BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF SOUTH DAKOTA

IN THE MATTER OF THE APPLICATION BY PREVAILING WIND PARK, LLC FOR A PERMIT OF A WIND ENERGY FACILITY IN BON HOMME COUNTY, CHARLES MIX COUNTY AND HUTCHINSON COUNTY, SOUTH DAKOTA, FOR THE PREVAILING WIND	* * * * * * * *	**INTERVENORS' RESPONSES TO STAFF'S SECOND SET OF DATA REQUESTS TO INTERVENORS** **EL18-026**

Intervenors Gregg Hubner, Marsha Hubner, Paul Schoenfelder, and Lisa Schoenfelder ("Intervenors"), through counsel, provide the following Responses to Applicant Prevailing Wind Park, LLC's ("Applicant") Second Set of Data Requests to Intervenors.

2-1) Refer to the Intervenor's response to Staff Data Request 1-4. The Intervenors "recommend a 2-mile setback from non-participating residences and a 1,500 ft. setback from a property line and public rights-of-way with waivers available for those who want them closer." Please provide references to the direct testimony, including page and line numbers, submitted by Richard R. James, Jerry L. Punch, and Prof. Mariana Alves-Pereira, that support this condition.

RESPONSE:

Gregg Hubner: I was advocating for a 2-mile setback since the spring of 2015. My first support for this idea was from the book "Wind Turbine Syndrome" by Dr. Nina Pierpont, MD, PhD on page 254. (Attachment A) In the Shirley Wind Farm in Brown County, Wisconsin, infrasound was detected 6.2 miles away from the turbine, with complaints at 4.2 miles. The Shirley Wind Farm was designated a "human health hazard" in 2014 by the Brown County Board of Health. https://www.michigancapitolconfidential.com/20690.

Also, I am attaching a study on blade and ice throw that shows these throw distances can be up to 6500 ft. (Attachment B)

In August of 2017 I met Vicki May, who lives about an hour south of us in Nebraska. She lives 1 1/3 miles from the closest of 200 wind turbines. I have been to her place and in her home. I heard her testimony in front of the State of Nebraska Natural Resources Committee in September of 2017. (Attachments C and D) Early in 2018 I got a call from Jerome Powers who suffers from some symptoms of WTS. He lives well over a mile and a half from the Beethoven Wind Farm. It makes sense to me to listen to people that live in a wind farm and under these conditions than some computer model or highly educated person that has never lived near a wind farm. I do know certain people have ill effects up to 4.2 miles away (Shirley Wind Farm). It makes sense to me to error on the side of caution since the only recourse for a resident who suffers problems is to move from his home. Walworth County, South Dakota has a 2-mile setback.

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2-2) Refer to the direct testimony of Mr. Richard James, Page 2, line 55. Is compliance with the Bon Homme County's noise regulation associated with wind energy systems achieved through a sound model based on predicted sound levels, or is compliance based on actual sound levels? Please explain.

RESPONSE:

Reece Almond: Section 1741 of the Bon Homme County Zoning Ordinance addresses what a LWES must do in order to comply with the Ordinance. Section 1741 provides:

> Noise level produced by the LWES shall not exceed forty five (45) dBA, average A-weighted sound pressure at the perimeter of occupied residences existing at the time the permit application is filed, unless a signed waiver or easement is obtained from the owner of the residence.
>
> The permittees shall submit a report of predicted noise levels at habitable residential dwellings within one mile of proposed tower locations to the Board no less than forty five (45) days prior to commencing construction.

Based on this language and my interpretation thereof, the answer to the question in Data Request 2-2 is both.

Richard James: Models are, at best, approximations of what be expected if the project is constructed. Measurements are the only accurate method for assessing whether a project complies with a regulation. It is the developer's responsibility to understand the limitations of the models, and to apply appropriate safety factors to the design to accommodate the limitations of the model such that once operating, the measured sound levels do not exceed the regulatory limit. Models cannot substitute for measurements.

2-3) Refer to the direct testimony of Mr. Richard James, Page 3, lines 101, through Page 4, 105.

a) Have any U.S. counties or states adopted the Intervenors' recommended maximum sound level regulation for wind energy facilities of 35 dBA? Please provide documentation to support the response.

b) Have any U.S. counties or states adopted the Intervenors' recommended sound level regulation for wind energy facilities of no more than 5 dBA louder than the pre-operational background sound levels? Please provide documentation to support the response.

