BEFORE THE SOUTH DAKOTA PUBLIC UTILITIES COMMISSION

DOCKET NO. EL- 18-026

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 PARK PROJECT

RESPONSE OF SHERMAN FUERNISS TO DIRECT TESTIMONIES

26 September, 2018

I would like to submit the following as response/rebuttal to a number of filed testimonies and statements concerning Docket EL 18-026.

1) In response to Dr. Mark Roberts' supplemental direct testimony, especially exhibits 2, 2a, 2b and 2c, I would like to submit the peer-review of the Australian National Health and Medical Research Council Draft Information Paper "Evidence on Wind Farms and Human Health" conducted, at the request of the NHMRC, by Dr. Colin Hansen (see attachment). Dr. Hansen is also currently involved in a 5-year project funded by the NHMRC titled "Establishing the physiological and sleep disruptive characteristics of wind farm versus traffic noise disturbances in sleep".

On page 45 of the book 'Wind Farm Noise: Measurement, Assessment and Control' Hansen, C., Doolan, C. and Hansen, K.(2017) John Wiley and Sons, Ltd. the authors quote Hanning, C. 2015 Submission to the Australian Senate Select Committee on Wind Turbines, Technical report, University Hospitals of Leicester as follows:

> "… in considering the evidence, NHMRC adopted inappropriately strict evidential criteria. This is the reactionary approach to public health risks and is clearly not in the public interest. Action in the defense of the public health does not require certainty. In addition, they have turned the burden of proof on its head. It is the wind industry's duty to prove the safety of its activities not that of the public."

2) In response to Mr. David Hessler's answer to the Staff Question: Can you please summarize your overall opinion of the sound study submitted on behalf of the project? Answer: "In general, the noise modeling methodology and assumptions are satisfactory …", I would submit that pages 230-231 of 'Wind Farm Noise: Measurement, Assessment and Control' Hansen et al.(2017) list nine "uncertainties and issues associated" with the ISO9613-2 model used for the Applicant's sound study as follows:

- "It has only been validated for distances between source and receiver of less than 1 km.
- The model is only valid for octave band analysis for octave band centre frequencies ranging from 63-4000 Hz. Of course, it is also valid for calculating overall A-weighted sound pressure levels over the frequency range covered by the 63-4000 Hz octave bands.
- Downwind propagation is assumed by the ISO model, but only wind speeds between 1 and 5 m/s (measured between 3 and 11 m above the ground) are valid.
- Significant deviations from the ISO model may be expected for wind speeds above the 5 m/s limit (Kalapinski and Pellerin 2009).
- The ISO model has only been validated for source heights of less than 30m above the ground.

- No allowance is made for the attenuation effects of scattering due to atmospheric turbulence.

- The ISO standard states that the expected accuracy of sound level predictions are plus/minus 3dB for source heights less than 30 m and for distances between the source and receiver that are less than 1000 m. It is expected that the errors will increase as the source-receiver distance increases. Also as the source height increases above 30 m the calculation of the excess attenuation due to the ground becomes less accurate.

- The ISO model assumes that sound propagation is from point sources, which makes the calculated sound levels within about 200 m of the closest turbine subject to greater errors than those estimated above.

- As for all models, the ISO model assumes that the turbine sound power levels as a function of wind speed at rotor height are accurate. In most cases, turbine sound power levels are derived from measurements made on flat ground with a smooth horizontal air flow into the turbine rotor. These conditions deviate considerably from those generally found in practice. In many cases, turbines are mounted on hilltops in hilly terrain, so the inflowing air can deviate considerably from horizontal. In addition, local turbulence due to the uneven terrain and uneven heating of the air near the ground results in an air flow into the turbines that is often far from smooth. Inflow turbulence and non-horizontal inflow can both add to the rated turbine sound power levels."

Moller, H. & Pedersen, C. S. (2011). Low-frequency noise from large wind turbines. The Journal of the Acoustical Society of America, 129(6), 3727-3744. DOI:10.1121/1.3543957 also have this to say regarding ISO 9613-2 and ground reflection:

> "On this background, it is reasonable to suspect that the addition of 1.5 dB for the ground reflection is too low at low frequencies, and that higher values up to a theoretical maximum of 6 dB would be more appropriate. Thus, the procedure used to calculate out-door sound pressure levels at the neighbors is likely to underestimate the low-frequency sound."

3) In response to Mr. Hessler's answer to Staff Question:"What about Ms. Jenkins' proposed conditions of 35 dBA?", I would submit that page 33 of 'Wind Farm Noise: Measurement, Assessment and Control' Hansen et al. (2017) gives examples of "Maximum Allowed Calculated External Noise Levels" which include:

> "An allowed A-weighted (see section 2.2.11) nighttime limit of 35 dBA or La90+5 dBA, whichever is lower, when La90 is determined using several 10-min measurements during the quiet night hours between 10pm and 4am when the wind is blowing slightly (<2 m/s at 1.5 m above the ground) from the wind farm to the residence and the wind farm is not operating. Daytime levels can be 5 dBA higher."

