Ex. A9

BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF SOUTH DAKOTA

IN THE MATTER OF THE APPLICATION BY DEUEL HARVEST WIND ENERGY LLC FOR ENERGY FACILITY PERMITS OF A WIND ENERGY FACILITY AND A 345-KV TRANSMISSION LINE IN DEUEL COUNTY, SOUTH DAKOTA FOR THE DEUEL HARVEST NORTH WIND FARM

SD PUC DOCKET EL18-053

PRE-FILED SUPPLEMENTAL DIRECT TESTIMONY OF MICHAEL HANKARD
ON BEHALF OF DEUEL HARVEST WIND ENERGY LLC

February 14, 2019

I. INTRODUCTION

Q. Please state your name and business address.

A. My name is Mike Hankard. I am the president and principal of Hankard Environmental, Inc. ("Hankard Environmental"). My business address is 211 East Verona Avenue, Verona, Wisconsin 53593.

Q. Did you provide Direct Testimony in this docket on October 26, 2018?

A. Yes.

II. PURPOSE AND OVERVIEW OF TESTIMONY.

Q. What is the purpose of your Supplemental Direct Testimony?

A. I am providing Supplemental Direct Testimony to support a sound condition that would limit sound from the turbines at any non-participating residence to 45 dBA L_{eq} and at any participating residence to 50 dBA $L_{eq.}$ Such a condition would be consistent with the South Dakota Public Utilities Commission's ("Commission") decision in the Dakota Range I and II docket, EL18-003, the Crocker docket, EL17-055, Deuel County requirements, and is a reasonable regulatory limit.

Q. Please state the sound condition that Deuel Harvest Wind is proposing.

A. As Mr. Svedeman testifies, Deuel Harvest generally supports the following sound condition, which was previously imposed by the Commission as Condition No. 27 in Dakota Range I and II:

> The Project, exclusive of all unrelated background noise, shall not generate a long-term average sound pressure level (equivalent continuous sound level, L_{eq}), as measured over a period of at least two weeks, defined by Commission staff, that includes all integer wind speeds from cut in to full power, of more than 45 dBA within 25 feet [of] any non-participating residence or more than 50 dBA within 25 feet [of] any

participating residence. [Dakota Range I and II] shall, upon Commission formal request, conduct field surveys or provide post-construction monitoring data verifying compliance with specified noise level limits using applicable American National Standards Institute (ANSI) methods[.] If the long-term average level exceeds 45 dBA at any non-participating residence or 50 dBA at any participating residence, then the Project Owner shall take whatever steps are necessary in accordance with prudent operating standards to rectify the situation. Sound monitoring will not be repeated in a representative area during any five-year period unless operational or maintenance changes result in a reasonable assumption of higher turbine sound levels.

Q. Do you have any clarifications that you feel are necessary regarding the above condition?

A. Yes. The condition seems to indicate that the measured noise level to be reported is the L_{eq} over a two-week period. In other words, the L_{eq} (i.e. average) of noise levels measured over the course of the entire two weeks. I believe the intent of the condition is to measure for two weeks. However, in my experience, and also in keeping with applicable acoustic standards, one measures on a one-hour basis (for example) and only analyzes those hours when (1) all turbines near a measurement location are operating at full acoustic output (about 80% of full power or greater), and (2) simultaneously the ground-level wind speed is 5 m/s or less. Furthermore, many other hours are typically discarded due to too much influence by noise from other sources, such as the wind, traffic, etc. Therefore, compliance is generally determined on the basis of a few to a few dozen “valid” one-hour periods. Thus, I would interpret the condition as requiring the L_{eq} of the valid one-hour samples to be less than the noise level limits contained in the condition.

III. SOUND POWER LEVEL

Q. Why do you believe it is appropriate for the Project to have sound limits of 45 dBA L_{eq} at non-participating residences and a 50 dBA L_{eq} at participating residences?

A. First, the 45 dBA L_{eq} limit is a reasonable regulatory standard for non-participating landowners based on what I have seen used in other counties and states across the United States. In fact, until recently, a majority of wind projects in the United States were permitted using a standard of 50 dBA for all residences. This is true in many states (Minnesota, Illinois, Colorado, and North Dakota) and at the local level (Iowa, Nebraska, and Indiana). While 50 dBA is still in common use, some states and local governments apply a 45 dBA standard at non-participating residences (Wisconsin, New York, and Deuel County).

Second, these sound limits comply with the Deuel County Zoning Ordinance, Section 1215(13), which sets the following limit at non-participating residences:

> Noise levels shall not exceed 45 dBA average A-weighted Sound pressure at the perimeter of existing residences, for non-participating residences.

The 45 dBA limit for non-participating residences was established in Deuel County through a recent and exhaustive zoning amendment process in which I participated. Deuel Harvest is voluntarily committing to a 50 dBA limit at participating residences. Deuel Harvest used the 45 dBA standard and voluntary 50 dBA limit to develop the turbine locations proposed in this docket.

Third, the 45 dBA limit at non-participating residences and 50 dBA at participating residences is a regulatory limit the Commission has applied in past dockets, including Dakota Range I and II, EL18-003 and Crocker, EL17-055.

Fourth, limits below 45 dBA L_{eq} also presents compliance challenges. This is because it is not technically feasible to measure the noise from a source when background noise levels are equal to or greater than that of the source. In fact,

ANSI S12.9 Part 3 requires the background noise level to be at least 3 dB lower than that of the source to undertake measurements. The primary background noise of concern is that of the wind. Even a light breeze will produce levels in the 40 dBA range. In fact, in a strong wind noise from the wind in the vegetation can be as high as 55 dBA. In this sense a majority of the time it will be technically infeasible to directly measure the noise from wind turbines at a level of 40 dBA or less.