RESPONSE:

Gregg Hubner: Here are some setback distances used around the world, with examples both from residences and property lines: http://www.wiseenergy.org/Energy/Wind_Ordinance/Setbacks.pdf.

Here are some decibel limits used around the world:
http://wiseenergy.org/Energy/Health/Acoustical_Limit.pdf.

Richard James: I do not maintain a comprehensive list of regulatory limits and documents. My response is thus an example of regulations in jurisdictions where I have had some involvement. First, it needs to be understood that a good regulatory limit to control noise in a community must address the characteristic of the noise source that is considered to be objectionable. For utility scale wind turbines those characteristics are amplitude modulation (fluctuations) of the sound pressure levels and tones particularly in the infrasonic and low frequency range. It is accepted in acoustics that fluctuating sounds are more annoying and more likely to cause sleep disturbance than steady sounds. The presence of audible tones also increase annoyance potential and sleep because the human auditory function is about 10 dB more sensitive to tones than to broadband sound. Thus, the ideal regulatory limit for wind turbines would be a not-to-exceed sound level measured with an instrument set to measure the current sound without any averaging. If the regulation is using a single number limit in dBA this would be expressed as dBA $L_{MaxFast}$. That is the maximum dBA level using the meter's fast response. However, many jurisdictions, and the wind industry have attempted to apply thresholds based on the long-term average sound level (Leq) which does not reflect the fluctuations that are present in wind turbine noise emissions. Long term normally means a measurement averaged over a period of ten minutes to one hour, but can also mean over periods of days and nights.

Field measurements of wind turbine sound has demonstrated that the $L_{MaxFast}$ measurement will exceed the Leq measurement by 10 dB or more under normal operating conditions. These conditions normally occur at night during the time when people are expecting quiet for sleep. Dr. Punch provides an example of this from the Michigan, Almer Township case where the US District court accepted that the ordinance limiting wind turbine noise to 45 dBA $L_{MaxFast}$ was acceptable. The acoustician for the developer had filed statements saying that the equivalent average sound level (Leq) would need to be 11 dBA lower than this limit to comply. Since the primary adverse health impact from noise is sleep disturbance and studies have shown that fluctuating sounds outside a home when windows are open cause awakenings and delay return to sleep when they exceed 40 dBA $L_{MaxFast}$ jurisdictions that are required to set thresholds to protect public health have variously adopted limits ranging from 35 dBA Leq to 45 dBA $L_{MaxFast}$. All of them are roughly equivalent in terms of protection, but the $L_{MaxFast}$ thresholds are more specific to the character of the sounds that need to be controlled.

This type of threshold is also easier to enforce. It is like how highway speeds are enforced. For example, if a driver on a road with a speed limit of 70 miles per hour averages 70 mph during the entire trip, but during part of the drive is exceeding that limit when a police radar tracks the car there is a violation. If the police officer was required to show that the driver's average speed exceeded 70 mph the limits would become unenforceable. They would need to follow the driver for long periods and the driver's knowledge of being under surveillance could lead to modified driving behavior. The same happens when a jurisdiction sets an average sound level (Leq) as the threshold. First, the measurements needed to confirm the exceedance become burdensome and subject to argument. Second, the applicant can raise all sorts of arguments about the period of time being averaged, length of the average, etc.. Thus, the use of limits set to control the maximum sound emissions are more direct and result in less burden on the local

government if or when complaints are filed. This line of reasoning has been applied in many jurisdictions who have re-written their wind turbine regulations to control the fluctuating character of wind turbine noise.

In response to part A of the question I refer back to Table 3in my first statement's Exhibit "Noise: WindFarms." It shows that many countries where the wind industry has installed large projects have regulations set around the 35 dBA Leq threshold. Germany, Australia and New Zealand all have limits based on some form of 35 dBA average sound level and this has not prevented development of wind energy projects. In response to Part B regarding jurisdictions that use Background plus 5 dB method Table 3 shows this is also a common threshold. Some jurisdictions in the US also use background plus a constant (5, 6 or 10). For example, Oregon developed wind energy project sound limits in the early 2000s using a limit of 10 dB over the background sound as the goal. After doing a number of tests for background sound levels Oregon concluded that the background sound level in rural/wilderness locations where wind turbines were likely to be installed were about 25 dBA (L90). Thus, they adopted a limit 35 dBA (L50). New York's Noise Guidelines call for the new noise source to not increase the background sound levels by more than 6 dBA. Massachusetts uses 10 dBA but has some local rules using lower levels.

