

BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF SOUTH DAKOTA

IN THE MATTER OF THE)
APPLICATION BY CROCKER WIND)
FARM, LLC FOR A PERMIT OF A)
WIND ENERGY FACILITY AND A 345)
KV TRANSMISSION LINE IN CLARK)
COUNTY, SOUTH DAKOTA, FOR)
CROCKER WIND FARM)

EL 17-028

DIRECT TESTIMONY OF

MICHAEL P. MORRIS

ON BEHALF OF

CROCKER WIND FARM, LLC

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1 **Q. Please state your name and business address for the record.**

2 A. My name is Michael Morris. My business address is 7650 Edinborough Way, Suite 725,
3 Edina, MN 55436.

4 **Q. Can you briefly describe your education and experience?**

5 A. I have B.S. (2006) and M.S. (2008) degrees in Meteorology from the University of
6 Oklahoma. I have been working in the renewable energy industry since 2008, and have been
7 responsible for siting, design, and resource assessment activities for over 5,000 megawatts of
8 projects in 8 states.

9 **Q. Have you attached a resume or CV.**

10 A. Yes

11 **Q. Have you previously submitted or prepared testimony in this proceeding in South
12 Dakota?**

13 A. No

14 **Q. What is the purpose of your direct testimony?**

15 A. I am testifying in support of the turbine siting and technology aspects of the project.

16 **Q. Which sections of the application are you responsible for?**

17 A. I contributed to the following sections:

- 18 • Section 8.1 – Wind Farm Facility
- 19 • Section 8.2 – Wind Turbine Generators
- 20 • Section 8.3 – Wind Turbine Towers
- 21 • Section 8.5 – Generator Step-up Transformers
- 22 • Section 8.8 – Meteorological Towers and Sodar Units
- 23 • Section 15.4.1 – Existing Visual Resources – Wind Farm and Transmission Line

- 24 • Section 15.5.5 – Shadow Flicker Impacts – Wind Farm
- 25 • Section 24.1 - Reliability
- 26 • Appendix E – Crocker Wind Farm Shadow Flicker Assessment

27 **Q. Describe the information presented in Section 8.1 – Wind Farm Facility**

28 **A:** Section 8.1 summarizes the geographical and environmental characteristics of the project
29 area, and the types of facilities which are expected to be installed. In particular, I authored
30 paragraph 2 of this section, which discusses the regional wind resource characteristics. The
31 information presented in this section demonstrates that the area chosen for the Crocker Wind
32 Farm is very suitable for wind energy development both from a productivity and environmental
33 standpoint.

34 **Q. Describe the information presented in Section 8.2 – Wind Turbine Generators.**

35 **A:** Section 8.2 describes the dimensions and major components of a series of wind turbine
36 models being considered for this project. The dimensions and design are generally consistent
37 with utility-scale wind turbines installed in South Dakota and elsewhere. The platforms
38 described in the application are among some of the most widely deployed in the U.S. market and
39 are considered the best match for the wind resource and terrain conditions at the site.

40 **Q: Section 8.2: Why are there four turbine models under consideration? When will a**
41 **turbine be selected?**

42 **A:** The four turbines in the application represent a broad spectrum of possible dimensions
43 available with current technology. This allows us to demonstrate that the range of impacts will
44 be similar regardless of the turbine chosen. We expect to begin the turbine selection process in
45 the summer/fall of 2018 with a final decision made in late 2018 or early 2019.

46 **Q. Describe the information presented in Section 8.3 – Wind Turbine Towers**

47 A. Section 8.3 describes the visual and engineering properties of the towers supporting the
48 hub and nacelle of the wind turbines. Towers will be painted white or off-white so as not to be
49 visually obtrusive (to be contrasted with regional practices in Europe or Canada where
50 alternating red rings are sometimes required). The towers will be generally cylindrical rolled
51 steel (i.e. they will not be lattice structures) with a base width of 12 to 14 feet.

52 **Q. Describe the information presented in Section 8.5 – Generator Step-up**
53 **Transformers**

54 A: Section 8.5 describes the transformer used to increase the voltage of the electricity
55 coming out of the generator (typically 690 volts) to the nominal collection system voltage
56 (34,500 volts). The transformers will be internal to the tower for three of the turbine models
57 under consideration, and would require a small additional disturbed area at the base of the tower
58 to accommodate an external transformer if the GE 2.5-116 is selected.

59 **Q. Describe the information presented in Section 8.8 – Meteorological Towers and**
60 **Sodar Units.**

61 A. Section 8.8 describes the types of monitoring devices that may be deployed at the project.
62 These will be used to study the performance of the wind farm and ensure compliance with
63 warranty conditions. The meteorological towers will allow for measurement of wind speed,
64 direction, temperature, and pressure at the hub height for comparison to warranted power
65 performance. SODAR units are able to measure past hub height, and in many cases through the
66 entire rotor disk, which can reveal the presence of wind speed and direction gradients otherwise
67 not sampled by the meteorological tower that can affect performance of the turbines.

