EXHIBIT A5

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 FOR A WIND ENERGY FACILITY IN BON HOMME, CHARLES MIX, AND HUTCHINSON COUNTIES, SOUTH DAKOTA, FOR PREVAILING WIND PARK ENERGY FACILITY

SD PUC DOCKET EL-18-026

PREFILED REBUTTAL TESTIMONY OF DR. MARK ROBERTS
ON BEHALF OF PREVAILING WIND PARK, LLC

September 26, 2018

I. INTRODUCTION

Q. Please state your name.

A. My name is Dr. Mark Roberts.

Q. Did you provide Supplemental Direct Testimony in this Docket?

A. Yes. I submitted Supplemental Direct Testimony in this docket on August 10, 2018.

Q. What is the purpose of your Rebuttal Testimony?

A. The purpose of my Rebuttal Testimony is to respond to the testimony of Professor Mariana Alves-Pereira, Jerry Punch, Ph.D., and Richard James, each of whom submitted testimony on behalf of Intervenors in this docket.

Q. Are there any exhibits attached to your Rebuttal Testimony?

A. The following exhibits are attached to my Rebuttal Testimony:

- Exhibit 1: Ministry for the Environment, Climate and Energy of the Federal State of Baden-Wuerttemberg, Germany (2016). *Low-frequency Noise Incl. Infrasound from Wind Turbines and Other Sources*. LUBW Landesanstalt fur Umwelt, Messungen and Naturschutz Baden-Wuerttemberg.

- Exhibit 2: Akira Shimada and Mimi Nameki (2017). *Evaluation of Wind Turbine Noise in Japan. Ministry of the Environment of Japan.*

- Exhibit 3: Danish Energy Agency (2009). *Wind Turbines in Denmark.*

- Exhibit 4: Frits van den Berg, Public Health Service Amsterdam, and Irene van Kamp, National Institute for Public Health and the Environment (2017). *Health effects related to wind turbine sound. Swiss Federal Office for the Environment.*

- Exhibit 5: Stephen Chiles (2010). *A new wind farm noise standard for New Zealand, NZS 6808:2010*. Proceedings of 20th International Congress on Acoustics, ICA 2010.

- Exhibit 6: Eja Pedersen, Högskolan i Halmstad (2003). *Noise Annoyance 116 from Wind Turbines: A Review.* Swedish Environmental Protection Agency.

- Exhibit 7: Hitomi Kimura, Yoshinori Momose, Hiroya Deguchi, and Nameki, Mimi (2016). *Investigation, Prediction, and Evaluation of Wind Turbine Noise in Japan.* Ministry of the Environment of Japan.

- Exhibit 8: C. Yan, K. Fu and W. Xu. *On Cuba, diplomats, ultrasound, and intermodulation distortion. University of Michigan Tech Report*. March 1, 2018.

- Exhibit 9: Crichton, F., et al. (2014). *The link between health complaints and wind turbines: Support for the nocebo expectations hypothesis*. *Frontiers in Public Health* 2:220.

- Exhibit 10: Enck, P., et al. "New Insights Into the Placebo and Nocebo Responses," Neuron (July 31, 2008): Vol. 59, No. 2, pp. 195–206.

- Exhibit 11: Colloca, L. (2017). *Nocebo effects can make you feel pain: Negative expectancies derived from features of commercial drugs elicit nocebo effects*. *Science*, 358(6359): 44.

II. RESPONSE TO TESTIMONY OF PROFESSOR MARIANA ALVES-PEREIRA

A. Overview.

Q. Have you reviewed the Prefiled Testimony of Prof. Mariana Alves-Pereira, submitted on behalf of Intervenors in this proceeding?

A. Yes. I reviewed Prof. Alves-Pereira's testimony, as well as the exhibits attached to her testimony.

Q. Please summarize your response to Prof. Alves-Pereira's testimony.

A. As I discussed in my Supplemental Direct Testimony, I am aware of Prof. Alves-Pereira's assertions regarding vibroacoustic disease. A majority of the work involving vibroacoustic disease has originated from Dr. Castelo Bronca's research group in Portugal, of which Prof. Alves-Pereira is a member. A majority of the research group's efforts have focused on low frequency sound at high levels (*e.g.*, 120 decibels and above, well above the sound levels of wind turbines). Their work has not been replicated by other research groups to the point where vibroacoustic disease has been accepted as a medical diagnosis. As I discussed previously, based on my work and review of reliable scientific literature, I am not aware of any link between wind turbines and what Prof. Alves-Pereira describes as vibroacoustic disease.

B. <u>Scientific Method</u>.

Q. Professor Alves-Pereira references the scientific method and evidence-based medicine in her testimony. (Alves-Pereira Direct, lines 63-66.) Please describe these concepts.

A. I previously discussed the scientific method in detail in my Supplemental Direct Testimony. To summarize, during a clinical encounter between a patient and a physician, medical information is collected and analyzed. First, the physician will note the patient's report of symptoms and concerns. That consists of what the patient says he or she is experiencing. This may include the patient's attribution of their symptoms (headache, dizziness, upset stomach, etc.) to some event or activity. This is often referred to as the "subjective" information and refers to what the patient reports. Next, the physician attempts to obtain information that will verify or clarify the patient's reported symptoms or concern (objective information). This verification consists of probing questions to clarify the information and includes assessment of past medical history (previous injury or illness), collection of information during the physical examination, and testing (laboratory and or imaging). Next, the physician assesses the subjective information and the objective evidence and compares this

information with the physician's clinical experience, training, and other medical knowledge to arrive at a diagnosis and a plan for treatment. In common conditions (flu, high blood pressure, gastrointestinal conditions, etc.), the physician will usually have sufficient experience to make the diagnosis without going into the published literature. In other cases, the physician may need to gather additional information or refer the patient on to a specialist.