Tennessee recently adopted a state regulation of 35 dBA $L_{MaxFast}$ at the receptor's dwelling and 45 dBA $L_{MaxFast}$ at the property line.

In Michigan, regulations are set by counties, but each township has the right to set different limits under state law. Most of the wind turbines in Michigan are located in Huron County, which is the "thumb" region on the east side located between Saginaw Bay and Lake Huron. The County originally had limits of 50 dBA which attracted considerable development starting back in 2007. Because of the problems with complaints of annoyance and adverse health effects that have occurred in townships where the projects were located many of the remaining townships have adopted their own regulations setting not-to-exceed limits ranging from 30 to 45 dBA $L_{MaxFast}$. Those townships include:

Townships in Huron County

Almer Effectively 45 LA_{Max} at the non-participating property line (day), 39 LA_{Max} (night)
Ellington 40 LA_{Max} at non-participating property line
Denmark Shall not exceed 35 dBA at property line
Merritt 40 dBA (LA_{Max}) at property line
Sand Beach 35 dBA (LA_{Max}) during day and 30 dBA at night
Marion 40 LA_{Max} at non participating property line
Bridgehampton 40 LA_{Max} at non-participating property line
Elmwood 40 LA_{Max} at non-participating property line
Kingston 45 LA_{Max} at non-participating property line
Greenwood Shall not exceed 45 dB(A) at any property line adjacent to the wind energy system

Other Michigan Townships and Counties (not exhaustive)

Ingersoll Twp 45 LA_{Max} at non-participating property line (day) 35 LA_{Max} at property line (night) at same
Beaver Twp 45 LA_{Max} at non-participating property line
Burnside Twp 45 LA_{Max} at non-participating property line
Shiawassee 45 LA_{Max} at non-participating property line

Other Non-Michigan Jurisdictions
Vermont 38 dBA Leq
New Hampshire 45 LA_{Max} Day or 5 dB over background whichever is greater and 40 LA_{Max} Night or 5 dB over background.
Sweetwater County, Wyoming 40 dBA (LA_{Max}) and 50 dBC (LC_{Max}) (this addresses the low frequency character of wind turbine sounds)

The link below shows a summary of some decibel limits used around the world:
http://wiseenergy.org/Energy/Health/Acoustical_Limit.pdf.

2-4) Refer to the direct testimony of Mr. Richard James, Page 3, lines 101 – 105, and Page 5, lines 158 – 163. If Mr. James recommends a maximum sound level of 35 dBA, and states the setback distance would be on the order of 3600 feet to meet the 35 dBA Leq limit, why does Mr. James calculate the setback to prevent annoyance during nighttime periods from multi-turbine projects would need to be 1.25 miles? Please explain.

RESPONSE:

Richard James: The 3600-foot setback relates to the goal of limiting wind turbine noise to 35 dBA Leq, a point where annoyance will still occur, but high annoyance is limited to the more sensitive people. The 1.25-mile setback (roughly double the distance and thus about 6 dBA lower in sound level) is the distance needed to prevent high annoyance from audible sounds (infra sound will still be an issue for those sensitive to it). The predicted sound level at 1.25 miles is about 30 dBA Leq. High Annoyance is the descriptor for annoyance that results in health effects and threats of action. (See Health Canada study graph in first statement)

Since rural communities have nighttime sound levels of 25 dBA and often lower the sound of distant wind turbines is still audible even at the 1.25 mile distance.

Also, as revealed in the Health Canada study, the prevalence rates for health effects that are related to pulsating infra and low frequency sound, such as, tinnitus, dizziness, and migraines for people living 1.25 miles from the nearest wind turbine are still double that of the non-exposed population. These sounds may or may not be audible, but still have an impact on sensitive people through non-auditory processes. Thus, we cannot say that 1.25 miles represents a "safe" setback distance for all people.

