Opening Statement of Richard R. James, INCE
Proceeding Number 1955, 18th November, 2013

Thank you for the opportunity to provide my opinions and testimony as an acoustical engineer and acoustician regarding the materials submitted by BluEarth and its experts related to noise prepared and filed as part of the record of this hearing. My testimony on the noise impacts of wind energy projects, the characteristics of sounds emitted by industrial scale wind turbines, and my understanding of human response to noise with respect to how those sounds have affected people living in the footprint of wind energy utilities, will offer contrast to the testimony of the applicant's experts previously filed and as presented in oral testimony during the past few weeks.

The reports and responses to information requests that I have prepared go into considerable detail regarding the basis for my conclusion that the BluEarth project, as currently proposed, has significant potential to adversely affect the people who live within at least 2 km of the project. This is not a new opinion. It was first formulated and published in 2008, in a whitepaper co-authored with Mr. George Kamperman, a senior acoustician whose career spans 65 years with a focus on community noise. That paper was titled: "The 'How To' Guide to Siting Wind Turbines to Prevent Health Risks from Sound."

In that document we presented noise limits based on information that was available from literature including studies of wind turbines conducted in Canada, the EU, U.K. and from technical reports on wind turbine sound emissions provided by several of the manufacturer's. This research was concurrent with the study being conducted by Dr. Nina Pierpont that resulted in the report "Wind Turbine Syndrome." Dr. Pierpont's study participants had noise studies of their homes conducted by independent acousticians and she was kind enough to make those studies available for our research. The result of this work was the joint decision between Dr. Pierpont, Mr. Kamperman and myself that we would recommend that industrial scale wind turbines be set back from residential properties by at least 2 km. We also set 35 dBA (Leq) as the not-to-exceed sound level for audible sound (to prevent sleep disturbance at night) and, for quiet rural communities, 55 dBC (Leq) to address low frequency sounds that would be expected to be more problematic indoors than outdoors.

Since that time, much has been learned about the impact of industrial scale wind turbines on people living near them. Our recommendations of 2008 have been adapted in whole or part by many communities and have been updated to address noise characteristics of wind turbines such as blade swish and the shifting of the acoustic energy to lower frequencies that has

occurred as wind turbines have increased in size from the 1.5 MW models common in 2008 to the 2.5 MW and higher models currently being installed. The downward shift in acoustic energy has resulted in reducing the permitted dBC limit from 55 to 50 dBC. The updated criteria were included in the paper: Noise: WindFarms, by Shepherd, Hanning, and Thorne published in the 2012 edition of the Encyclopedia of Environmental Management.

The point is: even as early as 2008 there was sufficient information available to raise my concern that industrial scale wind turbines were a source of community noise that required stricter limits than other common community noise sources. Protective criteria were derived based on the distances reported for adverse health effects from the case-crossover study of Dr. Pierpont and on the sound level information upon which Mr. Kamperman and I based our recommendations in our 2008 document. Information from studies conducted since that time supports these early precautionary criteria.

My written testimony in the two reports critiquing the noise studies and models prepared for the project by Golder and Aercoustics reveal several deficiencies in the work of BluEarth's experts that can be summarized as:

1. Use of a general purpose sound propagation model (ISO 9613-2) that is not validated for wind turbine models and where the specific assumptions of the ISO methods are not met. The BluEarth experts claim that because the ISO method is used by others doing similar work that these deviations from the model's assumptions and validation are acceptable. It appears that the rational is that because others use it, it is acceptable for them to use it. Given that the ISO model, with most, if not all, of the same assumptions used by Golder and Aercoustics, is the 'industry standard,' one must ask: Does the track record of prior projects support this assumption?" Are there signs that the predictions may not represent what occurs when the project is operational?
   I am aware that the industry has sponsored several studies that report that the predicted sound levels from the models are accurate. Yet, I am also aware of studies by independent acousticians, plus my own experiences, that show that it is common for the sound levels at night to be 5 dBA or higher during weather and operational conditions common at night. These conditions are the ones that I assert are not accounted for in the studies for the BluEarth project using the ISO model and input data and assumptions following the 'industry standard". The studies and reports by acousticians not affiliated with or sponsored by the wind industry warrant substantially more weight because they are less subject to issues of 'group think' or confirmation bias. Further, this range of

difference has also been observed and reported by field staff for the Ontario, Ministry of Environment.