For an example of this process: Patient comes to the doctor with severe headache and is concerned that he might have a brain tumor. The doctor does not immediately schedule the patient for brain surgery but instead evaluates the patient in an orderly process that rules in or rules out the presence of a brain tumor. The physician evaluates what the patient reports, the outcome of the physical examination and tests or imaging, then assesses this information, makes a diagnosis, and develops a treatment plan.

Q. Prof. Alves-Pereira asserts that "[w]hen it comes to studying the health effects of ILFN exposure, however, these fundamental axioms of the Scientific Method and Evidence-based Medicine are somehow forgotten, or deemed not applicable." (Alves-Pereira Direct, lines 68-70.) What is your response?

A. I do not agree. The publications attached to my Supplemental Direct Testimony and this Rebuttal Testimony utilize the scientific method. Despite Prof. Alves-Pereira's assertions otherwise, it is not sufficient to take the patient's reported health concerns and immediately draw a conclusion regarding causation without including an evaluation of objective evidence and appropriate peer-reviewed, published literature. The key point is to look at the "evidence" – that is, objective findings from a clinical evaluation conducted by a physician that bases opinions based on data that has passed review.

Q. Prof. Alves-Pereira states that "[a]nnoyance is not an objective parameter and hence, in accordance with the axioms of Evidence-based Medicine, cannot be

used to ascertain de facto health effects." (Alves-Pereira Direct, lines 77-78.) What is your response?

A. I agree. This statement is consistent with my prior testimony and the fact that "annoyance" is the most commonly recognized "effect" in the applicable peer-reviewed published literature and the reviews by scientific committees that I have previously identified. Annoyance in and of itself is not a health effect but instead is a normal physiological response to one's surroundings. As I have testified many times before, one person's music can be perceived as an annoying noise by another person. It is the perception of the noise that often makes it annoying - not the noise itself. I note, however, that Prof. Alves-Pereira's statement here seems inconsistent with the remainder of her testimony. She appears to transform complaints of annoyance into objective health issues solely because the complaints were described to a doctor.

Q. Prof. Alves-Pereira states that, "[i]n accordance with the axioms of Evidence-based Medicine and, even more fundamentally, the Scientific Method, *psychosomatic illnesses must also be clinically corroborated*; their proposed existence based on mere assertions is not scientifically valid." (Alves-Pereira Direct, lines 83-86.) What is your response?

A. Again, I agree. This statement is entirely consistent with my testimony and well-accepted peer-reviewed literature. However, it is not consistent with the remainder of Prof. Alves-Pereira's testimony, where she indicates that a person's report of illness is sufficient for there to be the documented occurrence of a health issue related to wind turbines.

Q. Prof. Alves-Pereira discusses the scientific validity of self-reported health complaints in lines 134-50 of her testimony. Do you have a response?

A. Yes. Prof. Alves-Pereira's discussion is not consistent with the normal clinical process I have previously described in this testimony. Self-reported health complaints are certainly part of the clinical process, but they do not become scientifically valid simply because they are reported to a physician. Rather, as I

discussed previously, a patient's self-reported health complaints are subjective information – they are one part of the clinical evaluation process, but a patient's recitation of a series of subjective symptoms to a physician does not make those symptoms objective evidence. Prof. Alves-Pereira uses the term *anamnesis* to bolster her argument. Although a medical term, the term *anamnesis* simply refers to the patient history as described by the patient. It does not confer special verification. Again, in the normal clinical process, the physician takes what the patient reports, what is identified from the physical examination along with any laboratory testing or imaging results, and compares this information to his or her clinical experience, training, and current medical information to make a diagnosis, if possible, and set out a treatment plan, or refers the patient on to a specialist for further assessment.

C. Infrasound and Wind Turbines.

Q. Prof. Alves-Pereira discusses infrasound and low-frequency noise, or "IFLN." What is infrasound?

A. As I described in my Supplemental Direct Testimony, infrasound is sometimes referred to as low frequency sound and is sound that is between 0 hertz ("Hz") and 20 Hz. A level of 20 Hz is commonly considered to be the low end of the range of human hearing. It is very important to specify the sound because the human ear responds differently to different frequencies.

Q. What are sources of infrasound?

A. As I noted in my Supplemental Direct Testimony, human organs produce infrasound. For example, heart sounds are in the range of 27 to 35 dBA at 20-40 Hz, and lung sounds are reported in the range of 5-35 dBA at 150-600 Hz; these sources are in the range of sound produced by wind turbines. In addition, infrasound comes from numerous natural and man-made sources. With respect to natural sources, waves, thunder, and waterfalls are natural sources of infrasound. With respect to man-

made sources, common household objects such as washing machines, fans and heating and refrigeration systems are also sources of infrasound.

Q. Professor Alves-Pereira discusses infrasound, particularly that from wind turbines, and its potential impacts on human health. Are you aware of any recent studies on this topic?

A. Yes. Researchers in the United States (Massachusetts) (2012) (Roberts Supplemental Direct Testimony, Exhibit 7), Germany (2016) (Exhibit 1), Japan (2017) (Exhibit 2), France (2017) (Roberts Supplemental Direct Testimony, Exhibit 3), Denmark (2009) (Exhibit 3), Switzerland (2017) (Exhibit 4), New Zealand (2010) (Exhibit 5), Sweden (2003) (Exhibit 6), and Australia (2015) (Roberts Supplemental Direct Testimony, Exhibit 2c) have reviewed the literature regarding infrasound from wind turbines. Each study, using recognized scientific methods, concluded that infrasound levels are multiple orders of magnitude below the threshold of human hearing. For example, the 2016 German study concluded that "[t]he infrasound levels generated by [wind turbines] lie clearly below the limits of human perception. There is no scientifically proven evidence of adverse effects in this level range." (Exhibit 1, at 12.) Similarly, the Ministry of the Environment of Japan's 2016 study *Investigation, Prediction, and Evaluation of Wind Turbine Noise in Japan* states that, "Super-low (below 20 Hz) frequency range components of wind turbine noise are at imperceptible levels. Therefore, wind turbine noise is not an issue caused by super-low frequency range." (Exhibit 7, at 5760.) These are just a few of the reports of expert panels at state, national, and international levels that have not found a specific health condition associated with wind turbines.

