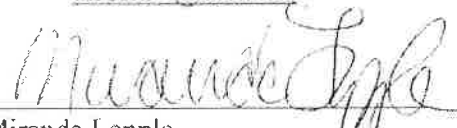
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Miranda Leppla

**BEFORE
THE OHIO POWER SITING BOARD**

In the Matter of the Application of) Champaign Wind LLC, for a Certificate) to Construct a Wind-Powered Electric) Generating Facility in Champaign) County, Ohio)	Case No. 12-0160-EL-BGN
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AMENDED DIRECT TESTIMONY OF DAVID M. HESSLER

Q.1. Please state your name and business address?

A.1. My name is David Hessler. I am a principal consultant and vice president of Hessler Associates, Inc., an acoustical engineering firm located at 3862 Clifton Manor Place, Haymarket, Virginia.

Q.2. What is your educational background?

A.2. I have a Bachelor of Arts Degree from the University of Hartford in Hartford, CT where I graduated in 1982, and a Bachelor of Science degree in Mechanical Engineering from the University of Maryland, College Park where I graduated *summa cum laude* in 1997.

Q.3. What is your professional background?

A.3. I have been employed as an acoustical engineer with Hessler Associates, Inc. for over 21 years. I am a licensed Professional Engineer and a member of the Institute of Noise Control Engineering (INCE). The firm is a member of the National Council of Acoustical Consultants (NCAC). Since its founding in 1976, the company has specialized almost exclusively in the prediction and measurement of noise from power generation facilities. Consequently, I have been the principal acoustical designer of hundreds of power stations all over the world; most commonly combustion turbine combined cycle plants along with coal, gas fired and diesel facilities. Typical projects

involve field surveys to establish baseline background sound level conditions - usually for the purpose of determining appropriate project design goals, computer modeling and the development acoustical design specifications. Follow-up surveys of completed projects are commonly carried out so the validity of the modeling and design can be verified. Over roughly the last 7 years, wind energy projects have emerged as one of the more dominant types of new power generation and throughout that period about 75% of my work load has involved performing noise assessments and operational surveys for wind farms. At this point I have worked on approximately 70 (usually large) wind projects all over North America. Based largely on my field experience measuring numerous operational projects, I have contributed to the professional literature with a number of articles and technical papers on the subject and have authored the chapter on measuring and analyzing wind turbine sound emissions in the recently published book *Wind Turbine Noise*¹. I have attended all of the bi-annual Wind Turbine Noise conferences since the series began as a small gathering in Berlin in 2005. These important conferences bring together all of the top experts in the field, who are mostly from Europe, and essentially summarize the current state of knowledge on the subject.

Q.4. On whose behalf are you offering testimony?

A.4. I am testifying on behalf of the Applicant, Champaign Wind, LLC.

Q.5. What is the purpose of your testimony?

A.5. The purpose of my testimony is to summarize the results of the noise impact assessment I carried out with respect to the Champaign Wind (or Buckeye II) Wind Project.

Q.6. Please describe the history of your involvement with the Buckeye II Wind project and the studies that you and your firm undertook on behalf of the Applicant.

A.6. A field survey was carried out in November of 2011 to establish what the existing environmental sound levels were within the Buckeye II project area. The potential impact of any project is generally related to how much, if at all, its sound level exceeds the background level.

A pre-construction background survey for a wind project is unique in the sense that the noise source that the study is concerned with fundamentally requires moderate to strong winds in order to operate and begin to produce any sound emissions. When the winds are light at hub height the project is completely inert and silent. Consequently, the background sound levels that are of relevance to wind turbine projects are not the absolute quietest levels that occur during calm conditions but rather the sound levels that exist under the wind conditions associated with normal project operation. An apples-to-apples comparison is required. At the present time, no ANSI or ISO standard exists for this specific type of field survey for the simple reason that these test protocols were written with conventional, non-wind dependent noise sources, such as fossil fueled power stations or industrial facilities, in mind. Existing standards correctly limit measurements to low wind conditions because the operation of a "conventional" source is utterly unrelated to the wind conditions and, in fact, such sources are most apt to be prominent during calm and quiet conditions. In a wind turbine analysis, however, it is essential, almost by definition, to measure during moderately windy conditions. Therefore, standards, such as ANSI S12.9-1992/Part 2ⁱⁱ, were followed to extent that they were relevant in the field survey but additional techniques and analyses, such as a correlation

between the measured sound levels and the concurrent high elevation wind speed, were required to obtain a sensible and meaningful result.

In brief, the survey measured a variety of statistical sound levels on a continuous basis day and night for 18 days at 10 positions distributed over the project area. These positions were selected to:

- be located at or near residences with the maximum proximity to proposed Buckeye II turbine locations
- cover the project area in a more or less uniform manner
- be located in open areas remote from any significant sources of man-made noise
- be located away from any reflective vertical surfaces

Over 2500 measurements were made in 10 minute increments at each position, resulting in over 25,000 measurements collected in a wide variety of wind and weather conditions. These sound measurements were then compared to the concurrent wind speed over each 10 minute period as measured by the highest anemometers, ranging from 58 m to 80 m (190 ft. to 260 ft.), on all 6 met towers then operational across the site area. Thus, the high elevation wind speeds that the turbines would see were directly related to the sound levels measured at the same time near ground level (where the local wind speed is often negligible) at typical residences and farms throughout the project area.

Q.7. Please explain why you used an evaluation threshold of 44 dBA as a relative design goal for operational noise levels at non-participating residences?

A.7. The wind speed and average (Leq) sound levels measured exclusively at night (10 p.m. to 7 a.m.) were compared to find the conditions when the project would theoretically be most audible relative to the background level. Substantially higher daytime sound levels were neglected. This critical wind analysis indicated that the nighttime

background level would be lowest relative to the project sound level at a wind speed of 6 m/s (at a standard reference elevation of 10 m). The mean nighttime Leq sound level measured under those wind conditions was 39 dBA. Moreover, a simple average of all the nighttime Leq sound levels measured throughout the survey at all positions *irrespective* of wind speed was also 39 dBA. Consequently, a 5 dBA relative increase due to the project would put the nominal noise impact threshold at 44 dBA. This design approach has been used since it is my understanding that the OPSB has approved a metric of Leq + 5 dBA for other projects in Ohio.

Q.8. Setting aside for the moment a relative increase of Leq + 5 dBA as a design basis, do you think a project design goal of 44 dBA is appropriate for a wind project in a rural area?

A.8. Yes. My experience conducting the field surveys of similar newly completed wind projects in very comparable settings indicates that the likelihood of complaints is quite small whenever the average project sound level is below 45 dBA, regardless of the actual background sound level, and we recommend a mean, long-term project sound level of 45 dBA as a regulatory limit for any new wind project in a rural environment. The relative limit of 44 dBA derived from the site-specific field survey performed for this project is consistent with, and even a slight improvement on, this recommendation.

Q.9. Has this recommendation been publicized in any way that is unrelated to a specific project?

A.9. Yes. Our suggestion of 45 dBA as a regulatory limit that fairly balances the interests of all parties first appeared in a peer-reviewed articleⁱⁱⁱ in the January 2011 issue of the *Noise Control Engineering Journal* and was subsequently included in a set of best practices guidelines^{iv} for siting new wind projects prepared under a federal grant for the

National Association of Regulatory Utility Commissioners (NARUC) on behalf of the Minnesota Public Utilities Commission.

Q.10. Please explain why you used an evaluation threshold of 50 dBA as a design goal for operational noise levels at non-participating property boundaries?

A.10. At the boundaries of the project, or, more specifically, at the property lines of adjoining non-participating land parcels, a relatively low project sound level is generally unnecessary because no one is usually permanently present at the fringe of a land parcel, particularly at night, to be potentially affected by noise. Consequently, an evaluation criterion of 50 dBA has been used as a reasonable impact threshold at property lines. In the rare instances where property line noise limits have been imposed on wind turbine developments (based on our experience with dozens of other wind projects), nothing lower than an absolute noise limit of 50 dBA has typically been used.

Q.11. What were the results of your modeling as to non-participating residences and non-participating boundaries considering only the Buckeye II project?

A.11. Initial modeling, with all of the units operating normally, showed that there were a number of non-participating residences with predicted levels slightly above the 44 dBA design goal. However, subsequent iterative modeling indicates that if certain units (16 out of the 56 total) are set up to operate in low noise mode (5 dBA lower than normal) at night, then a mean sound level of 44 dBA can be met at all non-participating residences. My understanding is that Champaign Wind intends to operate the 16 units identified as requiring low noise operating mode in the modeling study in low noise mode. Consequently, I expect that the mean project sound level will meet the design goal with respect to non-participating residences.

With this same restriction (16 of 56 units operating in low noise mode) it is anticipated that the assumed 50 dBA property line design goal will also be met in the vast

majority of cases, although in rare instances the predicted level in odd corners of various land tracts may exceed the goal by 1 or 2 dBA. Such a small overage has no tangible meaning in terms of audibility (i.e. 52 dBA sounds essentially the same as 50 dBA) and would not affect the probability of an adverse reaction due to noise.

Q.12. What were the results of your modeling as to non-participating residences and non-participating boundaries considering the cumulative impacts of both the Buckeye II and Buckeye Wind projects?

A.12. In general, the combined sound emissions from both projects would have an ostensible effect on the community that is similar to that of the Buckeye II project operating by itself in the sense that all non-participating residences remain outside of the 44 dBA sound contour (the nominal design limit) and the assumed design goal of 50 dBA is met at nearly all adjoining property lines. As with the case of the Buckeye II project operating alone, 16 of the turbines would need to be operated in low noise mode to achieve this result. In this or any scenario, low noise operation is not required from any of the Buckeye I turbines to meet the 44 dBA design goal.

Q.13. Do you believe that the Buckeye II project as designed will result in acceptable operational noise levels at non-participating properties?

A.13. Yes, for the reasons alluded to above where I describe our recommendation that a mean sound level of 45 dBA is a fair and reasonable regulatory noise limit for wind projects in rural areas. Our study of operating projectsⁱⁱⁱ suggests that the rate of complaints for a project sound level between 40 and 45 dBA is about 2% of the total population (i.e. those within 2000 ft. of a turbine), meaning, inversely, that the apparent acceptance rate is on the order of 98%.

Q.14. Does this opinion remain the same if both the Buckeye II and Buckeye Wind projects are constructed?

A.14. Yes.

Q.15. Have you reviewed the Staff Report of Investigation issued in this proceeding?

A.15. Yes.

Q.16. On Page 59 of the Report, Staff recommends a condition (Condition 49) that in effect limits the project sound level to 44 dBA at night at non-participating receptors. Do you believe that the Applicant can comply with this condition?

A.16. As our modeling indicates, the mean project sound level is predicted to be less than 44 dBA (39 dBA plus 5 dBA) at all non-participating residences at the critical wind speed. Consequently, when measured over a period of days or weeks, as wind project sound levels typically are during compliance tests, I would expect the mean level to agree with the predictions. However, it is critical to understand that it is impractical for any wind project to maintain a sound level below a given threshold all of the time under all conditions. The actual sound level will vary above and below the mean predicted level due to naturally unsteady and uncontrollable wind and weather conditions with the result that there may be intermittent, short-term excursions, usually lasting no more than 10 to 20 minutes, that exceed 44 dBA by some amount. It is also important to realize that the models indicates that the mean project sound levels are predicted to be less than 44 dBA (39 dBA plus 5 dBA) at all non-participating residences at the critical wind speed. This means that at higher wind speeds, the project sound levels may be higher than 44 dBA, but they would be less than 5 dBA above the Leq for that higher wind speed. In fact, at 9 m/s, the mean nighttime Leq, without project generated sound, is 45 dBA. Consequently, while fully meeting the intent and spirit of Condition 49, the project would most likely be unable to meet a strict reading of the condition as it is currently, and probably unintentionally, written. As a concession to the simple realities of the situation, I would suggest amending the condition to read: "The facility shall be operated so that the facility noise contribution, other than during short-term excursions, does not result in

noise levels at the exterior of any currently existing non-participating residence that exceed the greater of: (a) the project area ambient nighttime *Leq* (39 dBA) plus five dBA; or, (b) the validly measured ambient *Leq* plus five dBA at the exterior of any currently non-participating residence. After commencement of commercial operation, the Applicant shall conduct further review of the impact and possible mitigation of all project-related noise complaints through its complaint resolution process.” Note that this suggested revision more clearly defines the point of application as at ‘non-participating residences’ rather than at ‘sensitive receptors’, which is somewhat vague.

Q.17. Does this conclude your direct testimony?

A.17. Yes.

References

ⁱ Bowdler, R. & Leventhall, G. Editors, “Wind Turbine Noise”, Multi-Science Press, Essex, UK, 2011, Chapter 7 *Measuring and Analyzing Wind Turbine Noise*.

ⁱⁱ *American Nation Standard Quantities and Procedures for Description and Measurement of Environmental Sound – Part 2: Measurement of Long-term, Wide-Area Sound*, ANSI S12.9-1992/Part 2 (R2008), Acoustical Society of America, New York, NY, 2008.

ⁱⁱⁱ Hessler, D. M., Hessler, G. F., “Recommended noise level design goals and limits at residential receptors for wind turbine developments in the United States”, *Noise Control Engineering Journal*, J. 59 (1), Jan-Feb 2011.

^{iv} National Association of Regulatory Utility Commissioners (NARUC), *Best Practices Guidelines for Assessing Sound Emissions from Proposed Wind Farms & Measuring the Performance of Completed Projects*, Oct. 2011 (<http://www.naruc.org/Grants/default.cfm?page=10>).

CERTIFICATE OF SERVICE

I hereby certify that a copy of the foregoing document was served upon the following parties of record via electronic mail on this 31st day of October, 2012.

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in

Case No(s). 12-0160-EL-BGN

**Summary: Motion for Leave to File INSTANTER Amended Testimony of David M. Hessler
electronically filed by Ms. Miranda R Leppla on behalf of Champaign Wind LLC**

BEFORE THE
PUBLIC SERVICE COMMISSION OF WISCONSIN

Application of Highland Wind Farm, LLC, for a
Certificate of Public Convenience and Necessity
to Construct a 102.5 Megawatt Wind Electric Generation
Facility and Associated Electric Facilities, to be Located
In the Towns of Forest and Cylon, St. Croix County,
Wisconsin

Docket No. 2535-CE-100

EX.-CW-HESSLER-4

Please enter the attached exhibit, previously marked as Ex.-CW-Hessler-4, *Low frequency noise and infrasound from wind turbines*, by Robert D. O'Neal, Robert D. Hellweg Jr., and Richard M. Lampeter, NOISE CONTROL ENGINEERING JOURNAL, vol. 59, no. 2 (Mar.-Apr. 2011).

Noise Control Engineering Journal

— An International Publication —

Volume 59, Number 2

March-April 2011

AUTOMOTIVE NOISE

Variability of automotive interior noise from engine sources

E. Hills, N. S. Ferguson and
B. R. Mace

DAMPING ON SHIPS

Measurement of spray-on damping effectiveness and application to bow thruster noise on ships

Jesse Spence

WIND TURBINES

Low frequency noise and infrasound from wind turbines

Robert D. O'Neal,
Robert D. Hellweg, Jr. and
Richard M. Lampeter

TUBE RESONATORS

Experimental validation of the 1-D acoustical model for conical concentric tube resonators with moving medium

P. Chaitanya and M. L. Munjal

TRANSMISSION LOSSES

Interference effects in field measurements of airborne sound insulation of building facades

Umberto Berardi, Ettore Cirillo
and Francesco Martellotta

HVAC SYSTEMS

Aero-acoustic predictions of industrial dashboard HVAC systems

Stéphane Détry, Julien Manera,
Yves Detandt and Diego d'Udekem

OPEN-PLAN OFFICES

Open-plan office noise levels, annoyance and countermeasures in Egypt

Sayed Abas Ali

JET TEST STAND

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Wei Hua Ho, Jordan Gilmore and
Mark Jermy

TRAFFIC NOISE

Dynamic traffic noise simulation at a signalized intersection among buildings

F. Li, M. Cai, J. K. Liu and Z. Yu

BOOK REVIEW

Speech Dereverberation

Seismic Design of Buildings to Eurocode 8
Auditorium Acoustics and Architectural Design, 2nd Edition
Technology for a Quieter America

Patrick A. Naylor and
Nikolay D. Gaubitch
Ahmed Y. Elghazouli
Michael Barron
The National Academy of Engineering

INCE

Published by the Institute of Noise Control Engineering of the USA

Low frequency noise and infrasound from wind turbines

Robert D. O'Neal^{a)}, Robert D. Hellweg Jr.^{b)} and Richard M. Lampeter^{b)}

(Received: 5 October 2010; Revised: 7 January 2011; Accepted: 8 January 2011)

A common issue raised with wind energy developers and operators of utility-scale wind turbines is whether the operation of their wind turbines may create unacceptable levels of low frequency noise and infrasound. In order to answer this question, one of the major wind energy developers commissioned a scientific study of their wind turbine fleet. The study consisted of three parts: 1) a world-wide literature search to determine unbiased guidelines and standards used to evaluate low frequency sound and infrasound, 2) a field study to measure wind turbine noise outside and within nearby residences, and 3) a comparison of the field results to the guidelines and standards. Wind turbines from two different manufacturers were measured at an operating wind farm under controlled conditions with the results compared to established guidelines and standards. This paper presents the results of the low frequency noise and infrasound study. Since the purpose of this paper is to report on low frequency and infrasound emissions, potential annoyance from other aspects of wind turbine operation were not considered, and must be evaluated separately. © 2011 Institute of Noise Control Engineering.

Primary subject classification: 14.5.4; Secondary subject classification: 21.8.1

1 INTRODUCTION

Early down-wind wind turbines in the US created low frequency noise; however current up-wind wind turbines generate considerably less low frequency noise. Epsilon Associates, Inc. ("Epsilon") was retained by NextEra Energy Resources, LLC ("NextEra"), formerly FPL Energy, to investigate whether the operation of their wind turbines may create unacceptable levels of low frequency noise and infrasound. This question has often been posed to NextEra, and other wind energy developers and operators of utility-scale wind turbines. NextEra is one of the world's largest generators of wind power with approximately 7,600 net megawatts (MW) in operation as of July 2010.

The project was divided into three tasks: 1) literature search, 2) field measurement program, and 3) comparison to criteria. Epsilon conducted an extensive literature search of the technical and scientific literature on the effects of low-frequency noise and infrasound and existing criteria in order to evaluate low-frequency noise and infrasound from wind turbines. After

completion of the literature search and selection of criteria, a field measurement program was developed to measure wind turbine noise to compare to the selected criteria.

The frequency range 20–20,000 Hz is commonly described as the range of "audible" noise. The frequency range of low frequency sound is generally from 20 Hertz (Hz) to 200 Hz, and the range below 20 Hz is often described as "infrasound". However, audibility extends to frequencies below 20 Hz.

Low frequency sound has several definitions. American National Standards ANSI/ASA S12.2¹ and ANSI S12.9 Part 4² have provisions for evaluating low frequency noise, and these special treatments apply only to sounds in the octave bands with 16, 31.5, and 63-Hz mid-band frequencies. For these reasons, in this paper on wind turbine noise, we use the term "low frequency noise" to include 12.5 Hz–200 Hz with emphasis on the 16 Hz, 31 Hz and 63 Hz octave bands with a frequency range of 11 Hz to 89 Hz.

International Electrotechnical Commission (IEC) standard 60050-801:1994³ defines "infrasound" as "Acoustic oscillations whose frequency is below the low frequency limit of audible sound (about 16 Hz)." This definition is *incorrect* since sound remains audible at frequencies well below 16 Hz provided that the sound level is sufficiently high. In this paper we define infrasound to be below 20 Hz, which is the limit for the standardized threshold of hearing. Since there is no sharp

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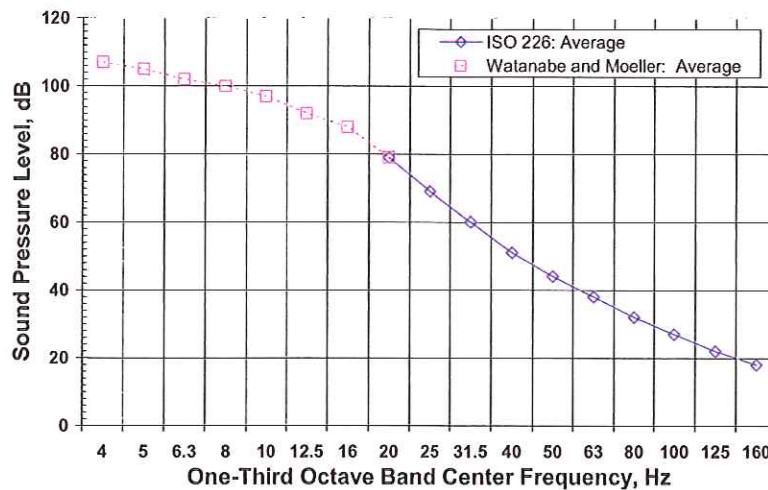


Fig. 1—Low frequency average threshold of hearing from ISO 226⁶ and Watanabe and Moeller⁷.

change in hearing at 20 Hz, the division into “low-frequency sound” and “infrasound” should only be considered “practical and conventional.”

2 EFFECTS AND CRITERIA OF LOW FREQUENCY SOUND AND INFRASOUND

We performed an extensive world-wide literature search of over 100 scientific papers, technical reports and summary reports on low frequency sound and infrasound—hearing, effects, measurement, and criteria. Leventhall⁴ presents an excellent and comprehensive study on low frequency noise from all sources and its effects. The Leventhall report also presents criteria in place at that time, which does not include some of the more recently developed ANSI/ASA standards on outdoor environmental noise and indoor sounds.

The United States government does not have specific criteria for low frequency noise. The US Environmental Protection Agency (EPA) has guidelines for the protection of public health with an adequate margin of safety in terms of annual average A-weighted day-night average sound level (L_{dn}), but there are no corrections or adjustments for low frequency noise. The US Department of Transportation (DOT) has A-weighted sound pressure level criteria for highway projects and airports, but these do not have adjustments for low frequency noise. The following sections describe the low frequency and infrasound criteria to which wind turbine sounds are compared in later sections.

2.1 Threshold of Hearing and Audibility

Moeller and Pedersen⁵ present an excellent summary on human perception of sound at frequencies below 200 Hz. The ear is the primary organ for sensing infrasound. Hearing becomes gradually less sensitive for

decreasing frequencies. But, humans with a normal hearing organ can perceive infrasound at least down to a few hertz if the sound level is sufficiently high.

The threshold of hearing is standardized for frequencies down to 20 Hz⁶. Based on extensive research and data, Moeller and Pedersen propose normal hearing thresholds for frequencies below 20 Hz; however, their proposed threshold is higher than that obtained by Watanabe and Moeller⁷. To be conservative, we have used the data from Watanabe and Moeller⁷ for the region below 20 Hz. (See Fig. 1.) Moeller and Pedersen⁵ suggest that the curve for low frequency thresholds for normal hearing is “probably correct within a few decibels, at least in most of the frequency range.”

The hearing thresholds show considerable variability from individual to individual with a standard deviation among subjects of about 5 dB independent of frequency between 3 Hz and 1000 Hz with a slight increase at 20–50 Hz. This implies that the audibility threshold for 97.5% of the population is greater than the values in Fig. 1 minus 10 dB and for 84% of the population is greater than the values in Fig. 1 minus 5 dB. Moeller and Pedersen suggest that the “pure-tone threshold can with a reasonable approximation be used as a guideline for the thresholds also for [low frequency] non-sinusoidal sounds”⁵; ISO 226 has thresholds for frequencies at and above 20 Hz and approximately equates the thresholds and equal loudness contours for non-sinusoidal sounds to those in the standard for sinusoidal sounds⁶.

As frequency decreases below 20 Hz, if the noise source is tonal, the tonal sensation ceases. Below 20 Hz tones are perceived as discontinuous. Below 10 Hz it is possible to perceive the single cycles of a tone, and the perception changes into a sensation of pressure at the ears.

Below 100 Hz, the dynamic range of the auditory system decreases with decreasing frequency, and the compressed dynamic range has an effect on equal loudness contours: a slight change in sound level can change the perceived loudness from barely audible to loud. This combined with the large variation in individual hearing may mean that a low frequency sound that is inaudible to some may be audible to others, and may be relatively loud to some of those for whom it is audible. Loudness for low frequency sounds grows considerably faster above threshold than for sounds at higher frequencies⁵.

Non-auditory perception of low frequency and infrasound occurs only at levels above the auditory threshold. In the frequency range of 4–25 Hz and at “levels 20–25 dB above [auditory] threshold it is possible to feel vibrations in various parts of the body, e.g., the lumbar, buttock, thigh and calf regions. A feeling of pressure may occur in the upper part of the chest and the throat region” [emphasis added]⁵.

2.2 ANSI S12.9-Parts 4 and 5—Evaluating Outdoor Environmental Sound

American National Standard ANSI/ASA S12.9-2007/Part 5⁸ has an informative annex which provides guidance for designation of land uses compatible with existing or predicted annual average adjusted day-night average outdoor sound level (DNL). Ranges of the DNL are outlined, within which a specific region of compatibility may be drawn. These ranges take into consideration the noise reduction in sound level from outside to inside buildings as commonly constructed in that locality and living habits there. There are adjustments to day-night average sound level to account for the presence of low frequency noise, and the adjustments are described in ANSI S12.9 Part 4, which use a sum of the sound pressure levels in octave bands with center frequencies of 16, 31 and 63 Hz.

ANSI S12.9/Part 4 identifies two thresholds: annoyance is minimal when the 16, 31.5 and 63 Hz octave band sound pressure levels are each less than 65 dB and there are no rapid fluctuations of the low frequency sounds. The second threshold is for increased annoyance which begins when rattles occur, which begins at L_{LF} 70–75 dB. L_{LF} is 10 times the logarithm of the ratio of time-mean square sound pressure in the 16, 31.5, and 63-Hz octave bands divided by the square of the reference sound pressure.

The adjustment procedure for low frequency noise to the average annual A-weighted sound pressure level in ANSI S12.9/Part 4 uses a different and more complicated metric and procedure (Equation D.1) than those used for evaluating low frequency noise in rooms contained in ANSI/ASA S12.2. (See Sec. 2.3). Since

we are evaluating low frequency noise and not A-weighted sound levels, we do not recommend using the procedure for adjusting A-weighted levels. Instead we recommend using the following two guidelines from ANSI S12.9/Part 4: a sound pressure level of 65 dB in each of the 16-, 31.5-, and 63 Hz octave bands as an indicator of minimal annoyance, and 70–75 dB for the summation of the sound pressure levels from these three bands as an indicator of possible increased annoyance from rattles.

2.3 ANSI/ASA S12.2—Evaluating Room Noise

ANSI/ASA S12.2-2008¹ discusses criteria for evaluating room noise, and has two separate provisions for evaluating low frequency noise: (1) the potential to cause perceptible vibration and rattles, and (2) meeting low frequency portions of room criteria curves. Since the ANSI S12.2 criteria are for indoor sounds, in order to determine equivalent outdoor criteria for comparison to outdoor measurements, data from Sutherland⁹ and Hubbard and Shephard¹⁰ were used to determine typical noise reductions from outdoor to indoor with windows open. (The Appendix of this paper describes the noise reductions used to determine equivalent outdoor criteria to indoor criteria.) Table A1 presents octave band noise reductions applied in this evaluation along with the average low frequency octave band noise reductions from outdoor to indoors from Refs. 9 and 10 for open and closed windows. Table A2 presents the one-third octave band noise reductions applied in the analysis that were determined in the same manner using data from the same references.

Vibration and Rattles: Outdoor low frequency sounds of sufficient amplitude can cause building walls to vibrate and windows to rattle. Homes have low values of transmission loss at low frequencies, and low frequency noise of sufficient amplitude may be audible within homes. Window rattles are not low frequency noise, but may be caused by low frequency noise. ANSI/ASA S12.2 presents limiting levels at low frequencies for assessing (a) the probability of *clearly* perceptible acoustically induced vibration and rattles in lightweight wall and ceiling constructions, and (b) the probability of *moderately* perceptible acoustically induced vibration in similar constructions. The limiting sound pressure levels in the octave bands with center frequencies of 16, 31.5 and 63 Hz are presented in Table 1.

Applying the outdoor to indoor attenuations for wind turbine sources with windows open given in the last row of Table A1 to the ANSI/ASA S12.2 indoor sound pressure levels in Table 1 yields the equivalent

Table A1—Average low frequency octave band home noise reductions from outdoor to indoors in dB (from Ref. 9 and 10).

Noise Source	Window condition	Octave Band Center Frequency			
		16 Hz	31.5 Hz	63 Hz	125 Hz
Average aircraft and traffic sources	Closed windows	16	15	18	20
Average aircraft and traffic sources	Open windows	(11)*	(10)*	12	11
Average Wind Turbine	Closed windows	8	11	14	18
Average Wind Turbine	Open windows	(3)**	(6)**	9+	9+

* No data are available for windows open below 63 Hz octave band. The values for 16 Hz and 31 Hz were obtained by subtracting the difference between the levels for 63 Hz closed and open conditions to the 16 and 31 Hz closed values.

+ Used in this paper to determine equivalent outdoor criteria from indoor criteria in Tables 2 and 4

outdoor sound pressure levels that are consistent with the indoor criteria and are presented in Table 2.

Room Criteria Curves: ANSI/ASA S12.2 has three primary methods for evaluating the suitability of noise within rooms: a survey method—A-weighted sound levels, an engineering method—noise criteria (NC) curves, and a method for evaluating low-frequency fluctuating noise using room noise criteria (RNC) curves. ANSI/ASA S12.2 states “The RNC method

should be used to determine noise ratings when the noise from HVAC systems at low frequencies is loud and is suspected of containing sizeable *fluctuations or surging*.” [emphasis added] The NC curves are appropriate to evaluate low frequency noise from wind turbines in homes since wind turbine noise does not have significant fluctuating low frequency noise sufficient to warrant using RNC curves and since A-weighted sound levels do not adequately determine

Table A2—Average low frequency one-third octave band noise reduction in dB for homes from outdoor to indoors.

Condition	One-Third Octave Band Center Frequency, Hz												
	10	12.5	16	20	25	31.5	40	50	63	80	100	125	160
Open Window*	2	2	3	4	4.5	5	7	8	9	9	9	9	9
Average Closed Window with wind turbines ¹⁰	8	7	8	8	8	11	13	14	15	12	18	18	18

* Used to determine equivalent outdoor levels as shown in Table 7.

** Used to determine equivalent outdoor levels as shown in Table 9.

Table 1—ANSI/ASA S12.2 measured interior sound pressure levels for perceptible vibration and rattle in lightweight wall and ceiling structures.¹

Condition	Octave-band center frequency (Hz)		
	16	31.5	63
Clearly perceptible vibration and rattles likely	75 dB	75 dB	80 dB
Moderately perceptible vibration and rattles likely	65 dB	65 dB	70 dB

Table 2—Equivalent outdoor sound pressure levels to the ANSI/ASA S12.2 indoor sound pressure levels for perceptible vibration and rattle in lightweight wall and ceiling structures for wind turbines.

Condition	Octave-band center frequency (Hz)		
	16	31.5	63
Clearly perceptible vibration and rattles likely	78 dB	81 dB	89 dB
Moderately perceptible vibration and rattles likely	68 dB	71 dB	79 dB

if there are low frequency problems. [ANSI/ASA S12.2, Sec. 5.3 gives procedures for determining if there are large fluctuations of low frequency noise.]

Annex C.2 of ANSI/ASA S12.2 contains recommended room criteria curves for bedrooms, which are the rooms in homes with the most stringent criteria: NC and RNC criteria curve between 25 and 30. The recommended NC and RNC criteria for schools and private rooms in hospitals are the same. The values of the sound pressure levels in the 16–125 Hz octave bands for NC curves 25 and 30 are shown in Table 3. Applying the outdoor to indoor attenuations for wind turbine sources with windows open given in the last row of Table A1 to the ANSI/ASA S12.2 indoor sound pressure levels for NC-25 and NC-30 in Table 3 yields the equivalent outdoor sound pressure levels that are consistent with the indoor criteria and are presented in Table 4.

ANSI/ASA S12.2 also presents a method to determine if the levels below 500 Hz octave band are too high in relation to the levels in the mid-frequencies which could create a condition of “spectrum imbalance”. The method for this evaluation is:

- Calculate the speech interference level (SIL) for the measured spectrum. [SIL is the arithmetic average of the sound pressure levels in the 500, 1000, 2000 and 4000 Hz octave bands.] Select the NC curve equal to the SIL value with a symbol NC(SIL).
- Plot the measured spectra and the NC curve equal to the SIL value on the same graph and

Table 3—ANSI/ASA S12.2 low frequency octave band sound pressure levels for noise criteria curves NC-25 and NC-30. [Table 1 from Ref. 1].

NC Criteria	Octave-band-center frequency, Hz			
	16	31.5	63	125
NC-25	80	65	54	44
NC-30	81	68	57	48

determine the differences between the two curves in the octave bands below 500 Hz.

- Estimate the likelihood that the excess low-frequency levels will annoy occupants of the space using Table 5.

2.4 Other Criteria

2.4.1 World Health Organization (WHO)

No specific low frequency noise criteria are proposed by the WHO. The Guidelines for Community Noise report¹¹ mentions that if the difference between

Table 4—Equivalent outdoor sound pressure levels to the ANSI/ASA S12.2 low frequency octave band sound pressure levels for noise criteria curves NC-25 and NC-30. [Table 1 from Ref. 1].

NC Criteria	Octave-band-center frequency, Hz			
	16	31.5	63	125
NC-25	83	71	63	53
equivalent outdoor				
NC-30	84	74	66	57
equivalent outdoor				

Table 5—Measured sound pressure level deviations from an NC (SIL) curve that may lead to serious complaints¹.

Octave-band frequency, Hz=>	Measured Spectrum—NC(SIL), dB			
	31.5	63	125	250
Possible serious dissatisfaction	*	6–9	6–9	6–9
Likely serious dissatisfaction	*	>9	>9	>9

* Insufficient data available to evaluate

Table 6—DEFRA proposed criteria¹³ for the assessment of low frequency noise disturbance: Indoor L_{eq} one-third sound pressure levels for non-steady and steady low frequency sounds.

Location	One-Third Octave Band Center Frequency, Hz												
	10	12.5	16	20	25	31.5	40	50	63	80	100	125	160
Non-Steady L_{eq} , dB	92	87	83	74	64	56	49	43	42	40	38	36	34
Steady L_{eq} , dB	97	92	88	79	69	61	54	48	47	45	43	41	39

the C-weighted sound level and A-weighted sound level is greater than 10 decibels, then a frequency analysis should be performed to determine if there is a low frequency issue. A document prepared for the World Health Organization states that “there is no reliable evidence that infrasounds below the hearing threshold produce physiological or psychological effects. Infrasounds slightly above detection threshold may cause perceptual effects but these are of the same character as for ‘normal’ sounds. Reactions caused by extremely intense levels of infrasound can resemble those of mild stress reaction and may include bizarre auditory sensations, describable as pulsation and flutter”¹².

2.4.2 The UK Department for Environment, Food, and Rural Affairs (DEFRA)

The report prepared by the University of Salford for the UK Department for Environment, Food, and Rural Affairs (DEFRA) on low frequency noise proposed one-third octave band sound pressure level L_{eq} criteria and procedures for assessing low frequency noise¹³. The guidelines are based on complaints of disturbance from low frequency sounds and are intended to be used by Environmental Health Officers.

Existing low frequency noise criteria from several countries were reviewed and experiences with low frequencies complaints were considered in developing the proposed guidelines. The criteria are “based on

5 dB below the ISO 226 average threshold of audibility for steady [low frequency] sounds.” However, the DEFRA criteria are at 5 dB lower than ISO 226 only at 20–31.5 Hz; at higher frequencies the criteria are equal to the Swedish criteria which are higher levels than ISO 226 less 5 dB. For frequencies lower than 20 Hz, DEFRA uses the thresholds from Ref. 7 less 5 dB.

The DEFRA criteria are based on measurements in an unoccupied room, and it was noted by a practicing consultant that measurements should be made with windows closed¹⁴. However, we conservatively used windows open conditions for our assessment to determine equivalent outdoor criteria since the DEFRA measurement procedure does not explicitly state measurements are with windows closed. If the low frequency sound is “steady” then the criteria may be relaxed by 5 dB. A low frequency noise is considered steady if either $L_{10}-L_{90} < 5$ dB or the rate of change of sound pressure level (Fast time weighting) is less than 10 dB per second in the third octave band which exceeds the criteria by the greatest margin.

Applying indoor to outdoor one-third octave band transfer functions for open windows (as presented in Table A2 from analysis of data in Refs. 9 and 10) yields *equivalent* one-third octave band sound pressure level proposed DEFRA criteria for outdoor sound levels. Table 6 presents the indoor DEFRA proposed criteria for non-steady and steady low-frequency sounds. Table

Table 7—Equivalent outdoor L_{eq} one-third sound pressure levels for non-steady and steady sounds to the DEFRA indoor criteria¹³ for the assessment of low frequency noise disturbance.

Location	One-Third Octave Band Center Frequency, Hz												
	10	12.5	16	20	25	31.5	40	50	63	80	100	125	160
Non-Steady Equivalent outdoor L_{eq} , dB	94	89	86	78	68.5	61	56	51	51	49	47	45	43
Steady Equivalent Outdoor* L_{eq}	99	94	91	83	73.5	66	61	56	56	54	52	50	48

* With windows open

Table 8—Japan Ministry of Environment Guidance for evaluating complaints of low frequency noise: Reference one-third octave band sound pressure level values for complaints of rattling.

Location	One-Third Octave Band Center Frequency, Hz										
	5	6.3	8	10	12.5	16	20	25	31.5	40	50
Outdoor L_{eq} , dB	70*	71*	72*	73	75	77	80	83	87	93	99

* The reference values are several dB lower than the supporting data contained in Ref. 15. At 5 Hz, window rattles started at about 74 dB in one study and 79 dB in another; at 6.3 Hz, rattles started at 74 dB in the first study and at 78 dB in the second; and at 8 Hz, window rattle started at 74 dB in the first study and 77 dB in the second study.

7 presents the DEFRA equivalent outdoor criteria for non-steady and steady low frequency sounds.

2.4.3 Japan Ministry of Environment

The Japan Ministry of Environment has published a handbook to deal with low frequency noise problems and has established reference values for guidance in dealing with complaints of rattling windows and doors and complaints of “mental and physical discomfort”¹⁵. It was noted that traditional Japanese houses have relatively light-weight and sensitive windows and partitions¹⁶.

Table 8 presents the Japanese reference outdoor one-third octave band sound pressure level values for guidance in dealing with complaints of rattling from environmental sounds from 5 Hz to 50 Hz. From 10 Hz to 50 Hz the guidance levels are equal to the observed threshold of rattles from two studies with a total of 78 samples. However, for the bands centered at 5, 6.3 and 8 Hz, the reference values are several dB lower than the supporting data contained in these two studies¹⁵. At 5 Hz, the lowest observed window rattle was at 74 dB in one study and 79 dB in another; at 6.3 Hz, rattles started at 74 dB in the first study and at 78 dB in the second; and at 8 Hz, window rattle started at 74 dB in the first study and 77 dB in the second study. Thus the reference values at 5, 6.3 and 8 Hz in Table 8 are conservative in comparison to the other values by 4, 3, and 2 dB respectively.

Table 9 presents the Japanese reference one-third octave band sound pressure level values for guidance in dealing with complaints of mental and physical discomfort from environmental sounds when evaluated indoors. Evaluation measurements are to be performed with windows closed to the outside. The values in Table 9 are less stringent than the DEFRA values in Table 6 for non-steady sounds but more stringent than the DEFRA values for steady sounds in some one-third octave bands. In order to obtain equivalent outdoor sound levels, the average noise reduction from wind turbine noise with windows closed from Ref. 10 was applied to the Japan reference values. Table 9 presents the Japanese indoor reference values, the noise reduc-

tions for windows closed¹⁰ and the equivalent outdoor reference values. These equivalent outdoor values are less stringent than the equivalent outdoor DEFRA values in Table 7 for both non-steady sounds and steady sounds except for the 80 Hz band in which the Japanese level is 1 dB more stringent than the DEFRA level for steady sounds.

2.4.4 C-weighted minus A-weighted ($L_{pC} - L_{pA}$)

Leventhall⁴ and others indicate that the difference in C-weighted and A-weighted sound pressure levels can be a predictor of annoyance. Leventhall states that if ($L_{pC} - L_{pA}$) is greater than 20 dB there is “a potential for a low frequency noise problem.” He further states that ($L_{pC} - L_{pA}$) cannot be a predictor of annoyance but is a simple indicator that further analysis may be needed. This is due in part to the fact that the low frequency noise may be inaudible even if ($L_{pC} - L_{pA}$) is greater than 20 dB.

3 LITERATURE REVIEW

The authors performed an extensive literature search of over 100 scientific papers, technical reports and summary reports on low frequency sound and infrasound—hearing, effects, measurement, and criteria. The following paragraphs briefly summarize the findings from some of these papers and reports.

3.1 Leventhall

Leventhall⁴ presents an excellent study on low frequency noise from all sources and its effects. The report presents criteria in place at that time and includes data relating cause and effects. Leventhall¹⁷ reviewed data and allegations on alleged problems from low frequency noise and infrasound from wind turbines, and concluded the following: “It has been shown that there is insignificant infrasound from wind turbines and that there is normally little low frequency noise.” “Turbulent air inflow conditions cause enhanced levels of low frequency noise, which may be disturbing, but the overriding noise from wind turbines is the fluctuating audible swish, mistakenly referred to

Table 9—Japan Ministry of Environment Guidance for evaluating complaints of low frequency noise: Reference one-third octave band sound pressure level values for complaints of mental and physical discomfort.

Location	One-Third Octave Band Center Frequency, Hz									
	10	12.5	16	20	25	31.5	40	50	63	80
Indoor L_{eq} , dB	92	88	83	76	70	64	57	52	47	41
Noise Reduction*, dB	8	7	8	8	8	11	13	14	15	12
Equivalent Outdoor L_{eq} , dB	100	95	91	84	78	75	70	66	62	53

* from Hubbard¹⁰ windows closed condition

as “infrasound” or “low frequency noise”. “Infrasound from wind turbines is below the audible threshold and of no consequence”. Other studies have shown that wind turbine generated infrasound levels are below threshold of perception and threshold of feeling and body reaction.

3.2 DELTA

The Danish Energy Authority project on “low frequency noise from large wind turbines” comprises a series of investigations in the effort to give increased knowledge on low frequency noise from wind turbines¹⁸. One of the conclusions of the study is that wind turbines do not emit audible infrasound, with levels that are “far below the hearing threshold.” Audible low frequency sound may occur both indoors and outdoors, “but the levels in general are close to the hearing and/or masking level.” “In general the noise in the critical band up to 100 Hz is below both thresholds”. The final report notes that for road traffic noise (in the vicinity of roads) the low frequency noise levels are higher [than wind turbine] both indoors and outdoors.

3.3 Hayes McKenzie Partnership

Hayes McKenzie Partnership Ltd performed a study for the UK Department of Trade & Industry (DTI) to investigate complaints of low frequency noise that came from three of the five farms with complaints out of 126 wind farms in the UK¹⁴. The study concluded that:

- Infrasound associated with modern wind turbines is not a source which will result in noise levels that are audible or which may be injurious to the health of a wind farm neighbor.
- Low frequency noise was measureable on a few occasions, but below DEFRA criteria. Wind turbine noise may result in indoor noise levels

within a home that is just above the threshold of audibility; however, it was lower than that of local road traffic noise.

- The common cause of the complaints was not associated with low frequency noise but the occasional audible modulation of aerodynamic noise, especially at night.
- The UK Department of Trade and Industry, which is now the UK Department for Business Enterprise and Regulatory Reform (BERR), summarized the Hayes McKenzie report: “The report concluded that there is no evidence of health effects arising from infrasound or low frequency noise generated by wind turbines.”¹⁹.

3.4 Howe

Howe performed extensive studies on wind turbines and infrasound and concluded that infrasound was not an issue for modern wind turbine installations—“while infrasound can be generated by wind turbines, it is concluded that infrasound is not of concern to the health of residences located nearby.”²⁰. Since then Gastmeier and Howe²¹ investigated an additional situation involving the alleged “perception of infrasound by individual.” In this additional case, the measured indoor infrasound was at least 30 dB below the audibility threshold given by Ref. 7 as presented in Fig. 1.

3.5 Branco

Branco and other Portuguese researchers have studied possible physiological affects associated with high amplitude low frequency noise and have labeled these alleged effects as “Vibroacoustic Disease” (VAD)²². “Vibroacoustic disease (VAD) is a whole-body, systemic pathology, characterized by the abnormal proliferation of extra-cellular matrices, and caused by excessive exposure to low frequency noise.”

Hayes^{23,24} concluded that levels from wind farms are not likely to cause VAD after comparing noise levels from alleged VAD cases to noise levels from wind turbines in homes of complainers. Noise levels in aircraft in which VAD has been hypothesized are considerably higher than wind turbine noise levels. Hayes also concluded that it is “unlikely that symptoms will result through induced internal vibration from incident wind farm noise.”²³ Other studies have found no VAD indicators in environmental sound that have been alleged by VAD proponents²⁵.

3.6 French National Academy of Medicine

In 2006, the French National Academy of Medicine recommended²⁶ “as a precaution construction should be suspended for wind turbines with a capacity exceeding 2.5 MW located within 1500 m of homes.” [emphasis added] However, this precaution is not because of definitive health issues but because:

- Sound levels one km from some wind turbine installations “occasionally exceed allowable limits” for France (note that the allowable limits are long term averages).
- French prediction tools for assessment did not take into account sound levels created with wind speeds greater than 5 m/s.
- Wind turbine noise has been compared to aircraft noise (even though the sound levels of wind turbine noise are significantly lower), and exposure to high level aircraft noise “involves neurobiological reactions associated with an increased frequency of hypertension and cardiovascular illness. Unfortunately, no such study has been done near wind turbines.”²⁷

In March 2008, the French Agency for Environmental and Occupational Health Safety (AFSSET) published a report on “the health impacts of noise generated by wind turbines”, commissioned by the Ministries of Health and Environment in June 2006 following the report of the French National Academy of Medicine in March 2006²⁸. The AFSSET study recommends that one does not define a fixed minimum distance between wind farms and homes, but rather to model the acoustic impact of the project on a case-by-case basis. One of the conclusions of the AFSSET report is: “The analysis of available data shows: The absence of identified direct health consequences concerning the auditory effects or specific effects usually associated with exposure to low frequencies at high level.” (“L’analyse des données disponibles met en évidence: L’absence de conséquences sanitaires directes recensées en ce qui concerne les effets auditifs, ou les effets spécifiques généralement attachés à l’exposition à des basses fréquences à niveau élevé.”).

4 FIELD PROGRAM

Two types of utility-scale wind turbines were studied for this field program. These two turbines are among the most commonly used in the NextEra fleet: General Electric (GE) 1.5sle (1.5 MW), and Siemens SWT-2.3-93 (2.3 MW).

Sound levels for these wind turbine generators (WTGs) vary as a function of wind speed from cut-in wind speed to maximum sound level. Cut-in wind speed for the GE 1.5sle wind turbine is 3.5 m/s while the Siemens wind turbine has a cut-in wind speed of 4 m/s. Maximum reference sound power levels for the GE 1.5sle and Siemens 2.3-93 are approximately 104 dB and 105 dB respectively as provided by the manufacturer. These sound power levels are reached at electrical output levels of approximately 924 kW and 1767 kW for the GE and Siemens units, respectively. Under higher wind speeds, the sound levels from the wind turbines do not increase although electrical power output does continue to increase up to the rated power of each wind turbine (1500 kW and 2300 kW respectively).

Each wind turbine manufacturer has an uncertainty factor “K” of 2 dB to guarantee the turbine’s sound power level. (K accounts for both measurement variations and production variation²⁹.) The results presented later in this paper include sound power values which have added the manufacturer’s K value to the reference values, that is, 2 dB above the expected reference levels for the measured wind conditions and power output.

Real-world data were collected from operating wind turbines to compare to the low frequency noise guidelines and criteria discussed previously in Sec. 2. These data sets consisted of outdoor measurements at various reference distances, and concurrent indoor/outdoor measurements at residences within the wind farm.

NextEra provided access to the Horse Hollow Wind Farm in Taylor and Nolan Counties, Texas in November 2008 to collect data on the GE 1.5sle and Siemens SWT-2.3-93 wind turbines. The portion of the wind farm used for testing is relatively flat with no significant terrain. The land around the wind turbines is rural and primarily used for agriculture and cattle grazing. The siting of the sound level measurement locations was chosen to minimize local noise sources except the wind turbines and the wind itself. Hub height for these wind turbines is 80 meters above ground level (AGL).

Two of the authors collected sound level and wind speed data over the course of one week under a variety of operational conditions. Weather conditions were dry the entire week with ground level winds ranging from calm to 12.5 m/s (28 mph) over a 1-minute average. In order to minimize confounding factors, the data collection tried to focus on periods of maximum sound levels from

the wind turbines (moderate to high hub height winds) and light to moderate ground level winds.

Ground level (2 meters AGL) wind speed and direction were measured continuously at one representative location. Wind speeds near hub height were also measured continuously using the permanent meteorological towers maintained by the wind farm.

A series of simultaneous interior and exterior sound level measurements were made at four houses owned by participating landowners within the wind farm. Two sets were made of the GE WTGs, and two sets were made of the Siemens WTGs. Data were collected with both windows open and windows closed. Due to the necessity of coordinating with the homeowners in advance, and reasonable restrictions on time of day to enter their homes, the interior/exterior measurement data sets do not always represent ideal conditions. However, enough data were collected to compare to the criteria and draw conclusions on low frequency noise.

Sound level measurements were also made simultaneously at two reference distances from a string of wind turbines under a variety of wind conditions. Using the manufacturer's sound power level data, calculations of the sound pressure levels as a function of distance in flat terrain were made to aid in deciding where to collect data in the field. Based on this analysis, two distances from the nearest wind turbine were selected—305 meters (1,000 feet) and 457 meters (1,500 feet)—and were then used where possible during the field program. Distances much larger than 457 meters (1,500 feet) were not practical since an adjacent turbine string could then be closer and affect the measurements, or would put the measurements beyond the boundaries of the wind farm property owners. Brief background sound level measurements were conducted several times during the program whereby the Horse Hollow Wind Farm operators were able to shutdown the nearby WTGs for a brief (20 minutes) period. This was done in real time using cell phone communication.

All the sound level measurements described above were attended. One series of unattended overnight measurements was made at two locations for approximately 15 hours to capture a larger data set. One measurement was set up approximately 305 meters (1,000 feet) from a GE 1.5sle WTG and the other was set up approximately 305 meters (1,000 feet) from a Siemens WTG. The location was chosen based on the current wind direction forecast so that the sound level equipment would be downwind for the majority of the monitoring period. By doing this, the program was able to capture periods of strong hub-height winds and moderate to low ground-level winds.

All sound levels were measured using two Norsonic Model Nor140 precision sound analyzers, equipped

with a Norsonic-1209 Type 1 Preamplifier, a Norsonic-1225 half-inch microphone and a 7-inch Aco-Pacific untreated foam windscreen Model WS7. The instrumentation meets the "Type 1—Precision" requirements set forth in American National Standards Institute (ANSI) S1.4 for acoustical measuring devices³⁰. The microphone was tripod-mounted at a height of 1.5 meters (five feet) above ground. The measurements included simultaneous collection of broadband (A-weighted) and one-third-octave band data (3.15 hertz to 20,000 hertz bands). Sound level data were primarily logged in 10-minute intervals to be consistent with the wind farm's Supervisory Control And Data Acquisition (SCADA) system which provides electrical power output (kW) in 10-minute increments. A few sound level measurements were logged using 20-minute intervals for use in determining home transmission loss values. The meters were calibrated and certified as accurate to standards set by the National Institute of Standards and Technology. These calibrations were conducted by an independent laboratory within the past 12 months. Ground level wind speed and direction were measured with a HOBO H21-002 micro weather station (Onset Computer Corporation). The wind data were sampled every three seconds and logged every one minute.

5 RESULTS AND COMPARISON TO CRITERIA

Results from the field program are organized by wind turbine type. For each wind turbine type, results are presented per location type (outdoor or indoor) with respect to applicable criteria. Results are presented for 305 meters (1,000) feet from the nearest wind turbine. Data were also collected at 457 meters (1,500 feet) from the nearest wind turbine which showed lower sound levels. Therefore, wind turbines that met the criteria at 305 meters also met it at 457 meters. Data were collected under both high turbine output and moderate turbine output conditions (defined as sound power levels 2 or 3 dB less than the maximum sound power levels), and low ground-level wind speeds. The sound level data under the moderate conditions were equivalent to or lower than the high turbine output scenarios, thus confirming the conclusions from the high output cases. None of the operational sound level data were corrected for background noise. A-weighted sound power levels presented in this section (used to describe turbine operation) were estimated from the actual measured power output (kW) of the wind turbines and the sound power levels as a function of wind speed plus an uncertainty factor K of 2 dB.

Outdoor measurements are compared to criteria for audibility, for UK DEFRA disturbance using equivalent outdoor levels, for rattle and annoyance criteria as

Table 10—Summary of operational parameters—
Siemens SWT-2.3-93 (Outdoor).

Parameter	Sample #34	Sample #39
Distance to nearest WTG	305 meters	305 meters
Time of day	22:00-22:10	22:50-23:00
WTG power output	1,847 kW	1,608 kW
A-weighted sound power level*	107 dB	106.8 dB
Measured wind speed @ 2 m	3.3 m/s	3.4 m/s
L_{Aeq}	49.4 dB	49.6 dB
L_{A90}	48.4 dB	48.6 dB
L_{Ceq}	63.5 dB	63.2 dB

* Includes K, uncertainty factor of 2 dB

contained in ANSI S12.9/Part 4, for evaluating complaints of rattling using Japan Ministry of Environment guidance, and for perceptible vibration using equivalent outdoor levels from ANSI/ASA S12.2. Indoor measurements are compared to criteria for audibility, for UK DEFRA disturbance, for evaluating complaints of mental and physical discomfort using Japan Ministry of Environment guidance, and for suitability of bedrooms, hospitals and schools and perceptible vibration from ANSI/ASA S12.2.

5.1 Siemens SWT-2.3-93

5.1.1 Outdoor measurements—Siemens SWT-2.3-93

Sound levels during six 10-minute periods of high wind turbine output and relatively low ground wind speed (which minimized effects of wind noise) were measured outdoors approximately 305 meters (1,000 feet) from the closest Siemens WTG. This site was actually part of a string of 15 WTGs, four of which were within 610 meters

(2,000 feet) of the monitoring location. Representative sound level data from two 10-minute periods are presented herein and include contributions from all wind turbines as measured by the recording equipment. One data set is representative of time periods with low frequency sound level values near the maximum measured and the other data set is representative of the mean. The standard deviations for the low frequency one-third octave band levels for the six measurement periods were between 0.2–0.7 dB. The key operational and meteorological parameters during these two measurement periods are listed in Table 10.

Figure 2 plots the one-third octave band sound levels (L_{eq}) for both samples of high output conditions. The results show that infrasound is inaudible to even the most sensitive people 305 meters (1,000 feet) from these wind turbines (more than 20 dB below the median thresholds of hearing). Low frequency sound above 40 Hz may be audible depending on background sound levels.

Figure 3 plots the one-third octave band sound levels (L_{eq}) for both samples of high output conditions. The low frequency sound was “steady” according to DEFRA procedures, and the results show that all outdoor equivalent DEFRA disturbance criteria are met.

Figure 4 compares the one-third octave band sound levels (L_{eq}) for both samples of high output conditions to the Japan Ministry of Environment levels for evaluating complaints on rattle. The rattle criteria is met at all frequencies except at 5 Hz where the mean value is 1 dB (standard deviation of 0.4 dB) higher than the Japanese evaluation value. When one considers that the 5 Hz sound level is 3 dB lower than the observed threshold of rattle, one concludes that the Japanese criteria are met.

The measured outdoor sound levels also meet the outdoor equivalent Japan Ministry of Environment

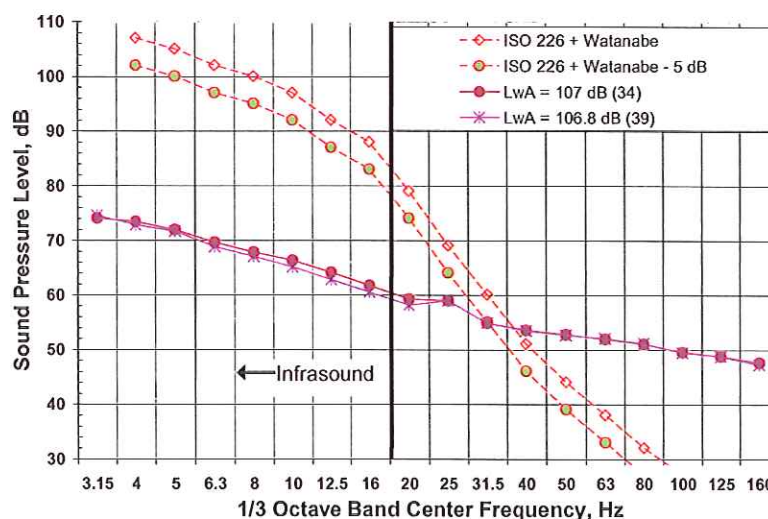


Fig. 2—Siemens SWT-2.3-93 wind turbine outdoor sound levels at 305 meters compared to audibility criteria.

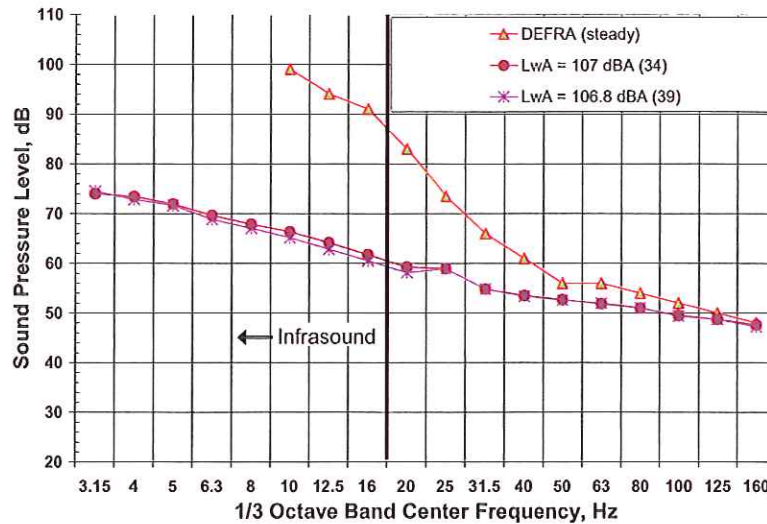


Fig. 3—Siemens SWT-2.3-93 wind turbine outdoor sound levels at 305 meters compared to outdoor equivalent DEFRA criteria.

criteria for evaluating complaints of mental and physical discomfort. This comparison is not presented in a figure since these criteria are generally less stringent than the DEFRA criteria.

Figure 5 plots the 16, 31.5, 63, and 125 Hz octave band sound levels (L_{eq}) for both samples of high output conditions. The results show that all outdoor equivalent ANSI/ASA S12.2 perceptible vibration criteria are met. In addition, the results show that all outdoor equivalent ANSI/ASA S12.2 low frequency NC-25 and NC-30 criteria for bedrooms are met. The low frequency sound levels are below the ANSI S12.9 Part 4 thresholds for the beginning of rattles (16, 31.5, 63 Hz total less than 70 dB). The 31.5 and 63 Hz sound levels are below the level of 65 dB identified for minimal annoyance in ANSI S12.9 Part 4,

and the 16 Hz sound level is within 1.5 dB of this level, which is an insignificant increase since the levels were not rapidly fluctuating.

5.1.2 Indoor measurements—Siemens SWT-2.3-93

Simultaneous outdoor and indoor measurements were made at two residences at different locations within the wind farm to determine indoor audibility of low frequency noise from Siemens WTGs. In each house a 10-minute measurement was made in a room facing the wind turbines with a window both open and closed. Results from the testing at one of the homes are not presented due to the very high ground level winds

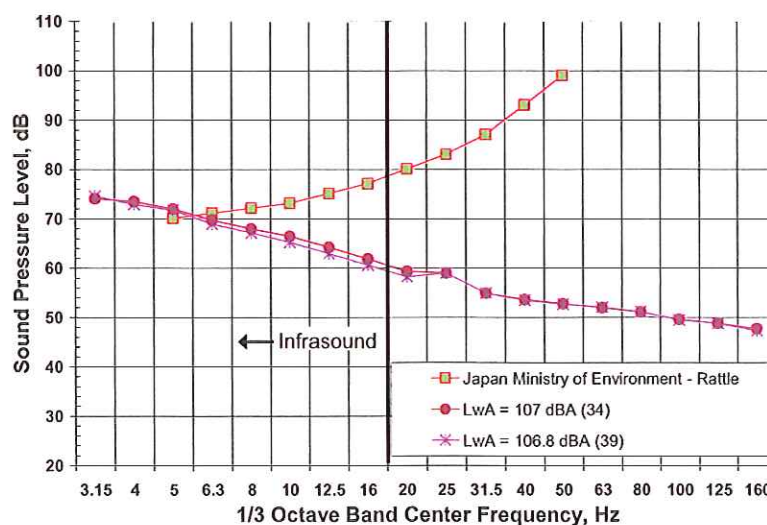


Fig. 4—Siemens SWT-2.3-93 wind turbine outdoor sound levels at 305 meters compared to Japan Ministry of Environment rattle criteria.

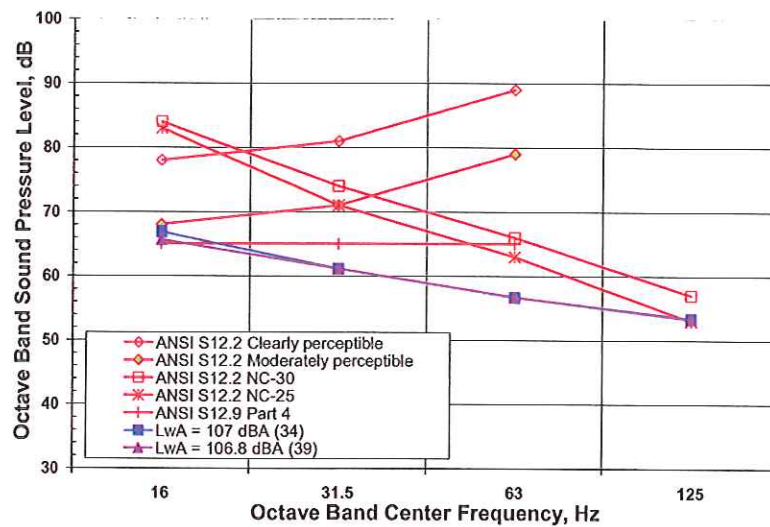


Fig. 5—Siemens SWT-2.3-93 wind turbine outdoor sound levels at 305 meters compared to ANSI criteria.

(~ 9 m/s) which dominated the sound environment. The remaining residence is designated Home “A” and was approximately 323 meters (1,060 feet) from the closest Siemens WTG. The home was near a string of multiple WTGs, four of which were within 610 meters (2,000 feet) of the house. The sound level data presented herein include contributions from all wind turbines as measured by the recording equipment. The key operational and meteorological parameters during these measurements are listed in Table 11.

The room in Home “A” where interior measurements were made had the following characteristics: approximately 3.6 meters wide (12 feet) by 4.9 meters long (16 feet), no furniture, carpeted flooring, two relatively new double-hung windows (no storm windows), sheetrock interior walls, and clapboard exterior walls. The sound level meter was located in the center of the room.

Figure 6 plots the indoor one-third octave band sound levels (L_{eq}) for Home “A”. The results show that infrasound is inaudible to even the most sensitive people approximately 1,000 feet from these wind turbines with

the windows open or closed (more than 20 dB below the median thresholds of hearing). Low frequency sound at or above 50 Hz may be audible depending on background sound levels.

Figure 7 plots the indoor one-third octave band sound levels (L_{eq}) for Home “A”. The low frequency sound was “steady” according to DEFRA procedures under the window open condition, and the results show that all indoor DEFRA disturbance criteria are met.

Although not shown in Fig. 7, the one-third octave band levels meet the Japan Ministry of Environment criteria for evaluating complaints of mental and physical discomfort since in the frequency range of the Japan criteria both samples meet the more stringent DEFRA criteria for “non-steady” sounds, which is more stringent than the Japan criteria.

Figure 8 plots the indoor 16 Hz to 125 Hz octave band sound levels (L_{eq}) for Home “A”. The results show the ANSI/ASA S12.2 low frequency criteria for perceptible vibration were easily met for both windows open and closed scenarios. The ANSI/ASA S12.2 low frequency NC-25 and NC-30 criteria for bedrooms, classrooms and hospitals were met, the spectrum was balanced, and the criteria for moderately perceptible vibrations in light-weight walls and ceilings were also met.

Table 11—Summary of operational parameters—Siemens SWT-2.3-93 (Indoor).

Parameter	Home “A” (closed/open)
Distance to nearest WTG	323 meters
Time of day	07:39-07:49/07:51-08:01
WTG power output	1,884 kW/1564 kW
A-weighted sound power level*	107 dB/106.7 dB
Measured wind speed @ 2 m	3.2 m/s/3.7 m/s
L_{Aeq}	33.8 dB/38.1 dB
L_{A90}	28.1 dB/36.8 dB
L_{Ceq}	54.7 dB/57.1 dB

* Includes K, uncertainty factor of 2 dB

5.2 GE 1.5sle

5.2.1 Outdoor measurements—GE 1.5sle

Sound level data during twelve 10-minute periods of high wind turbine output and relatively low ground wind speed (which minimized effects of wind noise) were measured outdoors approximately 305 meters (1,000 feet) from the closest GE 1.5sle WTG. This site was actually part of a string of more than 30 WTGs, four of which were within 610 meters (2,000 feet) of the

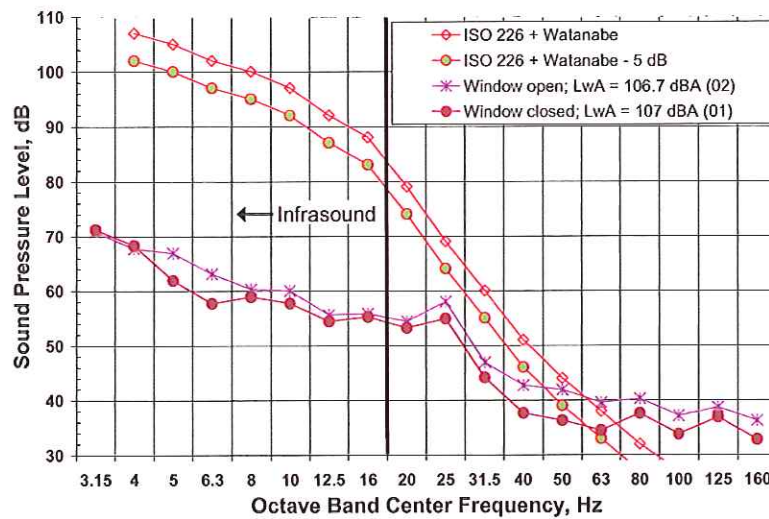


Fig. 6—Siemens SWT-2.3-93 wind turbine indoor sound levels at 323 meters compared to audibility criteria (Home “A”).

monitoring location. Representative sound level data from two 10-minute periods are presented herein and include contributions from all wind turbines as measured by the recording equipment. One data set is representative of time periods with low frequency sound level values near the maximum and the other data set is representative of the mean. The standard deviations for the low frequency one-third octave band levels for the twelve measurement periods were between 0.3–1.9 dB with the largest variation in the 10–16 Hz bands and the lowest at 160 Hz. The key operational and meteorological parameters for these two measurement periods are listed in Table 12.

Figure 9 plots the one-third octave band sound levels (L_{eq}) for both samples of high output conditions. The results show that infrasound is inaudible to even the most

sensitive people 305 meters (1,000 feet) from these wind turbines (more than 20 dB below the median thresholds of hearing). Low frequency sound at and above 31.5–40 Hz may be audible depending on background sound levels.

Figure 10 plots the one-third octave band sound levels (L_{eq}) for both samples of high output conditions. The low frequency sound was “steady” according to DEFRA procedures, and the results show the low frequency sound meet or are within 1 dB of outdoor equivalent DEFRA disturbance criteria.

Figure 11 compares the one-third octave band sound levels (L_{eq}) for both samples of high output conditions to the Japan Ministry of Environment levels for evaluating complaints on rattle. The rattle criteria is met at all

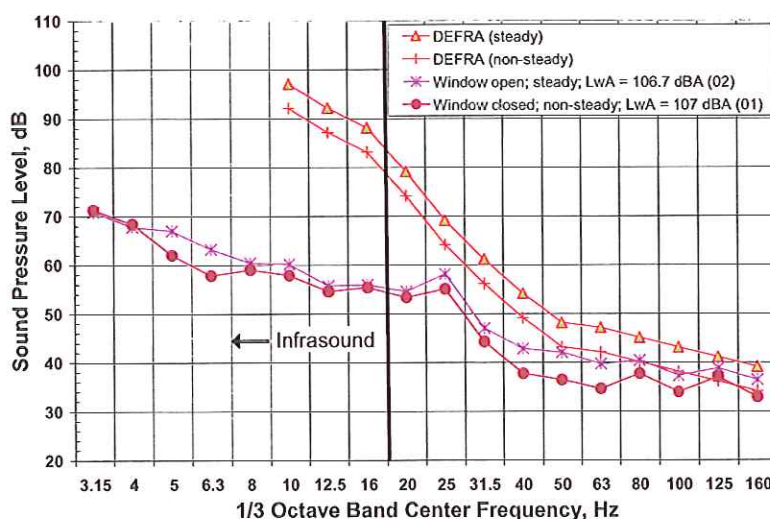


Fig. 7—Siemens SWT-2.3-93 wind turbine indoor sound levels at 323 meters compared to DEFRA criteria (Home “A”).

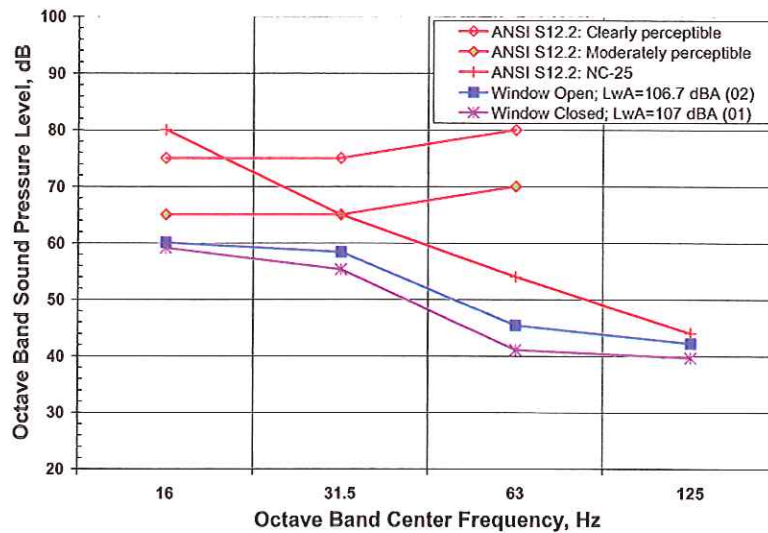


Fig. 8—Siemens SWT-2.3-93 wind turbine indoor sound levels at 323 meters compared to ANSI 12.2 criteria for perceptible vibrations and NC-25 (Home “A”).

frequencies; at 5 Hz the mean value is 70 dB (standard deviation=0.9 dB), while the two presented measure-

Table 12—Summary of operational parameters—GE 1.5sle (Outdoor).

Parameter	Sample #46	Sample #51
Distance to nearest WTG	305 meters	305 meters
Time of day	23:10-23:20	00:00-00:10
WTG power output	1,293 kW	1,109 kW
A-weighted sound power level*	106 dB	106 dB
Measured wind speed @ 2 m	4.1 m/s	3.3 m/s
L_{Aeq}	50.2 dB	50.7 dB
L_{A90}	49.2 dB	49.7 dB
L_{Ceq}	62.5 dB	62.8 dB

* Includes K, uncertainty factor of 2 dB

ments are approximately 1 dB higher, an insignificant increase. When one considers that the 5 Hz sound level is 3 dB lower than the observed threshold of rattle, one concludes that the Japanese criteria are met.

The measured outdoor sound levels also meet the outdoor equivalent Japan Ministry of Environment criteria for evaluating complaints of mental and physical discomfort. This comparison is not presented in a figure since these criteria are generally less stringent than the DEFRA criteria.

Figure 12 plots the 16, 31.5, 63 and 125 Hz octave band sound levels (L_{eq}) for both samples of high output conditions. The results show that all outdoor equivalent ANSI/ASA S12.2 perceptible vibration criteria are met. The results show that all outdoor equivalent ANSI/ASA S12.2 low frequency NC-25 and NC-30 criteria for

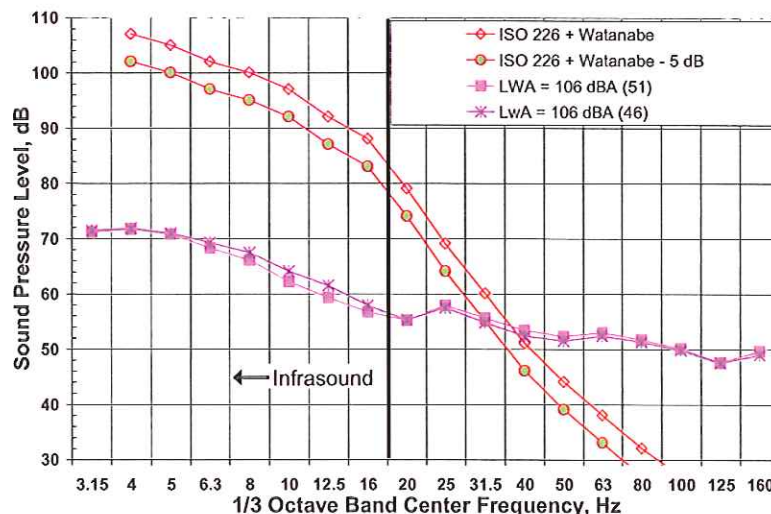


Fig. 9—GE 1.5sle wind turbine outdoor sound levels at 305 meters compared to audibility criteria.

