

MEMORANDUM

Date: April 17, 2020

To: Crowned Ridge Wind, LLC

From: Mr. Richard Lampeter, Epsilon Associates Inc.

Subject: **Crowned Ridge Wind – Sound Level Compliance Evaluation – Initial Findings**

Epsilon Associates, Inc. (Epsilon) is pleased to provide this memo summarizing the initial findings of the Crowned Ridge Wind (CRW) sound level compliance evaluation per the requirements identified in the “2020 Sound Level Measurement Program Protocol – Curtailed Operations” dated February 12, 2020 (2020 Protocol).

CRW is a 200-megawatt (MW) wind power generation facility composed of 87 General Electric (GE) wind turbines. All of the 87 wind turbines within the site are GE 2.3-116 units with a rotor diameter of 116 meters. Nine (9) GE 2.3-116 wind turbines have a hub height of 80 meters and 78 have a hub height of 90 meters. All wind turbines were proposed and permitted to have Low Noise Trailing Edge (LNTE) blades. Currently only eight (8) of the 87 wind turbines have LNTE blades installed. These wind turbines are all GE 2.3-116 units at a 90-meter hub height. A temporary curtailment program has been designed, through predictive sound level modeling by EAPC, to mitigate sound levels produced by the Project such that compliance is demonstrated until all wind turbines are equipped with LNTE blades. The plan includes curtailing (shutting down) select wind turbines when the wind speeds reach 6 m/s at hub height. A total of 16 wind turbines in the layout are being curtailed in this manner.

The measurement program was designed to fulfill the requirements with respect to pre-LNTE sound levels of the temporary waiver granted on January 9, 2020 and Condition 26 of the Final Decision.

Regulatory Requirements

Order Granting Temporary Waiver

In the matter of the application by Crowned Ridge Wind, LLC for a permit of a wind energy facility in Grant and Codrington Counties (EL 19-003) a temporary waiver was granted on January 9, 2020. This order included four (4) conditions as specified below:

- 1) The temporary waiver expires September 15, 2020;
- 2) Applicant shall file with the Commission beginning April 1, 2020, monthly progress reports explaining the status of the LNTE installation;
- 3) Applicant shall curtail 16 turbines at wind speeds above 6 meters per second in accordance with the sound model using a 0.3 ground attenuation factor; and
- 4) Applicant shall conduct post-construction sound compliance testing in accordance with Condition 26 of the Final Order during the Temporary Waiver period and again after the LNTEs are installed on all turbines.

Final Decision and Order Granting Permit to Construct Facility; Notice of Entry

CRW is subject to permit conditions per the “Final Decision and Order Granting Permit to Construct Facility; Notice of Entry” (Final Decision). Condition 26 pertains to sound level limits and monitoring methodologies. The language in Condition 26 defining sound level limits is the following:

The Project, exclusive of all unrelated background noise, shall not generate a sound pressure level (10-minute equivalent continuous sound level, Leq) of more than 45 dBA as measured within 25 feet of any non-participating residence unless the owner of the residence has signed a waiver, or more than 50 dBA (10-minute equivalent continuous sound level, Leq) within 25 feet of any participating residence unless the owner of the residence has signed a waiver. The Project Owner shall, upon Commission formal request, conduct field surveys and provide monitoring data verifying compliance with specified noise level limits. If the measured wind turbine noise level exceeds a limit set forth above, then the Project Owner shall take whatever steps are necessary in accordance with prudent operating standards to rectify the situation.

Sound level monitoring methodologies utilized in this program have been designed to abide by the procedures outlined in subparts a) through f) of Condition 26 in the Final Decision.

Codington County Ordinance

A section of CRW is within Codington County, SD and is subject to the following sound level requirements in Section 5.22.03(12) of Ordinance #65 Zoning Ordinance of Codington County, Noise subsection of General Provisions for Wind Energy Systems (WES):

Noise level generated by the wind energy system shall not exceed 50 dBA, average A-weighted Sound pressure level effects at the property line of existing non participating residences, businesses, and buildings owned and/or maintained by a governmental entity.

Noise level measurements shall be made with a sound level meter using the A-weighting scale, in accordance with standards promulgated by the American National Standards

Institute. An L90 measurement shall be used and have a measurement period no less than ten minutes unless otherwise specified by the Board of Adjustment.

A complaint has been issued by a residence in the vicinity of the Project to Codrington County. As part of this study, an evaluation of sound level compliance was made at the intervenor property line per the ordinance.

Sound Level Measurement Program

Broadband A-weighted (dBA) and one-third octave-band (dB) sound levels were measured at six (6) locations in the vicinity of the Project to collect post-construction sound level data. These locations are consistent with the six primary locations identified in the 2020 Protocol. The six locations are summarized below and shown in Figure 1.