An independent review of the literature relative to wind turbines and health was commissioned by the National Health and Medical Research Council ("NHMRC") with the goal of determining whether there was an association between exposure to wind farms and human health effects. The document is approximately 300 pages and covers peer-reviewed, published literature, government reports, and some lay publications. The overall conclusions of this extensive review were:

> "[t]here is no consistent evidence that noise from wind turbines—whether estimated in models or using distance as a proxy—is associated with self-reported human health effects. Isolated associations may be due to confounding, bias or chance." (Roberts Supplemental Direct Testimony, Exhibit 2c.)

Most recently, the March 2017 French National Agency for Food Safety, Environment and Labor ("ANSES") carried out measurement campaigns near three wind farms. A summary of this study is included as Exhibit 3 of my Supplemental Direct Testimony (the original study is in French). The summary notes that the study concluded:

- "the results of these campaigns confirm that wind turbines are sources of infrasound and low sound frequencies, but no exceedance of the audibility thresholds in the areas of infrasound and low frequencies up to 50 Hz has been found";[1] and

- "all the experimental and epidemiological data available today do not show any health effects related to exposure to noise from wind turbines, other than noise-related annoyance."

(Roberts Supplemental Direct Testimony, Exhibit 3.)

Q. Do you agree with the ANSES conclusions?

A. Yes. They are consistent with the peer-reviewed literature on wind turbine noise.

Q. In response to the question, "[w]hy are some people affected and others not within the same household" regarding infrasound, Prof. Alves-Pereira

[1] French Agency for Food, Environmental and Occupational Health & Safety, *Exposure to low-frequency sound and infrasounds from wind farms: improving information for local residents and monitoring noise exposure* (Mar. 30, 2017), https://www.anses.fr/en/content/exposure-low-frequency-sound-and-infrasounds-wind-farms-improving-information-local; *see also* Roberts Supplemental Direct Testimony, Exhibit 3.

discusses "two exposure-linked factors." (Alves-Pereira Direct, lines 180-88.) Do you have a response?

A. Yes. First, without evidence, Prof. Alves-Pereira asserts that individuals are negatively affected by infrasound. Second, Prof. Alves-Pereira makes the assertion that two "exposure-linked factors" "profoundly condition the onset of symptoms among families living in ILFN-contaminated homes." She identifies these factors as "prior ILFN exposure histories" and "residential time exposure patterns." Although these phrases may sound official and technical, they are not. Prof. Alves-Pereira provides no scientific support for her assertions, and I am not aware of any. We are all exposed to all sorts of sounds all the time. None of the reviews by governmental organizations and other groups of scientists impaneled to review the material relative to wind turbine sound and health effects have referenced the process of "exposure-linked processes" that Prof. Alves-Pereira has used.

Q. In response to the same question, Prof. Alves-Pereira then discusses "individual susceptibility factors." (Alves-Pereira Direct, line 189.) Do you agree?

A. No. As with her assertions regarding "exposure-linked factors," Prof. Alves-Pereira provides no scientific support for her statements, and I am not aware of any.

Q. Prof. Alves-Pereira states that she and her group are collecting data regarding wind turbines, including "conducting extensive interviews among the complaining populations." (Alves-Pereira Direct, line 214.) What are your thoughts on these statements?

A. Prof. Alves-Pereira's statements demonstrate the serious flaws of her described "study." It is hard to evaluate the study without reading it, but Prof. Alves-Pereira's reliance on "complaining populations" without comparison to noise exposure measurements and her evaluation of common everyday health issues has been repeated by many researchers opposed to wind energy, starting with Prof. Nina Pierpont. This method of research is fraught with bias that cannot be overcome. Prof. Alves-Pereira appears to have already concluded that her research is going to

find adverse health impacts from wind turbines. As such, she is only conducting interviews with complaining persons. However, the research she describes collects, at best, anecdotal information. As I have stated time and again, interviewing complaining populations is not an epidemiological study and does not follow the scientific method that must be followed to move from an observation, to correlation, and ultimately to causal proof.

Q. Prof. Alves-Pereira asserts that "[s]afe distances have not yet been established for the IFLN generated by wind turbines." Do you agree with this conclusion?

A. No. Again, Prof. Alves-Pereira implies that there are adverse health effects from wind turbines, but she fails to back up these claims with scientific data. Put simply, adverse health effects have not been linked to infrasound generally or to infrasound generated by wind turbines, more specifically.

D. Prof. Alves-Pereira's Statements Regarding My Supplemental Direct Testimony.

Q. Prof. Alves-Pereira asserts that your testimony treats wind turbines, rather than infrasound, as "agents of disease." Do you agree?

A. No. Prof. Alves-Pereira misunderstands my testimony and my opinions. What I have clearly stated is that the peer-reviewed, published literature and the results of numerous reviews of that literature do not indicate that infrasound at the levels generated by a wind turbine is an "agent of disease." I certainly have not confused these concepts, as Prof. Alves-Pereira appears to believe. However, the literature also clearly identifies the presence of wind turbines as a point of annoyance for some individuals.

Q. Prof. Alves-Pereira asserts that "studies comparing people who live near wind turbines with those who do not" are not scientifically valid. (Alves-Pereira Direct, lines 314-15.) Do you agree?

A. No, not at all. The cornerstone of an epidemiological study – and the scientific method – is the fact that there is a comparison group. It is critical to have a comparison group to determine whether there is an increase in health factors – This is especially important with respect to issues like wind turbine effects, where there are subjective complaints with the overlay of annoyance.