I have taken measurements of wind turbine noise at the homes of people who have filed complaints or are considering legal action. These show that complaint conditions tend to be 5 to 8 dBA higher than modeled. Thus, if the model predicted 40 dBA at a receptor, measurements under commonly occurring weather conditions (not considered in the ISO model) will be 45 to 48 dBA.

2. In the critical reviews of the noise models prepared for this hearing I list several reasons why the models developed according to the 'industry standard' methods will under predict the real world sound immissions. This includes: failure to adjust the sound power level of the wind turbines to account for the commonly occurring weather and wind conditions mentioned above, and failure to acknowledge that the use of the mean apparent sound power level without application of confidence limits results in predictions that are not scientifically correct.

   The testimony of BluEarth's acoustic experts has denied that these issues are important or even relevant. Yet, outside of that group, acousticians have traditionally applied sound propagation models using confidence limits to establish an upper bound and adjusted sound power of the noise sources to represent the conditions that are most likely to cause complaints.

3. These deviations from commonly accepted practice in modeling are further compounded by the assertion that if the model shows that at a particular receiving location the predicted sound level is only 0.1 or so below a limiting criterion that it can be relied on as some type of proof that there will not be an exceedance when operating.

   Models are not as accurate as measurements. Does one trust yesterday's weather forecast or the outdoor thermometer more? When sound is measured using the standard professional acoustical analyzers commonly used by my profession we know that there is always some measurement error. This is commonly expressed as the measurement value ± 1 dB for a Type 1 Precision instrument. How can the acousticians who developed the models of the BluEarth project claim that a predicted value 0.1 decibels below a criterion means that the project complies? What evidence is there that the model's accuracy is better than a tenth of a decibel? Why would acoustical experts even make such assertions?

4. All of the concerns above would be of little interest if the track record for projects already permitted and operating demonstrated that the people living in the footprint or around

the perimeter of a wind energy project with such narrow margins of compliance were not adversely affected by noise and that measurements of the wind turbine sounds during times associated with complaints showed that the models were accurate. However, that is not what is being reported.

While there are a number of wind energy projects that do not result in complaints, there is a long and growing history of complaints from people living in or near some industrial scale wind energy projects. This is being reported from locations around the world. It is not specific to any make or model of wind turbine and is not even limited to whether the wind turbines are mixed into the community versus located on a ridge or plateau at a distance from people's homes. There appears to be substantial evidence that the current process for permitting wind turbine projects is not working.

If the above is not enough to trigger the precautionary principle, then the newer research related to how wind turbines acoustic emissions are predominantly centered in the infra and very low frequencies should raise concerns above the threshold. As I explain in my 2012 paper on "wind Turbine Infrasound: Warning signs that went unheard" I demonstrate that the potential for wind turbine infrasound to cause annoyance and other adverse effects has been known since the early 1980's leading to over ten (10) years of research funded by US NASA/DOE. Studies by Dr. Neal Kelley demonstrated that low levels of pulsating tonal infrasound caused adverse reactions in test subjects. This research is generally denied by the wind industry and its acoustical experts. In a recent interview, Dr. Kelley now retired from a managerial position at the National Renewable Energy Laboratory (NREL), re-confirmed that the studies he conducted in the 1980's apply to the modern upwind wind turbine designs in use today. He challenged acousticians to install infrasound measurement instruments inside homes if they doubted his opinion.

As I discuss later, that has been done and infrasound, distinct from naturally occurring background infrasound has been found in homes around the world. A paper recently accepted for publication in JASA by my Ontario colleague, Andy Metalka, shows that the blade pass tones and harmonics from a large wind utility using wind turbines if 2+Mw capacity and larger are clearly distinguishable at distances of 10 km when measurements are taken downwind of the project.

Dr. Alec Salt and his colleagues have added to our knowledge of how infrasound is processed in the inner ear. Since the early research papers in 2010 to his presentation at the New York 2012 Noise Con he has used his research on animal test subjects to further demonstrate that

infrasound is processed by our inner ear at sound pressure levels as much as 30 dB below the Threshold of Audibility that Dr. Leventhall uses as his threshold for adverse effects.