68 **Q. Describe the information presented in Section 15.4.1 – Existing Visual Resources –**
69 **Wind Farm and Transmission Line**

70 A. Section 15.4.4 describes environmental features / phenomena which affect the
71 occurrences of shadow flicker, and outlines assumptions used in the shadow flicker study. In
72 particular, we have used a wind direction distribution based on 7+ years of wind data collected at
73 the site, and cloud cover frequency data from the NWS ASOS station at Huron, South Dakota.
74 Table 15.4 presents the wind direction distribution at the project, indicating predominant
75 northwesterly and southerly wind which is typical of this region. In particular, the prevailing
76 wind tends to be from the northwest in the cold season and from the south in the warm season.
77 Table 15.5 presents the historical probability of sunshine (i.e. the percent of hours in which no
78 clouds were recorded) at the Huron, South Dakota airport for the period between 1956 and 1983.
79 Of the stations in the NCDC database (available electronically at
80 <https://www1.ncdc.noaa.gov/pub/data/ccd-data/pctpos15.dat>), Huron is the best combination of
81 representativeness and data record length. Other stations considered were Aberdeen, South
82 Dakota, and Sioux Falls, South Dakota but these stations only offered 1 and 3 years of data,
83 respectively. Rapid City, South Dakota was not considered due to the distance from the site.
84 These two factors put together determine the likelihood of shadow flicker occurring – wind
85 direction affects the orientation of the turbine relative to the sun, and the sunshine probability
86 affects whether or not direct sunlight is available to cast a shadow.

87 **Q. Describe the information presented in Section 15.5.5 – Shadow Flicker Impacts –**
88 **Wind Farm**

89 A. Section 15.5.5 presents the shadow flicker modeling results for participating and non-
90 participating residences in and near the project. We have modeled a ‘worst case’ - in which all
91 turbines are operating all the time, and oriented such that the turbine is perpendicular to the axis
92 between the sun and the receptor – and a ‘real case’ which incorporates the wind direction and

93 sunshine probabilities presented in Tables 15.4 and 15.5. For each turbine model, we have
94 presented the highest individual receptor value ('Max') and the average across all receptors
95 ('Avg') for both the worst case and the real case. We have further subdivided the results by
96 participating and non-participating receptors in order to demonstrate that the shadow flicker
97 impacts to non-participants will be below the commonly-accepted threshold for nuisances.
98 Though the model predicts higher impacts to participants, these impacts are being caused by
99 turbines on the landowner's property for which they are receiving compensation. We note that in
100 both worst case and real case the receptors are considered to be exposed in all directions to
101 sunlight and there is no consideration for trees or other shading obstacles near the receptors, so
102 the real case results are still somewhat conservative.

103 **Q: Section 15.5.5 – Can shadow flicker cause health issues like seizures?**

104 **A:** We are not aware of any peer-reviewed medical study which demonstrates a causative
105 link between shadow flicker and seizures.

106 **Q: What will be done if flicker concerns are reported to Crocker?**

107 **A:** If shadow flicker concerns are reported, we will evaluate the operating data during the
108 period in question to determine if the turbines were running and weather conditions were in a
109 state that would give rise to shadow flicker. If it is determined that shadow flicker was likely
110 occurring at that time, we would work with the community member reporting the impact to
111 mitigate, likely by installation of window shades or planting of trees/shrubs.

112 **Q. Describe the information presented in Section 24.1 – Reliability**

113 **A.** Section 24.1 states that we expect the wind turbines in the project to be available 97
114 percent of the time. This is a common warranty level offered by turbine vendors for projects in
115 the United States. In particular, turbine vendors seek to perform scheduled services during

116 periods where wind speeds are low to minimize lost production and ensure safety of their crews.

117 **Describe the information presented in Appendix E – Crocker Wind Farm Shadow Flicker**
118 **Assessment**

119 A. Appendix E provides a detailed description of the shadow flicker model, the assumptions
120 used in the calculation, and provides detailed receptor-specific results.

121 **Q: Have you reviewed the list and map of proposed tower locations in the application?**

122 A: Yes

123 **Q: Do your comments and conclusions apply to each of those locations individually?**

124 A: Yes

125 **Q: Would your answers change for any of the locations?**

126 A: No

127 **Q: Do you have any specific concerns about moving tower locations?**

128 A: No, I expect any moves could be accommodated without increasing impacts above the
129 levels described in the application.

130 **Q: If the applicant later moved any tower locations, what would be the effects?**

131 A: Changes to the turbine locations would result in adjustments to the road and collection
132 system alignments, and may result in changes to the modeled levels of sound and shadow flicker
133 at receptors in and near the project. However, care would be taken to ensure that any moves
134 would not result in impacts beyond those described in the application.

135 **Q: Does this conclude your written pre-filed direct testimony?**

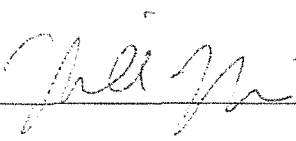
136 A: Yes

137

138 Dated this 26 day of September, 2017.

139

140



141 Michael P Morris

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