Q. Professor Alves-Pereira asserts that "receiving 10 chest x-rays per day for a year, might indeed begin to pose a problem in terms of health effects. It is the same with IFLN." (Alves-Pereira Direct, lines 363-64.) Do you agree?

A. This is not a valid comparison. There is a significant body of reliable, published, peer-reviewed literature regarding the adverse effects of x-rays, starting with Madame Curie. By contrast, there is no evidence that the sound levels generated by wind turbines cause specific health effects, let alone any health effects separate and distinct from the infrasound we are exposed to in our environment 24 hours a day.

E. Discussion of Certain Exhibits to Professor Alves-Pereira's Testimony.

Q. Prof. Alves-Pereira attaches a document titled *Neurological Manifestations Among US Government Personnel Reporting Directional Audible and Sensory Phenomena in Havana, Cuba* as Exhibit 3 to her testimony ("Havana Paper"). Are you familiar with the Havana Paper?

A. Yes. The "Havana Paper" is a brief description of health investigations of U.S. government personnel serving on diplomatic assignment in Havana, Cuba, that they experienced "neurological symptoms" thought to be associated with exposure to auditory and sensory phenomena in 2016 and 2017.

Q. In your opinion, does the Havana Paper provide the Commission with helpful information related to this Project?

A. No. Prof. Alves-Pereira asserts that the symptoms reported by the Cuban diplomats "are very similar to those made by families living in ILFN-contaminated homes."

This assertion is not well-founded. Diplomatic staff complained of a high-pitched noise. Researchers at the University of Michigan analyzed audio records provided by the United States Department of State. The researchers' analysis indicated that the sound recording in the Cuba Embassy was a mixture of high frequency sound (ultrasound) in the thousands of Hz range. The sound identified as potentially affecting Cuban diplomats was thousands of times higher than the frequencies generated by wind turbines. (Yan, et al. 2018, Exhibit 8.) Prof. Alves-Pereira's comparison of the Cuban Embassy investigation is misguided and inapt.

Q. Prof. Alves-Pereira attaches a document titled *Occupational and Residential Exposures to Infrasound and Low Frequency Noise in Aerospace Professionals: Flawed Assumptions, Inappropriate Quantification of Acoustic Environments, and the Inability to Determine Dose-Response Values* as Exhibit 4 to her testimony ("Aerospace Paper"). Are you familiar with the Aerospace Paper?

A. Yes. The Aerospace Paper is co-authored by Prof. Alves-Pereira and asserts, as Prof. Alves-Pereira does in her testimony, that the dBA metric is not adequate to protect against excessive infrasound exposure.

Q. In your opinion, does the Aerospace Paper provide the Commission with helpful information related to this Project?

A. No. This paper focuses on the noise levels associated with the aerospace industry, which are orders of magnitude greater that the noise levels measured at wind farms. The graphs shown in that paper are illustrating levels of 70+ decibels. In addition, under the disclaimer on page 96 of the paper, the authors state that they "[a]re not producing an environmental noise assessment report focused on wind turbines."

Q. Prof. Alves-Pereira attaches a document titled *Infrasound and Low Frequency Noise: Shall we Measure it Properly?* as Exhibit 5 to her testimony ("ILFN Paper"). Are you familiar with the ILFN Paper?

A. Yes. As Prof. Alves-Pereira notes, it is a "more informal paper" that described her fieldwork in Ireland.

Q. In your opinion, does the ILFN Paper provide the Commission with helpful information related to this Project?

A. No. The paper lacks significant information needed to assess it. First, the testing does not report background levels of low frequency sound in the homes. Secondly, there is no indication of the type of wind turbine or power output that could give the reader an indication of the contribution of these factors. The report uses a set of observations that are not adequately described to bolster Prof. Alves-Pereira's claims regarding low frequency noise measurements. In addition, the report does not appear to have been published, which would have subjected it to peer review.

Q. Prof. Alves-Pereira attaches a document titled *An Evaluation of Environmental, Biological, and Health Data from the Island of Vieques, Puerto Rico* as Exhibit 6 to her testimony ("Vieques Paper"). Are you familiar with the Vieques Paper?

A. Yes.

Q. In your opinion, does the Vieques Paper provide the Commission with helpful information related to this Project?

A. No. The Vieques Paper highlights how the investigation of public health events can be performed but sheds no light on the questions regarding wind turbines and health. It does, however, highlight the fact that the claim made by the Portuguese reseach group that there was a high level of vibroacoustic disease among Vieques fisherman was not confirmed by an independent review panel. Rather, the independent review panel determined, after conducting blind-coding and repetition of

that analysis by Mayo Clinic, that there was no evidence to indicate clinically significant heart disease. (Alves-Pereira Direct, Exhibit 6 at A-52.)

Q. Prof. Alves-Pereira attaches a document titled *Vibroacoustic Disease: Biological effects of infrasound and low-frequency noise explained by mechanotransduction cellular signalling* as Exhibit 7 to her testimony ("2006 VAD Paper"). Are you familiar with the 2006 VAD Paper?

A. Yes.

Q. In your opinion, does the 2006 VAD Paper provide the Commission with helpful information related to this Project?

A. No. As noted by the researchers in the 2006 VAD Paper, there has been "much controversy and acrimonious debate over whether or not acoustical phenomena can cause extra-auditory effects on living organisms." In addition, it is not evident from a review of the published literature that the findings, referred to as vibroacoustic disease or "VAD" by these researchers, has been confirmed by others or generally accepted by medical or acoustical professions. There are no epidemiologically-sound studies that have found what these researchers refer to as vibroacoustic disease associated with wind turbines. The fact that there is not widespread acceptance is evidenced by the fact that the International Classification of Disease 10th Edition ("ICD-10") does not list vibroacoustic disease. The ICD-10 is the tenth revision of the codes for recognized diseases, health complaints, and causes for disease and injury listed by the World Health Organization and is used by the National Center for Health Statistics to code and classify illness and deaths in the United States. The ICD-10 classification lists over 14,000 major diseases and injuries but can be expanded to 70,000 codes when the major categories are expanded.