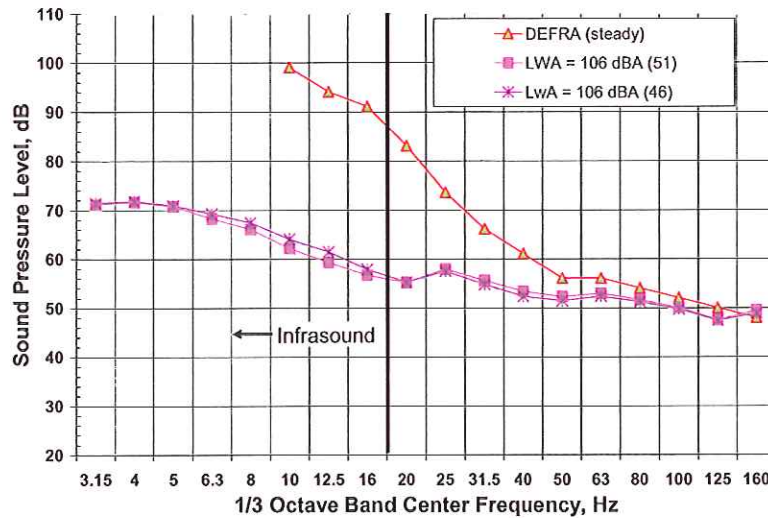


Fig. 10—GE 1.5sle wind turbine outdoor sound levels at 305 meters compared to outdoor equivalent DEFRA criteria.

bedrooms are met. The low frequency sound levels are below the ANSI S12.9 Part 4 thresholds for the beginning of rattles (16, 31.5, 63 Hz total less than 70 dB). The 16, 31.5, 63 Hz sound levels are below the level of 65 dB identified for minimal annoyance in ANSI S12.9 Part 4.

5.2.2 Indoor measurements—GE 1.5sle

Simultaneous outdoor and indoor measurements were made at two residences at different locations within the wind farm to determine indoor audibility of low frequency noise from GE 1.5sle WTGs. In each house, measurements were made in a room facing the wind turbines, and were made with a window both open and closed. These residences are designated Homes “B” and “C” and were approximately

305 meters (1,000 feet) from the closest GE WTG. Operational conditions were maximum turbine noise and high ground winds at Home “B”, and within 1.5 dB of maximum turbine noise and high ground level winds at Home “C”. Home “B” was near a string of multiple WTGs, four of which were within 610 meters (2,000 feet) of the house, while Home “C” was at the end of a string of WTGs, two of which were within 610 meters of the house. The sound level data presented herein include contributions from all wind turbines as measured by the recording equipment. The key operational and meteorological parameters during these measurements are listed in Table 13.

The room in Home “B” where interior measurements were made had the following characteristics:

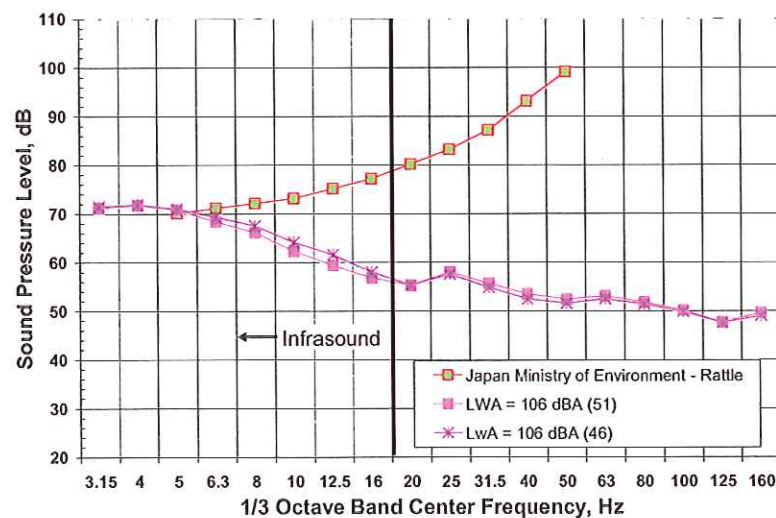


Fig. 11—GE 1.5sle wind turbine outdoor sound levels at 305 meters compared to Japan Ministry of Environment rattle criteria.

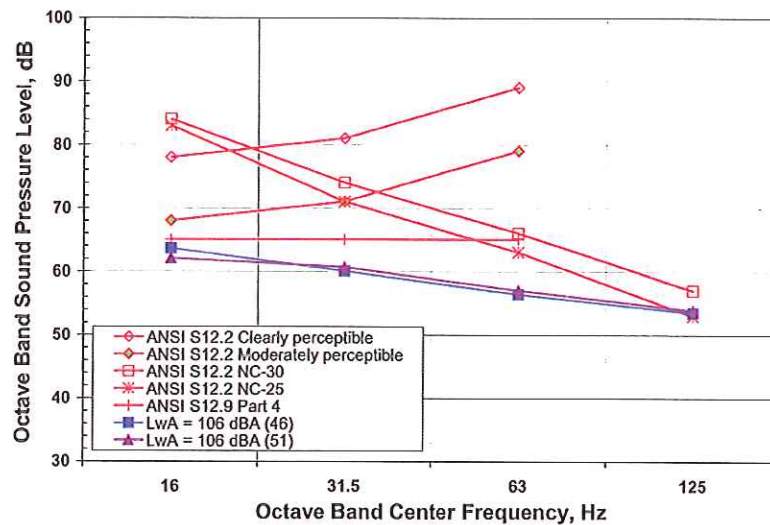


Fig. 12—GE 1.5sle wind turbine outdoor sound levels at 305 meters compared to ANSI criteria.

approximately 3.0 meters wide (10 feet) by 3.6 meters long (12 feet), bedroom furniture, carpeted flooring, two relatively new double-hung windows (no storm windows), paneling on the interior walls, and bricked exterior walls. The sound level meter was located just off-center in the room. The room in Home “C” where interior measurements were made had the following characteristics: approximately 2.4 meters wide (8 feet) by 3.6 meters long (12 feet), bathroom fixtures, linoleum flooring, one old casement window (no storm window), paneling on the interior walls, and wooden exterior walls. The sound level meter was located in the center of the room.

Figure 13 plots the indoor one-third octave band sound levels (L_{eq}) for Home “B”, and Fig. 14 plots the indoor one-third octave band sound levels for Home “C”. The results show that infrasound is inaudible to even the most sensitive people at around 305 meters (1,000 feet) from these wind turbines with the windows open or closed (more than 20 dB below the median thresholds of hearing). Low frequency sound at and above 63 Hz may be audible depending on background sound levels.

Figure 15 plots the indoor one-third octave band sound levels (L_{eq}) for Home “B”, and Fig. 16 plots the indoor one-third octave band sound levels (L_{eq}) for Home “C”. The results show the DEFRA disturbance criteria were met for steady and non-steady low frequency sounds.

Although not shown in Figs. 15 and 16, the one-third octave band levels meet the Japan Ministry of Environment criteria for evaluating complaints of mental and physical discomfort since both samples meet the more stringent DEFRA criteria for “non-steady” sounds, which is more stringent than the Japan criteria.

Figure 17 plots the indoor 16 Hz to 125 Hz octave band sound levels (L_{eq}) for Home “B”, and Fig. 18 plots the indoor 16 Hz to 125 Hz octave band sound levels (L_{eq}) for Home “C”. The results show the ANSI/ASA S12.2 low frequency criteria for perceptible vibration were met for both windows open and closed scenarios. The ANSI/ASA S12.2 low frequency NC-25 and NC-30 criteria for bedrooms, classrooms and hospitals were met,

Table 13—Summary of operational parameters—GE 1.5sle (Indoor).

Parameter	Home “B” (closed/open)	Home “C” (closed/open)
Distance to nearest WTG	290 meters	312 meters
Time of day	09:29-09:39/09:40-09:50	11:49-11:59/12:00-12:10
WTG power output	1,017 kW/896 kW	651 kW/632 kW
A-weighted sound power level	106 dB/105.8 dB	104.7 dB/104.6 dB
Measured wind speed @ 2 m	6.2 m/s/6.8 m/s	6.4 m/s/5.9 m/s
L_{Aeq}	27.1 dB/36.0 dB	33.6 dB/39.8 dB
L_{A90}	23.5 dB/33.7 dB	27.6 dB/34.2 dB
L_{Ceq}	47.1 dB/54.4 dB	50.6 dB/55.1 dB

* Includes K, uncertainty factor of 2 dB

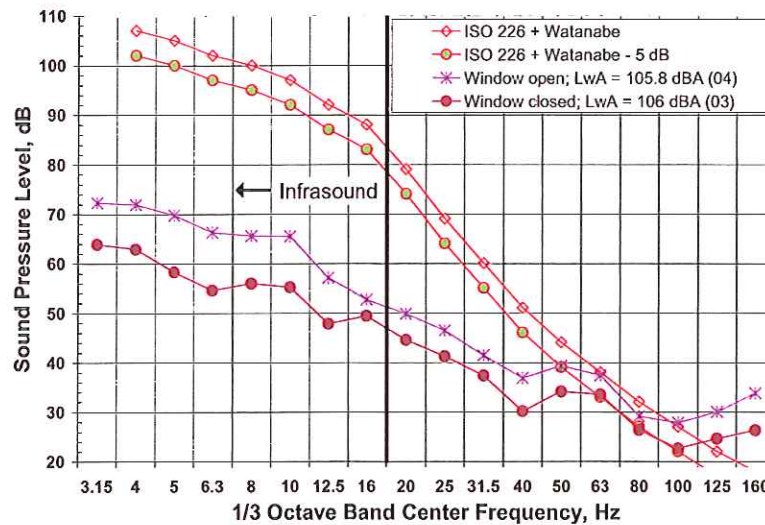


Fig. 13—GE 1.5sle wind turbine indoor sound levels at 290 meters compared to audibility criteria (Home “B”).

the spectrum was balanced, and the criteria for moderately perceptible vibrations in light-weight walls and ceilings were also met.

5.3 Noise Reduction from Outdoor to Indoor

Simultaneous outdoor and indoor measurements made at the three residences within the Horse Hollow Wind Farm discussed above, were used to determine noise reductions of the homes for comparison to that used in the determination of equivalent outdoor criteria for indoor criteria, such as ANSI/ASA S12.2 and DEFRA. Indoor measurements were made with windows open and closed. Tables 11 and 13 list the conditions of measurement for these houses.

Figures 19 and 20 present the measured one-third octave band noise reduction for the three homes with windows closed and open, respectively. Also presented in these same figures are the one-third octave noise reductions discussed in the Appendix of this paper to obtain equivalent outdoor criteria for the indoor DEFRA criteria as well as the equivalent outdoor criteria for the Japanese mental and physical discomfort indoor criteria. It can be seen that for the window closed condition in Fig. 19, the measured noise reductions for all houses were greater than that used in our analysis for determining the equivalent outdoor criteria for the Japanese mental and physical discomfort indoor criteria. For the open window case in Fig. 20, which

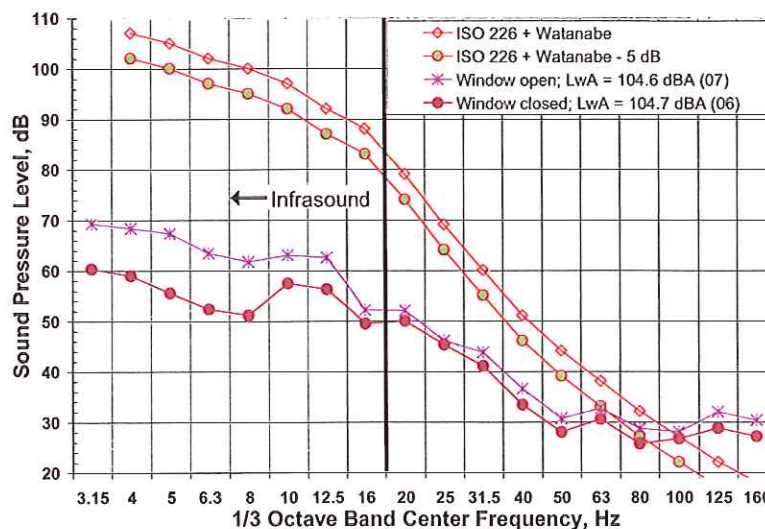


Fig. 14—GE 1.5sle wind turbine indoor sound levels at 312 meters compared to audibility criteria (Home “C”).

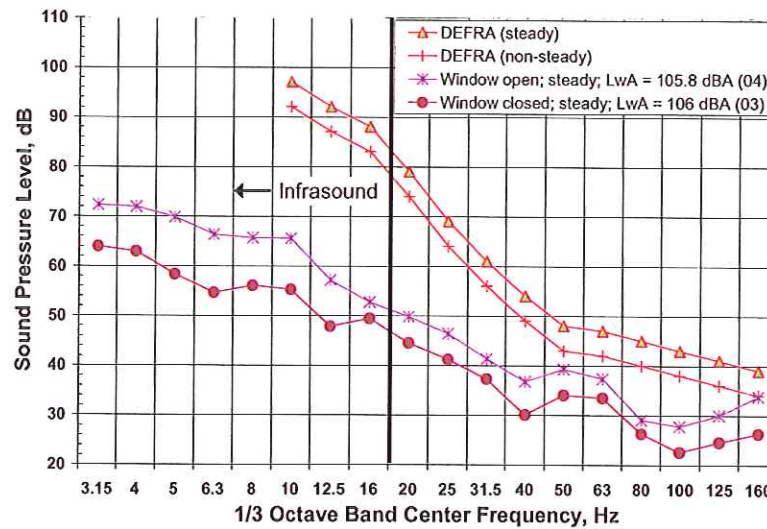


Fig. 15—GE 1.5sle wind turbine indoor sound levels at 290 meters compared to DEFRA criteria (Home "B").

was used in our analysis for obtaining the equivalent outdoor DEFRA criteria, the average of the three homes has a greater noise reduction than assumed in the Appendix and all houses at all frequencies have higher values with one minor exception. Only Home "A" at 25 Hz had a lower noise reduction (3 dB), and this difference is not critical since the measured indoor sounds at 25 Hz at each of these home was significantly lower than the indoor DEFRA criteria and the indoor Japanese criteria. Furthermore, the outdoor measurements for both Siemens and GE wind turbines at 305 meters (1,000 feet) under high output/high noise levels met the equivalent outdoor DEFRA criteria at 25 Hz.

Table 14 presents the measured octave band noise reduction for the three homes with windows closed and open, respectively. Also presented in Table 14 are the

octave band noise reductions used in Table 2 of this paper to obtain equivalent outdoor criteria for the indoor ANSI/ASA S12.2 criteria for perceptible vibration and for NC-25 and NC-30. It can be seen that for the window closed condition, the measured noise reductions for all houses were greater than that used in our analysis. For the open window case, the average of the three homes has a greater noise reduction than the values from Table A1, and all houses at all frequencies have higher values with one minor exception. Only Home "A" at 31 Hz (which contains the 25 Hz one-third octave band) had a lower noise reduction (3 dB), and this difference is not critical since the measured indoor sounds at 31 Hz at each of these homes was significantly lower than the indoor ANSI/ASA S12.2 criteria. Furthermore, the outdoor measurements for both Siemens and GE wind

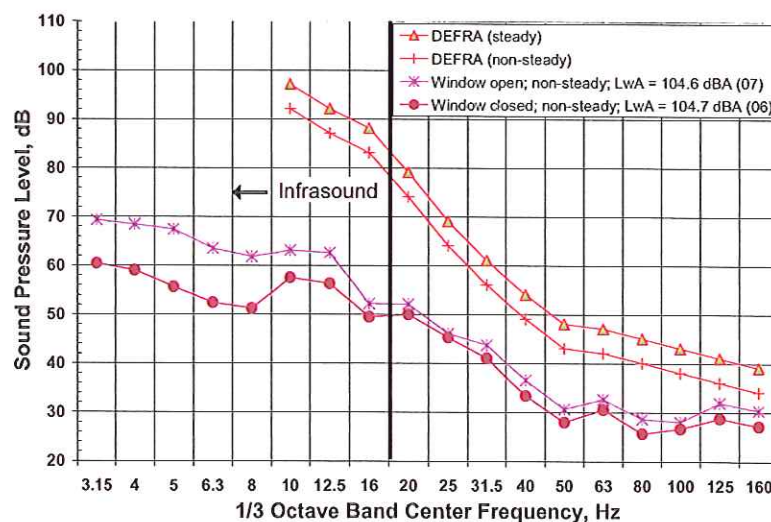


Fig. 16—GE 1.5sle wind turbine indoor sound levels at 312 meters compared to DEFRA criteria (Home "C").



Fig. 17—GE 1.5sle wind turbine indoor sound levels at 290 meters compared to ANSI 12.2 criteria for perceptible vibrations and NC-25 (Home “B”).

turbines at 305 meters (1,000 feet) under high output/high noise levels met the equivalent outdoor ANSI/ASA S12.2 criteria at 31 Hz.

6 CONCLUSION

Sound levels from Siemens SWT 2.93-93 and GE 1.5sle wind turbines under maximum noise conditions at a distance more than 305 meters (1,000 feet) from the nearest residence meet the low frequency and infrasound standards and criteria published by several independent agencies and organizations. At this distance the wind farms:

- meet ANSI/ASA S12.2 indoor levels for low frequency sound for bedrooms, classrooms and hospitals;
- meet ANSI/ASA S12.2 indoor levels for moderately perceptible vibrations in light-weight walls and ceilings;
- meet ANSI/ASA S12.2 criteria for balanced spectrum from low frequency sounds;
- meet ANSI S12.9/Part 4 thresholds for annoyance from low frequency sound and beginning of rattles;
- meet UK DEFRA disturbance based guidelines for low frequency sound;
- meet Japan Ministry of Environment Guidance for evaluating complaints of rattling from low frequency noise;
- meet Japan Ministry of Environment Guidance for evaluating complaints of mental and physi-

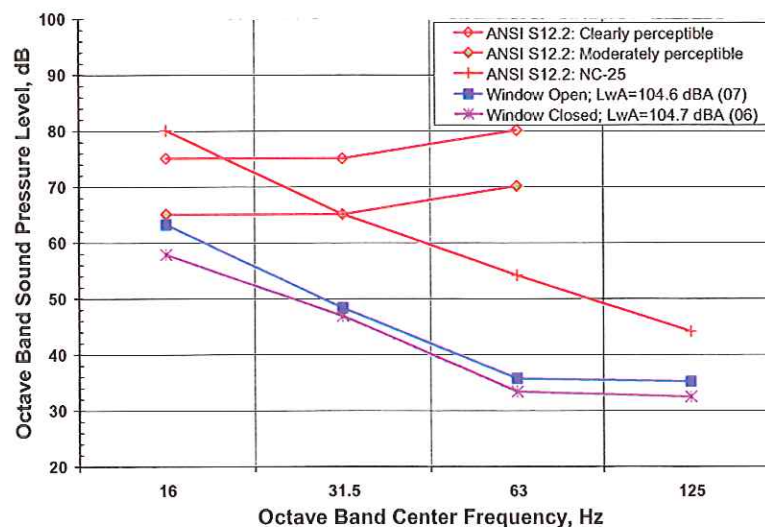


Fig. 18—GE 1.5sle wind turbine indoor sound levels at 312 meters compared to ANSI 12.2 criteria for perceptible vibrations and NC-25 (Home “C”).

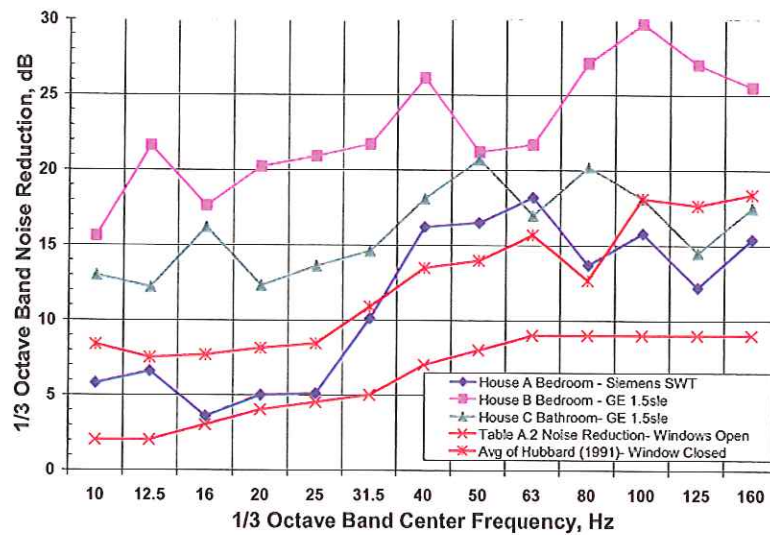


Fig. 19—One-third octave band interior noise reduction—Windows closed.



Fig. 20—One-third octave band interior noise reduction—Windows open.

- cal discomfort from low frequency noise;
- have no audible infrasound to the most sensitive listeners; and
- might have slightly audible low frequency noise at frequencies at 50 Hz and above depending on

other sources of low frequency noises in homes, such as refrigerators or external traffic or airplanes.

In accordance with the above findings, and in conjunction with our extensive literature search of

Table 14—Summary of octave band noise reduction—Interior measurements.

Home	Wind Turbine	Windows	16 Hz	31.5 Hz	63 Hz	125 Hz
A	Siemens SWT-2-3-93	Closed	5	6	16	14
A	Siemens SWT-2-3-93	Open	4	3	12	12
B	GE 1.5sle	Closed	20	22	22	27
B	GE 1.5sle	Open	13	17	18	21
C	GE 1.5sle	Closed	13	14	19	17
C	GE 1.5sle	Open	8	13	17	14
Table A1 Noise Reduction		Open	3	6	9	9

scientific papers and reports, there should be no adverse public health effects from infrasound or low frequency noise at distances greater than 305 meters (1,000 feet) from the wind turbine types measured: GE 1.5sle and Siemens SWT 2.3-93.

7 ACKNOWLEDGMENTS

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8 APPENDIX: HOME NOISE REDUCTION USED TO DETERMINE EQUIVALENT OUTDOOR SOUND PRESSURE LEVEL CRITERIA BASED ON INDOOR CRITERIA

Since indoor measurements are not always possible, for comparison to outdoor sound levels the indoor criteria from ANSI/ASA S12.2 should be adjusted. Outdoor to indoor low frequency noise reductions have been reported by Sutherland for aircraft and highway noise for open and closed windows⁹ and by Hubbard and Shepherd for aircraft and wind turbine noise for closed windows¹⁰. Table A1 presents the average low frequency octave band noise reductions from outdoor to indoors from these two papers for open and closed windows. Sutherland only reported values down to 63 Hz; whereas Hubbard and Shepherd presented values to less than 10 Hz. The closed window conditions of Ref. 10 were used to estimate noise reductions less than 63 Hz by applying the difference between values for open and closed windows from Ref. 9 data at 63 Hz. It should be noted that the attenuation for wind turbines in Ref. 10 is based on only three homes at two different wind farms, whereas the traffic and aircraft data are for many homes. The wind turbine open window values were determined from the wind turbine closed window values by subtracting the difference in values between windows closed and open obtained by Ref. 9.

To be conservative, we use the open window case instead of closed windows except for the adjustments to the Japanese guideline which specifically called for closed windows. To be further conservative, we use the wind turbine noise reduction data in Ref. 10 (adjusted to open windows). However, it should be noted that it is

possible for some homes to have some slight amplification at low frequencies with windows open due to possible room resonances.

The average one-third octave band noise reductions used to determine equivalent outdoor one-third octave band criteria were determined in a similar manner. The first row of Table A2 and Fig. 20 present the average one-third octave band noise reductions values for *windows open* that were used to determine the equivalent outdoor one-third octave band criteria levels in Table 7 from the indoor criteria. The second row of Table A2 and Fig. 19 presents the one-third octave band noise reductions for windows closed determined by Ref. 10 for homes exposed to wind turbine sounds—these higher closed window noise reduction values were only used to determine equivalent outdoor levels for determining the equivalent Japanese guidance one-third octave band sound pressure level values for dealing with complaints of mental and physical discomfort from environmental sounds.

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October 17, 2012

Michael E. Newmark
Administrative Law Judge
Public Service Commission
P.O. Box 7854
Madison, WI 53707

Re: PSC Docket No. 2535-CE-100, Application of Highland Wind Farm, LLC, for a Certificate of Public Convenience and Necessity to Construct a 102.5 Megawatt Wind Electric Generation Facility and Associated Electric Facilities, to be Located in the Towns of Forest and Cylon, St. Croix County, Wisconsin

Dear Judge Newmark:

Clean Wisconsin respectfully requests admission of the exhibit marked as Ex.-Clean Wisconsin-Hessler-4 in the above-mentioned proceeding into the record. This exhibit consists of a scientific, peer-reviewed article by Robert D. O'Neal, Robert D. Hellweg Jr., and Richard M. Lampeter, *Low frequency noise and infrasound from wind turbines*, NOISE CONTROL ENGINEERING JOURNAL, vol. 59, no. 2 (Mar.-Apr. 2011).

Clean Wisconsin's expert witness Mr. David Hessler testified to the accuracy and probative value of this exhibit at the technical hearing on October 10, 2012. Admission of this exhibit was initially denied pending the resolution of Clean Wisconsin's requests to conduct independent low-frequency noise testing at the Glacier Hills Wind Park or the Shirley Wind project in the Town of Glenmore, Wisconsin.

This proposed exhibit represents the most recent and comprehensive scientific information on low frequency noise and infrasound from wind turbines. It consists of three parts: 1) a comprehensive literature review to determine unbiased guidelines and standards used worldwide to test low frequency sound and infrasound; 2) a field study measuring low frequency noise and infrasound and collecting data from two models of operating wind turbines, one of which, the Siemens SWT-2.3-93 (2.3 MW), is similar in size to turbine models being considered by Highland Wind; and 3) a comparison of the field study data to the guidelines and standards. The site of the field study, Horse Hollow Wind Farm in Texas, is a 735.5 MW capacity facility, more

than seven times the proposed capacity of the Highland Wind Farm. The authors conducted measurements outdoors at 1,000-foot and 1,500-foot setback distances from the turbines and concurrent indoor/outdoor measurements at four residences within the footprint of the wind farm.

Although Mr. Hessler intends to conduct low frequency and infrasound noise measurements at the homes of a few residents near Shirley Wind and will enter the results as a separate exhibit in this docket, Mr. Hessler and Clean Wisconsin were unable to obtain permission from either Duke Energies or WEPCO to conduct outdoor measurements at set reference distances comparable to the measurements discussed in this proposed exhibit. Additionally, due to time constraints, Mr. Hessler will not duplicate the thorough review of guidelines and standards for low frequency noise and infrasound worldwide that the exhibit contains.

Because Mr. Hessler's Shirley Wind study will be limited to data which can be collected without the express cooperation of the wind facility owner, this exhibit properly supplements the record on low frequency noise and infrasound in the present case. All parties received copies of this article at the hearing and have since had a full and fair opportunity to review it and share it with their own noise experts. Therefore, Clean Wisconsin respectfully requests that Ex.-Clean Wisconsin-Hessler-4 be admitted into the record at this time.

Sincerely,

/s/ Katie Nekola

Katie Nekola
General Counsel
Clean Wisconsin

Noise Control Engineering Journal

— An International Publication —

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AUTOMOTIVE NOISE

Variability of automotive interior noise from engine sources

E. Hills, N. S. Ferguson and
B. R. Mace

DAMPING ON SHIPS

Measurement of spray-on damping effectiveness and application to bow thruster noise on ships

Jesse Spence

WIND TURBINES

Low frequency noise and infrasound from wind turbines

Robert D. O'Neal,
Robert D. Hellweg, Jr. and
Richard M. Lampeter

TUBE RESONATORS

Experimental validation of the 1-D acoustical model for conical concentric tube resonators with moving medium

P. Chaitanya and M. L. Munjal

TRANSMISSION LOSSES

Interference effects in field measurements of airborne sound insulation of building facades

Umberto Berardi, Ettore Cirillo
and Francesco Martellotta

HVAC SYSTEMS

Aero-acoustic predictions of industrial dashboard HVAC systems

Stéphane Détry, Julien Manera,
Yves Detandt and Diego d'Udekem

OPEN-PLAN OFFICES

Open-plan office noise levels, annoyance and countermeasures in Egypt

Sayed Abas Ali

JET TEST STAND

Reduction of engine exhaust noise in a jet engine test cell

Wei Hua Ho, Jordan Gilmore and
Mark Jermy

TRAFFIC NOISE

Dynamic traffic noise simulation at a signalized intersection among buildings

F. Li, M. Cai, J. K. Liu and Z. Yu

BOOK REVIEW

Speech Dereverberation

Seismic Design of Buildings to Eurocode 8
Auditorium Acoustics and Architectural Design, 2nd Edition
Technology for a Quieter America

Patrick A. Naylor and
Nikolay D. Gaubitch
Ahmed Y. Elghazouli
Michael Barron
The National Academy of Engineering

INCE

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Low frequency noise and infrasound from wind turbines

Robert D. O'Neal^{a)}, Robert D. Hellweg Jr.^{b)} and Richard M. Lampeter^{b)}

(Received: 5 October 2010; Revised: 7 January 2011; Accepted: 8 January 2011)

A common issue raised with wind energy developers and operators of utility-scale wind turbines is whether the operation of their wind turbines may create unacceptable levels of low frequency noise and infrasound. In order to answer this question, one of the major wind energy developers commissioned a scientific study of their wind turbine fleet. The study consisted of three parts: 1) a world-wide literature search to determine unbiased guidelines and standards used to evaluate low frequency sound and infrasound, 2) a field study to measure wind turbine noise outside and within nearby residences, and 3) a comparison of the field results to the guidelines and standards. Wind turbines from two different manufacturers were measured at an operating wind farm under controlled conditions with the results compared to established guidelines and standards. This paper presents the results of the low frequency noise and infrasound study. Since the purpose of this paper is to report on low frequency and infrasound emissions, potential annoyance from other aspects of wind turbine operation were not considered, and must be evaluated separately. © 2011 Institute of Noise Control Engineering.

Primary subject classification: 14.5.4; Secondary subject classification: 21.8.1

1 INTRODUCTION

Early down-wind wind turbines in the US created low frequency noise; however current up-wind wind turbines generate considerably less low frequency noise. Epsilon Associates, Inc. ("Epsilon") was retained by NextEra Energy Resources, LLC ("NextEra"), formerly FPL Energy, to investigate whether the operation of their wind turbines may create unacceptable levels of low frequency noise and infrasound. This question has often been posed to NextEra, and other wind energy developers and operators of utility-scale wind turbines. NextEra is one of the world's largest generators of wind power with approximately 7,600 net megawatts (MW) in operation as of July 2010.

The project was divided into three tasks: 1) literature search, 2) field measurement program, and 3) comparison to criteria. Epsilon conducted an extensive literature search of the technical and scientific literature on the effects of low-frequency noise and infrasound and existing criteria in order to evaluate low-frequency noise and infrasound from wind turbines. After

completion of the literature search and selection of criteria, a field measurement program was developed to measure wind turbine noise to compare to the selected criteria.

The frequency range 20–20,000 Hz is commonly described as the range of "audible" noise. The frequency range of low frequency sound is generally from 20 Hertz (Hz) to 200 Hz, and the range below 20 Hz is often described as "infrasound". However, audibility extends to frequencies below 20 Hz.

Low frequency sound has several definitions. American National Standards ANSI/ASA S12.2¹ and ANSI S12.9 Part 4² have provisions for evaluating low frequency noise, and these special treatments apply only to sounds in the octave bands with 16, 31.5, and 63-Hz mid-band frequencies. For these reasons, in this paper on wind turbine noise, we use the term "low frequency noise" to include 12.5 Hz–200 Hz with emphasis on the 16 Hz, 31 Hz and 63 Hz octave bands with a frequency range of 11 Hz to 89 Hz.

International Electrotechnical Commission (IEC) standard 60050-801:1994³ defines "infrasound" as "Acoustic oscillations whose frequency is below the low frequency limit of audible sound (about 16 Hz)." This definition is *incorrect* since sound remains audible at frequencies well below 16 Hz provided that the sound level is sufficiently high. In this paper we define infrasound to be below 20 Hz, which is the limit for the standardized threshold of hearing. Since there is no sharp

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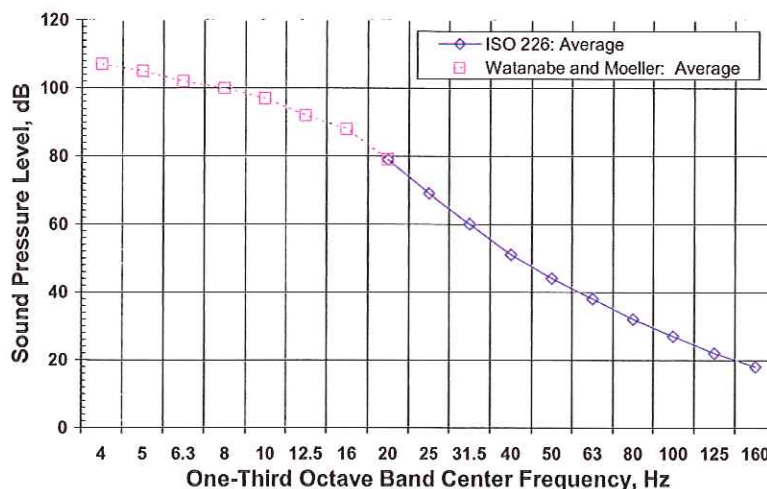


Fig. 1—Low frequency average threshold of hearing from ISO 226⁶ and Watanabe and Moeller⁷.

change in hearing at 20 Hz, the division into “low-frequency sound” and “infrasound” should only be considered “practical and conventional.”

2 EFFECTS AND CRITERIA OF LOW FREQUENCY SOUND AND INFRASOUND

We performed an extensive world-wide literature search of over 100 scientific papers, technical reports and summary reports on low frequency sound and infrasound—hearing, effects, measurement, and criteria. Leventhall⁴ presents an excellent and comprehensive study on low frequency noise from all sources and its effects. The Leventhall report also presents criteria in place at that time, which does not include some of the more recently developed ANSI/ASA standards on outdoor environmental noise and indoor sounds.

The United States government does not have specific criteria for low frequency noise. The US Environmental Protection Agency (EPA) has guidelines for the protection of public health with an adequate margin of safety in terms of annual average A-weighted day-night average sound level (L_{dn}), but there are no corrections or adjustments for low frequency noise. The US Department of Transportation (DOT) has A-weighted sound pressure level criteria for highway projects and airports, but these do not have adjustments for low frequency noise. The following sections describe the low frequency and infrasound criteria to which wind turbine sounds are compared in later sections.

2.1 Threshold of Hearing and Audibility

Moeller and Pedersen⁵ present an excellent summary on human perception of sound at frequencies below 200 Hz. The ear is the primary organ for sensing infrasound. Hearing becomes gradually less sensitive for

decreasing frequencies. But, humans with a normal hearing organ can perceive infrasound at least down to a few hertz if the sound level is sufficiently high.

The threshold of hearing is standardized for frequencies down to 20 Hz⁶. Based on extensive research and data, Moeller and Pedersen propose normal hearing thresholds for frequencies below 20 Hz; however, their proposed threshold is higher than that obtained by Watanabe and Moeller⁷. To be conservative, we have used the data from Watanabe and Moeller⁷ for the region below 20 Hz. (See Fig. 1.) Moeller and Pedersen⁵ suggest that the curve for low frequency thresholds for normal hearing is “probably correct within a few decibels, at least in most of the frequency range.”

The hearing thresholds show considerable variability from individual to individual with a standard deviation among subjects of about 5 dB independent of frequency between 3 Hz and 1000 Hz with a slight increase at 20–50 Hz. This implies that the audibility threshold for 97.5% of the population is greater than the values in Fig. 1 minus 10 dB and for 84% of the population is greater than the values in Fig. 1 minus 5 dB. Moeller and Pedersen suggest that the “pure-tone threshold can with a reasonable approximation be used as a guideline for the thresholds also for [low frequency] non-sinusoidal sounds”⁵; ISO 226 has thresholds for frequencies at and above 20 Hz and approximately equates the thresholds and equal loudness contours for non-sinusoidal sounds to those in the standard for sinusoidal sounds⁶.

As frequency decreases below 20 Hz, if the noise source is tonal, the tonal sensation ceases. Below 20 Hz tones are perceived as discontinuous. Below 10 Hz it is possible to perceive the single cycles of a tone, and the perception changes into a sensation of pressure at the ears.

Below 100 Hz, the dynamic range of the auditory system decreases with decreasing frequency, and the compressed dynamic range has an effect on equal loudness contours: a slight change in sound level can change the perceived loudness from barely audible to loud. This combined with the large variation in individual hearing may mean that a low frequency sound that is inaudible to some may be audible to others, and may be relatively loud to some of those for whom it is audible. Loudness for low frequency sounds grows considerably faster above threshold than for sounds at higher frequencies⁵.

Non-auditory perception of low frequency and infrasound occurs only at levels above the auditory threshold. In the frequency range of 4–25 Hz and at “levels 20–25 dB above [auditory] threshold it is possible to feel vibrations in various parts of the body, e.g., the lumbar, buttock, thigh and calf regions. A feeling of pressure may occur in the upper part of the chest and the throat region” [emphasis added]⁵.

2.2 ANSI S12.9-Parts 4 and 5—Evaluating Outdoor Environmental Sound

American National Standard ANSI/ASA S12.9-2007/Part 5⁸ has an informative annex which provides guidance for designation of land uses compatible with existing or predicted annual average adjusted day-night average outdoor sound level (DNL). Ranges of the DNL are outlined, within which a specific region of compatibility may be drawn. These ranges take into consideration the noise reduction in sound level from outside to inside buildings as commonly constructed in that locality and living habits there. There are adjustments to day-night average sound level to account for the presence of low frequency noise, and the adjustments are described in ANSI S12.9 Part 4, which use a sum of the sound pressure levels in octave bands with center frequencies of 16, 31 and 63 Hz.

ANSI S12.9/Part 4 identifies two thresholds: annoyance is minimal when the 16, 31.5 and 63 Hz octave band sound pressure levels are each less than 65 dB and there are no rapid fluctuations of the low frequency sounds. The second threshold is for increased annoyance which begins when rattles occur, which begins at L_{LF} 70–75 dB. L_{LF} is 10 times the logarithm of the ratio of time-mean square sound pressure in the 16, 31.5, and 63-Hz octave bands divided by the square of the reference sound pressure.

The adjustment procedure for low frequency noise to the average annual A-weighted sound pressure level in ANSI S12.9/Part 4 uses a different and more complicated metric and procedure (Equation D.1) than those used for evaluating low frequency noise in rooms contained in ANSI/ASA S12.2. (See Sec. 2.3). Since

we are evaluating low frequency noise and not A-weighted sound levels, we do not recommend using the procedure for adjusting A-weighted levels. Instead we recommend using the following two guidelines from ANSI S12.9/Part 4: a sound pressure level of 65 dB in each of the 16-, 31.5-, and 63 Hz octave bands as an indicator of minimal annoyance, and 70–75 dB for the summation of the sound pressure levels from these three bands as an indicator of possible increased annoyance from rattles.

2.3 ANSI/ASA S12.2—Evaluating Room Noise

ANSI/ASA S12.2-2008¹ discusses criteria for evaluating room noise, and has two separate provisions for evaluating low frequency noise: (1) the potential to cause perceptible vibration and rattles, and (2) meeting low frequency portions of room criteria curves. Since the ANSI S12.2 criteria are for indoor sounds, in order to determine equivalent outdoor criteria for comparison to outdoor measurements, data from Sutherland⁹ and Hubbard and Shephard¹⁰ were used to determine typical noise reductions from outdoor to indoor with windows open. (The Appendix of this paper describes the noise reductions used to determine equivalent outdoor criteria to indoor criteria.) Table A1 presents octave band noise reductions applied in this evaluation along with the average low frequency octave band noise reductions from outdoor to indoors from Refs. 9 and 10 for open and closed windows. Table A2 presents the one-third octave band noise reductions applied in the analysis that were determined in the same manner using data from the same references.

Vibration and Rattles: Outdoor low frequency sounds of sufficient amplitude can cause building walls to vibrate and windows to rattle. Homes have low values of transmission loss at low frequencies, and low frequency noise of sufficient amplitude may be audible within homes. Window rattles are not low frequency noise, but may be caused by low frequency noise. ANSI/ASA S12.2 presents limiting levels at low frequencies for assessing (a) the probability of *clearly* perceptible acoustically induced vibration and rattles in lightweight wall and ceiling constructions, and (b) the probability of *moderately* perceptible acoustically induced vibration in similar constructions. The limiting sound pressure levels in the octave bands with center frequencies of 16, 31.5 and 63 Hz are presented in Table 1.

Applying the outdoor to indoor attenuations for wind turbine sources with windows open given in the last row of Table A1 to the ANSI/ASA S12.2 indoor sound pressure levels in Table 1 yields the equivalent

Table A1—Average low frequency octave band home noise reductions from outdoor to indoors in dB (from Ref. 9 and 10).

Noise Source	Window condition	Octave Band Center Frequency			
		16 Hz	31.5 Hz	63 Hz	125 Hz
Average aircraft and traffic sources	Closed windows	16	15	18	20
Average aircraft and traffic sources	Open windows	(11)*	(10)*	12	11
Average Wind Turbine	Closed windows	8	11	14	18
Average Wind Turbine	Open windows	(3)**	(6)**	9+	9+

* No data are available for windows open below 63 Hz octave band. The values for 16 Hz and 31 Hz were obtained by subtracting the difference between the levels for 63 Hz closed and open conditions to the 16 and 31 Hz closed values.

+ Used in this paper to determine equivalent outdoor criteria from indoor criteria in Tables 2 and 4

outdoor sound pressure levels that are consistent with the indoor criteria and are presented in Table 2.

Room Criteria Curves: ANSI/ASA S12.2 has three primary methods for evaluating the suitability of noise within rooms: a survey method—A-weighted sound levels, an engineering method—noise criteria (NC) curves, and a method for evaluating low-frequency fluctuating noise using room noise criteria (RNC) curves. ANSI/ASA S12.2 states “The RNC method

should be used to determine noise ratings when the noise from HVAC systems at low frequencies is loud and is suspected of containing sizeable *fluctuations or surging*.” [emphasis added] The NC curves are appropriate to evaluate low frequency noise from wind turbines in homes since wind turbine noise does not have significant fluctuating low frequency noise sufficient to warrant using RNC curves and since A-weighted sound levels do not adequately determine

Table A2—Average low frequency one-third octave band noise reduction in dB for homes from outdoor to indoors.

Condition	One-Third Octave Band Center Frequency, Hz												
	10	12.5	16	20	25	31.5	40	50	63	80	100	125	160
Open Window*	2	2	3	4	4.5	5	7	8	9	9	9	9	9
Average Closed Window with wind turbines ¹⁰	8	7	8	8	8	11	13	14	15	12	18	18	18

* Used to determine equivalent outdoor levels as shown in Table 7.

** Used to determine equivalent outdoor levels as shown in Table 9.

Table 1—ANSI/ASA S12.2 measured interior sound pressure levels for perceptible vibration and rattle in lightweight wall and ceiling structures.¹

Condition	Octave-band center frequency (Hz)		
	16	31.5	63
Clearly perceptible vibration and rattles likely	75 dB	75 dB	80 dB
Moderately perceptible vibration and rattles likely	65 dB	65 dB	70 dB

Table 2—Equivalent outdoor sound pressure levels to the ANSI/ASA S12.2 indoor sound pressure levels for perceptible vibration and rattle in lightweight wall and ceiling structures for wind turbines.

Condition	Octave-band center frequency (Hz)		
	16	31.5	63
Clearly perceptible vibration and rattles likely	78 dB	81 dB	89 dB
Moderately perceptible vibration and rattles likely	68 dB	71 dB	79 dB

if there are low frequency problems. [ANSI/ASA S12.2, Sec. 5.3 gives procedures for determining if there are large fluctuations of low frequency noise.]

Annex C.2 of ANSI/ASA S12.2 contains recommended room criteria curves for bedrooms, which are the rooms in homes with the most stringent criteria: NC and RNC criteria curve between 25 and 30. The recommended NC and RNC criteria for schools and private rooms in hospitals are the same. The values of the sound pressure levels in the 16–125 Hz octave bands for NC curves 25 and 30 are shown in Table 3. Applying the outdoor to indoor attenuations for wind turbine sources with windows open given in the last row of Table A1 to the ANSI/ASA S12.2 indoor sound pressure levels for NC-25 and NC-30 in Table 3 yields the equivalent outdoor sound pressure levels that are consistent with the indoor criteria and are presented in Table 4.

ANSI/ASA S12.2 also presents a method to determine if the levels below 500 Hz octave band are too high in relation to the levels in the mid-frequencies which could create a condition of “spectrum imbalance”. The method for this evaluation is:

- Calculate the speech interference level (SIL) for the measured spectrum. [SIL is the arithmetic average of the sound pressure levels in the 500, 1000, 2000 and 4000 Hz octave bands.] Select the NC curve equal to the SIL value with a symbol NC(SIL).
- Plot the measured spectra and the NC curve equal to the SIL value on the same graph and

Table 3—ANSI/ASA S12.2 low frequency octave band sound pressure levels for noise criteria curves NC-25 and NC-30. [Table 1 from Ref. 1].

NC Criteria	Octave-band-center frequency, Hz			
	16	31.5	63	125
NC-25	80	65	54	44
NC-30	81	68	57	48

determine the differences between the two curves in the octave bands below 500 Hz.

- Estimate the likelihood that the excess low-frequency levels will annoy occupants of the space using Table 5.

2.4 Other Criteria

2.4.1 World Health Organization (WHO)

No specific low frequency noise criteria are proposed by the WHO. The Guidelines for Community Noise report¹¹ mentions that if the difference between

Table 4—Equivalent outdoor sound pressure levels to the ANSI/ASA S12.2 low frequency octave band sound pressure levels for noise criteria curves NC-25 and NC-30. [Table 1 from Ref. 1].

NC Criteria	Octave-band-center frequency, Hz			
	16	31.5	63	125
NC-25	83	71	63	53
equivalent outdoor				
NC-30	84	74	66	57
equivalent outdoor				

Table 5—Measured sound pressure level deviations from an NC (SIL) curve that may lead to serious complaints¹.

Octave-band frequency, Hz=>	Measured Spectrum—NC(SIL), dB			
	31.5	63	125	250
Possible serious dissatisfaction	*	6–9	6–9	6–9
Likely serious dissatisfaction	*	>9	>9	>9

* Insufficient data available to evaluate

Table 6—DEFRA proposed criteria¹³ for the assessment of low frequency noise disturbance: Indoor L_{eq} one-third sound pressure levels for non-steady and steady low frequency sounds.

Location	One-Third Octave Band Center Frequency, Hz												
	10	12.5	16	20	25	31.5	40	50	63	80	100	125	160
Non-Steady L_{eq} , dB	92	87	83	74	64	56	49	43	42	40	38	36	34
Steady L_{eq} , dB	97	92	88	79	69	61	54	48	47	45	43	41	39

the C-weighted sound level and A-weighted sound level is greater than 10 decibels, then a frequency analysis should be performed to determine if there is a low frequency issue. A document prepared for the World Health Organization states that “there is no reliable evidence that infrasounds below the hearing threshold produce physiological or psychological effects. Infrasounds slightly above detection threshold may cause perceptual effects but these are of the same character as for ‘normal’ sounds. Reactions caused by extremely intense levels of infrasound can resemble those of mild stress reaction and may include bizarre auditory sensations, describable as pulsation and flutter”¹².

2.4.2 The UK Department for Environment, Food, and Rural Affairs (DEFRA)

The report prepared by the University of Salford for the UK Department for Environment, Food, and Rural Affairs (DEFRA) on low frequency noise proposed one-third octave band sound pressure level L_{eq} criteria and procedures for assessing low frequency noise¹³. The guidelines are based on complaints of disturbance from low frequency sounds and are intended to be used by Environmental Health Officers.

Existing low frequency noise criteria from several countries were reviewed and experiences with low frequencies complaints were considered in developing the proposed guidelines. The criteria are “based on

5 dB below the ISO 226 average threshold of audibility for steady [low frequency] sounds.” However, the DEFRA criteria are at 5 dB lower than ISO 226 only at 20–31.5 Hz; at higher frequencies the criteria are equal to the Swedish criteria which are higher levels than ISO 226 less 5 dB. For frequencies lower than 20 Hz, DEFRA uses the thresholds from Ref. 7 less 5 dB.

The DEFRA criteria are based on measurements in an unoccupied room, and it was noted by a practicing consultant that measurements should be made with windows closed¹⁴. However, we conservatively used windows open conditions for our assessment to determine equivalent outdoor criteria since the DEFRA measurement procedure does not explicitly state measurements are with windows closed. If the low frequency sound is “steady” then the criteria may be relaxed by 5 dB. A low frequency noise is considered steady if either $L_{10}-L_{90} < 5$ dB or the rate of change of sound pressure level (Fast time weighting) is less than 10 dB per second in the third octave band which exceeds the criteria by the greatest margin.

Applying indoor to outdoor one-third octave band transfer functions for open windows (as presented in Table A2 from analysis of data in Refs. 9 and 10) yields *equivalent* one-third octave band sound pressure level proposed DEFRA criteria for outdoor sound levels. Table 6 presents the indoor DEFRA proposed criteria for non-steady and steady low-frequency sounds. Table

Table 7—Equivalent outdoor L_{eq} one-third sound pressure levels for non-steady and steady sounds to the DEFRA indoor criteria¹³ for the assessment of low frequency noise disturbance.

Location	One-Third Octave Band Center Frequency, Hz												
	10	12.5	16	20	25	31.5	40	50	63	80	100	125	160
Non-Steady Equivalent outdoor * L_{eq} , dB	94	89	86	78	68.5	61	56	51	51	49	47	45	43
Steady Equivalent Outdoor* L_{eq}	99	94	91	83	73.5	66	61	56	56	54	52	50	48

* With windows open

Table 8—Japan Ministry of Environment Guidance for evaluating complaints of low frequency noise: Reference one-third octave band sound pressure level values for complaints of rattling.

Location	One-Third Octave Band Center Frequency, Hz										
	5	6.3	8	10	12.5	16	20	25	31.5	40	50
Outdoor L_{eq} , dB	70*	71*	72*	73	75	77	80	83	87	93	99

* The reference values are several dB lower than the supporting data contained in Ref. 15. At 5 Hz, window rattles started at about 74 dB in one study and 79 dB in another; at 6.3 Hz, rattles started at 74 dB in the first study and at 78 dB in the second; and at 8 Hz, window rattle started at 74 dB in the first study and 77 dB in the second study.

7 presents the DEFRA equivalent outdoor criteria for non-steady and steady low frequency sounds.

2.4.3 Japan Ministry of Environment

The Japan Ministry of Environment has published a handbook to deal with low frequency noise problems and has established reference values for guidance in dealing with complaints of rattling windows and doors and complaints of “mental and physical discomfort”¹⁵. It was noted that traditional Japanese houses have relatively light-weight and sensitive windows and partitions¹⁶.

Table 8 presents the Japanese reference outdoor one-third octave band sound pressure level values for guidance in dealing with complaints of rattling from environmental sounds from 5 Hz to 50 Hz. From 10 Hz to 50 Hz the guidance levels are equal to the observed threshold of rattles from two studies with a total of 78 samples. However, for the bands centered at 5, 6.3 and 8 Hz, the reference values are several dB lower than the supporting data contained in these two studies¹⁵. At 5 Hz, the lowest observed window rattle was at 74 dB in one study and 79 dB in another; at 6.3 Hz, rattles started at 74 dB in the first study and at 78 dB in the second; and at 8 Hz, window rattle started at 74 dB in the first study and 77 dB in the second study. Thus the reference values at 5, 6.3 and 8 Hz in Table 8 are conservative in comparison to the other values by 4, 3, and 2 dB respectively.

Table 9 presents the Japanese reference one-third octave band sound pressure level values for guidance in dealing with complaints of mental and physical discomfort from environmental sounds when evaluated indoors. Evaluation measurements are to be performed with windows closed to the outside. The values in Table 9 are less stringent than the DEFRA values in Table 6 for non-steady sounds but more stringent than the DEFRA values for steady sounds in some one-third octave bands. In order to obtain equivalent outdoor sound levels, the average noise reduction from wind turbine noise with windows closed from Ref. 10 was applied to the Japan reference values. Table 9 presents the Japanese indoor reference values, the noise reduc-

tions for windows closed¹⁰ and the equivalent outdoor reference values. These equivalent outdoor values are less stringent than the equivalent outdoor DEFRA values in Table 7 for both non-steady sounds and steady sounds except for the 80 Hz band in which the Japanese level is 1 dB more stringent than the DEFRA level for steady sounds.

2.4.4 C-weighted minus A-weighted ($L_{pC} - L_{pA}$)

Leventhall⁴ and others indicate that the difference in C-weighted and A-weighted sound pressure levels can be a predictor of annoyance. Leventhall states that if ($L_{pC} - L_{pA}$) is greater than 20 dB there is “a potential for a low frequency noise problem.” He further states that ($L_{pC} - L_{pA}$) cannot be a predictor of annoyance but is a simple indicator that further analysis may be needed. This is due in part to the fact that the low frequency noise may be inaudible even if ($L_{pC} - L_{pA}$) is greater than 20 dB.

3 LITERATURE REVIEW

The authors performed an extensive literature search of over 100 scientific papers, technical reports and summary reports on low frequency sound and infrasound—hearing, effects, measurement, and criteria. The following paragraphs briefly summarize the findings from some of these papers and reports.

3.1 Leventhall

Leventhall⁴ presents an excellent study on low frequency noise from all sources and its effects. The report presents criteria in place at that time and includes data relating cause and effects. Leventhall¹⁷ reviewed data and allegations on alleged problems from low frequency noise and infrasound from wind turbines, and concluded the following: “It has been shown that there is insignificant infrasound from wind turbines and that there is normally little low frequency noise.” “Turbulent air inflow conditions cause enhanced levels of low frequency noise, which may be disturbing, but the overriding noise from wind turbines is the fluctuating audible swish, mistakenly referred to

Table 9—Japan Ministry of Environment Guidance for evaluating complaints of low frequency noise: Reference one-third octave band sound pressure level values for complaints of mental and physical discomfort.

Location	One-Third Octave Band Center Frequency, Hz									
	10	12.5	16	20	25	31.5	40	50	63	80
Indoor L_{eq} , dB	92	88	83	76	70	64	57	52	47	41
Noise Reduction*, dB	8	7	8	8	8	11	13	14	15	12
Equivalent Outdoor L_{eq} , dB	100	95	91	84	78	75	70	66	62	53

* from Hubbard¹⁰ windows closed condition

as “infrasound” or “low frequency noise”. “Infrasound from wind turbines is below the audible threshold and of no consequence”. Other studies have shown that wind turbine generated infrasound levels are below threshold of perception and threshold of feeling and body reaction.

3.2 DELTA

The Danish Energy Authority project on “low frequency noise from large wind turbines” comprises a series of investigations in the effort to give increased knowledge on low frequency noise from wind turbines¹⁸. One of the conclusions of the study is that wind turbines do not emit audible infrasound, with levels that are “far below the hearing threshold.” Audible low frequency sound may occur both indoors and outdoors, “but the levels in general are close to the hearing and/or masking level.” “In general the noise in the critical band up to 100 Hz is below both thresholds”. The final report notes that for road traffic noise (in the vicinity of roads) the low frequency noise levels are higher [than wind turbine] both indoors and outdoors.

3.3 Hayes McKenzie Partnership

Hayes McKenzie Partnership Ltd performed a study for the UK Department of Trade & Industry (DTI) to investigate complaints of low frequency noise that came from three of the five farms with complaints out of 126 wind farms in the UK¹⁴. The study concluded that:

- Infrasound associated with modern wind turbines is not a source which will result in noise levels that are audible or which may be injurious to the health of a wind farm neighbor.
- Low frequency noise was measureable on a few occasions, but below DEFRA criteria. Wind turbine noise may result in indoor noise levels

within a home that is just above the threshold of audibility; however, it was lower than that of local road traffic noise.

- The common cause of the complaints was not associated with low frequency noise but the occasional audible modulation of aerodynamic noise, especially at night.
- The UK Department of Trade and Industry, which is now the UK Department for Business Enterprise and Regulatory Reform (BERR), summarized the Hayes McKenzie report: “The report concluded that there is no evidence of health effects arising from infrasound or low frequency noise generated by wind turbines.”¹⁹.

3.4 Howe

Howe performed extensive studies on wind turbines and infrasound and concluded that infrasound was not an issue for modern wind turbine installations—“while infrasound can be generated by wind turbines, it is concluded that infrasound is not of concern to the health of residences located nearby.”²⁰. Since then Gastmeier and Howe²¹ investigated an additional situation involving the alleged “perception of infrasound by individual.” In this additional case, the measured indoor infrasound was at least 30 dB below the audibility threshold given by Ref. 7 as presented in Fig. 1.

3.5 Branco

Branco and other Portuguese researchers have studied possible physiological affects associated with high amplitude low frequency noise and have labeled these alleged effects as “Vibroacoustic Disease” (VAD)²². “Vibroacoustic disease (VAD) is a whole-body, systemic pathology, characterized by the abnormal proliferation of extra-cellular matrices, and caused by excessive exposure to low frequency noise.”

Hayes^{23,24} concluded that levels from wind farms are not likely to cause VAD after comparing noise levels from alleged VAD cases to noise levels from wind turbines in homes of complainers. Noise levels in aircraft in which VAD has been hypothesized are considerably higher than wind turbine noise levels. Hayes also concluded that it is “unlikely that symptoms will result through induced internal vibration from incident wind farm noise.”²³ Other studies have found no VAD indicators in environmental sound that have been alleged by VAD proponents²⁵.

3.6 French National Academy of Medicine

In 2006, the French National Academy of Medicine recommended²⁶ “as a precaution construction should be suspended for wind turbines with a capacity exceeding 2.5 MW located within 1500 m of homes.” [emphasis added] However, this precaution is not because of definitive health issues but because:

- Sound levels one km from some wind turbine installations “occasionally exceed allowable limits” for France (note that the allowable limits are long term averages).
- French prediction tools for assessment did not take into account sound levels created with wind speeds greater than 5 m/s.
- Wind turbine noise has been compared to aircraft noise (even though the sound levels of wind turbine noise are significantly lower), and exposure to high level aircraft noise “involves neurobiological reactions associated with an increased frequency of hypertension and cardiovascular illness. Unfortunately, no such study has been done near wind turbines.”²⁷

In March 2008, the French Agency for Environmental and Occupational Health Safety (AFSSET) published a report on “the health impacts of noise generated by wind turbines”, commissioned by the Ministries of Health and Environment in June 2006 following the report of the French National Academy of Medicine in March 2006²⁸. The AFSSET study recommends that one does not define a fixed minimum distance between wind farms and homes, but rather to model the acoustic impact of the project on a case-by-case basis. One of the conclusions of the AFSSET report is: “The analysis of available data shows: The absence of identified direct health consequences concerning the auditory effects or specific effects usually associated with exposure to low frequencies at high level.” (“L’analyse des données disponibles met en évidence: L’absence de conséquences sanitaires directes recensées en ce qui concerne les effets auditifs, ou les effets spécifiques généralement attachés à l’exposition à des basses fréquences à niveau élevé.”).

4 FIELD PROGRAM

Two types of utility-scale wind turbines were studied for this field program. These two turbines are among the most commonly used in the NextEra fleet: General Electric (GE) 1.5sle (1.5 MW), and Siemens SWT-2.3-93 (2.3 MW).

Sound levels for these wind turbine generators (WTGs) vary as a function of wind speed from cut-in wind speed to maximum sound level. Cut-in wind speed for the GE 1.5sle wind turbine is 3.5 m/s while the Siemens wind turbine has a cut-in wind speed of 4 m/s. Maximum reference sound power levels for the GE 1.5sle and Siemens 2.3-93 are approximately 104 dB and 105 dB respectively as provided by the manufacturer. These sound power levels are reached at electrical output levels of approximately 924 kW and 1767 kW for the GE and Siemens units, respectively. Under higher wind speeds, the sound levels from the wind turbines do not increase although electrical power output does continue to increase up to the rated power of each wind turbine (1500 kW and 2300 kW respectively).

Each wind turbine manufacturer has an uncertainty factor “K” of 2 dB to guarantee the turbine’s sound power level. (K accounts for both measurement variations and production variation²⁹.) The results presented later in this paper include sound power values which have added the manufacturer’s K value to the reference values, that is, 2 dB above the expected reference levels for the measured wind conditions and power output.

Real-world data were collected from operating wind turbines to compare to the low frequency noise guidelines and criteria discussed previously in Sec. 2. These data sets consisted of outdoor measurements at various reference distances, and concurrent indoor/outdoor measurements at residences within the wind farm.

NextEra provided access to the Horse Hollow Wind Farm in Taylor and Nolan Counties, Texas in November 2008 to collect data on the GE 1.5sle and Siemens SWT-2.3-93 wind turbines. The portion of the wind farm used for testing is relatively flat with no significant terrain. The land around the wind turbines is rural and primarily used for agriculture and cattle grazing. The siting of the sound level measurement locations was chosen to minimize local noise sources except the wind turbines and the wind itself. Hub height for these wind turbines is 80 meters above ground level (AGL).

Two of the authors collected sound level and wind speed data over the course of one week under a variety of operational conditions. Weather conditions were dry the entire week with ground level winds ranging from calm to 12.5 m/s (28 mph) over a 1-minute average. In order to minimize confounding factors, the data collection tried to focus on periods of maximum sound levels from

the wind turbines (moderate to high hub height winds) and light to moderate ground level winds.

Ground level (2 meters AGL) wind speed and direction were measured continuously at one representative location. Wind speeds near hub height were also measured continuously using the permanent meteorological towers maintained by the wind farm.

A series of simultaneous interior and exterior sound level measurements were made at four houses owned by participating landowners within the wind farm. Two sets were made of the GE WTGs, and two sets were made of the Siemens WTGs. Data were collected with both windows open and windows closed. Due to the necessity of coordinating with the homeowners in advance, and reasonable restrictions on time of day to enter their homes, the interior/exterior measurement data sets do not always represent ideal conditions. However, enough data were collected to compare to the criteria and draw conclusions on low frequency noise.

Sound level measurements were also made simultaneously at two reference distances from a string of wind turbines under a variety of wind conditions. Using the manufacturer's sound power level data, calculations of the sound pressure levels as a function of distance in flat terrain were made to aid in deciding where to collect data in the field. Based on this analysis, two distances from the nearest wind turbine were selected—305 meters (1,000 feet) and 457 meters (1,500 feet)—and were then used where possible during the field program. Distances much larger than 457 meters (1,500 feet) were not practical since an adjacent turbine string could then be closer and affect the measurements, or would put the measurements beyond the boundaries of the wind farm property owners. Brief background sound level measurements were conducted several times during the program whereby the Horse Hollow Wind Farm operators were able to shutdown the nearby WTGs for a brief (20 minutes) period. This was done in real time using cell phone communication.

All the sound level measurements described above were attended. One series of unattended overnight measurements was made at two locations for approximately 15 hours to capture a larger data set. One measurement was set up approximately 305 meters (1,000 feet) from a GE 1.5sle WTG and the other was set up approximately 305 meters (1,000 feet) from a Siemens WTG. The location was chosen based on the current wind direction forecast so that the sound level equipment would be downwind for the majority of the monitoring period. By doing this, the program was able to capture periods of strong hub-height winds and moderate to low ground-level winds.

All sound levels were measured using two Norsonic Model Nor140 precision sound analyzers, equipped

with a Norsonic-1209 Type 1 Preamplifier, a Norsonic-1225 half-inch microphone and a 7-inch Aco-Pacific untreated foam windscreen Model WS7. The instrumentation meets the "Type 1—Precision" requirements set forth in American National Standards Institute (ANSI) S1.4 for acoustical measuring devices³⁰. The microphone was tripod-mounted at a height of 1.5 meters (five feet) above ground. The measurements included simultaneous collection of broadband (A-weighted) and one-third-octave band data (3.15 hertz to 20,000 hertz bands). Sound level data were primarily logged in 10-minute intervals to be consistent with the wind farm's Supervisory Control And Data Acquisition (SCADA) system which provides electrical power output (kW) in 10-minute increments. A few sound level measurements were logged using 20-minute intervals for use in determining home transmission loss values. The meters were calibrated and certified as accurate to standards set by the National Institute of Standards and Technology. These calibrations were conducted by an independent laboratory within the past 12 months. Ground level wind speed and direction were measured with a HOBO H21-002 micro weather station (Onset Computer Corporation). The wind data were sampled every three seconds and logged every one minute.

5 RESULTS AND COMPARISON TO CRITERIA

Results from the field program are organized by wind turbine type. For each wind turbine type, results are presented per location type (outdoor or indoor) with respect to applicable criteria. Results are presented for 305 meters (1,000) feet from the nearest wind turbine. Data were also collected at 457 meters (1,500 feet) from the nearest wind turbine which showed lower sound levels. Therefore, wind turbines that met the criteria at 305 meters also met it at 457 meters. Data were collected under both high turbine output and moderate turbine output conditions (defined as sound power levels 2 or 3 dB less than the maximum sound power levels), and low ground-level wind speeds. The sound level data under the moderate conditions were equivalent to or lower than the high turbine output scenarios, thus confirming the conclusions from the high output cases. None of the operational sound level data were corrected for background noise. A-weighted sound power levels presented in this section (used to describe turbine operation) were estimated from the actual measured power output (kW) of the wind turbines and the sound power levels as a function of wind speed plus an uncertainty factor K of 2 dB.

Outdoor measurements are compared to criteria for audibility, for UK DEFRA disturbance using equivalent outdoor levels, for rattle and annoyance criteria as

Table 10—Summary of operational parameters—
Siemens SWT-2.3-93 (Outdoor).

Parameter	Sample #34	Sample #39
Distance to nearest WTG	305 meters	305 meters
Time of day	22:00-22:10	22:50-23:00
WTG power output	1,847 kW	1,608 kW
A-weighted sound power level*	107 dB	106.8 dB
Measured wind speed @ 2 m	3.3 m/s	3.4 m/s
L_{Aeq}	49.4 dB	49.6 dB
L_{A90}	48.4 dB	48.6 dB
L_{Ceq}	63.5 dB	63.2 dB

* Includes K, uncertainty factor of 2 dB

contained in ANSI S12.9/Part 4, for evaluating complaints of rattling using Japan Ministry of Environment guidance, and for perceptible vibration using equivalent outdoor levels from ANSI/ASA S12.2. Indoor measurements are compared to criteria for audibility, for UK DEFRA disturbance, for evaluating complaints of mental and physical discomfort using Japan Ministry of Environment guidance, and for suitability of bedrooms, hospitals and schools and perceptible vibration from ANSI/ASA S12.2.

5.1 Siemens SWT-2.3-93

5.1.1 Outdoor measurements—Siemens SWT-2.3-93

Sound levels during six 10-minute periods of high wind turbine output and relatively low ground wind speed (which minimized effects of wind noise) were measured outdoors approximately 305 meters (1,000 feet) from the closest Siemens WTG. This site was actually part of a string of 15 WTGs, four of which were within 610 meters

(2,000 feet) of the monitoring location. Representative sound level data from two 10-minute periods are presented herein and include contributions from all wind turbines as measured by the recording equipment. One data set is representative of time periods with low frequency sound level values near the maximum measured and the other data set is representative of the mean. The standard deviations for the low frequency one-third octave band levels for the six measurement periods were between 0.2–0.7 dB. The key operational and meteorological parameters during these two measurement periods are listed in Table 10.

Figure 2 plots the one-third octave band sound levels (L_{eq}) for both samples of high output conditions. The results show that infrasound is inaudible to even the most sensitive people 305 meters (1,000 feet) from these wind turbines (more than 20 dB below the median thresholds of hearing). Low frequency sound above 40 Hz may be audible depending on background sound levels.

Figure 3 plots the one-third octave band sound levels (L_{eq}) for both samples of high output conditions. The low frequency sound was “steady” according to DEFRA procedures, and the results show that all outdoor equivalent DEFRA disturbance criteria are met.

Figure 4 compares the one-third octave band sound levels (L_{eq}) for both samples of high output conditions to the Japan Ministry of Environment levels for evaluating complaints on rattle. The rattle criteria is met at all frequencies except at 5 Hz where the mean value is 1 dB (standard deviation of 0.4 dB) higher than the Japanese evaluation value. When one considers that the 5 Hz sound level is 3 dB lower than the observed threshold of rattle, one concludes that the Japanese criteria are met.

The measured outdoor sound levels also meet the outdoor equivalent Japan Ministry of Environment

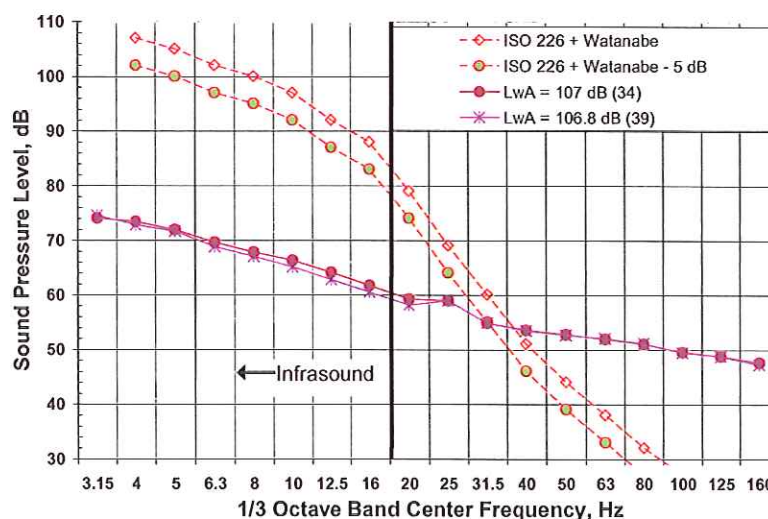


Fig. 2—Siemens SWT-2.3-93 wind turbine outdoor sound levels at 305 meters compared to audibility criteria.

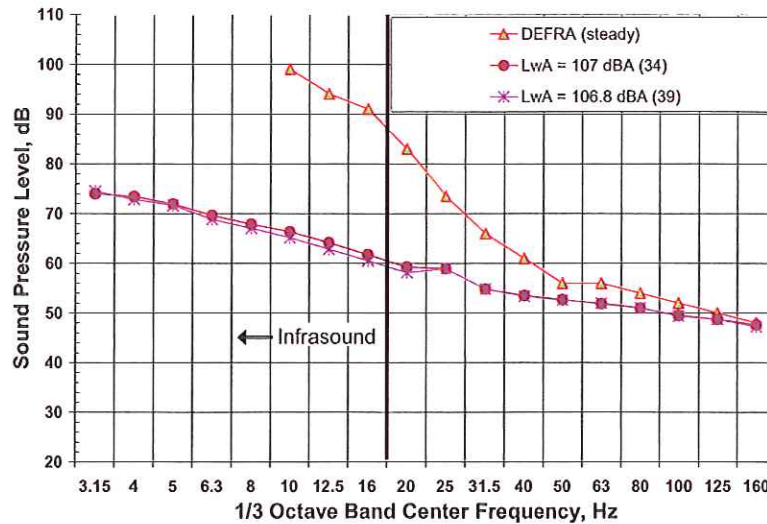


Fig. 3—Siemens SWT-2.3-93 wind turbine outdoor sound levels at 305 meters compared to outdoor equivalent DEFRA criteria.

criteria for evaluating complaints of mental and physical discomfort. This comparison is not presented in a figure since these criteria are generally less stringent than the DEFRA criteria.

Figure 5 plots the 16, 31.5, 63, and 125 Hz octave band sound levels (L_{eq}) for both samples of high output conditions. The results show that all outdoor equivalent ANSI/ASA S12.2 perceptible vibration criteria are met. In addition, the results show that all outdoor equivalent ANSI/ASA S12.2 low frequency NC-25 and NC-30 criteria for bedrooms are met. The low frequency sound levels are below the ANSI S12.9 Part 4 thresholds for the beginning of rattles (16, 31.5, 63 Hz total less than 70 dB). The 31.5 and 63 Hz sound levels are below the level of 65 dB identified for minimal annoyance in ANSI S12.9 Part 4,

and the 16 Hz sound level is within 1.5 dB of this level, which is an insignificant increase since the levels were not rapidly fluctuating.

5.1.2 Indoor measurements—Siemens SWT-2.3-93

Simultaneous outdoor and indoor measurements were made at two residences at different locations within the wind farm to determine indoor audibility of low frequency noise from Siemens WTGs. In each house a 10-minute measurement was made in a room facing the wind turbines with a window both open and closed. Results from the testing at one of the homes are not presented due to the very high ground level winds

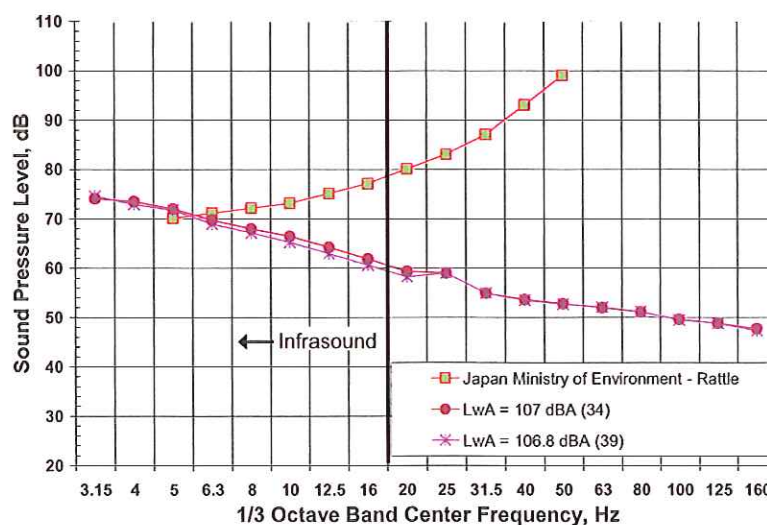


Fig. 4—Siemens SWT-2.3-93 wind turbine outdoor sound levels at 305 meters compared to Japan Ministry of Environment rattle criteria.

