April 16 Wind Energy Text Amendment Working Group
Meeting Notes

Members of Working Group present:
Matt Bauman, John Blas, Cindy Chapman, Bud Dasenbrock, Gary Hellerich, John Hill, Marilyn McNabb, Ben Mullarkey, Lucas Nelson, Tony Oberley, Curtis Schwaninger, Greg Schwaninger, Ed Swotek, Jeff Wagner, Paul Meints, Dennis Rosene, Lisa Wiegand. Approximately 35 members of the public were also present.

Meeting Summary

Introduction: Steve Henrichsen, Lincoln/Lancaster County Planning Department (LLCP) briefly reviewed the process by which this working group will aid in the development of a text amendment for wind farms. Gage County is also sitting in to share their experience and information. There will be various topics discussed at each meeting. Information about each meeting, various handouts and links to information from the staff, the working group, and the public are available for viewing on the website There will also be time for public comment at the end of the meeting.

Chris Schroeder, Lincoln/Lancaster County Health Department introduced each of the panelists. Dr. Cheenne holds a Master's Degree and phD in electrical engineering. In 1995 he joined the faculty of Columbia College where he directs the program and is full professor. He is a noise expert who has helped to develop noise metrics and language for ordinances dealing with noise.

Presentation from Dr. Dominique Cheenne:

Dr. Cheenne stated that it is important when having these discussions to be specific about terminology. There is a difference between sound and noise. The strength of sound is measured in decibels (dB), frequency is pitch is measured in hertz (Hz), the spectrum is the type of frequencies in the sound and the sampling rate is how often and how detailed sound samples are recorded. Duration of sound is measured in time units. Noise is unwanted sound.

One dB is unnoticeable to most people. Six sound bursts at 6 dB apart becomes audible. Different normalized sounds can measure in the same range even though they sound different. Frequencies within the sound define its quality; sounds with lots of frequencies are neutral and sounds with a broad range of frequencies can mask other sounds.

Some sounds are more annoying than others. Intermittent sounds are startling. Simple, modulated sounds cause annoyance. Different Hz sounds combine for different effects, not all pleasant. Does noise become sound when intermittent or modulated? No, music is intermittent modulated sound. Annoyance is personal. It is correlated to many factors such as the source, the level, the frequency content, control, and the ability to get away.

Measuring sound outdoors to come up with a standard upon which to base regulations is tricky. There are standards to measure outdoor sounds, but they insist on no wind. The rate of measurement can also change results. Existing standards are inappropriate for wind turbines.

Outdoors, in normal temperature conditions, sound waves bounce predictably up. In temperature inversions, sound waves bounce back and travel much farther. Temperature inversions come and go and do not appear consistently predictable times or locations. Software has a difficult time dealing accuracy and practicality when it comes to inversions. Models only measure averages.

Sound generated by wind farms is complex. Blades slice the air and create swish sounds, creating mid and high range frequencies. If the wind is not smooth, it can create other thumps and a pulsing quality as well as a whirr with bass and midrange. All of these will increase with wind speed.

Sound changes with distance. Mid and high frequencies fall below a range of audibility, but low are noticeable from a greater distance because the ground does not absorb low frequencies. Multiple turbines can also lead to a modulating effect and influence each other when it comes to smoothness.

Most noise complaints are associated with the swishing pulses. The night time operation infrasound complaints are difficult to assess due to limited equipment and testing methodology. It is difficult to regulate complaints because conditions could change between the time of complaint and the time of inspection. A few factors that can be controlled through careful management could be to have quieter turbines, show “worst-case” scenarios in models, and limit night operation.

Infrasound is at a frequency that is inaudible, and is more of a sensation, though it does take a substantial amount. It is comparable to what you might experience while walking on a beach. He gave the example of ultra violet light which cannot be seen, but can still cause harm.

Chris Schroeder introduced Dr. Edward Walsh and Mr. Robert O’Neal. Mr. O’Neal is a member of the Institute of Noise Control Engineers and has over 25 years experience in the area of community noise impact assessment. He also provides expert witness testimony on noise impact studies. Dr. Edward Walsh is the Director of the Developmental Auditory Physiology Laboratory at Boys Town National Research Hospital.

Presentation from Dr. Edward Walsh:

To address part of the health issue, the question about what frequency of range from turbines stimulates the inner ear must be answered. There are two kinds of sensory cells in the inner ear. Inner ear electrical potentials are sensitive to infrasonic stimuli. Even though you don't hear the sound because the inner hair is not active, the outer is still active and responding to inaudible sound. Turbines are registered outer hairs. Those outer hair cells do still communicate with the brain. The frequencies of wind turbine output activate the ear, send information to the brain, and create responses to alertness. Health effects from this might include annoyance, sleep disturbances, cognitive impairment, ringing headaches, lack of concentration, and vertigo. It is difficult to establish a causal relationship between turbines and health effects at this time. From a correlation point of view, it is individual dependent. Most do not feel any effects. On the other hand, there are a few are highly sensitive and then there is a strong correlation. People have different experiences based on their level hearing loss.

