Conditional Use Permit Application
Codington County, SD
Crowned Ridge Wind, LLC
Crowned Ridge Wind II, LLC

1. INTRODUCTION

EAPC was hired to conduct sound and shadow flicker studies for the two Crowned Ridge wind farm projects located in Codington County in northeastern South Dakota near the town of Watertown. The layout consists of 13 GE 1.7 MW wind turbines with a hub height of 80 meters, 14 GE 2.1 MW wind turbines with a hub height of 80 meters, and 239 GE 2.3 MW wind turbines with a hub height of 90 meters. The locations of the proposed wind turbines were supplied by Crowned Ridge Wind, LLC. From the database of occupied residences and coordinates supplied by Crowned Ridge Wind, LLC, 204 occupied residences and 156 land parcels in Codington County were found to be within 2 km of a wind turbine and were included in the sound and shadow models. Of the 156 land parcels, 97 are non-participating.

The area of interest is located in Codington County near the town of Watertown in northeastern South Dakota. The surrounding terrain has a change in elevation across the Codington County portion of the project site ranging from 570 to 621 meters (1,870 to 2,037 feet). The region's vegetation is comprised primarily of agricultural land. Project overview maps can be found in Appendix B.

2. BACKGROUND - SOUND

To determine if the layout provided would be compliant with the Codington County regulations, detailed sound scenarios were analyzed using windPRO. The scenarios assumed that the wind turbines were operating at a wind speed that resulted in the loudest sound being emitted. According to the GE sound documentation provided to EAPC by Crowned Ridge Wind, LLC, the loudest normal operating sound pressure level emitted from the GE 1.7-103 is 107 dBA at 10 m/s and higher at 80 m above ground level (AGL). For the GE 2.1-116, the sound emission specifications for the 2.3-116 were used, which is a conservative assumption since the sound emission levels for the 2.1-116 will likely be lower than for the larger 2.3-116. For the 2.3-116, the loudest normal operating sound pressure level emitted is 107.5 at 10 m/s and higher at 90 m AGL. The specifications for the three GE wind turbine models used in this study are included in Table 1 below. The table of wind turbine coordinates and sound profiles for the subset of turbines within 2 km of occupied Codington County residences is included in Appendix A.

Table 1: Crowned Ridge wind turbine specifications.

Crowned Ridge Wind –Turbine Specifications							
Manufacturer	Model	Hub Height (m)	Rotor Dia. (m)	Cut-In Wind Speed (m/s)	Cut-Out Wind Speed (m/s)	Max. Sound Press. Level (dBA)	Max. Sound Press. Level LNTE (dBA)
General Electric	GE 1.7	80	103	3	23	107	105
General Electric	~~GE 2.1~~	80	116	3	22	107.5	106
General Electric	GE 2.3	90	116	3	22	107.5	106

3) DESCRIPTION OF PROPOSED FACILITIES

An individual lease agreement, permitting the siting of a facility/turbine, has been signed by the respective landowner for each proposed wind turbine and related facilities location. In addition, Crowned Ridge Wind has written agreements with each consenting landowner, which ensures minimal impact to their land and that public health and safety guidelines will be followed. The proposed Facility will not emit any fumes. Below, please find a listing of all proposed Crowned Ridge Wind facilities. See site plan in **Appendix E** for locations of all proposed facilities.

- **Generation Equipment Description**
  Crowned Ridge proposes to use GE 2.3 MW 116 meter (380ft) diameter rotor, 90 meter (295ft) tubular steel monopole, GE 2.1 MW 116 meter (380) diameter rotor, 80 meter (262ft) tubular steel monopole, and GE 1.7 MW 103 meter (337ft) diameter rotor, 80 meter (262ft) steel monopole throughout the Facility. These turbines employ active yaw control to steer the machine with respect to the wind. They have active blade pitching to maximize power output. The towers and turbines will be painted with a non-reflective/off-white color designed to minimize visual impacts. No advertising or graphics will be placed on any part of the tower or blades, however, the turbines will be clearly numbered above the entrance doors for identification and emergency response. The towers will not be illuminated except as required by the FAA.

- **Electrical Collection System**
  The power generated by the Facility will be collected and conveyed to the Crowned Ridge substations by an electrical power collection system as shown on the site plans. The location of the substations is shown on the site plan which is located in **Appendix E**. Crowned Ridge energy collection system will include pad-mounted transformers, buried cables, and junction boxes.

- **Substation**
  The Facility is proposing two (2) substations within Codington County. The substations increase the voltage from the 34.5 kV, as collected from the pad-mounted transformers at each wind turbine, to the 120 kV required for interconnection. The substations will contain a transformer, metering equipment, circuit breakers, poles, and disconnects, and other devices to regulate the flow of electrical power.

- **Overhead Transmission Line Connection**
  An overhead transmission line will be constructed to transfer wind energy system power from the substation into the switchyard. The proposed transmission line will be constructed and run within easements negotiated with private landowners.

- **Laydown Yard**
  Multiple gravel base laydown areas including small temporary concrete batch plants, located on approximately 25-28 acres of land, will be required during the construction phase of Crowned Ridge. The Laydown yards will be used to temporarily store turbine parts, equipment, office trailers, and employee parking. Upon completion of all reclamation activities, these laydown yards will be reclaimed to the pre-construction state. Prior to construction the location of the laydown yards will be provided to the County.

- **Operations & Maintenance Facility**
  Operations, storage, and repairs for the wind energy center Facility will take place at the proposed O&M facility. This facility contains offices, parking for maintenance trucks, and houses the control system for the wind turbines, spare parts, consumables, and tools.

8. CONCLUSIONS

The conservative results of this study indicate that, of the 97 non-participating property boundaries modeled, none measured more than 50 dBA, therefore the Crowned Ridge wind farm would be in compliance with both Codington County Ordinance #65 and #68.

The sound study assumes that all GE 2.1-116 turbines have the same sound profile as the GE 2.3-116, which is a conservative assumption since the sound emission levels of the GE 2.1-116 would be lower than for the larger GE 2.3-116. In eight cases, the GE 2.3-116 sound profile was changed to the LNTE version, which emits lower sound pressure levels than the standard blade. In all cases, an additional 2 dBA was added to the sound pressure emission levels to provide for more conservative results.

The shadow flicker impact on the receptors was calculated with reductions due to turbine operational direction and sunshine probabilities included. No occupied residences are expected to experience more than 28 hours and 48 minutes of shadow flicker per year, therefore the Crowned Ridge wind farm would be in compliance with the proposed Codington County Ordinance #68.

This shadow flicker analysis is based on a number of conservative assumptions including:

- No credit was taken for the blocking effects of trees or buildings.
- The receptors were omni-directional rather than modeling specific facades of buildings.
- Study assumes 100% turbine availability
- Study assumes all turbine locations are built and operating

The overall effect of using these conservative assumptions indicate that realistically, the number of hours of shadow flicker that would be observed will be less than those predicted by this study.