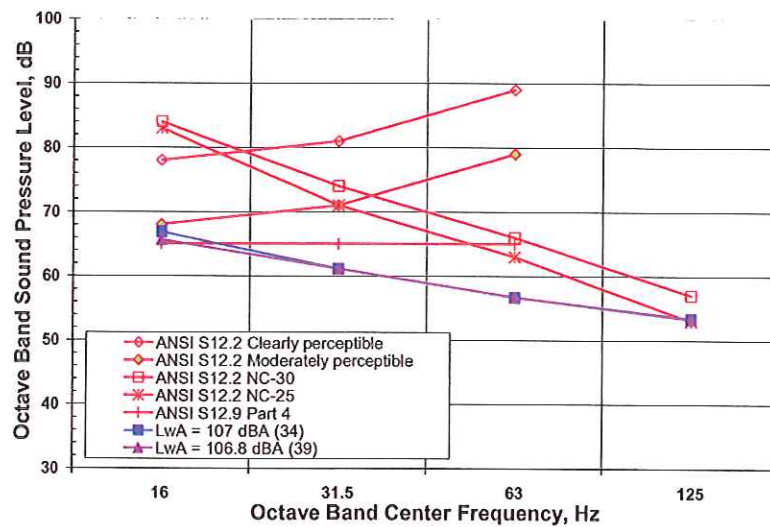


Fig. 5—Siemens SWT-2.3-93 wind turbine outdoor sound levels at 305 meters compared to ANSI criteria.

(~9 m/s) which dominated the sound environment. The remaining residence is designated Home “A” and was approximately 323 meters (1,060 feet) from the closest Siemens WTG. The home was near a string of multiple WTGs, four of which were within 610 meters (2,000 feet) of the house. The sound level data presented herein include contributions from all wind turbines as measured by the recording equipment. The key operational and meteorological parameters during these measurements are listed in Table 11.

The room in Home “A” where interior measurements were made had the following characteristics: approximately 3.6 meters wide (12 feet) by 4.9 meters long (16 feet), no furniture, carpeted flooring, two relatively new double-hung windows (no storm windows), sheetrock interior walls, and clapboard exterior walls. The sound level meter was located in the center of the room.

Figure 6 plots the indoor one-third octave band sound levels (L_{eq}) for Home “A”. The results show that infrasound is inaudible to even the most sensitive people approximately 1,000 feet from these wind turbines with

the windows open or closed (more than 20 dB below the median thresholds of hearing). Low frequency sound at or above 50 Hz may be audible depending on background sound levels.

Figure 7 plots the indoor one-third octave band sound levels (L_{eq}) for Home “A”. The low frequency sound was “steady” according to DEFRA procedures under the window open condition, and the results show that all indoor DEFRA disturbance criteria are met.

Although not shown in Fig. 7, the one-third octave band levels meet the Japan Ministry of Environment criteria for evaluating complaints of mental and physical discomfort since in the frequency range of the Japan criteria both samples meet the more stringent DEFRA criteria for “non-steady” sounds, which is more stringent than the Japan criteria.

Figure 8 plots the indoor 16 Hz to 125 Hz octave band sound levels (L_{eq}) for Home “A”. The results show the ANSI/ASA S12.2 low frequency criteria for perceptible vibration were easily met for both windows open and closed scenarios. The ANSI/ASA S12.2 low frequency NC-25 and NC-30 criteria for bedrooms, classrooms and hospitals were met, the spectrum was balanced, and the criteria for moderately perceptible vibrations in light-weight walls and ceilings were also met.

Table 11—Summary of operational parameters—Siemens SWT-2.3-93 (Indoor).

Parameter	Home “A” (closed/open)
Distance to nearest WTG	323 meters
Time of day	07:39-07:49/07:51-08:01
WTG power output	1,884 kW/1564 kW
A-weighted sound power level*	107 dB/106.7 dB
Measured wind speed @ 2 m	3.2 m/s/3.7 m/s
L_{Aeq}	33.8 dB/38.1 dB
L_{A90}	28.1 dB/36.8 dB
L_{Ceq}	54.7 dB/57.1 dB

* Includes K, uncertainty factor of 2 dB

5.2 GE 1.5sle

5.2.1 Outdoor measurements—GE 1.5sle

Sound level data during twelve 10-minute periods of high wind turbine output and relatively low ground wind speed (which minimized effects of wind noise) were measured outdoors approximately 305 meters (1,000 feet) from the closest GE 1.5sle WTG. This site was actually part of a string of more than 30 WTGs, four of which were within 610 meters (2,000 feet) of the

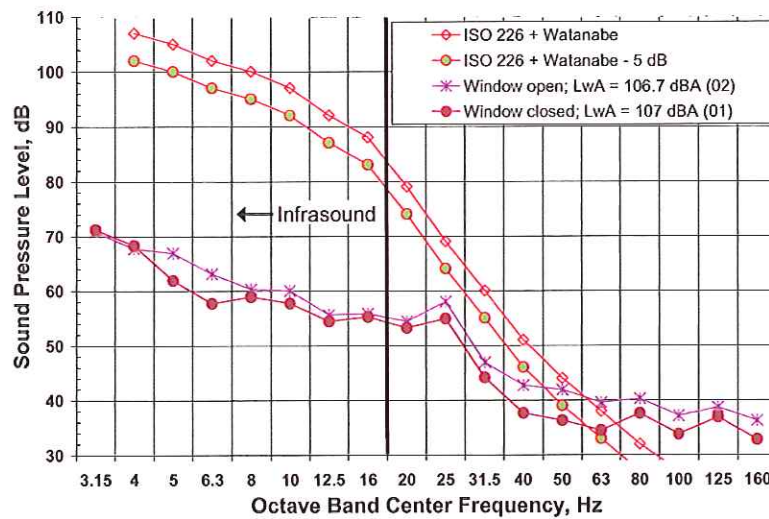


Fig. 6—Siemens SWT-2.3-93 wind turbine indoor sound levels at 323 meters compared to audibility criteria (Home “A”).

monitoring location. Representative sound level data from two 10-minute periods are presented herein and include contributions from all wind turbines as measured by the recording equipment. One data set is representative of time periods with low frequency sound level values near the maximum and the other data set is representative of the mean. The standard deviations for the low frequency one-third octave band levels for the twelve measurement periods were between 0.3–1.9 dB with the largest variation in the 10–16 Hz bands and the lowest at 160 Hz. The key operational and meteorological parameters for these two measurement periods are listed in Table 12.

Figure 9 plots the one-third octave band sound levels (L_{eq}) for both samples of high output conditions. The results show that infrasound is inaudible to even the most

sensitive people 305 meters (1,000 feet) from these wind turbines (more than 20 dB below the median thresholds of hearing). Low frequency sound at and above 31.5–40 Hz may be audible depending on background sound levels.

Figure 10 plots the one-third octave band sound levels (L_{eq}) for both samples of high output conditions. The low frequency sound was “steady” according to DEFRA procedures, and the results show the low frequency sound meet or are within 1 dB of outdoor equivalent DEFRA disturbance criteria.

Figure 11 compares the one-third octave band sound levels (L_{eq}) for both samples of high output conditions to the Japan Ministry of Environment levels for evaluating complaints on rattle. The rattle criteria is met at all

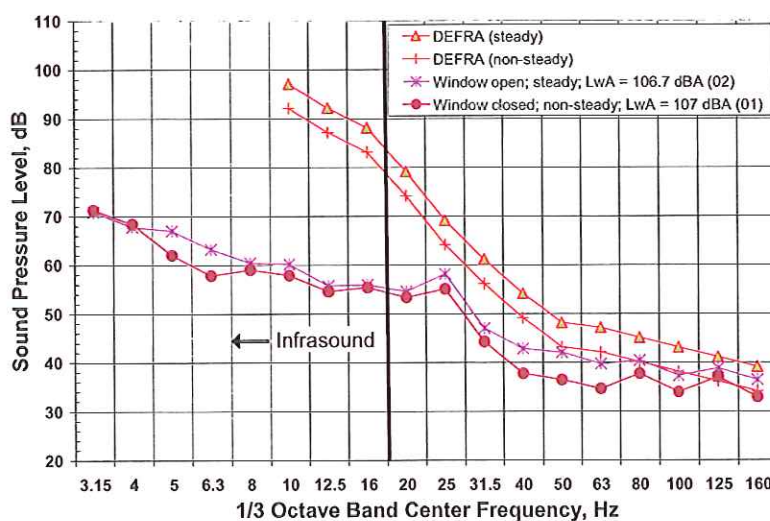


Fig. 7—Siemens SWT-2.3-93 wind turbine indoor sound levels at 323 meters compared to DEFRA criteria (Home “A”).

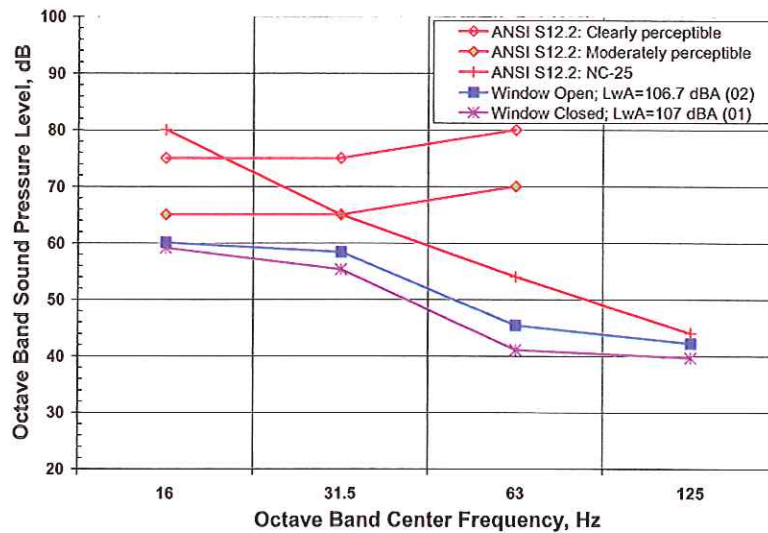


Fig. 8—Siemens SWT-2.3-93 wind turbine indoor sound levels at 323 meters compared to ANSI 12.2 criteria for perceptible vibrations and NC-25 (Home “A”).

frequencies; at 5 Hz the mean value is 70 dB (standard deviation=0.9 dB), while the two presented measure-

Table 12—Summary of operational parameters—GE 1.5sle (Outdoor).

Parameter	Sample #46	Sample #51
Distance to nearest WTG	305 meters	305 meters
Time of day	23:10-23:20	00:00-00:10
WTG power output	1,293 kW	1,109 kW
A-weighted sound power level*	106 dB	106 dB
Measured wind speed @ 2 m	4.1 m/s	3.3 m/s
L_{Aeq}	50.2 dB	50.7 dB
L_{A90}	49.2 dB	49.7 dB
L_{Ceq}	62.5 dB	62.8 dB

* Includes K, uncertainty factor of 2 dB

ments are approximately 1 dB higher, an insignificant increase. When one considers that the 5 Hz sound level is 3 dB lower than the observed threshold of rattle, one concludes that the Japanese criteria are met.

The measured outdoor sound levels also meet the outdoor equivalent Japan Ministry of Environment criteria for evaluating complaints of mental and physical discomfort. This comparison is not presented in a figure since these criteria are generally less stringent than the DEFRA criteria.

Figure 12 plots the 16, 31.5, 63 and 125 Hz octave band sound levels (L_{eq}) for both samples of high output conditions. The results show that all outdoor equivalent ANSI/ASA S12.2 perceptible vibration criteria are met. The results show that all outdoor equivalent ANSI/ASA S12.2 low frequency NC-25 and NC-30 criteria for

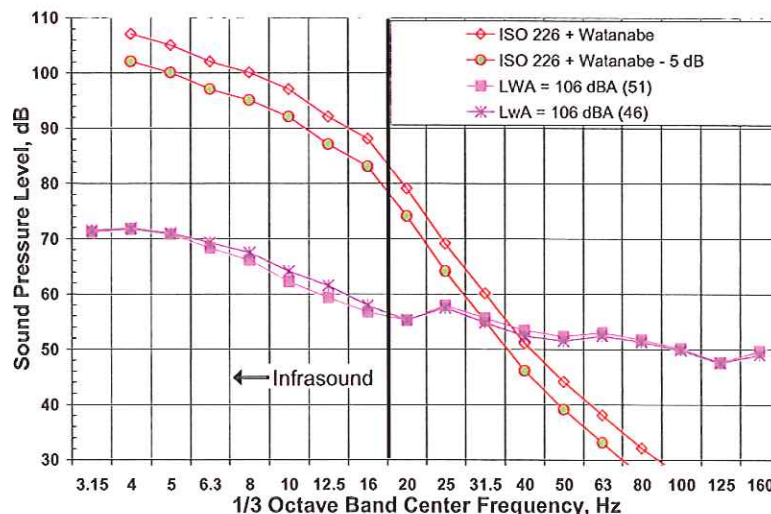


Fig. 9—GE 1.5sle wind turbine outdoor sound levels at 305 meters compared to audibility criteria.

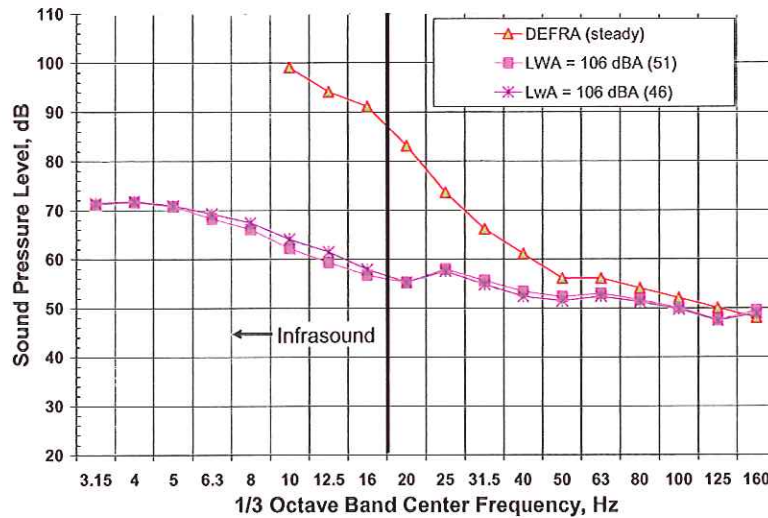


Fig. 10—GE 1.5sle wind turbine outdoor sound levels at 305 meters compared to outdoor equivalent DEFRA criteria.

bedrooms are met. The low frequency sound levels are below the ANSI S12.9 Part 4 thresholds for the beginning of rattles (16, 31.5, 63 Hz total less than 70 dB). The 16, 31.5, 63 Hz sound levels are below the level of 65 dB identified for minimal annoyance in ANSI S12.9 Part 4.

5.2.2 Indoor measurements—GE 1.5sle

Simultaneous outdoor and indoor measurements were made at two residences at different locations within the wind farm to determine indoor audibility of low frequency noise from GE 1.5sle WTGs. In each house, measurements were made in a room facing the wind turbines, and were made with a window both open and closed. These residences are designated Homes “B” and “C” and were approximately

305 meters (1,000 feet) from the closest GE WTG. Operational conditions were maximum turbine noise and high ground winds at Home “B”, and within 1.5 dB of maximum turbine noise and high ground level winds at Home “C”. Home “B” was near a string of multiple WTGs, four of which were within 610 meters (2,000 feet) of the house, while Home “C” was at the end of a string of WTGs, two of which were within 610 meters of the house. The sound level data presented herein include contributions from all wind turbines as measured by the recording equipment. The key operational and meteorological parameters during these measurements are listed in Table 13.

The room in Home “B” where interior measurements were made had the following characteristics:

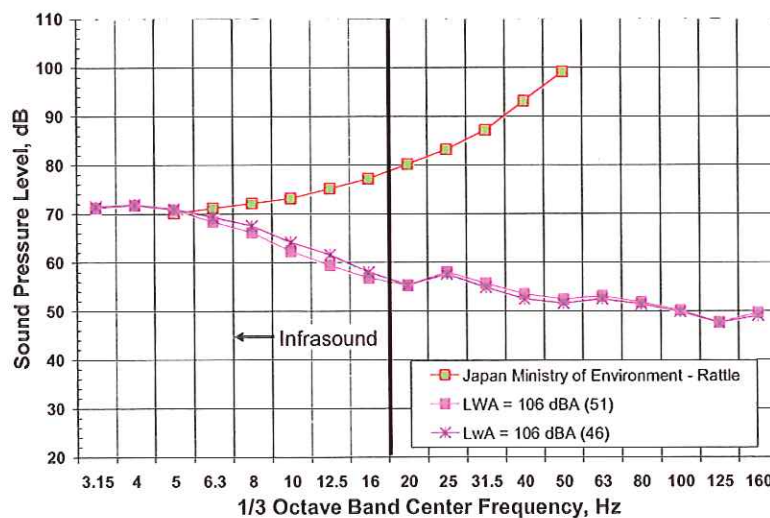


Fig. 11—GE 1.5sle wind turbine outdoor sound levels at 305 meters compared to Japan Ministry of Environment rattle criteria.

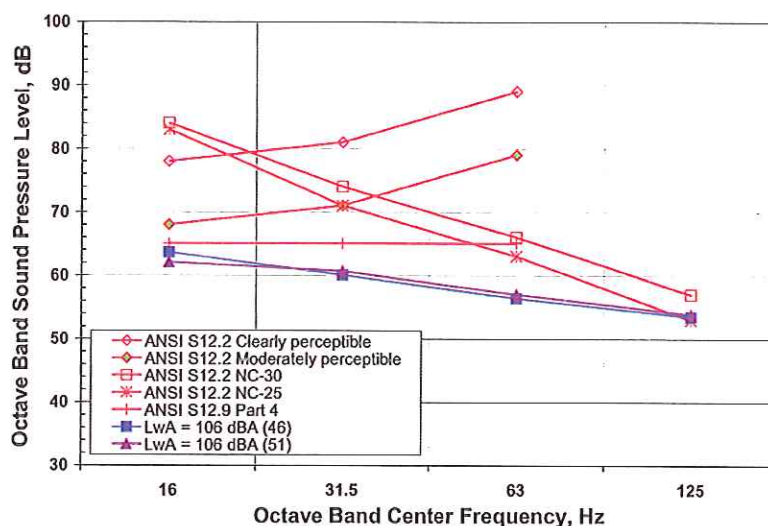


Fig. 12—GE 1.5sle wind turbine outdoor sound levels at 305 meters compared to ANSI criteria.

approximately 3.0 meters wide (10 feet) by 3.6 meters long (12 feet), bedroom furniture, carpeted flooring, two relatively new double-hung windows (no storm windows), paneling on the interior walls, and bricked exterior walls. The sound level meter was located just off-center in the room. The room in Home “C” where interior measurements were made had the following characteristics: approximately 2.4 meters wide (8 feet) by 3.6 meters long (12 feet), bathroom fixtures, linoleum flooring, one old casement window (no storm window), paneling on the interior walls, and wooden exterior walls. The sound level meter was located in the center of the room.

Figure 13 plots the indoor one-third octave band sound levels (L_{eq}) for Home “B”, and Fig. 14 plots the indoor one-third octave band sound levels for Home “C”. The results show that infrasound is inaudible to even the most sensitive people at around 305 meters (1,000 feet) from these wind turbines with the windows open or closed (more than 20 dB below the median thresholds of hearing). Low frequency sound at and above 63 Hz may be audible depending on background sound levels.

Figure 15 plots the indoor one-third octave band sound levels (L_{eq}) for Home “B”, and Fig. 16 plots the indoor one-third octave band sound levels (L_{eq}) for Home “C”. The results show the DEFRA disturbance criteria were met for steady and non-steady low frequency sounds.

Although not shown in Figs. 15 and 16, the one-third octave band levels meet the Japan Ministry of Environment criteria for evaluating complaints of mental and physical discomfort since both samples meet the more stringent DEFRA criteria for “non-steady” sounds, which is more stringent than the Japan criteria.

Figure 17 plots the indoor 16 Hz to 125 Hz octave band sound levels (L_{eq}) for Home “B”, and Fig. 18 plots the indoor 16 Hz to 125 Hz octave band sound levels (L_{eq}) for Home “C”. The results show the ANSI/ASA S12.2 low frequency criteria for perceptible vibration were met for both windows open and closed scenarios. The ANSI/ASA S12.2 low frequency NC-25 and NC-30 criteria for bedrooms, classrooms and hospitals were met,

Table 13—Summary of operational parameters—GE 1.5sle (Indoor).

Parameter	Home “B” (closed/open)	Home “C” (closed/open)
Distance to nearest WTG	290 meters	312 meters
Time of day	09:29-09:39/09:40-09:50	11:49-11:59/12:00-12:10
WTG power output	1,017 kW/896 kW	651 kW/632 kW
A-weighted sound power level	106 dB/105.8 dB	104.7 dB/104.6 dB
Measured wind speed @ 2 m	6.2 m/s/6.8 m/s	6.4 m/s/5.9 m/s
L_{Aeq}	27.1 dB/36.0 dB	33.6 dB/39.8 dB
L_{A90}	23.5 dB/33.7 dB	27.6 dB/34.2 dB
L_{Ceq}	47.1 dB/54.4 dB	50.6 dB/55.1 dB

* Includes K, uncertainty factor of 2 dB

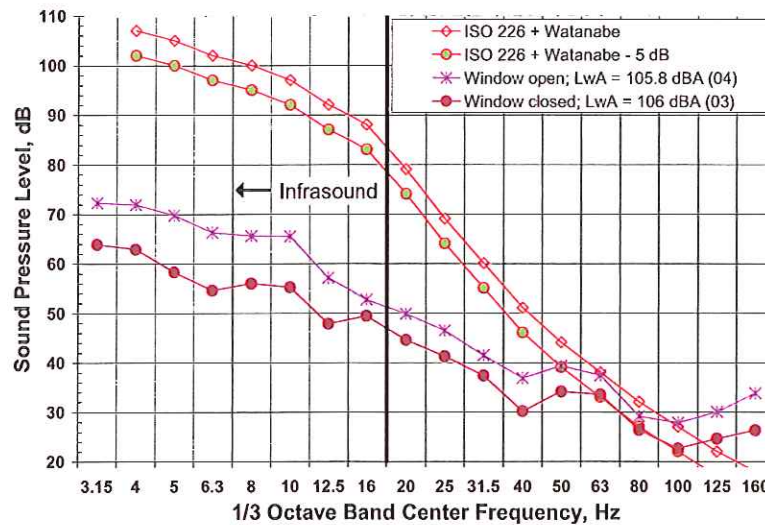


Fig. 13—GE 1.5sle wind turbine indoor sound levels at 290 meters compared to audibility criteria (Home “B”).

the spectrum was balanced, and the criteria for moderately perceptible vibrations in light-weight walls and ceilings were also met.

5.3 Noise Reduction from Outdoor to Indoor

Simultaneous outdoor and indoor measurements made at the three residences within the Horse Hollow Wind Farm discussed above, were used to determine noise reductions of the homes for comparison to that used in the determination of equivalent outdoor criteria for indoor criteria, such as ANSI/ASA S12.2 and DEFRA. Indoor measurements were made with windows open and closed. Tables 11 and 13 list the conditions of measurement for these houses.

Figures 19 and 20 present the measured one-third octave band noise reduction for the three homes with windows closed and open, respectively. Also presented in these same figures are the one-third octave noise reductions discussed in the Appendix of this paper to obtain equivalent outdoor criteria for the indoor DEFRA criteria as well as the equivalent outdoor criteria for the Japanese mental and physical discomfort indoor criteria. It can be seen that for the window closed condition in Fig. 19, the measured noise reductions for all houses were greater than that used in our analysis for determining the equivalent outdoor criteria for the Japanese mental and physical discomfort indoor criteria. For the open window case in Fig. 20, which

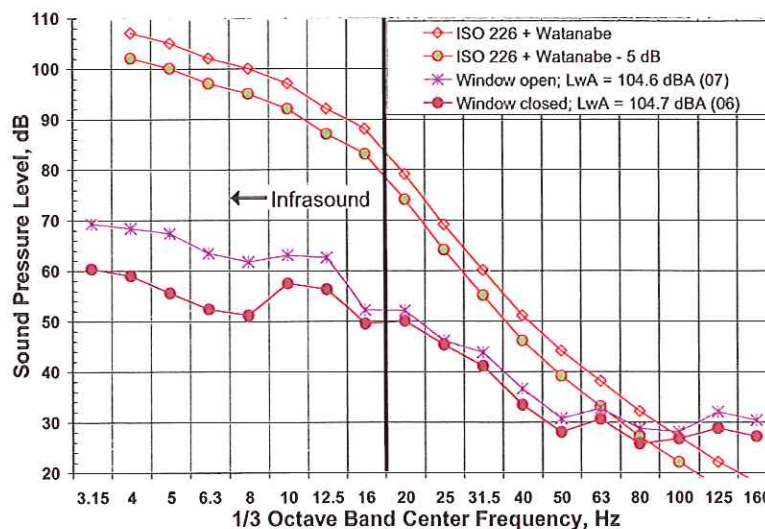


Fig. 14—GE 1.5sle wind turbine indoor sound levels at 312 meters compared to audibility criteria (Home “C”).

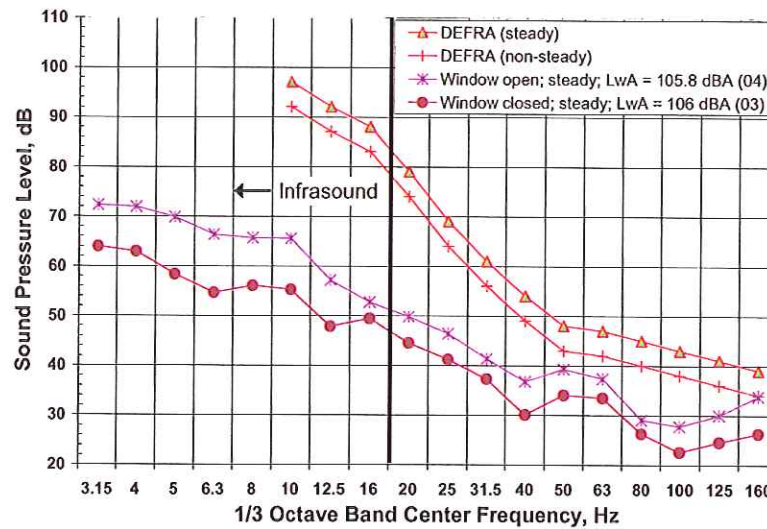


Fig. 15—GE 1.5sle wind turbine indoor sound levels at 290 meters compared to DEFRA criteria (Home “B”).

was used in our analysis for obtaining the equivalent outdoor DEFRA criteria, the average of the three homes has a greater noise reduction than assumed in the Appendix and all houses at all frequencies have higher values with one minor exception. Only Home “A” at 25 Hz had a lower noise reduction (3 dB), and this difference is not critical since the measured indoor sounds at 25 Hz at each of these home was significantly lower than the indoor DEFRA criteria and the indoor Japanese criteria. Furthermore, the outdoor measurements for both Siemens and GE wind turbines at 305 meters (1,000 feet) under high output/high noise levels met the equivalent outdoor DEFRA criteria at 25 Hz.

Table 14 presents the measured octave band noise reduction for the three homes with windows closed and open, respectively. Also presented in Table 14 are the

octave band noise reductions used in Table 2 of this paper to obtain equivalent outdoor criteria for the indoor ANSI/ASA S12.2 criteria for perceptible vibration and for NC-25 and NC-30. It can be seen that for the window closed condition, the measured noise reductions for all houses were greater than that used in our analysis. For the open window case, the average of the three homes has a greater noise reduction than the values from Table A1, and all houses at all frequencies have higher values with one minor exception. Only Home “A” at 31 Hz (which contains the 25 Hz one-third octave band) had a lower noise reduction (3 dB), and this difference is not critical since the measured indoor sounds at 31 Hz at each of these homes was significantly lower than the indoor ANSI/ASA S12.2 criteria. Furthermore, the outdoor measurements for both Siemens and GE wind

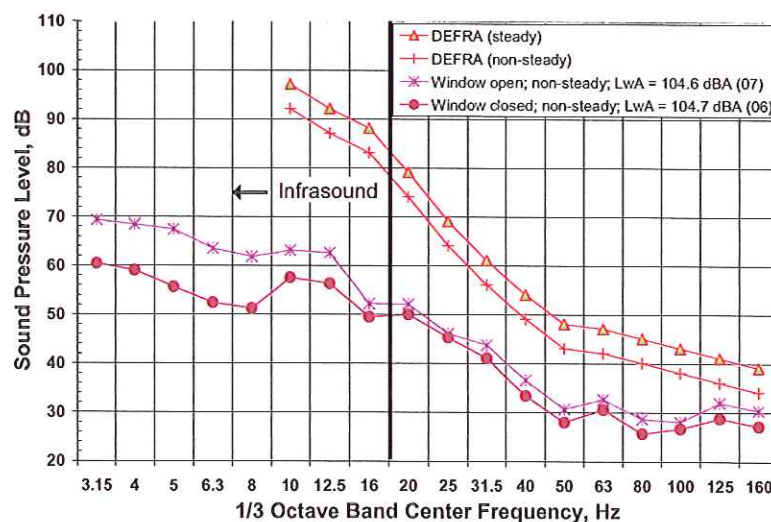


Fig. 16—GE 1.5sle wind turbine indoor sound levels at 312 meters compared to DEFRA criteria (Home “C”).

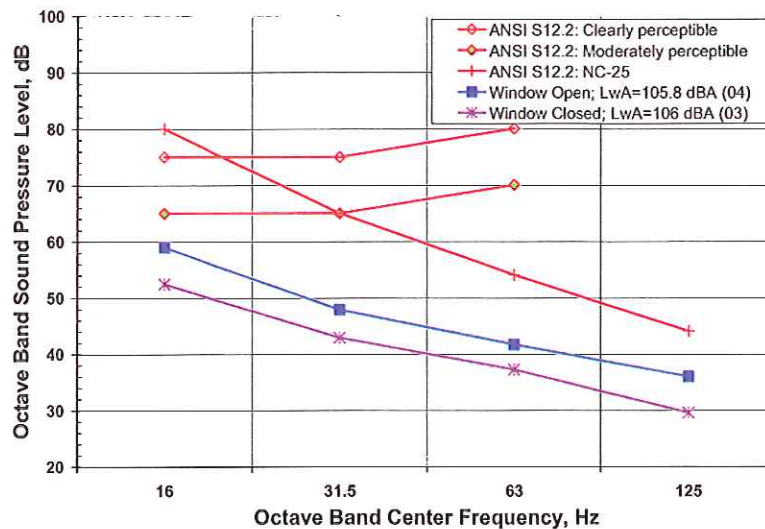


Fig. 17—GE 1.5sle wind turbine indoor sound levels at 290 meters compared to ANSI 12.2 criteria for perceptible vibrations and NC-25 (Home “B”).

turbines at 305 meters (1,000 feet) under high output/high noise levels met the equivalent outdoor ANSI/ASA S12.2 criteria at 31 Hz.

6 CONCLUSION

Sound levels from Siemens SWT 2.93-93 and GE 1.5sle wind turbines under maximum noise conditions at a distance more than 305 meters (1,000 feet) from the nearest residence meet the low frequency and infrasound standards and criteria published by several independent agencies and organizations. At this distance the wind farms:

- meet ANSI/ASA S12.2 indoor levels for low frequency sound for bedrooms, classrooms and hospitals;
- meet ANSI/ASA S12.2 indoor levels for moderately perceptible vibrations in light-weight walls and ceilings;
- meet ANSI/ASA S12.2 criteria for balanced spectrum from low frequency sounds;
- meet ANSI S12.9/Part 4 thresholds for annoyance from low frequency sound and beginning of rattles;
- meet UK DEFRA disturbance based guidelines for low frequency sound;
- meet Japan Ministry of Environment Guidance for evaluating complaints of rattling from low frequency noise;
- meet Japan Ministry of Environment Guidance for evaluating complaints of mental and physi-

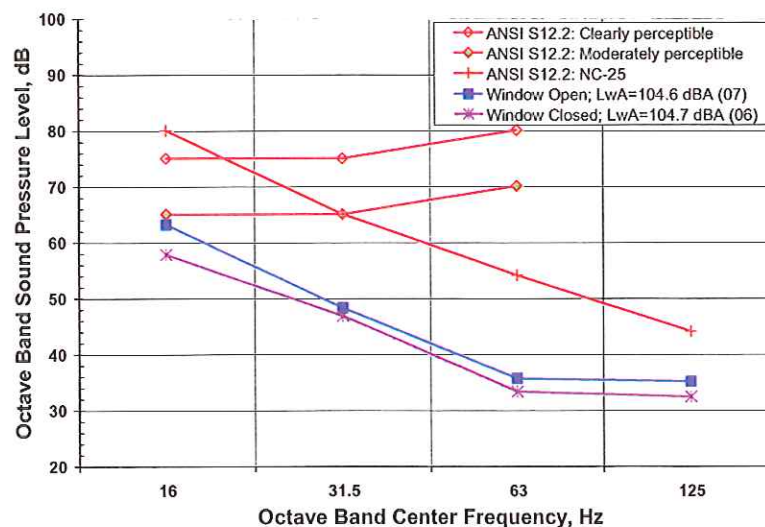


Fig. 18—GE 1.5sle wind turbine indoor sound levels at 312 meters compared to ANSI 12.2 criteria for perceptible vibrations and NC-25 (Home “C”).

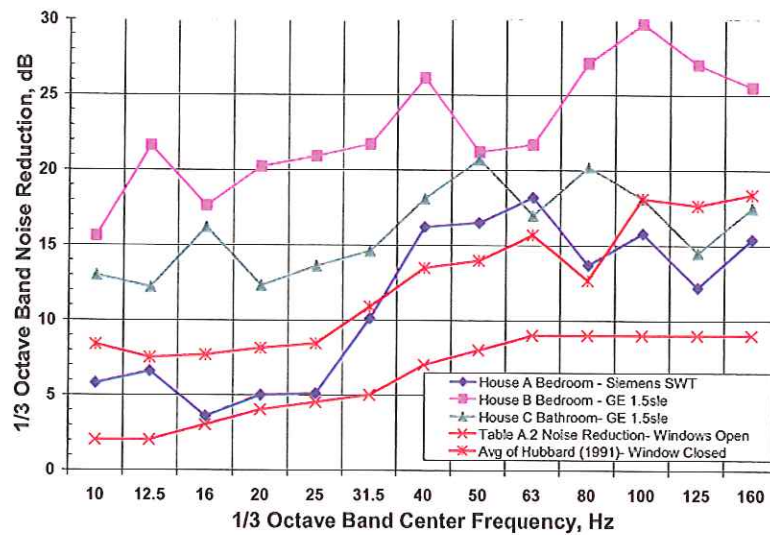


Fig. 19—One-third octave band interior noise reduction—Windows closed.



Fig. 20—One-third octave band interior noise reduction—Windows open.

- cal discomfort from low frequency noise;
- have no audible infrasound to the most sensitive listeners; and
- might have slightly audible low frequency noise at frequencies at 50 Hz and above depending on

other sources of low frequency noises in homes, such as refrigerators or external traffic or airplanes.

In accordance with the above findings, and in conjunction with our extensive literature search of

Table 14—Summary of octave band noise reduction—Interior measurements.

Home	Wind Turbine	Windows	16 Hz	31.5 Hz	63 Hz	125 Hz
A	Siemens SWT-2-3-93	Closed	5	6	16	14
A	Siemens SWT-2-3-93	Open	4	3	12	12
B	GE 1.5sle	Closed	20	22	22	27
B	GE 1.5sle	Open	13	17	18	21
C	GE 1.5sle	Closed	13	14	19	17
C	GE 1.5sle	Open	8	13	17	14
Table A1 Noise Reduction		Open	3	6	9	9

scientific papers and reports, there should be no adverse public health effects from infrasound or low frequency noise at distances greater than 305 meters (1,000 feet) from the wind turbine types measured: GE 1.5sle and Siemens SWT 2.3-93.

7 ACKNOWLEDGMENTS

Acknowledgement is made to NextEra Energy Resources, LLC ("NextEra"), formerly FPL Energy, for providing financial support for the study, allowing access to the wind farm, and supplying critical operational data. Epsilon determined all means, methods, and the testing protocol without interference or direction from NextEra. No limitations were placed on Epsilon by NextEra with respect to the testing protocol or upon the analysis methods; the conclusions are those of the authors.

8 APPENDIX: HOME NOISE REDUCTION USED TO DETERMINE EQUIVALENT OUTDOOR SOUND PRESSURE LEVEL CRITERIA BASED ON INDOOR CRITERIA

Since indoor measurements are not always possible, for comparison to outdoor sound levels the indoor criteria from ANSI/ASA S12.2 should be adjusted. Outdoor to indoor low frequency noise reductions have been reported by Sutherland for aircraft and highway noise for open and closed windows⁹ and by Hubbard and Shepherd for aircraft and wind turbine noise for closed windows¹⁰. Table A1 presents the average low frequency octave band noise reductions from outdoor to indoors from these two papers for open and closed windows. Sutherland only reported values down to 63 Hz; whereas Hubbard and Shepherd presented values to less than 10 Hz. The closed window conditions of Ref. 10 were used to estimate noise reductions less than 63 Hz by applying the difference between values for open and closed windows from Ref. 9 data at 63 Hz. It should be noted that the attenuation for wind turbines in Ref. 10 is based on only three homes at two different wind farms, whereas the traffic and aircraft data are for many homes. The wind turbine open window values were determined from the wind turbine closed window values by subtracting the difference in values between windows closed and open obtained by Ref. 9.

To be conservative, we use the open window case instead of closed windows except for the adjustments to the Japanese guideline which specifically called for closed windows. To be further conservative, we use the wind turbine noise reduction data in Ref. 10 (adjusted to open windows). However, it should be noted that it is

possible for some homes to have some slight amplification at low frequencies with windows open due to possible room resonances.

The average one-third octave band noise reductions used to determine equivalent outdoor one-third octave band criteria were determined in a similar manner. The first row of Table A2 and Fig. 20 present the average one-third octave band noise reductions values for *windows open* that were used to determine the equivalent outdoor one-third octave band criteria levels in Table 7 from the indoor criteria. The second row of Table A2 and Fig. 19 presents the one-third octave band noise reductions for windows closed determined by Ref. 10 for homes exposed to wind turbine sounds—these higher closed window noise reduction values were only used to determine equivalent outdoor levels for determining the equivalent Japanese guidance one-third octave band sound pressure level values for dealing with complaints of mental and physical discomfort from environmental sounds.

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Transcript of Proceedings - October 10, 2012
Volume 4

36
Public Service Commission of Wisconsin
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1 BEFORE THE
2 PUBLIC SERVICE COMMISSION OF WISCONSIN
3 - - - - -
4 APPLICATION OF HIGHLAND WIND FARM,)
5 LLC, FOR A CERTIFICATE OF PUBLIC)
6 CONVENIENCE AND NECESSITY TO)
7 CONSTRUCT A 102.5 MEGAWATT WIND)
8 ELECTRIC GENERATION FACILITY AND)
9 ASSOCIATED ELECTRIC FACILITIES, TO) Docket No.
10 BE LOCATED IN THE TOWNS OF FOREST) 2535-CE-100
11 AND CYLON, ST. CROIX COUNTY,)
12 WISCONSIN)
13 - - - - -

14 EXAMINER MICHAEL E. NEWMARK, PRESIDING
15 TRANSCRIPT OF PROCEEDINGS
16 OCTOBER 10, 2012
17 VOLUME 4
18 TECHNICAL SESSION

19 Reported By:

20 LYNN M. BAYER, RPR, CM
21 JENNIFER M. STEIDTMANN, RPR, CRR
22 Gramann Reporting, Ltd.
23 (414) 272-7878

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25 October 10, 2012	363 - 740, Incl.
Madison, Wisconsin	EXHIBITS:
9:00 a.m.	Hessler 5,6
	Schomer 9, Jaeger 4

Transcript of Proceedings - October 10, 2012
Volume 4

364

A P P E A R A N C E S

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TOWN OF FOREST, Reynolds & Associates, by GLENN
REYNOLDS, 407 East Main Street, Madison, Wisconsin
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COMMISSIONERS:
Ellen Nowak

OF THE COMMISSION STAFF
JOHN LORENCE, Office of General Counsel
James Lepinski

(FOR INDEX SEE BACK OF TRANSCRIPT.)

Transcript of Proceedings - October 10, 2012
Volume 4

365

1 (Discussion off the record.)

2 EXAMINER NEWMARK: Let's get on the
3 record. I think the applicant had questions. Might
4 as well take that one first.

5 MR. SCRENOCK: Thank you, Your Honor. We
6 just wanted to clarify, based on the prehearing
7 witness and exhibit list and the actions that were
8 taken at the beginning of the hearing yesterday,
9 what exhibits are currently in the record with
10 respect to Mr. Junker and Mr. Carlson.

11 EXAMINER NEWMARK: Okay. Interesting you
12 should ask about that. Okay. Well, it was my
13 understanding -- well, you know, it was my
14 understanding that all the exhibits were involved
15 and included in the record including the new ones,
16 Carlson 7 and Junker 18. But now that I think about
17 it, I guess they weren't on the list. They're on my
18 list, they're not on your list, the witness/exhibit
19 list. So when I said everything on the list, I
20 guess I should have been referring to the list that
21 you have that was an outdated version by the time we
22 got those two extra exhibits late -- was it Friday
23 or Monday, I'm not sure. So I can entertain, you
24 know, comments about that.

25 MR. SCRENOCK: I appreciate that. I think

Transcript of Proceedings - October 10, 2012
Volume 4

366

1 at this time our preference would be that you just
2 hold off ruling on those until the witnesses had the
3 opportunity to introduce them. Particularly with
4 Mr. Carlson, there is no -- to my knowledge, there
5 was no testimony in the record at all referring to
6 it or explaining what it is. And pretty much the
7 same thing with Mr. Junker.

8 So our preference would be we just wait.
9 You know, we may have some objections at that time;
10 but it would probably be more efficient to do it
11 that way than try to have a discussion right now
12 without the benefit of knowing for what purpose
13 they're offered and indeed what they are.

14 MR. REYNOLDS: Well, let me make a
15 representation, if you're ready for that. I wasn't
16 anticipating calling Mr. Carlson, but I certainly
17 can. Number 7 is basically the same map, same GIS
18 information, that corresponds with Junker
19 Exhibit 18, which is a compilation of the 16
20 residences that returned health surveys last
21 Thursday indicating the kinds of health problems
22 that I think the Public Service Commission should
23 know about when setting these, including the
24 autistic child that was mentioned. So this is 16
25 other individuals with various problems with ear --

Transcript of Proceedings - October 10, 2012
Volume 4

367

1 ear problems, headaches, nausea, vertigo, those
2 kinds of things, that may well be exacerbated with
3 wind turbines. That is the purpose.

4 The Carlson map simply shows where these
5 folks are, which I think would be very helpful
6 information for the company as well as the Public
7 Service Commission. Because recall in the initial
8 environmental assessment the Commission concluded
9 that there will be a certain small but unknown
10 percentage of people who will suffer, who will have
11 life-style changes and quality of life decreases.
12 And we responded by saying, well, you know, in order
13 to do your job, you must, Public Service Commission,
14 find out who they are.

15 There was no response. There is still
16 this generic kind of unknown subset of individuals
17 who will suffer. So the town took it upon itself to
18 attempt to do a survey and -- you know, in the
19 interest of protecting its citizens. So I received
20 the results of the survey on Thursday, Mr. Carlson
21 mapped it on I think late Friday, and I sent that to
22 everyone on late Friday. And I've made the -- all
23 the universe of returned surveys available to the
24 applicant and anyone else who wants it and filed
25 redacted and confidential versions.

Transcript of Proceedings - October 10, 2012
Volume 4

368

1 EXAMINER NEWMARK: Okay. In what form did
2 you make that available to parties?

3 MR. REYNOLDS: I told all of them that if
4 they wanted -- if they would respect the
5 confidentiality of the individuals, their names,
6 et cetera, I would make it available to them as of
7 last Friday. Received no response. And then I
8 talked to Mr. Lorence who suggested that I file a
9 redacted version and confidential version, which I
10 did on Monday.

11 EXAMINER NEWMARK: Okay. Let's get off
12 the record just for some housekeeping.

13 (Discussion off the record.)

14 EXAMINER NEWMARK: Junker has Exhibit 18
15 filed October 8th, and I'm assuming when it's filed
16 it's been served on parties by e-mail. Was that
17 done?

18 MR. REYNOLDS: That's right.

19 MR. SCRENOCK: That is not always correct,
20 Your Honor.

21 EXAMINER NEWMARK: It's not always
22 correct. Okay. In this case, did you receive an
23 e-mail?

24 MR. SCRENOCK: We did receive
25 Exhibit Junker 18. That's the only one of the ones

Transcript of Proceedings - October 10, 2012
Volume 4

369

1 we're discussing right now that we were ever served
2 with.

3 EXAMINER NEWMARK: Okay. So we have the
4 list of people that were surveyed.

5 (Document tendered to counsel.)

6 EXAMINER NEWMARK: I'm having problems
7 getting on ERF. Do you have a copy of 19C that I
8 could take a look at it?

9 MR. REYNOLDS: I just gave them -- let's
10 see, 19C, those are the surveys?

11 EXAMINER NEWMARK: I don't know. I need
12 to look at them.

13 MR. REYNOLDS: I think so.

14 EXAMINER NEWMARK: I see that there is a
15 corrected exhibit, cover sheet, part 2 of 2; and I
16 guess a 19C, that must be part 1 of 2.

17 MR. REYNOLDS: Oh, yeah. They wouldn't
18 all go -- they weren't -- we couldn't load them all
19 at once, so I think we did them in spots. So number
20 1 --

21 EXAMINER NEWMARK: Okay. Hang on. This
22 was filed -- this is the copy that was filed?

23 MR. REYNOLDS: That is the unredacted
24 version that was filed.

25 EXAMINER NEWMARK: Okay. But this is not

Transcript of Proceedings - October 10, 2012
Volume 4

370

1 as filed, though? There is no confidentiality
2 affidavit on there.

3 MR. REYNOLDS: Well, that's right. There
4 is no confidentiality affidavit. That's the
5 original document.

6 EXAMINER NEWMARK: All right. You know,
7 I'm just going to ask simply at this point why
8 wasn't this filed earlier?

9 MR. REYNOLDS: Didn't have the
10 information.

11 EXAMINER NEWMARK: Why wasn't the survey
12 done earlier?

13 MR. REYNOLDS: I mean, look, we got the
14 environmental assessment, we requested the Public
15 Service Commission to do this analysis. The town is
16 doing the best it can. This is very important
17 information, critical for this proceeding. And to
18 exclude it would be putting the public interest on
19 the side because of, in our view, failure of the
20 applicant or the agency to do this investigation.

21 This is important information that would
22 allow, if it's approved, for mitigation measures to
23 take place before harm occurs. So I don't think
24 there's any dispute about this. It is what it is.
25 It's important information. And Mr. Junker can

Transcript of Proceedings - October 10, 2012
Volume 4

371

1 explain the logistics of sending out 150
2 applications -- or surveys and getting the
3 information back on time and collating it and
4 getting it in a form that I could supply. But I
5 don't think there is any prejudice to the
6 applicants. I would think that the applicants would
7 be happy to have this information.

8 EXAMINER NEWMARK: Okay. Well, let's see
9 what the applicants have to say.

10 MR. SCRENOCK: Just to briefly respond,
11 with all due respect, Mr. Reynolds is aware that
12 there is a dispute over this. When he sent out the
13 e-mail on Friday indicating that he had some sort of
14 survey results and asked if we would all agree to
15 just have it entered in the record, we responded
16 with a request to explain why the information is
17 even relevant. And to my knowledge, we never got a
18 response back from him. So it's inaccurate to
19 suggest that there is no dispute about this
20 information.

21 We believe it is not relevant and, more to
22 the point, there is no way to verify the
23 information. There's -- these people are not -- you
24 know, looking through the survey, just for instance,
25 there is no -- people have self-selected and

Transcript of Proceedings - October 10, 2012
Volume 4

372

1 identified in very vague terms certain health
2 impact -- or certain health problems that they claim
3 to have at the current time. They're not available
4 for cross-examination. There is no doctor -- I'm
5 not aware of any sort of actual medical diagnosis or
6 anything that's involved here.

7 So it's -- our understanding is, as
8 Mr. Reynolds just described, it's being offered to
9 prove existing health conditions which, for one, are
10 not relevant to begin with; but even if it was
11 relevant, there is no way to test the validity of it
12 or to explore whether the information that's on
13 these pages has any relevance at all or correlation
14 to the operation of a wind turbine.

15 And so for those reasons, we don't think
16 it's relevant and we think it is prejudicial. We
17 did object when it was first mentioned as being
18 possibly available.

19 MR. McKEEVER: Judge, may I be heard on
20 this one?

21 EXAMINER NEWMARK: Hang on. I just want
22 to give everyone else -- everyone a turn.

23 MR. SCRENOCK: And even if there were
24 preexisting conditions that were proven to exist,
25 there is no basis to conclude that that would

Transcript of Proceedings - October 10, 2012
Volume 4

373

1 translate into any additional impact or harm that
2 would be caused by the wind turbines once they're
3 operational. There is just no basis to conclude
4 that a preexisting condition today translates into
5 some obligation to mitigate down the road.

6 EXAMINER NEWMARK: That's your relevance
7 argument.

8 MR. SCRENOCK: Yes.

9 EXAMINER NEWMARK: All right. Any other
10 parties wish to comment?

11 MR. McKEEVER: Thank you, Judge. The
12 applicant just said that the information is not
13 verifiable. Well, frankly, this is the same
14 argument that the wind turbine companies use when
15 people complain after the fact, that their headaches
16 or there is noise or something, well, it's not
17 verifiable, we don't know that this is the cause.

18 I think this is an opportunity for this
19 Commission to contribute significantly, frankly, to
20 the body of scientific knowledge around this whole
21 issue. If I read Dr. Roberts' testimony correctly,
22 Dr. Phillips, several of the others, Dr. Hessler, I
23 think there is an agreement among everybody that
24 some people are likely to have a complaint, call it
25 an annoyance, call it a health problem, call it what

Transcript of Proceedings - October 10, 2012
Volume 4

374

1 you will. We don't know who those are. We have no
2 idea of who that cohort of people are. We may find
3 that these 16 people don't complain. Okay. That
4 helps contribute to the body of knowledge, and I
5 think it goes directly to the question of public
6 health and safety here.

7 This is information that, to my knowledge,
8 has not been available in any other proceeding
9 certainly in Wisconsin nor anywhere else; and it's
10 useful information in getting to this whole question
11 of what is public health and safety, what are the
12 sound levels that are appropriate, how do we
13 mitigate these issues. I agree with Mr. Reynolds
14 that I think it's really valuable information to the
15 company. Now they've got it; and whether it's
16 admitted or not, you would hope that they would use
17 it. But I think it ought to be admitted and be part
18 of the record and the Commission ought to have an
19 opportunity to give it whatever weight it wants to
20 in terms of moving forward. Because I think it gets
21 us someplace in the ongoing debate reflected in the
22 literature, reflected in this proceeding, about what
23 is the impact of these things and who do they
24 affect. We don't know.

25 But back to my first point, we heard one

Transcript of Proceedings - October 10, 2012
Volume 4

375

1 of the witnesses say yesterday that really the
2 company is the one who decides whether a complaint's
3 valid, regardless of the fact that the individual
4 living there has headaches, has nausea, didn't have
5 them before, now has them, doesn't have them when
6 they leave. Health is psychological, it's mental,
7 it's stress. It's not always indicated by something
8 that can be shown up on a test. This is good
9 information that we ought to use because it
10 contributes to the body of knowledge.

11 EXAMINER NEWMARK: Anyone else?

12 MR. REYNOLDS: Yeah, just one response, if
13 I may. Number one on the list is a case history of
14 a 20-year-old --

15 EXAMINER NEWMARK: We don't need to go
16 through what's on the list.

17 MR. REYNOLDS: Okay. So that's in the
18 record and so when they say --

19 EXAMINER NEWMARK: There are a number of
20 these surveys that are mentioned on the record
21 already; is that what you're saying? Not the
22 surveys, but the situations of people involved.

23 MR. REYNOLDS: Well, yes, at least number
24 one. And, number two, this information could be the
25 basis of a condition of the permit that the

Transcript of Proceedings - October 10, 2012
Volume 4

376

1 applicant, who seems to believe that there is
2 absolutely no connection, there is no need to know
3 any of this information, that the Commission could
4 say, oh, yes, there is. So as a condition of your
5 permit, you're going to do a baseline health survey
6 so -- and we're going to require you to do sound
7 studies in the after-condition so that we can see
8 and maybe progress a little bit on the knowledge
9 base. So that if this is approved, that the
10 Commission can move forward with better data. And
11 that's what this is about. This is about finding
12 the right balance between wind turbines and the
13 ability of people to live in their homes.

14 So we heard some really stunning testimony
15 yesterday about Wisconsin residents who have lived
16 and made commitments to live in one particular place
17 and left because they couldn't stand the presence of
18 turbines. These aren't people that are whacky. I
19 mean, these are just regular people. This is an
20 important issue. And I know the company is going to
21 present its next witness to say that there is no
22 science that backs up these claims, that these guys
23 must be just complaining about everyday annoyances.
24 But from their perspective, it's real. And the
25 Commission has some important public health

Transcript of Proceedings - October 10, 2012
Volume 4

377

1 decisions to make, and this is a step toward that
2 resolution of finding a balance between wind
3 turbines and residential living.

4 EXAMINER NEWMARK: Yeah, you've made that
5 clear. Okay. I will rule on this. I am going to
6 affirm that objection leaving out -- let's see, it
7 would have to be 18, 19 of Junker and 7 of Carlson.
8 And is there no related testimony to that that --

9 MR. SCRENOCK: There is no related
10 testimony to Carlson's exhibit. There was --

11 EXAMINER NEWMARK: I'm -- go ahead.

12 MR. SCRENOCK: In Mr. Junker's
13 surrebuttal, his last Q and A indicated that he
14 was -- that he had disseminated the health survey
15 and planned to submit the results.

16 EXAMINER NEWMARK: Right. It doesn't
17 reflect the results.

18 MR. SCRENOCK: Correct.

19 EXAMINER NEWMARK: Now, the reason for
20 this, the primary reason is that in terms of best
21 evidence, these people are available tomorrow to
22 come to the public hearing. If they come of their
23 own volition and provide public testimony, such as
24 we've seen lay testimony presented by the parties,
25 that's their right to do so. But the survey, in

Transcript of Proceedings - October 10, 2012
Volume 4

378

1 terms of all the reasons the applicant provided us,
2 I agree with in terms of due process problems. And
3 really, we just really need to stick somehow to --
4 in some tangential way to the schedule and how we
5 organize this hearing. Having this kind of
6 information come in at this time, it's just not
7 feasible to produce a record that's -- that has
8 validity. So --

9 MR. REYNOLDS: But, Judge, you know, I
10 understand your ruling; but keep in mind that we got
11 flooded yesterday with ten different witness
12 responses and rebuttals and exhibits. And I think
13 this goes to weight rather than admissibility. I
14 mean, what is the harm of leaving it in? If the
15 applicant wants to --

16 EXAMINER NEWMARK: All right. Well, I've
17 already ruled, so let's not spend time on it.

18 MR. REYNOLDS: Okay.

19 EXAMINER NEWMARK: All right. Any other
20 outstanding?

21 MS. BENSKY: Your Honor, I sent an e-mail
22 around pretty late last night with a response to the
23 whole Larkin testimony matter. Did you receive
24 that?

25 EXAMINER NEWMARK: No. And, actually,

Transcript of Proceedings - October 10, 2012
Volume 4

379

1 well, I really shouldn't be getting your e-mails,
2 but that's another story.

3 MS. BENSKY: Well, I sent it to everybody.

4 EXAMINER NEWMARK: Okay. Yeah, I did
5 not -- yesterday. Yes, I do see it here.

6 MS. BENSKY: As a timesaving measure, I
7 figured I'd just write it out instead of argue
8 today. I have a copy of it. Can I show it to you
9 before you rule?

10 EXAMINER NEWMARK: Well, I was actually
11 going to just take arguments now. Is that something
12 we -- okay. That is another outstanding issue. Any
13 others that we know of? I have one more. Oh, yeah,
14 I wanted to -- okay, let's -- anything else? All
15 right. Okay. Yeah, why don't you start with your
16 argument.

17 MS. BENSKY: Well, we request that you
18 deny the oral motion to include the Richard Larkin
19 testimony, and the reason is because it's
20 prejudicial. You just mentioned due process. What
21 they want to do is put in testimony -- put in
22 surrebuttal testimony in an untimely manner from a
23 witness that we don't have the opportunity to
24 cross-examine. Had we known, had Mr. Larkin filed
25 surrebuttal testimony, we would have prepared

Transcript of Proceedings - October 10, 2012
Volume 4

380

1 cross-examination of him. We don't have the
2 opportunity to do that now.

3 There was a mistake on our part, a
4 procedural mistake, where we only referenced the
5 Exhibit 803 from the docket, we didn't actually
6 physically upload it to ERF. But there was no
7 surprise that Mr. Kielisch was relying on
8 Exhibit 803 to -- as one of the bases of his
9 opinions. It was referenced by PSC number and
10 docket number and he talked about it extensively in
11 his rebuttal testimony. So it was obvious to
12 everyone that it was in there.

13 The applicant had a full and fair
14 opportunity to cross-examine Mr. Kielisch on that
15 yesterday. He did. The applicant could have filed
16 the testimony of Mr. Larkin as surrebuttal
17 testimony. They could have had Mr. Poletti respond
18 to that in surrebuttal or in sur-surrebutal which he
19 submitted yesterday morning. And they chose not to.

20 So in terms of fairness, I think it's
21 extremely prejudicial to our clients to allow
22 testimony from a witness that has never been named
23 in this docket and we don't have the opportunity to
24 cross-examine.

25 EXAMINER NEWMARK: I just had a question,

Transcript of Proceedings - October 10, 2012
Volume 4

381

1 sorry if you covered this in the letter; but the
2 first time Kielisch references Exhibit 803, he does
3 it in a way where he's basically using it as a
4 citation to whatever argument he's making, whatever
5 facts he's trying to lay out. And I think it's
6 clear in the memo that that does not bring that
7 docket into the record.

8 The second time he does that on
9 surrebuttal, I guess, he actually states, you know,
10 by reference -- I'm incorporating this document by
11 reference. Now, we -- I think, you know, I'm going
12 to rule and I think it's pretty obvious you just
13 can't add documents into the record by reference in
14 that way. It just can't be done.

15 So with that said, when that document is
16 not on the record at this point, what does he need
17 to reference 803 for? What point is he trying to
18 make?

19 MS. BENSKY: Well, I guess with that, I
20 would ask that you rule either that everything is --
21 if you want to leave everything out, that's fine.
22 He discusses the study in his direct testimony and
23 the document is referenced in there. So there is no
24 prejudice to anyone, there is no surprise that he
25 was relying on his prior work in a different docket

Transcript of Proceedings - October 10, 2012
Volume 4

382

1 to help him make an opinion in this docket. That
2 was referenced in his rebuttal testimony.

3 And the applicant, my understanding was
4 that the applicant wanted that Exhibit 803 in the
5 record because they extensively cross-examined
6 Mr. Kielisch on it yesterday. So if that's the
7 case, that's fine. We don't object to filing
8 Exhibit 803. My understanding was that you had
9 ruled on that yesterday.

10 Later in the afternoon, the applicant
11 asked to file the testimony of Mr. Larkin. And
12 first they wanted it read through Mr. Poletti, which
13 is not proper because Mr. Poletti did not rely on
14 Mr. Larkin's testimony in that previous docket to
15 form the basis of his opinion. So normally an
16 expert can bring in that kind of stuff if they rely
17 on it. But Mr. Poletti didn't rely on it. He
18 wasn't even familiar with it until he was shown it.

19 So there is no proper evidentiary basis
20 for admitting the Larkin testimony, whereas I think
21 there is for admitting the Kielisch testimony.

22 If you want to leave out Kielisch 803 from
23 this docket, that's fine. But, regardless, the
24 Larkin testimony is not proper in this docket.

25 EXAMINER NEWMARK: Response?

Transcript of Proceedings - October 10, 2012
Volume 4

383

1 MR. WILSON: Well, there are a number of
2 responses. But let me just start with that
3 Mr. Poletti did rely on this Larkin testimony; in
4 fact, it was Mr. Poletti who provided me the Larkin
5 testimony. So he clearly has reviewed it and it
6 informed his decisions. And he testified yesterday
7 that he agreed with the contents of the Larkin
8 testimony.

9 EXAMINER NEWMARK: At what point did he do
10 that? Refresh my memory about when he mentioned the
11 Larkin testimony.

12 MR. WILSON: When he was on the stand
13 yesterday, I asked him questions about the Larkin
14 testimony, his rebuttal and surrebuttal, whether he
15 had reviewed them, whether he agreed with
16 Mr. Larkin's analysis regarding Mr. Kielisch's
17 study, and he agreed to that.

18 EXAMINER NEWMARK: So he has his own
19 opinion on Exhibit 803; is that correct?

20 MR. WILSON: Well, his opinion is that he
21 agrees with Mr. Larkin's analysis of 803. I think
22 that's what the record -- if you read back the
23 transcript, that's basically what he said.

24 EXAMINER NEWMARK: Okay. And how is that
25 different from having him come on the stand and

Transcript of Proceedings - October 10, 2012
Volume 4

384

1 explain his opinion on Exhibit 803?

2 MR. WILSON: It isn't any different, Your
3 Honor. I mean --

4 EXAMINER NEWMARK: Well, then why couldn't
5 he have done that? Because I asked -- I'm sorry, I
6 asked if he could come up and explain his opinion,
7 and you didn't want to do that. So why --

8 MR. WILSON: No, he did, to the extent --
9 the only thing that we were trying to do yesterday
10 was at your request get the information introduced
11 as an exhibit rather than allowing us to reference
12 sworn testimony in another case before this
13 Commission.

14 EXAMINER NEWMARK: Right, at that time.
15 Later on I asked, in terms of keeping him available
16 for re-call, can we just now put him on the stand
17 and have him give his own opinion on Exhibit 803.
18 And you said he could not do that, he needed to
19 reference Larkin's testimony.

20 MR. WILSON: He did need to reference
21 Larkin's testimony. Larkin's testimony informed his
22 opinion of Exhibit 803.

23 EXAMINER NEWMARK: But he has his own
24 opinion of it, he could not provide that yesterday.

25 MR. WILSON: I think that's already on the

Transcript of Proceedings - October 10, 2012
Volume 4

385

1 record.

2 EXAMINER NEWMARK: All right. Well, we're
3 just keeping it all out. 803 is out, any other
4 testimony is out. We just can't be referencing
5 other documents from other dockets or surrebuttal.
6 There may be cross. The documents were not provided
7 to parties. All kinds of reasons. Let's just move
8 on.

9 MR. WILSON: Your Honor, I --

10 EXAMINER NEWMARK: So Exhibit 2 --

11 MR. WILSON: Your Honor, can I ask a
12 clarification?

13 EXAMINER NEWMARK: Exhibit 2 Kielisch is
14 out. Okay? And anything else -- do you want to
15 take out references to Larkin in the testimony -- in
16 the cross too?

17 MR. WILSON: I think if you're going to
18 exclude 803, I think we need to expunge that -- any
19 references to the Larkin testimony or his
20 Exhibit 803 from the record.

21 EXAMINER NEWMARK: Okay.

22 MR. WILSON: I have no problem with your
23 ruling.

24 EXAMINER NEWMARK: Right.

25 MR. WILSON: But there is stuff in the

Transcript of Proceedings - October 10, 2012
Volume 4

386

1 record that --

2 EXAMINER NEWMARK: Well, stuff that was
3 prefiled, I agree that you had warning that that was
4 the citation for basically the basis of that
5 person's opinion. And at that point, you could have
6 responded to it in the proper order of testimony
7 filing. So I think that -- at least in direct and
8 rebuttal, does he do that in both direct and
9 rebuttal, reference 803?

10 MS. BENSKY: I believe he does. I know he
11 does in his -- he did not file direct. He only
12 filed rebuttal. But he referenced 803. And then he
13 described it pretty extensively, he spent several
14 pages talking about what he did for that.

15 EXAMINER NEWMARK: Right. That's fine.
16 But in terms of process, let's -- we'll take out
17 references to 803 in surrebuttal. There is that
18 footnote --

19 MS. BENSKY: I mean, Mr. Wilson is pretty
20 much asking that all of his cross-examination of
21 Mr. Kielisch be stricken. That's fine with me if he
22 wants to do that.

23 MR. WILSON: As long as 803 is not in the
24 record and they cannot brief 803, we can take
25 everything that I asked about 803 out. I'm fine

Transcript of Proceedings - October 10, 2012
Volume 4

387

1 with that.

2 EXAMINER NEWMARK: Okay. Well, I think
3 his rebuttal testimony is fair reference to 803. So
4 in that sense, you had an opportunity to rebut his
5 rebuttal on 803 at the time when you could file
6 surrebuttal.

7 MR. WILSON: He put it in for the truth of
8 the matter asserted.

9 EXAMINER NEWMARK: In surrebuttal.

10 MR. WILSON: In surrebuttal.

11 EXAMINER NEWMARK: He attempted --

12 MR. WILSON: And he testified to it on the
13 phone yesterday. I specifically asked him: Are you
14 putting this 803 before us for the same reasons that
15 you did in Glacier Hills in this docket, to show
16 that there's a property valuation issue? He said
17 yes. So he put it in for the truth of the matter
18 asserted. If you are going to exclude 803 --

19 EXAMINER NEWMARK: Correct.

20 MR. WILSON: -- that's fine. But I don't
21 think that anybody ought to be able to brief it or
22 rely on it in argument before the Commission. I
23 mean, there is not much difference, Your Honor, in
24 allowing them to cite 803, to rely on it and brief
25 it. It's an exhibit in another docket. Okay?

Transcript of Proceedings - October 10, 2012
Volume 4

388

1 Versus bringing in a piece of sworn testimony from
2 another docket. They're both evidence.

3 So I'm fine with excluding it if we
4 exclude all references, and we can take out all my
5 cross-exam of it. But if you're going to allow them
6 to argue 803, then we need to be able to bring in
7 another piece of testimony -- and I, by the way,
8 will make this offer with respect to the Larkin
9 testimony. I have no problem bringing in any
10 rebuttal testimony that Mr. Kielisch had in that
11 docket, I have no problem bringing in any
12 cross-examination on the record. I can tell you
13 that there was cross-examination of Mr. Kielisch,
14 there was no cross-examination of Mr. Larkin. So if
15 they want a balanced approach to it and you bring in
16 both sides from Glacier Hills, that's fine too.

17 But however you go, I mean, it's
18 prejudicial to allow them to argue 803 and not allow
19 us to basically respond with the same testimony --
20 or with information from the same docket.

21 EXAMINER NEWMARK: Is there a reason why
22 you weren't responding to it on surrebuttal?

23 MR. WILSON: The whole reason that we're
24 here, Your Honor, is because historically it has
25 been my practice, and I have never been called up on

Transcript of Proceedings - October 10, 2012
Volume 4

389

1 it, to cite to PSC reference dockets -- or
2 documents. So if it's on ERF in an official
3 document, it's got a PSC reference number, we have
4 always been able to cite that. It was not until
5 yesterday that you, you know, informed us that we
6 couldn't do that. Otherwise, I wouldn't have
7 brought it up.

8 It's their witness. It's their obligation
9 to know what their witness has testified to before
10 and what's out there. The fact that my witness
11 found it and provided it, you know, shouldn't be
12 held against us. They just didn't look at the
13 background of their witness.

14 MS. BENSKY: That's kind of an unfair
15 characterization. It's very simple. We don't want
16 to argue Glacier Hills. This docket is big enough
17 itself. They have Poletti, he issued the longest
18 report of any witness in this case. So they had a
19 full and fair opportunity to rebut anything that
20 Mr. Kielisch said. Mr. Kielisch gave a very brief
21 rebuttal statement, referenced the PSC number. He
22 explained in the text what he did, and obviously we
23 can cite that.

24 If they did not choose to file
25 surrebuttal, that was their choice. And at this

Transcript of Proceedings - October 10, 2012
Volume 4

390

1 point, they can't say that they have been prejudiced
2 because they failed to file surrebuttal testimony.
3 We don't want to bring in every single PSC docket
4 that has ever dealt with a wind case into this case.
5 The docket's big enough and it's going to get bigger
6 as the day goes on.

7 So they haven't shown that they have had
8 any prejudice. And Mr. Wilson can fault us for not
9 doing background research on our witness. That's a
10 non-issue. That has -- it's not helpful to this
11 discussion at all. So why don't we just say no
12 reference to PSC 803 in the text. We can argue and
13 quote to what Mr. Kielisch wrote in his rebuttal, he
14 was referring to that exhibit and he was discussing
15 that exhibit. But we don't have to go back to the
16 actual data. Let's just leave it all out.

17 MR. WILSON: I have no problem with
18 that --

19 EXAMINER NEWMARK: Okay.

20 MR. WILSON: -- with one caveat. We don't
21 need to go in and clean up the record. But if your
22 ruling were that nobody can argue 803 in their
23 briefs, I'm fine with that.

24 EXAMINER NEWMARK: Okay. Is that -- so do
25 you understand what that means? Because --

Transcript of Proceedings - October 10, 2012
Volume 4

391

1 MS. BENSKY: I understand what that means.
2 But we need to be able -- we can cite to his
3 testimony that he filed --

4 EXAMINER NEWMARK: His explanation of it.

5 MS. BENSKY: -- in which he discusses 803,
6 and that will go to weight and not admissibility
7 when the Commission is looking at it.

8 EXAMINER NEWMARK: All right. Let's do
9 that.

10 MR. WILSON: Would you clari -- can you --

11 EXAMINER NEWMARK: I thought you knew what
12 I was going to say. All right. We'll take out --
13 well, like I said, Kielisch 2 is out, which is the
14 Hills Exhibit 803. The -- there will be no Larkin
15 testimony coming into the record. The -- in terms
16 of making it available for briefing, the Exhibit 803
17 is not available for briefing. The testimony
18 provided by the witnesses on that exhibit may be
19 used in briefing. How is that?

20 MR. WILSON: I don't understand how his
21 testimony on 803 can be used in briefing if you're
22 not bringing in 803.

23 EXAMINER NEWMARK: Yeah.

24 MR. WILSON: So, I mean, if there is --
25 if -- what I meant was, is if you can't argue 803,

Transcript of Proceedings - October 10, 2012
Volume 4

392

1 you can't argue 803 or anything that emanates from
2 it.

3 MS. BENSKY: Absolutely not. We can't use
4 the --

5 EXAMINER NEWMARK: Well, I'm holding with
6 what I just said. So we'll move on. I think it's a
7 fair result.

8 So I think there is one other outstanding
9 issue, it's the Schomer page 6 surrebuttal.

10 MR. REYNOLDS: Yeah, Mr. Schomer is -- or
11 Dr. Schomer is here, and I think he would explain
12 that it is in response -- that it's proper rebuttal.
13 He'll explain it. That's what I would suggest.

14 EXAMINER NEWMARK: Okay. Let's see --

15 MR. REYNOLDS: He understands the issue
16 better than I do, or Mr. Wilson.

17 EXAMINER NEWMARK: Page 6, right? Okay.
18 If I remember correctly -- well, let me get your --
19 can you just restate your objection.

20 MR. SCRENOCK: Yeah. Thank you, Your
21 Honor. I don't suggest you want to sit and read all
22 of these; but the way that this testimony
23 progresses, best I can tell from the record, is that
24 it relates to Schomer's direct testimony on pages 4
25 and 5 of his direct where he was arguing that or

Transcript of Proceedings - October 10, 2012
Volume 4

393

1 asserting that the Commission ought to apply a 10
2 decibel adjustment from what would otherwise be an
3 urban area to a quiet rural area.

4 Mr. Hankard addressed it on rebuttal on
5 page 1 and beginning of page 2, generally talked
6 about urban and rural in rebuttal. And then on
7 surrebuttal, we have for the first time this notion
8 of a day/night sound level, an evening/night sound
9 level; and this comes after Mr. Schomer's addressed
10 the brief rebuttal testimony that Mr. Hankard
11 gave -- on the earlier brief rebuttal on page 5 at
12 the bottom.

13 And so our only objection is that this
14 reference to it, the day/night sound level and the
15 day/evening/night sound level, and that concept is
16 not responsive to the rebuttal testimony Mr. Hankard
17 gave. It's just -- it's information that he
18 apparently intended to include in his direct. And
19 that would have been the proper place for it.
20 That's our objection.

21 EXAMINER NEWMARK: Okay. Now, I recall
22 seeing testimony about day/night sound levels
23 yesterday when we were flipping through the pages,
24 and I don't think it was this page. Isn't there
25 references to that concept -- I mean, isn't that

Transcript of Proceedings - October 10, 2012
Volume 4

394

1 part of the rule? No? It's not a 120 day/night
2 sound level?

3 MR. SCRENOCK: No. This -- the rule
4 provides for different criteria during the day and
5 at night. This is talking about European and other
6 international standards that he's using to bolster
7 his idea that there ought to be a 10 decibel...

8 MR. REYNOLDS: Well, again, I'm not sure
9 the applicant really understands why Mr. Schomer
10 wrote that out; but it does pertain to circumstances
11 at Highland, it's relevant to the question of
12 conditions that the Commission might put on, and
13 he's available for cross-examination. It's
14 certainly not harmful.

15 EXAMINER NEWMARK: And in terms of the EU
16 sound level, there was references to the WHO
17 criteria. Was that in earlier testimony?

18 MR. REYNOLDS: It's been throughout, you
19 know, in terms of health versus annoyance.

20 EXAMINER NEWMARK: Does that relate to
21 this 10 decibel proposal?

22 MR. REYNOLDS: I think what it relates to,
23 if I'm not -- look, this sound stuff is rather
24 elusive. But I think what it relates to is the
25 ambient, the difference in -- that will -- from

Transcript of Proceedings - October 10, 2012
Volume 4

395

1 Mr. Schomer's point of view will occur in Highland
2 because it's so uniquely quiet, that the difference
3 between the background ambient day and night will
4 have a dramatic effect.

5 So it all goes to rebutting the
6 applicant's version that there will be no effect.
7 And I think it's a mistake to exclude Mr. Schomer's
8 testimony without an understanding of what he's
9 trying to get at. Because I think we're speculating
10 now.

11 EXAMINER NEWMARK: Well, I think the basis
12 would be timing of filing. That's -- basically it's
13 a procedural argument.

14 MR. SCRENOCK: It is; and Your Honor, I
15 would just remind you again, as you talked about
16 yesterday, it appeared you had concerns coming into
17 yesterday's hearing about the volume of surrebuttal
18 testimony to begin with. We were able to respond to
19 some of it. There are parts of it that were
20 improper and untimely. And in light of the fact
21 that we had to deal with, you know, a bunch of other
22 surrebuttal that arguably was legitimate, we ought
23 not to be held at the same time to dealing with
24 untimely surrebuttal. And to the extent that we can
25 stick with the schedule that was laid out in the

Transcript of Proceedings - October 10, 2012
Volume 4

396

1 prehearing conference memorandum, we think it ought
2 to be followed.