2-5) Refer to the direct testimony of Mr. Richard James, Page 5, lines 158 – 163, and the Intervenor's response to Staff Data Request 1-4. The Intervenors recommended a

condition that requires a 1,500 ft. setback from a property line, but Mr. James recommended a 1.25 mile setback from the property line. Please explain how the 1,500 ft. setback is consistent with Mr. James' testimony.

RESPONSE:

Gregg Hubner: As stated before, I have always advocated for a 2-mile setback from a residence and a 1500 ft. setback from a property or right of way line.

The reason I advocate for 1500 ft. is that people often are near their fence lines, farming, putting up hay or hunting. The Vesta Owners Safety Manual for a 3.0 MW Turbine recommends people to stay 400 meters (1300 ft.) from the turbine unless it is necessary to be closer, and 500 meters away from a runaway turbine (attachment E) This is for a 3.0 MW, and Prevailing Winds is using 3.8 MW turbines. General Electric uses the following calculation for ice throw: 1.5 x hub height plus blade diameter (1.5x (361+449)) = 1,215 foot setback from ROWs and property lines. (Attachment F)

The 2-mile setback for a non-participating resident and a 1500 ft. setback from a property or right of way line would be a good safe combination. It protects both homes and bare land, always considering people are not always in their home, they are across every acre of their land several times during the year.

Reece Almond: Mr. James' explanation for his 1.25-mile setback from a property line is explained on page 6, lines 178-185, of his pre-filed testimony.

2-6) Refer to the direct testimony of Prof. Mariana Alves-Pereira, Line 460: "Appropriate zoning laws for industrial wind turbines should be considered." Please provide Prof. Alves-Pereira recommendation for an appropriate zoning law for industrial wind turbines to address her concerns regarding ILFN.

RESPONSE:

Mariana Alves-Pereira: I am assuming the question posed above is: "Please request that Prof. Alves-Pereira provide recommendations for an appropriate zoning law for industrial wind turbines to address her concerns regarding ILFN."

Zoning laws were not conceived as legal entities to be solely based on economic convenience. In theory, zoning laws are founded on the idea of the protection of Public Health. In order to properly ascertain what are the 'safe-distances' for residential neighborhoods located in the vicinity of wind developments, then scientifically-valid studies must be undertaken by the appropriate authorities.

The possibility of such studies was briefly described in the subsequent Lines 463-466 of the same testimony:

epidemiological studies. Ideally, this would study relevant health endpoints *before* and *after* installation of the industrial wind turbines. It would also include the quantification of ILFN *before* and *after* the installations of the industrial wind turbines, with the same wind speed and wind direction, and evaluated *inside* the affected homes.

There are currently no scientifically-valid studies providing numerical data on 'safe-distances' that can effectively protect families against ILFN-contaminated homes (whatever the source).

2-7) Refer to the direct testimony of Prof. Mariana Alves-Pereira, Lines 460 – 462: "However, in the absence of zoning laws based on scientific information, then the governmental agencies responsible for Public Health should step in to conduct appropriately designed epidemiological studies." Which governmental agency in South Dakota is Prof. Alves-Pereira referring to?

RESPONSE:

Mariana Alves-Pereira: I am unclear as to the question posed here. I understand that the word 'governmental' within the context of the State of South Dakota may be misleading. Perhaps, therefore, the word 'governmental' should be replaced by 'federal and state,':

> "[I]n the absence of zoning laws based on scientific information, then *Federal and State agencies responsible for Public Health* should step in to conduct appropriately designed epidemiological studies."

I am not familiar with the details of South Dakota State Government, but I imagine that there is some Health Department at the State level whose job description would include the protection of Public Health.

At the Federal level, I would imagine that agencies such as the CDC (Center for Disease Control), the ATSDR (Agency for Toxic Substances and Disease Registry) or the NIH (National Institutes of Health) would have the expertise and the mandate to undertake properly designed studies that would begin to ascertain 'safe-distances' between residential areas and wind developments.

The lack of properly determined 'safe-distances' is not an issue merely in South Dakota, or merely in the United States. Countries all over the world are faced with this quagmire that is leading to the onset of illness among entire families and neighborhoods, and consequently, to increased healthcare costs. Within this context, perhaps the scientific determination of 'safe-distance' should be under the auspices of larger regulatory bodies, such as the World Health Organization or the International Standards Organization.