- ◆ **Location 1:** Participating – Modeling Receptor CR1-C30-P
 - Modeled Project-Only Curtailment Sound Level = 50 dBA
 - Highest modeled receptor
- ◆ **Location 2:** Non-Participating – Modeling Receptor CR1-G68-NP
 - Modeled Project-Only Curtailment Sound Level = 43 dBA
- ◆ **Location 3:** Non-Participating – Modeling Receptor CR1-C41-NP
 - Modeled Project-Only Curtailment Sound Level = 44 dBA
- ◆ **Location 4:** Non-Participating – Modeling Receptor CR1-C34-NP
 - Modeled Project-Only Curtailment Sound Level = 45 dBA
 - Highest modeled Project-Only sound level at non-participating receptor
- ◆ **Location 5:** Non-Participating – Modeling Receptor CR1-C14-NP
 - Modeled Project-Only Curtailment Sound Level = 44 dBA
- ◆ **Location 6:** Non-Participating – Modeling Receptor CR1-C29-NP
 - Intervenor (Christianson)

The two-week sound level measurement program at these locations began on Wednesday, March 4, 2020 and ended on Wednesday, March 18, 2020.

Sound Level Evaluation

Methodology

The 'total' L_{eq} sound level (wind turbines + background) measured during each of at least 10 periods meeting the conditions specified in the Final Decision is compared to the wind energy facility limits. This is conservative since it includes both wind turbines plus background.

Background sound levels, either continuous or from sporadic loud events, can impact the total sound level. A review of the data and/or audio recordings is performed to remove extraneous events when necessary for the analysis of evaluation periods. If necessary, a representative background sound level is subtracted (on an energy basis) from the operational sound level to obtain the "wind turbine only" L_{eq} sound pressure level. This subtraction procedure is supported by ANSI S12.18. The "wind turbine only" sound pressure level is then compared to the wind energy facility limits.

In order to compare the measured sound data to the applicable sound pressure level limits, Epsilon evaluated the sound level data meeting the following criteria:

1. There is no precipitation during the measurement period.¹
2. The average ground level wind speed is 5 m/s (11.2 mph) or less.²
3. Operational condition - Closest five wind turbines that are not being curtailed are operating and the closest wind turbine is operating at maximum sound power (within 1.0 dBA). As the sound power determination cannot be made based on a comparison to wind turbine electrical output due to insufficient data on the EPCO operations, maximum electrical output, i.e. 2,300 kW, is necessary at the closest wind turbine.

Since the Commission's Final Order established a project-only sound threshold, the following two criteria have been applied to minimize transient background noise (e.g. wind gusts, occasional traffic, and farming activities).

1. The L_{10} and L_{90} sound levels were reasonably close together (within 4 dBA) indicating a steady sound, possibly from the wind turbines.
2. Ground-level wind speed gusts were approximately 7 m/s or less.

¹ According to ANSI S12.18-1994 (R2019), "No measurements shall be made during measurable precipitation or freezing rain." This condition is also required per the Final Decision.

² According to ANSI S12.18-1994 (R2019), "No sound level measurement shall be made when the average wind velocity exceeds 5 m/s when measured at a height of 2 ± 0.2 m above the ground." This condition is also required per the Final Decision.

Initial Findings

The focus of this initial analysis was to analyze periods meeting the criteria presented above which contained total sound levels that exceeded the regulatory limits. The details of this analysis will be presented in the full report to be submitted in mid-May. These initial findings will be supplemented with the full analysis which will evaluate additional periods (periods meeting the evaluation criteria with sound levels at or below the regulatory limit). This additional analysis may result in Project-Only sound levels lower than those present in this initial summary.

The initial findings of the sound level evaluation show compliance at all six measurement locations. This evaluation has been conducted approximately 25 feet from the residences with the exception of Location 6 where sound levels were measured at the property line per the Codington County ordinance. Because compliance is demonstrated at Location 6 (the property line), compliance is also demonstrated at the home. In addition, the evaluation at Location 6 is further conservative because L_{eq} sound levels were evaluated as opposed to L_{90} sound levels, which are always lower.

A summary of the initial results is provided in Table 1. The table quantifies the number of valid 10-minute measurement periods, i.e., periods when all critical data were available and complete, the number of those valid periods that met all of the evaluation criteria, and the wind turbine only sound levels determined in the initial evaluation. 'Total' sound levels include contribution from ambient sound sources other than the Project. At this stage in the analysis, wind turbine only sound levels are generally based on 'total' sound levels; therefore, sound levels from the Project are anticipated to be these levels or lower at the respective locations. For periods when total sound levels exceeded the limit, an ambient sound level analysis was incorporated into the evaluation.

Table 1 Initial Results Summary

Loc.	Participation Status	# of Valid Periods	# of Evaluation Periods	Preliminary Wind Turbine Only L_{eq} Sound Level (dBA)
1	Participating	2,045	63	50
2	Non-Participating	2,050	75	45
3	Non-Participating	2,048	85	44
4	Non-Participating	2,064	173	45
5	Non-Participating	809	49	44
6	Non-Participating (PL)	2,058	43	40

Conclusions

Based on the initial results of the analysis of data collected during the two-week sound level measurement program, the sound levels at all six locations meet the sound level limits (County property line, non-participating residence, and participating residence limits). These results are only preliminary at this point. Additional periods remain to be evaluated, i.e. periods of lower total sound levels, which will potentially result in lower wind turbine only sound levels being assigned to each location as compared to those presented in Table 1. Therefore, this additional analysis is not anticipated to change the conclusions of this memo with respect to compliance. Further QA/QC will be conducted as well. The full analysis will be presented in a report to be submitted in mid-May.