3 It appears in his surrebuttal testimony,
4 you know, in the area where he's responding to
5 Mr. Hankard; and our position is it's not responsive
6 to Mr. Hankard's rebuttal.

7 MR. REYNOLDS: Well, I would say that it
8 is; but, you know, Mr. Schomer can testify one way
9 or the other. I think excluding evidence is really
10 a mistake on that basis.

11 EXAMINER NEWMARK: I'll think about that.
12 So let's get some witnesses on the stand. I think
13 we can start with Roberts.

14 MR. WILSON: Yes.

15 EXAMINER NEWMARK: Let me just make sure,
16 does Hessler have to go anywhere or can he wait for
17 Roberts?

18 MS. NEKOLA: He can wait.

19 EXAMINER NEWMARK: Okay. Let's do an
20 applicant witness first.

21 MARK A. ROBERTS, M.D., APPLICANT WITNESS, DULY SWORN

22 DIRECT EXAMINATION

23 BY MR. WILSON:

24 Q Morning, Dr. Roberts. Can you state your full name
25 and business address for the record.

Transcript of Proceedings - October 10, 2012
Volume 4

397

1 A My name is Mark A. Roberts. My business address is
2 525 West Monroe, Chicago, Illinois, 60 --

3 MR. McKEEVER: Doctor, would you pull the
4 mic closer.

5 THE WITNESS: If somebody would shut that
6 blind right over there. I can't see you.

7 MR. McKEEVER: That might be better.

8 EXAMINER NEWMARK: Let's go off the
9 record.

10 (Discussion off the record.)

11 EXAMINER NEWMARK: Let's get back on.

12 BY MR. WILSON:

13 Q Dr. Roberts, in connection with your appearance
14 today, did you prepare 24 pages of rebuttal
15 testimony?

16 A Yes, I did.

17 Q And did you prepare six pages of surrebuttal
18 testimony?

19 A Yes, I did.

20 Q And did you prepare 12 pages of sur-surrebuttal?

21 A Yes.

22 Q Did you also prepare or cause to be prepared what
23 have been marked as Exhibit HWF Roberts 1, 2 and 3?

24 A Could you give me the title of that?

25 Q Well, there's three of them. Three exhibits.

Transcript of Proceedings - October 10, 2012
Volume 4

398

1 A Yes. Oh, the exhibits, yes. I did prepare -- I had
2 them prepared, yes.

3 Q Okay. You were present yesterday during the hearing?

4 A I was.

5 Q Did you hear the testimony concerning the individual
6 with autism?

7 A I did.

8 Q Can you tell us what your reaction was to that
9 testimony?

10 A Well, the discussion about autism is perplexing in
11 the fact that autism has a very, very detrimental
12 effect on the family and on the individual. It's --
13 epidemiologically it's increasing in the number of
14 cases. There's an unfortunate situation involving
15 where association with thimerosal in childhood
16 immunization -- vaccines was thought to be attributed
17 to autism and so had some public health significance.
18 But the big thing is the fact that there is a huge
19 amount of epidemiology being developed about autism,
20 trying to find a cause.

21 Q Is there any science, to your knowledge, that links
22 autism with wind turbines or characteristics from a
23 wind turbine?

24 A Currently, I am not aware of any peer-reviewed
25 published literature that shows -- links autism to

Transcript of Proceedings - October 10, 2012
Volume 4

399

1 wind turbines or other noise-type activities.

2 MR. WILSON: Dr. Roberts is available for
3 cross.

4 EXAMINER NEWMARK: I just want to
5 interrupt for a second. Can we have the staff
6 member remove that sign from the back of the room.
7 I don't allow signs in the hearing room.

8 GENTLEMAN FROM AUDIENCE: Sorry, I'll get
9 it out of here.

10 EXAMINER NEWMARK: Okay. Just so it
11 doesn't intimidate anyone. Okay. Go ahead.

12 CROSS-EXAMINATION

13 BY MR. McKEEVER:

14 Q Good morning, Dr. Roberts.

15 A Good morning.

16 Q Let's focus on autism for a moment. You have some
17 familiarity with the condition known as autism?

18 A Yes, sir. I'm not a pediatrician, but yes, sir.

19 Q But you are a medical doctor?

20 A That is correct.

21 Q And you're aware that there are many different forms
22 of autism?

23 A Growing every day.

24 Q And that some people with autism react differently to
25 different changes in their environment, different

Transcript of Proceedings - October 10, 2012
Volume 4

400

1 circumstances?

2 A Yes.

3 Q Some react -- or can react very adversely to flashing
4 lights?

5 A I'm not aware of that.

6 Q Do you know whether some can react adversely to noise
7 in their -- noise in their environment?

8 A Changes in their environment, but I don't know
9 literature that shows specifically that noise changes
10 it.

11 Q But they can react significantly to changes in their
12 environment?

13 A They can react to changes in their environment, that
14 is correct.

15 Q So one of the things that some people with autism,
16 let's use the word need, is stability, constancy in
17 their environment, change is difficult for them?

18 A That is one of the things that, as I understand it,
19 that they work on with the families.

20 Q Okay. Thank you. Now, you heard -- you were here
21 yesterday and you heard testimony from several people
22 regarding health problems that they've experienced
23 that they attribute to presence of wind turbines?

24 A I heard a lot of health complaints, that's correct.

25 Q Now, you have no reason, do you, to disbelieve people

Transcript of Proceedings - October 10, 2012
Volume 4

401

1 who complain of sleeplessness, headaches, nausea,
2 problems using hearing aids, and similar problems,
3 when they are in their homes near wind turbines and
4 then state that the problems go away when they are
5 not home, even when they leave for a reason other
6 than to simply escape the problem? You have no
7 reason to disbelieve those people, do you?

8 A Scientifically, I question it. As a physician, I
9 wonder. But I take it at face value.

10 Q You take it at face value. You, in your experience
11 as a doctor -- and I recognize you're an
12 epidemiologist now. You don't have a private
13 practice where you see patients, I take it?

14 A I'm still a physician as well and licensed in three
15 states. And, yes, in occupational medicine, I still
16 have occupation -- people come to me with
17 occupational issues. So I still practice
18 occupational medicine in a sense. But the process --

19 Q You're -- I didn't ask that question.

20 A All right.

21 Q The question I asked is whether or not -- I asked you
22 whether you see patients, you said yes; is that
23 correct?

24 A Yes.

25 Q Okay. And when patients come to you with a

Transcript of Proceedings - October 10, 2012
Volume 4

402

1 complaint, you take that at face value and then begin
2 to investigate the nature of that complaint?

3 A In the occupational setting and environmental
4 setting, that's correct.

5 Q Thank you. Now, you've never examined Jeffrey Bump
6 who testified yesterday, have you?

7 A No, sir.

8 Q You've never been to his home?

9 A No, sir.

10 Q You never have examined David Enz?

11 A No, sir.

12 Q You've never been to his home?

13 A No.

14 Q Never examined Sarah Cappelle?

15 A No.

16 Q Never been to her home?

17 A No.

18 Q Okay. Now, according to your vita, I want to say
19 1996 but I might have the date wrong, but you wrote a
20 paper in Oklahoma having to do with the distribution
21 of Rocky Mountain spotted fever and ticks; is that
22 correct?

23 A I believe so. I don't have my C.V. in front of me.
24 It's been a while ago, but yes.

25 Q Okay. I'm going to ask you a series of hypothetical

Transcript of Proceedings - October 10, 2012
Volume 4

403

1 questions that don't talk about wind turbines, but I
2 think they provide an illustrative example here. And
3 I'm going to chase ticks for a minute and Rocky
4 Mountain spotted fever.

5 If a hundred people came to you
6 complaining of symptoms suggestive of Rocky Mountain
7 spotted fever, or Lyme disease here in the midwest,
8 and you discovered that all of them had been in
9 outdoor areas known to be habitat for the dog tick,
10 the brown tick or the deer tick, that would suggest
11 to you a pattern; is that correct?

12 A That is correct.

13 Q Wouldn't you call this, as you state in your
14 testimony, quote, a series of events that catches the
15 attention of a science-minded individual?

16 A It does.

17 Q Okay. And that pattern is highly suggestive, is it
18 not?

19 A Yes.

20 Q That does not mean that there's a relationship
21 between their symptoms and the fact that they were
22 present in ticks, the public -- the public health
23 problem, regardless of the cause, it's only
24 suggestive?

25 A That's correct.

Transcript of Proceedings - October 10, 2012
Volume 4

404

1 Q Now, but wouldn't you be likely to conclude, on the
2 basis of that pattern and your training, that it's
3 highly probable that those 100 people have Rocky
4 Mountain spotted fever or Lyme disease before you
5 learn the results of blood tests?

6 A Not necessarily, no.

7 Q You wouldn't be likely to conclude that in this
8 situation?

9 A As a scientist, I wouldn't conclude that.

10 Q Okay. What other things might they be -- might their
11 conditions be attributable to?

12 A Well, the whole thing about it is the set of symptoms
13 for Rocky Mountain spotted fever are similar to
14 others. So one of the things you have to look at is
15 case definition. So it's really important that you
16 look at that 100 and you look at do they meet the
17 case definition. Because one of the things that
18 you've got in your example is we know exactly the
19 epidemiology of Rocky Mountain spotted fever. We
20 know what the symptoms are. It's very dramatic in
21 the fact that it's one of the few diseases that has
22 rashes on the palm of the hands.

23 So -- but looking at the case definition,
24 it's really important because we don't know that all
25 100 of those people have Rocky Mountain spotted

Transcript of Proceedings - October 10, 2012
Volume 4

405

1 fever.

2 Q No, I'm not suggesting that we know that. All I'm
3 suggesting is that as a doctor, you would conclude
4 that it was likely that that was -- you wouldn't be
5 surprised if that was the diagnosis?

6 A I would not be surprised.

7 Q Okay. Thank you. And you would be inclined to
8 think, would you not, that they had been bitten by a
9 tick?

10 A Because we know the epidemiology of Rocky Mountain
11 spotted fever, yes.

12 Q Thank you. Now, in fact, wouldn't it be highly
13 improbable to find that this pattern did not lead to
14 tick-borne illnesses in this -- illnesses in this
15 hypothetical population of 100 people?

16 A I mean, we know the epidemiology, so yes.

17 Q Okay. Now, I'm going to ask you to assume for a
18 minute that there haven't been the peer-reviewed
19 studies that are undoubtedly in the literature
20 regarding Rocky Mountain spotted fever and Lyme
21 disease. Just assume that that work is not out
22 there, and I understand that's unrealistic, but
23 nevertheless.

24 Based on what we've learned so far about
25 these hundred people, you would not need a

Transcript of Proceedings - October 10, 2012
Volume 4

406

1 peer-reviewed study, would you, to conclude that
2 there may be a relationship between the symptoms and
3 the ticks?

4 A Also -- I -- number one is you're stressing
5 peer-reviewed. But you need an adequate
6 epidemiologically study --

7 Q That's not --

8 A -- which you've thrown out.

9 Q That's not what I asked.

10 A No, you've thrown out the epidemiology --

11 Q That's not what I asked.

12 MR. WILSON: Objection, Your Honor. Can
13 he be allowed to answer the question?

14 MR. McKEEVER: Well, he's answering a
15 question I didn't ask.

16 EXAMINER NEWMARK: I think he answered his
17 question. Go on.

18 BY MR. McKEEVER:

19 Q I asked you if you would conclude that there may be a
20 relationship. I didn't ask you if there was a
21 relationship. In your experience as an
22 epidemiologist and a doctor, given the history that
23 we've put in here, wouldn't you be likely to conclude
24 that there may be a relationship?

25 A I would certainly evaluate whether or not there was a

Transcript of Proceedings - October 10, 2012
Volume 4

407

1 relationship.

2 Q Okay. That would be a hypothesis, is that correct,
3 in the scientific process?

4 A Absolutely.

5 Q Okay. Now, do you have any idea how long it took to
6 come to a definitive conclusion in epidemiology and
7 medicine that there was, in fact, a relationship
8 between ticks and this series of health problems?
9 Any idea what that period of time was?

10 A Longer than I've been in the practice of medicine and
11 epidemiology. I don't know.

12 Q Okay. Now, and the prudent advice to give somebody
13 during that period of time, based on the hypothesis,
14 would have been that they should take precautions
15 against tick bites; isn't that correct? That would
16 have been prudent advice to give to your patients,
17 those 100 people out there?

18 A At what point? I mean --

19 Q Well, I mean you've created a hypothesis. Now we're
20 doing the epidemiological studies. I'm talking about
21 during that period of time, wouldn't the prudent
22 advice be to take precautions against tick bites?

23 A Actually, you would have to go back in time and look
24 and see what else is in the literature. Based on
25 what I know, the answer is yes. But we're evaluating

Transcript of Proceedings - October 10, 2012
Volume 4

408

1 it based on what we know today and not what was going
2 on back when we didn't know that the Rickettsia was
3 in a tick. It's a different situation.

4 Q Okay. But good advice: Patient, try to avoid
5 getting bit by a tick?

6 A But see --

7 Q During that period of time when all you've got is a
8 hypothesis. That's the point I'm trying to make.

9 A But you haven't talked about any other hypotheses,
10 and I don't know what the other hypotheses were at
11 that point.

12 Q But we've got one. Now, wouldn't you agree that the
13 many reports in the literature about health problems
14 in the presence of wind turbines constitutes a
15 hypothesis?

16 A There is a series of hypotheses out there, yes.

17 Q But that constitutes at this point at least one of
18 those hypotheses?

19 A I won't say one. A bunch.

20 Q Okay. And this is a hypothesis which has not been
21 demonstrated in the peer-reviewed literature at this
22 point, that's your testimony?

23 A No. My testimony is that it's in the literature.
24 There's hypotheses out there. They haven't been
25 proven.

Transcript of Proceedings - October 10, 2012
Volume 4

409

1 Q We're agreeing.

2 A Okay.

3 Q Your testimony is that this hypothesis has not been
4 proven that there is a relationship?

5 A And I won't say one. The hypotheses that have been
6 put out there.

7 Q Now, conversely, that hypothesis has not been
8 disproven, isn't that correct, it's still a
9 hypothesis?

10 A That is correct.

11 Q Thank you. Okay. So we can agree, can we not, that
12 there's a problem, we just don't know what causes it;
13 the problem being that some people complain of health
14 problems, as you heard yesterday, in the presence of
15 wind turbines; we can agree there's a problem, but we
16 can't agree on whether or not we know what the cause
17 is?

18 A I think it's clearly evident that there are problems.

19 Q Thank you. Now, is there an objective test for
20 headaches?

21 A The specialist in headaches would say there's a
22 series of questionnaires that they can use. Some
23 types of headaches, there's actually even tests that
24 you can use. But by and large, headache is a
25 subjective complaint that's got to be worked out.

Transcript of Proceedings - October 10, 2012
Volume 4

410

1 Q This is probably a little bit less clear. Is there
2 an objective test for sleeplessness?

3 A They use sleep diaries and sleep labs. There's a
4 number of objective -- there is at least one
5 objective test I can think of, and that is to put a
6 person in a sleep lab.

7 Q And in a sleep lab, there are a variety of conditions
8 in the environment that can be controlled: noise,
9 temperature, smell, all of those things theoretically
10 can be controlled so you can factor some in and some
11 out in a sleep lab?

12 A Actually, I've seen studies where they reported the
13 sound level in the sleep lab.

14 Q Now, the absence of a peer-reviewed study on a
15 medical condition does not necessarily indicate that
16 there is not a causal relationship, does it?

17 A This is the age-old discussion, and that is correct.

18 Q Okay. Thank you. Now, that could only mean -- I
19 mean it could mean, again, a variety of hypotheses.
20 It could mean that the study has not been done, it's
21 not been funded, it's not been designed, it's not
22 been implemented, or that it's difficult or even
23 impossible to design a study to test that hypothesis
24 if we don't have the peer-reviewed study that shows
25 the cause?

Transcript of Proceedings - October 10, 2012
Volume 4

411

1 A That's some of the examples. There are others.

2 Q Okay. Thank you. Now, you've prepared a report
3 that's Exhibit Roberts 2 that's entitled, "The
4 evaluation of the scientific literature on the health
5 effects associated with wind turbines and low
6 frequency sound"; is that correct?

7 A That is correct.

8 Q And you prepared that report in 2009, right?

9 A In 2009, that's correct.

10 Q Okay. And that report does not cite any literature
11 since 2009?

12 A It's not been updated.

13 Q Thank you. Now, what's an annoyance? You knew that
14 question was coming.

15 A Yes. And you ask everybody in this room, and the
16 annoyance is going to be different, not only to the
17 person, but the time and that sort of thing. It's
18 something that a person doesn't necessarily
19 appreciate, I can't say want. It's just an adverse
20 feeling to that situation.

21 Q Okay. Now --

22 A My daughter's music, your questions, whatever.

23 Q That's a fair response. I don't object. Stoplights
24 can be an annoyance to some people?

25 A Absolutely.

Transcript of Proceedings - October 10, 2012
Volume 4

412

1 Q Barking dogs?

2 A Absolutely.

3 Q A crying baby on an airplane?

4 A It might be a concern to some people. So they
5 appreciate it in different ways. But to some people
6 it would be an annoyance.

7 Q Is it fair to state that typically an annoyance, just
8 in the common vernacular, is relatively short-term?

9 A Not necessarily.

10 Q Okay. What's a long-term annoyance?

11 A A long-term annoyance is something that the stimulus
12 continues to occur.

13 Q Okay. And what is, in your experience, what would be
14 the normal reaction of somebody exposed to a
15 long-term annoyance? What would they do to avoid it,
16 let's say?

17 A There's a number of responses that come to mind. One
18 is to accommodate to it.

19 Q Okay. Another is to try to avoid it?

20 A Another one is try to avoid it. One would be to
21 modify it. One would be to mask it. Any number of
22 things that they could do.

23 Q Okay. Thank you. Now, you work in occupational
24 health. Tell me what occupational health is.

25 A Okay. My -- occupational health is really where you

Transcript of Proceedings - October 10, 2012
Volume 4

413

1 look at -- it's a population-based aspect of medicine
2 or health. We'll use them interchangeably here. And
3 so it's looking at populations in the workplace and
4 the health conditions that might be associated with
5 the workplace, or health conditions that they bring
6 to the workplace that might affect their ability to
7 work.

8 Q And so let's assume a factory floor which has
9 machines running. Is it fair to state that some of
10 those employees might find the noise of those
11 machines annoying?

12 A It could be.

13 Q And for whatever reason, they choose to continue to
14 work there and put up with that noise, to accommodate
15 to it to use your term?

16 A As long as it's not above the OSHA standard.

17 Q Okay. I'll come back to that. In your experience,
18 have you run into people in the workplace who are
19 experiencing what to them is an annoyance who become
20 stressed?

21 A Not that I recall.

22 Q Isn't stress a medical term?

23 A Stress is a lay term. I don't know that it's got
24 any -- anybody's got hold over it, any profession.

25 Q Okay. Isn't it a common -- maybe it's not common.

Transcript of Proceedings - October 10, 2012
Volume 4

414

1 Hypothetically, somebody goes to the doctor and the
2 doctor finds that they have high blood pressure, my
3 doctor at least says do you have a stressful
4 occupation?

5 A Okay. And who in this room says they don't? It's a
6 term that's not well defined. And we lay off a lot
7 of health complaints based on stress.

8 Q But do we know epidemiologically that stress, however
9 it's defined, can lead to objective determinable
10 health effects such as high blood pressure? We know
11 that, don't we?

12 A I think there are situations. I haven't looked at
13 the epidemiology of that beyond -- the most recent
14 one I looked at is posttraumatic stress syndrome.

15 Q Stress syndrome.

16 A Stress syndrome. And so it's really one of
17 evaluating what -- again, like what is annoyance,
18 what is noise to one person might be music to the
19 other, what might be stress to one person is
20 motivation to the other person.

21 Q And what might be an annoyance to one person might be
22 just fine to somebody else?

23 A That is correct.

24 Q Now, we've talked about health. High blood pressure
25 is a physiological health -- it's measurable, it's a

Transcript of Proceedings - October 10, 2012
Volume 4

415

1 physiological health effect, is that correct, health
2 problem?

3 A A health problem. Okay.

4 Q Okay. But we routinely in medicine and in health
5 also talk about psychological health, mental health.

6 A Absolutely.

7 Q Okay. And psychological or mental health
8 epidemiologically is known in some instances to cause
9 physiological health problems; is that correct?

10 A That is correct.

11 Q Do you agree that smoking causes health problems?

12 A Yes, sir, it does. We agree.

13 Q Epidemiologically we know that?

14 A The epidemiology is curious.

15 Q But you would agree that for many years the
16 epidemiology did not show that?

17 A Early on, maybe so.

18 Q Okay. Let's try another example. How about black
19 lung disease, do you have any familiarity with black
20 lung?

21 A It's an occupation-related disease.

22 Q And was there a period of time in the history of
23 medicine when we didn't know what caused black lung
24 disease in miners?

25 A You would have to go back a long way, but some of the

Transcript of Proceedings - October 10, 2012
Volume 4

416

1 very -- I mean, in -- hundreds of years ago, yes.

2 Q If a patient comes to you complaining of a headache,
3 that's self-reported; isn't that correct?

4 A That is correct.

5 Q That's correct. And if I come to you complaining
6 that my elbow's sore, I fell off my bicycle, that's
7 self-reporting?

8 A That is correct.

9 Q And we can take an X-ray of my elbow and figure out
10 if I broke it or not?

11 A That's correct.

12 Q Okay. But we can't take an X-ray of my headache and
13 figure out if I've got a headache?

14 A No, we can't.

15 Q Now, if somebody comes to you and reports a headache,
16 you already testified that you take that at face
17 value, they're not necessarily making that up. You
18 take it at face value, you don't assume that they're
19 just inventing this headache because they like coming
20 to the doctor?

21 A Well, I'll date myself and say that that is the part
22 we classify in taking -- in documenting a medical
23 encounter, that's the S of a SOAP note, subjective --

24 Q I'm sorry, I didn't understand you. That's the what?

25 A That is the first part of a medical note that I would

Transcript of Proceedings - October 10, 2012
Volume 4

417

1 make about you, that is the subjective evidence, what
2 do you report to me as you come into this encounter
3 today? Then I do a physical exam, I ask you some
4 questions. Take headache, for example. The first
5 question I'm going to ask you is describe it to me.

6 Q Where is it?

7 A Where is it? How does it feel? If you say this is
8 the worst headache I've ever had, it's like someone
9 driving a nail in my head, you immediately go for
10 imaging.

11 Q Okay.

12 A Because that's a dangerous sign. We know that as an
13 aneurism, stroke, something like that, something.
14 But then other questions, you know, is it a cluster
15 headache, is it -- all those sorts of things. So a
16 physician takes the -- what the patient reports and
17 tries to match it with what we know about medicine.

18 MR. MCKEEVER: Okay. Thank you. I have
19 no other questions. Thank you.

20 EXAMINER NEWMARK: Other cross?

21 MR. REYNOLDS: Yes.

22 CROSS-EXAMINATION

23 BY MR. REYNOLDS:

24 Q Dr. Roberts, you have a lot of degrees. You're a
25 physician? Yes?

Transcript of Proceedings - October 10, 2012
Volume 4

418

1 A Yes.

2 EXAMINER NEWMARK: That's on the record.

3 BY MR. REYNOLDS:

4 Q Okay. But you don't have a clinical practice, do
5 you?

6 A No, I don't have a clinical -- again, I mean, people
7 come to me. I see -- I don't wear a white coat and
8 carry a stethoscope. My stethoscope is hanging on
9 the back of the door of my office.

10 Q All right. But you don't see patients?

11 A In an occupational setting I do, in the fact that --

12 Q Do you treat patients?

13 A Well, I repeat, a guy will come in -- one of our
14 employees will come in and say -- one of them came in
15 and said I've got a rash on my stomach. Okay? So I
16 went from being a, you know, consultant to being a
17 physician for that individual, I made a
18 recommendation. So I get periodically -- that is --
19 that to me is a practice of medicine. I'm licensed
20 to do it.

21 Q I understand. But you don't make your living as a
22 clinician, do you?

23 A That is correct, I do not.

24 Q All right. You make your living as a consultant?

25 A I make my living by helping people understand about

Transcript of Proceedings - October 10, 2012
Volume 4

419

1 science.

2 Q All right. And at least at this point, your work is
3 through Exponent, you stated?

4 A All of my work is through Exponent.

5 Q And that is a consulting company mostly for industry,
6 right?

7 A It's a consulting company.

8 Q Okay. And it has industrial clients?

9 A You know, I don't know all the client continuum that
10 they've got. I know that they have some industry
11 clients, yes.

12 Q All right. And your background is consulting for
13 industry; is that right?

14 A That is correct.

15 Q You've consulted for petroleum companies and industry
16 and corporations in Milwaukee on occupational
17 health-type issues, I assume?

18 A In Milwaukee, if you're talking about while I was at
19 the Medical College of Wisconsin, that was a clinical
20 role. I did a little bit of consulting; but the
21 majority, 99 percent of what I was doing, was in a
22 clinical and teaching role.

23 Q All right. And I wasn't talking about the academic
24 thing. But you've consulted with industry for your
25 consulting career, is that right, as opposed to

Transcript of Proceedings - October 10, 2012
Volume 4

420

1 individuals?

2 A Oh, okay.

3 Q Yes?

4 A Yes. I would characterize it that way.

5 Q All right. And in your teaching role, your major
6 specialty was preventive health?

7 A Preventive medicine.

8 Q Preventive medicine. Sorry. So preventive medicine
9 means that you try to avoid health problems before
10 they occur, true?

11 A That's one aspect, but the point is prevention in
12 populations. That's the other part of that
13 definition. That separates preventive medicine from
14 the other clinical specialties.

15 Q All right. And so if you can identify a certain
16 group that might be at risk, you as a physician and a
17 public health person would advocate to try to avoid
18 the risk rather than allow the risk to occur?

19 A I would use the science that's available to help them
20 understand and avoid where they can.

21 Q All right. Now, you recognize that in this debate
22 that's ongoing right here, there is a debate between
23 risk to the public from wind turbines versus
24 industrial sort of effort for financial gain; is that
25 a fair assessment?

Transcript of Proceedings - October 10, 2012
Volume 4

421

1 A I see all that going on in this discussion.

2 Q Yes. And you've seen it before in your professional
3 career, haven't you?

4 A Not as intensely as I have here.

5 Q Well, is it your -- in this debate, do you see it as
6 all or nothing, either the turbines go in or they
7 don't? Or is there a potential resolution to find a
8 happy medium between public health and wind farms?

9 A I would hope there is some sort of medium, yes.

10 Q All right. So cutting to the chase, if this project
11 could be redesigned to minimize risk, you'd advocate
12 for that as a preventive health person, wouldn't you?

13 A Well, number one, you have to define risk for me.
14 Because you've got my testimony and you understand
15 what I say about -- what -- my interpretation of
16 science. So if you're talking about risk of
17 complaints, you're not going to get rid of that. If
18 you're talking about noise levels, you could probably
19 redesign. But, again, if the measure of success is
20 eliminating concerns and complaints concerning wind
21 turbines, you're not going to do it.

22 Q Well, what if the science says, Dr. Roberts, that by
23 minimizing exposure to audible noise levels reduces
24 levels of complaints, we should move in that
25 direction, shouldn't we, if we're going to be in a

Transcript of Proceedings - October 10, 2012
Volume 4

422

1 preventive care mode?

2 A But, see, the whole thing is what is audible? And
3 you're asking me -- this is a social question. It's
4 not a science question really. Because the science
5 is there. And so you're asking me to actually go
6 into a social issue that I'm not real comfortable
7 getting into.

8 Q Well, but you're in a social issue, aren't you?

9 A I am not advocating for or against wind turbines.

10 Q All right. But you're pretty much, are you not --
11 your testimony is that the complaints that have been
12 lodged against wind turbines are in the annoyance
13 category, right? That's your testimony?

14 A That is consistent with the peer-reviewed published
15 literature.

16 Q All right. But would you agree with me that the -- I
17 think you characterized as these nonspecific
18 complaints, and they're all subjective, of headaches,
19 earaches, vertigo, insomnia, those are all consistent
20 complaints; are they not?

21 A Okay. First of all, you included insomnia, and we
22 discussed the fact you can go into sleep lab and
23 determine that.

24 Q That wasn't my question.

25 A But I'm saying you called them all subjective. And

Transcript of Proceedings - October 10, 2012
Volume 4

423

1 I'm saying there is objective evidence to measure
2 insomnia. So I'm just saying let's exclude that one.

3 Q Well, if I come to you as a doctor and say I can't
4 sleep, that's a subjective complaint?

5 A That is correct.

6 Q All right. Now, all of these issues can well be
7 characterized as health complaints if they affect the
8 functioning of the individual; isn't that right?

9 A I think they can be health complaints whether they
10 affect the function of the individual or not.

11 Q All right. And you heard the testimony of these
12 individuals yesterday; did you not?

13 A I did.

14 Q And you said you had doubts about them?

15 A I didn't say that.

16 Q Okay. But did you believe them? Do you have any
17 reason to doubt that they were --

18 A I don't have any reason to doubt. I take them for
19 what they say, and that is what a physician is
20 supposed to do. But you're not supposed to jump to
21 the conclusion of what the cause is based on just
22 what we saw today -- yesterday, excuse me.

23 Q Well, of course, no one is asking anyone to jump to
24 any conclusions. But is it significant to you as an
25 epidemiologist that when the individuals, number one,

Transcript of Proceedings - October 10, 2012
Volume 4

424

1 had no predetermined disposition against wind farms,
2 number two, when the wind turbines started spinning
3 they started feeling these same complaints that we've
4 listed, and number three, when they go away the
5 symptoms disappear, is that significant from an
6 epidemiological point of view?

7 A That is an observation. It's not tested. You know,
8 this is not -- that was not a random sample of people
9 that you brought in the room yesterday.

10 Q Well, that's true because they are a unique set of
11 individuals who happen to live near wind turbines,
12 right?

13 A But the point being is, is it, like we go back, we
14 talked about annoyance, Pedersen, there is a
15 number -- out of Sweden, there's a number of people
16 talking about annoyance. And the process itself may
17 be annoying to the individual. Many of the symptoms
18 that they described, I would bet as a physician some
19 people were feeling those very symptoms in this room
20 yesterday during that process.

21 Q Yeah, well, that's true. But, so annoying, it was
22 I'm sure annoying for you to get in a traffic jamb on
23 the way here or whatever. But we're talking about
24 people, Dr. Roberts, who left their homes, they no
25 longer live in the homes that they've been in for

Transcript of Proceedings - October 10, 2012
Volume 4

425

1 decades. Is that significant to you?

2 A That is very significant.

3 Q All right. That gets beyond annoyance, doesn't it?

4 A Again, I don't know their history and that sort of
5 thing. That is significant to me. That's what I'm
6 saying.

7 Q Worthy of further investigation?

8 A I'm not -- I think medical evaluation, yes.

9 Q Well, what about from an epidemiological point of
10 view?

11 A Well, from an epidemiological point of view, a study
12 of one person or a study of the -- I didn't count
13 them, the number of people that were here yesterday,
14 I don't think that we would have enough power to
15 really determine the significance of it -- of those
16 symptoms.

17 But, you know, you take headache, for
18 example, we'll go back to that for a minute. In
19 excess of 50 percent of the population, depending on
20 the ethnic background, will report headaches at some
21 time during the month. Headaches are frequent. To
22 me it was significant that these people talked about
23 headaches. But in the literature, there's about 93
24 different sets of symptoms that have been identified
25 in internet searches about complaints about wind

Transcript of Proceedings - October 10, 2012
Volume 4

426

1 turbines. We can't identify a condition from the
2 literature that is associated specifically with wind
3 turbines.

4 Q Well, let's back up a little bit. It is a challenge
5 for science to prove much of anything conclusively,
6 isn't it?

7 A Yes, and I'm glad it is.

8 Q So we still debate whether the theory of evolution is
9 correct or the theory of relativity, don't we?

10 A I don't debate that.

11 Q Well, you don't, but there are folks who do?

12 A Probably so.

13 Q All right. And they're --

14 A That's part of the scientific process.

15 Q That's right. And so when -- let's take the folks
16 that you heard yesterday. Is it true, as far as you
17 know, that those complaints that you heard yesterday
18 are not unique to individuals living near wind
19 turbines?

20 A They're not unique to individuals period.

21 Q That wasn't my question.

22 A Well, that was my answer.

23 Q Yeah, well, try my question. Is it true that the
24 individuals that -- you've read hundreds of articles
25 now on wind turbines, right?

Transcript of Proceedings - October 10, 2012
Volume 4

427

1 A I hadn't counted them.

2 Q Okay. You did a report for the Glacier Hills case?

3 A In 2009.

4 Q And that was at the request of WEPCo, I believe?

5 A I believe it was; and I've continued to look at the
6 literature since then, so it's beyond that now.

7 Q All right. And fair to say that science is still
8 trying to quantify the relationship between wind
9 turbines and these subjective complaints that we
10 heard yesterday?

11 A They're still in the scientific process, I would put
12 it that way.

13 Q That's right. But there's no denying that
14 individuals that -- experience these same symptoms
15 near wind turbines, not just in Wisconsin, but all
16 over the world?

17 A Give me that question again. I got lost in that.

18 EXAMINER NEWMARK: Let's just read it
19 back.

20 (Question read by the reporter.)

21 A There is a -- the literature and -- there's two types
22 now. One is the lay literature and one is the
23 scientific literature. But when you look at it all,
24 like I said, there are a lot of different symptoms,
25 complaints, associated with wind turbine farms.

Transcript of Proceedings - October 10, 2012
Volume 4

428

1 BY MR. REYNOLDS:

2 Q Major four: headaches, ear problems/earaches,
3 vertigo, nausea/feeling of ill ease; those are the
4 top four, aren't they?

5 A No, sir. I don't know that to be the fact.

6 Q Well, are those ones that are consistent symptoms
7 that you've read or not?

8 A Oh, I've read about those symptoms, but I can't
9 quantify -- I don't know of any study that has looked
10 at all wind turbine or a sample of wind turbine
11 projects to find out what the symptoms -- what the
12 frequency are.

13 Q And you haven't done that study?

14 A I have not done that study.

15 Q You could, though, you could take -- you could
16 probably help us out a little bit and pull all of
17 those pieces together?

18 A Well, we can look at the literature. I would be glad
19 to work at it with you. But the problem is that
20 there is different instruments used, different
21 timing, different ethnic aspects. So there is a
22 bunch of epidemiological problems that go along with
23 that. But you can go in the literature and you can
24 look at that.

25 Q All right. Would you agree with me that it would be

Transcript of Proceedings - October 10, 2012
Volume 4

429

1 a good idea to try to assess health conditions of
2 individuals in the Town of Forest to potentially
3 prevent problems?

4 A It's too late for that.

5 Q It's too late?

6 A That is correct.

7 Q So -- why is it too late?

8 A The process has already started. The people in the
9 room that were from Forest that were here, they're
10 already talking about their symptoms and that sort of
11 thing. So there is this recall bias that's already
12 going on in the individuals in the Forest area. The
13 only real way you can do this would be to do a survey
14 before there is any discussion about wind turbines,
15 before there was any inkling.

16 Q So that means that the public can never have a survey
17 because it's the wind industry that decides where
18 they go and as soon as they're there it's too late?

19 A If that were the only design that we had, that would
20 be correct.

21 Q All right. Is it fair to say that if the Highland
22 project is built, the individuals there will have the
23 kinds of health problems we've been talking about?

24 A The -- as far as what we know about annoyance in the
25 literature, it would be reasonable that they would be

Transcript of Proceedings - October 10, 2012
Volume 4

430

1 annoyed and they would report similar symptoms.

2 Q And so you're using again the word "annoyance."

3 A Um-hmm.

4 Q What about health problems?

5 A Well, what is a health problem?

6 Q Well, all right. How about the individuals who
7 testified yesterday, were they experiencing health
8 problems or was it just annoyance?

9 A I heard health complaints yesterday.

10 Q Right.

11 A Okay. And so --

12 Q Serious health complaints?

13 A Health complaints. I can't tell you the seriousness
14 of it other than what they said. I would have to
15 evaluate as a physician. I was not in this room as a
16 physician yesterday, as a treating physician. I had
17 no patient-physician relationship with those
18 individuals. So the thing is that I heard complaints
19 that are very similar to what I've heard and seen in
20 the literature and that need to be addressed on a
21 one-on-one basis with their personal physician.

22 Q Well, that's fine. But keep in mind as a scientist
23 that the same turbines, same size turbines that are
24 in the Glenmore Shirley project -- three individuals
25 left their homes, and you heard them yesterday -- are

Transcript of Proceedings - October 10, 2012
Volume 4

431

1 going to be the same turbines that are planned for
2 Highland. Okay?

3 So with that question, is it a reasonable
4 hypothesis to assume that some of the folks in
5 Highland will suffer the same complaints as the folks
6 in the Glenmore project unless there's mitigation?

7 A I'm not an engineer. But one of the things as an
8 epidemiologist looking at the literature and looking
9 at the evolution of wind turbines from downwind to
10 upwind and vertical to horizontal and all that sort
11 of thing, you can't compare -- you've got to watch
12 that in the 40 years that we've had wind turbines in
13 the U.S.

14 But the other thing is I don't know what
15 has changed between the wind turbines that --
16 whatever they're going to use now versus whatever
17 you're comparing it to, I don't know the ins and
18 outs, I don't know the sound profile of those. No
19 matter what they use, there is an underlying set of
20 symptoms that we see in the literature, complaints
21 that we will hear wherever you put wind turbines if
22 there are people.

23 Q Well, what if the project is redesigned to minimize
24 risk?

25 A As I testified earlier, I don't think -- if you would

Transcript of Proceedings - October 10, 2012
Volume 4

432

1 evaluate -- equate risk with the number of health
2 complaints, I don't think you can do that.

3 Q Well, what if literature says that if you minimize
4 sound levels at the residence, the number of
5 complaints reported worldwide reduces to almost zero?

6 A It doesn't --

7 MR. WILSON: Objection, asked and
8 answered.

9 EXAMINER NEWMARK: You can answer.

10 A I need to see that reference because I don't -- I
11 don't -- one of the things that happens is, like if
12 you look at WHO, for example, they say health
13 complaints start at 30 decibels. But I'm not an
14 acoustical expert.

15 BY MR. REYNOLDS:

16 Q All right. Well, then let me ask you this. Would
17 you have a problem if another acoustical person said
18 a target level to reduce risk of complaints should be
19 40 decibels and this Commission redesigned this wind
20 turbine farm to minimize risk?

21 A That's entirely up to them.

22 Q Right. That would be consistent with preventive
23 health, wouldn't it?

24 A Not necessarily. Because, like I said, first of all,
25 there isn't any literature that there is a specific

Transcript of Proceedings - October 10, 2012
Volume 4

433

1 health effect associated with wind turbines. Okay?
2 Except annoyance. The second thing is if you
3 evaluate the success of that change and acceptability
4 based on complaints, you're not going to be
5 successful. There's more to it than just the wind
6 turbine itself.

7 Q What, you're talking about people just don't like
8 looking at wind turbines?

9 A Well, that's one of the things in the literature that
10 they say that there's -- in some of the studies
11 there's actually more of an effect from being able to
12 see the turbines than from hearing them.

13 Q That's your -- is that your assessment, that --

14 A That's what --

15 Q -- this is really a debate about visual stimuli and
16 irritation?

17 A No. No, sir, it is not.

18 Q You recognize that there is something medically going
19 on here, right? Otherwise we wouldn't have these
20 kinds of complaints worldwide, would we?

21 A The thing is that I don't know that there's a medical
22 condition. I know there's health concerns, I know
23 there's medical concerns by those individuals. But
24 do I know there's a health condition? No, I don't.

25 Q All right. So you -- all right. You're a spokesman

Transcript of Proceedings - October 10, 2012
Volume 4

434

1 for the absence of knowledge rather than the
2 profusion of knowledge, right? You say we don't
3 know, science isn't there, so don't worry about it;
4 is that it?

5 A No, sir, it's not. That's a mischaracterization of
6 what I think.

7 Q Well, do you have any proof for the citizens of
8 Forest that if this farm is built as designed, that
9 they will -- they are assured from science that there
10 will be no similar problems of people abandoning
11 their homes?

12 A Science can never assure that.

13 Q Right. But by -- preventive health can minimize the
14 risk by reducing sound levels?

15 A I'm not sure that that's the case. If you measure
16 risk based on complaints, I don't think you can.

17 Q All right. Is it fair to say that the folks that
18 have -- that distance from wind turbines is curative,
19 that folks that are far enough away from wind
20 turbines don't complain about them?

21 A I've got a problem, first of all, with curative.

22 Q Well, whatever.

23 A Throw that one out. And the next thing is --

24 Q Well, what --

25 A -- distance, because if they can see it, if they're

Transcript of Proceedings - October 10, 2012
Volume 4

435

1 concerned, if they're mad about the process, they're
2 more likely to recall symptoms. If they love them
3 and are a turbine hugger or whatever, I don't know,
4 if they -- if they're for them, they're not as likely
5 to report health complaints. That's called recall
6 bias. And so part of it's hearing it, part of it's
7 seeing it, part of it's the process.

8 Q Well, so since there is -- from your perspective
9 there is no science relating health complaints and
10 turbines, then why have any setbacks at all? What's
11 the point of the setback?

12 A Well, you know, you -- the point being -- there are
13 certain things. One is the fact of there is
14 information that there is annoyance. Number one,
15 though, is the fact that there are citizens that
16 complain, there are -- this process, that signifies
17 that society needs to make a decision about it.

18 Public health gets drawn into it. I got
19 drawn into these sorts of things as a public health
20 official in Oklahoma all the time. I could explain
21 the health. I could explain the epidemiology. I
22 can't -- I don't have -- I'm not in a position to
23 make social decisions.

24 Q That's for the Commission to decide.

25 A That is correct.

Transcript of Proceedings - October 10, 2012
Volume 4

436

1 Q But would you agree with me that if the choice is
2 between maximizing profit for a wind farm and
3 protecting public health, the Commission should err
4 on the side of public health?

5 MR. WILSON: Objection, calls for
6 speculation.

7 EXAMINER NEWMARK: Sustained.

8 A The Commission should use the science --

9 MR. WILSON: Dr. Roberts.

10 EXAMINER NEWMARK: No.

11 THE WITNESS: I don't have to answer?

12 EXAMINER NEWMARK: No. Sorry. I should
13 have explained.

14 THE WITNESS: All right.

15 BY MR. REYNOLDS:

16 Q Well, I think you talked about in your testimony
17 about biases, right, that science -- scientists have
18 biases?

19 A Everyone has biases.

20 Q Right. And you as a scientist have your biases?

21 A Yes.

22 Q And it appears that you are critical of individuals
23 like Dr. Pierpont for advocating for a closer look at
24 wind turbines, you seem very critical of her?

25 A I'm critical of her work.

Transcript of Proceedings - October 10, 2012
Volume 4

437

1 Q Right. But, Dr. Roberts, hasn't it been your basis
2 that you need a hypothesis and then you need to do
3 further study; isn't that --

4 A That is correct.

5 Q Isn't that what Ms. Pierpont is doing, she has a
6 hypothesis and she's collecting data?

7 A I don't have a problem with her hypothesis. I have a
8 problem with what she calls epidemiology. And it's
9 not epidemiology, it's got biases and that sort of
10 thing. And to propose something without science is
11 not good science.

12 Q Well, the tobacco industry raged for decades about
13 lack of science that connected smoking with heart
14 disease. Right?

15 A That's the history.

16 Q And there isn't any literature that ties those things
17 together, is there? Heart disease. Not lung cancer,
18 heart disease.

19 A Absolutely there is literature that shows increased
20 risk of heart disease in smokers.

21 Q That took how many decades?

22 A I don't know.

23 Q And you, I think, testified at some point that it
24 might take ten years for the science to wrap its arms
25 around this wind turbine issue.

Transcript of Proceedings - October 10, 2012
Volume 4

438

1 A That's not exactly what I said.

2 Q All right. Well, let me ask you this. If there were
3 one piece of peer-reviewed literature, such as
4 Dr. Salt who you don't seem very impressed with, that
5 said: I believe that I found the data that shows the
6 cause and effect, you would doubt that, wouldn't you,
7 unless there was another one?

8 A First of all, you mischaracterized my thoughts on
9 Dr. Salt.

10 Q All right. Let's start with Dr. Salt.

11 A He is contributing to the science, he's contributing
12 to the literature, and that's great. But he hasn't
13 made the statement that there is a disease
14 specifically associated with wind turbines that I'm
15 aware of.

16 Q Well, he is basically trying to identify the realm of
17 sound coming from wind turbines, which you agree is
18 unusual, it's different than the sound --

19 MR. WILSON: Objection, he's not here as a
20 sound expert.

21 EXAMINER NEWMARK: Yeah. Sustained.

22 BY MR. REYNOLDS:

23 Q Well, do you understand what Dr. Salt is trying to
24 do?

25 A I understand what is in his published -- in his

Transcript of Proceedings - October 10, 2012
Volume 4

439

1 peer-reviewed published literature. I have not
2 talked to Dr. Salt.

3 Q It's good work, isn't it?

4 A It seems reasonable.

5 Q All right. And it then is one more piece of evidence
6 that supports the hypothesis that there is a
7 cause-and-effect relationship between large wind
8 turbines and health problems, true?

9 A It is indication of the evolutionary process in
10 science. It's like a brick in the wall. He's added
11 one brick. We don't know what that wall is going to
12 look like yet.

13 Q So the people in the Town of Forest have to wait
14 until you're satisfied that the science has arrived
15 at the correct conclusion?

16 MR. WILSON: Object, it's argumentative,
17 Your Honor.

18 EXAMINER NEWMARK: Sustained.

19 BY MR. REYNOLDS:

20 Q Is it your view that -- you don't have any position
21 on the design of this project, do you?

22 A No, I don't.

23 Q And so you wouldn't oppose a redesign if sound
24 experts indicated that the lower -- a redesign of the
25 project would minimize risk?

Transcript of Proceedings - October 10, 2012
Volume 4

440

1 MR. WILSON: You know, I'm going to object
2 to the line of questioning about redesigning. He's
3 here as a health expert. He's not here with respect
4 to design of the project or what a redesign might or
5 might not do. It's not his area of expertise.

6 EXAMINER NEWMARK: Okay. I'll sustain the
7 objection. I think he's also answered.

8 BY MR. REYNOLDS:

9 Q Would you agree, Dr. Roberts, that in
10 post-construction scenarios, that the companies who
11 run these projects ought to do sound studies to
12 measure the amount of sound with respect to what is
13 being produced for the benefit of science?

14 MR. WILSON: Objection.

15 EXAMINER NEWMARK: You'll have to read
16 that back.

17 MR. REYNOLDS: I can restate it.

18 EXAMINER NEWMARK: No, no, let's read it
19 back.

20 (Question read by the reporter.)

21 EXAMINER NEWMARK: What's the basis?

22 MR. WILSON: He's here as a health expert,
23 not as a sound and -- it's basically asking him to
24 speculate on a potential condition.

25 MR. REYNOLDS: That's not the basis of my

Transcript of Proceedings - October 10, 2012
Volume 4

441

1 question.

2 EXAMINER NEWMARK: Well, I'll let him
3 answer that.

4 A I think that the public health officials should be
5 involved so that it's a third party, and whatever
6 investigative process is set up should be followed.

7 BY MR. REYNOLDS:

8 Q That wasn't my question. My question was, should
9 data be collected on sound produced by turbines after
10 construction for the -- for the benefit of science?

11 A I'm not sure that that would be that helpful.

12 Q Why not?

13 A Again, the -- would that be compared to -- if we're
14 talking about human health issues, you can't really
15 compare that because of what we've already said about
16 the recall bias and that sort of thing. So it sounds
17 like an operational issue, is it operating within the
18 guidelines of the proposal. That's all I can say.

19 Q Well, what's wrong with more information; so that if
20 people do have health problems and they're
21 verifiable, that they're correlated with objective
22 sound data?

23 A Well, again, unless there's objective outcomes that
24 you can tie that to, all you can say is that the
25 turbine is operating within or outside the guidelines

Transcript of Proceedings - October 10, 2012
Volume 4

442

1 it was set up for.

2 Q Those guidelines are based on science, aren't they?

3 A I think so.

4 Q And there are different guidelines in different
5 jurisdictions?

6 A I've seen different ones, that's correct.

7 Q New York, for instance, it's 38 or 40 dBA?

8 A I don't know about New York.

9 Q All right. Well, would you agree that we are in the
10 experimental stage of wind turbines and we're going
11 to learn and eventually hopefully develop a balance
12 between residences and wind turbine farms based upon
13 knowledge?

14 A I think there will be an evolution of that process.

15 Q And so, back to my question, you would oppose, then,
16 if the Commission -- if the Commission put as a
17 condition of this permit that post-construction sound
18 studies be performed so that the residences know what
19 sound is actually coming their way as opposed to
20 predicted models?

21 EXAMINER NEWMARK: Rephrase that. What do
22 you mean he would oppose?

23 BY MR. REYNOLDS:

24 Q All right. Dr. Roberts, you said that you didn't
25 think post-construction sound studies would be

Transcript of Proceedings - October 10, 2012
Volume 4

443

1 helpful, right?

2 A I said they would be hard to interpret because of the
3 fact of recall bias among the citizens.

4 Q So in other words, don't do it, don't look at this
5 evidence?

6 A You're putting words in my mouth.

7 Q All right. Well, I'm just trying to --

8 A I would consult with the Public Service Commission,
9 public health department. I would do what I do as a
10 public health official, and that would be consider
11 what you're doing and what you're going to do and how
12 is it going to be helpful to the citizens.

13 Q Well, wouldn't it be helpful for the citizens to know
14 objectively what sound is present so that if they do
15 have health problems, the Commission could have a
16 better understanding about the correlation between
17 particular sound levels and health conditions;
18 wouldn't that be helpful information?

19 A I wouldn't turn that information down.

20 Q All right. Would you recommend that that be a
21 condition of this permit?

22 A I would recommend there be a careful discussion of
23 any studies that are done after the wind turbines are
24 put in place.

25 Q As a condition of this permit?

Transcript of Proceedings - October 10, 2012
Volume 4

444

1 A I don't know about the permitting process.

2 MR. REYNOLDS: That's all I have.

3 EXAMINER NEWMARK: Okay. Questions?

4 MR. McKEEVER: I have a couple just to
5 follow up, if I may.

6 EXAMINER NEWMARK: All right.

7 RE CROSS-EXAMINATION

8 BY MR. McKEEVER:

9 Q On this question of recall bias, correct me if I'm
10 wrong, but you seem to imply in one of your answers
11 to your questions that the people who spoke yesterday
12 complaining of how -- were from the Town of Forest?

13 A No. I understand --

14 Q You understand that they're not from the Town of
15 Forest?

16 A That is correct.

17 Q They're not complaining -- we don't have anybody
18 who's complaining about wind turbine concerns or
19 noise concerns in the record from the Town of Forest?

20 A That's what I understand, correct.

21 Q Okay. Thank you. I just wanted to make sure.

22 Now, let me ask you a question about risk.
23 You were a public health official in Oklahoma?

24 A For 17 years.

25 Q Allergies, kids get allergies; and I suspect you had

Transcript of Proceedings - October 10, 2012
Volume 4

445

1 some dealings with allergy issues in schools?

2 A Sick building syndrome.

3 Q Sick building syndrome. Well, let me posit a very
4 short hypothetical. If two out of 100 children have
5 a severe peanut allergy, we're not going to force
6 those kids to eat peanuts?

7 A Definitely not.

8 Q Okay. And are you aware that the solution in most
9 public schools, at least in Wisconsin, is to ban
10 peanuts from all kids, not just those 200 (sic)?

11 A That is a social decision that they've made with
12 counsel probably from their attorneys.

13 Q Okay. Is it a sound epidemiological, medical
14 decision? You would support that decision? Let me
15 put it that way.

16 A It would be hard to not support it.

17 Q Okay. Thank you. Now...

18 A Okay. But -- now, while you're looking. But the
19 other thing is I would talk to the school about what
20 that means in terms of what else -- what other
21 allergies are you going to have to address, and make
22 sure that if they go down that road, they are
23 considering the risk to other allergies and that sort
24 of thing.

25 Q Now, through Mr. Reynolds -- your response to

Transcript of Proceedings - October 10, 2012
Volume 4

446

1 Mr. Reynolds' questions and to mine earlier, we came
2 to the conclusion that there is a working hypothesis
3 that there is a possible issue concerning noise
4 produced by wind turbines and people complaining
5 about health problems. It's a working hypothesis.

6 A That's one of them, yes.

7 Q Isn't that a hypothesis worthy of further
8 investigation?

9 A I think it's being investigated now, but one of the
10 things is epidemiologically it's difficult to do.

11 Q Tell me more about that. How would you go about
12 investigating that hypothesis if you were so inclined
13 to do so?

14 A And you gave me total funding and total carte blanche
15 to violate the confidentiality --

16 Q Well, I'm not going to give you any money right now.
17 What I'm going to do is to ask you to design the
18 proposal.

19 A Well, the problem is that research is very difficult
20 because one of the things is you've really gotta go
21 back and look at the medical history of the
22 individual, each of the individuals. And so this
23 recall bias thing, it is totally normal, it's human.
24 And so you've got to figure out some way to get
25 objective information about that individual, both

Transcript of Proceedings - October 10, 2012
Volume 4

447

1 those people who are complaining and those who
2 aren't, in order to make that comparison.

3 Q How would you design this -- I mean, we agreed
4 earlier that there is a problem. We don't agree
5 about the cause, and I appreciate that. The cause is
6 not proven. What I'm curious is how do we figure
7 that out? What's the research we're going to do to
8 get to that answer?

9 A Well, in science --

10 Q We all agree that we've got an energy problem and we
11 need to address it.

12 A Yes.

13 Q We all agree that wind is part of that solution. How
14 are we going to solve this problem?

15 A First of all is have patience.

16 Q I'm sorry?

17 A Have patience. Okay? It's not going to happen
18 overnight. But each bit, as we talked about with
19 Dr. Salt, Dr. Salt contributed something, a brick, to
20 this wall, to the scientific wall of deciding what
21 are the effects of -- if there are any of wind
22 turbines.

23 A number of researchers around the country
24 are doing work and they're publishing it; so we're
25 seeing it, we're evaluating it, we're comparing that

Transcript of Proceedings - October 10, 2012
Volume 4

448

1 to what we know now. To design a study, number one,
2 a study won't do it. It's going to be a series of
3 epidemiological studies that we can see that that
4 association is clear-cut.

5 Q I just wrote you a bigger check. Tell me how these
6 studies -- what they look like?

7 A Okay. One type -- well, I mean, we got the basic
8 science studies which Dr. Salt and others are doing.
9 Epidemiologically, it's going to take looking at a
10 population where data is collected before the wind
11 turbines are put in. So that can be going in and
12 looking at the medical histories of those
13 individuals, going in and looking at their medical
14 records. That's the confidential issue.

15 Maybe there is a group -- a wind turbine
16 goes in, a farm goes in, where there is a data
17 system, an insurance system, that they're covering
18 here. Indian Health Service might be one. So
19 something where data was collected prior to -- data
20 that's objective that we could get to that was
21 collected prior to the wind turbines farm even being
22 discussed.

23 Q So a moment ago you said prior to the wind turbines
24 going in. Now your contention is that we have to
25 have this information before it's even proposed?

Transcript of Proceedings - October 10, 2012
Volume 4

449

1 A That's correct.

2 EXAMINER NEWMARK: He's explained that
3 already.

4 A I've already explained. Excuse me.

5 BY MR. MCKEEVER:

6 Q Okay. Now, one follow-up question. One of these
7 hypothetical patients comes to you and they're
8 complaining of headaches and nausea and all these
9 things. It's -- would you agree that it's a -- I'm
10 not sure what adjective to use here -- an unhelpful
11 or an inappropriate response for the doctor to say to
12 the patients have patience?

13 A No. I --

14 Q Just put up with this for a while and --

15 A No, no.

16 Q That's what you said, let's have patience.

17 A No, no. You were talking about science. I --

18 Q Yeah. I'm talking about the individual person that's
19 affected.

20 A Okay. Please give me the question again as relates
21 to a patient.

22 Q Patient comes to you complaining of headache and
23 nausea and ear problems, things that literature, as
24 you agree, reports may be connected with wind
25 turbine. This patient comes to you, this individual.

Transcript of Proceedings - October 10, 2012
Volume 4

450

1 It strikes me, would you agree, that it's an
2 unhelpful or an inappropriate response to say to that
3 patient just have patience?

4 A I wouldn't say that.

5 Q But you suggested that if we're going to solve this
6 problem, we just need to have patience.

7 A Okay. And if you'll let me explain the two
8 situations --

9 Q Well --

10 A Bear with me.

11 Q I understand very well. I'm just pointing out --

12 A You haven't let me answer the question.

13 Q Well, you've answered it to my satisfaction.

14 A Okay. If the judge is okay with it, I'm stuck.

15 Q You would agree that that approach is going to leave
16 individuals complaining about these problems annoyed?

17 A The approach that you described is not what I would
18 use and I don't recommend it.

19 Q I'm confused now. What approach -- what approach did
20 I describe? I'm confused.

21 A Okay. If a patient came to me with the symptoms you
22 described, I would not say, oh, just have patience,
23 go away, it's in your head.

24 Q Okay. But if the population comes to you or a
25 population comes to you with those things, your

Transcript of Proceedings - October 10, 2012
Volume 4

451

1 testimony was have patience, we'll solve this?

2 A That is correct. It is a totally different question.

3 MR. McKEEVER: Thank you very much. I
4 have no further questions.

5 EXAMINER NEWMARK: Okay. Redirect?

6 REDIRECT EXAMINATION

7 BY MR. WILSON:

8 Q Just one area, Dr. Roberts. You indicated that you
9 hadn't updated your Exhibit 2 in this proceeding
10 since 2009, but you have followed the literature
11 since 2009?

12 A That is correct. Very much so.

13 Q And is there anything in the literature subsequent to
14 2009 that would change your conclusions in Exhibit 2?

15 A No. Up through publications in 2012, I have not
16 found anything that substantially changes my
17 position.

18 MR. WILSON: Thank you. That's all we
19 have.

20 EXAMINER NEWMARK: All right. You're
21 excused. Thanks very much.

22 MR. REYNOLDS: Hang on just a second.
23 I've got one follow-up on that. I've got --

24 EXAMINER NEWMARK: Follow-up --

25 MR. REYNOLDS: -- two articles. I'm

Transcript of Proceedings - October 10, 2012
Volume 4

452

1 wondering if he's looked at these.

2 EXAMINER NEWMARK: Follow-up on what?

3 MR. REYNOLDS: Follow-up on the question
4 of recent science. He's reviewed the literature. I
5 want to know if he's reviewed these two articles.

6 MR. WILSON: You already released him.

7 EXAMINER NEWMARK: He's answered the
8 question. You've had your chance to cross him.

9 MR. REYNOLDS: Well, this is in response
10 to the redirect. Just two articles.

11 EXAMINER NEWMARK: You had your chance to
12 cross him. You're excused. Thanks.

13 (Witness excused.)

14 EXAMINER NEWMARK: Is that the balance of
15 the applicant's witnesses?

16 MR. WILSON: They're all done.

17 EXAMINER NEWMARK: Okay. Believe it or
18 not, hm? All right. I think we have time for
19 Mr. Hessler.

20 MS. NEKOLA: Clean Wisconsin would like to
21 call Mr. Hessler.

22 DAVID HESSLER, CLEAN WISCONSIN WITNESS, DULY SWORN

23 EXAMINER NEWMARK: Thanks for your
24 patience.

25 DIRECT EXAMINATION

Transcript of Proceedings - October 10, 2012
Volume 4

453

1 BY MS. NEKOLA:

2 Q Good morning, Mr. Hessler.

3 A Good morning.

4 Q Please state your name and business address for the
5 record.

6 A My name is David Hessler. My business is located at
7 3862 Clifton Manor Place in Haymarket, Virginia.

8 Q Did you prepare 12 pages of direct testimony, nine
9 pages of rebuttal testimony, five pages of
10 surrebuttal testimony, and three exhibits in this
11 proceeding?

12 A Yes, I did.

13 Q And is the information in your testimony and exhibits
14 true and correct to the best of your knowledge?

15 A Yes, it is.

16 Q Mr. Hessler, have you had the opportunity to review
17 Mr. Schomer's surrebuttal testimony?

18 A Yes, I have.

19 Q Mr. Schomer states that low frequency pulse will be
20 audible to many residents of Forest. Do you agree
21 with that?

22 A No, I don't think that's an inevitable or foregone
23 conclusion. The --

24 MR. McKEEVER: Excuse me, Mr. Hessler.
25 Could you speak up.

Transcript of Proceedings - October 10, 2012
Volume 4

454

1 THE WITNESS: I'm as close as I can get to
2 this thing without eating it.

3 MR. McKEEVER: Thank you.

4 A No, I don't think that conclusion is inevitable.
5 That research that his testimony is based on is 30
6 years of experience evaluating health effects from
7 low frequency noise associated with military sources
8 like artillery and tanks. And he has just taken that
9 result and just applied it wholesale to wind turbines
10 without considering the dramatic difference in the
11 magnitude of the two sources.

12 An artillery shot is, I think everyone
13 realizes, much, much louder than any wind turbine
14 could be. There are many studies that show that wind
15 turbines -- the low frequency content of wind turbine
16 noise is very, very low and is around the -- at or
17 under the threshold of hearing. So tanks and
18 artillery are not -- I wouldn't describe them as
19 being near the threshold of (inaudible).

20 THE REPORTER: Near the threshold of what?

21 THE WITNESS: Hearing. (Laughter.) How
22 about that?

23 BY MS. NEKOLA:

24 Q Mr. Hessler, is there a particular recent study that
25 you can point to that assesses the magnitude of low

Transcript of Proceedings - October 10, 2012
Volume 4

455

1 frequency wind turbine noise?

2 A Yeah. There's many, many studies that have been
3 done, I've taken my own measurements. But there is
4 one that I think kind of epitomizes the research on
5 this topic, and it's a study that was undertaken
6 specifically to try to address this issue of what is
7 going on with low frequency noise in wind turbines.
8 It's a study that was published in the Noise Control
9 Engineering Journal April of last year by O'Neal.
10 And just to very briefly summarize it, they kind of
11 went through the literature and found all of the
12 existing -- all the ones they could, all the existing
13 thresholds for the perception of low frequency noise
14 worldwide.

15 They did a literature review of all the
16 papers that have -- that they could find that were
17 ever written on the subject and they summarized the
18 results of all of those. All of those results
19 essentially say that it's so low in magnitude that
20 it's pretty much inconsequential.

21 And then the last part of this study is
22 that they went out and did their own field
23 measurements on two different types of turbines; and
24 then they compared those findings to all of the
25 thresholds that they had found, and found that the

Transcript of Proceedings - October 10, 2012
Volume 4

456

1 levels were under the threshold of hearing in every
2 instance, every ANSI standard, every threshold they
3 could find.

4 (Hessler Exhibit No. 4 was marked.)

5 Q I'd like to hand you this. Is this a true and
6 correct copy of the study that you were just talking
7 about?

8 A Yes, it is.

9 MS. NEKOLA: Your Honor, we'd like to move
10 this study into the record as Hessler Exhibit 4.

11 MS. BENSKY: We object, Your Honor.

12 EXAMINER NEWMARK: Okay. Go ahead.

13 MS. BENSKY: Well, I haven't seen it. I
14 haven't had a chance to look through it. I'm paging
15 through his testimony now to see if he did talk
16 extensively about low frequency noise. I don't
17 recall that he did. I don't believe this was cited
18 in his testimony. So our witness can't see it and I
19 don't have the ability to read it now and ask
20 questions. So that's why I object.

21 EXAMINER NEWMARK: Response?

22 MS. NEKOLA: Your Honor, this is in
23 response to surrebuttal testimony that referenced
24 low frequency noise, and Mr. Hessler contemplated
25 addressing low frequency noise all along in this

Transcript of Proceedings - October 10, 2012
Volume 4

457

1 case. I think it's highly appropriate to add this
2 to the record. It's a more recent study than
3 anything else that we have so far in the record.
4 And if we -- we could give parties a chance to read
5 it and perhaps decide later. We think it's --

6 EXAMINER NEWMARK: And just -- I didn't
7 catch who he was responding to.

8 MS. NEKOLA: Mr. Schomer.

9 EXAMINER NEWMARK: Schomer's surrebuttal?

10 MS. NEKOLA: Surrebuttal, um-hmm.

11 MS. BENSKY: I guess there is no reason
12 this couldn't have been part of Mr. Hessler's direct
13 testimony. His work for Clean Wisconsin, as I
14 understand it, is quite extensive on this case. And
15 if this was going to be an issue that he wanted to
16 address all along, then -- this is a 2011 study,
17 there is no reason this couldn't have come in
18 earlier. It'll take me more than ten minutes to
19 read this and understand it.

20 We don't have any ability to put any
21 information in the record to rebut it. So that's
22 where the prejudice is.

23 MS. NEKOLA: Your Honor, this is a 2011
24 study that reviewed over 100 scientific papers
25 worldwide on this topic, and also included a field

Transcript of Proceedings - October 10, 2012
Volume 4

458

1 study to measure wind turbine noise outside and
2 within nearby residences. I think it would add to
3 the record.

4 EXAMINER NEWMARK: Yeah, it looks like,
5 from what I can see on direct, Schomer does
6 reference studies about low frequency noise. And so
7 I don't see why this couldn't have come in earlier.
8 I'm going to have to leave it out as prejudicial.
9 It's just too late to go through all of this and to
10 have another witness come in.

11 MS. NEKOLA: One more thing that is
12 relevant here, I think, is that we anticipated that
13 Mr. Hessler would be able to do his own study of low
14 frequency noise in another wind farm in Wisconsin.
15 And he was -- he has so far been unable to do that
16 because we haven't been able to get access to any
17 wind farms. And so I think this is also his attempt
18 to put in the best recent information on low
19 frequency noise that he has available to him.

20 EXAMINER NEWMARK: I understand. Does
21 staff have any opinion on this?

22 MR. LORENCE: I was just paging through
23 his testimony. I see a reference to low frequency
24 in his surrebuttal. But can you tell me where it is
25 in his direct?

Transcript of Proceedings - October 10, 2012
Volume 4

459

1 EXAMINER NEWMARK: Yeah, Schomer page 3,
2 that first top of the page, there's been a multitude
3 of literature published over the last 40 to 50 years
4 that indicates that low frequency, and it continues
5 on from there.

6 MR. LORENCE: Page 2 or 3?

7 EXAMINER NEWMARK: 3.

8 MR. LORENCE: I guess the only thought I
9 have is if this is the only reference, I don't think
10 he was really asserting anything other than the
11 statement saying that there is publications. I
12 thought his testimony was more direct in the
13 surrebuttal with respect to low frequency. And I
14 guess I thought -- and that was at least on page 16
15 of his sur-sur where he draws his last conclusion.
16 Maybe it's the same thing. And so that's why I
17 noticed that the -- the most as opposed to in his
18 direct.

19 EXAMINER NEWMARK: And what pages on his
20 surrebuttal? He just has surrebuttal, right? Does
21 he have a third round?

22 MR. LORENCE: I saw it on surrebuttal
23 page 16. And there may be other places. But I was
24 looking at his last conclusion which is lines 12
25 through 22.

Transcript of Proceedings - October 10, 2012
Volume 4

460

1 EXAMINER NEWMARK: I don't see that much
2 difference in those two passages. But let's back up
3 a little bit because I am aware that there is an
4 attempt to do a study, is that the Glacier Hills
5 farm? Is that the case?

6 MS. NEKOLA: Or the Shirley site.

7 EXAMINER NEWMARK: Or Shirley.

8 MS. BENSKY: He was denied access several
9 months ago; isn't that correct?

10 MS. NEKOLA: No. They have not made a
11 decision, final decision. But it has the same
12 effect of being denied, actually.

13 MS. BENSKY: But in his direct testimony,
14 doesn't he say he was denied?

15 MS. NEKOLA: Well, I'm not sure, but
16 the -- the truth is that he has not been able to get
17 access.

18 MR. REYNOLDS: Has there been any reason
19 given for that?

20 MS. NEKOLA: No. Right, his direct
21 testimony just says that we have not been granted
22 access to the site. So thus far, we haven't been
23 able to -- he hasn't been able to do the study.

24 EXAMINER NEWMARK: Okay. Well, the
25 problem with this is I don't think this is enough of

Transcript of Proceedings - October 10, 2012
Volume 4

461

1 a substitute for a study at the other wind farms,
2 and I know that the access question has not been
3 fully determined.

4 MS. NEKOLA: That's right.

5 EXAMINER NEWMARK: And I would be prepared
6 to reopen the hearing if we could have a study
7 developed on that specific -- on those locations,
8 one of those locations, if access is granted. But
9 that would mean scheduling that and having a process
10 for it.

11 But at this time in the game and at this
12 hearing, I don't think we can admit this -- this
13 study because the parties have not had a chance to
14 review it and their witnesses aren't available. You
15 know, if there is a point in time when we know
16 access cannot be given, I can consider reopening the
17 hearing to take a look at these late exhibits as a
18 substitute. But I would like to, you know, try
19 to -- I don't want to do that now and I don't want
20 to thwart any attempts to get the studies done. I
21 think that's much better evidence. So -- or it
22 would be evidence rather than, you know, literature
23 review.

24 So are there any other exhibits that
25 relate to this? I saw you had a number of items

Transcript of Proceedings - October 10, 2012
Volume 4

462

1 there.

2 MS. NEKOLA: Not on low frequency noise.
3 We have one other that we want to offer on another
4 matter.

5 EXAMINER NEWMARK: Okay. All right. So
6 are we okay with that?

7 MS. NEKOLA: We just want to point out
8 that the study that we're -- tried to move in was
9 not just a literature review, but that there were
10 also actual sound measurements at wind farms.

11 EXAMINER NEWMARK: Okay. Thanks for
12 clarifying that. So for now we will hold off on
13 that.

14 MR. WILSON: Your Honor, for what it's
15 worth, I had a discussion with Cindy Smith yesterday
16 morning where this topic came up about the inability
17 to do the low frequency testing --

18 EXAMINER NEWMARK: Let's go off the
19 record.

20 (Discussion off the record.)

21 EXAMINER NEWMARK: Let's get back on.

22 BY MS. NEKOLA:

23 Q Okay. So do you think that low frequency noise
24 problems can be ruled out?

25 A No. Despite the findings in that study, no, I don't

Transcript of Proceedings - October 10, 2012
Volume 4

463

1 think we can just assume that there won't be any
2 problems. And I say that with respect to the
3 testimony we heard yesterday from those three
4 homeowners that had to leave their house -- houses at
5 Shirley. That was very compelling and I think
6 irrefutable evidence that there is a problem at that
7 site. The question is why is that? And that's what
8 we were hoping to explore with that field survey.

9 So I think what's happening is that there
10 is a low frequency noise that is associated with very
11 specific turbine models or types of blades or blade
12 control mechanisms that results in, according to the
13 studies that I've seen recently, results in inaudible
14 low frequency sounds that can produce adverse
15 symptoms and problems in certain people in rare
16 cases. But it needs to be investigated. And that's
17 really the state of knowledge on that.

18 Q You say that these instances are rare. Can you give
19 an example of a more typical situation?

20 A Yeah. Yesterday we also heard from Jeff Bump who
21 lives at the Glacier Hills site. And I'm familiar
22 with Glacier Hills. And I know -- I met Jeff Bump.
23 My brother and I set up instruments at his house last
24 winter, and we measured day and night at his house
25 for about 18 days I think at his house, and ten other

Transcript of Proceedings - October 10, 2012
Volume 4

464

1 houses around that site. All the ones with the
2 closest possible exposure to turbines. We measured
3 off of the site to get the background conditions on
4 a -- kind of a running time history of background
5 throughout the survey.

6 And, you know, he said he was bothered by
7 this horn sound and that's -- I heard that, that's
8 associated with the hydraulic system in the Vestas
9 V90 turbine that's at that site. He said he was kept
10 awake by a swishing noise. That's mid-frequency
11 oscillation, around 500 hertz, due to the blades.
12 But what he didn't complain about is low frequency
13 issues and any of these adverse health effects. He
14 said, well, he might have got a headache once, but
15 really it was all about the fact that he was bothered
16 at night.

17 But the point is that this project,
18 Glacier Hills, has over -- I think it's over 120
19 turbines that are distributed over an area that's
20 about, very roughly, 40 square miles. There are
21 hundreds and hundreds of people that live in close
22 proximity to turbines at that project. Yet the only
23 people that are complaining are Mr. Bump and another
24 fellow that lives next -- or nearby him. Those two
25 people are the only ones that have any problem with

Transcript of Proceedings - October 10, 2012
Volume 4

465

1 noise out of many, many hundreds. And that is the
2 typical situation based on all of the
3 post-operational surveys that I've done. The number
4 of people that are actually complaining or bothered
5 by it is very, very low compared to the total
6 population.

7 Q Thank you. Mr. Schomer also mentioned that the data
8 contained in your Exhibit 1 is artificially elevated
9 by pseudo-noise or instrument error. Do you have a
10 response to that?

11 A Yeah. What we did in our analysis of the applicant's
12 sound study was to look at the data, the sound data,
13 as a function of wind speed. And that's been
14 criticized as, well, the sound levels are elevated
15 because the wind was blowing over the microphone.
16 But the fact of the matter is that the winds were
17 very light during that survey; and the peak wind, the
18 highest wind, at the microphone during that entire
19 two-week period was only seven miles per hour.

20 We have -- some years ago, I think it was
21 about 2008, we did study, a wind tunnel study, to
22 evaluate that phenomenon of wind blowing over the
23 microphone to quantify what that error is. And in
24 that study, what we found was for a
25 seven-mile-per-hour wind, the self-generated noise or

Transcript of Proceedings - October 10, 2012
Volume 4

466

1 pseudo-noise would be only around 20 dB, whereas in
2 the field survey at Highland, the levels being
3 measured under those conditions was in the
4 neighborhood of about 45 dBA. So there wouldn't be
5 any effect at all from a pseudo-noise. I believe the
6 data is perfectly valid.

7 (Hessler Exhibit No. 5 was marked.)

8 Q You've been handed a copy of a study that you just
9 referred to and described. Is that a true and
10 correct copy of that study?