2-8) Refer to the direct testimony of Mr. Jerry Punch, Page 14, lines 396 – 402, and the direct testimony of Mr. Richard James, Page 3, line 101 through Page 4, line 105.

Mr. James recommends that *"the maximum sound level for audible sounds should be 35 dBA (Leq) and 50 dBC, especially for nighttime wind turbine noise. We also limited the new noise source to be no more than 5 dBA louder than the pre-operational background sound level at night."*

Mr. Punch recommends that *"the WHO recommendation of 40 dBA Leq (night,outside) should not be exceeded at any residence, particularly at non-participating households. To provide adequate protection from sleep disturbance, nighttime noise levels should be limited to 40 dB LAmax. A metric of dB LA10(night, outside), the noise level exceeded 10% during nighttime hours and measured at the façade of the residence, may be a reasonable substitute for LAmax if considered by acoustical experts to be easier to apply for the purpose of compliance."*

The recommendations between these two witnesses for the Intervenors' appear inconsistent. Actually, Mr. James' states that the use of a limit of 40 dBA is inadequate to prevent adverse effect (Direct testimony, Page 5, lines 143 – 149).

Will the Intervenors advocate for Mr. James' recommendation or Mr. Punch's recommendation for audible noise at the hearing? Please explain.

RESPONSE:

Jerry Punch: The inconsistency of my recommendation with that of Mr. James is in question, and my response is that I stand by my statement that 40 dBA Leq(night, outside) should not be exceeded at any residence, but recognize that others, including Mr. James, may have reasons for recommending a lower level. For example, the WHO (2009)[1] notes that people complain of a sense of reduced well-being at an average noise level of 35 dBA Leq(night,outside), and that same level may be recommended to protect a higher percentage of residents from annoyance, which is known to be a major complaint of individuals living near wind turbines.

In the recent Health Canada study, for example, at least 10% of people in the area of a wind project area who were exposed to levels >35 dBA were extremely annoyed.[2] I am basing my recommendation to limit averaged nighttime, outside levels to 40 dBA on the WHO's 2009 recommendation to protect human health. The above-referenced extensive list of levels of noise permitted nationally and internationally[3] indicates that levels as low as 30 dBA have been recommended or utilized at a number of wind projects.

In my direct testimony, (page 11, lines 306-307), I stated that "The WHO (2009) Night Guidelines suggest that a 40 dB LAmax level should be the maximum allowable level during nighttime hours." In fact, the WHO (2009) states that some of the more subtle, physiologically

[1] World Health Organization (2009). Night Noise Guidelines for Europe, p. XIV.
[2] Michaud, D. S., Feder, K., Keith, S.E., Voicescu, S. A., Marro, L., Than, J., et al. (2016). Exposure to wind turbine noise: Perceptual responses and reported health effects. Journal of the Acoustical Society of America, 139, 1443-1454.
[3] http://wiseenergy.org/Energy/Health/Acoustical_Limit.pdf

measurable, aspects of sleep disturbance occur at noise levels of 32-42 dB LAmax(night,inside). According to James,[4] the LAmax level is 10 dB above that of Leq, so a level of 40 dB LAmax corresponds to a level of 30 dBA Leq; note that is a peak level at night, inside a residence.

My professional opinion is based not only on the concerns expressed in the WHO Night Noise Guidelines for Europe and the WHO Guidelines for Community Noise (Berglund et al., 1999),[5] but also on the notions that wind turbine noise consists of rapid energy peaks and valleys and that nearby residents need to be protected from inaudible infrasound, as well as audible sound.

The chart below is a graphic illustration of the presence of the highly fluctuant nature of wind turbine noise, over short periods of time. The chart is from Robert Rand, well-known acoustician, and it shows noise fluctuations between about 60 dB SPL to about 72 dB SPL in the one-third octave band centered at 25 Hz. These fluctuations occurred within a time period of only 30 seconds, captured using a fast setting on the sound level meter. The fluctuations occur above and below the average noise level of approximately 67-68 dB Leq(10sec). The chart also illustrates why Leq measurements do not adequately depict the emissions experienced by receptors in real time.