Q. Prof. Alves-Pereira attaches a document titled *Vibroacoustic Disease I: The Personal Experience of a Motorman* as Exhibit 8 to her testimony ("Motorman Paper"). Are you familiar with the Motorman Article?

A. Yes. This is a layperson's account of a presumed occupational exposure to low-frequency sound.

Q. In your opinion, does the Motorman Article provide the Commission with helpful information related to this Project?

A. No. The Motorman Article is a layperson's opinion and has no scientific data to contribute to a discussion about wind turbines.

Q. Prof. Alves-Pereira attaches a document titled *Vibroacoustic Disease and Respiratory Pathology III – Tracheal and Bronchial Lesions* as Exhibit 9 to her testimony ("VAD Respiratory Paper"). Are you familiar with the VAD Respiratory Paper?

A. Yes. This is a case series published by Prof. Alves-Pereira's research group. It is a report of the results of biopsies of the respiratory tract of four individuals (two of whom were smokers), three of whom were employed in occupations involving aviation, and all of whom had been diagnosed with what Prof. Alves-Pereira terms vibroacoustic disease. As pointed out earlier, case series are not epidemiological studies.

Q. In your opinion, does the VAD Respiratory Paper provide the Commission with helpful information related to this Project?

A. No. This paper has nothing to do with wind turbines. It also does not follow the scientific method of risk evaluation – there is no objective assessment of intensity, duration, or frequency of low-frequency noise exposure that would identify whether any of the individuals experienced low-frequency noise above normal background levels. In addition, there is no assessment of the individuals' occupational history, which could have included chemical exposures that adversely affect the upper

respiratory system and potentially produce cell damage similar to that described in the case series.

Q. Prof. Alves-Pereira attaches a document titled *Vibroacoustic Disease in a Ten Year Old Male* as Exhibit 10 to her testimony ("2004 VAD Paper"). Are you familiar with the 2004 VAD Paper?

A. Yes.

Q. In your opinion, does the 2004 VAD Paper provide the Commission with helpful information related to this Project?

A. No. This is a case report of claimed low-frequency noise exposure, but it is not clear that the source was identified, nor was the sound level quantified sufficiently to support the claimed effect. Once again, a "diagnosis" of what Prof. Alves-Pereira describes as vibroacoustic disease is made when, in fact, this is not a clinically recognized medical condition beyond the Portuguese researchers.

F. Conclusion Regarding Prof. Alves-Pereira's Testimony.

Q. What is your overall impression of Prof. Alves-Pereira's Testimony?

A. Prof. Alves-Pereira has not established that the peer-reviewed, published literature has documented a health problem associated with low-frequency sound at the levels generated by wind turbines, let alone that low-frequency sound from any source causes such health problems.

III. RESPONSE TO TESTIMONY OF JERRY PUNCH, Ph.D.

Q. Have you reviewed the Prefiled Testimony of Jerry L. Punch submitted on behalf of Intervenors in this matter?

A. Yes. I reviewed the testimony submitted by Dr. Punch, as well as the exhibits attached to that testimony.

A. <u>2016 Punch and James Paper</u>.

Q. On page 4 of his testimony, Dr. Punch references an article he authored titled *Wind turbine noise and human health: a four-decade history of evidence that wind turbines pose risks*, which he attaches as Exhibit 2 to his testimony (the "2016 Punch and James Paper"). Are you familiar with the 2016 Punch and James Paper?

A. Yes. I have observed this article on a number of anti-wind websites and seen it produced at various hearings. It is not consistent with the opinions of local, state, national, and international panels of experts who have reviewed the peer-reviewed, scientific publications related to wind turbines and health effects.

Q. Dr. Punch states that the 2016 Punch and James Paper was peer reviewed. Do you agree?

A. No. A summary of the 2016 Punch and James Paper describes the purported "peer review" of this paper as follows:

> This paper has been reviewed both by the anonymous Noise & Health reviewer and by three other reviewers who have substantial professional experience in the area of wind turbine noise. We gratefully acknowledge the helpful contributions of Keith Johnson, Esq., Michael Nissenbaum, MD, and Daniel Shepherd, PhD.
>
> Mr. Johnson provided a review from the perspective of an attorney who represents interveners in wind turbine siting cases. Dr. Nissenbaum provided a review from the perspective of a medical professional and expert in how ionizing and non-ionizing radiation affects humans. Dr. Shepherd provided a review from the perspective of a psychoacoustician with experience in how wind turbine sound affects people. Each of these reviewers' comments on earlier versions of our manuscript led to the final document. The opinions or assertions contained herein, however, are the personal views of the authors and are not to be

construed as reflecting the views of Michigan State University or Central Michigan University.[2]

This does not describe the typical level of rigorous peer review I would expect before labeling a report "peer reviewed." A law degree is not recognized as a science degree and, notably, Mr. Johnson is described as representing opponents to wind projects. It is also notable that Dr. Nissenbaum is on the Board of Directors of "The Society for Wind Vigilance," which is a well-known and decidedly anti-wind group.[3] Similarly, Dr. Shepherd is one of that group's "Scientific Advisors."[4] As such, these "reviewers" may have been predisposed to agreeing with Dr. Punch and with groups opposed to wind energy.

Q. In your opinion, does the 2016 Punch and James Paper provide the Commission with helpful information with respect to this Project?

