Exhibit 31

BEFORE THE STATE OF NORTH DAKOTA
PUBLIC SERVICE COMMISSION

RUSO WIND PARTNERS, LLC
RUSO WIND PROJECT - WARD AND MCLEAN COUNTIES
SITING APPLICATION

CASE NO. PU-19-28

PRE-FILED TESTIMONY OF CHRIS HOWELL
ON BEHALF OF RUSO WIND PARTNERS, LLC

May 29, 2019

26 PU-19-29 Filed 05/29/2019 Pages: 15
Exhibit 31 - Prefiled Testimony of Chris Howell
Ruso Wind Partners, LLC
Mollie Smith

I. INTRODUCTION AND QUALIFICATIONS

Q. Please state your name, employer, and business address.

A. My name is Chris Howell. I am an Associate Noise Specialist and Project Manager in the Environmental Services division at Burns & McDonnell Engineering Company, Inc. ("Burns & McDonnell"). My business address is 9400 Ward Parkway, Kansas City, Missouri 64114.

Q. Briefly describe your background and qualifications.

A. I am the noise lead for Burns & McDonnell. In that role, I specialize in generation and noise analyses, and also manage general environmental permitting teams. I have extensive experience conducting noise modeling for large-scale wind farms in multiple states. I have 17 years of professional experience, 15 of which have been with Burns & McDonnell. I have a Bachelor of Science degree in Mechanical Engineering and am a member of the Institute of Noise Control Engineering. A copy of my curriculum vitae is provided as proposed Exhibit 31-A.

II. PURPOSE OF TESTIMONY

Q. What are Burns & McDonnell's role and your role with respect to the Ruso Wind Project ("Project")?

A. Burns & McDonnell was retained to conduct shadow flicker and sound modeling. I conducted acoustic modeling of the Project's proposed layout and prepared an associated Sound Study, which is provided in Appendix R of the Project's Application for a Certificate of Site Compatibility ("Application") (Exhibit 1). I also conducted supplemental acoustic modeling, as set forth in the Additional Sound Modeling Results (Exhibit 18).

Q. What is the purpose of your Testimony?

A. The purpose of my testimony is to discuss the methodology and results of the acoustic modeling conducted for the Project. In addition, I will discuss how the modeling demonstrates that the Project will comply with applicable acoustic regulations.

Q. What proposed hearing exhibits are you sponsoring in your Testimony?

A. I am sponsoring the following proposed hearing exhibits:

- Exhibit 1: Application (Section 6.5 and Appendix R)
- Exhibit 18: Additional Sound Modeling Results

III. WIND TURBINE SOUND AND APPLICABLE STANDARDS

Q. Please provide an overview of the sound that may be generated by modern utility-scale wind turbines, such as those that will be used by the Project.

A. The sound commonly associated with a wind turbine is described as a rhythmic "whoosh" caused by aerodynamic processes. This sound is created as air flow interacts with the surface of rotor blades. As air flows over the rotor blade, turbulent eddies form in the surface boundary layer and wake of the blade. These eddies are where most of the "whooshing" sound is formed. Additional sound is generated from vortex shedding produced by the tip of the rotor blade. Air flowing past the rotor tip creates alternating low-pressure vortices on the downstream side of the tip, causing sound generation to occur.

Advancement in wind turbine technology has reduced distinct tonal sounds by reshaping turbine blades and adjusting the angle at which air contacts the blade. Pitching technology allows the angle of the blade to adjust when the maximum rotational speed is achieved, which allows the turbine to maintain a constant rotational velocity. Therefore, sound emission levels remain constant as the velocity remains the same.

Wind turbines can create noise in other ways as well. Wind turbines have a nacelle where the mechanical portions of the turbine are housed. The current generation of wind turbines uses multiple techniques to reduce the noise from this portion of the turbine: vibration isolating mounts, special gears, and acoustic insulation. In general, all moving parts and the housing of the current generation of wind turbines have been designed to minimize the sound generated.