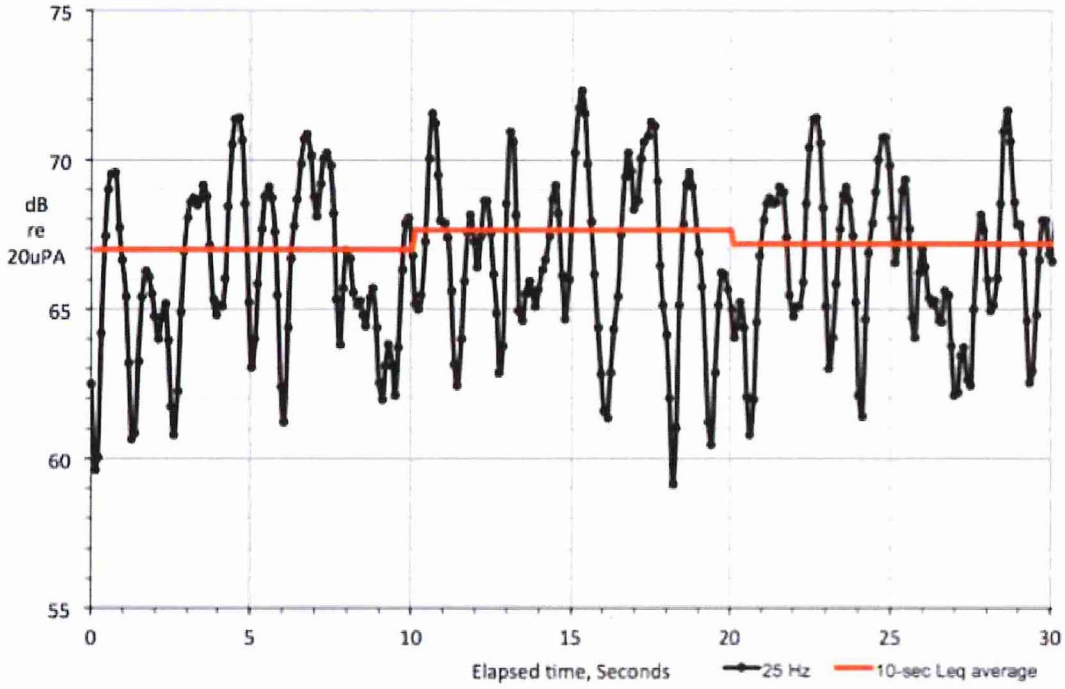

Figure 6.1. 25 Hz one-third octave band noise level, 2000-feet upwind, turbines 2 and 3 operating, Freedom, Maine (acquired 8Jan2010). 1/10 second sample (black), 10-second averages (red). R. Rand

[4] James, R. (March 27, 2018). Recommended Amendments to Section 4.3.76 Shiawassee County Zoning Ordinance, Article 4, Specific Use Regulations Prepared On Behalf of: Regulated Wind of Shiawassee County (RWSC), p. 6.

[5] Berglund, B., Lindvall. T., & Schwela, D.H. (eds.) (1999). Guidelines for Community Noise. World Health Organization, April 1999.

With respect to the WHO guidelines, two primary considerations need to be taken into account. Together, they justify the necessity of establishing reasonably conservative noise exposure guidelines with respect to wind turbine noise. First, the WHO bases its recommended noise limits largely on transportation noises, which contain low-frequency energy, but substantially less infrasonic energy than wind turbine noise. Secondly, the WHO assumes that the outside-to-inside attenuation for transportation noises is about 15 dB. Neither of these assumptions can be applied to the infrasonic energy in wind turbine noise, which travels long distances and is not easily attenuated by traditional physical barriers. It is also true that people have a right to sleep with their bedroom windows open, and that should be especially true for those individuals who have chosen to live in an area where they can enjoy the peace and quiet of a rural community.

