Exhibit 30

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 AARON ANDERSON
ON BEHALF OF RUSO WIND PARTNERS, LLC

May 29, 2019

I. INTRODUCTION AND QUALIFICATIONS

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

A. My name is Aaron Anderson. I am a senior mechanical engineer and project manager in the Renewable Energy Group 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 specialize in financial and engineering analyses of wind energy projects. I have 14 years of professional experience and have been with Burns & McDonnell for 12 years. As part of my responsibilities at Burns & McDonnell, I conduct shadow flicker analyses for proposed wind farms.

I have undergraduate degrees in Physics and Mechanical Engineering, a master's degree in Engineering Management, and I am a registered Professional Engineer in multiple states, including North Dakota. A copy of my curriculum vitae is provided as proposed <u>Exhibit 30-A</u>.

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 by Ruso Wind Partners, LLC ("Ruso Wind") to assist with sound modeling and to conduct a shadow flicker analysis for the Project. I supervised the shadow flicker modeling for the Project's proposed layouts and preparation of the associated shadow flicker analysis report, which is provided in Appendix Q of the Application for Certificate of Site Compatibility ("Application") (<u>Exhibit 1</u>). In addition, we conducted additional shadow flicker modeling, which is presented in proposed <u>Exhibit 17</u>.

Q. What is the purpose of your Testimony?

A. The purpose of my testimony is to discuss the methodology and the results of the shadow flicker modeling conducted for the Project. I will also discuss the results of additional modeling conducted for the Project after the Application was filed.

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

A. I am sponsoring the following proposed hearing exhibits:

- Exhibit 1: Application (Section 6.6 (shadow flicker only) and Appendix Q)
- Exhibit 17: Additional Shadow Flicker Modeling Results.

III. SHADOW FLICKER AND APPLICABLE STANDARDS

Q. Could you please explain what shadow flicker is?

A. Yes. Like any tall structure, wind turbines cast a shadow when the sun is visible. When the wind turbine blades rotate and pass in front of the sun, a flickering or flashing effect may occur when the shadows of the rotating blades cause alternating changes in light intensity at a given stationary location, a receptor, such as the window of a home. This recurring change in light intensity is known as shadow flicker.

Shadow flicker occurs only under very specific conditions. For example, shadow flicker can only occur when the sun is shining and the turbine is in operation (i.e., when the turbine blades are rotating). Moreover, shadow flicker is generally most notable when a turbine is facing a receptor, as this results in the widest-possible shadow being cast.

Shadow flicker intensity and frequency at a given receptor are determined by a number of interacting factors, such as sun position, wind direction, turbine locations, receptor locations, terrain, and time of day. The intensity of shadow flicker varies significantly with distance, and as separation between a turbine and receptor increases, shadow flicker intensity will generally diminish as shadows diffuse and become imperceptible.

Q Are you aware of any federal, state, or local shadow flicker regulations for the Project?

A. Shadow flicker impacts are not currently regulated in applicable state or federal law, nor are there requirements in the Ward County ordinance.

Q. Has Ruso Wind made a voluntary commitment regarding shadow flicker levels for the Project?

A. Yes. It is my understanding that Ruso Wind has made a voluntary commitment to limit shadow flicker to no more than 30 hours per year at currently occupied residences, unless the owner of the residence executes a shadow flicker acknowledgement and waiver.

IV. SHADOW FLICKER ANALYSIS (<u>EXHIBIT 1</u>, APPENDIX Q)

Q. What was the purpose of the shadow flicker modeling and analysis discussed in the Shadow Flicker Analysis included as Appendix Q to the Application (<u>Exhibit 1</u>)?

A. The purpose of the Shadow Flicker Analysis was to estimate the potential annual frequency of shadow flicker associated with the operation of the Project wind turbines at 68 existing occupied residences and to assess compliance with Ruso Wind's voluntary commitment regarding shadow flicker levels.

Q. What turbine models and receptor locations were used in the model?

A. Although fewer turbines are expected to be installed, in the initial analysis, modeling was conducted on a total of 66 turbine positions (including 13 alternates) to ensure that any location selected was considered in the Shadow Flicker Analysis and represented in the results of such analysis. The modeling was completed for a combination of two representative turbine models: 42 primary and 13 alternate locations as Siemens Gamesa SG-4.5-145 and 11 primary locations as Siemens Gamesa SWT-2.415-108. Modeling was done to assess shadow flicker durations at 68 receptors (i.e., occupied residences) located in and around the Project Area.

