

**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

1 **I. INTRODUCTION**

2

3 **Q. Please state your name and business address.**

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

7

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

9 A. Yes.

10

11 **II. PURPOSE AND OVERVIEW OF TESTIMONY.**

12

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

14 A. I am providing Supplemental Direct Testimony to support a sound condition that
15 would limit sound from the turbines at any non-participating residence to 45 dBA L_{eq}
16 and at any participating residence to 50 dBA L_{eq} . Such a condition would be
17 consistent with the South Dakota Public Utilities Commission’s (“Commission”)
18 decision in the Dakota Range I and II docket, EL18-003, the Crocker docket, EL17-
19 055, Deuel County requirements, and is a reasonable regulatory limit.

20

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

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

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

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

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

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

60
61 **III. SOUND POWER LEVEL**

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

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

74

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

77

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

81

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

87

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

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

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

100
101 Therefore, determining compliance with a dBA standard below 45 dBA would require
102 completely calm conditions, and these conditions do not often present themselves
103 when the turbines are producing full power (which is the condition of concern).
104 Thus, a developer would need to monitor over a very long time (possibly as long as
105 a month) until conditions presented themselves such that the turbines are operating
106 at or near full capacity, while wind speeds on the ground are very, very low (almost
107 dead calm). This condition can occur, when ground winds are almost completely
108 calm but those at hub-height are strong, but it does not happen often.

109
110 I note that also, as Mr. Michael Svedeman describes in his Supplemental Testimony,
111 sound was just one constraint that had to be met to design the layout for the Project.
112 This means that the sound levels could not be decreased by simply increasing the
113 setbacks from residences because this may impact other constraints, such as sound
114 levels at other residences, environmental, shadow flicker, and other setbacks.

115 116 **IV. SOUND METRICS**

117 118 **Q. Which sound metric is included in wind industry measurement standards?**

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

122
123 First, wind turbine manufacturers follow IEC 61400-11 to measure turbine noise
124 emissions close to the turbine, which I described in my direct testimony, pages 4-5.

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

127
128 Second, developers of wind turbine projects, or the acoustical consultant they hire,
129 use ISO 9613-2 to predict noise levels from the project as a whole, which typically
130 consist of multiple turbines placed at various distances from receptors. This
131 standard too predicts a L_{eq} , and uses as its primary input L_{eq} -based power levels.

132
133 Third, the standard most commonly used to measure wind turbine noise (ANSI
134 S12.9 Part 3), also specifies the measurement of the L_{eq} . In most cases, the
135 ultimate goal of the measurements is to determine how loud the wind turbines are on
136 a 10-minute or one-hour basis. However, in practice it is rare to get a full 10-minute
137 or one-hour time period where the only audible sound is that from the turbines.
138 Therefore, the ANSI S12.9 Part 3 standard prescribes a method for determining
139 turbine-only noise. One first measures noise levels in very short time intervals, such
140 as 10 seconds. This data is then reviewed, and time intervals containing non-turbine
141 noise, such as a wind gust, are removed from the analysis. The 10-minute or one-
142 hour average noise levels are then calculated with the remaining 10-second samples
143 containing only wind turbine noise.

144
145 Other acoustical standards, such as ISO 1996-1 (description, measurement and
146 assessment of environmental noise), recommend the use of the L_{eq} for continuous
147 sources of sound (such as wind turbines).

148
149 **Q. What are the L_{10} and other “statistical metrics” used for in acoustical**
150 **assessments?**

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

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

163

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

165 A. No.

166

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

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

170

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

181

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

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

190
191 3) A majority of the acoustic standards applicable to wind turbine projects
192 quantify noise using the L_{eq} metric. Manufacturers quantify noise from
193 turbines using the L_{eq} , propagation models specify the L_{eq} , as so do
194 environmental noise measurement standards. The primary method of
195 measuring compliance and of separating turbine and non-turbine noise, using
196 ANSI S12.9 Part 3, is designed to be used with the L_{eq} .

197
198 **Q. Are there any other concerns you have about measurements with respect to**
199 **the L_{10} metric?**

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

204
205
206 **V. CONCLUSION**

207
208 **Q. Does this conclude your Supplemental Direct Testimony?**

209 A. Yes.

210
211 Dated this 14th day of February, 2019.

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215 _____
216 Michael Hankard

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