A case in Vermont[6] supports the contention that the outside-to inside attenuation of wind turbine noise is much less than 15 dB, and that it is almost negligible, when windows are open. Paul Brouha of Sutton, Vermont, lives 6,385 feet from the nearest turbine in the area of the Sheffield Wind project. Brouha filed his first noise complaint on Dec. 24, 2011, after the wind turbines began operating in October. The Vermont Public Service Board (PSB) dismissed his complaint. An earlier report by the wind project operator showed virtually no reduction (1 dBA) in the broadband sound of the loudspeaker between outdoors and indoors, a value much lower than normally expected, even for large open windows. Brouha hired a noise expert, Acentech, which found that instead of the 15 dB noise attenuation between outside and inside projected by wind project's experts, the home attenuated the noise by 25 dBA when Brouha's bedroom windows were closed, by 9 dBA when the windows were partially open and by only 3 dB when the windows were fully open. The indoor measurements in the Brouha bedroom (averaged across locations within the room) did not exceed the project criterion level of 30 dBALeq(1hr) with the windows fully closed, but did exceed 30 dBA with the windows partially or fully open.

In the Brouha case, Acentech's measurements showed "multiple and frequent violations of the CPG noise criteria" adopted by the PSB, and the PSB ordered the Vermont Department of Public Service (DPS) to investigate the complaint early in 2014. DPS hired a consultant who conducted the same test on July 1, 2014. In January 2015, Brouha filed a nuisance lawsuit in superior court in Vermont. In September 2015, DPS reported to the PSB that Sheffield Wind exceeded interior noise standards 10 to 14 percent of the time. Because of PSB's laborious investigation and enforcement process, and the parties' noise experts' failure to agree on a new monitoring plan, his noise complaint had not been resolved as of February 2017, the time of the most recent report.

Justification for concern that LAmax be considered as an option (in addition to offering L10 as an option), stems from the following quotes from the 1999 WHO document, as well as the final quote, which is from the 2009 WHO Night Noise Guidelines:

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[6] Smith A, "The Kafkaesque world of windmill neighbors" (VTDigger [The Vermont Journalism Trust] Feb. 3, 2017), available at <https://vtdigger.org/2017/02/03/annette-smith-kafkaesque-world-windmillneighbors/>.

- "When the noise consists of a small number of discrete events, the A-weighted maximum level (LAmax) is a better indicator of the disturbance to sleep and other activities…. Where there are no clear reasons for using other measures, it is recommended that LAeq,T be used to evaluate more-or-less continuous environmental noises. Where the noise is principally composed of a small number of discrete events, the additional use of LAmax or SEL (sound exposure level) is recommended" (p. viii). (*I contend that whether the number of discrete events is small or large, the occurrence of discrete events that have their peak amplitudes during any nighttime period can be highly disturbing to sleep.)*

- "If negative effects on sleep are to be avoided the equivalent sound pressure level should not exceed 30 dBA indoors for continuous noise. If the noise is not continuous, sleep disturbance correlates best with LAmax and effects have been observed at 45 dB or less. This is particularly true if the background level is low." (p. 46)

- "When the background noise is low, noise exceeding 45 dB LAmax should be limited, if possible, and for sensitive persons an even lower limit is preferred. Noise mitigation targeted to the first part of the night is believed to be an effective means for helping people fall asleep. It should be noted that the adverse effect of noise partly depends on the nature of the source. A special situation is for newborns in incubators, for which the noise can cause sleep disturbance and other health effects (p. xii)…. The LAmax of sound events during the night should not exceed 40 dB(A) indoors. For ward rooms in hospitals, the guideline values indoors are 30dB LAeq, together with 40 dB LAmax during night." (p. xiii)

- "L10 values have been widely used to measure road-traffic noise, but they are usually found to be highly correlated measures of the individual events, as are LAmax and SEL." (p. 23)

- "Where the noise consists of a small number of discrete events, the A-weighted maximum level (LAmax) will be a better indicator of the disturbance to sleep and other activities." (p. 29)

- "A large number of events lead to high levels of awakening once the threshold of LAmax,inside is exceeded." (p. 105)

Richard James: As I explained in my response to question **2-3)** picking a regulatory limit should focus on the characteristic of the noise emitter that is most problematic. As Dr. Punch explains above the differences between our recommendations are mainly a result of which metric we are considering for limiting the intrusion. There are many different ways that limits can be set with the 35 dBA Leq or 45 dBA L_{Max} being two examples. Any differences between Dr. Punch's suggestions and mine are likely resolved when considering these various options for metrics.

I support Dr. Punch's response.

2-9) Refer to the direct testimony of Mr. Jerry Punch, Page 11, lines 303 – 314. Have any U.S. counties or states adopted the Intervenors' recommended maximum nighttime noise level regulation for wind energy facilities of 40 dB LA max? Please provide documentation to support the response.