Q. Were existing wind farms considered in your modeling?

A. Yes. Wind turbines from the existing neighboring Prairie Wind 1 and New Frontier wind projects were also included in the analysis.

Q. Could you provide an overview of the methodology used in conducting the shadow flicker modeling?

A. WindPRO, an industry-leading software package for the design and planning of wind energy projects, was used to predict the expected amount of annual shadow flicker produced by each of the turbines at each receptor location. The WindPRO software is able to incorporate the sun's path, the percentage of expected sunshine based on local regional sunshine data, topography of the Project site, locations of receptors and turbines, wind turbine specifications, and the anticipated wind speed and direction distribution to calculate shadow positions and orientations at one-minute intervals over a complete year. Any shadow flicker caused by each turbine is then aggregated for each receptor for the entire year.

The size of the turbine contributes to the length and width of the shadows cast. The modeling used the turbine models and dimensions noted below.

Project Representative Turbines:

- The Project's representative SG-4.5-145 turbine model has a hub height of 107.5 meters and rotor diameter of 145 meters.[1]

[1] Shadow flicker modeling results for the SG-4.8-145 would be the same as for the SG-4.5-145, as both models have the same hub height, rotor diameter, cut-in speed, and cut-out speed.

- The Project's representative SWT-2.415-108 turbine model has a hub height of 80 meters and rotor diameter of 108 meters.

Existing Wind Project Turbines:

- The General Electric ("GE") GE-1.5-77 turbine model, used in the neighboring Prairie Wind 1 Wind Farm, has a hub height of 80 meters and a rotor diameter of 77 meters.
- The V-126-3.45 turbine model, used in the neighboring New Frontier wind farm, has a hub height of 87 meters and rotor diameter of 126 meters.

At distances beyond 10 rotor diameters, shadow flicker effects are generally considered low, as shadows diffuse and become imperceptible. Thus, a distance equal to 10 times the rotor diameter of each turbine (i.e., for the SG-4.5-145, 1450 meters or 4757 feet, and for the SWT-2.415-1078, 1080 meters or 3543 feet) was modeled as the maximum distance at which shadow flicker was considered relevant; receptors greater than this distance from a given turbine were not evaluated.

Q. What assumptions were included in your model?

A. Shadow flicker modeling was performed using a conservative approach, with some Project Area-specific conditions. For example:

- Each receptor was modeled as having windows on all sides and effectively causing the home to be susceptible to flicker effects in all directions.
- The model utilized topography data to place turbines and receptors at the proper elevation. The terrain height elevations for each turbine and receptor were generated from elevation information derived from the U.S. Geological Survey's National Elevation Dataset.
- Except as explained below, the Project site was modeled as if no obstacles (other than natural topography) were present, such as trees and outbuildings, which may significantly reduce or eliminate the duration and/or intensity of shadow flicker at a receptor. Ruso Wind did identify six receptors for which we conducted the analysis with site-specific obstacles incorporated into the

WindPRO model. The six receptors are indicated by an asterisk (*) in Appendix C of the Shadow Flicker Analysis.

- Power curves were used to more accurately reflect each turbine's operational characteristics.

Additionally, although fewer turbines are expected to be installed, in the initial analysis, modeling was conducted at 66 potential turbine locations (including alternates) to ensure that any location selected was considered in the Shadow Flicker Analysis and represented in the results.

Q. Can you summarize the results of the shadow flicker modeling discussed in the report in Appendix Q of the Application (<u>Exhibit 1</u>)?

A. Four of the 68 known receptors exceed 30 hours per year of shadow flicker. Forty-six receptors are predicted to receive no shadow flicker. For receptors that may receive shadow flicker, the majority of observed shadow flicker for each receptor occurs during early morning or late afternoon and evening hours, as shown in Appendix E to the Shadow Flicker Analysis.

Q. You previously stated that you took into account obstacles for six receptors. Can you explain why obstacles were considered for those six receptors?

A. It is my understanding that Ruso Wind conducted preliminary internal modeling that showed the potential for shadow flicker levels above 30 hours per year at six receptors. Using aerial imagery, Ruso Wind identified tree growth that might reduce shadow flicker at the six receptors. At their request, obstacles were taken into account for Receptors 18, 24, 28, 40, 41, and 50.

Q. How did consideration of the obstacles affect the analysis?

A. When analyzed using obstacles, modeled shadow flicker levels at Receptors 18 and 40 fell below 30 hours per year. Modeled shadow flicker levels at the other four receptors remained above 30 hours per year of shadow flicker.