Therefore, determining compliance with a dBA standard below 45 dBA would require completely calm conditions, and these conditions do not often present themselves when the turbines are producing full power (which is the condition of concern). Thus, a developer would need to monitor over a very long time (possibly as long as a month) until conditions presented themselves such that the turbines are operating at or near full capacity, while wind speeds on the ground are very, very low (almost dead calm). This condition can occur, when ground winds are almost completely calm but those at hub-height are strong, but it does not happen often.

I note that also, as Mr. Michael Svedeman describes in his Supplemental Testimony, sound was just one constraint that had to be met to design the layout for the Project. This means that the sound levels could not be decreased by simply increasing the setbacks from residences because this may impact other constraints, such as sound levels at other residences, environmental, shadow flicker, and other setbacks.

IV. SOUND METRICS

Q. Which sound metric is included in wind industry measurement standards?

A. There are three applicable standards, one for each of three steps in the prediction and measurement of noise from wind turbines. Each standard specifies the use of the L_{eq}.

First, wind turbine manufacturers follow IEC 61400-11 to measure turbine noise emissions close to the turbine, which I described in my direct testimony, pages 4-5.

This standard results in a sound power level, which is the quantity reported by the manufacturers to tell prospective buyers the noise level from an individual turbine.

Second, developers of wind turbine projects, or the acoustical consultant they hire, use ISO 9613-2 to predict noise levels from the project as a whole, which typically consist of multiple turbines placed at various distances from receptors. This standard too predicts a L_{eq}, and uses as its primary input L_{eq}-based power levels.

Third, the standard most commonly used to measure wind turbine noise (ANSI S12.9 Part 3), also specifies the measurement of the L_{eq}. In most cases, the ultimate goal of the measurements is to determine how loud the wind turbines are on a 10-minute or one-hour basis. However, in practice it is rare to get a full 10-minute or one-hour time period where the only audible sound is that from the turbines. Therefore, the ANSI S12.9 Part 3 standard prescribes a method for determining turbine-only noise. One first measures noise levels in very short time intervals, such as 10 seconds. This data is then reviewed, and time intervals containing non-turbine noise, such as a wind gust, are removed from the analysis. The 10-minute or one-hour average noise levels are then calculated with the remaining 10-second samples containing only wind turbine noise.

Other acoustical standards, such as ISO 1996-1 (description, measurement and assessment of environmental noise), recommend the use of the L_{eq} for continuous sources of sound (such as wind turbines).

Q. What are the L_{10} and other "statistical metrics" used for in acoustical assessments?

A. In acoustics, "statistical levels" are the percentage of time the fluctuating sound level exceeds a specified level in a specified time frame. Commonly use time frames include one hour and ten minutes. The level exceeded 10% of the time, the L_{10}, represents the higher, sporadic noise levels that occur in the interval, such as wind gusts. It is most often used in traffic noise analyses or in the analysis of other highly

variable noise sources. The relatively constant sound emitted by wind turbines, when fully operational, is best measured by the L_{90} or L_{eq} sound level metrics. The L90, the level exceeded 90% of the interval, is commonly used to assess the constantly occurring sound level in an environment. Again, during a one-hour or 10-minute period of full operation, noise from wind turbines is relatively constant. The L_{eq} is the "energy average" sound level and is the metric preferred by wind turbine-related acoustical standards.

Q. Do you believe that the L_{10} metric is appropriate for wind turbines?

A. No.

Q. Please summarize the reasons you conclude that the L_{10} metric is not appropriate for wind turbines.

A. The L_{10} metric is not the appropriate acoustical metric to apply for three reasons:

1) The L_{10} is typically applied to sources of transient noise, such as highways, where there is a significant fluctuation in the noise level (e.g., very loud when a truck goes by, and almost silent when no traffic is present). Wind turbines, when operating near or at full power (which is the condition of interest in noise compliance studies), emit a relatively continuous noise. Continuous noise sources are best quantified using the L_{eq}, which is suitable for use on a wide range of environmental noise sources and is by far the most commonly used metric by environmental acoustics professionals, noise standards, regulations, and ordinances for wind turbine projects, highways and airports, and regulations and ordinances.

2) The primary challenge in conducting wind turbine noise compliance surveys is separating the relatively constant wind turbine noise from the time-varying noise made by all other noise sources in the environment, which is primarily that of the wind blowing through nearby vegetation, but also that produced by passing vehicles, barking dogs, etc. Because the L_{10} represents

the highest noise levels measured over a time interval, it better quantifies the non-turbine intermittent noise in the background than it does the constant noise from the wind turbines.

3) A majority of the acoustic standards applicable to wind turbine projects quantify noise using the L_{eq} metric. Manufacturers quantify noise from turbines using the L_{eq}, propagation models specify the L_{eq}, as so do environmental noise measurement standards. The primary method of measuring compliance and of separating turbine and non-turbine noise, using ANSI S12.9 Part 3, is designed to be used with the L_{eq}.

Q. Are there any other concerns you have about measurements with respect to the L_{10} metric?

A. Yes. In the Dakota Range I and II sound condition, the measurements are to be made "exclusive of all unrelated background noise." As I noted, due to what the L_{10} metric is specifically intended to measure, the L_{10} tends to represent the background noise rather than turbine noise and therefore using the L_{10} would be problematic.

V. CONCLUSION

Q. Does this conclude your Supplemental Direct Testimony?

A. Yes.

Dated this14th day of February, 2019.

Michael Hankard

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