11 A Yes, it is.

12 MS. NEKOLA: We'd like to enter this into
13 the record as Exhibit 5.

14 EXAMINER NEWMARK: Any objections?

15 MS. BENSKY: No objection.

16 EXAMINER NEWMARK: All right.

17 (Hessler Exhibit No. 5 received.)

18 BY MS. NEKOLA:

19 Q Turning to the surrebuttal testimony of
20 Mr. Horonjeff, have you had an opportunity to review
21 that testimony?

22 A Yes, I have.

23 Q Mr. Horonjeff points out that your comparison of the
24 Highland sound data with the met mast wind speed
25 shows considerable scatter at any given wind speed,

Transcript of Proceedings - October 10, 2012
Volume 4

467

1 and he suggests that the mean value should not be
2 used. Do you have a response to that?

3 A Yeah. It's not really a matter of where you draw the
4 line, the mean trend line, in that data. What it
5 shows is that the vast majority of the sound levels
6 that were measured during the survey were measured
7 under very low wind conditions that -- below the
8 point, generally speaking, where the turbines would
9 begin to operate. And the principal point is that
10 during the windier conditions when the project would
11 be operating, there are very, very few measurements
12 of low sound levels during those wind conditions,
13 only about six to a dozen ten-minute samples out of
14 roughly 2,000 measurements that were taken.

15 Mr. Horonjeff is saying that, well,
16 sometimes it's quiet when it's windy, but that is a
17 rarity and that's what that figure shows.

18 Q You were present yesterday when Mr. Reynolds
19 questioned Ms. Blank about the sound modeling for the
20 project, correct?

21 A Yes.

22 Q And do you recall that Mr. Reynolds quoted your
23 direct testimony at page 11 as saying that sound
24 models should have an ideal target level of 40
25 decibels? Do you recall him saying that?

Transcript of Proceedings - October 10, 2012
Volume 4

468

1 A Well, I think what he said was that the project
2 should be designed to 40. 40 is the recommended
3 level. My view on that is -- and what we've asserted
4 in papers and things that we've published based on
5 our field studies of completed projects -- is that if
6 possible, projects should use 40 dBA as an ideal
7 design goal if at all feasible because what we find
8 is that below 40 there's very few, if any,
9 complaints. But as a regulatory limit, we've put
10 forward a level of 45 because the regulatory limit is
11 different from an ideal design goal. A regulatory
12 limit has to balance everybody's best interest. So
13 the 40 we weren't saying was a suggested regulatory
14 limit but rather an ideal design goal.

15 Q So just to be clear, is it your position that the
16 Highland wind project should meet the 40 decibel
17 noise standard?

18 A Should it meet the 40?

19 Q Right, is that your position?

20 A No. I think it -- I would be satisfied or I would
21 recommend that it meet the 45 limit as currently it's
22 obligated to do.

23 MS. NEKOLA: Mr. Hessler is available for
24 cross-examination.

25 EXAMINER NEWMARK: All right. Do you have

Transcript of Proceedings - October 10, 2012
Volume 4

469

1 questions?

2 CROSS-EXAMINATION

3 BY MS. BENSKY:

4 Q Good afternoon, Mr. Hessler.

5 A Good afternoon.

6 Q In your papers, you have a very distinct talent in
7 taking complicated information and making it
8 understandable for everyone, so I commend you on that
9 and I ask that you do your best to keep it at that
10 level here.

11 A We'll see how it goes.

12 Q Let's start with page 2, I'm just going to go through
13 your testimony. So direct testimony page 2. At line
14 2, you say, "Typical projects involve field surveys
15 to establish baseline background sound level
16 conditions..." Is that the same way of saying
17 ambient sound?

18 A Yeah. It's essentially the same thing.

19 Q And why is it important to establish that baseline?

20 A Well, the way most projects -- not just wind
21 projects, but any fossil plant or any project --
22 would be evaluated is to see how its noise is going
23 to compare to the sound level that already exists at
24 that location. If the facility noise is going to
25 greatly exceed the existing level, then there's

Transcript of Proceedings - October 10, 2012
Volume 4

470

1 likely to be an adverse impact. If it's below the
2 background, you might not even hear it. So it gives
3 you a baseline to make a judgment on what the
4 impact's going to be.

5 Q And in your view, is establishing that baseline an
6 important thing to do?

7 A Yeah. We typically do do that for wind projects or
8 any power plant.

9 Q Turning to page 3. You have your testimony up there
10 with you?

11 A Yes, I do.

12 Q Now, page 3, and correct me if I'm wrong, it looks
13 like you are first reviewing the initial predictions
14 that were listed in the application using the zero
15 coefficient assuming a total reflective ground?

16 A Where is it that you're at there?

17 Q On page 3, question number 7 -- or line 7. Your
18 overall impression of the studies. I just want to
19 clarify that what you're talking about right there is
20 the modeling results where a zero coefficient was
21 used; is that correct?

22 A Yeah, yeah. That's correct.

23 Q And looking at those results, if the average
24 background noise was between 29 and 34 decibels and
25 the project level was 45 decibels, your opinion is

Transcript of Proceedings - October 10, 2012
Volume 4

471

1 that the project would be quite audible; is that
2 correct?

3 A Yes, that's right.

4 Q If those were the actual numbers. And is the reason
5 why the project would be quite audible is because you
6 have that 11 to 16 above ambient level?

7 A That's right.

8 Q And do you have an opinion as to whether an ambient
9 level of between 12 and 16 decibels -- or an actual
10 level above -- let me start over.

11 Do you have an opinion as to whether that
12 relative noise level would result in adverse
13 community reaction?

14 A Yeah. If those were the actual levels, then we would
15 conclude in any assessment that the project was
16 likely to have a pretty significant adverse impact.

17 Q So it's not necessarily that 45-decibel level you're
18 concerned about, you're more concerned about the
19 relative difference, that 11 to 16 decibel
20 difference; is that correct?

21 A Yeah. That's what I'm talking about in that
22 particular paragraph.

23 Q Now, on page 4, going down to line number 12, you're
24 talking about your review of the met tower data, and
25 you had requested a site plan that you did not

Transcript of Proceedings - October 10, 2012
Volume 4

472

1 receive?

2 A That's right.

3 Q And I understand later in your testimony that you
4 kind of reverse engineered a site plan based on the
5 available information?

6 A Yeah. It was possible to import into our modeling
7 software the -- I guess the sound contour map from
8 the application. It wasn't absolutely necessary to
9 get the site plan in the first place. It was just --
10 it would have helped things. That's all.

11 Q So what information would you have expected the site
12 plan to contain that would have been helpful to you?

13 A Just a particular kind of computer file that is
14 easily imported into the modeling program. Just more
15 to save time. What we had to do was just take the
16 PDF and work with it.

17 Q So you feel that you obtained all of the information
18 that you needed?

19 A Yeah. We made do.

20 Q The information that you used in your gathering of
21 that data, do you know if that's the exact data that
22 would have been contained in the site plan?

23 A We used the actual site plan from the application.

24 Q But you said you didn't receive the site plan.

25 A We used the site plan that was published in the

Transcript of Proceedings - October 10, 2012
Volume 4

473

1 environmental assessment. It was just a matter of
2 convenience to get the computer file. It wasn't
3 germane to anything really.

4 Q So the actual data would have been the same? What
5 I'm --

6 A That's right.

7 Q What I'm getting at is do you think that you input
8 the right numbers based on the information that you
9 had?

10 A Yes.

11 Q Now, let's talk about the met tower. The met tower
12 was 49.5 meters, 162 feet. And is it your
13 understanding that the hub height of the proposed
14 turbines is between 299 to 328 feet?

15 A Right. Yeah. This met tower anemometer puts it
16 within the rotor plane, not exactly at the hub
17 height. It's very rare to have a met tower high
18 enough that it goes all the way up to 80 or so
19 meters.

20 Q So it's at the bottom of the rotor plane, 162 feet
21 would be at the very bottom assuming the blade
22 lengths are between 160 and 180 feet?

23 A Right.

24 Q Is there some sort of formula that you applied to
25 that 49 meters to estimate the wind speed at the hub

Transcript of Proceedings - October 10, 2012
Volume 4

474

1 height?

2 A The hub height wind speed wasn't needed for anything.
3 What we did do was take the met tower wind speed at
4 49 and a half meters and then normalize that to 10
5 meters because you have to put the wind speed data on
6 an even footing with the turbine sound power level
7 data which is also -- which is always expressed as a
8 function of the wind speed of 10 meters.

9 Q But that's something different than estimating what
10 the wind speed would be at the hub height?

11 A Yes. The hub height, whether it's near the bottom of
12 the rotor plane or at the hub height, it doesn't make
13 any difference here, to what we were shooting for
14 here.

15 Q But wouldn't it be -- if you want to know how fast
16 the blades are going to turn, wouldn't you want to
17 know the wind speed at the hub height? Wouldn't that
18 be ideal?

19 A No. It's really -- it's all about the wind speed at
20 this normalized height of 10 meters that's relevant
21 to this whole thing. Even if we had a met tower that
22 was -- met mast that was 80 meters, we would have
23 just taken that value and normalized it to 10 meters.
24 It would have been the same.

25 Q But if you had a met tower at 100 meters, you would

Transcript of Proceedings - October 10, 2012
Volume 4

475

1 not have had to apply that formula?

2 A No. We would have had to apply it to any elevation
3 anemometer. We want to bring it down to 10 meters
4 from whatever height, the highest possible height.

5 Q So based on the met tower data, you don't know the
6 actual speed of the wind at the hub height; is that
7 correct?

8 A We could easily infer it from this 49 and a half
9 meter data if we wanted to know it.

10 Q So you didn't -- is your answer you did not have the
11 actual wind speed at the hub height?

12 A Met mast wasn't high enough.

13 Q And you did not have the actual speed at the rotor
14 tip of 500 feet?

15 A We could have inferred that if we needed to know.
16 The ideal thing would have been to have anemometers
17 over the whole diameter of the blade, but you never
18 have that.

19 Q So you have to make some approximations?

20 A Oh, yeah.

21 Q Is there generally a difference -- or can there be a
22 difference in wind speed at 500 feet as opposed to
23 162 feet?

24 A Yeah. It is typically higher with elevation.

25 Q What happens when there's a very -- there's a higher

Transcript of Proceedings - October 10, 2012
Volume 4

476

1 wind at the rotor tip than at the bottom of the
2 rotor?

3 EXAMINER NEWMARK: In what sense? What do
4 you mean what happens? In terms of what?

5 A Yeah, in terms of what?

6 BY MS. BENSKY:

7 Q When there is a higher -- when there's a higher wind
8 at the top than there is at the bottom of the rotor,
9 does that have any effect on the sound produced?

10 A Yeah. Yeah. The wind speed is typically always
11 higher at the top than it is at the bottom. It's
12 very rarely perfectly flat, although that does
13 happen. The degree to which the wind speed varies
14 from the top to the bottom or from -- between any two
15 heights is the wind sheer, and the higher the sheer
16 the more slanted that -- the greater the difference
17 between the wind speeds at different heights, the
18 greater the noise generation generally is.

19 Q Is there a particular season where the wind sheer is
20 greater?

21 A Yeah, at most sites it's typically in the summertime.

22 Q The wind sheer is greater in the summertime?

23 A Yeah.

24 Q Are there any other weather conditions where the wind
25 sheer would be greater?

Transcript of Proceedings - October 10, 2012
Volume 4

477

1 A It's typically higher at night than it is during the
2 day.

3 Q Now, looking at the bottom of page 4, is it your
4 testimony that when the near ground level wind speed
5 is very low, that does not necessarily mean that the
6 hub height wind speed is the same; is that correct?

7 A Right. You -- it's hard to tell anything from the
8 wind speed measured at a meter above the ground.
9 That generally remains pretty low even when it gets
10 really windy out. That's why we wanted to use the
11 met mast that -- at the highest possible anemometer
12 to get a sense of what's going on up at the elevation
13 that the turbines would see that wind.

14 Q Just so we're all on the same page, what's an
15 anemometer?

16 A A device for measuring wind speed.

17 Q And that's the thing that sits on top of that met
18 tower?

19 A Yeah.

20 Q Let's turn to page 5. Looks like I already covered
21 that. Let's go to page 10. Starting on line 6 and
22 just follow along. Is it correct that you state, "A
23 common design theory for new industrial projects of
24 all kinds is to design the project so that its sound
25 level does not exceed the background level by more

Transcript of Proceedings - October 10, 2012
Volume 4

478

1 than 5 decibels..." Did I read that correctly?

2 A That's right.

3 Q Then you state, "...the logic being that such an
4 increase is not particularly noticeable, at least
5 when the character of the noise is rather bland and
6 free of any prominent tones or other identifiable
7 characteristics. Because wind turbine noise often
8 has a variable, churning, sometimes periodic
9 character to it, this approach is somewhat tenuous
10 for wind projects, but nevertheless it is commonly
11 used..."

12 Is it your testimony that wind turbines
13 create a sound of such a characteristic that the 5
14 decibel above ambient is too much?

15 A Yeah. Yeah. The 5 increase would -- makes the most
16 sense when you have a, for example, a very constant
17 source that has a bland character to it like a
18 conventional power plant. That sound 5 above the
19 background is usually -- or usually results in a
20 negligible impact, people don't really notice it.
21 Now, wind turbines don't have a particularly steady
22 sound so that they are more audible than other
23 sources relative to the background. So even a 5
24 increase is generally pretty noticeable.

25 Q Thank you. Now, at the bottom of the page, you state

Transcript of Proceedings - October 10, 2012
Volume 4

479

1 that assuming a background noise of 34 to 36
2 decibels, your recommendation in an ideal world is
3 that the project noise be limited to between 39 to 41
4 decibels; is that correct?

5 A Yeah. That would be a 5 increase over this
6 background level that I'm coming up with.

7 Q Okay. Now, on the next page, and I'm going to hand
8 out an article that you reference and footnote on
9 page 11.

10 EXAMINER NEWMARK: That's Hessler 5,
11 right?

12 MS. NEKOLA: 6.

13 MS. BRANT: No, Your Honor. It's the same
14 scientific journal, I believe, or a very similar
15 format.

16 MS. BENSKY: No, it's a different article.

17 MS. NEKOLA: It's a different article,
18 right.

19 BY MS. BENSKY:

20 Q And the first question is looking at the publication
21 that I just gave you, is this indeed the publication
22 that you reference in footnote 3 on page 11 of your
23 direct testimony?

24 A Yeah, yeah. I'm glad you handed it out to everybody.

25 Q Now, let's turn to page 96, it's just this third page

Transcript of Proceedings - October 10, 2012
Volume 4

480

1 in. And you're talking about the World Health
2 Organization target noise level to protect the
3 public. And that is listed at 40 decibels day or
4 night; is that correct?

5 A I think they specifically call that the nighttime
6 target.

7 Q Okay. Oh, you're right, nighttime sound levels.

8 And has that changed since this paper was
9 published?

10 A Not to my knowledge, no.

11 Q And turning to page 98, first full paragraph
12 beginning with Considering the EPA guidelines. And
13 there's some discussion of day and night levels; and
14 then you state -- first of all, did you author this
15 paper?

16 A Yeah. I was a co-author on it.

17 Q Co-author with George Hessler?

18 A Yeah.

19 Q So you state, "A 45 decibel composite noise
20 equivalent level with a 5 decibel evening weighing
21 would be even more ideal at 45, 40 and 35 decibels
22 for day, evening and nighttime levels, respectively."

23 EXAMINER NEWMARK: Can you point to that
24 for the record.

25 MS. BENSKY: It is on -- it is a

Transcript of Proceedings - October 10, 2012
Volume 4

481

1 publication which is footnote 3 of Hessler Direct
2 11. It's called, "Recommended noise level design
3 goals and limits at residential receptors for wind
4 turbine developments in the United States," and it's
5 on page 98 of that publication.

6 EXAMINER NEWMARK: And where on page 98?

7 MS. BENSKY: It's in the middle of the
8 page. There's a first -- full paragraph begins with
9 Considering the EPA.

10 EXAMINER NEWMARK: Okay. Thanks.

11 MS. BENSKY: And I'm looking at the last
12 sentence.

13 EXAMINER NEWMARK: Um-hmm. Okay.

14 BY MS. BENSKY:

15 Q So my question is, is it correct that in this paper,
16 you recommend an ideal design target of 45, 40 and 30
17 decibels respectively during the day, evening and
18 nighttime?

19 A No. What we're doing in that part of the paper is
20 going through all of the regulations that pertain or
21 could possibly pertain to wind projects and just
22 summarizing each one. At the end of the section,
23 then draw a conclusion on what we recommend based on
24 all these various standards.

25 Q And your conclusion is that a composite noise

Transcript of Proceedings - October 10, 2012
Volume 4

482

1 equivalent level would be even more ideal at 45, 40
2 and 35; is that your conclusion in this paper?

3 A It's not a conclusion. It's just a comment on this
4 particular measure.

5 Q But it's correct that -- I'm reading it correctly,
6 right, that, "A 45 dBA composite noise equivalent
7 level with the 5 dBA evening weighing would be even
8 more ideal at 45, 40 and 35 decibels for day, evening
9 and nighttime levels, respectively." Am I reading
10 that correctly?

11 A Yeah, yeah. The lower the level the better. But we
12 end up concluding later that as a practical matter 40
13 is -- seems to make sense.

14 Q But taking out -- you're not a state regulator,
15 correct?

16 A That's right.

17 Q So -- you're a noise engineer, correct?

18 A Right.

19 Q And based on your very extensive expertise as a noise
20 engineer, your opinion is that it would be ideal to
21 have a 45, 40 and 35 dBA level for day, evening and
22 nighttime?

23 A I'll always say it's more ideal.

24 Q Let's move on. Tell me, did you make any differen --
25 what hours are we talking about? What's daytime?

Transcript of Proceedings - October 10, 2012
Volume 4

483

1 What are daytime hours as you're talking about here?

2 A It's usually 7 in the morning to 10:00 (sic) at
3 night.

4 Q And what's evening?

5 A Then that goes to -- I'd say it's 7 to 10 p.m. or
6 something.

7 Q So daytime would be 7 to 7, evening would be 7 to 10?

8 A Yeah.

9 Q And then nighttime would be 10 to 7 in the morning?

10 A Right.

11 Q Now, please turn to the next page, page 99, first
12 full paragraph on that page says -- starts The States
13 of New York, Massachusetts and California. Are you
14 there?

15 A Okay. Yeah.

16 Q The first -- or the second sentence reads, "An
17 ambient-based method is based on the perception of
18 the new sound in a specific residential community. A
19 perception-based method is clearly a better approach
20 than a single absolute limit, and, in fact, many
21 years of experience have shown this approach is
22 working well in all these three states."

23 Did I read that correctly?

24 A Yes, that's right.

25 Q And you're talking about three states that have an

Transcript of Proceedings - October 10, 2012
Volume 4

484

1 ambient-based guideline; is that correct?

2 A Right.

3 Q And the words that I just read, are those your
4 recommendations in this article? You're not quoting
5 anyone else. I want to know if that is your work
6 right there?

7 A Yeah, yeah. We're talking about how they do things
8 in New York, Massachusetts and California. And how
9 that is, how that works, is that you measure the
10 background, you add some factor to it, in
11 Massachusetts it's 10, and essentially what you come
12 up with is an absolute limit that is derived from the
13 background. But the final answer is an absolute
14 number.

15 Q But your opinion, is it correct that your opinion
16 here is a perception-based method, which is this
17 ambient relative standard, is clearly a better
18 approach than a single absolute limit; is that your
19 opinion?

20 A It's what's -- that's what it's saying here. But the
21 end result of the paper is that it's better to go
22 with absolute numbers.

23 Q So you contradict yourself in this publication?

24 A I suppose so. I think my father wrote that part,
25 but -- in fact, I'm sure he did.

Transcript of Proceedings - October 10, 2012
Volume 4

485

1 Q I'm going to tell him you said that.

2 A I'm always -- I'm used to that.

3 Q Now, on page 11 of your testimony, you're still
4 discussing this article and you're discussing the
5 results of it looks like a survey that you conducted?
6 Is that correct?

7 A Okay. We're back in the direct testimony again?

8 Q Yeah. The direct testimony on line 12 --

9 A Yeah, okay.

10 Q -- you're referring to a study, and the study that
11 you're referring to is still in this article?

12 A Yeah. It's just later on in the same article, yeah.

13 Q And you state at least 95 percent of residents were
14 apparently satisfied with or unfazed by the sound
15 emissions of the new wind project, even when sound
16 levels were around or above 45 decibels. Was that
17 your conclusion based on this study?

18 A Yes, it was. And what that study is all about is
19 we're --

20 Q I'm sorry. Let me ask you the questions, keep this
21 moving along.

22 A Okay. Go ahead.

23 Q Please look at Table 4 of your paper, it's on page
24 101, and it looks like those are the results of this
25 study that you're talking about in your direct

Transcript of Proceedings - October 10, 2012
Volume 4

486

1 testimony?

2 A Yes, that's right.

3 Q So looking at site A, there are approximately 107
4 households that are within this kind of target area
5 near wind turbines; is that correct?

6 A Um-hmm. Yes.

7 Q And you found that when noise decibel levels were
8 below 40, there were no complaints --

9 A That's correct.

10 Q -- correct? No sound complaints or no complaints at
11 all?

12 A No complaints related to noise.

13 Q Okay. So the survey didn't ask about did people have
14 problems with nausea or sleeplessness, it just said
15 are you bothered by the sound?

16 A Well, there was no official survey. These houses
17 that are in the table or are counted in the table,
18 what those are are all of the houses where the
19 project operations ever received a call with any kind
20 of concern about the noise from the project. Some
21 were definite complaints, others were just kind of
22 mild concern. But they're all included here. When
23 we do these surveys, we'll ask, you know, who has
24 ever called about a problem; and then we will put
25 instrumentation at that house and include them in the

Transcript of Proceedings - October 10, 2012
Volume 4

487

1 compliance study. So we know how many complain and
2 we know what the level was there.

3 Q Okay. So you had 107 homes where there were noise
4 complaints --

5 A No.

6 Q -- correct?

7 A No, that's incorrect. The 107 is the total number of
8 households that are within 2,000 feet of a turbine at
9 that project.

10 Q I'm sorry, I didn't hear you. My colleague was
11 talking to me.

12 A Yeah, the -- all the numbers in that column, the 107
13 is how many houses there were within 2,000 feet of a
14 turbine in that project. In other words, it's the
15 total population essentially.

16 Q Okay. And this -- to obtain the complaint data, you
17 went to the company to get their records, correct?

18 A Well, it was just a matter of talking with the
19 operations people. No records per se.

20 Q So you didn't receive anything saying here's our
21 stack of written complaints?

22 A We asked who has ever called with any kind of concern
23 about noise. And they -- then they told us. There
24 may be more. That's possible.

25 Q So it's -- you called up Bob who runs this project

Transcript of Proceedings - October 10, 2012
Volume 4

488

1 and said who's complained and he said, well, I think
2 this guy, this guy and this guy; that's what it was?

3 A Well, it's whoever called up at any time. And I
4 think this is -- it seemed to be pretty accurate.

5 Q But you didn't go to every -- you didn't send out a
6 survey to 107 residences --

7 A No, no, not at all. This -- the purpose of these
8 surveys was never to -- was not primarily to evaluate
9 the impact. It was to carry out a compliance survey
10 to see whether the project was meeting its
11 requirements. And we just were able to draw out of
12 that this information.

13 Q And that obviously is a very important distinction.

14 A Yeah. Yeah. None of these surveys were undertaken
15 with the primary purpose of counting how many people
16 complained.

17 EXAMINER NEWMARK: Let me just note, on
18 your direct, you label this study, not a survey. So
19 I don't know if that makes a difference as to what
20 we're really getting at. You weren't intending to
21 do a survey here, you were doing a study?

22 THE WITNESS: Well, all of the examples in
23 this table, they're all field surveys of actual
24 projects.

25 EXAMINER NEWMARK: Okay. So it did make a

Transcript of Proceedings - October 10, 2012
Volume 4

489

1 difference. All right.

2 BY MS. BENSKY:

3 Q So I just want to make a very important
4 clarification. You did not go -- for site A, you did
5 not go to 107 residences, personally ask somebody do
6 you have a problem with the noise, yes or no, and
7 then get a result, correct?

8 A Yeah, that's correct.

9 Q So if somebody didn't complain to the company -- even
10 if they did complain to the company, they might not
11 be included in this?

12 A Oh, yeah. There could be more. We're not claiming
13 that it is the definitive number, but this was what
14 we were able to find out.

15 Q Right. So you're not saying that 95 percent of 107
16 households are -- don't have any noise complaints
17 related to this project? That's not what this is
18 saying?

19 A Well, what it's saying is that we know how many
20 definitely did complain and there may be some more,
21 but in general it shows that the vast majority did
22 not complain.

23 Q All right. Now, you were here and -- you had the
24 great pleasure of sitting here all day yesterday,
25 correct?

Transcript of Proceedings - October 10, 2012
Volume 4

490

1 A Yes, I did.

2 Q And you heard some people come up and testify that
3 they had various complaints about noise, correct?

4 A Um-hmm. Yes.

5 Q Did you hear anybody say that they didn't go off and
6 complain to the company?

7 A It seemed like when asked, most of them said they did
8 call the company and made various progress.

9 Q Did you -- do you remember hearing anybody say they
10 did not complain to the company?

11 A I don't specifically remember any examples.

12 Q Okay. That's fine. Going back to the actual text of
13 your testimony, at line 11, the text reads, "In fact,
14 an interesting finding of the study was that at least
15 95 percent of residents were apparently satisfied
16 with or unfazed by the sound emissions of the new
17 wind project, even though sound levels around and
18 above 45 dBA were observed..." That's what it says,
19 correct?

20 A Yes, that's right.

21 Q But that's really not a conclusion that we can draw
22 because you're assuming that at no -- that if a
23 person did not complain to the company, that they are
24 satisfied or unfazed by the noise, correct?

25 A That's why I used the word "apparently."

Transcript of Proceedings - October 10, 2012
Volume 4

491

1 Q But that's an assumption that you're making in that
2 statement?

3 A Yes. But this is -- as you can see from the table,
4 this is repeatable over five sites in this study and
5 several more after it.

6 Q I'm not concerned about the decibels right now. I'm
7 just talking about the data, the number of
8 complaints. So one big assumption of this study is
9 that if a person was upset about the noise to any
10 degree, that they complained to the company. Would
11 you agree that that's an assumption that you're
12 making in that statement?

13 A Yes.

14 Q Now, the second assumption that we're making is that
15 the company gave you all of the complaints that they
16 received?

17 A Yes.

18 Q And we don't know -- those are big assumptions. We
19 just don't know if -- we don't know the answers, you
20 never went back and double-checked that?

21 A They're assumptions, but I think they're fairly
22 accurate.

23 Q But you really don't have a basis for thinking that
24 they're accurate?

25 A I can't imagine that -- you know, in this first site

Transcript of Proceedings - October 10, 2012
Volume 4

492

1 there was three complaints. I can't imagine there
2 was 50 complaints there. I don't think that's the
3 case.

4 Q But --

5 A And part of the reason for believing that is that we
6 measure -- when we do these surveys, we measure in
7 this example these three houses; but then at -- many,
8 many others throughout the project area all have the
9 houses that are closest to turbines. And not only do
10 we measure, but I personally have talked to all these
11 people, the ones that have complained and then the
12 other ones elsewhere. And it's -- it's surprising to
13 me, it was surprising to me how many people just
14 don't -- it's not the noise, even though the levels
15 are fairly high.

16 Q But that information that you just gave us is not
17 reflected in this survey? You said you went out and
18 you talked to people.

19 A Yeah.

20 Q But we don't know, based on this survey here, how
21 many people you talked to, what they said, there's no
22 written survey; is that correct?

23 A No. This is what I've gathered in the course of
24 doing this work.

25 Q Okay. Just a couple follow-up questions, one having

Transcript of Proceedings - October 10, 2012
Volume 4

493

1 to do with this. So let's turn to page 97. And
2 there's two columns on the right-hand column, first
3 full paragraph, that begins with, "In addition, the
4 report clearly indicates."

5 A Yeah. Okay. I'm there.

6 Q Okay. About -- looking at the very last sentence of
7 that paragraph beginning with Schomer. Do you see
8 that?

9 A Yes, um-hmm.

10 Q And you state, "Schomer suggests that an adjustment
11 of 10 decibels should be subtracted for quiet rural
12 environments and perhaps another 5 decibels if the
13 project is newly introduced into such a long-standing
14 quiet setting." Is that what this says?

15 A Um-hmm.

16 Q And getting into this issue of day and night levels.
17 Is there anywhere in this paper that you criticize
18 Mr. Schomer's suggestion?

19 A No. This is just saying that we're taking onboard
20 what he has to say about it and figured it into this
21 overall analysis.

22 Q But you agree that you're not critical of that
23 particular suggestion in this paper?

24 A No. That's why it's in there.

25 Q Now, you spent the day here yesterday and you heard

Transcript of Proceedings - October 10, 2012
Volume 4

494

1 Mr. Hankard say that if you measure at very close to
2 a wall, you're going to get a result that's three
3 decibels higher and that's not a good thing to do to
4 measure sound in a wall. Do you agree with that?

5 A Yes, yes. You don't want to put the microphone right
6 on a vertical surface, no.

7 Q My question is, what's the decibel level on the other
8 side of the wall? Does sound -- can sound waves go
9 through the wall?

10 A Yes. To some extent. Depends on the wall
11 construction and so on, frequency content of the
12 noise.

13 Q I hear some laughing behind me from Mr. Schomer, so I
14 don't know if that was a question showing a lot of
15 naivety.

16 But what I'm getting at is when there's a
17 45-decibel level outside a home, what's going on
18 inside the home? Does the sound travel through the
19 wall such that the walls can create some sort of
20 reverberation and make it even louder indoors than it
21 is outdoors?

22 A No. What typically happens is the level inside is
23 substantially lower than what you're measuring
24 outside.

25 Q With any frequency of sound?

Transcript of Proceedings - October 10, 2012
Volume 4

495

1 A Yeah, as a general rule.

2 Q Are there any frequencies that travel better through
3 walls than other frequencies?

4 A Sure, sure. The lower frequencies pass through a
5 given construction much more easily than high
6 frequencies.

7 Q And when you say low frequency, what is the kind of
8 baseline low frequency that's going to make it
9 through the wall?

10 A Any frequency down to 1 hertz.

11 Q But up to what hertz level?

12 A Well, let's say from 20 hertz down.

13 Q Okay. I'm almost done. Can you please turn to your
14 rebuttal testimony, and pull out Exhibit 3 from that
15 testimony, please.

16 Now, Exhibit 3 looks like it's a
17 comparison between the model predictions and the
18 actual noise levels measured; is that correct?

19 A Is it this figure, you mean?

20 Q Yeah.

21 A Okay. Yeah. What that's showing is the black
22 figures in the middle of the chart are the sound
23 level at 1,000 feet from an isolated wind turbine in
24 three different directions measured over 14 days.

25 Q So there are actually three black lines in here?

Transcript of Proceedings - October 10, 2012
Volume 4

496

1 A Yeah. They all kind of are similar.

2 Q And the -- I guess it would be the Y axis at the
3 bottom, that represents a total of 14 days?

4 A That's right.

5 Q So my first question is we see some peaks, correct?

6 A Yes.

7 Q What length of time is one of those peaks? Is it an
8 hour, a minute, a second?

9 A This data was measured in ten-minute increments, and
10 there's a couple of -- well, there is a very
11 prominent spike right in the middle of the survey,
12 that was probably 20 to 30 minutes in duration.

13 Q That spike?

14 A Yeah.

15 Q Is every spike -- is every little point a ten-minute
16 average or 30-minute average?

17 A Well, the sound level data appears as a continuous
18 line; but it's actually made up of many, many
19 thousands of ten-minute samples all strung together.

20 Q What I'm trying to figure out is for how long was it
21 that loud when we see a peak? Does this graph give
22 us that information?

23 A Well, from having looked at graphs like this a lot, I
24 can tell there's -- this peak in the middle is, like
25 I said, probably 20 to 30 minutes long.

Transcript of Proceedings - October 10, 2012
Volume 4

497

1 Q And where was this measurement taken? What state?

2 A This is at a site in Minnesota that was in an
3 extremely rural area, not near any roads or towns or
4 anything. And it was just in a wide open field.

5 Q And near what wind farm?

6 A Prairie Star, I believe it's called.

7 Q And do you know the make and model of the turbine?

8 A I think it was a Vestas V90.

9 Q And do you know what the power output was?

10 A The electrical power output? It was 2 megawatt, I
11 think.

12 Q And do you know how tall the turbine was?

13 A I think it was on a typical 80 meter mast. This is
14 just taken as an example just to compare modeling
15 versus what you measure.

16 Q So with an 80 meter mast it would be probably around
17 400 -- 360, 370 feet?

18 A Right, right.

19 Q And this 14-day period was in August?

20 A That's correct.

21 Q Is there a certain month of the year where the winds
22 are stronger?

23 A Well, it varies at every site. I don't know what the
24 wind rose was at this particular site, I don't
25 recall.

Transcript of Proceedings - October 10, 2012
Volume 4

498

1 Q As a general matter in Minnesota, is it windier in
2 the winter or in the summer?

3 A I think it's the wintertime there.

4 Q And you agree that in August there are generally more
5 leaves on the trees, more grass on the ground, more
6 birds?

7 A Yes.

8 Q Now, looking at this, we do see several points where
9 there are exceedances over 40 decibels; is that
10 correct?

11 A Yes. Remember, this is only a thousand feet away.

12 Q Right. But there are exceedances over 40 decibels?

13 A That's right.

14 Q Now, this bold red line looks like it is -- the first
15 bold line at the top is using that 0.0 coefficient --

16 A Yes, that's right. Um-hmm.

17 Q -- modeling? And the second line down is using the
18 .5 coefficient?

19 A Right.

20 Q And then there's a very, very faint red line down
21 below and that's the 1.0 coefficient?

22 A Right.

23 Q Now, if the standard was you may not exceed 40
24 decibels at night, looking at this graph, would you
25 think that there are exceedances?

Transcript of Proceedings - October 10, 2012
Volume 4

499

1 A Yeah. It does go over 40 for this particular
2 measurement setup, these distances and so on.

3 Q On average it doesn't, but it does go up there, it
4 goes above it?

5 A Right. Well, that's typical.

6 Q So it is typ -- are you saying that it's typical that
7 there are -- that the actual sound does exceed the
8 modeling at certain times? Would that be a correct
9 assumption?

10 A Oh, most definitely, yes.

11 MS. BENSKY: That's all I have.

12 MR. REYNOLDS: Could we take a break?

13 EXAMINER NEWMARK: It will be short if we
14 do it now. It will be longer if we wait 'til after
15 he's done.

16 MR. REYNOLDS: I'd rather take a short
17 break. It's going to be at least a half hour.

18 EXAMINER NEWMARK: All right. Let's take
19 20 minutes.

20 (Recess taken from 12:15 to 12:43 p.m.)

21 (Change of reporters.)

22 EXAMINER NEWMARK: Okay. There's a motion
23 to move Mr. Hessler's study that he footnoted in his
24 testimony, and that would be --

25 MS. BENSKY: Footnote 3, page 11 of

Transcript of Proceedings - October 10, 2012
Volume 4

500

1 direct.

2 EXAMINER NEWMARK: Okay. And his --

3 Exhibit 5 it would be, we would mark it as 5.

4 Any objections to that?

5 MS. BRANT: I'm sorry, Your Honor, would

6 it be 5 or 6? We have a pending with 4 that was

7 denied, but potentially to be admitted later.

8 MS. NEKOLA: And then we have 5.

9 MS. BRANT: Exhibit 5, which is his pseudo
10 notice.

11 MS. BENSKY: So 6. 4 was marked.

12 EXAMINER NEWMARK: So 5 is still pending.

13 Let's go off the record.

14 (Discussion off the record.)

15 EXAMINER NEWMARK: So Hessler 6, any

16 objections? No. Okay. It's in the record.

17 (Hessler Exhibit No. 6 marked and received.)

18 EXAMINER NEWMARK: All right. I think,

19 Mr. Hessler, remember you're under oath, and you're

20 available for cross.

21 CROSS-EXAMINATION

22 BY MR. REYNOLDS:

23 Q Mr. Hessler, I have a couple of questions for you.

24 You testified that you were struck by the testimony

25 of the Shirley Wind people.

Transcript of Proceedings - October 10, 2012
Volume 4

501

1 A Yes. That's correct.

2 Q Why is that?

3 A Because of the -- because it's completely credible,
4 and I don't doubt it at all.

5 Q And do you doubt -- is it significant to you that the
6 residents testified that they had no problems before,
7 and when they left the site, their symptoms
8 disappeared?

9 A Yeah. That's very simple. It appears to be due to
10 the project there.

11 Q And what -- was that one of the reasons you wanted to
12 do some testing of Glacier Hills? Sorry, at Shirley.

13 A Yes. And I think what's needed is to get to the
14 bottom of why that is.

15 Q And what -- is it fair to say that the symptoms that
16 they complained of, such as headache, nausea, ear
17 problems, are consistent with exposure to low
18 frequency sound?

19 A Yeah, I think that's true. Of course it depends on
20 the magnitude of the sound, whether you're affected
21 or not, but because specifically one fellow said he
22 lived one mile away, that means that it's the only
23 possible sound that could travel that far would be
24 low frequency noise.

25 Q And so what -- what has -- what's been the result of

Transcript of Proceedings - October 10, 2012
Volume 4

502

1 your effort to test up there? What would you have to
2 do and what request did you make, and what were the
3 results?

4 A Well, we came up with a preliminary test plan where
5 we had identified one or two units that were kind of
6 isolated so we could kind of more or less
7 scientifically measure them, and I think we submitted
8 that to the project up there so they would know they
9 were abound. But at first we didn't hear anything,
10 and I think they finally said, well, they don't want
11 to -- we're welcome to participate, but they don't
12 want to do it.

13 Q And what were you planning to actually test for?

14 A Well, low frequency specifically. And what we had in
15 mind was to test using a procedure that's outlined in
16 IEC standard 61400, which is a procedure for
17 measuring the sound power of wind turbines. It's
18 what all manufacturers use. But the point is that
19 that methodology uses a reflecting board that you put
20 on the ground and then you lay the microphone right
21 on the board, and the reason for that is that the
22 wind speed is theoretically zero at the surface. So
23 you're largely eliminating self-contamination from
24 pseudo-noise that we talked about a bit earlier
25 because it's very, very difficult to measure low

Transcript of Proceedings - October 10, 2012
Volume 4

503

1 frequency noise because it's covered up by cell noise
2 of wind. It's a real technical challenge.

3 Q And let me ask you this. You've noted that there are
4 significant differences. There's -- there's a
5 significant difference between, say, Mr. Bump's
6 testimony and the three individuals who abandoned
7 their homes at Shirley?

8 A Right.

9 Q Now, there are different machines at the farms,
10 right?

11 A That's right.

12 Q What's at Glacier Hills?

13 A Those are Vestas V90.

14 Q And what's the output?

15 A I think they're 2 megawatt.

16 Q All right. And what are the ones at Shirley?

17 A They're the Nordex N100, and that's two and a half --
18 I don't remember.

19 Q And the -- that's one of the machines that's proposed
20 at this Highland project; is that right?

21 A One of the three that are being considered. It's
22 prominent in these analyses I think just because it
23 has a slightly higher sound power level, but that's
24 the only reason it's really being looked at
25 carefully.

Transcript of Proceedings - October 10, 2012
Volume 4

504

1 Q All right. Are you aware of recent low frequency
2 noise from large turbine literature that describes
3 findings of higher low frequency noise from larger
4 turbines, those in the 2.3 to 3.6 megawatt category?

5 A Yeah. I have heard that, but my sense is that --
6 well, what strikes me is how remarkably similar the
7 sound power level is of all the turbines that are in
8 current use all the way from one-and-a-half-megawatt
9 units up to 3-megawatt units. They're all remarkably
10 similar in my view.

11 Q Well, are you familiar with a 2010 low frequency
12 noise from large turbines work by Henrik Moller and
13 Christian Pedersen on the subject?

14 A Yeah. Yeah, I've read that, but some time ago. And
15 I think they do some sort of analysis, and it appears
16 that it maybe is a little bit louder in the lower
17 frequencies for larger turbines, but that may be true
18 slightly.

19 Q So you would point to the potential cause of the
20 Shirley complaints to the machine itself?

21 A Yeah. I think -- I think this sort of problem is
22 related to the specific turbine. Now, before
23 yesterday when I heard that testimony, my view is
24 that those kinds of problems were principally
25 associated with the Vestas V82 in its early form that

Transcript of Proceedings - October 10, 2012
Volume 4

505

1 had stall-regulated blades instead of pitch-regulated
2 blades. But this is the first I've heard of a
3 problem with a N100 site. I've worked with project
4 that put in N90s and N100s and there aren't any
5 problems at that site, so it's puzzling.

6 Q Let me ask you this. You have -- you heard testimony
7 about your recommended noise level design goals,
8 right? That's a paper that you and your dad and --
9 you and your dad put together?

10 A Yeah.

11 Q All right. And would you -- your findings indicate
12 that a 40-decibel level in the A range, that's the
13 audible range, is ideal?

14 A Yeah. And the reason for that is that we found that
15 there are few, if any, complaints at houses where the
16 outside level was 40 or less.

17 Q And so in an ideal world, if it would be possible to
18 have a project where the maximum level is 40 --

19 A Uh-huh.

20 Q -- is it fair to say that we probably wouldn't see
21 the citizens come in here and talk about the need to
22 abandon their homes?

23 A I think what you would see is a lack of complaints
24 about audible noise and amplitude modulation, things
25 like that, but that 40 dBA level really is not

Transcript of Proceedings - October 10, 2012
Volume 4

506

1 connected in any way to this infrasonic situation.

2 Q The dBA level would be connected with sleep
3 disturbance?

4 A Yeah. It's the audible noise, the swishing sound
5 that you can hear, you know, as Mr. Bump said
6 yesterday.

7 Q Well, let me ask you this. There have been some
8 references to the sound of these turbines being at 40
9 dBA being like the sound of a refrigerator. Do you
10 agree with that?

11 A No. There's no -- nothing that you can compare it
12 to. It's not a constant sound. It's not
13 particularly loud, but it does have a time variance
14 to it that kind of calls attention to itself, and it
15 depends on the specific wind conditions and how much
16 turbulence there is and time of day. All kinds of
17 factors go into it so, yeah, it's more noticeable
18 than other things.

19 Q So that that you're referring to is the swishing
20 sound or the noise amplitude?

21 A Yeah. And that -- that does occur, but that is not
22 always the principal characteristic. In fact, I
23 spent a lot of time at wind projects, and it's more
24 or less a steady kind of -- I use the word churning
25 sound. It's -- but there's not -- you don't always

Transcript of Proceedings - October 10, 2012
Volume 4

507

1 or often see pronounced swishing or amplitude
2 modulation.

3 Q Would you -- is it fair to say then that the sound
4 from turbines combines three separate variables or
5 parameters: one is audible sound in the dBA range;
6 two is low frequency or infrasound in the very low to
7 nonaudible range; and three would be the amplitude
8 modulation from the -- from the pulsating action of
9 the turbine blades?

10 A Yeah. I think the first and the third one are kind
11 of related, but --

12 Q Well, is it fair to say that there's a difference in
13 the ability of folks to sleep, for instance, if the
14 sound is like white noise, just steady, as opposed to
15 pulsating noise?

16 MR. SCRENOCK: I'm going to object, Your
17 Honor. I'm not sure that Mr. Hessler's been
18 qualified as an expert on sleep disorders.

19 EXAMINER NEWMARK: He has testified on
20 people's reactions to sound, I think. Isn't that
21 what he's been saying?

22 MS. NEKOLA: No, I don't think that's
23 accurate.

24 EXAMINER NEWMARK: No? People complain,
25 certain distances and --

Transcript of Proceedings - October 10, 2012
Volume 4

508

1 MS. NEKOLA: Well, that's correct, but not
2 specific health or sleep reactions, just complaints.

3 MR. REYNOLDS: Well, he's done
4 investigation on complaints. He's analyzed ideal --
5 I mean, it's a pretty simple question. I mean, I'm
6 not calling him to ask him an opinion to a
7 reasonable certainty, but just a correlation between
8 this aspect of wind turbine noise and sleep
9 disturbance.

10 EXAMINER NEWMARK: Yeah.

11 MR. SCRENOCK: I understood his question
12 to be asking the witness whether a particular
13 parameter as he described it, wind turbine noise,
14 what would cause someone to have difficulty
15 sleeping, and I don't believe that is within the
16 realm of what Mr. Hessler's been testifying on.

17 EXAMINER NEWMARK: Well, I'm going to let
18 him answer. He can say he doesn't know.

19 THE WITNESS: You know what I would say to
20 that is, I think it's the highly variable nature of
21 wind turbine noise that appears to lead to sleep
22 disturbance because you can be standing next to a
23 turbine and it makes -- it will be making a certain
24 sound, and then the next minute it will suddenly get
25 louder and then get quieter again. And I think

Transcript of Proceedings - October 10, 2012
Volume 4

509

1 those changes, I think, may be associated with
2 people waking up and having problems sleeping.

3 BY MR. REYNOLDS:

4 Q How about the whistling sound that Mr. Bump talked
5 about?

6 A You know, that -- well, I think he said it was a
7 foghorn sound. That's the way I would describe it.
8 That's with a hydraulic pump that's in the nacelle of
9 every one of those turbines, and it is a constant
10 mechanical noise. He mentioned that it varied, but
11 what he's really talking about is the yaw mechanism
12 to move the nacelle back and forth, that's variable,
13 that comes and goes, but the hydraulic noise is
14 constant. That's just a feature of that particular
15 model turbine.

16 Q All right. You have made a recommendation -- well,
17 let me ask you this first. With respect to the
18 modeling, you took a look at the Applicant's model,
19 which predicted using the N100 predicted 45 residents
20 would be potentially over 45 dBA, right? You saw
21 that info?

22 A Yeah. That was with the -- I think the initial
23 application where they were using a ground absorption
24 coefficient of zero.

25 Q That's right. And when you used a ground absorption

Transcript of Proceedings - October 10, 2012
Volume 4

510

1 coefficient of .5, you found that it would be 45 --
2 four houses above 45 dBA?

3 A Yes. That's correct.

4 Q And would you agree with me that if you're going to
5 err on the side of public safety, that a more
6 conservative model is probably a better way to plan a
7 prospective wind farm?

8 A Well, when we first started analyzing wind projects
9 10 years ago or more, and we didn't know if the model
10 was accurate or not, they would put on a safety
11 factor and so on. Now since that time, we've had the
12 opportunity to do a lot of testing and compared
13 what's actually measured to what's predicted, and we
14 found the best agreement, the most realistic
15 agreement, is when you use .5 ground absorption.
16 That gives the closest correlation to what's actually
17 found out there.

18 Q All right. But you agree with me that models -- your
19 data shows that the models are generally consistent
20 but not perfectly on track with reality?

21 A Yeah. What the model gives you is the long-term
22 average level from the project at a given point, and
23 what we always made clear in our reports is that that
24 is the average, and the actual level is going to vary
25 commonly by plus or minus 5 dBA, sometimes by more.

Transcript of Proceedings - October 10, 2012
Volume 4

511

1 It will get noise spikes like we were looking at a
2 few minutes ago in that example. That's just the
3 nature of a wind turbine.

4 Q So the 45 dBA which you're advocating for is not a
5 maximum, it's an average?

6 A Yeah. That's a given. I'm glad you brought that up.
7 Yeah. In this paper where we recommend that, we say
8 what should be limited to 45 is the main long-term
9 average level at each house. There's no practical
10 way to maintain a level below a threshold like 45 or
11 even 50 all of the time. That never happens.
12 There's always spikes due to weather conditions and
13 things. They're short-lived, but they're almost
14 unavoidable.

15 Q All right. So then for a 45 dBA average, then you
16 might have spikes up to, say, 45, but probably not
17 over 50?

18 A I got mixed up in that. Can you --

19 Q All right. If you had the ideal target of 40 dBA, if
20 that were -- if that were basically the target here
21 measured by the model, and that would mean that there
22 would be levels at the farm of up to 45 but probably
23 not beyond 50 dBA?

24 A Yes. Yeah, it would go -- if you say designed to 40
25 at a particular point, the actual level would vary

Transcript of Proceedings - October 10, 2012
Volume 4

512

1 above and below that up to 45, within the 35-45
2 range, and there would be probably rare spikes to 50,
3 even more than 50.

4 Q So with respect to your ideal level, that's based
5 upon your evaluation of various venues and examining
6 available complaints from residents?

7 A Right, right. And those levels -- well, you know,
8 those -- that phenomenon where the level varies
9 happens at every site. So what we did was we
10 measured the main long-term level at all of these
11 houses, and that's what's tabulated there is how many
12 people were complaining between 40 and 44. That's
13 the main long-term level between that range. You
14 know, so at any given house they might be exposed to,
15 let's say, a level 43, but the actual level might
16 have gone up to 50 at times and down to 35. That
17 happens everywhere. So I'm trying to keep everything
18 on a level playing field.

19 Q All right. Now, assuming that the project could be
20 redesigned for a 40 dBA, making that assumption, that
21 would be your preferred dBA limit, would it not?

22 A Well, it would be better for everyone if that were
23 the actual performance of the project, but typically
24 it's not practical or feasible to achieve that level
25 at most projects. I would say 90 percent.

Transcript of Proceedings - October 10, 2012
Volume 4

513

1 Q So are we talking about economic development versus
2 the public interest to be free of noise complaints?

3 A I think it's just fundamental economics of the
4 project. To make 40 at a given site, you may --
5 oftentimes you have to remove so many turbines that
6 the project just becomes not viable.

7 Q All right. But assuming for the sake of this
8 question that this project could be redesigned for 40
9 dBA.

10 A Uh-huh.

11 Q You would recommend that based upon your work, right?

12 A That would be a good thing if that were possible,
13 yes.

14 Q And there are other jurisdictions such as New York
15 that have 38 to 40 dBA; isn't that right? I think
16 these are noticed in your paper. California, New
17 York. Page 98.

18 A Yeah. Now there that's what we talked about a little
19 while earlier. Those are relative limits that are,
20 like, converted to an absolute number. In New York
21 the methodology for years has been to measure the
22 background and then you could go over that by 5. So
23 I think the 38 is just based on a typical background
24 level of 33, plus 5. That's where that number comes
25 from.

Transcript of Proceedings - October 10, 2012
Volume 4

514

1 Q All right. I think you testified to this earlier
2 that there is a significant impact with respect to
3 noise if the ambient level is very low and with wind
4 turbines coming in with a higher noise threshold; is
5 that right?

6 A Yeah. If you had a -- in the specific example there,
7 if the project level were higher than 45 and the
8 background level were 16 below that, that means that
9 the project would be dominant, the only thing you
10 could hear pretty much. That's that situation. But
11 the absolute limits that we're putting forward of
12 40-45 are based on the -- the typical setting that
13 all of these projects normally are in. In other
14 words, rural farm country. Those levels appear to be
15 to our mind satisfactory given that sort of an
16 environment.

17 Q This is -- is it fair to say that the Town of Forest
18 is unique because of its very quiet background
19 levels?

20 A No, I wouldn't agree with that at all. That project
21 site is very similar to dozens and dozens of other
22 ones that I could think of.

23 Q Well, but we're talking about -- what areas where
24 people live in are quieter than these at the 20 dBA
25 level for ambient noise?

Transcript of Proceedings - October 10, 2012
Volume 4

515

1 A Well, those are the kind of levels we find in every
2 one of these sites that's in rural farm country.
3 When the wind is calm, the level is always 20, 25
4 dBA, and that happens everywhere. It's really the
5 wind. It's really the background level when the wind
6 is blowing that has some relevance.

7 Q So with respect to -- back to the Shirley Wind
8 Project. Given the fact that the applicant here is
9 recommending the potential use of the same machines,
10 of the same kind of configurations at the Highland
11 Project as the Shirley Project, would you have
12 concerns about potential impacts in the Town of
13 Forest that have been reported in Shirley?

14 A Yeah. As I think I mentioned earlier, I think the
15 issues there are related specifically to the -- to
16 that model turbine, and I think until that's better
17 understood, I don't see any reason why it wouldn't
18 repeat itself if that same turbine were used
19 somewhere else.

20 Q Do you -- now, with respect to the difficulty of you
21 being able to test at Glenmore -- are you having the
22 same problem at Glacier Hills?

23 A Yeah. We asked for permission, and same sort of no
24 response thing. Went on for a long time, and then I
25 think, oh, what was it, the other day they officially

Transcript of Proceedings - October 10, 2012
Volume 4

516

1 said, no, we don't want to do that.

2 Q All right. And do you think that it's -- that the
3 Applicants would be -- that it's in the nature of
4 good science to prevent scientists like you from
5 gathering data?

6 A Yeah. You know, I think what needs doing is -- is
7 some field testing to understand this thing.

8 Q And we agree that it's not completely understood?

9 A That's correct. Yeah.

10 Q And do you agree with the environmental assessment
11 here that a certain percentage of -- of Town of
12 Forest residents will suffer a decrease in quality of
13 their life if this project is approved?

14 MR. SCRENOCK: I object to that, Your
15 Honor. I'm not sure that Mr. Hessler's been
16 qualified as a quality of life expert.

17 EXAMINER NEWMARK: Yeah. I think it's too
18 ambiguous of a question.

19 BY MR. REYNOLDS:

20 Q All right. Have you read the environmental
21 assessment?

22 A Yes. Uh-huh.

23 Q All right. And you -- do you remember a part in
24 there where the environmental assessment assumes that
25 if this project goes forward, there will be a small

Transcript of Proceedings - October 10, 2012
Volume 4

517

1 percentage of Town of Forest residents who will be
2 adversely affected as designed?

3 A Yeah. I would say that's a very typical conclusion
4 at least. I mean, there's hardly any site where you
5 can sit back and comfortably say everybody's going to
6 be fine. I don't -- there's hardly any situation
7 that falls into that. I can only think of one
8 project, and it was on an island and nobody lived
9 there, but -- but for most projects, the norm is to
10 conclude there will probably be some small impact.

11 Q And so especially if the same turbines are used at
12 Shirley, you would expect the same result in the Town
13 of Forest?

14 A Well, I don't have any reason to believe that it
15 wouldn't -- that whatever is going on there would not
16 repeat itself.

17 MR. REYNOLDS: That's all I have.

18 EXAMINER NEWMARK: Okay. Other cross?

19 MR. SCRENOCK: I do, Your Honor.

20 EXAMINER NEWMARK: Oh, go ahead.

21 MR. SCRENOCK: Just a few questions.

22 CROSS-EXAMINATION

23 BY MR. SCRENOCK:

24 Q Mr. Hessler, I note that in your testimony, I don't
25 need to point to any specific points, but you refer

Transcript of Proceedings - October 10, 2012
Volume 4

518

1 throughout, or at least at different points, about
2 the incidence of complaints. And in response to one
3 of Ms. Bensky's questions earlier, you used the
4 phrase pretty significant adverse impact. By that
5 were you referring to the same thing in terms of
6 incidence of complaints?

7 A Yeah. I'm talking about complaints and that study we
8 were talking about before.

9 Q Thank you. And you had a lengthy discussion about
10 the wind speed monitor and the level from ground
11 where those measurements were taken. You were
12 talking about normalizing the wind speeds to 10
13 meters. Was the purpose of that to essentially
14 equate a -- excuse me -- that I'm assuming, and I
15 guess I want to know if my assumption is correct,
16 that the way that the model works or the reason that
17 you normalize the time of year is that there's
18 assumed sort of graduation of wind speed throughout
19 the elevations and that a wind speed at 50 meters
20 normalized to 10 meters will equate to a specific
21 wind speed up at the hub height. Is that the purpose
22 of the normalization?

23 A Yes. The -- the primary reason that I normalized it
24 to 10 meters is because that's what we always do in
25 these assessments. So I wanted to look at it in the

Transcript of Proceedings - October 10, 2012
Volume 4

519

1 way that we normally look at field data.

2 Q Okay.

3 A I wanted to keep it consistent so I can tell what it
4 meant relative to other sites and other situations.

5 Q Okay. Now, you had talked with Mr. Reynolds a little
6 bit about the 0.0 ground absorption coefficient
7 versus the 0.5, and I think you indicated that you
8 used that process frequently; is that right, that
9 type of modeling with those coefficients?

10 A Well, what we always do is assume .5 ground because,
11 as I mentioned, we get the best agreement between
12 modeled and measured results in a particular point.

13 Q So you don't do that for the purpose of skewing the
14 results?

15 A Oh, no. No. What I'm after is, I want to know what
16 it's really going to be at a given house.

17 Q And you had indicated that when you ran your model
18 with the 0.5 ground absorption coefficient for the
19 Highland Project, that you found that there were four
20 houses that you identified that would be within --
21 above the 45 decibels. Do you know whether those
22 houses represent participating or nonparticipating
23 landowners?

24 A I didn't at the time. I have heard recently that
25 they are all participants.

Transcript of Proceedings - October 10, 2012
Volume 4

520

1 Q Okay.

2 A Not sure about that, though.

3 Q And with -- Mr. Reynolds asked you about the use of
4 the similar model turbines from the Shirley Project,
5 I believe that's the N100 here, and you indicated
6 that you don't have any reason to think that the
7 problems -- the experiences of folks wouldn't
8 reoccur. Do you have any reason to believe that they
9 would?

10 A Well, I would say we don't fully understand why
11 there's problems at Shirley, but my belief is that
12 it's associated with a specific turbine model and
13 possibly the blade regulation, whether it's pitch or
14 stall regulated. I think I would be leery about
15 using that turbine again before more is known about
16 it.

17 Q If one of the other two turbine models that were
18 discussed being used for this project were being
19 used, what would be your perception?

20 A I would be more comfortable with that because I think
21 the other ones are the Siemens. I don't know of any
22 other model, Siemens and one other one, but I
23 don't -- I've never noticed any problems with those.

24 Q So based on whatever is going on at Shirley that
25 we're not sure what it is, you wouldn't have reason

Transcript of Proceedings - October 10, 2012
Volume 4

521

1 to expect those issues to reoccur with either of the
2 other two models?

3 A That's right.

4 MR. SCRENOCK: Thank you. I have nothing
5 further.

6 EXAMINER NEWMARK: Okay. Other questions?
7 I believe staff goes first.

8 CROSS-EXAMINATION

9 BY MR. LORENCE:

10 Q Mr. Hessler, are you familiar with the PSC noise
11 measurement protocol?

12 A Yes.

13 Q Is any part of that protocol oriented towards
14 infrasound?

15 A Well, I believe the intent of it was to try to
16 quantify low frequency sounds by involving the
17 C-weighted sound level and pre-construction
18 measurements and post-construction measurements.
19 That sounds good on paper, but the problem with
20 C-weighted levels is that they're extremely sensitive
21 to wind induced pseudo-noise that we talked about
22 earlier. That wind blowing over the microphone
23 affects only the lower -- the low end of the
24 frequency spectrum, and the C-weighted level is
25 directly dependent on what's going on in the low end

Transcript of Proceedings - October 10, 2012
Volume 4

522

1 of the frequency spectrum. So any little breeze
2 blowing over the microphone gives you a very high
3 obstensible C-weighted sound level.

4 So to answer your question, the protocol
5 has -- calls for C-weighted measurements, but -- and
6 we've taken that data, and what we found is that the
7 levels before the project and after the project are
8 identical because they're purely a function of how
9 fast the wind was blowing.

10 Q So the pre-construction measurements of the protocol
11 are you saying are not capable of measuring
12 infrasound?

13 A Yeah. That's right. That you get a result from
14 taking those measurements, but it has no actual
15 meaning. It's a false signal that's almost purely a
16 function of the wind speed of the microphone.

17 MR. LORENCE: No further questions. Thank
18 you.

19 EXAMINER NEWMARK: Go ahead.

20 MS. BENSKY: I have a follow-up.

21 RECROSS-EXAMINATION

22 BY MS. BENSKY:

23 Q How do you solve that problem? How should the
24 protocol be different to account for that?

25 EXAMINER NEWMARK: I think he answered

Transcript of Proceedings - October 10, 2012
Volume 4

523

1 that. You lay the microphone down on the ground
2 with a board, is that --

3 THE WITNESS: Can I answer?

4 EXAMINER NEWMARK: Well, did you answer
5 that already?

6 THE WITNESS: Not exactly.

7 EXAMINER NEWMARK: Okay.

8 THE WITNESS: No. You could use that
9 technique that I referred to, but the problem with
10 it is a practical nature. These surveys last -- or
11 need to last for a period of weeks to get -- catch
12 all kinds of wind speeds and times of day, and you
13 can't leave a microphone sitting on the ground. You
14 know, if it rains or snows, it destroys the
15 equipment. So those kinds of measurements have to
16 be attended. So to -- I suppose if you wanted to
17 document the pre-existing conditions, you would take
18 much shorter term measurements using -- perhaps
19 using that technique and taking short band sample,
20 but it's very -- it's a very challenging thing to
21 measure.

22 BY MS. BENSKY:

23 Q And are you aware of any -- switching gears a little
24 bit. Are you aware of any study that correlates wind
25 turbine make and model with a particular number of

Transcript of Proceedings - October 10, 2012
Volume 4

524

1 complaints? Is there anything that the Commission
2 can look at that would be helpful in deciding the
3 turbine model that would likely produce the least
4 amount of complaints?

5 A No. Most turbine models have no known noise issues
6 associated with them. The only ones -- there's only
7 one or two that I'm aware of that have -- that are
8 kind of special cases and have issues. I mentioned
9 the Vestas V82, or at least in the format what used
10 to be built five years ago. That -- I think that
11 one's a problem. But -- but of the ones being
12 considered here, only the Nordex appears to have
13 possibly something going on with it.

14 Q So is the answer that you're not aware that that has
15 been studied?

16 A No, it hasn't been specifically studied.

17 Q And one last question. To maintain absolute limit of
18 45 dBA that is never exceeded, what would -- what
19 should the project be designed at?

20 A Yeah, that's a good question. It has to be
21 substantially lower than that to allow for temporary
22 noise spikes, up to 10 dBA below. Now, that issue
23 has been around for a while of these temporary
24 exceedances. What I suggested, and I wrote some
25 siting guidelines for Minnesota Public Utilities

Transcript of Proceedings - October 10, 2012
Volume 4

525

1 Commission, and what I say in there is that, well, if
2 the measured level is in compliance 95 percent of the
3 time or more, then I would consider it in compliance.
4 So there has to be some allowance for these temporary
5 excursions because they're essentially unavoidable.

6 Q But that -- but that 10 decibel drop is consistent
7 with your recommendation in your paper that 35 dBA at
8 night should be the limit ideally, correct?

9 A Well, that wasn't the conclusion of the paper, but --

10 Q Are those two consistent?

11 A Yeah.

12 MS. BENSKY: Thank you.

13 MR. REYNOLDS: Have one follow-up
14 question.

15 EXAMINER NEWMARK: One. All right.

16 RECROSS-EXAMINATION

17 BY MR. REYNOLDS:

18 Q I wanted to show you, and I just want to identify
19 this. I marked it as Hessler A. I don't have
20 copies, but I just want to know if this is the paper
21 that shows that -- that you referred to that shows
22 that larger turbines above .2 -- .23 have higher low
23 frequency levels than less than 2? Is that the paper
24 you were referring to?

25 A Yes, I believe that's what this paper says. As I

Transcript of Proceedings - October 10, 2012
Volume 4

526

1 said, I haven't read it for years.

2 MR. REYNOLDS: Okay. And -- yeah, it's
3 Hessler Exhibit No. 8. I just wrote on it.

4 MS. NEKOLA: Your Honor, we object. We
5 haven't seen this.

6 MR. REYNOLDS: Yeah, I understand. I am
7 just marking it so that he can identify it.

8 EXAMINER NEWMARK: What's his next
9 exhibit?

10 MS. NEKOLA: It would be 7.

11 MR. REYNOLDS: Okay.

12 EXAMINER NEWMARK: It would be 7 anyway.
13 Okay. Are you trying to move it in now at this
14 point?

15 MR. REYNOLDS: I don't have to move it in
16 now. I just wanted him to identify it and then I
17 have one follow-up question.

18 EXAMINER NEWMARK: Well, based on this
19 exhibit?

20 MR. REYNOLDS: Well, okay. Let me do a
21 backup question.

22 BY MR. REYNOLDS:

23 Q What is the title of the exhibit that you're looking
24 at?

25 A Low frequency noise from large wind turbines.

Transcript of Proceedings - October 10, 2012
Volume 4

527

1 Q And is the premise of that article that large wind
2 turbines above point -- 2.3 megawatts tend to have
3 more low frequency sound than turbines less than 2
4 megawatts?

5 EXAMINER NEWMARK: He's already answered
6 that. No. He's already answered.

7 MR. REYNOLDS: Okay.

8 BY MR. REYNOLDS:

9 Q Do you know, the other turbines that are proposed
10 here are above 2.3 megawatts, are they not?

11 A There's been so much focus on the N100 that I don't
12 even remember what the other two models were.

13 Q Well, if -- if I told you that they were above 2.3
14 megawatts, then they would -- those turbines would
15 fall within the definition of larger turbines as
16 outlined in that paper, right?

17 A Yeah, I suppose so, but I would point to a figure in
18 that paper --

19 EXAMINER NEWMARK: Okay. Let's hold on,
20 though. We're really running far afield if we're
21 going to be digging into this exhibit since there's
22 an objection already based on entering it in the
23 record. Any response to that objection? You want
24 to move it?

25 MR. REYNOLDS: Well, yeah. I think it's

Transcript of Proceedings - October 10, 2012
Volume 4

528

1 relevant because the testimony about low frequency
2 noise, I think this witness has talked about that
3 it's not a big deal, and here we may have an answer
4 with respect to why there's a difference between the
5 wind turbines at Shirley, which are 2.5, and the
6 lack of low frequency symptoms at Glacier Hills,
7 which are less than 2, and the fact that this
8 witness thinks there are low frequency problems at
9 Shirley. So that the question is, well, we could
10 use the other turbine, but there's still within the
11 gamut of these larger turbines. So I think it's
12 relevant to that, and I -- I'm certainly willing to
13 give the -- my colleagues a chance to look at this.
14 I only had one copy. It came up, you know.

15 EXAMINER NEWMARK: Timing has been an
16 issue here. Do you guys have a response? Clean?

17 MS. NEKOLA: Just -- it's the same
18 response. We haven't had a chance to look at this.
19 Mr. Hessler hasn't seen it for a long time, and I
20 don't see the relevance. I'm confused really what
21 you're trying to do here.

22 MR. REYNOLDS: Difference between Glacier
23 Hills and Shirley is --

24 EXAMINER NEWMARK: I'm going to leave it
25 out.

Transcript of Proceedings - October 10, 2012
Volume 4

529

1 MR. REYNOLDS: Okay.

2 EXAMINER NEWMARK: We're not going to put
3 it in, and I think he's actually answered these
4 questions anyway. It's already on the record, so it
5 would be repetitive at this point. And let's move
6 on.

7 MS. NEKOLA: Can we go off the record a
8 minute?

9 (Discussion off the record.)

10 EXAMINER NEWMARK: All right. Back on the
11 record. Do you have anything else?

12 MR. SCRENOCK: No.

13 EXAMINER NEWMARK: All right. I had some
14 questions, but at the risk of opening up another
15 whole round of cross, I'll forgo it.

16 Any redirect?

17 MS. BRANT: Yeah, we have some redirect.

18 REDIRECT EXAMINATION

19 BY MS. BRANT:

20 Q Mr. Hessler, you talked with Ms. Bensky about your
21 Exhibit 3 in this proceeding?

22 A Yes. Uh-huh.

23 Q Can you just clarify for us the purpose of Exhibit 3?

24 A Yeah. It was just to give a generic example of
25 actual measurements of wind turbine sound compared to

Transcript of Proceedings - October 10, 2012
Volume 4

530

1 modeling using three different ground absorption
2 coefficients.

3 MS. NEKOLA: That's all we have.

4 MS. BRANT: That's all we have.

5 EXAMINER NEWMARK: All right. You're
6 excused. Thanks very much.

7 (Witness excused.)

8 EXAMINER NEWMARK: Okay. So we can get
9 into Forest Voice. Okay. We need to call
10 Mr. Horonjeff?

11 MS. BENSKY: Uh-huh.

12 EXAMINER NEWMARK: Let's go off the
13 record.

14 (Call placed to Mr. Horonjeff.)

15 RICHARD HORONJEFF, FOREST VOICE WITNESS, DULY SWORN

16 EXAMINER NEWMARK: Go ahead.

17 DIRECT EXAMINATION

18 BY MR. McKEEVER:

19 Q Good afternoon, Mr. Horonjeff. This is Peter
20 McKeever.

21 A Hi, Peter. How are you?

22 Q Just fine. Thank you. Thank you for your patience
23 in waiting a couple of days to have your moment in
24 the sun here.

25 A Not a problem.

Transcript of Proceedings - October 10, 2012
Volume 4

531

1 Q Would you please state your name for the record.

2 A First name is Richard. Last name is Horonjeff

3 spelled H-O-R-O-N, as in Nancy, J-E-F-F, as in Frank.

4 Q And what is your business address, please?

5 A 81 Liberty Square Road, Number 20B, as in boy, in

6 Foxborough, F-O-X-B-O-R-O-U-G-H, Massachusetts. And

7 the zip is 01719.

8 Q Thank you. Have you prepared and filed some

9 direct -- I'm sorry -- rebuttal and surrebuttal and

10 sur-surrebuttal testimony in this matter?

11 A I have submitted direct and surrebuttal, but not

12 sur-surr.

13 Q And have you also submitted a report as an exhibit to

14 one of those -- one of that testimony?

15 A Yes, I have.

16 Q And if you were to be asked those same questions

17 today, would your answers be the same?

18 A They would.

19 Q And was that testimony that you provided, it was

20 truthful and accurate?

21 A To the best of my knowledge, yes.

22 Q And those opinions that you made, were those made to

23 a degree of scientific certainty -- reasonable degree

24 of scientific certainty?

25 A Yes, they were. Yes, they were.

Transcript of Proceedings - October 10, 2012
Volume 4

532

1 MR. McKEEVER: Thank you. Dr. Horonjeff
2 is available for cross-examination.

3 EXAMINER NEWMARK: Okay. I just wanted to
4 check. He had three exhibits, right? You mentioned
5 one study as an exhibit, but he filed three
6 different exhibits?

7 MR. McKEEVER: He filed three exhibits.
8 One is his resume.

9 EXAMINER NEWMARK: Okay. Yeah. All
10 right.

11 Any cross? Go ahead.

12 CROSS-EXAMINATION

13 BY MR. WILSON:

14 Q Good afternoon, Mr. Horonjeff. I'm John Wilson. I'm
15 representing the Applicant in the proceeding.

16 A Good afternoon, Mr. Wilson.

17 Q Can you hear me okay?

18 A Yeah, I can hear you just fine. Thank you.

19 Q Okay. Can you turn to your Exhibit 3?

20 A Oh, let me just see. Exhibit 3 is which one? In my
21 report?

22 Q No. That's your summary -- your table summarizing
23 proposed and existing wind turbine installations in
24 which you provided written comment or testimony.

25 A I'm looking for that right now. You have to pardon

Transcript of Proceedings - October 10, 2012
Volume 4

533

1 me for a moment. I've got a notebook of double-sided
2 material that's filling a one-and-a-half-inch binder.
3 Okay. Tell me again which --

4 Q Your Exhibit 3.

5 A Exhibit 3?

6 EXAMINER NEWMARK: Let's go off the
7 record.

8 (Discussion off the record.)

9 EXAMINER NEWMARK: Let's get back on the
10 record.

11 Go ahead.

12 BY MR. WILSON:

13 Q It appears, Mr. Horonjeff, that -- that for these
14 examples where you provided written comments or
15 testified, that in most cases you produced a letter
16 report?

17 A That is correct.

18 Q And do I take it from your testimony that some of
19 these you testified for and some of them you did not?

20 A That is correct.

21 Q Which ones did you testify for?

22 A Just the Glacier Hills.

23 Q So the remainder of these were letter reports?

24 A That is correct.

25 Q Can I have you turn to page 16 of your direct

Transcript of Proceedings - October 10, 2012
Volume 4

534

1 testimony.

2 A Let me pull that up.

3 EXAMINER NEWMARK: Okay. Did he file
4 direct, or start with rebuttal?

5 MS. BENSKY: It's rebuttal.

6 MR. WILSON: I'm sorry. Your rebuttal
7 testimony.

8 THE WITNESS: Okay. Hold on. Okay. So
9 you said page --

10 MR. WILSON: 16.

11 THE WITNESS: 16.

12 BY MR. WILSON:

13 Q And I'd like to draw your attention to the answers --
14 the answer on lines 8 through 13.

15 A Lines 8 through 13, got it.

16 Q Take a moment and review that and let me know when
17 you've had a chance to review it.

18 A I have reviewed it.

19 Q Okay. My question for you is, for the items listed
20 on your Exhibit 3 where you provided letter reports
21 or testified, was your ultimate recommendation in
22 each of those cases consistent with your
23 recommendation on page 16, lines 8 through 13?

24 A I believe it was. I would have to look at each of
25 those individually, but I -- I have no reason to

Transcript of Proceedings - October 10, 2012
Volume 4

535

1 believe that it would not have been.

2 Q And as a consultant, you would -- typically do not
3 represent developers; is that true?

4 A That is correct.

5 Q Okay. I took a look at your resume in Exhibit 1, and
6 I just -- I just wanted to confirm that you don't
7 have any formal medical or health-type training or
8 degree?

9 A That's correct.

10 Q Mr. Horonjeff, are you familiar with the PSC staff
11 sound protocol?

12 A I have read through it, yes.

13 Q And do you have a view as to whether the Applicant
14 sound studies are consistent with that protocol?

15 A In terms of the process that they followed, is that
16 your question?

17 Q Yes.

18 A Yeah. It would appear to me that the process that
19 they followed did indeed follow the PSC 128 protocol.

20 Q Okay. So I'm looking at page 6 of your testimony,
21 lines 1 through 3.

22 A Same document?

23 Q Yes.

24 A Okay. Let me go to page 6 here. Okay. And you want
25 me to look at line 3?

Transcript of Proceedings - October 10, 2012
Volume 4

536

1 Q 1 through 3.

2 A Yes.

3 Q So is your criticism here, are you looking for
4 additional data that would be outside of the PSC
5 sound protocol?

6 A Essentially that is -- that is correct, yes.

7 Q On that same page at line 20.

8 A Yes.

9 Q It looks to me as if you're estimating here that
10 there was self-noise at about approximately 20 dBA?

11 A I -- that is not correct. I had said that I have
12 estimated the ambient sound level to be 20 dBA less.

13 Oh, oh. I'm sorry. I misread my own
14 sentence here. You are correct that I have estimated
15 from the information provided in the Applicant sound
16 report that there were times when the sound -- the
17 ambient sound level could drop to 20 dBA or less.