Q. Please provide an overview of how humans perceive sound, and how perceived levels are measured.

A. Sound energy travels through air as a pressure wave. The human ear perceives the amplitude of the sound pressure wave, and also its frequency (pitch). Human hearing is sensitive to sound fluctuations over an enormous range of pressures, from about 20 micropascals (the "threshold of human hearing") to about 20 pascals (the "threshold of pain"). The frequency of a sound is the rate at which it fluctuates in time, expressed in Hertz ("Hz"), or wave cycles per second.

The compressive decibel scale is used to make the numbers more manageable for discussion. Sound pressure is converted to sound levels in units of decibels ("dB"), which can be weighted and expressed in different ways. The most common weighting scale used in environmental noise analysis and regulation is the A-weighted decibel ("dBA"). This weighting mechanism emulates the human ear's varying sensitivity to the frequency of sound. The human ear is much more sensitive to medium frequencies (1,000 to 8,000 Hz) than to very low or very high frequencies. The A-weighted level represents the sum of the energy across the normal audible frequency spectrum for humans (20 to 20,000 Hz), weighted by frequency as the human ear would do.

In terms of human perception, a 10-dB change in sound levels is a perceived doubling (or halving, if the sound is decreasing) of loudness. A 5-dB change is considered "clearly noticeable," and a 3-dB change is considered "just barely noticeable." Changes in broadband sound level of less than 3 dB are generally not considered to be noticeable.

Q. How does the sound from wind turbines fit within the range of sound audible to humans?

A. Sound pressure levels at the base of a 1.5 megawatt ("MW") or greater wind turbine are typically between 55 and 60 dBA. For comparison, typical conversational speech between two people standing three feet apart is between 55 and 65 dBA, so one could hold a conversation at the base of a wind turbine. As sound spreads from a turbine, the sound level diminishes. At 45 to 50 dBA, it would sound approximately like conversational speech at home, and between 30 and 40 dBA it is comparable to background sound levels in a rural area.

Q. Are you aware of any federal or state sound level regulations for wind energy conversion facilities located in North Dakota?

A. There is no federal sound level regulation for wind turbines. The North Dakota Public Service Commission ("Commission") requires that sound produced by wind turbines not exceed 50 dBA within 100 feet of an inhabited residence or a community building, unless a waiver is obtained from the owner of the inhabited residence or the community building.

Q. Does Ward County have sound level requirements for wind energy facilities?

A. No, Ward County does not have a sound level requirement for wind energy facilities.

IV. SOUND STUDY (<u>EXHIBIT 1</u>, APPENDIX R)

Q. What was the purpose of the acoustic modeling and analysis discussed in the Sound Study (<u>Exhibit 1</u>, Appendix R)?

A. The purpose of the Sound Study was to determine through analysis whether the sound generated by the Project will comply with applicable noise standards. Consistent with these goals, the Sound Study describes the results of the acoustic modeling analysis we conducted, which demonstrates that Project sound levels will comply with the Commission's sound level requirement.

Q. Could you provide an overview of the general methodology used in conducting the acoustic modeling analysis for the Project?

A. Our modeling was completed using CadnaA, Version 2019, modeling software, which is a scaled, three-dimensional program that accounts for air absorption, terrain, ground absorption, and ground reflection for each piece of sound-emitting equipment and predicts downwind sound pressure levels.

The modeling utilized conservative assumptions and was conducted in accordance with International Organization for Standardization ("ISO") 9613-2, which is the international sound modeling standard used for predicting outdoor sound levels from specific sources. Specifically, ISO 9613-2 uses omnidirectional downwind sound propagation and worse-case directivity factors. In other words, the model assumes that each turbine transmits its maximum sound level in all directions at all times. Because CadnaA calculates the worst-case scenario for downwind sound propagation, predicted sound levels tend to be higher than what would actually occur.