More recent publications by professionals in related fields such as the paper by Dr. Michael Persinger: "Infrasound, Human health, and adaptation: an integrative overview of recondite hazards in a complex environment," Nat. Hazards, 2013 have added new perspectives to our understanding of how people respond to infrasound.

A new paper co-authored by Salt, Bray, James, and Lichtenhan titled: "Consequences of inner ear stimulation by infrasound and their relevance to the possible health effects of wind turbines" is currently being revised to respond to peer reviewers' suggestions. This paper will add more to the understanding of how infrasound causes the reported adverse symptoms and health effects.

Also in late 2010, Mr. Wade Bray and I conducted field tests of a 1.5 MW wind turbine in Michigan's Huron County, Michigan Wind I project. We conducted the analysis using methods different from the standard sound analyzers used in other infrasound studies. The analysis focused on the micro-time structure of the wind turbine sound emissions instead of average sound pressure levels in 1/3 octave bands as done for other studies. Our findings were reported at the 2011 Noise-Con, Portland OR. USA in a paper titled: "Dynamic measurement of WT noise considering time and frequency of human perception". We demonstrated that the infrasound received at the exterior of a home approximately 460 m. from the closest wind turbine, not only was present, but during some periods was at or above the Threshold of Audibility for the 10% most sensitive listeners. The study showed that the primary energy was at the blade pass frequency which for this wind turbine rotating at 20 rpm was 1 Hz. It was dominated by tones at that frequency and the harmonics of the blade pass frequency.

Other studies since that time have confirmed our findings. This includes the Wisconsin Public Service Commission's study known as the Shirley Wind Team Report which I included with my filed testimony. That study found infrasound from the 2.5 MW wind turbines installed at that project was dominate at 0.7 Hz (and its harmonics) and that it was also tonal with strong pulsations. The Team Report used standard instrumentation to analyze the audio files from that study, not the advanced methods used by Mr. Bray and myself for our Noise-Con paper. This resulted in the findings being presented as average (Leq) sound pressure levels which did not reveal the high dynamic range of the tones.

The background on that study is that the homes that were tested belong to people who are my clients. Thus, a condition of the test submitted by the home owners was that Mr. Bray and I would be provided a copy of all of the test data and the operating data for the wind turbines

(SCADA) data for analysis using the methods of the Noise-Con paper. In short, our analysis was presented as written and oral testimony to the Wisconsin PSC and was not part of the Team Report. I add this as a correction to the mischaracterization of my involvement in the Shirley study provided by Dr. Leventhall in during his cross-examination.

What we found was that the crests (peaks) of the tones were at or above the Threshold of Audibility at the two closest homes (R1 at 1067 m. and R2 at 335 m.). They were also routinely 10 dB above the sound pressure levels Dr. Swinbanks reports in his 2012 Noise-Con paper as triggering adverse reactions from people subjected to complex infrasound. The wind turbine sounds were found to be clearly tonal at the closest test home (R2) but due to manipulation of the wind turbines by the utility operator, they were not as clearly defined at the more distant home (R1) as they were at R2. The analysis did find tones at R1 but they would not have been observed using other analytical methods that did not have the fine time resolution of our method.

Some have speculated that the Shirley study found no infrasound from the wind turbines in measurements at R1. However, those who raise such questions cannot explain what would cause the tonal infrasound that was observed at R2 to vanish by the time it has propagated only a few hundred meters to R1. Infrasound does not decay as readily as sounds at higher frequencies, indeed it propagates much further. Thus, if it was present at the closest test home, it was present at the others. It may not have been clearly tonal because of operating conditions or due to there being multiple wind turbines downwind of this home such that the mixed signal from the combination was not as clearly tonal. Subsequent tests using micro-barometers which are sensitive only to infrasound (0.1 to 20 Hz) have confirmed that the tones observed at R1 by the Study Team exist in homes throughout the community out to distances of three miles or more from the nearest wind turbine.