A. No. The stated goal of the article is to "provide a systematic review of legitimate sources that bear directly and indirectly on the question of the extent to which WT noise leads to the many health complaints that are being attributed to it." The authors state that they used Google, Google Scholar, and PubMed for this information. I note that a Google search regarding wind turbines and health effects returns millions of results, which are not consistently reviewed or otherwise fact-checked. The scientific alternative is the U.S. National Library of Medicine, National Institute of Medicine's PubMed, which comprises more than 28 million citations for biomedical literature from MEDLINE, life science journals, and online books. My PubMed search of "wind turbines health effects" on September 23, 2018, returned only 54 articles in the scientific literature. In my experience, there is a lot of

[2] *See National Wind Watch: Presenting the Facts about Industrial Wind Power* website link, *available at* https://www.wind-watch.org/documents/wind-turbine-noise-and-human-health-a-four-decade-history-of-evidence-that-wind-turbines-pose-risks/ (last accessed Sept. 19, 2018).

[3] Dr. Punch's co-author, Richard James, is also on this Board of Directors. Similarly, Drs. Phillips, Salt, and Thorne, each of whom are quoted in the 2016 Punch and James Paper, are "Scientific Advisors" to The Society of Wind Vigilance and have each written opinion pieces against wind turbines.

[4] *See* http://www.windvigilance.com/home/advisory-group (last accessed Sept. 19, 2018).

"information" in the lay press, internet, or word of mouth, but very little of it is objective scientific evidence.

Q. Dr. Punch states: "I believe that a substantial proportion of people living in the vicinity of the proposed Project can be expected to experience not only annoyance, but also a variety of adverse health effects." Do you agree?

A. No. Dr. Punch's "belief" is not a scientifically-validated conclusion. His "belief" is also not supported by the published, peer-reviewed literature on this topic, as I discussed in my Supplemental Direct Testimony. Annoyance is not a health effect but a normal, everyday psychological and physiological response often manifested when a person does not like or does not agree with something occurring in his or her life. For example, a baby crying may be reassuring to a mother that the baby is breathing, is hungry, or needs its diaper changed, but a crying baby on an airplane may be annoying to some fellow passengers.

Q. Dr. Punch asserts that the 2016 Punch and James Paper "indicate[s] that there is a strong association between exposure to wind turbines and the health complaints, and they strongly suggest that the link is causative." (Punch Direct, lines 150-52.) Do you agree?

A. No. Based on Dr. Punch's testimony, he is not relying upon evidence from epidemiological studies conducted using the scientific method. To the extent Dr. Punch is referring to the process of asking individuals if they experienced health conditions before wind turbines were installed, this is not a reliable study method, as I have previously discussed (*e.g.*, recall bias).

Q. Dr. Punch states that "general causation and specific causation . . . differ based on the targets of interest: the general population versus targeted individuals, respectively." (Punch Direct, lines 159-60.) Do you agree with this characterization?

A. No, Dr. Punch is not correct. General causation refers to the science that identifies the cause of disease - the risk factors or characteristics generally associated with

the development of a disease. Specific causation refers to the determination that an individual has the risk factors or characteristics associated with the disease or health condition at a sufficient level to reasonably conclude the cause of an individual's disease or health condition.

B. Dr. Punch's Statements Regarding My Supplemental Direct Testimony.

Q. Dr. Punch states that your "testimony rests primarily on [your] credentials in epidemiology and apparently not on [your] first-hand experience with people who have been exposed to wind turbine noise over long periods of time." (Punch Direct, lines 175-77.) Do you have a response?

A. Dr. Punch appears to misunderstand what qualifies someone to evaluate an exposure situation based on the scientific method. I spent 17 years in the Oklahoma State Department of Health. During most of that time, I evaluated health concerns involving communicable and environmentally-related disease for Oklahoma residents. I use the same scientific method to evaluate health concerns anytime I am asked to evaluate a potential exposure situation, regardless of the purported cause.

Q. Dr. Punch also states that you "essentially dismiss[ ] most of the nine [Bradford Hill] criteria by naming them, without discussing their implications." (Punch Direct, lines 180-81.) What are the Bradford Hill criteria?

A. The "Bradford Hill" criteria were proposed by Sir Austin Bradford Hill in 1965. They are a set of nine criteria to provide epidemiologic evidence of a causal relationship between a presumed cause and an observed effect when the association of cause and effect are sufficiently identified. In other words, the criteria are used to evaluate the strength of an association between a disease and its supposed causative agent. Sir Bradford Hill made it clear in his 1965 Presidential Address at the Royal Society of Medicine where he stated *"Disregarding then any such problem in semantics we have this situation. Our observations reveal an association between two variables,*

perfectly clear-cut and beyond what we would care to attribute to the play of chance. What aspect of that association should we especially consider before deciding that the most likely interpretation of it is causation?" Sir Bradford Hill then went on to list his nine criteria.

Q. What is your response to Dr. Punch's assertion that you "dismissed" the Bradford Hill criteria?

A. I disagree. My assessment methods are consistent with the Bradford Hill criteria. It is apparent from the peer-reviewed, published research that specific health effects have not been proven to be associated with sounds produced by wind turbines.

Q. Dr. Punch cites a paper prepared by Dr. Carl Phillips. Are you familiar with Dr. Phillips?

A. Yes. Despite Dr. Punch's statement otherwise, Dr. Phillips is not an epidemiologist. Instead, he holds a Ph.D. in public policy and is a "Scientific Advisor" to the Society for Wind Vigilance.[5] As I noted earlier, this is a well-known anti-wind group.

Dr. Phillips' arguments center on the opinion that there is sufficient "scientific evidence" that wind turbines cause a multitude of symptoms and disease for residents living nearby. The basis of his opinion is that "people can observe that the noise from the turbines seems to be bothering them, and can surmise that what they are noticing may be causing their disease." While this sort of information provides impetus to explore what might be the underlying health issues and concerns, it does not confirm a causal pathway. It is, at most, an association that requires careful evaluation and hypothesis testing. An observation of noise that one concludes is bothersome does not necessarily translate into a cause of disease without objective measurements. As I have discussed previously, others who have done these kinds of objective measurements have, in fact, *not* found any causal relationship between wind turbines and adverse health effects.