The modeling did not include attenuation for sound propagation through wooded areas, existing barriers, and shielding. Additionally, all turbines were assumed to be operating at maximum power output (and therefore, maximum sound levels) at all times to represent worst-case noise impacts from the wind farm as a whole. The model also assumed atmospheric conditions that are favorable to sound propagation. Specifically, the analysis assumed an atmosphere of ten degrees Celsius and seventy percent humidity. Although ground attenuation is expected to be high due to soft ground, we used a conservative ground attenuation value of 0.5. These assumptions further added to the conservativeness of the model, which was designed to conservatively estimate even worst-case modeled sound levels.

Q. Did you use an uncertainty factor in your analysis? If not, why not?

A. No. Based on past experience, the methodology used in this analysis is typically 1 to 3 dBA more conservative than measured values. Use of an uncertainty factor would needlessly compound the already conservative assumptions.

Q. Has Mr. David Hessler previously had occasion to review the sound analysis methodology you just described?

A. Yes. As part of the Prevailing Wind Park Energy Facility permit process in South Dakota, I prepared a sound analysis using this same methodology. Mr. Hessler was retained by the South Dakota Public Utilities Commission Staff to provide an analysis of my methodology. As part of that proceeding, Mr. Hessler testified that the "modeling methodology and assumptions [were] satisfactory."[1]

Q. What Project-specific information was incorporated into the modeling?

A. For the initial analysis, modeling was conducted for the two turbine models being considered for the Project at that time: the Siemens Gamesa SG-4.5-145[2] and the Siemens Gamesa SWT-2.415-108. Although fewer turbines would be constructed, the initial modeling analysis was conducted at all 66 potential locations, with the Siemens Gamesa SG-4.5-145 at 55 turbine locations (42 primary and 13 alternate) and the Siemens Gamesa SWT-2.415-108 at 11 turbine locations (all primary).

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[1] *See* Testimony of David Hessler at 3, *In the Matter of the Application by Prevailing Wind Park, LLC for a Permit of a Wind Energy Facility in Bon Homme County, Charles Mix County and Hutchinson County, South Dakota, for the Prevailing Wind Park Project*, South Dakota Public Utilities Commission Docket EL18-026.

[2] Modeling was conducted using the Siemens Gamesa SG-4.5-145 Flexible Rating Performance Specifications. Those Specifications provide the sound level output range for between 4.2-4.8 MW, and the maximum sound level (associated with 4.8 MW) was incorporated into the modeling. As a result, the modeling is applicable to both the 4.5 MW and the 4.8 MW models.

Q. Did you consider existing wind farms in you modeling?

A. Yes. The modeling considered two existing neighboring wind farms. The New Frontier Wind Farm is located southeast of the Project and consists of 44 Vestas V126-3.45 WTGs. Prairie Wind Farms 1 is located northwest of the Project and consists of 82 GE-1.577 WTGs. Sound pressures were predicted using manufacturer-specified sound power levels for each wind-turbine. The New Frontier Wind Farm and the Prairie Wind Farms 1 turbines are identified with a prefix of "NF" and "PW," respectively, on the figures and charts provided with the Sound Study (Exhibit 1, Appendix R).

Cumulative sound levels from 66 proposed turbines, as well as all 126 existing turbines at the New Frontier Wind Farm and Prairie Wind 1 Wind Farm, were calculated for each of the 68 identified discrete receptors (residences) that surround the Project.[3] These receptors were identified by the Applicant, and they correspond to the physical residence. Each receptor was assumed to have a height of 1.52 meters (5 feet) above ground level.

Further discussion of the methodology used is provided in the Sound Study (Exhibit 1, Appendix R).

Q. Could you summarize the results of the Sound Study in Appendix R of the Application (Exhibit 1)?

A. Based on the analysis, sound levels from the Project are predicted to be less than 50 dBA at all inhabited residences. When taking into consideration the neighboring wind farms, the highest modeled sound level at a residence was 49.3 dBA. The source of the sound for that residence, however, was solely the existing New Frontier Wind Project. The highest modeled sound level at a residence attributable to the Ruso Wind Project turbines was 45.6 dBA.