Discussion:

Some members of the working group wondered if there have been studies developed to look specifically at these issues. The Acoustical Society of America is interested and it could be a National Institute of Health study as well. Chapman thought this is what the Cambridge study showed. Dr. Walsh said yes, there is that population who are affected; the correlations are strong. The transition from strong correlation to causal is big jump. There have been those who were in favor of wind energy development who then experienced bad symptoms.

Mr. O’Neal said that there is a causal relationship to annoyance; as exposure to noise goes up, annoyance goes up. There are not clear findings on the relationship with other health symptoms. Chapman noted that ongoing sleep disturbance can cause other health problems. Dr. Walsh agreed that there is a link between long-term annoyance or sleep disturbance and health issues. Dr. Cheenne said that this is also full of personal experience variables because factors such as whether or not a person was in favor of or against in the first place, age, hearing acuity, even what your house is made of affect the perception of the sounds. People simply do not hear sound the same way. You could err on the side of caution, but that could make it too difficult for projects to move forward. Walsh said studies with built in controls would be necessary for ultimately answering these questions.

Dr. Cheenne said that it is more difficult to escape from low frequency sounds. O'Neal agreed that distance is your friend since higher frequencies will attenuate over distance, but low will not. It is part of the sound spectrum we can't hear, so that unknown seems more frightening so many. It should be noted that infrasound is not unique to turbines. Noise output from turbines plateau when winds reach approximately 20 mph. Above that, the sound output does not change much, though the sound of the wind itself is louder.

McNabb asked if the 2012 study is well regarded or if it is out of date. O'Neal said it is older, but it is a collection of studies and is still informative and useful. In Massachusetts, they use a relative noise standard which means the sound cannot increase over 10dB over whatever exists. It adjusts for changes in the background noise.

Chapman said that a year of sound collection makes sense for coming up with what existing sound and wind conditions are. Cheenne agreed that a longer period of time for measurement is better, but it becomes cost prohibitive and is not practical. O'Neal said a good sample can be attained it two weeks, but seasonality is a valid point. Walsh said all of the studies presented focused on audible sound but there is that subpopulation affected by the infrasound.

Oberley asked how practical the current 35 db level is. Dr. Cheenne answered that most commercial wind projects will find it difficult to meet that. It ignores the fact that even in a cornfield, the dB level is more than 35. There should be two numbers used, essentially balancing the noise level with distance.

O'Neal said the 1,000 foot setback was historically used in areas with little development. The setbacks he recommends are based on safety; for a very large turbine, 1,000 feet many not be enough. There is a range of numbers from the very cautionary and on up for areas where higher noise levels are not an issue. There are also places that have multiple setbacks and levels in the same area. One size does not fit all.

Hellerich asked how the sound samples are accumulated. O'Neal said it is best to capture a "worst-case scenario", where the turbine is as loud as it can be. Conditions must be right when measuring because if the wind is strong, that is all the gauges will measure.

Dr. Cheenne said a good ordinance would have three elements: a reasonable dB number, a penalty clause for the presence of any tones, and a clause about noticeable modulation. Most people would not be annoyed by a reasonable level of noise, it is the tonal or modulating quality that causes annoyance.

Henrichsen thanked the panel and opened the meeting up for public comment.

<u>Open for Comments and Questions from Audience Member on Matters Discussed This Evening:</u>

- Why is there a different standard between day and night levels? Dr. Cheenne said natural noise levels change at night. O'Neal said it is also because the majority of people are sleeping, but a facility that could operate 24 hours if they have a lower nighttime limit. Walsh added that there is one study that suggests that noise induced hearing loss is greater at night.

- Noise is an aesthetic quality and is related to how we connect to our surroundings. It is very difficult to ignore sound or to get away from it. There are also people who are sensitive to sound which could be a factor in their decision to live in a rural area.

- Sleep deprivation was reported as a correlated problem and we know that can cause health problems. Dr. Cheenne said there is evidence that suggests a portion of our brain is dedicated to problem solving during sleep, so deprivation can mean more than just being tired. Walsh added that there is also a theory that people recreate and organize their day during sleep. The message

again is that it is very complex and the questions about health effects should be addressed eventually.

- Some mechanical malfunctions in turbines could create other disruptive noise, like high-pitched squeals. Wagner said it is always in the best interest of the owners to repair malfunctions quickly to avoid disturbance, and to maximize production.

- Some individuals have neurological problems that make them hypersensitive to their environments. Time and research will provide better answers to questions pertaining to effects on health. Until then, it is not right to make the public guinea pigs.

The meeting concluded at approximately 8:15 p.m.