[5] *See* http://www.windvigilance.com/home/advisory-group/bio_phillips, *last accessed* Sept. 19, 2018.

C. The Nocebo Effect.

Q. Dr. Punch attempts to critique your discussion of the "nocebo effect." What is the nocebo effect?

A. The nocebo effect is the recognized human response to a negative belief or impression. For example, if a patient does not think that a medication will be effective, there is a high probability that the medication will not be effective. Nocebo is the opposite of placebo, which is the normal response observed where, when a person thinks a medication will be effective, it is more likely to be effective. The nocebo effect has been described as follows: "When individuals expect a feature of their environment or medical treatment to produce illness or symptoms, then this may start a process where the individual looks for symptoms or signs of illness to confirm these negative expectations." (Crichton, et al. 2014, Exhibit 9.)

Q. What is the relevance of the nocebo effect to this proceeding?

A. There is clear evidence in the medical literature regarding both the placebo effect and nocebo effect. (Meissner 2011.) It is real, and it is key to understanding health complaints about phenomena that occur around us. Research going back decades indicates that one's perception dictates the physical and emotional response. The development of social media and the internet has only intensified this focus. Research into recent events such as the Boston Marathon bombing and Sandy Hook shootings have shown that media coverage has broadened the extent of the psychological effect. (Holman 2014.) One has to look no farther than the internet to find a litany of health complaints attributed to wind turbines with little or no scientific bases. When you are "told" that you are going to get sick, you become more cognizant of everyday occurrences. (Fasse 2012.) A quick search of the internet produces stressful and often unfounded negative assertions about wind turbines.

Q. Dr. Punch states that, in the 2016 Punch and James Paper, he and his co-author concluded that it is most plausible that "a variety of adverse reactions

are *physiological* effects caused directly or indirectly from exposure to low-frequency sound and infrasound from wind turbines." (Punch Direct, lines 259-61 (emphasis in original).) Do you agree?

A. No. Neither Dr. Punch nor Mr. James is a physician. I do not find it convincing that they can determine the cause of a health complaint simply by evaluating an individual's claim. As I have discussed multiple times herein, there is an established, well-recognized scientific method for conducting this type of research. Dr. Punch has not followed that scientific method.

Q. Dr. Punch states that, "[w]hile psychological expectations and the power of suggestion can influence perceptions of the effects of wind turbine noise on health status, no scientifically valid studies have yet convincingly shown that psychological forces are the major driver of such perceptions." (Punch Direct, lines 261-64.) What is your response?

A. Dr. Punch's statement is not true and demonstrates a lack of basic understanding about the psychological factors associated with human response. Even a cursory review of the literature negates this argument. For example, in a paper published by Enck, et al. 2008 (Exhibit 10), the authors state: "The latest scientific evidence has demonstrated, however, that the placebo effect and the nocebo effect, the negative effects of placebo, stem from highly active processes in the brain that are mediated by psychological mechanisms such as expectation and conditioning."[6] More recently, a paper was published in 2017 exploring the concept that negative expectations result in nocebo (perceived negative) effects.[7] In this paper, the author describes the nocebo effect as the effect of negative expectations.

Q. Dr. Punch states, "I believe that most of these adverse reactions are mediated by disturbances of the hearing and balance mechanisms of the inner ear

[6] Enck P, et al. "New Insights Into the Placebo and Nocebo Responses," Neuron (July 31, 2008): Vol. 59, No. 2, pp. 195–206. (Exhibit 10.)

[7] Colloca, L. 2017. *Nocebo effects can make you feel pain: Negative expectancies derived from features of commercial drugs elicit nocebo effects*. *Science*, 358(6359): 44. (Exhibit 11.)

resulting from the low-frequency noise emitted by industrial wind turbines." (Punch Direct, lines 276-78.) Do you agree?

A. No. Dr. Punch provides no scientific support for his belief. I am not aware of any human data showing that wind turbines have a biological effect on the inner ear.

D. Conclusion Regarding Testimony of Dr. Punch.

Q. What is your overall impression of Dr. Punch's testimony?

A. A review of the peer-reviewed, published data does not support Dr. Punch's general statement about health effects being attributed to the noise of wind turbines. In addition, his attempts to support his opinions about specific mechanisms of adverse health effects that he attributes to wind turbine noise are not reflected in the science related to noise and human hearing or in the numerous reviews of the published scientific works by local, state, national, and international health organizations.

IV. RESPONSE TO TESTIMONY OF RICHARD JAMES

Q. Mr. James references Steven Cooper's Cape Bridgewater study. Are you familiar with this study?

A. Yes. I believe Mr. James is referring to a study performed in Australia in 2014. It was an evaluation of three households (six adults) who had previously lodged multiple complaints with the wind turbine operator relative to noise levels of the Cap Bridgewater Wind Farm. The individuals had reported subjective complaints relative to the wind farm for more than six years prior to participating in the evaluation.

Q. Do you believe that the Cape Bridgewater study supports any conclusion regarding the potential health effects of low frequency sound from wind turbines?