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[3] Ruso Wind did not identify any community buildings in the Project Area.

To confirm that the predicted sounds levels 100 feet from any of the residences are also below the 50-dBA limit, we identified the worst-case receptor (Receptor 53), which had a predicted sound pressure level of 49.3 dBA. A new receptor was then placed 100 feet from Receptor 53 in the direction of the nearest turbine (i.e., closer to the turbine), where there were limited interfering structures, and the full model was re-run. The result was a predicted sound pressure level of 49.6 dBA at that receptor. Based on the analysis of this worst-case receptor, we concluded that there were no expected exceedances of the 50-dBA limit at 100 feet from the receptor. Any increase in sound level at 100-foot from any other receptor would be similar in magnitude to the 0.3-dBA increase modeled for Receptor 53. Further, considering that the highest sound level attributable to the Project (as opposed to an existing wind farm) was 45.6 dBA, the sound levels from the Project would be well below the 50 dBA within 100 feet of a receptor. Thus, the analysis demonstrates the Project would comply with the Commission's sound level requirement.

V. ADDITIONAL SOUND MODELING (<u>EXHIBIT 18</u>)

Q. You have also provided Additional Sound Modeling Results (<u>Exhibit 18</u>). Can you explain what was modeled for this analysis?

A. Yes. Ruso Wind identified three General Electric ("GE") turbine models that may potentially be used for the Project: GE-2.3-116 (80-meter hub height), GE-2.5-116 (90-meter hub height), and GE-2.82-127 (89-meter hub height); and eliminated one primary turbine location from consideration. Ruso Wind asked that we run a sound analysis using the turbine that would result in the greatest potential impacts at all potential turbine locations.

Based on that instruction, we re-ran the analysis using the GE-2.82-127 model for 65 potential turbine locations. Of the three GE models under consideration by Ruso Wind, the GE-2.82-127 would have the greatest potential sound impact.

Q. For purposes of your analysis for the Additional Sound Modeling Results (Exhibit 18), were there any changes to the turbine locations?

A. No. The turbines remained in the same location as was previously modeled, except for the one removed. One minor change was that the turbine ID numbers changed between the initial layout modeled and the later layout.

It is my understanding that Ruso Wind subsequently removed two of the proposed alternative turbines from consideration. If anything, this makes the sound modeling that was performed more conservative.

Q. In conducting your analysis for the Additional Sound Modeling Results (Exhibit 18), did you use the same methodology as you did in the Sound Study (Exhibit 1, Appendix R)?

A. Yes. I used the CadnaA, Version 2019, modeling software, and included the same assumptions. Like before, my analysis also considered 126 turbines from the two existing wind farms located in the area.

Q. Can you summarize the results of the Additional Sound Modeling Results (Exhibit 18)?

A. Based on the analysis, if any of three proposed GE turbine models were used, predicted sound levels from the Project (i.e., the cumulative sound levels, including the two existing wind farms) are less than 50 dBA at 100 feet from all residences. The highest modeled sound level was 49.3 dBA at the receptor, which is the same as the highest sound level in the original Sound Study (Exhibit 1, Appendix R). Again, this is caused solely by the New Frontier wind turbines.[4] For the reasons discussed previously, the Project will comply with the Commission's 50-dBA limit within 100 feet of an inhabited residence or community building.

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[4] In the GE turbine model analysis, the highest modeled sound level at a receptor that is attributable to the Project (as opposed to an existing wind project) is 48.5 dBA.

VI. MODELING ACCURACY

Q. Has Burns & McDonnell conducted post-construction sound studies to determine the accuracy of the modeling methodology used to predict sound levels generated by the Project?

A. Yes. The methods used in this study to develop the potential sound impacts of this Project are consistent with those used in most of our predictive studies. We perform many acoustical studies per year, with nearly half requiring post-construction compliance demonstration. Both in-house and third-party monitoring has routinely demonstrated that our prediction methods are conservative, and monitoring results are typically between 1 and 3 dBA lower than our predictions.