Dr. Paul Schomer, one of the Team members for the Shirley study, presented a paper at the 2013 Wind Turbine Noise conference in Denver, CO, USA that was discussed at some length in the oral testimony of Dr. Leventhall. While, Dr. Leventhall may have a different opinion than Dr. Schomer, there are many acousticians who find Dr. Schomer's recent work to be a breakthrough in linking the symptoms being reported by people around the world to the characteristics of wind turbine infrasound emissions. Another paper at the Denver conference confirming the emission of infrasound was presented by Steve Cooper, an Australian acoustician. This paper was titled: "The Measurement of Infrasound and Low Frequency Noise for Wind Farms." Mr. Cooper has duplicated the studies of Bray/James and the Shirley Team Report and has found

similar infrasound emissions that he has associated with symptoms of vestibular disturbance such as nausea and motion sickness.

The trends are clearly moving in the direction of support by both medical and acoustical research that modern upwind horizontal axis wind turbines, especially the larger, higher capacity models with slower hub rotational speeds have a significant potential to cause adverse impacts on the people who live near or in the project footprints. Evidence of these effects has been reported by studies published in peer reviewed papers from researchers in Europe, U.K., New Zealand, Australia, Ontario and the US. This research spans the health effects from sleep disturbance to the group of symptoms collectively called Wind Turbine Syndrome.

The acoustical experts who work closely with the wind energy utility developers continue to conduct noise impact assessments and sound propagation models using the same assumptions that were applied to prior projects now known to cause problems for some of the people in the community. There has been no attempt to revise methods or in any visible way to address what I would call past failures. It is often the case that engineers learn from their mistakes. Our first bridge might fall down because of design failures but eventually engineers learn how to design a bridge that is safe and functional. Each new project is a slight improvement upon the prior projects until the problems have been worked out and new projects result in successful outcomes. However, there is no indication that this is occurring in general when it comes to wind utility permitting documents whether in Alberta, Ontario, the US or elsewhere. My review and critiques of the acoustical work done for the BluEarth project finds that it there are no signs of this type of learning curve in the documents submitted on BluEarth's behalf.

Comments on New Evidence from Oral Testimony

There were a number of comments made during the testimony of BluEarth's acoustical experts, especially Drs. Leventhall and Ashtiani that deserve to be explored in more depth. A partial list of these is provided below. It is hoped that there will be an opportunity for me to provide my opinions and insights into them during my oral testimony.

Leventhall

1. There is a large difference in the way that Dr. Leventhall characterizes the noise emissions of modern wind turbines in his testimony and what has been reported in the studies mentioned above and my own personal measurements. This spans the range from how he characterizes wind turbine infrasound and how he characterizes the more audible sounds such as blade swish.

2. With respect to other forms of infra and low frequency noise syndrome Dr. Leventhall's testimony mischaracterized the work done for ASHRAE to identify the cause(s) of noise induced Sick Building Syndrome. In the 1997 JASA paper co-authored by Kirsten Persson Waye, Rylander and Leventhall, the results of some of the ASHRAE research are presented. While the overt focus of this study was on "productivity" and the impact of modulated low frequency sound on productivity, when one reads the descriptions of the reactions of the test subjects it is clear that the reason productivity was affected is because the test subjects (and by extension workers in Sick Buildings) felt ill. As stated in the JASA paper: "Some of the symptoms that are related to exposure to low frequency noise such as mental tiredness, lack of concentration, and headache related symptoms could be associated with a reduced performance and work satisfaction." The symptoms fit the symptom list for Wind Turbine Syndrome if one accounts for the lower exposure of workers (eight hours per day) versus people at home (24 hours a day). Further, my review of memos between Dr. Leventhall and the ASHRAE project managers shows that the pulsations in some of the buildings were below 10 Hz, in other works in the infrasound range.

   While Dr. Leventhall might wish to focus on the differences between noise induced sick building syndrome and wind turbine syndrome, it is the similarities that are most important. One might go so far as to conclude that Wind Turbine Syndrome is really Sick Building Syndrome. The difference being that the rotating air equipment producing the pulsating infra and low frequency sound are outside the home (wind turbines) instead of in the air handling room (HVAC fans).