Page 33 also contains Table 1.7 ISO 1996-1971 recommendations for allowable community Laeq noise limits. Limits for a rural district are: Day 7am-7pm, 35dBA; Evening 7pm-11pm, 30 dBA; and Night 11pm-7am, 25 dBA.

In their conclusions Moller and Pedersen (2011) write:

"Indoor levels of low-frequency noise in neighbor distances vary with turbine, sound insulation of the room, and position in the room. If the noise from the investigated large turbines has an outdoor A-weighted sound pressure level of 44 dB (the maximum of the Danish regulation for wind turbines), there is a risk that a substantial part of the residents will be annoyed by low-frequency noise even indoors. The Danish evening/night limit of 20 dB for the A-weighted noise in the 10-160 Hz range, which applies to industrial noise (but not to wind turbine noise), will be exceeded somewhere in many living rooms at the neighbors that are near the 44 dB limit. Problems are much reduced with an outdoor limit of 35 dB."

Also concerning noise limits, Hansen et al.(2017) state on pages 32-33 of 'Wind Farm Noise: Measurements, Assessment and Control':

"However, noise measurements by the authors of this book indicate that for modern wind farms with turbine powers of 3 MW and greater, the setback distance should be much larger than 2 km if intrusive noise at noise-sensitive locations is to be at acceptable levels at night when people are trying to sleep. In addition there should be a minimum setback distance of 4 to 5 times the total turbine height (nacelle height plus blade length) to the nearest neighbour's property line."

4) In response to Staff's question to Mr. Hessler concerning C-weighted sound levels and low frequency sound Question: Would you agree with this recommendation?, which Mr. Hessler answers in part with "The low frequency sound emissions … are below the ability of normal instrumentation to measure.", I would submit that section 6.2.7 on page 317 of 'Wind Farm Noise: Measurement, Assessment and Control', Hansen et al.(2017) describes the use of infrasound sensors, also referred to as microbarometers, by Woolworth et al.(2017) and in addition states:

"The infrasound monitoring system described by Annan et al., (2015) consists of infrasound sensors, a wind-filtering apparatus, data-logging equipment and signal processing capabilities. It was demonstrated that this system performed well in isolating wind turbine noise from other sources of infrasound such as marine storms, aeroplanes, urban noise and wind noise. Through use of four infrasound sensors arranged in a square topology with 50-m spacing, the direction of arrival of infrasound signals could be monitored and it was found that this correlated well with the direction of the wind farm.

A range of infrasound sensors (such as Infiltec) are commercially available and in cases where the infrasonic and low-frequency range is of prime importance (such as at large distances from a wind farm), they can prove to be more cost effective than a microphone.

Other advantages of these sensors are their low power consumption and ruggedness, as discussed above. The main disadvantage is that they can only be used to measure noise at low and infrasonic frequencies."

5) In response to Mr. Hessler's answer to Staff's question about larger turbines producing more or worse low frequency noise Question: Would you agree with this assertion?, I would submit the following from the conclusions of Moller, H., & Pedersen, C. S. (2011). Low-frequency noise from large wind turbines. The Journal of the Acoustical Society of America, 129(6), 3727-3744. DOI: 10.1121/1.3543957 :

"The results confirm the hypothesis that the spectrum of wind turbine noise moves down in frequency with increasing turbine size. The relative amount of emitted low-frequency noise is higher for large turbines (2.3-3.6 MW) than for small turbines (< 2MW). The difference is statistically significant for one-third-octave bands in the frequency range 63-250 Hz. The difference can also be expressed as a downward shift of the spectrum of approximately one third of an octave. A further shift of similar size is suggested for turbines in the 10-MW range.

When outdoor sound pressure levels in relevant neighbor distances are considered, the higher low-frequency content becomes even more pronounced. This is due to the air absorption, which reduces the higher frequencies a lot more than the lower frequencies. Even when A-weighted levels are considered, a substantial part of the noise is at low frequencies, and for several of the investigated large turbines, the one-third-octave band with the highest level is at or below 250 Hz. It is thus beyond any doubt that the low-frequency part of the spectrum plays an important role in the noise at the neighbors."

6) In response to references to studies concerning population of upland game species after establishment of wind farms, I would submit that this is a straw man argument. Out of state hunters from urban and suburban areas have visited our farm to hunt pheasants for the last 15 years. The number of birds to hunt and the number birds taken is of secondary importance to the ambience and experience of the hunt. These visitors enjoy the quiet, the scenery, the serenity, the sunrises, the sunsets and the comaraderie and fellowship. They no longer hunt very near our property but go 10 to 40 miles away for the majority of their hunting.

7) In response to Staff's consideration of the thoroughness and completeness of the permit application, I would submit that there are still misidentifications of land use and participating/nonparticipating residences, as well as lack of consideration for rural cemeteries

8) In response to the South Dakota Department of Health's comments on health impacts and studies, I am submitting as an attachment a copy of an open letter to the members of the panel developing the revised WHO Environmental Noise Guidelines for the European Region.

This concludes my responses at this time.
Sherman Fuerniss