VII. CONCLUSION

Q. Does this conclude your Testimony?

A. Yes.

Exhibit 31-A

CHRIS HOWELL, INCE

Project Manager

EDUCATION

- BS, Mechanical Engineering, Kansas State University, 1999

ASSOCIATIONS

- Institute of Noise Control Engineering

17 YEARS WITH BURNS & MCDONNELL

19 YEARS OF EXPERIENCE

Mr. Howell is a Project Manager in the Environmental Services group, with a specialty in generation permitting and is also the Noise Lead. He manages the overall environmental permitting and licensing of complex facilities. He leads an experienced team of permitting specialists who conduct feasibility studies and assist clients with regulatory compliance and/or mitigation efforts. Chris has performed projects in all 50 of the United States, Puerto Rico, Canada, Mexico, Asia, Africa, and the Middle East. His clients range from generation, transmission and distribution, to transporation and other industries. Many of his projects require public involvement and/or interaction with regulatory agencies and expert testimony. Mr. Howell is an Associate at Burns & McDonnell.

Ruso Wind Farm Permitting Studies | Ruso Wind Partners, LLC

North Dakota | 2018 – Current

Noise Lead: Chris performed acoustical modeling for the proposed Ruso Wind Farm in North Dakota. The results of the study will be used by the client to pursue a special use permit for the project. Modeling was performed using CadnaA. Chris will be testifying before the North Dakota Public Service Commission.

Philip Wind Farm Permitting Studies | Philip Wind Partners, LLC

South Dakota | 2018 – 2019

Noise Lead: Chris performed acoustical modeling for the proposed Philip Wind Farm in South Dakota. The results of the study were used by the client to pursue a special use permit for the project. Modeling was performed using CadnaA. Written testimony was submitted for public hearings.

Bitter Ridge Wind Farm | Scout Clean Energy

Jay County Indiana | 2018 – Current

Noise Lead: Chris performed acoustical modeling for the proposed Bitter Ridge Wind Farm in Indiana. The results of the study will be used by the client to pursue a special use permit for the project. Modeling was performed using CadnaA.

Prevailing Winds Wind Farm, Prevailing Winds LLC.

South Dakota | 2016 and 2018

Noise Lead. Chris managed an ambient survey team, performed predictive noise modeling using CadnaA, and assisted Prevailing Winds with public testimony during the licensing and permitting phase of a 200-MW wind farm. The wind farm spanned three counties. Chris testified before the SDPUC and assisted Prevailing Winds in gathering data to bolster their application.

Exhibit 31-A

CHRIS HOWELL, INCE
(continued)

Big Blue River Wind Farm | Confidential Client
Henry County Indiana | 2018 – Current

Noise Lead: Chris performed acoustical modeling for the proposed Big Blue River Wind Farm in Indiana. The results of the study will be used by the client to pursue a special use permit for the project. Modeling was performed using CadnaA.

Thunder Spirit | ALLETE Clean Energy
North Dakota | 2018

Noise Lead**:** Chris managed and performed an acoustical assessment for ALLETE Clean Energy during the development, design, and construction of the Thunder Spirit II Wind Farm. The noise assessment study consisted of predictive modeling using the CadnaA software.

Big Sky Wind Farm Permitting Studies | Confidential Client
Illinois | 2018

Noise Lead: Chris managed a project team that performed ambient sound monitoring and the predictive modeling during for development of the proposed Big Sky Wind Farm. Chris helped with graphical representation of expected impacts and provided assistance for public meetings. The results of the study were used by the client to pursue a special use permit for the project.

Mountain Breeze Wind Farm Permitting Studies | Confidential Client
Colorado | 2018

Noise Lead: Chris provided predictive modeling and micro-siting assistance during the development of the proposed Mountain Breeze Wind Farm. The results of the study will be used by the client to pursue a special use permit for the project.

Nimbus Wind Farm Permitting Studies | Scout Clean Energy
Arkansas | 2018

Noise Lead: Chris preformed predictive modeling during the development of the proposed Nimbus Wind Farm. The results of the study were used by Scout to pursue a special use permit for the project.