3. Dr. Leventhall's position seems to be fixed on the assumption that infrasound cannot be perceived unless it exceeds the threshold of audibility. The works of Salt, Swinbanks, Schomer and others showing that for complex sounds, especially pulsatile tones perception occurs at lower sound pressure levels does not seem to sway him from that position. His position appears to be that complaints from people around the world, many who have never read anything about wind turbine syndrome and who welcomed wind turbines to their communities, do not have a physical basis. Thus, he purports that they are a NOCEBO effect, or some other type of psychological process. This position has caused many other acousticians to conclude that if they find wind turbine infrasound at sound pressure levels below the Threshold of Audibility that they can also discount complaints. As the acousticians who conducted the Shirley Wind noise study concluded in their Team Report:

> The four investigating firms are of the opinion that enough evidence and hypotheses have been given herein to classify LFN and infrasound as a serious issue, possibly affecting the future of the industry. It should be addressed beyond the present practice of showing that wind turbine levels are magnitudes below the threshold of hearing at low frequencies." (Emphasis added)

Indeed, in my opinion, it is time to move beyond the limiting views of Dr. Leventhall and others who cling to the hope that the symptoms are all in the minds of the people and that given enough time they will learn to cope with their problems.

Ashtiani

1. Mr. Ashtiani adheres to the industry standard of not applying confidence limits to his models. While this is covered in my written testimony critiquing the models prepared by Golder and Aercoustics it is worth revisiting his oral testimony on this issue.
2. Mr. Ashtiani adopts the same position as Dr. Leventhall regarding infrasound below the Threshold of Audibility. While it may be that Mr. Ashtiani has arrived at this conclusion independently, it is possible that he is merely accepting Dr. Leventhall's opinion and has no basis other than his belief that Dr. Leventhall is correct.
3. Mr. Ashtiani believes that there is no need to make adjustments to the reported apparent sound power level used in the BluEarth models to account for differences in sound emissions during operating conditions not present during the IEC 61400-11 measurements. The term “apparent mean sound power level” is not seen as a caution about its accuracy even for the measurement conditions. In 1971, my undergraduate thesis was on calculation of the sound power level of large industrial machines that had to be tested in a manner similar to the IEC 61400-11 procedure for wind turbines. In that thesis I used the phrase "apparent sound power level" to distinguish between the lower quality sound power levels derived from in-situ testing and the higher quality sound power level that would be obtained if the machine was relocated to a reverberant of anechoic chamber where the sound power could be more accurately measured. I do not know if there was prior usage, but I do know that my thesis advisor required that I distinguish between the high quality sound power levels derived from tests standardized by ANSI and ISO requiring special facilities and the lower quality value derived from my in-situ test procedure. Mr. Ashtiani goes so far as to opine that the IEC method derives

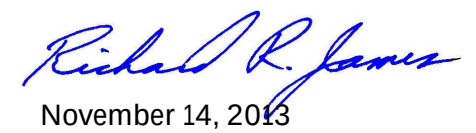
higher quality sound power levels than the ISO and ANSI procedures. Well, if so, then why does IEC call it “apparent”?

4. Mr. Ashtiani also seems to be oblivious to my critique of the various assumptions of the ISO 9613-1 sound propagation model that are exceeded when the model is used to predict noise from wind turbines. This defies logic. If a model has been validated for a limited set of conditions and that model is used to predict the sound levels at distances from wind turbines that exceed the validation distance and the noise source elevations, it is reasonable to conclude that whatever the range of confidence levels was for models meeting all assumptions that when those assumptions are not met the potential for error can only be greater. Yet, in reviewing Mr. Ashtiani's oral testimony and his responses to my critique of his model, it appears that this does not enter into his opinion about model accuracy. He openly admits that the assumptions of the ISO model are not met, yet he still has no issues with presenting model results without confidence limits (margins of error) purporting to have a precision of 0.1 dB.

I would like to continue with comments on the testimony of other BluEarth experts, Dr. McCunney, Dr. Ollson, and Mr. Da Silva. But, I recognize that my time is too short to cover all of the concerns that I had while listening to the testimony and/or reading the transcripts. To get on with the oral examination I welcome any questions by the examining attorney that may arise about comments and opinions of the other experts.

I now close my Witness Statement.

Richard R. James, INCE



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