18 Q Okay. So that statement is not based upon any data
19 that you collected?

20 A That is correct.

21 Q In fact, you haven't collected any data at all, have
22 you?

23 A On this project, no.

24 Q Have you visited the site?

25 A No, I have not.

Transcript of Proceedings - October 10, 2012
Volume 4

537

1 Q If I could draw your attention to page 12, lines 10
2 and 11.

3 A I have it.

4 Q I take it given your earlier testimony that you don't
5 have any medical or health background, that your
6 testimony here is from a layperson's perspective?

7 A That is correct.

8 Q I'm looking at the last page of your testimony now,
9 Mr. Horonjeff, at --

10 A That -- that would be page 17, correct?

11 Q Yes. And I'm looking at your testimony that you
12 believe a reasonable margin of safety could be
13 achieved using a setback distance criterion equal to
14 at least 1.5 to two miles; is that correct?

15 A That is correct.

16 Q Yet your recommendation on page 16 recommends one
17 mile.

18 A That's true. The basic difference between those two
19 pages is that on the last page I include a margin of
20 safety, a specific margin of safety.

21 Q Is that 1.5 to two miles in addition to the one mile
22 that you mention on page 16?

23 A No. No, it is not in addition. It is the total.

24 Q Okay. So in an ideal world, would you recommend that
25 the setbacks be 1.5 to two miles?

Transcript of Proceedings - October 10, 2012
Volume 4

538

1 A That is correct.

2 MR. WILSON: I believe that's all I have.

3 Thank you.

4 EXAMINER NEWMARK: Okay. Other questions?

5 MR. REYNOLDS: Nope.

6 EXAMINER NEWMARK: No. Redirect?

7 MR. McKEEVER: No.

8 EXAMINER NEWMARK: All right, sir. You're
9 excused. Thanks very much for your participation.
10 I'm going to disconnect now.

11 THE WITNESS: Okay. My pleasure. Thank
12 you very much.

13 (Witness excused.)

14 EXAMINER NEWMARK: Anyone else for Forest
15 Voice?

16 MS. BENSKY: No.

17 EXAMINER NEWMARK: Town of Forest, you're
18 next.

19 MR. REYNOLDS: Oh, okay. You want to
20 cross Wes Slaymaker?

21 MR. WILSON: No.

22 MR. LORENCE: Do you want to stipulate to
23 his testimony?

24 MR. REYNOLDS: He's here.

25 WES SLAYMAKER, TOWN OF FOREST WITNESS, DULY SWORN

Transcript of Proceedings - October 10, 2012
Volume 4

539

1 EXAMINER NEWMARK: Okay.

2 DIRECT EXAMINATION

3 BY MR. REYNOLDS:

4 Q Could you state your name, please.

5 A Wes Slaymaker, S-L-A-Y-M-A-K-E-R.

6 Q And Mr. Slaymaker, you filed some direct testimony in
7 this case?

8 A That's correct.

9 Q Is it true and correct to the best of your knowledge?

10 A It is.

11 MR. REYNOLDS: All right. That's it.

12 EXAMINER NEWMARK: Okay. You're excused.

13 (Witness excused.)

14 EXAMINER NEWMARK: All right. Who's next?

15 MR. REYNOLDS: Dr. SCHOMER.

16 PAUL SCHOMER, TOWN OF FOREST WITNESS, DULY SWORN

17 EXAMINER NEWMARK: Okay.

18 DIRECT EXAMINATION

19 BY MR. REYNOLDS:

20 Q Can you state your name, please.

21 A Paul Schomer.

22 Q All right. And have you filed testimony in this
23 case?

24 A Yes.

25 Q All right. In the form of direct?

Transcript of Proceedings - October 10, 2012
Volume 4

540

1 A Yes.

2 Q And rebuttal?

3 A Surrebuttal.

4 Q Yeah, whatever.

5 A Yes.

6 Q Did you bring that testimony with you?

7 A I did not.

8 Q All right. And since giving that testimony, have you
9 received other information such as Roberts
10 surrebuttal or listening to the testimony of
11 Mr. Hessler? Do you have anything to add to that
12 testimony that you've already given in written form?

13 A I would have comment on what Mr. Hessler said this
14 morning.

15 Q All right.

16 A That would be all.

17 Q Go ahead.

18 A There's two points I would make very briefly and very
19 simply. One has to do with the pseudo-noise, and
20 he's talked about it. We've talked about it a lot.
21 It's a very important issue in terms of being able to
22 measure things around a wind farm, and Mr. Hessler's
23 introduced it. He and his father did a study which
24 was published in NCEJ, which he referred to this
25 morning.

Transcript of Proceedings - October 10, 2012
Volume 4

541

1 And when you're dealing with wind noise --
2 I'm going to try to make this very simple -- there's
3 two kinds of turbulence. Turbulence is the air
4 moving around for one reason or another. One kind of
5 turbulence is just like the -- if you put a stick in
6 water, a stream, and you see the line go out behind
7 the stick, and that's called wake turbulence because
8 it's just like a wake from a boat.

9 And there's another kind of turbulence
10 called intrinsic turbulence. This is the air moving
11 around on its own, heating the air against the ground
12 or being turned over by buildings nearby or stones or
13 shrubbery or whatever makes the air mixed up and not
14 steady. So there's these two kinds of turbulence
15 that is pseudo-noise, and this is what we're trying
16 to get rid of so that we can make measurements that
17 are accurate.

18 Q Okay. So what's your comment on Mr. Hessler's
19 comment?

20 A The comment is that Mr. Hessler and his father
21 measured only the wake turbulence in the wind tunnel
22 because it was very smooth flow. It didn't have
23 intrinsic turbulence, and the intrinsic turbulence is
24 the much more dominating factor. And so the numbers
25 he quotes for -- for what turbulence causes are quite

Transcript of Proceedings - October 10, 2012
Volume 4

542

1 low compared to what you measure in reality.

2 Q All right. And how is that relevant to what we're
3 considering here?

4 A That's relevant in the difference between the level
5 of the turbine noise and the level of the background,
6 that the level of the turbine compared to the level
7 of the background exceeds 10 dBA. It's not less than
8 10 dBA.

9 Q And why is that important?

10 A That is -- 10 dBA is thought of when you start to
11 have serious problems with a new noise source
12 compared to what was existing. And so this
13 exceedance is significant, and the numbers presented
14 by Mr. Hessler are identical to what has been
15 published for just the total pseudo-noise.

16 Q All right. Do you have any comments on the issue of
17 low frequency sound emanated from large turbines
18 defined as above 2.3 megawatts versus low turbines,
19 smaller turbines, less than 2 megawatts?

20 A I would expect in just about any machine, as the
21 machine gets bigger, the dimensions get bigger. It's
22 how it couples energy out of it. As the sound
23 radiated will get bigger, which means the wavelength
24 is longer. The fundamental dimension to the sound
25 gets bigger, which means it's lower frequency. This

Transcript of Proceedings - October 10, 2012
Volume 4

543

1 would -- I would expect from any machine, and I'm not
2 surprised to see the data for this machine go that
3 way.

4 Q And would that explain the wide or rather consistent
5 complaints of health effects from the residents at
6 Shirley that have 2.5 megawatt machines as opposed to
7 other wind farms?

8 MR. WILSON: I'm going to object to that
9 question to the extent that it goes to health
10 impact. I don't think he's qualified as a health
11 expert.

12 EXAMINER NEWMARK: Okay. I'll sustain
13 that.

14 BY MR. REYNOLDS:

15 Q You have given testimony on the -- do you have
16 information about the relative impacts of low
17 frequency sound on health?

18 A Yes.

19 MR. WILSON: Objection.

20 MR. REYNOLDS: This has been the part of
21 it. He's testified to this. We've had Mr. Hankard
22 who testified about annoyance versus health.

23 EXAMINER NEWMARK: The first question, did
24 you say complaints or did you say health?

25 MS. BENSKY: That was just a foundational

Transcript of Proceedings - October 10, 2012
Volume 4

544

1 question.

2 MR. REYNOLDS: Yes. Exactly.

3 EXAMINER NEWMARK: That's fine. Let him
4 answer.

5 THE WITNESS: What question am I answering
6 now?

7 EXAMINER NEWMARK: None. Let him think.

8 BY MR. REYNOLDS:

9 Q All right. There has been testimony about -- from
10 the Shirley Wind residents who have machines that are
11 2.5 megawatts, and then we've had testimony about --
12 from complaints that -- that are more of the sleep
13 category as opposed to the nausea, headache, earache
14 category, okay? You've given testimony that the
15 infrasound impacts to human health focus on those
16 kinds of symptoms like headache, nausea, vertigo,
17 feeling of ill at ease, right?

18 A Yes.

19 Q Would the size of the turbines at Shirley and its
20 likely higher production of low frequency noise have
21 a potential explanation for why the folks at Shirley
22 are having such difficulty?

23 A I think it's a potential explanation, but I think I
24 could come up with -- there's other explanations
25 maybe. But that's certainly a potential explanation.

Transcript of Proceedings - October 10, 2012
Volume 4

545

1 Q All right. Well, the whole -- the point of this
2 hearing is to try to determine whether the project as
3 designed for the Town of Forest is -- is appropriate.

4 A Yes.

5 Q And size of turbines is one factor?

6 A It is a factor.

7 Q What else?

8 A I think that -- that the -- to me, one of the
9 important factors has been the nature of the
10 community being somewhat unique. This is -- the
11 basic things that have been talked about here are
12 most important. The testimony you had yesterday,
13 although I was not here, I've heard that kind of
14 thing before, and I think that the issue before us is
15 whether that's going to continue. The people are
16 being taken out of their homes by the sound. This is
17 not new. As I've pointed out in my testimony, this
18 has been going on for 30 years, not with wind farms
19 but with low frequency noise, and especially
20 pulsating noise.

21 The notion that wind farms is somehow
22 different is just not -- makes sense. And that we
23 know and we've known for years that these same
24 symptoms have occurred over time with different kinds
25 of sources of low frequency sound, and the result is

**Transcript of Proceedings - October 10, 2012
Volume 4**

546

1 always the same. There's a fraction of the
2 population, we don't think it's a large fraction,
3 that has these symptoms to the point where some are
4 driven out of their homes.

5 EXAMINER NEWMARK: Okay. Sir, I think
6 wasn't the question what -- what was your question,
7 what things can be done to prevent this, to reduce
8 this?

9 MR. REYNOLDS: Yes.

10 BY MR. REYNOLDS:

11 Q Okay. So there are -- in your view, you've made a
12 recommendation that if this project is -- is -- is
13 approved, that the -- that the noise limits be
14 reduced?

15 A I have made a recommendation that the noise limits be
16 reduced and that the -- I have made a recommendation
17 that the prediction based upon the average is not
18 consistent with what's been put together as the
19 procedures in Wisconsin.

20 Q All right. Explain that.

21 EXAMINER NEWMARK: Well, is this in his
22 testimony already? He said he explained this.

23 MR. REYNOLDS: All right. Yeah.

24 EXAMINER NEWMARK: Okay.

25 BY MR. REYNOLDS:

Transcript of Proceedings - October 10, 2012
Volume 4

547

1 Q Well, let me ask you this. We've been talking about
2 average noise limits and maximum noise limits.

3 A Correct.

4 Q What are the limits that we should be shooting for
5 here?

6 A Well, what I think about always is are things
7 logical, is this what was meant. And as I understand
8 it in Wisconsin and in this proceeding, people have
9 said there's a 45 dB nighttime limit, and it has to
10 be designed for 100 percent of the houses, the homes
11 of nonparticipating residents meet 45 dB. It
12 wouldn't be acceptable for 50 percent of the homes to
13 meet 45 dB.

14 And then I ask the question, if 100
15 percent of the homes have to meet 45 dB, how can you
16 have 100 percent of the homes meeting it half the
17 time is somehow different than half the homes meeting
18 it all the time. To me the two are the very same
19 thing, just on a basis of logic that if you have a
20 rule of 45 dB, it should be that way. You can't have
21 it -- it's met half the time at all the houses but
22 it -- the two are the same.

23 Q So is that the -- is your recommendation for a 39 dB
24 limit designed then to make sure that the maximum
25 doesn't exceed 45?

Transcript of Proceedings - October 10, 2012
Volume 4

548

1 A No. I was saying that we should model using zero at
2 a minimum, model using zero as the modeling rather
3 than .5.

4 Q Okay.

5 A So that there is -- you get closer to this
6 realization that you have a limit met all the time at
7 all the houses and not -- well, all the time at some
8 of the houses you wouldn't permit, but some of the
9 time at all the houses is permitted. And the two are
10 identical, so it's difficult to understand the
11 distinction.

12 Q So when you first looked at this, the model that you
13 looked at in the application was based upon a zero
14 coefficient?

15 A The original material presented, I think it was
16 called Appendix V as I recall, had zero for the
17 modeling.

18 Q And you thought that was an appropriate number?

19 A I believe that is an appropriate number.

20 Q And why be conservative in modeling?

21 A Well, one of the reasons I came to this -- two
22 reasons I come to this. One is the one I've just
23 illuminated, that if you have a rule that all the
24 houses meet it and then you say half the time, and
25 then you say but you can't have -- it's met 100

Transcript of Proceedings - October 10, 2012
Volume 4

549

1 percent of the time at half the houses, there's no
2 logic there.

3 The other reason is that this is supposed
4 to be done in terms of the ISO standard. People say
5 we're applying ISO 9613, and ISO 9613 calls for --
6 if you follow it, it says we're making a
7 conservative prediction and that the only
8 permissible way and to say you're using 9613 is to
9 make the prediction, and then if you want to have a
10 time average according to ISO 9613, there's a
11 specific procedure in the standard for doing that,
12 and that's not being followed.

13 So I do it on the basis of logic, of what
14 the rule is, and I've come to that conclusion on the
15 basis of following the standards, which have not
16 been followed.

17 Q So is it -- is it fair to say that a conservative
18 model will err, if at all, on the side of public
19 safety?

20 A I wouldn't call it erring, but it will certainly be
21 on the side of public safety.

22 MR. REYNOLDS: Okay. That's all I have.

23 EXAMINER NEWMARK: Okay. Other questions?

24 CROSS-EXAMINATION

25 BY MR. WILSON:

Transcript of Proceedings - October 10, 2012
Volume 4

550

1 Q Mr. Schomer, have you visited the site?

2 A No.

3 Q So that means you haven't taken any data at the site?

4 A No.

5 Q You testified in response to some questions from
6 Mr. Reynolds that the nature of this community was
7 very unique. If you haven't been to the site, how
8 can you understand whether this community is unique
9 or not?

10 A I find the unique factor in the activities this
11 community has engaged in in terms of trying to
12 maintain the quiet, rural nature of the community,
13 and I find that to be similar to situations I've seen
14 in other parts of the country where that kind of
15 community existed, and I've seen very unique
16 reactions when that exists.

17 Q So if I understood your testimony, what's unique
18 about this community is that they're -- at least some
19 people in the community are fighting the project?

20 A No. I said that in the testimony I've read that's
21 been put in place in this, that this community has a
22 land use plan of some kind. I don't profess to be a
23 planner and get all the terms right, but that this
24 community has gone out and said we want to maintain
25 the quiet, rural nature of this community, we don't

Transcript of Proceedings - October 10, 2012
Volume 4

551

1 want to plan for industry, we want a plan for
2 five-acre homes and the maintenance of farms. That's
3 where they're unique.

4 And the similarity I find that was I --
5 plans that the FAA tried to implement some probably
6 25 or 30 years ago, and probably the one example I
7 can think of where the FAA was eventually stopped by
8 Congress because of the uproar. And I find this --
9 the dynamics of this community to be along those
10 lines.

11 Q So you've reviewed the comprehensive plan for the
12 Town of Forest?

13 A I've reviewed the testimony.

14 Q But you haven't reviewed the plan?

15 A I've not reviewed the document, no.

16 Q Are you familiar with the fact that in Wisconsin,
17 most local communities have to do some type of
18 comprehensive plan by law?

19 A Yes.

20 Q Okay. So they're not unique from that perspective?

21 A No.

22 Q Okay. You don't have any medical training; is that
23 right?

24 A That's correct.

25 Q You have an engineering degree?

Transcript of Proceedings - October 10, 2012
Volume 4

552

1 A Correct.

2 Q So if you take a look at page 2 of your direct
3 testimony. You have a copy of your testimony with
4 you?

5 A I wasn't asked to bring them, so I am at the mercy of
6 somebody to give me a copy.

7 MR. REYNOLDS: What do you want, direct?

8 MR. WILSON: For the time being, yes.

9 MR. REYNOLDS: All right.

10 MR. WILSON: He'll need sur, too.

11 MR. REYNOLDS: He is on direct.

12 THE WITNESS: All right. Page 2.

13 BY MR. WILSON:

14 Q Line 17 and 18, I find within a reasonable degree of
15 engineering certainty that there will be significant
16 health impacts. Can you explain to me the
17 relationship between engineering and health impacts?

18 A I think that we've heard Mr. Hessler testify, and I
19 think that on the same basis we have been observing
20 and learning about these problems for many years.
21 And, no, we're not going to give prescriptions out
22 and -- but we understand better the acoustics and the
23 physics, and I think that there's a shared burden to
24 do these things properly, but we are part of the
25 team.

Transcript of Proceedings - October 10, 2012
Volume 4

553

1 Q Okay. Are you saying that -- you've already
2 testified you're not a health expert; is that
3 correct?

4 A I have testified, and I'm certainly not trained as a
5 health expert.

6 Q Are you a health expert?

7 A I think I understand something about the health
8 effects of noise from the literature that I follow.
9 Does that say I'm a doctor, no.

10 MR. WILSON: Did you give him his sur?

11 MR. REYNOLDS: He's got it.

12 BY MR. WILSON:

13 Q So at page 11 of your sur, you're talking about your
14 conclusion that the 0.00 contour is appropriate?

15 THE WITNESS: I have to ask for page 11 of
16 the sur.

17 MR. REYNOLDS: I'm sorry?

18 THE WITNESS: The surrebuttal.

19 MR. REYNOLDS: It's right there.

20 THE WITNESS: It is?

21 MR. REYNOLDS: Yeah. It's all tabbed
22 together.

23 THE WITNESS: Oh, right behind that?

24 MR. REYNOLDS: Yep.

25 THE WITNESS: Okay. That should be easy.

Transcript of Proceedings - October 10, 2012
Volume 4

554

1 Page 11.

2 MR. WILSON: Yes.

3 BY MR. WILSON:

4 Q So at 11 there, you are testifying at line 15 about
5 the appropriateness of the zero contour, correct?

6 A Correct.

7 Q And you would agree that that contour is the most
8 conservative possible?

9 A It's the most conservative possible using 9613.

10 Q Okay. Now, if we could go back to your direct
11 testimony on page 9. On page 9 in the middle of the
12 page there you're describing your Exhibit 2, which
13 is, you know, the results of you running a model, and
14 in this case you used -- you used both zero and .5;
15 is that correct --

16 A Yes.

17 Q -- to produce Exhibit 2?

18 A That is true.

19 Q Okay. And reviewing your testimony here on page 9,
20 there's nowhere where you indicate in your direct
21 testimony here that using the .5 is inappropriate?

22 A At that point in time, we had not received the
23 operation of the source levels from proponent as
24 perhaps you recall, and I was trying to make sense
25 out of this with data that we had been able to

Transcript of Proceedings - October 10, 2012
Volume 4

555

1 collect off the internet, which were apparently
2 precursor data to the real data. And my whole
3 original testimony is somewhat screwed up because we
4 didn't have the source data that should have been a
5 part of the application.

6 Q Are you done?

7 A I'm saying I did the best I could given the data we
8 did and didn't have.

9 Q Fair enough.

10 A And I did analysis of .5, but the analysis I did of
11 .5 was equal to the zero case because the source data
12 that I found were that much higher.

13 Q Okay. But you used a ground factor of .5 in your
14 initial creation of Exhibit 2, correct?

15 A That was one of the numbers I looked at.

16 Q Okay. And why did you not at that time use zero for
17 the entire run to create Exhibit 2?

18 A As I just told you, I was trying to figure out what
19 was going on because I could not understand even what
20 was being recommended by proponent, whether it was
21 zero or .5, what the data were that were to be used.
22 When I made my .5 predictions, they came out zero.
23 The zero predictions of the report, I didn't know if
24 the report was labeled wrong, whether there was 141
25 houses as Mr. Hessler criticized my report for. It

Transcript of Proceedings - October 10, 2012
Volume 4

556

1 was just -- would have been much better if we had the
2 source data.

3 Q Okay. You have a fundamental belief that these
4 models should be run using the zero contour, correct?

5 A I think that that's something that I thought about.
6 I've not articulated it.

7 Q But you articulated it in your testimony?

8 A In this. Not up until here. I have -- I've come to
9 that conclusion for Wisconsin for two reasons. One
10 is because the standard that you say is being used
11 calls for it. And the second is, when I read the
12 rule, or as I understand the rule, and I have read
13 the rule, there just doesn't seem to be a difference
14 between the application two different ways. I have
15 made predictions using the annual average for sources
16 that call for that specifically. When you make
17 predictions for an airport, it calls for the annual
18 average. When you make predictions for a highway,
19 these are called for. I didn't see that they were
20 called for here. I saw a different kind of thing.

21 Q Okay. So you testified that you just recently came
22 to the conclusion that zero is appropriate only here
23 in Wisconsin; is that correct?

24 A No. I think it's probably a good idea all over, but
25 it's something that we haven't done in this country

Transcript of Proceedings - October 10, 2012
Volume 4

557

1 in transportation noise sources.

2 Q Okay. But this was a recent revelation that you've
3 had; is that correct?

4 A This actually occurred serendipitously. I was asked
5 to give a lecture this coming November on ISO 9613.
6 And when I started to put the lecture together, I
7 realized that it was calling for this conservative
8 prediction and that indeed I had been misusing the
9 standard, and I was on the committee that wrote it
10 when it was written.

11 Q So does this revelation occur between the time that
12 you submitted your direct testimony and the time you
13 submitted your surrebuttal testimony?

14 A That part of it does, yes.

15 Q Yeah. So that explains why you were willing to use a
16 .5 in your direct testimony but not in your
17 surrebuttal testimony?

18 A No. The .5, as I've tried to say, is lots of reasons
19 for it being there. Part of it is I tried to
20 understand what was going on.

21 MR. WILSON: I think that's all we have.

22 EXAMINER NEWMARK: May or may not be. I
23 want to let you know before you stop, I've decided
24 to allow that Schomer page 6 on surrebuttal in.
25 Basically we have so many standards at this point in

Transcript of Proceedings - October 10, 2012
Volume 4

558

1 the record, and the studies we let in refer to WHO
2 and all kinds of European standards, day and night
3 standards. Let's just put it all in, and I'll give
4 you a chance to cross him on that if you need to.
5 None?

6 MR. WILSON: We're just fine with your
7 ruling.

8 EXAMINER NEWMARK: All right. Any other
9 questions?

10 MS. BENSKY: I have a few.

11 CROSS-EXAMINATION

12 BY MS. BENSKY:

13 Q We've talked a lot about this ISO 9613 standard. You
14 said you were on the committee that wrote it?

15 A Correct.

16 Q Mr. McKeever is passing them out to everyone so I
17 think it will be helpful to --

18 A I can't hear so well at my -- you have to speak up a
19 little bit.

20 Q You spent too much time around wind turbines? Sorry.
21 That was a joke. It was funny.

22 So you've just been handed a piece of
23 paper. Is this the international standard 9613-2
24 that you helped create?

25 A Yes.

Transcript of Proceedings - October 10, 2012
Volume 4

559

1 Q And this was designed in 1996, correct?

2 A This was first edition it says 1996, December 15th.

3 Q And has it been revised since then?

4 A No.

5 Q Was this standard designed specifically for wind
6 turbine noise?

7 A No.

8 Q And if you turn to page -- I don't know what page it
9 is -- the pages don't appear to be numbered. If you
10 turn five pages in, it says acoustics.

11 A Okay. Maybe you have a clause number.

12 Q Part 2, acoustics attenuation of sound during
13 propagation outdoors. It's the fifth page in.

14 A I'm not sure I know what -- there's Clause 2 is the
15 following -- there's normative references. Are you
16 in the --

17 EXAMINER NEWMARK: I think you have it
18 right in front there.

19 THE WITNESS: Part 2, yes. That's all
20 dealing with Part 2. Part 1 is air absorption,
21 tables of air absorption.

22 EXAMINER NEWMARK: Can I have that back,
23 please? I'm going to follow along.

24 THE WITNESS: Okay. Part 2.

25 BY MS. BENSKY:

Transcript of Proceedings - October 10, 2012
Volume 4

560

1 Q And there are two columns on this page, and the
2 right-hand column, the second paragraph beginning
3 with the word, this method is applicable. Do you see
4 where I am? That's on the right-hand column near the
5 top.

6 A This method is applicable, yes.

7 Q Uh-huh. And it says, it is applicable directly or
8 indirectly to most situations concerning road or rail
9 traffic, industrial noise sources, construction
10 activities, and many other ground-based noise
11 sources. Is a wind turbine a ground-based noise
12 source?

13 A Probably not. There's no other standard to use.

14 Q So this is the best standard, but it's not quite
15 right?

16 A It's not going to be quite right.

17 Q But this standard specifically does not apply to
18 sound from aircraft and flight or blast waves from
19 mining, right?

20 A Okay. That was probably inserted by me.

21 Q Is one of the reasons why you are calling for using
22 this very conservative absorption coefficient because
23 of this limitation?

24 A That would be one of the reasons. We have -- we
25 studied in my laboratory air to ground versus ground

Transcript of Proceedings - October 10, 2012
Volume 4

561

1 to ground propagation by having one experiment where
2 we had 100-foot-high tower that we did sound
3 propagation measurements for, and then we had a
4 source on the ground that we did the propagation
5 measurements for, and the difference of 100-foot-high
6 tower versus on the ground was -- oh, I've got
7 published papers on it. I don't know that I remember
8 the exact numbers. The levels -- the higher levels
9 are about the same, but they're three times more
10 often, then you're up 100 feet.

11 Q What happens if you're up 100 meters?

12 A It's going to possibly be even more frequent.
13 Possibly be the same. I guess that didn't answer
14 much, but that's the best I can do.

15 Q Well, the point is that we just don't know?

16 A Well, I know it won't be less, but I don't know
17 that -- I haven't reached the saturation or that it's
18 going to continue to grow.

19 Q Having this in your hand, and if you can do it very
20 quickly, can you point to other paragraphs that
21 encourage the model to be used in a conservative
22 manner?

23 A Say that again, please.

24 Q Well, you talked about after looking through this,
25 you realized that the intention was to obtain

Transcript of Proceedings - October 10, 2012
Volume 4

562

1 conservative results; is that correct?

2 A Yes.

3 Q And I'm asking you where in the document we should
4 look to get that information.

5 A Okay. That is one place. When it talks about the
6 cement, and I just have to find where it talks about
7 that. Well, in 3.2 in definitions it gives
8 equivalent continuous downwind octave band sound
9 pressure level, and downwind is a shorthand name for
10 sound -- propagated sound where it travels in the
11 louder manner. Because as everybody knows, you're
12 downwind outdoors, it's louder than if you're upwind,
13 and that's what the downwind means here, that you're
14 getting a prediction that's hearing-enhanced
15 propagation. So in 3.2, the definition of downwind
16 indicates this. And then it talks about predicting
17 the downwind. Let's see. I think on Equation 5 and
18 6 -- in 5 it talks about the downwind again.

19 EXAMINER NEWMARK: That's meteorological
20 conditions, number five? Is that where you're at?

21 THE WITNESS: No. I'm on Equation 5 on
22 the unknown page, but it's in the end of Clause 6.

23 EXAMINER NEWMARK: Oh.

24 THE WITNESS: And this is the basic
25 equation for using ISO 9613, and it talks about

Transcript of Proceedings - October 10, 2012
Volume 4

563

1 downwind. And as I said, if one wants to calculate
2 the long-term -- the long-term averages, if you look
3 at the bottom of just before you get to 7,
4 there's -- you go up two paragraphs, it says the
5 long-term average weighted sound pressure LAT,
6 paren, LT for long-term, shall be calculated
7 according to the equation there, and that's not been
8 done.

9 BY MS. BENSKY:

10 Q In this project?

11 A In this project.

12 Q And what's the significance of that?

13 A Well, this is the procedure that was designed in the
14 standard for going from downwind to long-term if
15 long-term wanted to be used. What this does is it
16 says that if you're up in the air, which is what I
17 just -- we know we are, they recognized when this was
18 written, they being -- this was really based upon a
19 German standard initially -- that when you have an
20 elevated source, you're going to get this high level
21 more of the time, as I said, three times as often,
22 which was a whole lot of the time from 100-foot high.
23 When you look at this case, this standard says that
24 you never have anything but the high levels from an
25 elevated source and that the -- the average that's

Transcript of Proceedings - October 10, 2012
Volume 4

564

1 used for other sources shouldn't be used for this
2 because it is elevated, and I think that's the
3 difference that comes in here.

4 MS. BENSKY: Thank you.

5 EXAMINER NEWMARK: Anything else?

6 MS. BENSKY: Briefly.

7 BY MS. BENSKY:

8 Q Is it necessary for you to visit a site to be able to
9 analyze data that was taken at that site?

10 A No.

11 Q Is this something that you do all the time in your
12 professional work?

13 A Well, I like to judge the people that have made the
14 measurements and have some feel for things, but I
15 would say that things that are done by Mr. Hankard or
16 Mr. Hessler, I believe the measurements in general.
17 Now, I've said that I thought he was wrong on the
18 empty pseudo-noise, but that's a separate thing.

19 Q And even though that you -- so, is your own
20 experimentation necessary to be able to reach the
21 opinions that you've reached in this case? Is it
22 necessary for you personally to conduct experiments
23 in order for you to reach the opinions that you have
24 reached in this case?

25 A No. As I've said, even if I had done studies that

Transcript of Proceedings - October 10, 2012
Volume 4

565

1 would be part of the team, that I think that nothing
2 is done by one person alone.

3 Q And in fact, whoever uses this model is to some
4 extent relying on your work, right?

5 A They're relying on my work. They're relying on the
6 Deutsches In -- DIN, Deutsches Institut fur Normung.

7 Q So even though you've not been to the site, and even
8 though you haven't done your own experimentation, can
9 you still state the opinions that you stated in this
10 case to a reasonable degree of scientific certainty?

11 A Yes, I do.

12 MS.

13 MS. BENSKY: Thank you.

14 EXAMINER NEWMARK: Okay. Other questions?

15 REXCROSS-EXAMINATION

16 BY MR. WILSON:

17 Q Just a couple questions following up on ISO 9613-2.
18 When you testified earlier that you were implementing
19 a method incorrectly, was it this method that you
20 were --

21 A I'm sorry? I don't quite follow the question.

22 Q Well, you told me -- you told me before when I was
23 asking you questions that you had this recent
24 epiphany which is the result now of using -- you're
25 saying you use the zero ground contour, and you told

Transcript of Proceedings - October 10, 2012
Volume 4

566

1 me that up until recently something had been -- had
2 been implemented improperly by yourself as well.

3 A Yes. I had forgotten. I don't -- you know, I don't
4 use 9613 that often. It's used for this, but it's
5 not used -- I use 9613 for this, and I use it for
6 small arms ranges occasionally.

7 Q Okay.

8 A But when you're doing airports or highways or other
9 things, there's models put out by the DOT for those
10 kinds of sources. So if you do general work, which I
11 do in all kinds of noise areas, you use different
12 things at different times. What I was saying is
13 until I had looked over this to prepare this lecture
14 for Brazil when I'll be there, I remembered that this
15 was for the downwind situation, which is also called
16 for in ISO 1996, which I do know because I'm chairman
17 of that committee.

18 Q Okay. I just have one other question for you. Have
19 you done any studies that implement this standard
20 with your new recollection against actual sound
21 measurements to be able to tell whether it's a good
22 fit?

23 A Well, you're not looking for a good fit. When
24 you're --

25 Q That's not my -- my question is this, have you

Transcript of Proceedings - October 10, 2012
Volume 4

567

1 compared your calculations using this method against
2 actual sound measurements with your recent
3 recollection that you've got to do in a certain way?

4 A Well, of course I haven't.

5 MR. WILSON: Thank you. That's all.

6 EXAMINER NEWMARK: Okay. Redirect?

7 MR. REYNOLDS: Just a couple questions.

8 MR. LORENCE: Your Honor --

9 EXAMINER NEWMARK: Oh.

10 MR. LORENCE: -- I may have a question
11 before we get to redirect.

12 MR. REYNOLDS: Sorry. Go ahead.

13 EXAMINER NEWMARK: While you're doing
14 that, I was going to take a minute. Did we verify
15 his testimony?

16 MR. REYNOLDS: If I didn't -- I thought I
17 did.

18 EXAMINER NEWMARK: Did you? You know
19 what, just do it again just in case because I don't
20 remember.

21 FURTHER DIRECT EXAMINATION

22 BY MR. REYNOLDS:

23 Q Dr. Schomer, do you verify that the rebuttal or
24 surrebuttal that you've given, or direct and
25 surrebuttal, is true and correct?

Transcript of Proceedings - October 10, 2012
Volume 4

568

1 A Yes.

2 MR. REYNOLDS: Okay.

3 EXAMINER NEWMARK: And these Exhibits 1
4 through 4 as well?

5 MR. WILSON: Your Honor, I think given the
6 discussion of this document, it probably ought to go
7 in as an exhibit.

8 MR. McKEEVER: Yes.

9 MR. LORENCE: I'm going to ask a couple
10 questions on it, so you may want to hold off on
11 that.

12 EXAMINER NEWMARK: Okay. Let me just have
13 him answer. Are Exhibits 1 through 4 -- sir?
14 Mr. Schomer, Exhibits 1 through 4, were they
15 filed -- are they correct to the best of your
16 knowledge?

17 THE WITNESS: I'm sorry?

18 EXAMINER NEWMARK: Your Exhibits 1 through
19 4, are they correct to the best of your knowledge?

20 THE WITNESS: Yes.

21 EXAMINER NEWMARK: Okay. Thanks.

22 All right. Commission staff.

23 CROSS-EXAMINATION

24 BY MR. LORENCE:

25 Q Dr. Schomer, on page 12 of your surrebuttal

Transcript of Proceedings - October 10, 2012
Volume 4

569

1 testimony, and I'm looking on lines 6 through 8.

2 A Uh-huh. I guess I'm not fast enough. All right. I
3 got to page 12.

4 Q On lines 6 through 8 you say, ISO 1996 requires what
5 is termed "downwind" or weather-enhanced propagation
6 conditions so that model predictions are only
7 infrequently exceeded. Do you see that sentence?

8 A Yes.

9 Q I have never seen ISO 9613-2 before today. Could you
10 tell me where that's required in this -- in this ISO
11 9613?

12 A Those are the questions we just answered, but I can
13 go through it again.

14 Q Well, you talked about the downwind stuff, but you
15 say it says that it's only infrequently exceeded, and
16 I'm wondering if it says that in here anywhere?

17 A That's what the downwind nomenclature means, and I
18 believe it's in either 9613 -- I know it's in either
19 9613 or in 1996, which 9613 incorporates by
20 reference.

21 Q I have one more question, and again this shows my
22 complete ignorance on this standard. In Section 7.3,
23 that's called ground effects, and again there's not a
24 page number here, but if you could turn to that.

25 A Okay. 7.3. 7.3, ground effects, yes.

Transcript of Proceedings - October 10, 2012
Volume 4

570

1 Q Is this section equivalent of the ground factor that
2 we've been talking about the last two days?

3 A This section is -- makes use of the ground factor.
4 It's not equivalent. This is where the ground factor
5 comes in. What you have is on the next page there's
6 graphs showing the -- what the sound propagation is
7 in different octave bands. And then in the
8 implementation there's a table on the next page,
9 Table 3, and in Table 3 if you look in there, there's
10 A sub S or A sub R in the middle column at the top,
11 and that's for the source or receiver region. We've
12 been talking about there's really three factors, the
13 .5 or the zero whatever. You have a factor for the
14 source region, a factor for the middle, and a factor
15 for the receiver region. And if you look at the
16 formulas under A sub R of the middle column, you'll
17 see a G. That's the ground factor that goes between
18 zero and 1.

19 Q And that's the ground factor we have been talking
20 about for two days?

21 A There's three of them technically: one for the
22 source, one for the receiver, and one for the middle.

23 Q So if we turn back one page where it begins with the
24 letter A, then it says hard ground.

25 A Hard ground, yes.

Transcript of Proceedings - October 10, 2012
Volume 4

571

1 Q That first paragraph ends -- it says, for hard ground
2 G equals zero. So this is the ground factor zero
3 that we've been talking about, correct?

4 A Correct.

5 Q And then for porous ground in B, it's G equals 1?

6 A Correct.

7 Q And then for mixed ground, it says it's someplace in
8 between zero and 1. Do you see that?

9 A I see that.

10 Q So this is the ground factor we've been talking about
11 here?

12 A Yes. But to understand that is a question that was
13 earlier. You've got a source up in the air and not
14 on the ground, so does this standard really apply.
15 And my answer was, it's the best we have, but you
16 can't apply it exactly the way you would if it was on
17 the ground because the source is as high in the air,
18 it changes what the propagation is. So that the
19 definition of what is hard and what is soft, you have
20 a source that's 100 meters in the air on average.
21 That's not on the ground as one of the other
22 counsel's pointed out.

23 Q But it has to get to the ground -- the sound has to
24 get to the ground eventually, doesn't it?

25 A It has to get to the ground eventually.

Transcript of Proceedings - October 10, 2012
Volume 4

572

1 Q And once it's on the ground, won't it travel along
2 the ground?

3 A No. It's only -- the only thing you have is an
4 effect of the microphone height at your receiver.
5 The other -- it doesn't -- it doesn't come down to
6 the ground and then travel across the ground like
7 this. It doesn't do that. What you're interested in
8 is the path that goes straight from this up in the
9 air source to your receiver, which may be near the
10 ground, but you don't have any other path. If you
11 do, it's because you don't have good propagation.
12 Then it's poor propagation conditions.

13 MR. LORENCE: Thank you. I have no
14 further questions.

15 MS. BENSKY: Your Honor, can I follow up
16 on that? This is really important, and I want to
17 make sure I understand.

18 RECROSS-EXAMINATION

19 BY MS. BENSKY:

20 Q So are you saying that if we have a flat -- if we
21 have a flat ground, if there's a source that's close
22 to the ground emanating sound, that sound can just go
23 and be absorbed in the ground, correct?

24 A Ground absorption -- what happens, and this is more
25 related to people's experience. You know, if we went

Transcript of Proceedings - October 10, 2012
Volume 4

573

1 through all the details, it would be complicated, but
2 I think people's experience is useful here. First of
3 all, the first rule is that if you're downwind, it's
4 louder than if you're upwind, and there's -- the
5 reason is the downwind, and this is going to seem
6 strange, we think of sound almost as rays, sound rays
7 rather than waves.

8 And let's put it this way. Let's say you
9 were behind the barrier. You expect it to be
10 quieter. It's quieter because there's no direct path
11 from the sound to you. It has to come around the
12 corner just like if you had a -- something to stop
13 the sun or a reflector of light. You go behind it,
14 it's not as light as in front of it. Sound is the
15 same thing. If you have a barrier or something that
16 prevents the sound from getting to you, it's quieter
17 than if you don't have that. Well, on a sunny day
18 and you're upwind, you don't hear things. But if
19 you're downwind, you do.

20 Another thing -- example, if you're out in
21 a boat, do you hear things far away out in a boat?
22 You've seen that? This is the hard surface of the
23 water, and frequently above the water there's a
24 temperature inversion because of the cooling and
25 heating of the water. And those two can form two

Transcript of Proceedings - October 10, 2012
Volume 4

574

1 layers that the sound gets trapped in, and then you
2 have very -- you hear the people whispering on the
3 shore, and it's like they're 10 feet away from you.
4 I'm sure many of you have experienced this. This has
5 to do with the propagation downwind versus upwind,
6 has to do with the propagation.

7 The physics is complicated, but the
8 effects -- same thing. Ever hear sources very early
9 in the morning? You wake up at 5:00 a.m. and you
10 hear a distant train or horns or the wheels? Have
11 you experienced that? That again has -- at that time
12 of day, you've got a direct path from the source,
13 which is -- you don't hear the rest of the day to
14 you. It has to do with the physics of the situation.

15 I'm not going to attempt to go into the
16 physics, but I'm trying to give you different
17 examples out of your daily life that show you this is
18 what goes on. We don't want to really go into the
19 details of what's going on.

20 Q So if there's a source up in the air that's emitting
21 sound, the sound's going to come down and it's going
22 to hit the receptor before it hits the ground and
23 absorbs; is that correct?

24 A It's going to hit the receptor directly. There will
25 be -- it gets confusing.

Transcript of Proceedings - October 10, 2012
Volume 4

575

1 Q That's for sure.

2 A The ground is important only that it gives a
3 reflection that can enhance or interfere with the
4 direct path. But it does hit the microphone, that's
5 the first thing it hits in time. The sound will
6 arrive at the microphone before -- it comes directly
7 from the source, so it will arrive first.

8 Q So somebody standing outside near a wind turbine or
9 any source up in the air, that sound wave is going to
10 travel down, and it's going to hit that person's ear
11 before it goes down to the ground and gets absorbed?

12 A Well, won't be totally absorbed but, yes, it does hit
13 you before it's absorbed. And I think your point is
14 good, that as you're traveling along the ground, from
15 ground to ground it will be absorbing some of the
16 sounds, and that alone is -- that's part of the
17 reason that the air-to-ground path is louder.

18 Q And so do you think it's proper to assume no
19 absorption and use that 0.0 coefficient for this
20 reason?

21 A That's part of the reason. Part of the reason is
22 the -- in order to have a prediction that is what is
23 called for in the standard, which is a prediction
24 that is -- if you like the term conservative, a
25 prediction that predicts what's going to happen 90

Transcript of Proceedings - October 10, 2012
Volume 4

576

1 percent of the time or 95 percent of the time or some
2 percentage of the time, I actually think that from
3 the data that I know of, the prediction is probably
4 the -- about 85 percent of the time would be
5 included, and 15 percent of the time you would be
6 above what's being predicted with the 0.00
7 prediction. It's not the most conservative
8 prediction in the world by any means.

9 Q But considering we have to use this model because we
10 don't have anything better, the best way to use this
11 model for a source that's 100 meters in the air is to
12 use that 0.0 coefficient?

13 A 0.00 is the best you can do with this.

14 MS. BENSKY: Great. That's very helpful.
15 Thank you.

16 MR. REYNOLDS: Couple questions on
17 redirect.

18 REDIRECT EXAMINATION

19 BY MR. REYNOLDS:

20 Q Dr. Schomer, is it the heart of it that the challenge
21 of creating a model to reflect what the citizens of
22 Forest will actually experience, is that the heart of
23 why it's better to have conservative estimates than
24 not conservative estimates of sound? Because we're
25 trying to figure out what's going to happen to the

Transcript of Proceedings - October 10, 2012
Volume 4

577

1 citizens in Forest.

2 A I think there's probably lots of reasons I can think
3 of for doing this. Again, we're dealing with a low
4 frequency sound primarily. The A-weighted sound is
5 going to correlate with it as it does with nearly all
6 noise sources.

7 I think it's important to understand how
8 the ear hears because that's all a part of this, and
9 the ear doesn't hear all frequencies equally. It
10 doesn't process all frequencies equally, and it gets
11 very different at low frequencies. The ear gets very
12 different at low frequencies, and this is one of the
13 reasons I would say this is important. We -- I think
14 Mr. Hessler testified that the threshold of hearing
15 changes, or maybe it was in that paper that was
16 passed out, but the threshold of hearing is very
17 different from one person to another.

18 But what's even more important is that at
19 the middle frequencies, like 1,000 hertz, a change of
20 10 decibels is a doubling or a cutting in half of
21 loudness. At these low frequencies, like let's say
22 10 hertz, at 10 hertz, about a 2 dB change is a
23 doubling of loudness. So at low frequencies,
24 anything that you're off gets magnified by the ear.
25 If you're off by 5 dB at low frequencies, that's a

Transcript of Proceedings - October 10, 2012
Volume 4

578

1 factor of four in loudness. Whereas if you're off by
2 5 dB at a middle frequency in a prediction, that's
3 not even a factor of two in loudness. So errors get
4 magnified at the low frequencies just because of how
5 we hear.

6 Q That was one of the reasons for looking at the more
7 conservative model. Are there any others?

8 A Well, let's see. I've talked about the standard
9 calling for it. I've talked about it makes sense
10 from the -- from the way the rule is written.
11 Certainly it makes sense from being conservative from
12 just the standpoint of how the ear hears. I think
13 that just what we've talked about, the health effects
14 and the fact that there's people that may be affected
15 just like in one other community, somehow it seems
16 like it calls for us to be cautious.

17 I think that if -- if it were some other
18 area where government was involved directly, let's
19 say, we're going to install -- we're going to license
20 fire detectors that only work 90 percent of the time
21 and 10 percent of the time people aren't warned about
22 the fire protector, but that's good enough. People
23 wouldn't say that's good enough, so the fire
24 protection has to work all the time. And I think
25 when we're talking about people literally being

Transcript of Proceedings - October 10, 2012
Volume 4

579

1 driven out of their homes, we have to be a little bit
2 cautious.

3 MR. REYNOLDS: Thank you. I don't have
4 anything else.

5 EXAMINER NEWMARK: Highland?

6 MR. WILSON: No.

7 EXAMINER NEWMARK: All right. What are we
8 doing with our ISO 9613-2?

9 MS. BENSKY: I'd like to move it into
10 evidence.

11 EXAMINER NEWMARK: All right. Any
12 objections?

13 MR. LORENCE: I guess I'd like to talk
14 about that for a second.

15 EXAMINER NEWMARK: Okay.

16 MR. LORENCE: We've kept out all kinds of
17 reports and exhibits today because they didn't come
18 in at the proper time. Professor Schomer could have
19 put it in at any time with his exhibits. I
20 recognize that counsel here is not -- is not -- his
21 witness is not asking this. But I guess I would ask
22 the ALJ that under the theory that, you know, we've
23 been keeping out late-filed things and this is
24 awfully dense information, whether this should go in
25 the record.

Transcript of Proceedings - October 10, 2012
Volume 4

580

1 EXAMINER NEWMARK: Okay.

2 MR. LORENCE: And I just as a second aside
3 for counsel, I'm not positive, but I think that
4 these are usually under copyright, and is this
5 something that we would be able to place on our
6 website and make available to the world if -- I
7 don't want to get you in any kind of copyright
8 trouble if that's the case.

9 MR. MCKEEVER: I'll just say I got it on
10 the internet.

11 MR. LORENCE: Yeah.

12 MR. REYNOLDS: And this is the standard
13 that has been used by all the measurers of sound, so
14 this is -- this is kind of the bible of sound
15 measurement.

16 MR. LORENCE: And I guess that reinforces
17 my question then. Anybody could have put it in.
18 Any of the experts could have put it in from direct
19 testimony on it. So whether we get it here at this
20 late hour or not, I'll defer to the decision, but
21 I'm -- given what we've done today with other
22 things, I just wanted to raise that point.

23 MS. BENSKY: I guess the nature of this
24 exhibit is totally different. This exhibit doesn't
25 give any opinions. It's just a standard that

Transcript of Proceedings - October 10, 2012
Volume 4

581

1 everybody -- all the sound people in this case have
2 used and relied upon. So I think it would be
3 helpful to have it in. And even if it wasn't in, I
4 think it's the type of material that could be quoted
5 and briefed anyway, so --

6 EXAMINER NEWMARK: Let's not get into
7 that.

8 MR. WILSON: I think at the risk of making
9 it look like Ms. Bensky and I are on the same
10 team --

11 EXAMINER NEWMARK: We would like to see
12 that.

13 MR. WILSON: I agree.

14 EXAMINER NEWMARK: Okay.

15 MR. WILSON: It should come in.

16 EXAMINER NEWMARK: I understand.

17 MR. WILSON: There's a lot of testimony on
18 it.

19 EXAMINER NEWMARK: Let me say the
20 overarching concern I have or rationale for letting
21 it in is we've cited to equations and all kinds of
22 portions of this document which I think can only be
23 correctly or adequately explained or referenced by
24 having the document. So for the abundance of
25 caution for making the record even larger, I think

Transcript of Proceedings - October 10, 2012
Volume 4

582

1 it would enhance the Commissioner's review of the
2 testimony we've just heard. So what's the number
3 for this one? It's 9, Schomer 9, is that --

4 MR. REYNOLDS: I thought it was 5.

5 EXAMINER NEWMARK: Well, I don't know if
6 we ever marked your other ones. I might have
7 mentioned on the record because Mr. Schomer, I was
8 not accepting his Exhibits 5 through 8, and I am
9 pretty sure I referenced that at the beginning of
10 the hearing. So we're just going to call this 9.

11 MS. BENSKY: Okay.

12 (Schomer Exhibit No. 9 marked and received.)

13 EXAMINER NEWMARK: All right. I think
14 you're done.

15 THE WITNESS: Thanks.

16 EXAMINER NEWMARK: You're excused.

17 (Witness excused.)

18 EXAMINER NEWMARK: 3 o'clock. Let's take
19 15 minutes.

20 (Break taken from 3:05 p.m. to 3:20 p.m.)

21 EXAMINER NEWMARK: Well, got enough people
22 back, I guess. You want to start off the record?

23 MR. McKEEVER: Yeah.

24 (Discussion held off the record.)

25 EXAMINER NEWMARK: All right. Next?

Transcript of Proceedings - October 10, 2012
Volume 4

583

1 MR. REYNOLDS: Mr. Punch.

2 (Call placed to Mr. Punch.)

3 JERRY PUNCH, TOWN OF FOREST WITNESS, DULY SWORN

4 EXAMINER NEWMARK: All right. Go ahead.

5 DIRECT EXAMINATION

6 BY MR. REYNOLDS:

7 Q Good afternoon, Dr. Punch. Can you hear me okay?

8 A Good afternoon.

9 Q I want to just simply ask you if you have filed
10 direct and rebuttal testimony in this case --
11 surrebuttal, I guess?

12 A I have. Direct and surrebuttal, yes.

13 Q Yes. And do you affirm that that testimony is true
14 and correct to the best of your knowledge?

15 A Yes.

16 Q Okay. If you had to change anything, would you?

17 A No. No, I don't think so.

18 Q All right. You apparently spelled Ms. Pierpont's
19 name wrong. Would you change that?

20 A I am so sorry about that typo.

21 MR. REYNOLDS: All right. Turning over to
22 cross.

23 EXAMINER NEWMARK: Okay. Also submitted
24 one exhibit; is that right?

25 THE WITNESS: I'm sorry?

Transcript of Proceedings - October 10, 2012
Volume 4

584

1 EXAMINER NEWMARK: You submitted an
2 exhibit, too, as well.

3 THE WITNESS: Well, the only exhibit I
4 think was in the record -- is in the record is my
5 curriculum vitae, my resume.

6 EXAMINER NEWMARK: But you can confirm
7 that as well?

8 THE WITNESS: Yes.

9 EXAMINER NEWMARK: Okay. All right.
10 Questions?

11 THE WITNESS: Sure.

12 CROSS-EXAMINATION

13 BY MS. BENSKY:

14 Q Good afternoon, Dr. Punch. My name is Anne Bensky,
15 and I'm an attorney for Forest Voice, and they're the
16 citizens' group that's involved in this docket.

17 A Yes. Good afternoon.

18 Q I just have a couple questions for you. You talk
19 about your work related to hearing aids; is that
20 correct?

21 A Yes, yes. Much of my research in the past has had to
22 do with hearing aids and hearing aid failure.

23 Q There's some testimony in this case where one witness
24 reported being unable to wear her hearing aid in her
25 home while the wind turbines nearby are running. Do

Transcript of Proceedings - October 10, 2012
Volume 4

585

1 you have any explanation for why that's the case?

2 A I think the explanation is probably -- probably has
3 to do with the fact that some of the energy in wind
4 turbine noise is audible, and the frequency range
5 above 20 hertz. Hearing aids, basically they don't
6 amplify beyond or below about 200 hertz that well.
7 So she's probably hearing frequencies or pitches in
8 the range of maybe 200 to 500, possibly as much as
9 1,000 hertz and she's probably hearing -- my guess
10 is, and I haven't talked to this person of course,
11 that she's hearing the thumping and the additional
12 noise because hearing aids do fairly notoriously a
13 poor job with handling background noise in general
14 because you have a microphone at or behind the ear,
15 and it's picking up all the sounds, including all the
16 sounds you want to hear as well as all the background
17 sounds you don't want to hear. So I think it's
18 probably just a bothersome background noise that's
19 amplified that she doesn't want to hear, and that's
20 bothersome and requiring her to take out the hearing
21 aid.

22 Q So do people who wear hearing aids generally in your
23 experience have a problem if there is a loud noise in
24 the background? Does that interfere with their --

25 A Yes, it can because of what I said before. The

Transcript of Proceedings - October 10, 2012
Volume 4

586

1 microphone picks up all the sounds. Now, there are
2 noise-reduction algorithms in the newer digital
3 hearing aids that can suppress a little bit of the
4 background noise.

5 There's one other thing that's helpful by
6 a few decibels is directional microphones which tend
7 to amplify the sounds from in front and de-amplify or
8 attenuate sounds from the side and the back on the
9 theory that you look at people you talk to and so
10 you're facing the person you want to hear. They're
11 not effective beyond about a reduction of 4 to 5
12 decibels, but that can be very critical in certain
13 situations, like maybe a noisy restaurant where you
14 and your spouse or your partner are talking, that
15 sort of thing.

16 So there are algorithms to deal with it.
17 Hearing aid companies are always coming up with new
18 ways -- that's a perpetual problem in hearing aids,
19 in the manufacturing of hearing aids. And it hasn't
20 been resolved yet, so it still persists.

21 Q In your work have you heard of other people who wear
22 hearing aids have complaints about wind turbine
23 noise?

24 A Well, no. I must say no because I haven't -- I only
25 got interested in this about three or so years ago,

Transcript of Proceedings - October 10, 2012
Volume 4

587

1 and I haven't really done clinical practice since
2 then. And we don't have wind turbines in the
3 immediate area. We have some maybe -- I'd say 50
4 miles away or a little bit farther in Michigan, so I
5 don't think any one audiologist is going to see that
6 many patients, or you wouldn't see a pattern probably
7 at this point. Although I understand there are some
8 audiologists beginning to see some in the Town of
9 Alma north of us, about -- around 50 miles away. So
10 we just don't have the experience yet, most of us as
11 audiologists with wind turbines, enough experience to
12 answer that kind of question.

13 Q Now, if you knew that there were a group of people in
14 the Town of Forest in the footprint of this Highland
15 Wind Project who did wear hearing aids, do you have
16 any special advice for them in terms of dealing with
17 the wind turbine noise?

18 A Well, as long as they wear the hearing aids, they're
19 probably going to hear it. Particularly I would say
20 outside where the high frequencies aren't attenuated
21 very much, not as much as one is indoors. They're
22 probably going to be bothered by wind in fact in that
23 situation as well.

24 But if they're in critical situations,
25 conversational situations where they really need to

Transcript of Proceedings - October 10, 2012
Volume 4

588

1 hear the person they're talking to, they can wear or
2 obtain what's called assistive listening devices of
3 various types, one or more types. For example,
4 indoors with the T.V., there are infrared systems you
5 can buy to help people pick up sounds just from the
6 T.V. without wearing your hearing aid. And some of
7 those can be coupled directly to -- that is
8 electrically coupled to the hearing aid without
9 getting -- picking up the interfering acoustic
10 signals, you know, from background noise and so
11 forth.

12 So, you know, in group situations there
13 are ALDs like loop systems. If you go to a play or a
14 concert, or a church or synagogue, for example, you
15 can find those systems, and I don't -- I'm suggesting
16 they could use something other than their hearing
17 aid. But, no, if they use their hearing aid, they're
18 probably going to pick up the noise most of the time.

19 Q Thank you. Now you -- you talk about in your
20 testimony that, and I'll quote here, hearing alerts
21 us to danger and provides us with a way to monitor
22 our surroundings on a constant basis, even during
23 sleep. My question is, do people hear during sleep?

24 A Yes. I mean, there's certain stages of sleep. I
25 must say I'm not a sleep expert physiologist, but

Transcript of Proceedings - October 10, 2012
Volume 4

589

1 certainly during certain stages of sleep we're very
2 aware of things that are changing in the environment
3 sound-wise. If a car blows a horn, you know, nearby
4 the house you're sleeping in, you know, it might wake
5 you up even though you are -- you might describe
6 yourself as soundly asleep. You know, we have alarm
7 clocks that wake us up during sleep. Sounds that are
8 loud enough or perhaps particularly sounds that
9 aren't just low level and constant will probably wake
10 you up because the ear is an open system. As I said
11 there, it's in my testimony, it's -- hearing really
12 is never off really as long as we're alive. Hearing
13 is always on, except in stages of real exhaustion and
14 fatigue, deep sleep, and that sort of thing.

15 Q Based on your experience, and if you can't answer
16 this, if it's beyond your expertise, just say so, but
17 my question is, what happens to a hearing-impaired
18 person's well-being if they are unable to wear their
19 hearing aids in their home?

20 A Well, I think I have enough expertise to make an
21 educated guess. Basically they've gotten hearing
22 aids because they've exhausted other possibilities.
23 They probably denied having a hearing loss for some
24 time, and they really need the hearing aid to
25 function, and function includes not only the

Transcript of Proceedings - October 10, 2012
Volume 4

590

1 environmental awareness, alertness, and that sort of
2 thing, but certainly communication, which is a very
3 human condition or human trait that's unique to us,
4 and that becomes very psychologically important.

5 There's even data now showing that people
6 who either go a long time without -- who have hearing
7 loss who don't get hearing aids or people who need
8 more hearing than they have available to them,
9 amplified or not amplified, suffer -- and this is
10 after everything else is controlled for -- suffer
11 more illness, they are in the hospital, more sick
12 days. They are out of work more often and that sort
13 of thing. So it has a wide range of psychological
14 and social implications not to be able to hear well.

15 Q So not being able to hear well can affect you
16 physically?

17 A Well, I meant physically in the sense that the ear is
18 physically damaged or impaired, and so you're
19 affected physically by virtue of having the hearing
20 impairment. It can affect you physically aside from
21 that only in the sense that if you miss some alerting
22 signals, you might get run over by a car, for
23 example. I mean, only in an indirect sense. I don't
24 mean that you'll necessarily suffer physical
25 ailments, crippling injuries or that sort of thing

Transcript of Proceedings - October 10, 2012
Volume 4

591

1 more often necessarily, but basically you will become
2 psychologically depressed.

3 Depression is a big symptom in hearing
4 impaired people. They become socially isolated, and
5 that can lead to, you know, less activity, less going
6 out in public, and generally sort of isolation into
7 yourself. And a depression can lead to, I would
8 think, and I'm not a medical doctor here, could lead
9 to physical symptoms in that way.

10 Q Okay. The bottom of page 6 of your testimony you
11 talk a little bit about infrasound. Is it generally
12 accepted science that exposure to infrasound can
13 cause health effects, or is that still being worked
14 out?

15 A Well, as you heard in the testimony in the last
16 couple of days, I'm sure that you know there's --
17 it's a controversy that it isn't settled. From my
18 own -- my own opinion is, after several years of
19 experience and interest in this and thinking about it
20 and reading about it and trying to interpret what I'm
21 reading, I've come -- if I can make a personal
22 opinion here.

23 Q Please do.

24 A Opinion that -- that infrasound, even though it's
25 inaudible, it can hurt people. It can lead to

Transcript of Proceedings - October 10, 2012
Volume 4

592

1 adverse hearing -- I mean, excuse me, health effects.
2 Not hearing loss of course but adverse health effects
3 of other kinds. And you've heard all the
4 descriptions I think already. Sleep disturbances is
5 one of the main ones, and that almost everybody who
6 lives close, if they have a complaint, they will
7 complain about sleep disturbance first. And then
8 after that, headaches and nausea and sometimes
9 tinnitus, and it goes on and it can -- and it varies
10 from person to person of course. The large variety
11 of ailments, and no one personally is probably going
12 to suffer all these ailments. They might suffer
13 several or a couple. Sometimes they're crippling
14 enough and debilitating enough that people can't
15 tolerate it --

16 Q Sure.

17 A -- and leave their homes, for example.

18 Q Sure. At the bottom of page 7 of your testimony, you
19 talk about being a chairperson of the Wind and Health
20 Technical Work Group.

21 A Yes. I was up until about a year ago when the
22 committee was disbanded.

23 Q Okay. At the bottom of the page you state that the
24 noise issues proved by far to be the most
25 contentious. Do you know why?

Transcript of Proceedings - October 10, 2012
Volume 4

593

1 A We couldn't settle on a noise level, a limit,
2 allowable noise limit. The previous guideline, the
3 only one that Michigan -- the State of Michigan had
4 ever adopted in the past was just a guideline. It
5 wasn't a mandated regulation, but it was a guideline
6 that local communities were using, and it allowed 55
7 dBA as the maximum average level of exposure day and
8 night. And so I as chair and an epidemiologist who
9 was co-chair, I appointed him as co-chair because he
10 had the epidemiological background, were pushing
11 pretty heavily along with one or so other -- at least
12 one other member of the committee -- I think there's
13 seven people on the committee -- for a level of
14 about -- oh, of -- I think it was exactly 40
15 decibels. We weren't trying to make a distinction at
16 that time in Michigan between day and nighttime
17 because we were just trying to push that level below
18 55 because we knew that that level was potentially
19 harmful to a lot of people, and so now -- well, let
20 me stick with your question.

21 Do you have other questions about that?

22 Q Well, noise has been a big issue in this docket, and
23 I'm just trying to figure out, can you give us any
24 insight as to why this is such a contentious issue?
25 I think you're the only audiologist who is testifying

Transcript of Proceedings - October 10, 2012
Volume 4

594

1 here. So if you can give us some insight, that would
2 be helpful. And if not, that's okay.

3 A Well, for a couple of reasons. One is the A-weighted
4 scale, which I think Dr. Schomer -- or Mr. Schomer
5 testified to earlier. He made some points about
6 A-weighting. I think it's a flawed metric if you use
7 it alone because of the reason he stated. It
8 basically adjusts for the difference in sensitivity
9 of the ear at different frequencies, the middle
10 frequencies being the most sensitive and the low
11 frequencies being the least sensitive. It
12 essentially puts in a filter or reverses the -- the
13 sensitivity curve so that you don't really hear the
14 low frequencies where the ear is least sensitive.

15 The problem is, the A-weighting is for
16 moderate-level sounds, and by the time you get up to
17 very high levels, there's no longer this big
18 difference between low and high frequencies. And
19 Dr. Schomer -- or Mr. Schomer related -- I think he
20 made -- he made some comments about -- I forget now
21 the details, but he said basically that there's a
22 difference in the response of the ear in terms of
23 loudness. Loudness grows for a large part of the
24 levels, I'll call it the range of levels that we can
25 hear, much faster as it changes in the low

Transcript of Proceedings - October 10, 2012
Volume 4

595

1 frequencies as opposed to loudness grows or
2 diminution in the middle frequencies. So there's
3 that difference.

4 And so at very high levels, though, my
5 point is, it's not the same as it was at middle
6 frequency, I mean middle levels or middle decibel
7 levels, let's say. And so it's no longer very
8 fitting to use A-weighting for -- for low frequencies
9 and infrasound.

10 Basically one other thing is that the
11 sensitivity is not the same for noise and pure tones,
12 and the noise weighting scale is based on pure tones.
13 So we've tried -- people in industrial noise
14 measurements, for example, have tried to apply a
15 scale that was better fitted -- was fitted to
16 quantifying pure tones, and it's not very good when
17 it comes to -- in my opinion, and I think opinion of
18 a lot of other audiologists and related
19 professionals. Some engineers I'm sure.

20 The worst problem is the A-weighting scale
21 cuts out infrasound entirely, so you're not even
22 picking up with your sound-level meters if you're
23 measuring on the A scale, this critical region that's
24 very low in frequency that's maybe inaudible but
25 seems to have some real impact on resulting in

Transcript of Proceedings - October 10, 2012
Volume 4

596

1 adverse health conditions.

2 Q Okay.

3 A So that's a big problem. The other general problem
4 I'd say is the big-picture problem in my view is that
5 the ear is more sensitive. It's a more sensitive
6 mechanism than any sound level instrument, and a lot
7 of this -- I've been hearing some of the -- most of
8 the testimony in the last two days online, and it
9 seems like much of the problem is that people can't
10 decide on what's the right standard, what's the right
11 weighting scale perhaps, what's the right model to
12 use in predicting noise using the sound level
13 instrument we have available.

14 I think the ear is so much more sensitive
15 than any instrument that it's going to be a while
16 'til the instrumentation catches up with the ear.
17 And my point is that we need to listen to people
18 because the ear is the most sensitive -- the ear and
19 the brain are much more sensitive and detailed than
20 our current instrumentation can corroborate.

21 Q Thank you. Speaking of infrasound, on page 8 and 9
22 you talk a little bit about infrasound. Can you tell
23 me if there is -- if you know, if there's some
24 biological or evolutionary reason why the ear filters
25 out low frequency noise?

Transcript of Proceedings - October 10, 2012
Volume 4

597

1 A Well, there's only a couple articles that I am aware
2 of, or that I've read, talking about the evolution of
3 the ear as animals have evolved from lower animals to
4 higher animals. And if you, of course, believe in
5 evolution, as most of us do. And the explanations,
6 I'll tinker, aren't quite clear enough for me to
7 describe what's really going on. I think that the --
8 you know, in lower animals, the vestibular system is
9 probably more well-designed than it is in humans, and
10 in a few animals, you know, dogs and maybe cats, but
11 particularly dogs and a few other lower animals, the
12 ear is better adapted to environments of humans. I'm
13 sorry, better designed for hearing certain sounds
14 that humans cannot hear, okay?

15 Generally when sound comes into the ear,
16 it segregates. It could, given its physical
17 pathways, the physiological -- or let's say given
18 the anatomy and physiology together, it could be
19 directed toward the vestibular system, but it
20 primarily is picked up and used, transmitted to the
21 brain via the inner ear or the cochlea.

22 So they're two very separate functions.
23 Sometimes they can be found -- a lot of sounds I
24 think can affect -- vibrations can certainly affect
25 the vestibular parts of the ear, the inner ear,

Transcript of Proceedings - October 10, 2012
Volume 4

598

1 portions of the ear. There are -- I don't know if
2 I'm answering your question. I'm trying to get to
3 that.

4 Dr. Salt's research always comes up in
5 this context. Basically he talks about there are
6 ways for sound to get to the brain through the
7 what's called the inner hair cells of the inner ear.
8 If I had more time, I would go into all this, but I
9 don't really think you want me to do that.

10 But the outer hair cells can pick up
11 infrasound. It is transmitted to the brain, but my
12 understanding is that is -- it's at lower levels.
13 It's not picked up as sound per se, but it is -- it
14 goes to certain centers of the brain, maybe the
15 associated auditory cortex areas that sort of don't
16 know what to do with it. And that's kind of my
17 understanding of it, don't really know how to
18 interpret the sounds and how to use it, and so I
19 think the brain is sending out signals. And I'm not
20 a, you know, a cortical or a brain expert either.
21 But I'm trying to make as much sense of all this as
22 I can, and this is what I've come to.

23 There are signals sent to the body to try
24 to make certain adjustments, and I'm sort of getting
25 pretty deep here, and I don't want to go too deeply

Transcript of Proceedings - October 10, 2012
Volume 4

599

1 into this because I really don't understand fully
2 all of it. But the point is generally that what you
3 don't hear or can't hear can hurt you because the
4 brain is just trying to make sense of everything
5 that it -- that comes into it and because it is a
6 sensory organ as well as a motor organ. It tells
7 you to move your arms and legs, that sort of thing,
8 but it's a major sense organ.

9 Q So is Dr. Salt's research, does that show that the
10 brain can detect low frequency noise even if you
11 can't hear it? Is that the essence of what he's
12 doing?

13 A He's basically showing in the cochlea there are
14 mechanisms by which the ear receives and transmits
15 these signals -- infrasound signals to the brain, and
16 I sort of took a leap further just a minute ago and
17 said the brain interprets those sounds in the best
18 way it can, not necessarily as sound, but as other
19 kinds of stimulation to which the body tries to make
20 adjustments.

21 Q And that could be nausea, vertigo?

22 A Yes. It could be nausea, vertigo, dizziness -- well
23 vertigo and dizziness are pretty similar, although
24 vertigo is more severe, fullness of the ear. And
25 Salt has made those kind of comparisons himself.

Transcript of Proceedings - October 10, 2012
Volume 4

600

1 I would make one further comment about the
2 vestibular system. There are diseases in the ear
3 like Meniere's Disease where medical researchers
4 seem to think that there's an overproduction of
5 inner ear fluid that affects both the vestibular
6 system and cochlea, the inner ear, which has to do
7 with hearing. And among other systems are these
8 that I mentioned, vertigo, tinnitus, extreme nausea,
9 fullness of the ear. And these are exactly the
10 kinds of symptoms that have been widely reported,
11 and Dr. Salt makes that very kind of comment. I've
12 known that for some time.

13 And so things that -- says that things we
14 know more about like Meniere's Disease, there are
15 also a couple other disorders that we know more
16 about now than we used to, we know that the -- these
17 kind of symptoms can also result from those
18 disorders.

19 Q Now, you state on page 9 near the top of your direct
20 testimony that the ear is more sensitive to
21 infrasound when there is no or very little high
22 frequency sound. Is that a correct characterization
23 of your testimony?

24 A Well, that's a good characterization of what I said,
25 and that is not based on my own work but it's based

Transcript of Proceedings - October 10, 2012
Volume 4

601

1 on Salt's work. He has a study, I forget his
2 co-author, but in the last year or two he's published
3 a couple of papers, that is journal articles, and
4 presented some papers at various society meetings or
5 conferences where he's talked about -- he makes these
6 direct measurements in the cochlea.

7 And people should understand, this is in
8 the guinea pig. Guinea pig is a good model of the
9 human ear. The cat and Rhesus monkey have been used
10 as long as I've been in the field, as well as guinea
11 pigs, to model what's going on in the human ear.
12 You're not going to do these kind of experiments in
13 humans. I mean, nobody wants electrodes stuck into
14 their inner ear. So you're going to have to do them
15 in these kinds of animals, and he's found that the
16 electrical activity in the inner ear, the cochlea, is
17 greater in the low frequencies when you put
18 simultaneous higher frequency into the ear.

19 Q Okay.

20 A So he has -- he has recording electrodes stuck in
21 certain points in the hair cells, for example, in the
22 cochlea, and he's just putting a sound through the
23 normal ear, although the animal is anesthetized. So
24 his work has created quite a big buzz in people who
25 are interested in it for sound, and more recently he

Transcript of Proceedings - October 10, 2012
Volume 4

602

1 and others have become interested in applying his
2 work to wind turbine noise.

3 Q And in taking -- in taking that, would you say that
4 people are more sensitive to infrasound at night
5 because there are very few other sounds going on --

6 A Yes.

7 Q -- that they can hear?

8 A Yes. Absolutely. I think that's a direct inference
9 of that finding.

10 Q Okay. Thank you. At the top of page 10 of your
11 testimony, you talk about the importance of
12 identifying vulnerable populations when you are
13 introducing a noise source into a community?

14 A Yes.

15 Q What's the best way to identify vulnerable people, or
16 what is a way to do it?

17 A Well, certainly case history questionnaires would be
18 possible. I don't know that wind developers are in
19 the position to do that. I think it would take
20 medical or, you know, allied medical personnel to do
21 that. Self reports, I and Dr. Phillips and others I
22 think have pointed out is very critical. The whole
23 basis of medicine is depending on giving weight and
24 validity to a person's report that something a wrong,
25 and even when the -- all the technical --

Transcript of Proceedings - October 10, 2012
Volume 4

603

1 technological instrumentation doesn't corroborate it,
2 you still don't decide that you no longer believe
3 that person's complaint. So self-report.

4 I mean, if I may say so, the case of the
5 autistic child in the one family, I think I read some
6 of the -- I don't know if it was exhibits or some --
7 I think it was exhibits where they had the
8 questionnaires -- showed the results of the
9 questionnaires or there are open comments made, and I
10 thought they described the problem very clearly. I
11 mean, very well, and indicated they had spent years
12 with I believe what's now a 20-year-old son
13 evaluating his responses to different stimuli. And I
14 would just consider that very valid information, and
15 I say based -- I'd say based on the details of that
16 description, this child probably would, although,
17 again, I'm not a psychologist or expert in autism,
18 that would seem to be a real critical indication that
19 this child probably would suffer critically from
20 exposure -- any significant exposure with wind
21 turbine noise.

22 Q And you said you've been -- you have been watching
23 these proceedings the last two days?

24 A Well, I read much of the testimony in the last couple
25 of weeks, it was available, particularly where health

Transcript of Proceedings - October 10, 2012
Volume 4

604

1 was involved, and I listened to all the testimony
2 yesterday online and most of it, not all of it,
3 today. As much as I could today given my other
4 things I was -- other things I was doing.

5 Q Okay. Limiting this question to anything that you
6 have heard online in the last day and a half, do you
7 have any other comments you'd like to add on to any
8 piece of testimony that has been discussed today?

9 A Well, I guess one thing that struck me was questions
10 came up, and again I'm -- I can tell you what I think
11 I'm expert at and what I'm not, and I wouldn't say
12 I'm an acoustic engineer kind of expert, but I did
13 write an article with Rick James, who I think is, and
14 one of our statements together, this is a
15 corroborative effort, was that it's important to take
16 note that there's little difference in noise
17 generated across different makes and models of modern
18 utility-scale wind turbines. Once you normalize
19 their power output, so a 1.5 or a 2 -- and again,
20 this is not -- obviously not as an audiologist but as
21 one who understands sound and to some extent sound
22 measurements and so forth, perhaps I'm qualified to
23 make this statement, or to make it in this context.

24 The data from Camperman and others show
25 that low frequency energy from what I'll call

Transcript of Proceedings - October 10, 2012
Volume 4

605

1 industrial wind turbines increases inversely with
2 frequency. As you go down, in other words, there's a
3 3 dB per octave rise to level or frequencies around
4 10 hertz, and I don't think any -- any data are
5 available below 10 hertz. So he keeps going -- the
6 energy keeps rising, and Camperman, who's worked with
7 James, and I've talked to Camperman but don't know
8 him personally, he's concluded that the amount of
9 noise generated at low frequencies increases by 3 to
10 5 decibels for every -- excuse me -- megawatt of
11 power generated. So that's one point.