Lone Tree Wind Farm, Leeward
Illinois | 2017

Noise Lead. Chris managed ambient monitoring and performed predictive noise modeling using CADNA to assist Leeward in the permitting and licensing phase for a proposed wind farm in Bureau County, IL. Octave band analysis and existing wind farms cumulative impacts were performed. Chris provided written and oral testimony in front of the zoning board.

Milligan 1 and 3 Wind Farms, Aksamit
Nebraska | 2016

Noise Lead. Chris performed predictive noise modeling using CadnaA to assist Aksamit in the permitting and licensing phase of 374-MW of turbines in Saline County, NE.

Exhibit 31-A

CHRIS HOWELL, INCE

(continued)

Mendota Hills Wind Farm Repower, Leeward

Illinois | 2016

Noise Lead. Chris managed and ambient monitoring and predictive noise modeling using CadnaA to assist Leeward in the permitting and licensing phase for repowering an existing wind farm, using fewer, larger turbines. Comparisons were performed to the currently operating wind farm's impacts. Chris provided written and oral testimony for the project.

Broken Bow 2 Wind Farm | Sempra U.S. Gas & Power

Nebraska | 2015

Noise Lead: Chris performed predictive modeling and commercial negotiation support for Sempra U.S. Gas & Power during development of a 75-MW wind energy project in central Nebraska.

Energia Sierra Juarez Wind Farm, Sempra International

Baja California, Mexico | 2014

Noise Lead. Chris is performed predictive noise modeling using CadnaA to assist Sempra in the permitting and licensing phase of a 155-MW wind farm.

Twin Groves Phases 4 & 5, Horizon Wind Energy

Illinois | 2009 And 2011

Noise Lead. Chris performed background noise monitoring and predictive noise modeling using CadnaA to assist Horizon in the permitting and licensing phase of a 500-megawatt wind farm. He successfully assisted with public testimony. Later, Chris assisted Horizon with the determining the noise implications that changing turbines would have to the already approved wind farm.

Top Crop 3&4 Wind Farm, Horizon Wind Energy

Illinois | December 2011

Noise Lead. Chris performed ambient monitoring and predictive noise modeling using CadnaA to assist Horizon in the permitting and licensing phase of adding 300-MW of turbines to the existing TC1&2 Wind Farm. A cumulative analysis of various surrounding wind farms was completed the three counties as a whole using data from nearby, non-Horizon wind farms in conjunction with the Horizon project and various design options.

Rail Splitter, Horizon Wind Energy

Illinois | 2008 and 2011

Noise Lead. Chris performed background noise monitoring and predictive noise modeling using CadnaA to assist Horizon in the permitting and licensing phase of a 500-megawatt wind farm. Later, Chris assisted Horizon in determining what cumulative noise impacts would occur when of adding WindBOOST technology.

Bright Stalk, Horizon Wind Energy

Illinois | 2010

Noise Lead. Chris performed background noise monitoring and predictive noise modeling using CadnaA to assist Horizon in the permitting and licensing phase of a 400-megawatt wind farm. He also assisted with public testimony.

Exhibit 31-A

CHRIS HOWELL, INCE

(continued)

Meadow Lake Phases 1-5, Horizon Wind Energy

Indiana | 2009 and 2011

Noise Lead. Chris performed background noise monitoring and predictive noise modeling using CadnaA to assist Horizon in the permitting and licensing phase of a 500-megawatt wind farm. Later, Chris assisted Horizon in determining what cumulative noise impacts would occur when of adding WindBOOST technology.

Lompoc Wind Farm, Acciona

California | July 2010

Noise Lead. Chris performed predictive noise modeling using CadnaA to assist Acciona in the permitting and licensing phase of a wind farm. He also created documentation regarding public interaction and action plans. He also developed a monitoring plan for the project and was to coordinate a team of specialists to carry out ambient noise monitoring. The project is currently on hold.