RESPONSE:

Jerry Punch: In answer to the staff's Question 2-9, it is understandable that few if any U.S. counties or states have adopted 40 LAmax, or the LAmax metric in general, as a means of quantifying maximum nighttime noise. LAmax has been discussed, however, as a recommended metric at some wind projects, but there is scant evidence that 40 dB LAmax has been adopted at any specific facility. I can point, though, to several communities where the concept of LAmax (sometimes referred to as Lmax) has been recommended as a legitimate metric for measuring the level of wind turbine noise, or where the refusal of a wind company to adopt Lmax was a partial basis for disapproval of a wind project.

According to Robert Chanaud,[7] who recently developed a document that serves as an update of the EPA's Model Community Noise Control Ordinance, the Leq metric is part of the noise ordinances in Seattle, Washington, and Portland, Oregon. The Seattle ordinance stipulates that "…the Lmax must not be more than 15 dB over the Leq" (p. A-17). The same document states: "Set the maximum levels sufficiently high that it is unlikely for the ambient to exceed it. This approach requires either an arbitrary assumption or extensive measurements. It also does not satisfy the health and welfare goals of the community so no communities have taken it" (p. 6-3).

In Almer Township, Michigan, the local ordinance specified a noise limit of 45 dBA. The presiding judge interpreted the ordinance to mean that no sound should be allowed to exceed 45 dBA, and ruled that Tuscola Wind's refusal to adopt Lmax as a means to comply with the ordinance was tantamount to its refusal to protect citizens from fluctuating wind turbine noise. In his final ruling, the judge stated: "…it is ORDERED that Defendant Almer Township Board's denial of Plaintiff Tuscola Wind III, LLC's, SLUP application is AFFIRMED" (p. 46). In footnote 12 of that document (p. 45), it is stated: "Tuscola has not demonstrated that it is entitled to deferential or economically favorable conditions. Perhaps application of an Lmax standard creates such an economic hardship that it constitutes de facto exclusionary zoning. But Tuscola's conclusory briefing on this point falls far short of showing that to be true."

Despite the low prevalence of the adoption of LAmax as a preferred metric in local zoning ordinances, the use of LAmax deserves to be explored by wind developers, as it offers an increased probability that the numerous complaints of annoyance and adverse effects related to wind turbine noise exposure can be substantially reduced.

In my direct testimony, I provided several alternative metrics as recommendations for determining the maximum allowable limits for wind turbine noise emissions. I have offered the above detailed explanation of my justification for including both an Leq level and LAmax level

[7] Chanaud, R. C. (July 2014). Noise ordinances: Tools for enactment, modification and enforcement of a community noise ordinance.

because of a specific question raised regarding inconsistency between my recommendation and that of Mr. James.

Having given my rationale for recommending 40 dB LAmax as one such metric, it is the case that the use of LAmax could entail some rather complex measurement issues. It would be a relatively simple matter to determine whether a specific LAmax level has been exceeded in a given nighttime period of time, such as an 8-9 hour night, or nights over a one-week period. However, a decision would have to be made regarding how many discrete occurrences of that maximum level are allowable before the noise is ruled in noncompliance. While the WHO (2009, p. XV) states that a large number of events lead to high levels of awakening once the LAmax threshold is exceeded, it also indicates that there is no generally accepted way to count the number of relevant noise events, and that the options include the number of measured LAmax levels and the number exceeding a specific LAmax level (p. 8). For this reason, it is understandable that most wind projects have adopted the use of dBA Leq, which—despite its extreme limitations when applied to wind turbine noise—is a traditional metric around which there is a considerable body of data for comparison. Although resolution of these issues could be achieved with careful thought, it would require an effort the wind industry thus far has not been willing to expend.

Dated this 2nd day of October, 2018.

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CERTIFICATE OF SERVICE

The undersigned, one of the attorneys for Intervenors Gregg C. Hubner, Marsha Hubner, Paul M. Schoenfelder, and Lisa A. Schoenfelder, certifies that a true and correct copy of the **Intervenors' Responses to Staff's Second Set of Data Requests to Intervenors** was served on October 2nd, 2018, via email, upon the following:

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