12 There was something else. I took a lot of
13 notes. I don't know if I'm going to be able to find
14 any more. Well, yeah. Here. The other thing was
15 that, and this is more in the realm of acoustic
16 engineering, but an article by van den Berg from, I
17 believe, the Netherlands in 2003 in the Journal of
18 Sound and Vibration looked at measurements of noise
19 levels that were taken at daytime and nighttime, and
20 science found that the turbine rotation and the wind
21 speeds were greater, much greater, two and a half or
22 so times greater at night than during the day and
23 that they -- he concluded that predicting the noise
24 at night from tall wind turbines underestimates the
25 data you're going to get during the daytime.

Transcript of Proceedings - October 10, 2012
Volume 4

606

1 So these measurements need to be taken at
2 night when the wind speeds are higher, much higher,
3 at higher altitudes near, you know, the blades than
4 at the base of the tower. That's basically all I
5 would have to say I think about the testimony that
6 I've heard.

7 MS. BENSKY: Great. Thank you very much.

8 THE WITNESS: You're welcome.

9 MS. BENSKY: I don't have anything
10 further.

11 EXAMINER NEWMARK: All right. More
12 questions?

13 MR. WILSON: Yep.

14 EXAMINER NEWMARK: Yeah.

15 MR. WILSON: I wasn't going to ask any
16 questions, but after all that, I can't resist.

17 THE WITNESS: You promised.

18 CROSS-EXAMINATION

19 BY MR. WILSON:

20 Q Dr. Punch, I'm John Wilson. I'm representing the
21 Applicant in the proceeding.

22 A Yes.

23 Q I just wanted to clarify -- well, I wanted to ask you
24 a few questions, but the first one I wanted to ask
25 you about is clarifying Dr. Salt's work.

Transcript of Proceedings - October 10, 2012
Volume 4

607

1 A Yes.

2 Q Did I hear you testify that Dr. Salt's work is solely
3 on guinea pigs and has not been duplicated in humans
4 yet?

5 A He makes that very clear I think, yes. It can't be
6 duplicated in humans, that's my point. I think
7 that's why I think everybody needs to understand
8 that.

9 Q Okay. And that's all I needed. Thank you.

10 A Oh, okay.

11 Q And just a couple of questions about your expertise.
12 You're not a physician, correct?

13 A Right.

14 Q And you're not an epidemiologist?

15 A Correct.

16 Q Okay. Is it -- would it be a fair
17 characterization -- you had a lot of testimony about
18 the health impacts of infrasound, correct?

19 A Yes. A great deal.

20 Q Okay. Is it a fair characterization of the -- of the
21 general literature in this area that those infrasound
22 studies are usually done at very high decibel levels?

23 A I'm not sure exactly how to interpret that question,
24 at high decibel levels. I think the levels have been
25 measured, and some of them have been found to be

Transcript of Proceedings - October 10, 2012
Volume 4

608

1 high. I've seen some measurements that are quite
2 high in the very low frequencies below 20 hertz in
3 Michigan. The measurements were taken by Rick James
4 and interpreted by Wade Bray, who's another
5 acoustician in the Michigan area, near me in fact,
6 and who works for Mercedes-Benz to study noise in
7 cars and that sort of thing. So I think the answer
8 is yes to your question.

9 Q I'm sorry? Could you repeat that?

10 A I said I think the answer is basically yes to the
11 question of whether high level sounds had been, if
12 that was your question, had been measured in terms of
13 infrasound.

14 Q Taking just a quick look at your surrebuttal
15 testimony.

16 A Okay.

17 Q On the very last page you have some references in
18 footnotes, and I want to ask you about a couple of
19 those.

20 A Okay.

21 Q On page 2, you're referencing a presentation by
22 Carmen Krogh?

23 A Krogh.

24 Q Okay. And that's -- that was a presentation at an
25 inner noise conference; is that right?

Transcript of Proceedings - October 10, 2012
Volume 4

609

1 A I believe so, yes. That's the first reference, I
2 believe.

3 Q Okay. So has that work been peer reviewed at all, to
4 your knowledge?

5 A I can't say that I know for sure that it's been peer
6 reviewed. I think for any -- I do know to this
7 extent that it's been peer reviewed at a certain
8 level. Peer review has a -- there's a continuum of
9 peer review. I mean, when you present a paper -- I'm
10 sure this is true in this case at this conference --
11 somebody had to read it, and usually at least two
12 people read it. The same process happens when you
13 submit a journal article, a manuscript for
14 publication in a peer-reviewed journal. So almost
15 everything is peer reviewed. These conferences are
16 fairly well peer reviewed. There's some industry
17 magazines and journals that aren't that well peer
18 reviewed. An editor might, for example, decide I
19 like this article and I'm going to publish it, but
20 that's not what I'm talking about here.

21 Q Uh-huh.

22 A So I would have to classify it at least at a certain
23 level of a peer-reviewed article or peer-reviewed
24 presentation, and usually these are published as a
25 result of the conference afterwards.

Transcript of Proceedings - October 10, 2012
Volume 4

610

1 Q Okay. Were you in attendance at that conference?

2 A No, I was not.

3 Q Okay. Then on page 4, starting on line 5, using data
4 from a home in Michigan, Swinbanks -- well, Bray and
5 James and Swinbanks have shown that the wind turbines
6 produce modulated infrasound. On it goes.

7 A Right.

8 Q And there's a reference for Swinbanks is Footnote 4
9 on the last page, and that reference is also to a
10 conference and not a peer-reviewed paper?

11 A Well, I would have to say the same thing. I see an
12 extra little dot in there, but it's the same
13 conference that Krogh presented at. Let's see. It's
14 the same date.

15 Q Okay.

16 A So it was this past August. So I would have to say
17 the same thing about his as I said about Krogh's
18 work.

19 Q Okay. So if you weren't there for Krogh's work, you
20 weren't there to see Swinbanks' either?

21 A Right.

22 MR. WILSON: Okay. Thank you. That's all
23 I have.

24 THE WITNESS: Okay.

25 EXAMINER NEWMARK: Questions?

Transcript of Proceedings - October 10, 2012
Volume 4

611

1 (No response.)

2 EXAMINER NEWMARK: Sir, I had a question
3 for you, and I'm not sure which witness had
4 testified to this, but it was my understanding from
5 the record that low frequency sound is not audible
6 by humans, and it seemed like someone was saying one
7 of the reasons, one of the benefits of that, I
8 guess, is that you can't hear, like, your heart
9 beating, things like that?

10 THE WITNESS: That's probably the
11 statement I made maybe in my direct testimony.

12 EXAMINER NEWMARK: Okay. Because your
13 answer seemed to sound like you didn't really know
14 why there would be some sort of rationale that we
15 couldn't hear those frequencies. I just wanted to
16 make sure you weren't contradicting yourself.

17 THE WITNESS: Well, we certainly can hear
18 low frequency sound. We can hear low frequency
19 sound to about 20 hertz. That's the average.
20 People differ. Some people can hear a little below
21 that. Some people don't hear that far down. But
22 infrasound, it generally is defined -- of course
23 it's inaudible sound to all of us, essentially. We
24 don't register it as sound per se.

25 EXAMINER NEWMARK: Okay.

Transcript of Proceedings - October 10, 2012
Volume 4

612

1 THE WITNESS: I guess in some of the other
2 comments I made earlier, just a while ago, you might
3 have picked up on the fact that I said the brain
4 doesn't always know what to do with every sensation
5 it gets delivered to it.

6 EXAMINER NEWMARK: Right.

7 THE WITNESS: And I guess I base that
8 partially on personal experience. I don't know if I
9 can go do that here, but I was told that by a
10 physician. I don't have any other reference. It's
11 certainly not a peer-reviewed scientific conclusion.

12 EXAMINER NEWMARK: That you don't hear
13 your heartbeat for that reason, or is that what
14 you're saying?

15 THE WITNESS: Oh, I see. Yeah. That was
16 sort of -- I guess I would have to say that was
17 speculative on my part. I have -- I think I've read
18 about it, but I've come to believe it. Your mind
19 likes to fit the pieces of the puzzle together, and
20 that was a more speculative aspect of my trying to
21 see that the pieces all fit well.

22 I have heard that. I have read it. I
23 think based on some early work that maybe Leventhall
24 did, and I don't want to be that definitive because
25 I'm not sure it was Leventhall, who did some early

Transcript of Proceedings - October 10, 2012
Volume 4

613

1 work in occupational plants on ventilation/heating
2 systems and so on and infrasound. He did some very
3 early work in England on infrasound, and I think he
4 might have made that kind of statement. But he's a
5 noise engineer, and I'm not sure it was he. So I
6 can't be definite about that.

7 EXAMINER NEWMARK: That's fine.

8 THE WITNESS: I've seen references to it,
9 though.

10 EXAMINER NEWMARK: All right. Redirect?

11 MR. REYNOLDS: No.

12 EXAMINER NEWMARK: Okay. I think that's
13 all the questions we have, so thanks very much.

14 THE WITNESS: Thank you.

15 EXAMINER NEWMARK: We're going to
16 disconnect.

17 (Witness excused.)

18 MR. REYNOLDS: Ready for another one?

19 EXAMINER NEWMARK: I'm ready for anything.

20 MR. WILSON: Your Honor, I am doing the
21 next one, but I need to take four minutes with my
22 client.

23 EXAMINER NEWMARK: Four minutes. You're
24 doing the next cross you mean?

25 MR. WILSON: Yeah.

Transcript of Proceedings - October 10, 2012
Volume 4

614

1 EXAMINER NEWMARK: Okay. Sure. We'll go
2 off the record.

3 (Brief break taken.)

4 EXAMINER NEWMARK: You have another Town
5 witness?

6 MR. REYNOLDS: Yes, I do. In terms of
7 housekeeping, we can deal with this later. There's
8 one lay witness where I'll need to submit an
9 affidavit. We can do that.

10 EXAMINER NEWMARK: Carlson?

11 MR. REYNOLDS: Carlson and Wirtz.

12 EXAMINER NEWMARK: Okay. There's no
13 questions for Wirtz?

14 MR. REYNOLDS: No.

15 EXAMINER NEWMARK: All right. Not a
16 problem.

17 And since we're on the topic, there's also
18 that Horonjeff surrebuttal that was filed in
19 confidential form. You need to refile that.

20 MR. MCKEEVER: You want a marking on that?
21 We got that listed.

22 MS. BENSKY: We filed one confidential --

23 EXAMINER NEWMARK: Off the record.

24 (Discussion off the record.)

25 EXAMINER NEWMARK: Go ahead.

Transcript of Proceedings - October 10, 2012
Volume 4

615

1 MR. REYNOLDS: Carl Phillips will be the
2 next one by phone.

3 EXAMINER NEWMARK: Okay.

4 (Call placed to Mr. Phillips.)

5 (Unable to reach Mr. Phillips by telephone.)

6 MR. REYNOLDS: Let's do Mr. Stamberg.

7 JOHN STAMBERG, TOWN OF FOREST WITNESS, DULY SWORN.

8 EXAMINER NEWMARK: Have a seat.

9 DIRECT EXAMINATION

10 BY MR. REYNOLDS:

11 Q Your name, please.

12 A John Stamberg.

13 Q And you have filed direct and rebuttal testimony in
14 this case?

15 A That is correct.

16 EXAMINER NEWMARK: Is it rebuttal or
17 surrebuttal?

18 MR. REYNOLDS: It's probably surrebuttal.

19 EXAMINER NEWMARK: It matters.

20 MR. REYNOLDS: Okay. It's direct and
21 surrebuttal. Sorry.

22 BY MR. REYNOLDS:

23 Q That's true and correct to the best of your
24 knowledge?

25 A Yes.

Transcript of Proceedings - October 10, 2012
Volume 4

616

1 Q You affirm the exhibits that were also attached?

2 A Yes.

3 Q Okay. And do you have anything to add based upon
4 testimony, surrebuttal and otherwise, that you heard
5 yesterday?

6 A I probably have comments on the sur-surrebuttal by
7 Mr. Pobloskie.

8 Q All right. Let's take that one piece at a time.
9 What is the first comment that you have?

10 A Probably the first thing I'd like to do is he made a
11 chart that's Pobloskie 2 that showed average Michels
12 and Stamberg comparison turbine removal costs.

13 Q Okay.

14 A I've got -- I reviewed those as best I could from the
15 internet references that were made.

16 Q All right. Let me ask you this just to clarify.
17 We're talking about the seven sites that the witness
18 basically found on the internet?

19 EXAMINER NEWMARK: It's in the exhibit,
20 right?

21 MR. REYNOLDS: Yeah.

22 EXAMINER NEWMARK: Pobloskie 2?

23 MR. REYNOLDS: Right.

24 EXAMINER NEWMARK: We know it's in there.

25 BY MR. REYNOLDS:

Transcript of Proceedings - October 10, 2012
Volume 4

617

1 Q And so did you have a chance to review the
2 information submitted yesterday?

3 A Yes, I did.

4 Q All right. And what did you find out?

5 A First of all, the wind turbines were small. They
6 were sub -- two were smaller megawatt units, not the
7 larger 2.5 megawatt units, which makes a big
8 difference in height, foundation, and weight.

9 Q All right. And so were those sites then comparable
10 in any respect to this project?

11 A No.

12 Q And were there any pieces missing in the -- in the
13 decommissioning reports in this?

14 A Yes. They were incomplete in land reclamation,
15 non-metal concrete, and that disposal cost, and the
16 crane pad cost to remove either one that they
17 installed or one that they left behind.

18 Q And how about concrete removal?

19 A Most of them were deficient in that or silent on
20 that.

21 Q When you say deficient, that means it had something
22 but not enough or --

23 A Right.

24 Q Or were they silent completely?

25 A There was a combination of silent and deficient.

Transcript of Proceedings - October 10, 2012
Volume 4

618

1 Q What do you -- what do you consider deficient?

2 A One is they removed some small token amount of
3 foundations or stuff like that that just disappeared,
4 and they didn't have the trucking costs and disposal
5 costs included in their estimate.

6 Q All right. How about the removal cost?

7 A The removal costs for these were much less by --- for
8 example, I did the same thing with the internet. On
9 a couple of wind turbines that were two and a half
10 megawatts, not 2 and below. One was Record Hill in
11 Maine. It was about five times the dismantling
12 decommissioning costs as the average in
13 Mr. Pobloskie's cull of material.

14 Q Let's -- all right. We'll get to that, but first
15 let's talk about the seven and then we'll talk about
16 the ones that are more comparable.

17 A Oh, okay.

18 Q All right. So were there any -- any of those seven
19 that are comparable to Highland --

20 A No.

21 Q -- on Mr. Pobloskie's list?

22 A No.

23 Q All right. Were there any that were at least close?

24 A No.

25 Q Why not?

Transcript of Proceedings - October 10, 2012
Volume 4

619

1 A The reason was, they used exceedingly high steel
2 salvage values. They were using salvage values that
3 weren't site specific, but they looked up what a
4 recycler sells to the steel mill type of steel, or
5 what we would get for shearable metal, such as an
6 auto body, not two inch, one-and-a-half-inch thick
7 steel tubes that are eight to ten foot in diameter.
8 There is a limited number of people that can plasma
9 cut and reduce that into sellable quantities to the
10 steel mills.

11 In this area, rather than use a generic
12 number what the steel sells for the steel mill, I
13 contacted specific auto recyclers in Eau Claire and
14 Minneapolis. And the Eau Claire group, there was an
15 EMR, European Metal Recycle, sister company in Eau
16 Claire that didn't have the capabilities. Alert
17 Recycling and A&W Recycling did not have the
18 capabilities to handle this large, thick metal.

19 The number that Mr. Pobloskie uses is for
20 shearable stuff, such as auto bodies, waste, heating
21 and ventilating ducts and that type of thing. And so
22 you need to check with them. And so I, you know,
23 contacted and visited American Iron, which is part of
24 the national -- or Northern Metal Recycling Group
25 owned by EMR, European Metal Recycling. There's, you

Transcript of Proceedings - October 10, 2012
Volume 4

620

1 know, consolidation. They have about a three- or
2 four-block facility that has rail for delivering to
3 the steel mill on one side and barge capability on
4 the Mississippi on the other.

5 Q And would this be the kind of facility that would be
6 able to recycle this kind of metal?

7 A Yes. And I've talked to them, and I've talked to
8 them again last week, and of course the metal prices
9 have gone down from when I contacted them.

10 Q All right. Well, let's just talk about the logistics
11 of getting the metal to the recycler. How would a
12 decommissioning effort accomplish that feat?

13 A First you'd have to what I call de-erect the maso-hub
14 tower and lay it down. You can't lay it in just a
15 cornfield or muck. You've got to have a crane pad or
16 lay-down area, whatever the wording is, and it would
17 be very similar to the lay-down and crane pad that
18 you used to put it up.

19 You've got two choices. One is you leave
20 this lay-down crane pad, or whatever you call it,
21 area from construction or redo it, okay? I assumed
22 it would stay, and it would be maintained and not let
23 it get weeds, mud, and become forest, okay?

24 Q Are we talking about 30 years?

25 A Yes. So somebody would have to maintain that. If

Transcript of Proceedings - October 10, 2012
Volume 4

621

1 not, the cost of redoing that and removing it gets to
2 be a higher cost, which I could do. But if you get
3 too many things, you can make -- you know, exaggerate
4 it or not.

5 Q All right. So you got the -- you've got the metal on
6 the ground. How do you get the metal to the
7 recycler?

8 A There's two steps that I use. One is to reduce it to
9 53 foot or thereabouts length and 20, 25 tons, which
10 is road legal in Wisconsin, okay? If you do the
11 blades, the extra-long tower sections and all that,
12 then you have to add the cost of more expensive
13 equipment such as when you bring it in and modify all
14 the corners that they have to go through throughout
15 the 41 turbines as far as moving electrical
16 equipment, making radius turns that are temporary,
17 and doing those kinds of operations.

18 So that's why I chose to have it at the
19 site reduced to typical normal trucking size and
20 weight because the cost of redoing all the radiuses
21 and all that stuff is just way too expensive.

22 EXAMINER NEWMARK: Okay, sir.

23 Mr. Reynolds, how does your question relate to this
24 exhibit? Because I think he's repeating a lot of
25 his direct right now.

Transcript of Proceedings - October 10, 2012
Volume 4

622

1 MR. REYNOLDS: Okay. Thank you.

2 BY MR. REYNOLDS:

3 Q Are any of the things you're talking about accounted
4 for in these other seven examples?

5 A Not that I could tell from the internet sites.

6 Q Would the prices that would be quoted be comparable
7 to what it actually would take to remove the concrete
8 pads and reduce the towers to the ground and cut them
9 up for the recycling?

10 A Six of the seven had what I call Michels' level type
11 of estimates that weren't itemized to the point where
12 you could tell what they were based on.

13 Q And were they in the ballpark? Low? High? What?
14 What do you mean by Michels-type estimates?

15 A I can't tell what they include or don't include, and
16 seem artificially low and have exaggerated steel
17 price salvage values to negate some of the cost.

18 Q And how did their salvage values compare with the
19 salvage values that you checked out?

20 A What I've checked out is the average net back to the
21 project is 44 and a half dollars a ton, and they were
22 using -- like Pobloskie picked the sheering price at
23 220 versus the 44 and a half for what actually has
24 happened with people I've contacted, you know,
25 visited and understand that they're capable of doing

Transcript of Proceedings - October 10, 2012
Volume 4

623

1 that.

2 Q So were you able to find any recycling prices that
3 matched the either Michels' estimates or the seven
4 that were submitted yesterday?

5 A The answer is no.

6 Q All right. And with respect to the removal of the
7 concrete, there was -- there was no removal of
8 concrete provisions in any of those seven?

9 A Oh, it was so de minimis or token addressed that --
10 no explanation of why or what they were, based on
11 what is possible seems, you know, almost artificially
12 low, and I didn't have time to go into what the
13 requirements of the various people were.

14 Q All right. Now, your estimate to remove four or five
15 feet is something in the order of \$7 million, half of
16 your decommissioning estimate?

17 A For the 41?

18 Q For the 41.

19 A Yes.

20 Q And you also had an estimate for a potential removal
21 of 35-foot depth?

22 A Yes. Because what -- when you look at the drawings
23 S1 and S2, it is the minimum value or size of the
24 structure based on the soil bearing strength of about
25 3,000 pounds per square foot, which in my opinion is

Transcript of Proceedings - October 10, 2012
Volume 4

624

1 only the 26, 27, 28, and alternate 20A at the east
2 central area where it gets to be rocky and minimum
3 amount of soil area that the minimum has even any
4 possibility. You get into the areas where you have
5 the wetlands or underneath the hay, beans, soybeans,
6 and the corn areas, those soils are typically 1,000
7 PSI -- or PSF or less bearing strength.

8 Q All right.

9 A In which case you'd have to either make the spread
10 footing maybe three times as large. You typically
11 don't do that. You compromise and go deep like you
12 do a fence post as opposed to a flange that lays on
13 something strong.

14 Q That doesn't really matter for only removing the top
15 four or five feet, does it?

16 A No.

17 Q Okay. Any other -- any other comments on
18 Mr. Pobloskie's testimony from yesterday?

19 A No. Other than the comment that he won't just go to
20 the internet and you get ones with comparable
21 megawatt and size to what is proposed at Highland
22 Wind. Those numbers are four and a half to five
23 times his average, which means size matters I guess
24 is what it boils down to.

25 Q And what are the names of those projects that you

Transcript of Proceedings - October 10, 2012
Volume 4

625

1 found?

2 A It was Montage Wind in Oregon, and the other one was
3 Record Hills in Maine.

4 Q And these are --

5 A And then I went to bed.

6 Q These are decommissioning plans that have been
7 accepted?

8 A And on the internet.

9 Q Now, what is the -- does the Applicant have a
10 motivation to have a low decommissioning cost?

11 A Yes.

12 Q Why is that?

13 A Well, it's out of sight, out of mind. Then they
14 don't have to -- performance bond, bond an amount, or
15 have a sinking fund factor that takes away from their
16 income stream, that lowers their value in 20, 30
17 years or whatever the time is. Somebody else gets
18 stuck with cleaning it up. Mr. Pobloskie was unaware
19 that -- who would or whatever would have to take up
20 and clean up the mess.

21 Q Well, who would if the company doesn't?

22 A It would most likely go to the community that
23 authorized it. Less likely that the county or the
24 state would take it up. It would be sort of like,
25 you asked for it, Forest, you think you got some

Transcript of Proceedings - October 10, 2012
Volume 4

626

1 benefits from it, you clean it up. And that's just
2 speculation, but right now there is no
3 decommissioning program at the federal or state
4 level.

5 Q What -- what about projecting labor costs in 30
6 years? Give us a comparison of labor costs --

7 MR. LORENCE: Your Honor, can I just
8 interject here? We're getting a bunch of questions
9 that could have been asked as part of this witness's
10 direct and prefiled a long time ago, it sounds to me
11 at least.

12 EXAMINER NEWMARK: Right. I agree. I
13 think it's also clear that this witness has
14 calculated and investigated this topic, and that his
15 estimate is way higher than the company's. So we're
16 clear on that.

17 MR. REYNOLDS: All right. That's fine. I
18 have nothing further.

19 EXAMINER NEWMARK: Okay.

20 MR. REYNOLDS: Oh, did I do the testimony?
21 Yes, I did. I think I did. All right.

22 EXAMINER NEWMARK: Yep. We're all good
23 with that.

24 MR. REYNOLDS: Okay.

25 EXAMINER NEWMARK: All right. Cross?

Transcript of Proceedings - October 10, 2012
Volume 4

627

CROSS-EXAMINATION

BY MR. WILSON:

Q So I was little bit confused by some of your exchanges here. At the beginning of your questioning by Mr. Reynolds, you said something about two of the turbines were different, or two of the projects were different somehow?

A No. None of the seven in Pobloskie's case are of the size or completeness or realistic salvage value that had any meaning to my estimate, which is complete site specific in this case.

Q Were all of the sites that Mr. Pobloskie found dealing with utility-scale turbines?

A Say that again.

Q Were they all dealing with utility-scale turbines?

A They were dealing with 1.7 to 2 range. I don't care what you call them. They're smaller than the 2.5.

Q Do you happen to know --

A So you can put any label on them. They're about two-thirds the size of the turbines being proposed in this project.

Q Do you know what --

A In other words, that's the number. You can put whatever label you want on that.

Q Do you happen --

Transcript of Proceedings - October 10, 2012
Volume 4

628

1 A They are smaller.

2 Q Do you happen to know how tall the towers were for

3 each of these?

4 A No.

5 Q Did you look?

6 A But by compare --

7 Q Did you look?

8 A What? It wasn't part of the stuff that was

9 downloaded that was used by Mr. Pobloskie, and he

10 didn't go into any of those details either. He just

11 took the numbers from the sites that he took, and I

12 would have to spend a lot of time to go into those.

13 And if you go to the smaller turbines independent of

14 the height, you have less weight in the tower --

15 Q Mr. Stamberg, you've already testified to that.

16 A Okay.

17 Q Please answer my question. My question is, when you

18 reviewed these sites, did you specifically look for

19 the height of the towers?

20 A I did not and --

21 Q That's all I need. Thank you.

22 A And quite frankly, that's not important.

23 Q Thank you. Let's take a look at your testimony.

24 Let's start with your direct. You would agree with

25 me, Mr. Stamberg, that we have very little experience

Transcript of Proceedings - October 10, 2012
Volume 4

629

1 with actually decommissioning wind farms in this
2 country, correct?

3 A Nobody has that experience.

4 Q Okay.

5 A Yet. What I tried to do is itemize all the
6 functions, some of which Mr. Pobloskie described, and
7 then I went to a standard estimating manual.

8 Q I understand what you did. I've read your testimony.
9 Thank you.

10 MR. REYNOLDS: Well, he's trying to answer
11 your question.

12 EXAMINER NEWMARK: No. Let's move on. I
13 think we got it.

14 MR. REYNOLDS: Okay.

15 BY MR. WILSON:

16 Q So on page 3 of your direct testimony, you're giving
17 examples --

18 A Page what?

19 Q Page 3.

20 A Okay, 3.

21 Q You're giving examples of wind and wind projects that
22 you've worked on. Were all of these examples that
23 you're giving here regarding decommissioning costs?

24 A Some of them were. Others -- the Alaskan thing
25 addressed the CO2 benefit because when you run a wind

Transcript of Proceedings - October 10, 2012
Volume 4

630

1 turbine, you have to run an auxiliary other thing to
2 make up the difference when you lose wind or gain
3 wind, and the CO2 benefit isn't just the fuel that's
4 displaced --

5 Q I'm really not interested in CO2. What I'm
6 interested in --

7 A Oh, okay. I thought you asked me for it.

8 Q What I asked you is, your examples here, how many of
9 them dealt with decommissioning costs?

10 A Most of them did.

11 Q Most of them. And in most of those cases, you were
12 reviewing those projects on behalf of who?

13 A The town -- the State of Alaska. Let's see. Yeah.
14 If you're going at it, I did not work directly for
15 the developers.

16 Q You've never done any work for a developer?

17 A On wind, no.

18 Q Okay.

19 A On other subjects, yes.

20 Q Okay. At line 13 of your testimony, 13 and 14, you
21 bring up the issue of decommissioning agreements.

22 Can you describe for me generally what those
23 agreements are?

24 A Where are you?

25 Q I'm at lines 13 and 14 on page 3.

Transcript of Proceedings - October 10, 2012
Volume 4

631

1 A Yes. Because when I looked at some of the
2 decommissioning costs that we have participated in
3 and compared them to Michels Corporation or Michels
4 Wind Energy, subdivision of them.

5 Q Okay. I guess I don't understand that. What is in a
6 decommissioning agreement? Is that an agreement
7 between the town and the developer?

8 A The developer, the bonding company, sinking fund
9 factor. And the bonds can be either performance,
10 which they say you do it no matter what, versus an
11 estimated amount.

12 Q Okay.

13 A And those are two different structures of bonds. And
14 the sinking fund factor is where you put it in an
15 escrow account.

16 Q Sure. So these decommissioning agreements are
17 essentially the surety agreements for the project?

18 A Yes.

19 Q Thank you. And on line 16 you begin referencing
20 decommissioning plans that you reviewed, and like
21 your previous work, none of that was done on behalf
22 of the developer?

23 A Those items were not in there or in there properly.

24 Q I'm sorry? Say that again.

25 A Oh. The preparation, loading, and salvage, those

Transcript of Proceedings - October 10, 2012
Volume 4

632

1 items were often not done properly. They used either
2 internet quotes of what a recycle facility sells --

3 EXAMINER NEWMARK: Wait, wait, wait.

4 Restate your question and let's focus.

5 BY MR. WILSON:

6 Q Do you see the reference to submit a decommissioning
7 plan on line 16?

8 A Say that again.

9 Q Do you see the reference to decommissioning plans on
10 line 16?

11 A Yes.

12 Q Okay. My question was, like your previous work, none
13 of those decommissioning plans were reviewed on
14 behalf of the developer?

15 A No.

16 Q And what was your charge when you were reviewing
17 these plans? Was it for the adequacy of the plan?
18 Was it for the cost?

19 A Accuracy of the plan, completeness of the elements in
20 a decommissioning, and the salvage value that you
21 would get in the site-specific area. Like I searched
22 out a number of people here and found American Iron,
23 Northern Recycling Group owned by EMR as the one that
24 has the capability that you would --

25 EXAMINER NEWMARK: Okay.

Transcript of Proceedings - October 10, 2012
Volume 4

633

1 MR. WILSON: You've already testified to
2 that.

3 THE WITNESS: Okay.

4 MR. WILSON: You already testified to
5 that.

6 BY MR. WILSON:

7 Q Let me just ask you. This is your -- on page 3, this
8 is your body of work as it were with respect to
9 decommissioning, and I just wanted to ask you if in
10 any of your professional work regarding
11 decommissioning whether you have ever concluded that
12 a cost estimate was too high?

13 A No.

14 Q Have you ever concluded that a cost estimate was
15 reasonable?

16 A Not in total, but certain elements I agreed with.

17 Q Okay. So not in total means you've never found one
18 reasonable?

19 A If it's underneath the cost and they excluded things
20 or overvalued the actual site-specific salvage value,
21 the answer is I have not done that.

22 Q I also was curious about your dialogue with
23 Mr. Reynolds with regard to foundations. As you're
24 aware, there's been a difference of opinion about the
25 depth of the foundations. Is it -- is it still your

Transcript of Proceedings - October 10, 2012
Volume 4

634

1 testimony that foundations in this project will need
2 to be 32-feet deep?

3 A They -- several things. First of all, the not
4 subject to construction for permit review only --

5 MR. REYNOLDS: Let me object.

6 THE WITNESS: -- quantities and all that
7 is not --

8 MR. REYNOLDS: Excuse me. I'm objecting.
9 This isn't -- his design criteria of the foundation
10 is irrelevant. We're talking about decommissioning,
11 and he's perfectly happy to design these pads if
12 you'd like, but I think we're going to waste a lot
13 of time.

14 EXAMINER NEWMARK: All right. Well, the
15 company wanted some clarification on what he said,
16 and I agree, I was lost. So, I mean, if you want
17 that clarification, you can keep going. That's fine
18 with me.

19 BY MR. WILSON:

20 Q And if you can answer this yes or no, I would really
21 appreciate it. Is it your position that there will
22 still be a need for foundations for this project that
23 are two or -- 32-feet deep? Yes or no.

24 A That is one of the options with the foundations that
25 don't meet the specific requirement by Renewable

Transcript of Proceedings - October 10, 2012
Volume 4

635

1 Recycle Consultants --

2 Q Okay.

3 A -- that LLC. It is one of the options, you go deep
4 rather than spread it out in the poorer soils as
5 defined by them.

6 Q Okay. Is it your testimony that the foundation
7 designs in this project by RRC are faulty?

8 MR. REYNOLDS: Objection. Relevance.
9 This isn't what his testimony is about.

10 EXAMINER NEWMARK: Overruled. Overruled.

11 THE WITNESS: They're premature. There
12 has not been soil borings specific to the area to
13 decide whether you go spread footings that are
14 larger or deeper, okay? The submitted S1, S2 is
15 minimal. It's stated on the drawing, these are
16 minimum sizes and assume a soil strength that
17 probably doesn't exist in the surface other than
18 probably in the area of 27, 28, and 29, and 20A may
19 be able to use foundations that would be the
20 minimum. The others will likely have to be wider or
21 deeper.

22 BY MR. WILSON:

23 Q And if no soil borings have been done, how can you
24 possibly tell us whether we've got the right turbine
25 foundation or not?

Transcript of Proceedings - October 10, 2012
Volume 4

636

1 A Yeah. There's two things that are needed. One is
2 you need to select the turbine because the turbine's
3 weight and momentum for falling over are different
4 and specific, difference between Siemens and the
5 Nordex ones. So to do this properly, you need to
6 select the turbines, do the soil boring, and then do
7 the foundation design, be it spread, deeper, or you
8 cut the hole deep enough that you get to some soil
9 that is strong enough to meet the criteria in the
10 design.

11 Q And what's the basis of your assumption that there
12 are no soil borings that have been done?

13 A I found no soil borings specific to the different
14 turbines. One size does not fit all. You've got the
15 rocky stuff to the center and east, and then you go
16 to the wetlands and the agricultural soils with the
17 hay, soybeans, and corn.

18 Q So did you request from the developer or the
19 Applicant in this proceeding whether they had any
20 soil data?

21 A They may have soil data. There's only a few data,
22 but none of them is specific to the turbines that you
23 would need for design.

24 Q Okay. Did you ask for any data that they may have
25 with regard to soil?

Transcript of Proceedings - October 10, 2012
Volume 4

637

1 A No.

2 Q Okay. And when you say you looked, where did you

3 look? Just in the application?

4 A The application and the revised applications, yes.

5 Q Okay. Your Exhibit 6, this was taken directly from

6 the application?

7 A Correct.

8 Q Okay. Mr. Stamberg, I've just handed you an enlarged

9 drawing of sheet S3 which was contained in the

10 original application in this proceeding right behind

11 the two that are contained in your Exhibit 6. Have

12 you seen this document before?

13 A No, I have not. I looked for it in the stuff that we

14 downloaded, but I did not have that.

15 Q Okay. So at the top on the left, do you see that, an

16 indication of what the height of the foundation is

17 going to be?

18 A Yes.

19 Q And what would that be?

20 A This is the way -- it's a preliminary drawing is, 8

21 foot 2 plus 2 foot, which makes it 10 foot 2 inches.

22 Q Okay. And taken together with these other drawings,

23 this would be spreader foot foundations?

24 A Is this what?

25 Q Are these -- is this a spreader foot foundation?

Transcript of Proceedings - October 10, 2012
Volume 4

638

1 A This is a preliminary, not for construction, minimum
2 design.

3 Q Right. Did you base your testimony on the two
4 drawings, S1 and S2?

5 A Yes.

6 Q Okay.

7 A And I assumed that the base of the foundation was
8 about two foot under the surface below the frost line
9 so you wouldn't get heave without this drawing. That
10 was a basis of my calculation.

11 Q And did it surprise you at all when you found sheets
12 S1 and S2 that there was no profile drawing of the
13 foundation?

14 A I could not find it in the stuff that we had.

15 Q I understand you couldn't find it. I asked you if
16 you were surprised that it was there.

17 A I wasn't surprised. I looked for it, and I couldn't
18 find it, and I made assumptions that the foundation
19 at least had to be two-feet deep or thereabouts to be
20 below the frost line of design so you wouldn't get
21 frost heave where you get frozen water, it expands,
22 and deteriorates that. So you probably have to be
23 about two feet, at least, deep.

24 Q Okay.

25 A And that's the basis of my calculations.

Transcript of Proceedings - October 10, 2012
Volume 4

639

1 Q So all of your testimony was done without knowledge
2 that sheet S3 existed?

3 A Correct.

4 Q You would agree with me, Mr. Stamberg, that
5 foundation removal is one of the most expensive tasks
6 in decommissioning?

7 A Yes.

8 Q In fact, in your estimate, it's approximately 50
9 percent of the cost?

10 A 48 percent, yes.

11 Q Okay. I'm looking at -- take a quick look at
12 Exhibit 8.

13 A Yes.

14 Q So in the first line on your Exhibit 8 is the
15 foundation removal. Only five feet of the
16 30-foot-deep foundation, correct?

17 A Yes. And that's 680 cubic feet, thereabouts. Your
18 minimum drawing is 690 something. So we pretty much
19 agree on how much minimum cement is there. The
20 difference between S3 that you just showed me and my
21 assumption was that the foundation was only deep
22 enough to meet the frost requirement for frost heave
23 as opposed to being variable.

24 Q Okay. Let's start, are you familiar with PSC 128
25 decommissioning provisions?

Transcript of Proceedings - October 10, 2012
Volume 4

640

1 A Say that again.

2 Q Are you familiar with the PSC 128 rules
3 decommissioning provision?

4 A Not in detail, no.

5 Q Are you aware that those rules only require removal
6 to four feet instead of five feet?

7 A Yeah. And by varying the foundation, you can gain
8 and leave this 95 percent still in place.

9 Q Okay. My question was, are you aware that the
10 requirements are that you only remove four feet below
11 the surface?

12 A If you say so, that's fine.

13 Q Okay. So to the extent that you're removing five
14 feet here, your estimate's going to be a little bit
15 high because there's a foot that we aren't going to
16 have to remove, correct?

17 A Yeah. I had the whole foundation was at least two
18 feet which is sitting above the four-foot level.

19 Q Okay. All right. And so I think you referenced this
20 already, but if you -- if you go to S1 in your
21 Exhibit 6, and under the design criteria there on the
22 right-hand side of the page.

23 A Yes.

24 Q Under two, that's the estimated structural material
25 quantities. Do you see that?

Transcript of Proceedings - October 10, 2012
Volume 4

641

1 A Uh-huh.

2 Q And between the base concrete and the pedestal

3 concrete, the pedestal concrete is what would be

4 essentially above ground. You've got approximately

5 707 cubic yards, correct?

6 A Where is that on there?

7 Q Well, the base --

8 A There's A, B, C, D, E.

9 Q Under A, base concrete, there's 694 cubic yards,

10 correct?

11 A Yes. And I've used 680 in my calculation assuming

12 that was two foot below.

13 Q And then B is the pedestal concrete?

14 A All right.

15 Q Which is 13-and-a-half cubic yards?

16 A Yeah.

17 Q Okay. So together those are approximately 707 cubic

18 yards?

19 A That's correct.

20 Q Correct. Okay. So for the foundations that are

21 represented by this set of drawings, your cost

22 estimate is removing 90-some percent of that

23 foundation, correct?

24 A Yeah. Basically the whole foundation because I

25 assumed it was all --

Transcript of Proceedings - October 10, 2012
Volume 4

642

- 1 Q And that's not required, is it?
- 2 A What?
- 3 Q And that's not required, is it?
- 4 A What is not required?
- 5 Q To remove 90-some percent of the concrete.
- 6 A No. If you go by 128, it's four feet.
- 7 Q Correct.
- 8 A And so the way to avoid getting rid of the foundation
- 9 is just make it deeper below the four feet, and the
- 10 ground level thing needs to be sophisticatedly
- 11 defined, original contour, slope, and different
- 12 things like that that can make several feet
- 13 difference.
- 14 Q All right. So if we have a foundation which is 10
- 15 feet 2 inches deep, and we only remove down to four
- 16 feet below the surface, that's approximately 40
- 17 percent of the -- of the foundation, correct?
- 18 A I haven't done the arithmetic, yes. But by putting
- 19 the spread foundation deep, under four foot, you can
- 20 meet the minimum requirements of 128, but not the
- 21 spirit of removing it.
- 22 Q Okay. My question was, if we have an approximately
- 23 10-foot-deep foundation and we're only required to
- 24 remove four feet of it.
- 25 A Correct.

Transcript of Proceedings - October 10, 2012
Volume 4

643

1 Q Does that not mean that approximately 60 percent is
2 going to be left in the ground?

3 A I'd have to sit here and calculate it, but it would
4 be less.

5 Q How much less?

6 A Well, you want me to sit here and calculate it?

7 Q Yeah, I do.

8 A Okay. I don't know what the percentages are.

9 Q Mr. Stamberg, I'm showing you a set of calculations
10 that Mr. Pobloskie did. He -- those numbers indicate
11 that if you remove four feet, that you're only
12 removing 26 percent of the base and pedestal. Do you
13 see that?

14 A I see that, but I can't verify it unless I sit
15 down -- you give me an hour, I can make my own chart,
16 okay?

17 Q Okay.

18 A Then the other thing is --

19 Q I didn't ask you a question.

20 A Oh, okay.

21 Q You can't give me an answer as to whether that 26
22 percent looks reasonable for a spreader foundation?

23 A I calculate stuff. I can't do that right now.

24 Q Fair enough.

25 A You give me a half hour, I will.

Transcript of Proceedings - October 10, 2012
Volume 4

644

1 Q Fair enough. Subject to check, if only 26 percent of
2 the foundation is being removed -- let's just use 25
3 percent for round figures.

4 A That's your assumption.

5 MR. REYNOLDS: Is this a hypothetical
6 question?

7 MR. WILSON: It's a subject to check
8 question.

9 MR. REYNOLDS: Okay. Is that --

10 BY MR. WILSON:

11 Q 26 percent of the foundation would be removed to get
12 down to four feet below grade, and if that were true,
13 then your removal of 680 tons is -- the proper amount
14 that would have to be removed is one quarter of 680
15 tons, correct?

16 MR. REYNOLDS: Object to the form of the
17 question. There's no foundation for these numbers
18 in the record. These are just assumptions.

19 EXAMINER NEWMARK: Well --

20 MR. REYNOLDS: I'm mean, we're back to
21 kind of the late exhibit, that Mr. Pobloskie could
22 have testified to these facts if that's true, but I
23 think it's too late now.

24 EXAMINER NEWMARK: Fine.

25 MR. WILSON: Let me ask the hypothetical

Transcript of Proceedings - October 10, 2012
Volume 4

645

1 then.

2 EXAMINER NEWMARK: Yeah. If that's how
3 you want to do it, yeah.

4 BY MR. WILSON:

5 Q Hypothetically, Mr. Stamberg, if we only had to
6 remove 26 percent of the foundation to get down to
7 the required four feet, would we have to remove all
8 680 tons in your estimate, or would we have to remove
9 approximately 25 percent of that?

10 A I can't stipulate to the 25. When you say four
11 feet --

12 Q No. I'm asking you to make that assumption. This is
13 a hypothetical question. Your answer has to assume
14 that we only are removing 26 percent of the
15 foundation. If that's true --

16 A If it's proportionately less, the estimate will be
17 proportionately lower. Then your assumption about
18 the four feet is at odds with Pobloskie's thing which
19 shows four feet dipping down into the cone and back
20 up. If you look at Pobloskie --

21 Q We can get out Mr. Pobloskie's picture and look at it
22 in a few minutes, but I think you just said that
23 your -- the amount of concrete that we would have to
24 take out would be proportionately reduced?

25 A Under your assumptions, that's correct.

Transcript of Proceedings - October 10, 2012
Volume 4

646

1 Q Right. So at 25 percent, we would need to take out
2 only 25 percent of 680?

3 A That is purely based on your assumptions, and I have
4 not made independent calculations of that.

5 Q And so if that's true, then the cost of removing the
6 foundation would be significantly less than is in
7 your estimate; isn't that right?

8 A It would be less and proportional under those series
9 of assumptions, the four feet and the 26 percent.

10 Q Okay. Mr. Stamberg, when you estimated 680 tons for
11 only the first five feet --

12 A I said what I did. I assumed that the foundation was
13 surface mounted and two-feet deep under the frost
14 line, so the entire model lid or foundation was above
15 the four feet. And these preliminary designs,
16 without knowing the turbine or the soil conditions,
17 may be different.

18 Q How does that relate to the 32-foot assumption?

19 A The --

20 Q Was that 32 feet underground?

21 A Yes. And what you do is when you look at this, this
22 is predicated on a 3,000 pounds per square foot soil
23 bearing strength. The cornfields, the hayfields, the
24 soybean fields, the agricultural area does not have
25 that. So you have to either make a much bigger

Transcript of Proceedings - October 10, 2012
Volume 4

647

1 spread foundation, or you go deep like a fence post,
2 or find an economic optimum between the two. And my
3 judgment is that only about three of the foundations
4 have a possibility of using the minimum design here.
5 The rest of the designs would either have to be
6 spread out, much larger, calculated last night maybe
7 about 120-foot diameter, which would be probably
8 about three times the concrete. That's probably not
9 what you would do to optimize this design. You would
10 compromise the spread footing and try and get rid of
11 the load and bearing strength down to areas that have
12 the strength and will take the momentum of tipping
13 over that. You've got 2.5 megawatts, which is like a
14 3,000 horsepower engine up there working in reverse
15 generating. It's about 90 tons up there. You don't
16 want this thing to tip. Two things that you need to
17 be aware of site specific because one is the --

18 Q You're not being responsive to my question. Let's
19 try it a different way.

20 Tell me how you calculated 680 cubic yards
21 was being removed. How did you come up with 680
22 yards?

23 MR. REYNOLDS: Your Honor, I object.
24 We've been around this now for almost a half an
25 hour, and I think he's beat it to death.

Transcript of Proceedings - October 10, 2012
Volume 4

648

1 MR. WILSON: I don't even think I've
2 started, Glenn.

3 MR. REYNOLDS: Okay.

4 MR. WILSON: It's pretty clear that he's
5 overestimated the amount of concrete, and that's
6 pretty critical to the record.

7 MR. REYNOLDS: I think we've been through
8 that.

9 EXAMINER NEWMARK: It would be much
10 quicker if you could direct your witness to answer
11 the questions. When the company asks a question,
12 give a specific answer. We could move on.

13 BY MR. WILSON:

14 Q How did you calculate 680 cubic yards had you removed
15 only down to five feet?

16 A I took the 67-foot diameter and calculated the volume
17 of the cone and pedestal and came up with 680, versus
18 your 690 minimum, okay? It's essentially the same,
19 okay?

20 Q So you essentially --

21 A But you got to let me answer now. Is I assumed that
22 this would be a surface-mounted spread footing and
23 not buried to minimize or move the foundation out of
24 the four feet and comply with a four-foot compliance.

25 Q I thought you just told me the 32-foot assumption,

Transcript of Proceedings - October 10, 2012
Volume 4

649

1 that 32 feet was all underground?

2 A No. That's not what I have in my estimate.

3 Q Yeah, but you -- did you testify that the 32 feet of
4 the foundation that you assumed was underground?

5 A No.

6 Q Do we need to go back and read your testimony?

7 A I made the judgment, okay, knowing the typical soil
8 strength that you would probably preserve the
9 foundation and work with caissons, piling, or some
10 deeper foundation to gain the strength where you
11 lacked it in the soil bearing strength that's on the
12 high side in the assumption of the 680- or
13 690-cubic-yard feet.

14 Q So was your assumption that -- you testified earlier,
15 I believe, that you went two feet into the ground?

16 A With the minimum design, I assumed it had to be at
17 least two feet under the ground or surface to prevent
18 frost heave.

19 Q And how much would be above ground?

20 A The rest of the 10 feet -- the 10 feet minus the two.

21 Q Oh, okay. So your assumption is about the same as
22 the Applicants, it's just that you've got it all
23 above ground except for two feet?

24 A Correct.

25 Q Have you ever seen a foundation designed like that?

Transcript of Proceedings - October 10, 2012
Volume 4

650

1 A Yeah.

2 Q Where?

3 A That was in Connecticut and some of these places.
4 That's a foundation. A lot of people don't
5 traditionally bury spread foundations.

6 Q But would you have understood that had you looked at
7 drawing S3?

8 A No. The design of S3 buries the concrete so that the
9 four or five foot or the dip that was shown in
10 Pobloskie's thing, the amount of removal required
11 under 128 is avoided by burying the foundation.

12 Q So I think we've discovered the source of our
13 misunderstanding. You believe we have to move 680
14 tons because in your design it's mostly above ground?

15 A Correct.

16 Q Okay. Can you please turn to page 9 of your direct.
17 Now let me -- let me ask you, based upon the
18 design -- foundation design that you assumed went
19 into the ground two feet?

20 A Yes.

21 Q So under the PSC requirement to go to at least four
22 feet, we would have to remove 100 percent of your
23 design, correct?

24 A Not my design, of the amount --

25 Q Of what you assumed?

Transcript of Proceedings - October 10, 2012
Volume 4

651

1 A Of a spread footer if it's on the surface and not
2 over four-feet deep.

3 Q Right. Which is what you assume in coming up with
4 your estimate?

5 A Correct.

6 Q Okay. So why then at line 7 on page 9 do you say
7 that 85 percent of the tower foundation will remain?

8 A Where is this?

9 Q Line 7.

10 A Page 9 where?

11 Q Line 7.

12 EXAMINER NEWMARK: Direct 9.

13 MR. REYNOLDS: Your direct.

14 BY MR. WILSON:

15 Q Are you looking at your direct testimony?

16 A Yes.

17 Q Page 9, line 7.

18 EXAMINER NEWMARK: It's in print.

19 THE WITNESS: I got the erection of 41
20 turbines placing them on the ground at the site.

21 EXAMINER NEWMARK: This is not what was
22 filed.

23 MR. REYNOLDS: Here you go.

24 EXAMINER NEWMARK: Maybe we'll find S3 in
25 there somewhere.

Transcript of Proceedings - October 10, 2012
Volume 4

652

1 THE WITNESS: The 85 percent is incorrect.

2 BY MR. WILSON:

3 Q Your testimony is incorrect?

4 A This note is, and this is for the minimum design
5 foundation. If you have to increase it because of
6 poor soils, then the deeper, wider foundation --
7 well, you decrease that, but that's in error.

8 Q So if -- if this is incorrect that 85 percent of the
9 tower foundation will remain, does that also mean
10 that your calculation of how much concrete had to be
11 removed is incorrect?

12 A No. The amount on my assumption that it's two feet
13 into the ground is correct. The 85 percent is
14 incorrect.

15 Q Okay. Then let's go back to your Exhibit 8. Are you
16 there?

17 A Yes.

18 Q Okay. Item 1, foundation removal, paren, only five
19 feet of 30-foot-deep foundation. So that
20 parenthetical is incorrect, too?

21 A Yeah. It should be a possible 30-foot depth if you
22 don't have the soil conditions to justify the minimum
23 amount of things. So it should be in a possible
24 30-foot depth.

25 Q And your assumption on foundation here is the

Transcript of Proceedings - October 10, 2012
Volume 4

653

1 foundation that you described, two feet under and --

2 A Yeah, below the frost line.

3 Q Okay. So if you look at -- there's an -- after
4 foundation removal, there's a footnote, Footnote 1.
5 And Footnote 1 says, design submitted by the Highland
6 Wind Farm per Exhibit JBS 6?

7 A Right.

8 Q So the design of the Highland Wind Farm is not what
9 you assumed in your testimony, is it?

10 A No. It was based on S1, S2, and I did not have S3.

11 EXAMINER NEWMARK: Do we need any more?
12 Do we need any more? I mean --

13 MR. WILSON: Just give me one second.

14 EXAMINER NEWMARK: Okay.

15 MR. WILSON: I think that's all we have
16 for Mr. Stamberg, but I think we're going to end up
17 having to put Mr. Pobloskie back up to substantiate
18 the calculation of the amounts removed.

19 EXAMINER NEWMARK: Okay. Any other cross
20 for Mr. Stamberg?

21 MR. LORENCE: No.

22 EXAMINER NEWMARK: Redirect?

23 MR. REYNOLDS: Yes.

24 REDIRECT EXAMINATION

25 BY MR. REYNOLDS:

Transcript of Proceedings - October 10, 2012
Volume 4

654

1 Q Bottom line is that regardless of the design of the
2 foundation or how much, you know, is compliant with
3 128, you have concrete that needs to get taken out of
4 the ground and removed, right?

5 A Yes.

6 Q And you've given a per cubic yard expense for that,
7 haven't you?

8 A Yes.

9 Q All right. And so even with a reduced amount, how
10 does your foundation removal estimate compare with
11 Michels Pipeline's removal estimate?

12 A They are -- I'm around --

13 MR. WILSON: I'm going to object to that.
14 That's improper redirect. I never asked anything
15 about the Michels' plan.

16 MR. REYNOLDS: Well, I'm just trying to
17 get to the heart of this issue that we've spent at
18 least a half an hour on.

19 MR. WILSON: Right. And there's proper
20 direct and redirect.

21 MR. REYNOLDS: Well, I'm redirecting on
22 this subject matter.

23 EXAMINER NEWMARK: Well, these figures are
24 in the record. I think the calculations can be made
25 based on that, so let's go on.

Transcript of Proceedings - October 10, 2012
Volume 4

655

1 THE WITNESS: It's about --

2 EXAMINER NEWMARK: That's okay. Do you
3 have another question?

4 BY MR. REYNOLDS:

5 Q I'm sorry. So is there -- if your estimate of \$7
6 million to remove 41 turbines is less -- is reduced
7 by a certain percentage, then we would get to your
8 figure by whatever percentage less of concrete that
9 needs to be removed --

10 A Yes.

11 Q -- is that right?

12 All right. Now, with respect to the
13 recycling of the metal, how do we get the metal --

14 MR. WILSON: Objection. I never asked a
15 thing about recycling.

16 EXAMINER NEWMARK: Yeah. Sustained.

17 MR. REYNOLDS: All right. That's all I've
18 got.

19 EXAMINER NEWMARK: Okay. You're excused.
20 Thanks very much.

21 (Witness excused.)

22 MR. LORENCE: Off the record.

23 (Discussion off the record.)

24 EXAMINER NEWMARK: I just want to be sure,
25 you don't need to put it in as a separate item, S3,

Transcript of Proceedings - October 10, 2012
Volume 4

656

1 but it is part of the application. It is in a
2 document titled RCC Turbine Foundation Design
3 Drawings, which is part of Appendix E in the
4 application, PSC reference number 160362, and that's
5 been on ERF.

6 Okay. So what do we have left? Do we
7 want to re-call --

8 MR. REYNOLDS: Yep. I've got a new
9 number.

10 EXAMINER NEWMARK: Oh, right. The call
11 and re-call, okay.

12 MR. WILSON: I think we'll forgo any cross
13 of Mr. Phillips.

14 EXAMINER NEWMARK: Generous of you.
15 Anyone else need cross of Mr. Phillips?

16 MR. McKEEVER: Give me just a moment to
17 look at my notes.

18 EXAMINER NEWMARK: Off the record.

19 (Discussion off the record.)

20 (Call placed to Mr. Phillips.)

21 CARL PHILLIPS, TOWN OF FOREST WITNESS, DULY SWORN

22 EXAMINER NEWMARK: All right. Go ahead.

23 DIRECT EXAMINATION

24 BY MR. REYNOLDS:

25 Q Mr. Phillips, can you hear me okay?

Transcript of Proceedings - October 10, 2012
Volume 4

657

1 A Yes.

2 Q All right. You have submitted some surrebuttal
3 testimony in this case?

4 A Yes.

5 Q All right. Is it true and correct to the best of
6 your knowledge?

7 A Yes, it is.

8 Q And if you were -- if you -- is there anything you'd
9 want to change in it as of today?

10 A No.

11 MR. REYNOLDS: All right. That's all I've
12 got.

13 EXAMINER NEWMARK: And you'll affirm your
14 exhibit as well? Your exhibit is true and correct
15 to the best of your knowledge?

16 THE WITNESS: I'm sorry? What was it?

17 EXAMINER NEWMARK: Your exhibit, is that
18 true and correct to the best of your knowledge?

19 THE WITNESS: My submitted testimony and
20 CV, yes, they are.

21 EXAMINER NEWMARK: Okay. Cross?

22 CROSS-EXAMINATION

23 BY MR. MCKEEVER:

24 Q Good evening, Mr. Phillips. This is Peter McKeever.
25 I'm one of the lawyers for the Forest Voice group,

Transcript of Proceedings - October 10, 2012
Volume 4

658

1 the group of citizens.

2 A Hello.

3 Q I've got a couple of questions for you. Do you have
4 a copy of your surrebuttal testimony there in front
5 of you?

6 A I do.

7 Q Okay. On page 3 at line 19, you state that there's
8 overwhelming scientific evidence that wind turbines
9 cause serious health problems for some people living
10 near those residences; is that correct?

11 A Yes.

12 Q Okay. We can argue a lot about what constitutes
13 scientific evidence, and there's plenty in this
14 record that does that. Isn't it true that there's
15 also overwhelming anecdotal evidence of the same
16 thing?

17 A Well, yes. In fact, most of the scientific evidence
18 as I state elsewhere in this document actually takes
19 the form of what's sometimes called anecdote, though
20 in this case they're better considered to be
21 individual experiments. So that's the bulk of the
22 scientific evidence that I'm referring to. Not all
23 of it, but the bulk of it.

24 Q Okay. And these reports, they constitute what you
25 refer to in your testimony as AERs; is that right?

Transcript of Proceedings - October 10, 2012
Volume 4

659

1 A That's right. Adverse event report.

2 Q Okay. And you're an epidemiologist, correct?

3 A That's right.

4 MR. McKEEVER: Okay.

5 EXAMINER NEWMARK: I don't think anything
6 here is something we haven't seen in direct --

7 MR. McKEEVER: I understand.

8 EXAMINER NEWMARK: -- or surrebuttal.

9 BY MR. McKEEVER:

10 Q I lost my train of thought. Those AERs play an
11 important role in -- let's call it the
12 epidemiological process; is that right?

13 A That's right. In addition to cases like this where
14 they actually contain individual experimental data,
15 they also play a very crucial role in the drug
16 monitoring and approval process. They're called AVEs
17 in that context, adverse drug events. But the idea
18 is that when we don't have a formalized study going
19 on to look for a particular outcome, it's this type
20 of report that's our best source of information to
21 discover it.

22 Q Okay. You state in your testimony, and I'm not going
23 to be able to put my finger on the page and the line
24 right at the moment, but you state that there is,
25 quote, a clear pattern of disease. What does that

Transcript of Proceedings - October 10, 2012
Volume 4

660

1 mean?

2 A By that I'm referring to the particular type of
3 health outcomes that we've seen. While any given
4 individual report might have a few odd claims where
5 someone suffered some other disease just by
6 coincidence probably, we have this clear pattern of
7 these stress-related diseases that identify insomnia,
8 inability to concentrate, headaches, stress
9 disorders, mood disorders, and that is -- that's a
10 pattern of outcome that are quite reasonably related
11 to each other. It's not like we saw something
12 strange like, you know, bladder cancer and spinal
13 injuries showing up. And it's that pattern that's
14 part of what helps us conclude that, yes, there
15 really is a phenomenon we're observing here.

16 Q Right. So these elements that are what you include
17 and what you call a clear pattern of disease, those
18 conditions, would you consider those health problems?

19 A Oh, absolutely.

20 Q Okay. From an epidemiological point of view, are
21 they still health problems even if scientifically we
22 don't fully understand how the human body is
23 stimulated by the sounds and infrasounds of wind
24 turbines?

25 A I'm sorry. I missed the phrase. It's the yes-or-no

Transcript of Proceedings - October 10, 2012
Volume 4

661

1 nature of that. But to answer, absolutely they are
2 health problems even to the extent that we don't
3 understand why they're happening. In fact, that is
4 one of the most important aspects of epidemiology is
5 it lets us detect a health problem, a
6 cause-and-effect relationship, without knowing every
7 intervening step that's the causal mechanism in
8 between. And so there's -- you know, there's nothing
9 that changes the fact that these are serious health
10 problems to be found in our lack of understanding
11 about exactly why they occur.

12 Q And you would agree that more data, more research, is
13 needed on that causal question?

14 A Yes. That would be very useful. If we had that
15 research, we'd have a much better idea about what --
16 what intervention, what technological changes, and so
17 forth could eliminate these problems. Without that,
18 all we have is the broad sweep of the cause and
19 effect, and it's very difficult for us to figure out
20 how to improve the situation.

21 Q Now, epidemiology is -- it's defined -- it's defined
22 in your testimony and it has consequences, excuse me,
23 for let's call it social policy, does it not?

24 A Yes.

25 Q Okay. Do you have an opinion based on this pattern

Transcript of Proceedings - October 10, 2012
Volume 4

662

1 that you -- that you perceive in the literature, do
2 you have an opinion what would be a prudent social
3 policy to pursue at this stage when we're talking
4 about this issue?

5 A Yes. Well, it's been the case for quite some time
6 that the reasonable policy to pursue would be to find
7 out more before continuing to expose more people to
8 these risks. For almost everything in society where
9 we have a situation where a lot of people are going
10 to be exposed to something that might be harming
11 their health, we require analysis about what's going
12 to happen and -- you know, and a reason for why we
13 should allow that to happen or how we can stop it
14 from happening before we go on and create the
15 exposure. This case is a situation -- you know, not
16 this case particular in Wisconsin, but this entire --
17 this entire technology is a situation where we've
18 done it completely backwards from what's considered
19 the normal acceptable practice.

20 MR. McKEEVER: Thank you. I have no other
21 questions. I appreciate your time and your patience
22 with us.

23 THE WITNESS: You're welcome.

24 EXAMINER NEWMARK: Okay. Do you want to
25 reconsider?

Transcript of Proceedings - October 10, 2012
Volume 4

663

1 MR. WILSON: I suppose I have to.

2 EXAMINER NEWMARK: Okay.

3 MR. McKEEVER: No, you don't.

4 CROSS-EXAMINATION

5 BY MR. WILSON:

6 Q Dr. Phillips, I'm John Wilson. I'm representing the
7 Applicant in this proceeding.

8 A Hello.

9 Q Do you have any formal academic training as an
10 epidemiologist?

11 A I -- I have a Ph.D. in public policy in which I
12 studied econometrics ostensibly. That's basically
13 the same science, the same statistical method, the
14 data collection and analysis. It just happens to be
15 the economist's word for it rather than the public
16 health people's word for it. Then I did a postdoc in
17 public health specifically.

18 Q Okay. And do you hold yourself out as an expert in
19 epidemiology?

20 A Yes.

21 Q Do you have any medical training?

22 A Actual clinical practice training, no. I've taught
23 in medical school, but -- certainly been involved in
24 medical education, but I haven't attempted to --
25 clinical education myself.

Transcript of Proceedings - October 10, 2012
Volume 4

664

1 MR. WILSON: That's all I've got.

2 EXAMINER NEWMARK: Okay. Other questions?

3 (No response.)

4 EXAMINER NEWMARK: Redirect?

5 MR. REYNOLDS: No.

6 EXAMINER NEWMARK: All right. Well, I'm
7 glad we found you, but now we'll have to let you go.
8 Thanks very much.

9 THE WITNESS: I apologize for the
10 difficulty. Thanks.

11 (Witness excused.)

12 MR. REYNOLDS: Jaime Junker would be my
13 next witness.

14 EXAMINER NEWMARK: Okay. Let's go off the
15 record.

16 (Discussion off the record.)

17 (Brief break taken.)

18 JAIME JUNKER, TOWN OF FOREST WITNESS, DULY SWORN

19 DIRECT EXAMINATION

20 BY MR. REYNOLDS:

21 Q Could you state your name, please.

22 A Jaime Junker.

23 Q And Mr. Junker, have you submitted testimony in this
24 proceeding?

25 A Yes.

Transcript of Proceedings - October 10, 2012
Volume 4

665

1 Q In the form of direct and surrebuttal?

2 A Correct.

3 Q Yes. And is that testimony true and correct to the
4 best of your knowledge?

5 A Yes.

6 Q Yes. And the exhibits that you've submitted, are
7 they true and correct?

8 A Yes.

9 Q Okay. Now, there has been responses to your
10 testimony in these proceedings, Mr. Munding among
11 others, sur-surrebuttal or whatever. Is there
12 anything that you would like to add to in response?

13 A Yes.

14 Q What is that?

15 A So Mr. Munding on his sur-surrebuttal, page 1, line
16 9, the question is, on page 2 of Mr. Junker's
17 surrebuttal, he suggests the company showed up
18 unannounced to a January 10, 2008 meeting of the town
19 board, how do you respond? Essentially he says that
20 is correct, they weren't on the agenda, and then he
21 points out through Exhibit Munding 8 --

22 MR. WILSON: Now, Your Honor, I'm going to
23 object. All he's doing is repeating what's in his
24 sur-surr.

25 EXAMINER NEWMARK: Well, let's have him

Transcript of Proceedings - October 10, 2012
Volume 4

666

1 answer as it relates to -- his sur-surr, right. As
2 it relates to Exhibit 8 anyway. So what were you
3 going to say?

4 THE WITNESS: Yeah. So actually this is
5 responding to what was handed to me yesterday
6 morning.

7 EXAMINER NEWMARK: I understand.

8 THE WITNESS: Okay. So basically in a
9 nutshell they spoke at the public input section of
10 the Forest town meeting. My point was, they used in
11 Appendix Z attendance at that meeting, what people
12 would think -- it says they gave a presentation. So
13 that confused people that they gave a presentation
14 at a town board meeting when they apparently did
15 that during public input.

16 The point being, if anyone wanted to be
17 invited to public output, you usually wouldn't do
18 that through the public input section of a meeting
19 because nobody knew they were coming.

20 BY MR. REYNOLDS:

21 Q Anything else?

22 A Yeah. It shows up saying he says they never came
23 unannounced again, but the fact is they, on the very
24 next month, showed up to the plan commission meeting.
25 And again the plan commission made a vote to put him

Transcript of Proceedings - October 10, 2012
Volume 4

667

1 on the agenda right there at the meeting, which in
2 government is not appropriate to do. The issue is
3 they're using that as their public outreach again in
4 Appendix Z, and so the broad public did not have an
5 ability to know that they were communicating about
6 this information.

7 Q Anything else? Any other responses to Munding's
8 latest?

9 A Yeah. There's a clear issue. So on page 3, the
10 first question, basically it says, how do you respond
11 to Mr. Junker's assertion that the plan commission
12 was unaware of any project details when -- when it
13 was developing the Town of Forest comprehensive plan.
14 So essentially the Town is asserting and has asserted
15 that, you know, the plan commission was not aware of
16 all the details.

17 And again, the way I would respond to that
18 is, if you look at the Appendix 3 in the Town's
19 testimony, it basically shows the plan commission
20 chairman on January 10, 2010 through basically
21 getting a question -- we're reading the plan
22 commission minutes, okay. And the plan commission --
23 commissioners are asking this figure, Carl Cress, who
24 was the chair of that plan commission, they're asking
25 him, do you have any details about this project. And

Transcript of Proceedings - October 10, 2012
Volume 4

668

1 he basically responds, there's no details available
2 at this time. This is January 10, 2010.

3 MR. WILSON: Your Honor, this is all in
4 the record. All of it.

5 THE WITNESS: But it's to his surrebuttal
6 that I got yesterday morning.

7 EXAMINER NEWMARK: But you haven't changed
8 your answer in terms of what's already prefiled.

9 THE WITNESS: But he's given new
10 information.

11 EXAMINER NEWMARK: Okay. So you're using
12 the information currently on the record to respond
13 to the new information. Okay. So it does -- so
14 your information on the record applies to what he's
15 saying here, that's what you're saying?

16 THE WITNESS: Yes.

17 EXAMINER NEWMARK: Okay.
18 Anything else?

19 THE WITNESS: The last comment would be,
20 then in August 2010, the attorneys of the Town and
21 Highland are going back and forth, and they're
22 trying to sort out --

23 MR. WILSON: Again, it's already in the
24 record, Your Honor.

25 EXAMINER NEWMARK: Okay. Is there just

Transcript of Proceedings - October 10, 2012
Volume 4

669

1 someplace you can point to your prefiled that you
2 can say responds to this section?

3 THE WITNESS: Sure. It's -- I'll give you
4 that reference.

5 EXAMINER NEWMARK: Okay.

6 THE WITNESS: It looks like Appendix 10.

7 EXAMINER NEWMARK: Okay. And just in
8 terms of how we're labeling things, is there --

9 MR. REYNOLDS: You mean Exhibit 10?

10 THE WITNESS: Exhibit 10.

11 EXAMINER NEWMARK: Okay. Your Exhibit 10
12 responds to that portion of Munding's sur-surr?

13 THE WITNESS: Well, it was Exhibit 10 of
14 my direct -- of the Town's direct.

15 EXAMINER NEWMARK: Okay. Right. Okay.

16 THE WITNESS: Okay.

17 BY MR. REYNOLDS:

18 Q I have a question about Mr. Munding's testimony
19 about his interpretation of your comprehensive plan
20 and the basis for his belief that he knows more about
21 that subject than you do. Can you respond to that?

22 EXAMINER NEWMARK: Was he here for that
23 discussion?

24 MR. REYNOLDS: I believe he was.

25 EXAMINER NEWMARK: You're talking about

Transcript of Proceedings - October 10, 2012
Volume 4

670

1 what was dealt with at the hearing yesterday?

2 MR. REYNOLDS: Yes.

3 EXAMINER NEWMARK: Okay.

4 MR. WILSON: I'm going to object to the --
5 object to the question because it mischaracterizes
6 Mr. Mundinger's testimony. He never said he was
7 more qualified than Mr. Junker.

8 EXAMINER NEWMARK: More qualified, okay.
9 Can you rephrase?

10 BY MR. REYNOLDS:

11 Q Well, okay. Is it your understanding that mister --
12 that there's dispute between you and Mr. Mundinger
13 about how your plan should be interpreted?

14 A Yes.

15 Q All right. And you heard Mr. Mundinger's response to
16 my question answering basically why do you think
17 your -- your view of the comprehensive plan carries
18 more weight?

19 A Yes.

20 Q All right. And what's your response to that?

21 A Okay. So the comprehensive plan is a document that's
22 60 pages long. Basically you can read the document,
23 and it says very clearly that -- probably the number
24 one thing in our township is this visual aspect of
25 being in the country. Everything else falls in after

Transcript of Proceedings - October 10, 2012
Volume 4

671

1 that, okay? So that's number one.

2 Now, part of the question is, Highland
3 keeps coming back to the fact that the plan mentions
4 renewable energies, and it does, but everything in
5 the comprehensive plan is small scale. Also --

6 MR. WILSON: That's already in the record,
7 Your Honor.

8 EXAMINER NEWMARK: Yeah. I guess if you
9 can answer how -- how your interpretation is more --
10 why the Commission should be giving greater weight
11 to your view of the comprehensive plan as opposed to
12 Mr. Mundinger's. What's your background, your
13 personal experience with it that gives you that
14 edge.

15 THE WITNESS: Well, I represent the Town,
16 and it's the Town's opinion that should matter the
17 most. And we're just going to the facts where the
18 Town created the document, and if we listed the
19 things pro and con, it's the reasons in the plan
20 document that don't favor large wind turbines.

21 EXAMINER NEWMARK: Okay.

22 BY MR. REYNOLDS:

23 Q Are you considering the -- this project to be an
24 industrial project with respect to how that's defined
25 in the land use plan?

Transcript of Proceedings - October 10, 2012
Volume 4

672

1 A Absolutely.

2 Q And why is that?

3 A Everything in the land use plan reads -- refers to
4 scope and scale, an appropriate small scale, and
5 these 500-foot turbines no one envisioned when they
6 drew up the comprehensive plan.

7 Q All right. And you were -- before being on the town
8 board, were you on the plan commission?

9 A I was.

10 Q For how long?

11 A Approximately six and a half years.

12 Q All right. And you've lived in the town how long?

13 A Dozen years.

14 MR. REYNOLDS: That's it.

15 EXAMINER NEWMARK: All right.

16 MR. REYNOLDS: Your witness.

17 EXAMINER NEWMARK: Do you have questions?

18 MR. WILSON: Yes.

19 EXAMINER NEWMARK: Okay. Let's go in
20 order.

21 CROSS-EXAMINATION

22 BY MR. WILSON:

23 Q Do you have a copy of the comprehensive plan up
24 there?

25 A I do.

Transcript of Proceedings - October 10, 2012
Volume 4

673

1 Q Have you reviewed what's been marked as
2 Mr. Mundinger's Exhibit 3? Would you agree that that
3 is the comprehensive plan that we're talking about?

4 A I believe so. We've referenced it, yes.

5 Q Okay. It hasn't -- hasn't been amended since
6 Mr. Mundinger submitted it into evidence here?

7 A No.

8 Q Okay. You said you were on the plan commission for
9 six and a half years. Can you give me the dates?

10 A Sure. It's in my testimony, but it's approximately
11 December of 2001 to December of 2007.

12 Q And when did you become town chairperson?

13 A It's in the spring of 2011.

14 Q So between December of '07 when you came off of the
15 plan commission until the spring of 2011 when you
16 went onto the town board, did you have any official
17 capacity with the town government?

18 A No.

19 Q Okay. The comprehensive plan was prepared between
20 2008 and 2009; isn't that correct?

21 A I believe so, ending in 2009.

22 Q Right?

23 A That's the date on it.

24 Q And so you weren't on the plan commission at the time
25 that they developed the plan?

Transcript of Proceedings - October 10, 2012
Volume 4

674

1 A That's correct.

2 Q And you weren't on the plan commission when -- at any
3 of the plan commission meetings where Emerging
4 Energies was making presentations about the project?

5 A No.

6 Q So the exhibit that Mr. Mundinger put in with the --
7 the May 7, 2008 PowerPoint presentation --
8 February 7th -- had you seen that presentation
9 before?

10 A No.

11 Q Okay. So you never saw that presentation until it
12 came into this record?

13 A Correct.

14 Q Okay. And would you agree with me that there are a
15 number of things in that presentation that have
16 already been talked about that indicate that these
17 gentlemen were talking about a utility-scale project
18 to the plan commission in early 2008?

19 A No. You can't tell that by what somebody sees as a
20 picture, and I don't know how those people are
21 looking at that, and I know that --

22 Q You can't tell that by references to 100-meter towers
23 and 100 meter --

24 A You know they didn't know that because they didn't
25 understand and they kept asking him for questions

Transcript of Proceedings - October 10, 2012
Volume 4

675

1 about details of the plan, which they weren't given
2 by Highland. At no time did Highland ever give the
3 number of turbines, size of the turbines, or where
4 they're going to be located to the plan commission.
5 Never. That created a huge confusion, and they were
6 in the fog.

7 Q You would agree with me that in that presentation
8 that was made in both February and March of 2008,
9 that there are indications in that presentation of
10 turbines that would be utility scale?

11 A That's Highland's perception, but at no place did
12 they ever spell it out for people.

13 Q Are you aware of any utility-scale turbines that are
14 on 100-meter towers?

15 A I don't think it's a relevant question. You're
16 asking me to -- certainly the PowerPoint
17 presentation, I have looked through it. I saw it
18 come in. One of the questions was why wasn't it put
19 in Appendix Z. It's coming in seven months later.