A. No. The Cape Bridgewater study has not been peer-reviewed, and its methodology flaws make the evaluation's results suspect and unreliable:

- Because Mr. Cooper evaluated individuals who have already made complaints about the wind farm, there was a selection bias in who participated in the study. With respect to selection bias, the selection of six individuals who had previously complained about wind turbine operations would have added the effects of recall bias into the study, meaning that the study individuals had already formed an opinion, which would have a direct effect on their reporting of subjective sensations. More simply, individuals who have already reported complaints are more likely to continue to do so.
- The evaluation includes no reference group (or "control group") to compare the results of the six individuals' subjective reports. A reference group is the hallmark of an epidemiological study. A researcher cannot reliably evaluate a complaint about turbine operations, or any other stimuli, without having both a group that is exposed to the operations and one that is not to determine if there is a difference in effects that could be attributed to the stimuli.
- In an appropriately designed epidemiological study, the subjects would be "blinded" to the status of the turbines, meaning that they would not know whether the turbines were operational. This did not occur in the Cape Bridgewater study.
- As pointed out by the author of the Cape Bridgewater study, their sample was limited to six individuals who had previously complained – that is, the study was assessing the subjective "sensations" reported by six individuals who feel they have been adversely affected in one way or the other as a result of the wind farm. (Cape Bridgewater study at p. 212.)
- Notably, the correlations reported by the author have not been repeated using a valid epidemiological study design.

Q. Mr. James attaches a document titled *Noise: Windfarms* as Exhibit 2 to his testimony (the "Shepherd Paper"). Are you familiar with the Shepherd Paper?

A. Yes. I note that its authors are all affiliated with the anti-wind group, Society for Wind Vigilance. Specifically, Dr. Hanning is on that group's Board of Directors, and Drs. Shepherd and Thorne are each a "Scientific Advisor."[8]

Q. In your opinion, does the Shepherd Paper provide the Commission with helpful information concerning the Project?

A. No, in the sense that this is a recitation of opinions of individuals who are affiliated with anti-wind groups. As I noted, Drs. Shepherd and Thorne are "Scientific Advisors" for the Society of Wind Vigilance, and Dr. Hanning and Mr. James are on its Board of Directors. That said, there are some thoughtful comments regarding the psychological aspects of annoyance and reported health concerns. However, the term epidemiology and its attribution to a number of reports or opinion pieces is misleading. For example, Dr. Nina Pierpont's work is not a scientific study, and the Shepherd Paper fails to make that clear. The Shepherd Paper's reliance on pieces written by Harry, Pierpont, Krogh, Hanning, Alves-Pereira, and Nissenbaum clearly indicate the slant of the article toward the views of the Society for Wind Vigilance.

Q. The Shepherd Paper states that annoyance is an adverse health effect, relying on the World Health Organization ("WHO"). What is your response?

A. Annoyance is not an adverse health effect, it is a normal physiological response which is deeply rooted in the beliefs, culture, and psychological makeup of the individual. The prevention of annoyance is a worthy but unachievable goal. It is important to recognize that the WHO document that the Shepherd Paper relies upon is from 1999 and does not address wind turbines. Overall, it is an outdated, single reference that does not reflect the current state of the research on this topic. There is peer-reviewed, published research since that time, much of which I have identified

[8] *See* http://www.windvigilance.com/home/advisory-group (last accessed Sept. 24, 2018).

in my testimony, that provides more reliable and relevant information for the Commission.

In addition, importantly, the WHO document that the Shepherd Paper relies upon defines annoyance broadly as "a feeling of displeasure associated with *any* agent or condition, known *or believed* by an individual or group to adversely affect them."[9] I further note that the WHO document discussed annoyance in terms of a social/behavioral effect and states: "it should be recognized that equal levels of different traffic and industrial noises cause different magnitudes of annoyance. This is because annoyance in populations varies not only with the characteristics of the noise, including the noise source, but also depends to a large degree on many non-acoustical factors of a social, psychological, or economic nature."[10]

Q. The Shepherd Paper notes that some individuals describe themselves as "noise sensitive." What is your response?

A. That phrase, as used in the Shepherd Paper, is not a recognized specific health condition in medical literature. It is neither an illness nor a disease but more likely a conditioned response. In lay terms, this might be described as a state of mind. As I discussed previously regarding the nocebo effect, if a person does not like something, he or she is more likely to have a negative response to any situation reflective of the stimulating event.

Q. Are you familiar with the Shirley Wind Project study by Dr. Schomer referred to by Mr. James?

A. Yes.

[9] WHO, *Guidelines for Community Noise*, at 32 (1999).

[10] *Id.* at xi; *see also id.* at 33 and 42 ("[A]nnoyance reactions are sensitive to many non-acoustical factors of social, psychological or economic nature, and there are also considerable differences in individual reactions to the same noise.").

Q. Do you believe that Dr. Schomer's study provides helpful information to the Commission with respect to this Project?

A. No. The study did not use study methods such that specific conclusions could be scientifically supported. It also did not demonstrate a causal relationship between the wind farm and the health complaints reported by some residents.

Q. Mr. James asserts that you are "not qualified to speak to the issue of acoustics or human response to wind turbine noise." (James Direct, lines 398-99.) What is your response?

A. I will be the first to admit that I am not an acoustician. I am, however, a graduate trained epidemiologist with 30 years of experience working in public health and 20 of those years working in the areas of occupational and environmental medicine as a Board Certified Physician. I am using this experience and training to assess the health and exposure claims made by persons who are attributing various health conditions to wind turbine noise.

V. CONCLUSION

Q. After reviewing the testimonies of Prof. Alves-Pereira, Dr. Punch, and Mr. James, do you still hold the opinions offered in your Supplemental Direct Testimony?

A. Yes. My opinions are based on peer-reviewed, published literature, and Dr. Alves-Pereira, Dr. Punch, and Mr. James did not present any testimony based on similarly reliable research. It is important to acknowledge that there have been more than 400 gigawatts of wind power generation installed around the world,[11] and Prof. Alves-Pereira, Dr. Punch, and Mr. James base their opinions largely only on a small number of self-reported complaints. As such, my opinions remain unchanged.

[11] *See* https://www.worldenergy.org/data/resources/resource/wind/ (last accessed Sept. 24, 2018).

Q. Does this conclude your Rebuttal Testimony?

A. Yes.

Dated this 26th day of September, 2018.

Dr. Mark Roberts

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