20 Q That's not responsive to my question.

21 A Okay.

22 Q If you were on the plan commission at the time that
23 that presentation was made and you saw references in
24 that presentation to wind turbines that were going to
25 sit on 100-meter towers, are you telling me you won't

Transcript of Proceedings - October 10, 2012
Volume 4

676

1 understand that we're talking about utility-scale
2 turbines?

3 A Well, if I was on the plan commission, I would have
4 been asking questions just like they asked the
5 chairman, and the questions were do we have any more
6 details about it, and they weren't given any
7 information.

8 Q This was -- this was at the 2008 -- February 2008
9 meeting?

10 A That was all the way to 2010 with the same members.
11 So you can assume that same group wasn't given any
12 details all the way back to 2008.

13 Q You were not present at that meeting, correct?

14 A In 2008 or '10, no.

15 Q Okay.

16 A But the minutes clearly show they didn't have those
17 details.

18 Q Is it possible they didn't have the details about the
19 number and the locations of the turbines because they
20 didn't exist yet?

21 A No. Because that information wasn't given by
22 Highland until August of 2010.

23 Q Is it your testimony that they withheld that, that
24 that -- that that data existed and they withheld it?

25 A I don't know if it existed, but it is that they

Transcript of Proceedings - October 10, 2012
Volume 4

677

1 withheld it from even the town board right up until
2 the afternoon of August 10th and 11th, and it's in my
3 testimony. They weren't --

4 Q Another way to say that, isn't it, that in August of
5 2010, they presented the town board with the
6 information about the number of the turbines and the
7 size of the turbines?

8 A For the first time.

9 Q Yes. Okay. We can agree on that. So I believe you
10 told Mr. Reynolds that you believe that this project
11 is incompatible with the comprehensive plan primarily
12 because you view it as an industrial activity,
13 correct?

14 A No. Primarily because the comprehensive plan spells
15 out that all -- anything larger than a small-scale
16 activity needs to go down into the hamlet, which
17 would essentially be the downtown of Forest, which is
18 about one square block. And it says that in the
19 comprehensive plan several times, three or four
20 times. So that would be the first reason it's not
21 compatible.

22 The second is the biggest thing in the
23 comprehensive plan with a clear reading for anyone is
24 that the town wants to preserve its visual impact,
25 its visual view, and the 500 turbines or -- sorry --

Transcript of Proceedings - October 10, 2012
Volume 4

678

1 the 500-foot turbines just don't sync up with that in
2 any way, shape, or form.

3 Q Okay. Mr. Junker, do you believe that the -- putting
4 in this project constitutes industrial activity?

5 A We watched and was debated yesterday, so it comes
6 down to semantics. It -- many people would say that
7 the pictures that we see in the application of the
8 size of the trucks necessary to bring in a single
9 blade would absolutely qualify that as industrial no
10 matter what you want to call it, and --

11 Q So it is industrial?

12 A That might not be the industry's terminology, but in
13 terms of how the comprehensive plan defines it, it's
14 industrial. Absolutely. No question about it.

15 MR. WILSON: Okay.

16 EXAMINER NEWMARK: He's asking you, is it
17 industrial?

18 THE WITNESS: Oh.

19 MR. WILSON: Yeah.

20 THE WITNESS: Yes. Absolutely.

21 BY MR. WILSON:

22 Q Okay. And you just mentioned by definition in the
23 plan it's industrial, and one of my questions was, as
24 I wasn't able to locate a definition of industrial in
25 the comprehensive plan, can you point me to a

Transcript of Proceedings - October 10, 2012
Volume 4

679

1 definition of industrial?

2 A I don't think that definition would be in the plan,
3 but I think we're messing with the intention of the
4 plan because I can point to four or five places where
5 the plan says it promotes small-scale things. And I
6 could go to those, and that's in my testimony, but
7 did the comprehensive plan make a definition of
8 industrial, I don't think so, but --

9 Q Would you like to take the time to check?

10 A Well --

11 Q Or are you sure that there's no definition?

12 A What if I can point to the three or four places that
13 says small-scale?

14 Q You get to answer my questions, unfortunately.

15 A Okay.

16 Q Do you want to take the time to look and see if
17 there's a definition of industrial, or do you just
18 agree that there is no definition of industrial in
19 the plan?

20 A Let's take some time and see what it does say.

21 Q All right.

22 A Yes.

23 Q That's fine. Let's take the time to look for a
24 definition of industrial.

25 A The plan shows on page 39 that it intended zero

Transcript of Proceedings - October 10, 2012
Volume 4

680

1 growth --

2 Q Hold on. Let me get there. 39 you say?

3 A Yep. The plan has zero industrial and zero
4 commercial use. That's one thing you would use to
5 interpret the meaning of the plan.

6 Q Where on page 39?

7 A There's a table. Do you see that?

8 Q Uh-huh.

9 A Okay. If you look at commercial and industrial,
10 between 2007 and 2030, there is zero growth in either
11 commercial or industrial categories for the Town.

12 Q Okay. That's your forecasted growth. I'm looking
13 for the definition of industrial.

14 A That's pretty good right there.

15 Q That's not a definition. Find me a definition of
16 industrial.

17 MS. BENSKY: I'm going to object to this.

18 MR. REYNOLDS: Can we consult Black's Law
19 Dictionary?

20 MS. BENSKY: We can move on.

21 MR. REYNOLDS: These are standard
22 definitions of agricultural, residential,
23 commercial, and industrial. They have standard
24 definitions in the land use.

25 MR. WILSON: There are no definitions in

Transcript of Proceedings - October 10, 2012
Volume 4

681

1 this document that I have been able to find.

2 THE WITNESS: I found it.

3 BY MR. WILSON:

4 Q Where we at? What page?

5 A Page 36.

6 Q Okay.

7 A Large-scale commercial and industrial uses.

8 Q Where?

9 A Okay. To the right side of the picture. Large-scale
10 commercial and industrial uses are seen as potential
11 conflicts with the existing uses in the Town.

12 Q Okay. Where's the definition of industrial?

13 A I think people would agree in reasonable terms that
14 that's --

15 MR. McKEEVER: Judge, I'm going to object.
16 He's asked the question several times. It's a
17 question of interpretation. If a court had to
18 interpret it, they would have looked to the rest of
19 the document for context and meaning. They use
20 typical rules of statutory interpretation. I think
21 he's beating a dead horse and a dog that doesn't
22 hunt.

23 EXAMINER NEWMARK: All right. Well, look
24 at page 27, which by the way is the last page I have
25 on exhibit -- is it multiple pages? You're right.

Transcript of Proceedings - October 10, 2012
Volume 4

682

1 27 in the green box, it says in some dashes down --

2 THE WITNESS: You know what, Judge, you
3 might be referencing, like, Mundinger's testimony
4 where I happen to be looking at the actual plan.

5 EXAMINER NEWMARK: Hang on. Hang on.
6 There's a green box on page 27, it says industrial
7 building, State Highway 64 and County Highway D.

8 THE WITNESS: Okay.

9 EXAMINER NEWMARK: Does that help you in
10 determining what is meant by an industrial building
11 in this document -- industrial use, I guess, in this
12 document?

13 THE WITNESS: You're looking at the green
14 box?

15 EXAMINER NEWMARK: Uh-huh.

16 THE WITNESS: The green box says
17 structures on the Wisconsin Architecture and History
18 Inventory.

19 EXAMINER NEWMARK: Uh-huh. It's pointing
20 out a particular building like that exists.

21 THE WITNESS: Industrial building.

22 EXAMINER NEWMARK: Okay.

23 THE WITNESS: Okay. So it's design the
24 industrial building on South 64 and County Road D.

25 EXAMINER NEWMARK: Okay.

Transcript of Proceedings - October 10, 2012
Volume 4

683

1 THE WITNESS: Which would be -- yeah, it's
2 the stuff down in the hamlet. Thank you.

3 EXAMINER NEWMARK: Well, that doesn't get
4 us as far as we want to get I don't think, but let's
5 see.

6 THE WITNESS: It's pretty good, though.
7 Well, you found a use of industrial in the plan.

8 BY MR. WILSON:

9 Q Is there a section in this comprehensive plan that
10 has definitions in the traditional sense?

11 A I don't believe so.

12 Q Okay. So it's fair to say that you believe that this
13 is an industrial activity, but the plan doesn't
14 necessarily define large-scale utilities as
15 industrial, does it?

16 A I believe it's -- if I can back up. I believe it's
17 either commercial or industrial, okay?

18 Q That's your belief?

19 A Yeah. But you pin me into the corner of
20 industrial -- commercial or industrial, yes. That's
21 a fair response to your question.

22 Q Okay.

23 A And I -- yes.

24 Q But there's no definition in the document?

25 A Right.

Transcript of Proceedings - October 10, 2012
Volume 4

684

1 MR. REYNOLDS: We've covered that ground.

2 MR. WILSON: I've never gotten an answer.

3 MR. REYNOLDS: Look, these are land use
4 categories. You don't need to define residential.

5 EXAMINER NEWMARK: But he answered, right?
6 Didn't he just answer?

7 MR. WILSON: He just answered.

8 EXAMINER NEWMARK: All right. Let's move
9 on.

10 BY MR. WILSON:

11 Q I'm looking at your surrebuttal testimony,
12 Mr. Junker, at page 5. I'm looking at lines 15
13 through 18 where you testified that although the
14 comprehensive plan references renewable energy, this
15 can be attributed to the small-scale types of
16 projects such as solar panels on the roof of a local
17 chicken coop recently erected in Forest. Can you
18 point me to a place in the plan that substantiates
19 that?

20 A I believe I can. The comprehensive plan in Section
21 7.2.

22 Q Can you give me a page number? Okay. Hold on a
23 minute, Mr. Junker.

24 MR. WILSON: Your Honor, the next section
25 of it is under 168663.

Transcript of Proceedings - October 10, 2012
Volume 4

685

1 EXAMINER NEWMARK: There's three parts,
2 right?

3 MR. WILSON: Yeah.

4 EXAMINER NEWMARK: Okay.

5 BY MR. WILSON:

6 Q Go ahead, Mr. Junker.

7 A I'm referencing a reference in my testimony right
8 above where you are at, and it says, overall other
9 than agricultural, forestry, recreation, and cottage
10 industry consistent with the community's rural
11 nature, no new large-scale business or industry is
12 desired in the Town of Forest unless it is located in
13 the designed -- I'm sorry -- located in the
14 designated area in the hamlet of Forest along State
15 Highway 64.

16 Q Okay. Let me ask the question a different way. Can
17 you show me a place in the comprehensive plan where
18 it's referring to renewable energy that makes a
19 distinction between small and large? Specifically
20 where renewable energy is mentioned, a distinction
21 between the large and small?

22 A So if I go into the plan, and one of the 12 uses of
23 renewable energy and I have to link that to small
24 scale, I don't think I can do that. But we can link
25 small business, and this is a business. So if the

Transcript of Proceedings - October 10, 2012
Volume 4

686

1 comprehensive plan says a small business, I think
2 it's more than reasonable to connect those two.

3 Q Okay.

4 A The plan says small business.

5 Q Okay. So I think what I heard you say at the
6 beginning of that was that you cannot point me to
7 anyplace in the plan that mentions renewable energy
8 where there is a distinction made between large and
9 small renewable projects?

10 A If A equals B, and B equals C, A equals C. So if
11 this says small business and what we're talking about
12 here is a business, then by definition small -- large
13 scale or small scale, it doesn't matter.

14 Q Mr. Junker, you didn't respond to my question.

15 A I really did.

16 Q No. My question is, in any of the 12 places where
17 renewable energy is mentioned in the comprehensive
18 plan, does the plan distinguish between large and
19 small scale for the renewable energy?

20 MR. REYNOLDS: Asked and answered.

21 Objection.

22 MR. WILSON: He did not answer.

23 EXAMINER NEWMARK: Overruled.

24 THE WITNESS: I would have to read the
25 whole plan document and find each one -- each time

Transcript of Proceedings - October 10, 2012
Volume 4

687

1 that it uses renewable energy and -- to see if small
2 scale is linked.

3 EXAMINER NEWMARK: Okay. Well, the
4 document speaks for itself. If you want to go with
5 a hypothetical that it doesn't say that and
6 continue, we can, but --

7 BY MR. WILSON:

8 Q So, Mr. Junker, in your testimony you testified to
9 the fact that 77 percent of the Town in the survey
10 now that was done for the comprehensive plan, 77
11 percent of those people agreed, visual impacts are
12 important; is that correct?

13 A What page are you on, please?

14 Q I think it's in the direct on page 7, I believe.
15 Yeah, page 7, line 13.

16 A Yes. What you said is referenced, 77 percent believe
17 the visual impact of development is an important
18 consideration when evaluating proposed development.

19 Q Okay. You would agree with me also that the
20 survey -- in the survey, 75 percent of the people
21 responding to the survey agreed or strongly agreed
22 that wind should be in any economic development
23 strategy; is that correct?

24 A I believe seeing that reference, I have no reason to
25 doubt it. I probably didn't tie it into the last two

Transcript of Proceedings - October 10, 2012
Volume 4

688

1 weeks.

2 Q Okay.

3 A You could probably tell me where it is in the plan.
4 I have no reason to doubt that.

5 Q So is it fair to say that given that those numbers
6 are both so high, right? That at least some of the
7 people who said that visual impacts are important
8 also agreed that wind should be used in economic
9 development?

10 A That's true. But it all comes down to scope and
11 scale, which the plan says over and over. It's about
12 scope and scale, and nobody was thinking of 500-foot
13 wind turbines. Nobody.

14 MR. WILSON: I think that's all we have.
15 Thank you very much.

16 THE WITNESS: You're welcome.

17 EXAMINER NEWMARK: All right. Any
18 questions?

19 MR. McKEEVER: I have a couple questions.
20 Thank you, Judge.

21 CROSS-EXAMINATION

22 BY MR. McKEEVER:

23 Q Mr. Junker, give us a layperson's -- give us your
24 definition of industrial.

25 A It has to do with factories, large equipment, things

Transcript of Proceedings - October 10, 2012
Volume 4

689

1 that need to be put on very large trucks, things that
2 make a lot of noise, things of a commercial nature.

3 Q Prior to -- you've been here for two days. You've
4 heard all the testimony; is that correct?

5 A Yes.

6 Q Okay. Prior to today or yesterday, had you ever
7 heard the expression utility-scale wind turbine
8 project?

9 A No. No, I've just become aware the last two days how
10 it's being contrapted to kind of pin this thing down.

11 Q And what was the expression -- or was there an
12 expression that you used or you had heard to describe
13 what is proposed for Highland?

14 A It's commercial. It's industrial. It's very large
15 that requires large trucks to move around.

16 Q Was the expression, an industrial wind project or a
17 wind farm a term that you had heard previously, IWT?

18 MR. WILSON: Objection. Leading the
19 witness.

20 THE WITNESS: Yeah, that's how -- that's
21 how these projects are being referenced. The health
22 aspects are IWTs.

23 EXAMINER NEWMARK: It's in his testimony,
24 IWT. That's in someone's testimony.

25 MR. WILSON: That's right.

Transcript of Proceedings - October 10, 2012
Volume 4

690

1 BY MR. McKEEVER:

2 Q Now, as a resident of the Town of Forest, did you
3 participate in the planning process for the
4 comprehensive plan?

5 A No. No, I was off the planning commission at that
6 time. You know, I did my six and a half years, and I
7 was raising my family.

8 Q Well, did the -- do you know, maybe you don't know,
9 did the plan commission have a public participation
10 process?

11 A Not about the wind that I'm aware of.

12 Q No, no. About the comprehensive plan.

13 A Oh, yes. Yes.

14 Q Often townships when they're developing a
15 comprehensive plan, or cities and villages in
16 Wisconsin for that matter, collect information from
17 residents via a survey. Do you recall if there was a
18 survey like that that was circulated?

19 A Yes. Mr. Wilson's referencing it with the 77 and 75.

20 Q Okay.

21 A So they did a survey. That's at the tail end of the
22 plan.

23 Q Okay. Did you participate in that survey, do you
24 recall?

25 A You know, when I was on the plan commission, we did

Transcript of Proceedings - October 10, 2012
Volume 4

691

1 one six years earlier. I can't recall if I
2 participated in that particular one or not.

3 Q Okay. Now, you have a plan commission now.

4 A The -- I'm a town board member, town chairman now.

5 Q I understand that, but there is plan commission?

6 A Oh. We have one, yes.

7 Q And if a proposal comes before that plan commission
8 for a building or some other structure, do your
9 ordinances provide that the plan commission will
10 review it for its visual appearance, the facade, the
11 design, those kinds of issues?

12 A Yes. And we've got an ordinance that says the plan
13 commission would review anything relating to wind as
14 well and make a recommendation.

15 Q Okay. As the -- as the town chairman and a former
16 plan commissioner, do you have an opinion regarding
17 the extent to which a locally developed comprehensive
18 plan ought to be respected and followed?

19 A Yes. It's sacrosanct. It needs to be followed to
20 absolutely the letter. That was Wisconsin's complete
21 intention when it came out with smart growth in 2009,
22 that the comprehensive plans would be adopted for
23 this exact purpose, to protect the town that did a
24 plan from this type of industrial wind and commercial
25 wind plan.

Transcript of Proceedings - October 10, 2012
Volume 4

692

1 Q Has the Town of Forest comprehensive plan changed
2 since it was adopted? I believe you said no earlier;
3 is that correct?

4 A That's correct.

5 Q Just one last question. I believe you said in
6 response to a question that Mr. Wilson asked that it
7 was your belief that commercial and industrial were
8 similar?

9 A The plan specifies both and predicted that between
10 2007 and 2030 both -- both commercial and industrial
11 in our comprehensive plan would grow by zero.

12 Q Okay. Do you have an opinion as the town chair and
13 former plan commissioner, even though you weren't
14 involved in the development of this particular plan,
15 do you have an opinion what the residents -- what the
16 intent of the residents of your community was on
17 these issues, industrial commercial development in
18 the scale and scope of a wind farm at the time they
19 adopted the comprehensive plan?

20 MR. WILSON: Objection. Calls for
21 speculation.

22 MR. McKEEVER: It calls for an opinion.
23 He's the town chair.

24 EXAMINER NEWMARK: Well, then I think he's
25 answered this already, but go ahead.

Transcript of Proceedings - October 10, 2012
Volume 4

693

1 THE WITNESS: Yes.

2 BY MR. McKEEVER:

3 Q And what's that opinion? What was their intent?

4 A Their intent was that anything in the Town -- the
5 visual aspect of things is so important, anything
6 coming into the Town needs to go down into the
7 hamlet, and it needs to be small scale. The intent
8 was to keep things out just like this, something that
9 would -- we have the subdivision ordinance as an
10 example. That was a document that when I was on the
11 plan commission we put together. Five-acre minimum.
12 We had farmers on our group, and the whole idea was
13 that people's land was their 401k is the quote, and
14 that you couldn't do anything in Forest to mess up
15 anyone's individual homeland acreage. You just
16 couldn't do anything to hurt that. So we developed
17 the subdivision ordinance in light of that because
18 that would -- that is what was considered the biggest
19 thing that could foul up any one person's land, a big
20 development coming in. And so this subdivision
21 ordinance was made. And, you know, just the
22 comprehensive plan did not envision any kind of big
23 projects. No industrial, no commercial, and nothing
24 that would mess up or foul up the visual landscape of
25 the Town.

Transcript of Proceedings - October 10, 2012
Volume 4

694

1 EXAMINER NEWMARK: Okay.

2 BY MR. McKEEVER:

3 Q And is it your view that the proposed project would
4 be in violation of that tenent that you just
5 articulated?

6 A Yes. Absolutely.

7 MR. McKEEVER: I have nothing further.

8 MR. WILSON: And I have just one question.

9 EXAMINER NEWMARK: Okay.

10 RECROSS-EXAMINATION

11 BY MR. WILSON:

12 Q Mr. Junker, are you aware that in most places where
13 zoning ordinances contemplate wind farms, that it's
14 typically a conditional use in an ag district?

15 A No, I'm not aware of that.

16 MR. WILSON: Thank you.

17 EXAMINER NEWMARK: Redirect?

18 MR. REYNOLDS: No.

19 MR. LORENCE: Your Honor.

20 EXAMINER NEWMARK: Sorry.

21 CROSS-EXAMINATION

22 BY MR. LORENCE:

23 Q Mr. Junker, a quick question. The plan was adopted
24 in 2009, correct?

25 A Yes.

Transcript of Proceedings - October 10, 2012
Volume 4

695

1 Q And Section 5 has to do with utilities and community
2 facilities, correct?

3 A Page, please.

4 Q 21 of your plan.

5 A Okay.

6 Q Why is there no mention of a wind farm in the plan?

7 A They didn't know about it. They did not know about
8 the wind farm. I've given that -- I started that
9 off. Why is there no mention of the wind farm in the
10 comp plan? They didn't know about it.

11 Q There's a picture of the weather tower in the plan,
12 but they didn't know there's a wind farm planned
13 here?

14 A They didn't know any of the details.

15 Q I didn't ask if they knew about the details. I just
16 asked why there's no reference to the wind farm in
17 the plan.

18 A Well, I wasn't on that plan commission.

19 Q If you know.

20 A What I do know is there's minutes in January of 2010
21 where the plan commission is asking Carl Cress, the
22 chairman of the plan commission, where's the beef.
23 It's in the minutes, where's the beef.

24 Q I recognize that. But it just seems to me that if
25 someone is planning a wind farm in your area, it

Transcript of Proceedings - October 10, 2012
Volume 4

696

1 would be mentioned in the 30-year plan, wouldn't it?

2 A That's a huge cover-up. Yes. I mean, very much so.
3 Highland didn't give any of the details to the plan
4 commission or the Town throughout the whole process.
5 Nobody knew, and it's spelled out in the e-mails.
6 It's in the record. Nobody knew in the Town.

7 Q But Highland had been talking to the Town?

8 A Okay. So the practicality of it is they were talking
9 to the town chairman who signed the 2008 wind
10 development agreement. Now he's getting a turbine.

11 Q But they represent the -- the town chair represents
12 the Town at that time just like you represent the
13 Town today, correct?

14 A Right. But because of the conflict, he wasn't
15 communicating to the town people.

16 Q No, I understand that. I was -- I think your answer
17 is, you don't know why it's not mentioned in the
18 plan?

19 A I do know.

20 Q And how do you know that?

21 A Because I've talked to the plan commission members,
22 and I've read the minutes, and I see that that group
23 was asking for details and they weren't getting them.
24 I'm just trying to -- that's the facts. That's the
25 knowledge that the Town has, and it's spelled out in

Transcript of Proceedings - October 10, 2012
Volume 4

697

1 the e-mails and the minutes.

2 MR. LORENCE: No, I understand. Thank
3 you.

4 THE WITNESS: Okay.

5 EXAMINER NEWMARK: Okay. Redirect?

6 MR. REYNOLDS: Nothing.

7 EXAMINER NEWMARK: All right. Thank you,
8 sir. You've excused.

9 (Witness excused.)

10 MS. BENSKY: Can we go off the record a
11 minute?

12 (Discussion off the record.)

13 JAMES LEPINSKI, COMMISSION STAFF WITNESS, DULY SWORN

14 EXAMINER NEWMARK: Have a seat.

15 DIRECT EXAMINATION

16 BY MR. LORENCE:

17 Q State your name, please.

18 A James Lepinski.

19 Q And you work for the Public Service Commission?

20 A Yes.

21 Q In preparation of this hearing, did you prepare
22 direct testimony and two exhibits marked No. 1 and 2?

23 A Yes.

24 Q And if I asked you the questions in your direct
25 testimony today, would your answers be the same?

Transcript of Proceedings - October 10, 2012
Volume 4

698

1 A Yes.

2 Q And are Exhibits 1 and 2 accurate to the best of your
3 knowledge?

4 A Yes.

5 Q And are you also preparing to submit a delayed
6 exhibit, Exhibit 3, which will be the public
7 comments --

8 A Yes.

9 Q -- filed in this case?

10 A Yes.

11 MR. LORENCE: I have no further questions.
12 Mr. Lepinski's available.

13 EXAMINER NEWMARK: Okay. Is there any
14 questions of Mr. Lepinski?

15 MR. REYNOLDS: Yes.

16 EXAMINER NEWMARK: Go ahead.

17 CROSS-EXAMINATION

18 BY MR. REYNOLDS:

19 Q Mr. Lepinski, you're an engineer?

20 A Yes.

21 Q Are you kind of the central engineer for this
22 project?

23 A Yes.

24 Q All right. And you heard a lot of debate about
25 decommissioning?

Transcript of Proceedings - October 10, 2012
Volume 4

699

1 A Yes.

2 Q Are you going to -- what are you going to do with
3 this information? Are you going to do something, or
4 are you going to -- are you going to try to figure it
5 out?

6 A I will prepare a section in all likelihood for the
7 briefing memo that goes to the Commission that
8 addresses the arguments of the parties on the
9 decommissioning costs.

10 Q Okay. Forgetting about the arguments, how about the
11 facts? Are you going to do an independent analysis
12 of trying to project out in 30 years what it's going
13 to cost the Town of Forest --

14 EXAMINER NEWMARK: What?

15 BY MR. REYNOLDS:

16 Q -- to take these things down?

17 EXAMINER NEWMARK: No. Don't answer that.
18 Move on. What are you talking about? The record
19 will be closed. How can he do an independent
20 analysis without -- after the hearing? Just move
21 on. Move on.

22 BY MR. REYNOLDS:

23 Q Do you feel like you're a prisoner of the record, or
24 can you do -- can you independently verify as an
25 engineer for the PSC?

Transcript of Proceedings - October 10, 2012
Volume 4

700

1 MR. LORENCE: Objection, Your Honor. The
2 attorney is just, you know, putting his own
3 testimony into the record here.

4 EXAMINER NEWMARK: Do you have anything
5 else?

6 MR. REYNOLDS: No.

7 EXAMINER NEWMARK: Okay.

8 MR. McKEEVER: I have a very quick
9 question.

10 EXAMINER NEWMARK: Go ahead.

11 CROSS-EXAMINATION

12 BY MR. McKEEVER:

13 Q You're an engineer?

14 A Yes.

15 Q Do you have formal training in acoustics?

16 A No formal training.

17 Q Do you have formal training in the measurement of
18 noise?

19 A No formal training. Let me answer that again. In
20 college I had a class, which is very odd, it's called
21 metrology.

22 Q Metrology?

23 A Yes.

24 Q Sounds like weather.

25 A No. It's the studying of measuring anything and

Transcript of Proceedings - October 10, 2012
Volume 4

701

1 everything.

2 Q Okay.

3 A A very brief, probably one-session class -- not even
4 a full session was devoted to the measurement of
5 sound.

6 Q Okay. Now, at the risk of exposing our mutual age,
7 how long ago was that class?

8 A 1982. Maybe '81 or '82.

9 Q Okay. One last question. To your knowledge, has the
10 Public Service Commission retained the services of an
11 outside consultant to either develop the sound
12 measurement protocol that's been discussed here today
13 or to help the staff evaluate the kind of evidence
14 that we've heard and is in this record regarding
15 sound?

16 A No.

17 MR. McKEEVER: Thank you. I have no other
18 questions.

19 EXAMINER NEWMARK: Okay. Anyone else?
20 Redirect?

21 MR. LORENCE: No.

22 EXAMINER NEWMARK: Okay. You're excused.
23 (Witness excused.)

24 MR. LORENCE: Any chance we can get
25 Mr. Jaeger on as well?

Transcript of Proceedings - October 10, 2012
Volume 4

702

1 EXAMINER NEWMARK: He's right there.

2 MICHAEL JOHN JAEGER, COMMISSION STAFF WITNESS, DULY SWORN

3 EXAMINER NEWMARK: Have a seat.

4 DIRECT EXAMINATION

5 BY MR. LORENCE:

6 Q Can you state your name and where you work.

7 A My name is Michael John Jaeger, and I work for the
8 Public Service Commission.

9 Q In preparation for this hearing, did you prepare
10 direct testimony and three exhibits?

11 A Yes, I did.

12 Q And if you were asked the questions in your direct
13 testimony today, would your answers be the same?

14 A Yes, they would.

15 Q And are the three exhibits correct to the best of
16 your knowledge?

17 A Yes, they are.

18 MR. LORENCE: Mr. Jaeger's available for
19 questions.

20 EXAMINER NEWMARK: Any questions?

21 MR. McKEEVER: I have some questions for
22 Mr. Jaeger.

23 CROSS-EXAMINATION

24 BY MR. McKEEVER:

25 Q First, let me make sure. Is it Jaeger, Jaeger, or

Transcript of Proceedings - October 10, 2012
Volume 4

703

1 something different?

2 A My family pronounces it Jaeger. I respond to any of
3 those.

4 Q Okay. Thank you. You're an analyst in the gas and
5 energy division at the Public Service Commission?

6 A That's correct.

7 Q And your formal training is in zoology?

8 A That's correct.

9 Q Do you have formal training in acoustics, noise
10 measurement, or noise prediction?

11 A No, sir, I do not.

12 Q You participated in the preparation of the
13 environmental assessment?

14 A Yes, I did.

15 Q And a couple of your colleagues joined you in that
16 work, Andrea Rankin and Marilyn Weiss; is that
17 correct?

18 A That's correct.

19 Q Do you know whether either of them has formal
20 training in acoustics or noise measurement?

21 A I do not believe so.

22 Q Did you personally visit the Town of Forest?

23 A Yes, I have.

24 Q Okay. And in the context of this project?

25 A Yes, I have.

Transcript of Proceedings - October 10, 2012
Volume 4

704

1 Q Okay. Thank you. Now, you would agree that there
2 are studies out there that support the fact that some
3 people have had bad reactions or complaints about
4 wind turbine noise primarily through sleep
5 disturbance and nausea and the things that we've
6 talked about?

7 MR. LORENCE: And I object. And ask for
8 more clarification when he says some studies.

9 EXAMINER NEWMARK: Okay.

10 BY MR. McKEEVER:

11 Q Well, I'm just asking him whether or not he's aware
12 that there are studies out there and whether he
13 agrees that there are studies that report that?

14 A Well, my direct testimony says essentially that.

15 Q Thank you. Now -- and you've been handed a document
16 there. Let me find my copy, which I -- just
17 disappeared someplace. Here it is. PSC reference
18 number 117032. This purports to be the excerpt from
19 the EIS for the Glacier Hills Wind Project. Does
20 that look like what that is?

21 A It appears to be an excerpt from the draft
22 environmental impact statement for Glacier Hills,
23 yes.

24 Q Okay. And would you agree that this is a copy of the
25 noise section of that document?

Transcript of Proceedings - October 10, 2012
Volume 4

705

1 A Yes, that's what it appears to be.

2 Q And you agree that the environmental -- your opinion
3 and your colleagues in preparing the environmental
4 assessment was that you did not need an EIS in this
5 matter because you were relying, to a very large
6 extent, on this EIS, that is the Glacier Hills EIS?

7 MR. LORENCE: Hang on. Object, Your
8 Honor. I don't believe that's in his testimony.
9 That's assuming facts. Further, this is not the EIS
10 in this matter, this is the draft, and I would not
11 have this be placed in the record. And I don't
12 think there should be any questions given to this
13 because the draft is the draft, and it wasn't what
14 the Commission reviewed or accepted in that case.

15 EXAMINER NEWMARK: Okay. Well, let's just
16 back up a little bit. Ask your -- this current
17 question you'll just need to, you know, just point
18 to his testimony. But I guess my question is, do
19 we -- why -- is there a reason why you're using the
20 draft? Is there something special or different than
21 the final? Are you going to bring the final out or
22 compare them? Or why are we dealing with the draft
23 document?

24 MR. MCKEEVER: Because I made a mistake,
25 okay? Mr. Reynolds has just handed me the final,

Transcript of Proceedings - October 10, 2012
Volume 4

706

1 and because I frankly made a mistake and copied the
2 wrong one.

3 EXAMINER NEWMARK: Okay. So you have the
4 final?

5 MR. McKEEVER: I have the final here, yes.

6 EXAMINER NEWMARK: All right.

7 MR. McKEEVER: And my intention would have
8 been to do the same thing, make it the excerpt of
9 the noise section. What I'm trying to get to here,
10 Judge, and I can do it in a variety of ways, is the
11 same question that Mr. Wilson had the other day.
12 I've been assuming that we could refer in briefing
13 to other documents that were ERFed previously in
14 other dockets. I'm trying to get to the point where
15 this EIS upon which great reliance was given in this
16 matter is part of the docket in this case and can be
17 used in briefing.

18 EXAMINER NEWMARK: Okay. And that's in
19 Jaeger's testimony?

20 MR. McKEEVER: That's in his testimony,
21 and it's to a great extent his exhibit, the
22 environmental assessment, which is incorporated in
23 his testimony.

24 EXAMINER NEWMARK: And do you dispute
25 that, they're relying on the -- I'll ask you. Do

Transcript of Proceedings - October 10, 2012
Volume 4

707

1 you dispute that you're relying on the FEIS for
2 Glacier Hills in this case?

3 MR. LORENCE: I'd like to respond first.

4 EXAMINER NEWMARK: Yeah.

5 MR. LORENCE: And what he's shown us here
6 is just the excerpt with respect to noise. There's
7 nothing in his testimony or in the EA that says we
8 relied on the Glacier Hills with respect to noise.
9 The Glacier Hills exhibit or the Glacier Hills EIS,
10 if they wish to have that in this record, would need
11 to be introduced in its totality because otherwise
12 he's taking it out of context.

13 EXAMINER NEWMARK: Uh-huh. Okay. Okay.
14 But -- but the -- okay. So we don't know whether --
15 all right. Well, does anyone object to just putting
16 the whole final EIS in?

17 MR. SCRENOCK: I have a question, Your
18 Honor.

19 EXAMINER NEWMARK: Okay.

20 MR. SCRENOCK: I guess it would go to
21 respond or ask a further question about what
22 Mr. McKeever means when he says cite to it. I don't
23 know if what he's referring to is citing to it for
24 purposes of making arguments in briefing on the
25 merits on the CPCN, or making arguments that would

Transcript of Proceedings - October 10, 2012
Volume 4

708

1 be challenging the Commission's decision to conduct
2 only an environmental assessment and not proceed to
3 prepare an EIS in this particular case. I think --
4 I think the answer would be different depending on
5 which use he's talking about.

6 MR. McKEEVER: I'm talking about the first
7 use. The question of whether or not they should
8 have prepared an EIS has been resolved. They
9 didn't. So I'm talking about using it in support of
10 an argument having to do with the CPCN in this
11 matter. In fact, the EA almost quotes exactly word
12 for word. If one was to compare the text, I suspect
13 that there was some cutting and pasting going on
14 because comparison language that's in the EA for
15 this docket is essentially identical to the
16 language, some of the language from the EIS for
17 Glacier Hills.

18 MR. SCRENOCK: We would object, Your
19 Honor. I'm sorry.

20 MR. LORENCE: Go ahead. I was going to
21 say, that begs the question why you need that in the
22 final then.

23 MR. SCRENOCK: Well, it does. And to the
24 extent that there's questions about the statements
25 that are in the EA, we can question the staff if we

Transcript of Proceedings - October 10, 2012
Volume 4

709

1 want to as to those that were responsible for those
2 statements. We have no way of knowing which staff
3 members may have been involved in preparing the EIS
4 for Glacier Hills or whether they're even still on
5 the staff, whether they're even available for
6 questioning. And I guess that I don't know that
7 it's relevant to the issues that are in this docket.

8 MR. McKEEVER: I've never seen another
9 situation in which an environmental assessment in
10 one project relies as heavily as this one does on an
11 EIS done three years previously. And I think the
12 fact that it states that in the EA, it states that
13 in Mr. Jaeger's testimony, is worthy of bringing
14 this document into this record for reference
15 purposes.

16 If they want to bring the whole thing in,
17 that's fine with me. I won't object to that. But I
18 think we only need the chapter on noise, the section
19 on noise, for my purposes. If somebody else wants
20 to use it for some other purpose, but I think this
21 is essentially an exceptional circumstance that
22 there was great reliance on this EIS. We won't
23 learn anything more from it. This docket ought to
24 be -- that's what the language of the EA says,
25 essentially, not going to inform them. We ought to

Transcript of Proceedings - October 10, 2012
Volume 4

710

1 have the opportunity to refer back to that document
2 and see with whether in fact it does inform this
3 discussion, because I think it does.

4 MR. LORENCE: That sounds like an argument
5 that could have been put in rebuttal testimony, Your
6 Honor.

7 MR. REYNOLDS: This is an issue for
8 appeal, by the way, because the -- there is no
9 Environmental Impact Statement, and that is a
10 potential appealable issue. And I think for
11 purposes of preserving that issue, it should be part
12 of the record. It's not a big deal.

13 MR. McKEEVER: In response to
14 Mr. Lorence's comment, it could have been part of
15 rebuttal, but I was operating, frankly, on the same
16 assumption that Mr. Wilson was, that it was in the
17 record. With all due respect, I found the
18 scheduling order on that point a little vague and a
19 little difficult to understand, and I interpreted it
20 the same way that Mr. Wilson did, that if it was
21 previously ERFed in another docket, it was fair game
22 for purposes for reference in this case.

23 MR. WILSON: I wonder why we didn't hear
24 that earlier.

25 MR. McKEEVER: I didn't argue with you

Transcript of Proceedings - October 10, 2012
Volume 4

711

1 when you said it.

2 MS. BENSKY: There's no prejudice here.

3 EXAMINER NEWMARK: Anything else?

4 MR. SCRENOCK: Your Honor, we just don't
5 see it.

6 MR. McKEEVER: There's no prejudice at
7 all.

8 MR. SCRENOCK: We don't see it as relevant
9 to the issues to this docket.

10 MS. BENSKY: Except that EA says that it
11 is.

12 EXAMINER NEWMARK: Hang on. You said it
13 for me. It's in his testimony. To the extent that
14 it's mentioned earlier in his testimony, we can let
15 it in. We'll just put the whole thing in, the
16 final -- the final version of this document. You'll
17 have to ERF that.

18 MR. SCRENOCK: Where is it in his
19 testimony?

20 EXAMINER NEWMARK: I'm relying on their
21 representation that it is.

22 MS. BENSKY: It's in the EA, which is an
23 exhibit to his testimony.

24 MR. McKEEVER: It's in the exhibit,
25 several references to it.

Transcript of Proceedings - October 10, 2012
Volume 4

712

1 Just a procedural question, will the --
2 will the staff here ERF it, or do we need to do it?

3 EXAMINER NEWMARK: You need to do it.

4 MR. McKEEVER: Okay.

5 EXAMINER NEWMARK: And that will be
6 Jaeger 4.

7 MR. McKEEVER: Yes.

8 (Jaeger Exhibit No. 4 marked and received.)

9 MR. McKEEVER: A couple more questions if
10 we've resolved that issue.

11 EXAMINER NEWMARK: Okay.

12 BY MR. McKEEVER:

13 Q Mr. Jaeger, you refer in the EA, and I believe in
14 your testimony, but at least in the EA, to recent
15 literature reviews from Minnesota and Massachusetts;
16 is that correct?

17 A Yes, I do.

18 Q Did you read those?

19 A Yes, I have.

20 Q Okay. And you would agree that what those studies
21 say is that there's no evidence that industrial wind
22 turbines cause health problems and -- but that they
23 don't say the opposite of that. They simply say
24 there's no evidence in the scientific way in the
25 literature to say that, but they don't exclude

Transcript of Proceedings - October 10, 2012
Volume 4

713

1 industrial wind turbines as a potential cause of the
2 problems that are out there?

3 A I don't think that's an accurate characterization. I
4 believe that the studies say, and the way I've tried
5 to discuss it in the EA and in my testimony, is that
6 those two particular reviews conclude that there is
7 limited evidence. But there is evidence that there
8 is, and I believe the Massachusetts study combined
9 annoyance and sleep disturbance. So they did
10 recognize that there was evidence for annoyance and
11 sleep disturbance. They also concluded that there
12 was no evidence to support any other direct health
13 effects other than the annoyance and sleep
14 disturbance. And then they went on to conclude a few
15 other things, and part of it was that there was no
16 basis that they were able to find to support the --
17 the -- a pure point wind turbine syndrome, and there
18 was some discussion also about low frequency noise.

19 Q Yes. Thank you. So essentially they say the same
20 thing that we heard Dr. Roberts say earlier, that we
21 can agree that there's a problem, and we can disagree
22 about whether there's evidence that wind turbines are
23 the cause?

24 MR. LORENCE: I object. He's asking for
25 an opinion that's beyond Mr. Jaeger's testimony.

Transcript of Proceedings - October 10, 2012
Volume 4

714

1 EXAMINER NEWMARK: Okay. Sustained.

2 BY MR. McKEEVER:

3 Q You heard Dr. Roberts testify, did you not?

4 A I did.

5 MR. McKEEVER: That's all I'm asking is
6 whether or not he agrees with what Dr. Roberts
7 testified to.

8 MR. LORENCE: He's asking for him to
9 testify to medical opinions, and Mr. Jaeger isn't a
10 witness to that.

11 EXAMINER NEWMARK: I agree. Sustained.

12 BY MR. McKEEVER:

13 Q The -- as far as you know, the actual turbine model
14 to be used in this project has not yet been selected?

15 A That's my understanding.

16 Q So we really don't know how much noise will be
17 produced by this project, do we?

18 A At this point, there are three possible turbine
19 models that had been proposed. There has been some
20 information and modeling done on those. I do not
21 know whether any of those three would be the actual
22 model they would choose and install if they get
23 approval. So the question is, no, we don't know
24 exactly what the turbine model is and what --

25 Q What the consequences of that choice will be? We

Transcript of Proceedings - October 10, 2012
Volume 4

715

1 don't know what the consequences in terms of noise
2 will be?

3 A We don't know exactly because we don't know the
4 turbine model, that's correct.

5 MR. McKEEVER: Thank you. I have no other
6 questions.

7 EXAMINER NEWMARK: All right. Other
8 cross?

9 MR. REYNOLDS: Yes.

10 CROSS-EXAMINATION

11 BY MR. REYNOLDS:

12 Q Mr. Jaeger, you've been at this hearing for both
13 days, haven't you?

14 A Yes, I have.

15 Q And you heard the testimony of the citizens at
16 Shirley and Horicon?

17 A Yes, I did.

18 Q All right. And you heard Mr. Hessler's assessment
19 that the -- that the folks in the Town of Forest may
20 be in danger if the same turbines are put in the Town
21 of Forest?

22 A I heard Mr. Hessler's testimony, yes.

23 Q All right. And is that evidence significant to you
24 in terms of determining whether there's a basis to do
25 an Environmental Impact Statement?

Transcript of Proceedings - October 10, 2012
Volume 4

716

1 A I don't think what Mr. Hessler said in his testimony
2 changes my -- what we have said in either the
3 environmental assessment or in my testimony.

4 Q Did you agree with Mr. Hessler that the -- that the
5 statements of the Shirley residents was irrefutable,
6 that they're having health impacts as a result of the
7 wind turbines?

8 A I don't have an opinion on his statement about that.

9 Q All right. If you accepted Mr. Hessler's opinion
10 that it was irrefutable, would this potentially be a
11 significant impact in Forest?

12 MR. SCRENOCK: Your Honor, I'm going to
13 object. I don't recall that Mr. Hessler referred to
14 it as irrefutable. And I object to the form of the
15 question.

16 EXAMINER NEWMARK: Yeah. Well, I can't
17 verify that right now, so you'll have to rephrase
18 it.

19 BY MR. REYNOLDS:

20 Q All right. Assuming that Mr. Hessler -- you know
21 that Mr. Hessler wanted to do some testing at
22 Shirley?

23 A Yes, I do.

24 Q All right. And you heard him testify that he saw the
25 symptoms complained of by the Shirley residents as

Transcript of Proceedings - October 10, 2012
Volume 4

717

1 consistent with low frequency noise: nausea, vertigo,
2 headaches, et cetera?

3 MR. SCRENOCK: Your Honor, object. I
4 don't believe Mr. Hessler connected those.

5 MR. REYNOLDS: Well, I'm asking him a
6 question. I'm not asking you.

7 MR. SCRENOCK: And I'm objecting to the
8 question.

9 MS. NEKOLA: So am I.

10 EXAMINER NEWMARK: Can we just ask him if
11 Hessler said it was irrefutable, what would he do in
12 terms of the EIS?

13 MR. REYNOLDS: Yeah.

14 EXAMINER NEWMARK: Just leave it at that.

15 BY MR. REYNOLDS:

16 Q Did you hear Mr. Hessler talk about any concern about
17 replicating what's happening in Shirley in the Town
18 of Forest, Mr. Jaeger?

19 A I actually do not remember if he said something
20 specifically about that.

21 Q If -- if his testimony was offering an opinion that
22 if the same turbine that's used in Shirley is used in
23 Forest, that they will have similar experiences,
24 would that be significant to you in terms of
25 determining whether an environmental impact statement

Transcript of Proceedings - October 10, 2012
Volume 4

718

1 is going to --

2 MR. LORENCE: Object, Your Honor. This
3 has been asked and answered. He said he's listened
4 to Mr. Hessler's testimony and it made no difference
5 with respect to his opinion with the EA or EIS
6 questions.

7 MR. REYNOLDS: Well, he may not have been
8 listening when Mr. Hessler was testifying.

9 MR. LORENCE: That was a very specific
10 answer that he gave, Your Honor.

11 MR. REYNOLDS: He hasn't had a chance to
12 answer the question.

13 MR. LORENCE: He did five minutes ago.

14 EXAMINER NEWMARK: Let him answer it.

15 THE WITNESS: Could you read me the
16 question, please.

17 (RECORD READ.)

18 THE WITNESS: I think what I have said in
19 both my testimony and in the environmental
20 assessment is that our -- my interpretation is that
21 there's -- there could be people who are going to be
22 bothered by wind turbines in the Town of Forest.
23 There's -- but I don't have any way of saying how
24 many or who those people are, but I -- what I tried
25 to do in the testimony is recognize that there's a

Transcript of Proceedings - October 10, 2012
Volume 4

719

1 chance of that. What I heard Mr. Hessler say I
2 thought was consistent with what I've said in my
3 testimony. I don't see that there's anything
4 different in what he said except maybe in the extent
5 or maybe in the -- how emphatic he was about certain
6 aspects of it, but --

7 BY MR. REYNOLDS:

8 Q Well, your environmental assessment relied on Glacier
9 Hills primarily, did it not?

10 A We used a lot of the analysis we did in Glacier Hills
11 because it was still relevant, yes.

12 Q It didn't rely on the experiences of the Town of
13 Shirley, did it?

14 A No. The Town of Shirley Project was not in place at
15 that point.

16 Q Was that information important to you as the EA
17 coordinator, the Shirley resident testimony and
18 Mr. Hessler's evaluation of it?

19 A The Shirley testimony in my opinion is similar to
20 some of the reactions we were seeing or the reactions
21 we were seeing to some individuals in the Forward
22 Project, some individuals in the Glacier Hills
23 Project, some individuals -- I mean, essentially in
24 any wind project in the state, there have been a few
25 people who have had significant complaints. I didn't

Transcript of Proceedings - October 10, 2012
Volume 4

720

1 see necessarily that the Shirley complaints were
2 fundamentally different. But then again, I'm not --
3 I don't have a medical background to be able to draw
4 that finding or distinction.

5 Q Well, you distinguish between annoyance and the level
6 of complaint that causes individuals to leave their
7 homes?

8 A I don't know if I've distinguished that yet. I
9 recognize that some people through annoyance, through
10 sleep disturbance in particular -- sleep disturbance
11 I think can significantly affect a person's
12 well-being, and I could see how that could lead to
13 someone leaving their home. I don't know if there
14 are other reasons why people leave their homes. I
15 can't specifically say for any of those individuals
16 what the situation was.

17 Q Well, is it -- is it fair to say -- well, let me ask
18 you this. The Town of Forest's response to your
19 conclusion that some -- that folks may suffer or will
20 suffer in the Town of Forest was to request the
21 Public Service Commission to do an evaluation, do you
22 recall that?

23 MR. LORENCE: Object, Your Honor. He's
24 mischaracterizing what the Town of Forest replied in
25 their comments.

Transcript of Proceedings - October 10, 2012
Volume 4

721

1 EXAMINER NEWMARK: Okay. Well, if you
2 can -- you want to point to something, you can.

3 BY MR. REYNOLDS:

4 Q Do you recall receiving the Town of Forest comments
5 on the EA?

6 A Yes, I do.

7 Q All right. And did it remind -- was it consistent
8 with the basic statement that if the -- if this CPCN
9 is granted, it has to be in the public interest?

10 A It may have said that. I do not --

11 Q All right. And is it in the public interest to try
12 to assess who in the Town of Forest may be leaving
13 their homes if this project is built?

14 MR. LORENCE: I object, Your Honor.
15 Again, he's asking for a legal conclusion that's
16 outside the scope of his testimony.

17 EXAMINER NEWMARK: Okay. Sustained.

18 MR. REYNOLDS: I'm not asking for a legal
19 conclusion. I'm asking for what would trigger an
20 Environmental Impact Statement. Does that clare --
21 do I have to ask the question again? I'm trying to
22 understand at what point evidence would be
23 sufficient -- significant enough where we dig a
24 little deeper and find out with respect to the
25 turbines in Shirley and their application to the

Transcript of Proceedings - October 10, 2012
Volume 4

722

1 Town of Forest, when we're going to try to make a
2 better prediction about what's going to happen if
3 this project goes through.

4 MR. LORENCE: Your Honor, I'll object
5 again. He's asking for speculation. The Commission
6 has put in the environmental assessment and the
7 testimony. Asking when we might do something in the
8 future or what would change our situation is pure
9 speculation.

10 EXAMINER NEWMARK: You're asking him why
11 he didn't do an EIS, is that your question?

12 MR. LORENCE: I believe he asked when we
13 would do an EIS.

14 EXAMINER NEWMARK: Right, right.

15 MR. LORENCE: What would change to make us
16 change an EIS, and nothing's going to need to change
17 at this point, and that's why it's speculation.

18 MR. REYNOLDS: Only this witness knows if
19 it's speculation.

20 MR. LORENCE: That doesn't change my
21 objection.

22 EXAMINER NEWMARK: Well, let's see what he
23 says. You can answer.

24 THE WITNESS: I guess I do not want to
25 speculate about that.

Transcript of Proceedings - October 10, 2012
Volume 4

723

1 BY MR. REYNOLDS:

2 Q All right. Did you -- you're aware that the -- last
3 week one day after Jaime Junker's testimony was
4 filed, the Town submitted a series of questionnaires
5 showing health problems at at least 16 residences in
6 the Town of Forest.

7 MR. LORENCE: Object, Your Honor.
8 Objection. I don't believe that's in evidence.

9 EXAMINER NEWMARK: That's correct.

10 MR. REYNOLDS: Well, I'm going to make an
11 offer of proof if I can, and I'd like to ask him
12 questions about it. I think it's legitimate. If
13 he's seen it.

14 EXAMINER NEWMARK: So you want to object
15 to the ruling keeping those documents out, and
16 you're making an offer of proof for that purpose?

17 MR. REYNOLDS: Absolutely, yes. And I
18 meant to bring that up with you. I definitely want
19 it in the record. You can say it's out, but -- and
20 I'll ask you perhaps to revisit that after tomorrow,
21 but I certainly want to ask this witness if he's
22 aware of what was filed.

23 EXAMINER NEWMARK: Okay. So let's --

24 MR. LORENCE: Your Honor, if he was going
25 to make an offer of proof, wouldn't he have had to

Transcript of Proceedings - October 10, 2012
Volume 4

724

1 do that through his witness that he was trying to
2 offer the exhibit. He can't do that through
3 Mr. Jaeger.

4 EXAMINER NEWMARK: Okay.

5 MR. REYNOLDS: I just want to know if
6 Mr. Jaeger's aware of the evidence that the Town of
7 Forest submitted in the ERF.

8 EXAMINER NEWMARK: For what purpose?

9 MR. REYNOLDS: Well, because if we're
10 going to take the Town of Shirley incident
11 seriously, and we're going to believe what
12 Mr. Hessler's concern is, and we know that if this
13 project goes in without knowing who the vulnerable
14 people are, that people will be leaving their homes
15 unless the Public Service Commission changes
16 something. This is a major action affecting the
17 human environment from the Town of Forest
18 perspective, and if the Public Service Commission is
19 refusing to acknowledge the information, refusing to
20 do an EIS, that's certainly an appealable issue. If
21 the Public Service Commission ignores it all and
22 just, you know, approves the permit. So we're
23 entitled to make a record on this.

24 EXAMINER NEWMARK: Well, if you want to
25 make an offer of proof, we'll be back here next week

Transcript of Proceedings - October 10, 2012
Volume 4

725

1 so we can recall your witness for that purpose.

2 MR. REYNOLDS: Well, the offer of proof
3 would pretty much be the -- it's really a simple
4 offer of proof. I can make it now. It's the --

5 EXAMINER NEWMARK: Well, no. I think what
6 we'll do is we'll -- it's better to have your
7 witness who conducted the study make the offer. So
8 we can do that next week, but it's not appropriate
9 to do that right now.

10 MR. REYNOLDS: All right. Well, let me
11 just ask this witness if he knows anything about it,
12 and then I can be done.

13 EXAMINER NEWMARK: Well --

14 MR. LORENCE: Back to my first objection,
15 Your Honor, is saying that he's asking a question
16 about things not in evidence.

17 EXAMINER NEWMARK: Yeah. Okay. I'm
18 sustaining the objection, so let's move on.

19 MR. REYNOLDS: Well, this is -- I know
20 it's late. I understand your ruling. This is
21 extremely important information. Are we going to
22 basically say that we're going to --

23 EXAMINER NEWMARK: No, sir. I said next
24 week -- first of all, I said tomorrow those people
25 can come to the hearing, and they can put their

Transcript of Proceedings - October 10, 2012
Volume 4

726

1 evidence in. It's their right to do so.

2 MR. REYNOLDS: Okay.

3 THE COURT: And I said next week you can
4 make your offer of proof through your own witness.
5 So what else do you need to know?

6 MR. REYNOLDS: Well, I want to get the
7 offer of proof before this technical expert on the
8 EIS issue. That's it. So we'll have all 16 folks
9 come tomorrow and we'll verify --

10 EXAMINER NEWMARK: You can recall this
11 witness if this -- if this -- during your offer of
12 proof.

13 MR. REYNOLDS: Save a lot of time if I
14 could just ask him if he's aware of it. Maybe he's
15 not and then I don't have to recall him.

16 EXAMINER NEWMARK: It's not on the record
17 right now.

18 MR. REYNOLDS: That's all I have.

19 EXAMINER NEWMARK: All right. Redirect?

20 MR. SCRENOCK: I have one question, Your
21 Honor.

22 EXAMINER NEWMARK: Sorry.

23 CROSS-EXAMINATION

24 BY MR. SCRENOCK:

25 Q Mr. Jaeger, in your testimony on your direct, pages 4

Transcript of Proceedings - October 10, 2012
Volume 4

727

1 and 5, you reference the noise modeling that was
2 submitted with the application and the reference to
3 the potentially 45 homes that may experience sound
4 above 45 decibels. I think we all understand that it
5 was based on the models submitted with the
6 application which was based on the 0.0 ground
7 absorption coefficient. Is that your understanding?

8 A That's my understanding, yes.

9 Q My question is this, Mr. Jaeger. If the application
10 would have included the modeling results from both
11 the 0.0 ground absorption coefficient and the 0.5
12 ground absorption coefficient model that was
13 submitted later with Ms. Blank's rebuttal testimony,
14 would your testimony on the environmental assessment
15 reflect both models?

16 A I would have reflected both, yes.

17 Q And in that reflection would you have made some
18 qualitative statement as to which was better or more
19 appropriate?

20 A I would not have made a statement as to which were
21 better or more appropriate, no.

22 MR. SCRENOCK: Thank you.

23 EXAMINER NEWMARK: Redirect?

24 MR. LORENCE: No, Your Honor.

25 EXAMINER NEWMARK: All right. You're

Transcript of Proceedings - October 10, 2012
Volume 4

728

1 excused.

2 (Witness excused.)

3 MR. McKEEVER: Judge, may I ask on the
4 record a procedural question? The prescheduling
5 order provides on page 4 at Section 6(A)(1) that 15
6 collated paper copies of all exhibits shall be filed
7 with the Commission's record management unit. I'd
8 like to ask that that condition be waived for
9 purposes of this EIS which you admitted into
10 evidence this time. It seems to me to be more than
11 redundant and an environmental unsound use of paper
12 to make 15 more copies of this document. Can we --
13 would you be willing to waive that requirement?

14 EXAMINER NEWMARK: I can get back to you.

15 MR. McKEEVER: Thank you.

16 EXAMINER NEWMARK: Because, to be honest
17 with you, it's not my request. So I can get back to
18 you.

19 MR. McKEEVER: Oh, you mean it's a request
20 from the -- gotcha. Thank you.

21 EXAMINER NEWMARK: Anything else?

22 MR. REYNOLDS: Yeah, I have a question
23 about -- I didn't perhaps understand. Are we
24 continuing this hearing until next week?

25 EXAMINER NEWMARK: Well, let's go off the

Transcript of Proceedings - October 10, 2012
Volume 4

729

1 record.

2 (Discussion held off the record.)

3 EXAMINER NEWMARK: On the record.

4 MR. WILSON: It's fairly clear based upon
5 the questioning from Mr. Reynolds that there is
6 going to be an argument that the Commission ought to
7 require that this project be redesigned to a 40 dB
8 standard, and if that argument is made, there's
9 nothing in this record that would indicate to the
10 Commission what the impact of that would be, and we
11 think that that's important information that the
12 Commission would have to have or should have in
13 making a decision on that question. And Mr. Hankard
14 is -- is able to address that issue with regard to
15 the scheduling of it. I think it actually would be
16 beneficial to continue the hearing until next week,
17 because I think it would give him an opportunity to
18 more thoroughly look at the question and make sure
19 that the responses are well thought out as opposed
20 to just bringing them up today.

21 EXAMINER NEWMARK: Okay. And there's an
22 objection, so let me hear that.

23 MR. REYNOLDS: My objection would be that
24 all the direct testimony from Mr. Schomer and
25 surrebuttal and Mr. Hessler's testimony had an ideal

Transcript of Proceedings - October 10, 2012
Volume 4

730

1 dBA limit of 40. Ms. Blank testified that the
2 project could be redesigned with a dBA limit of 40,
3 and so there was plenty of opportunity in rebuttal,
4 surrebuttal, which we got at the last minute, or
5 Mr. Hankard to address this issue. It was -- it was
6 right up front last -- yesterday in all the direct
7 and everything that's preceded this.

8 I got hammered by missing a day of putting
9 in health surveys, and now we're in a position where
10 new information is coming up that we don't have the
11 ability to even know what it is. That's just
12 unfair. Now we have to get responses to
13 Mr. Hankard's new testimony. That's number one.

14 Number two, I think Mr. Pobloskie wants to
15 come in and testify about a decommissioning study.

16 EXAMINER NEWMARK: Well, let's work on one
17 thing at a time.

18 MR. REYNOLDS: Fine.

19 EXAMINER NEWMARK: Do we have any other
20 response?

21 MS. BENSKY: I guess my position on
22 Hankard is I think that would be fair to allow that
23 ultimately, but I would ask that Mr. Hankard submit
24 that testimony in writing to us as soon as possible,
25 and because of the nature of the material, we would

Transcript of Proceedings - October 10, 2012
Volume 4

731

1 need the opportunity to go over it with our own
2 noise engineers and give them the opportunity if
3 they choose to rebut it, and then come back for a
4 hearing. Because just having him come in for
5 cross-examination is not going to be meaningful.

6 EXAMINER NEWMARK: Okay. Clean, anything?

7 MS. NEKOLA: I would agree with that,
8 actually. I would like an opportunity to look at
9 that and involve Mr. Hessler in it.

10 EXAMINER NEWMARK: Okay. Do you agree,
11 it's -- I forgot how you characterized it.

12 MS. BENSKY: It's a technical issue that's
13 beyond what I can meaningfully do in
14 cross-examination.

15 EXAMINER NEWMARK: But you don't -- you
16 don't object to the concept of having that evidence
17 on the record?

18 MS. BENSKY: I don't object to the
19 concept.

20 EXAMINER NEWMARK: Okay. And you as well
21 do not object?

22 MS. NEKOLA: I think it's likely that an
23 argument is going to be made that the project should
24 be redesigned, that the Commission would absolutely
25 need to know what that meant.

Transcript of Proceedings - October 10, 2012
Volume 4

732

1 EXAMINER NEWMARK: Uh-huh. Staff, any
2 comments?

3 MR. LORENCE: Nope.

4 EXAMINER NEWMARK: Okay. All right. And
5 what was the other -- Pobloskie as well was going to
6 be recalled for additional evidence. So anything
7 you want to say on that front?

8 MR. WILSON: I think it's one of the --
9 one of the critical disagreements in this hearing
10 is, you know, that the estimates on decommissioning,
11 and Mr. Stamberg wasn't able to sit up there and do
12 those calculations for what it meant to his -- how
13 much of the foundation would actually be removed.
14 Mr. Pobloskie has already done that, that
15 calculation. And I think to inform the record and
16 again inform the Commission about the difference
17 between these two estimates, that they need to
18 understand that particular calculation and how much
19 of the foundations would actually be removed to
20 understand the impact on the cost.

21 EXAMINER NEWMARK: Okay. Response?

22 MR. REYNOLDS: Well, Mr. Pobloskie
23 testified yesterday that he wasn't doing a
24 decommissioning study. Now he's doing a
25 decommissioning study. I'd say it's too late. The

Transcript of Proceedings - October 10, 2012
Volume 4

733

1 record's closed pretty much, and we're out of time
2 for Mr. Pobloskie's study.

3 EXAMINER NEWMARK: Anyone else?

4 MR. WILSON: I would just note that it's
5 fairly common to do these types of things at the end
6 of the hearing where there's a hole in the record,
7 and we know there's a hole in the record.

8 EXAMINER NEWMARK: Staff?

9 MR. LORENCE: Once again, I don't have a
10 strong opinion on this. You know, it appears we're
11 in a never-ending hearing here, and so that's one
12 argument. But I can see Mr. Reynolds' side on this
13 as well. So I don't have an opinion.

14 EXAMINER NEWMARK: Okay.

15 MR. WILSON: We're happy to also provide
16 this in advance to the parties, allow them to look
17 at it before they have to cross Mr. Pobloskie on it.

18 EXAMINER NEWMARK: Okay. So what's our
19 timing like for the process? We might need
20 Mr. Lepinski's advice on this.

21 MR. LEPINSKI: I think some of these dates
22 were already set, but I have initial briefs due on
23 December 17th.

24 EXAMINER NEWMARK: No. We can go off.

25 (Discussion off the record.)

Transcript of Proceedings - October 10, 2012
Volume 4

734

1 EXAMINER NEWMARK: So the Applicant has
2 offered to submit information related to development
3 of the project using a 40-decibel variable in this,
4 or limit I guess in this case, and suggestions were
5 made for how that would be presented in testimony
6 and how we would proceed from that point. I think
7 at this point from what we know now and what the
8 Applicants propose, you know, my initial response
9 would be to have the Applicant file its
10 presentation, its case on this point, and they've
11 committed to Monday on the 15th, and I'll review
12 what's been filed and determine the process from
13 that point as to how much time to give response and
14 in what form that will take and what point we'll
15 hold a hearing on that issue.

16 And if we treated this like an offer for
17 late evidence to come into the record, that does
18 provide parties an opportunity to respond. And what
19 I would do is give parties a chance. We could do
20 that by Thursday. Parties can take a look and then
21 give me their suggestion on the process that would
22 be required for fair evaluation on the new filings.

23 MS. BENSKY: So by Thursday we're going to
24 tell you what we think -- what we would like the
25 schedule to be going forward?

Transcript of Proceedings - October 10, 2012
Volume 4

735

1 EXAMINER NEWMARK: Yeah. If you can get
2 me the schedule, that would be good. At least give
3 me what you think you need to do to respond.

4 MS. BENSKY: Okay.

5 MR. REYNOLDS: Judge, I have one point.

6 EXAMINER NEWMARK: Yeah.

7 MR. REYNOLDS: For the record, I object
8 for the reasons I've stated. But if now the record
9 is going to be extended, I would ask you to reverse
10 your ruling on the health surveys. I don't see any
11 reason to keep that out now.

12 EXAMINER NEWMARK: Okay. Note your
13 objection.

14 Okay. Anybody else?

15 (No response.)

16 EXAMINER NEWMARK: Okay. So at this point
17 we have some new stuff to deal with, and we do have
18 a hearing tomorrow. And I don't know if there's
19 anything else outstanding at this point. Anyone
20 think of anything?

21 MR. WILSON: Pobloskie.

22 EXAMINER NEWMARK: Well, why don't you --
23 can you file his calculations on Monday as well?
24 We'll deal with it all the same way.

25 MR. WILSON: Okay.

Transcript of Proceedings - October 10, 2012
Volume 4

736

1 EXAMINER NEWMARK: That will work.

2 All right. Thank you very much. We're
3 adjourned. We'll see some of you tomorrow.

4 (The hearing adjourned at 7:41 p.m.)

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Transcript of Proceedings - October 10, 2012
Volume 4

737

1 STATE OF WISCONSIN)

2 MILWAUKEE COUNTY)

3
4 We, JENNIFER M. STEIDTMANN, RPR, CRR,
5 Registered Professional Reporter, Certified Realtime
6 Reporter, Notary Public, and LYNN PEPPEY BAYER, CM,
7 Certificate of Merit, Notary Public, with the firm of
8 Gramann Reporting Ltd., 710 North Plankinton Avenue, Suite
9 710, Milwaukee, Wisconsin, do hereby certify that we
10 reported the foregoing proceedings had on October 10,
11 2012, and that the same is true and correct in accordance
12 with our original machine shorthand notes taken at said
13 time and place.

14
15 _____
16 Jennifer M. Steidtmann
17 Registered Professional Reporter
18 Certified Realtime Reporter

19
20 _____
21 Lynn Peppy Bayer
22 Certificate of Merit

23
24 Dated this 18th day of October, 2012.
25 Madison, Wisconsin.

Transcript of Proceedings - October 10, 2012
Volume 4

1	I N D E X		
2	WITNESS	EXAMINATION	PAGE
3	MARK A. ROBERTS, M.D., APPLICANT WITNESS		
4		DIRECT EXAMINATION BY MR. WILSON	396
5		CROSS-EXAMINATION BY MR. MCKEEVER	399
6		CROSS-EXAMINATION BY MR. REYNOLDS	417
7		RECROSS-EXAMINATION BY MR. MCKEEVER	444
8		REDIRECT EXAMINATION BY MR. WILSON	451
9	DAVID HESSLER, CLEAN WISCONSIN WITNESS		
10		DIRECT EXAMINATION BY MS. NEKOLA	452
11		CROSS-EXAMINATION BY MS. BENSKY	469
12		CROSS-EXAMINATION BY MR. REYNOLDS	500
13		CROSS-EXAMINATION BY MR. SCRENOCK	517
14		CROSS-EXAMINATION BY MR. LORENCE	521
15		RECROSS-EXAMINATION BY MS. BENSKY	522
16		RECROSS-EXAMINATION BY MR. REYNOLDS	525
17		REDIRECT EXAMINATION BY MS. BRANT	529
18	RICHARD HORONJEFF, FOREST VOICE WITNESS		
19		DIRECT EXAMINATION BY MR. MCKEEVER	530
20		BY MR. WILSON	532
21	WES SLAYMAKER, TOWN OF FOREST WITNESS		
22		DIRECT EXAMINATION BY MR. REYNOLDS	539
23	PAUL SCHOMER, TOWN OF FOREST WITNESS		
24		DIRECT EXAMINATION BY MR. REYNOLDS	539
25		CROSS-EXAMINATION BY MR. WILSON	549

Transcript of Proceedings - October 10, 2012
Volume 4

739

1	CROSS-EXAMINATION BY MS. BENSKY	558
2	RECROSS-EXAMINATION BY MR. WILSON	565
3	FURTHER DIRECT EXAMINATION BY MR. REYNOLDS	567
4	CROSS-EXAMINATION BY MR. LORENCE	568
5	RECROSS-EXAMINATION BY MS. BENSKY	572
6	REDIRECT EXAMINATION BY MR. REYNOLDS	576
7	JERRY PUNCH, TOWN OF FOREST WITNESS	
8	DIRECT EXAMINATION BY MR. REYNOLDS	583
9	CROSS-EXAMINATION BY MS. BENSKY	584
10	CROSS-EXAMINATION BY MR. WILSON	606
11	JOHN STAMBERG, TOWN OF FOREST WITNESS	
12	DIRECT EXAMINATION BY MR. REYNOLDS	615
13	CROSS-EXAMINATION BY MR. WILSON	627
14	REDIRECT EXAMINATION BY MR. REYNOLDS	653
15	CARL PHILLIPS, TOWN OF FOREST WITNESS	
16	DIRECT EXAMINATION BY MR. REYNOLDS	656
17	CROSS-EXAMINATION BY MR. MCKEEVER	657
18	CROSS-EXAMINATION BY MR. WILSON	663
19	JAIME JUNKER, TOWN OF FOREST WITNESS	
20	DIRECT EXAMINATION BY MR. REYNOLDS	664
21	CROSS-EXAMINATION BY MR. WILSON	672
22	CROSS-EXAMINATION BY MR. MCKEEVER	688
23	RECROSS-EXAMINATION BY MR. WILSON	694
24	CROSS-EXAMINATION BY MR. LORENCE	694
25	JAMES LEPINSKI, COMMISSION STAFF WITNESS	

Transcript of Proceedings - October 10, 2012
Volume 4

740

1	DIRECT EXAMINATION BY MR. LORENCE	697
2	CROSS-EXAMINATION BY MR. REYNOLDS	698
3	CROSS-EXAMINATION BY MR. MCKEEVER	700
4	MICHAEL JOHN JAEGER, COMMISSION STAFF WITNESS	
5	DIRECT EXAMINATION BY MR. LORENCE	702
6	CROSS-EXAMINATION BY MR. MCKEEVER	702
7	CROSS-EXAMINATION BY MR. REYNOLDS	715
8	CROSS-EXAMINATION BY MR. SCRENOCK	726

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E X H I B I T S

13	NUMBER	MARKED	RECEIVED
14	Hessler 4	456	--
15	Hessler 5	466	466
16	Hessler 6	500	500
17	Schomer 9	582	582
18	Jaeger 4	712	712

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7030.0050 NOISE AREA CLASSIFICATION.

Subpart 1. **Applicability.** The noise area classification is based on the land use activity at the location of the receiver and determines the noise standards applicable to that land use activity unless an exception is applied under subpart 3.

Subp. 2. **Noise area classifications.** The noise area classifications and the activities included in each classification are listed below:

Noise Area Classification	Land Use Activities
1	Household Units (includes farm houses) Hotels, motels, or other overnight lodging Mobile home parks or courts Other residential units Motion picture production Medical and other health services Correctional institutions Educational services Religious activities Cultural activities and nature exhibitions Entertainment assembly Camping and picnicking areas (designated) Resorts and group camps Other cultural, entertainment, and recreational activities.
2	Railroad terminals (passenger and freight) Rapid rail transit and street railway passenger terminals Bus passenger terminals (intercity and local) Other motor vehicle transportation Airport and flying field terminals (passenger and freight) Marine terminals (passenger and freight) Automobile parking Transportation services and arrangements Wholesale trade

- Retail trade, including restaurants and bars
- Finance, insurance, and real estate services
- Personal services
- Business, legal, or other professional services
- Repair services
- Contract construction services
- Governmental services (except correctional institutions)
- Miscellaneous services (except religious activities)
- Public assembly (except entertainment assembly and race tracks)
- Amusements (except fairgrounds and amusement parks)
- Recreational activities (except designated camping and picnicking areas)
- Parks
- 3 Manufacturing
- Transportation (except passenger terminals)
- Highway and street right-of-way
- Communication
- Utilities
- Race tracks
- Fairgrounds and amusement parks
- Agricultural and related activities
- Forestry activities and related services (including commercial forest land, timber production, and other related activities)
- Fishing activities and related services
- Mining activities and related services
- Other resource production and extraction
- All other activities not otherwise listed.
- 4 Undeveloped and unused land area
- Noncommercial forest development
- Water areas
- Vacant floor area
- Under construction

Subp. 3. **Exceptions.** The noise area classification for a land use may be changed in the following ways if the applicable conditions are met.

A. The daytime standards for noise area classification 1 shall be applied to noise area classification 1 during the nighttime if the land use activity does not include overnight lodging.

B. The standards for a building in a noise area classification 2 shall be applied to a building in a noise area classification 1 if the following conditions are met:

(1) the building is constructed in such a way that the exterior to interior sound level attenuation is at least 30 dB(A);

(2) the building has year-round climate control; and

(3) the building has no areas or accommodations that are intended for outdoor activities.

C. The standards for a building in a noise area classification 3 shall be applied to a building in a noise area classification 1 if the following conditions are met:

(1) the building is constructed in such a way that the exterior to interior sound level attenuation is at least 40 dB(A);

(2) the building has year-round climate control; and

(3) the building has no areas or accommodations that are intended for outdoor activities.

D. The standards for a building in a noise area classification 3 shall be applied to a building in a noise area classification 2 if the following conditions are met:

(1) the building is constructed in such a way that the exterior to interior sound level attenuation is at least 30 dB(A);

(2) the building has year-round climate control; and

(3) the building has no areas or accommodations that are intended for outdoor activities.

Statutory Authority: *MS s 115.03; 116.07*

History: *11 SR 43; 18 SR 614; 41 SR 763*

Published Electronically: *January 27, 2017*

7030.0040 NOISE STANDARDS.

Subpart 1. **Scope.** These standards describe the limiting levels of sound established on the basis of present knowledge for the preservation of public health and welfare. These standards are consistent with speech, sleep, annoyance, and hearing conservation requirements for receivers within areas grouped according to land activities by the noise area classification (NAC) system established in part 7030.0050. However, these standards do not, by themselves, identify the limiting levels of impulsive noise needed for the preservation of public health and welfare. Noise standards in subpart 2 apply to all sources.

Subp. 2. **Noise standards.**

Noise Area Classification	Daytime		Nighttime	
	L ₅₀	L ₁₀	L ₅₀	L ₁₀
1	60	65	50	55
2	65	70	65	70
3	75	80	75	80

Statutory Authority: *MS s 116.07*

History: *11 SR 43; 18 SR 614*

Published Electronically: *December 12, 2003*