Q. You mentioned earlier that you also considered the neighboring Prairie Wind 1 and New Frontier turbines. Did taking those turbines into account change the outcome?

A. No. While the modeling indicated that four receptors experienced shadow flicker from these neighboring projects, it was due solely to the existing neighboring wind farms and was less than 30 hours per year. The Project turbines were modeled as resulting in zero hours of shadow flicker at those four receptors.

V. ADDITIONAL SHADOW FLICKER MODELING RESULTS (<u>EXHIBIT 17</u>)

Q. You also provided Additional Shadow Flicker Modeling Results (<u>Exhibit 17</u>). Can you explain what these Modeling Results are showing?

A. Ruso Wind identified three General Electric 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 I run a shadow flicker analysis using the model that would result in the greatest potential impacts.

Based on that request, I re-ran my analysis using the GE-2.82-127 model for 65 potential turbine locations. It has a hub height of 89 meters, and a rotor diameter of 127 meters, which is the largest rotor diameter of the three GE models being considered and, combined with the hub height, was estimated to have the greatest potential shadow flicker impact for these three models. The maximum distance at which shadow flicker was considered relevant for this model (10 rotor diameters) was 1270 meters or 4166 feet.

Q. For purposes of your analysis for the Additional Shadow Flicker Modeling Results (<u>Exhibit 17</u>), were there any changes to the Project layout?

A. No. The turbines remained in the same location as was previously modeled, except for the one primary turbine location that was 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 has subsequently removed two alternate turbines from consideration. Since these two alternate turbine locations were included in our shadow flicker modeling, this makes the modeling that was performed even more conservative.

Q. Did you consider Prairie Wind 1 and New Frontier in the analysis for your Additional Shadow Flicker Modeling Results (<u>Exhibit 17</u>)?

A. No. As explained above, the existing neighboring wind farms did not increase the shadow flicker results at any receptor in the prior analysis. As a result, there was no need to include the existing farms in the updated modeling analysis.

Q. In conducting your analysis for the Additional Shadow Flicker Modeling Results (<u>Exhibit 17</u>), did you use the same methodology as you did for the Shadow Flicker Analysis (Appendix Q of <u>Exhibit 1</u>)?

A. Yes.

Q. Does the Additional Shadow Flicker Modeling Results (<u>Exhibit 17</u>) also take into account the same obstacles at the six receptors identified in Appendix Q (<u>Exhibit 1</u>)?

A. Yes. The footnote to the Additional Shadow Flicker Modeling Results only mentions five obstacles. This was a typographical error; our analysis used obstacles at the same six receptors identified in Appendix Q of the Application (<u>Exhibit 1</u>). These were Receptors 18, 24, 28, 40, 41, and 50.

Q. Can you summarize the results of the Additional Shadow Flicker Modeling Results (<u>Exhibit 17</u>)?

A. The Modeling Results show both the original modeling results for the Siemens Gamesa turbines, and the additional modeling for the GE turbines. In the GE scenario, a total of four receptors were modeled as potentially experiencing shadow flicker levels above 30 hours per year, specifically at Receptors 14, 28, 41, and 50. In the original modeling scenario, Receptors 24, 28, 41, and 50 were modeled as potentially experiencing shadow flicker levels above 30 hours per year. Thus, between the two scenarios, a total of five receptors (Receptors 14, 24, 28, 41, and 50) may experience shadow flicker levels greater than 30 hours per year, depending on the layout and turbine models considered.

VI. MODELING CONSERVATISM AND SHADOW FLICKER MITIGATION

Q. You noted that your modeling made conservative assumptions. Do you believe that shadow flicker levels for all Receptors with an exceedance would be reduced if you re-ran the model using realistic assumptions, e.g., actual window configuration instead of assuming windows on all sides?

A. Yes. Due to the conservative approach of the analysis, the actual duration and intensity of shadow flicker experienced at each receptor is expected to be less than the levels reported in the Shadow Flicker Analysis and Additional Shadow Flicker Modeling Results. Thus, I would expect the amount of shadow flicker to be reduced for all five receptors under more realistic modeling assumptions. For example, if actual window locations were considered along with the actual angle of the sun, rather than modeling the home as having windows on all sides that are always perpendicular to the sun, it is anticipated that the shadow flicker levels would be less than modeled.

Q. Are there mitigation measures that can be employed to reduce shadow flicker?

A. Yes. Mitigation measures include, but are not limited to, installation of exterior or interior screening and installation of vegetation, such as trees or bushes.

Q. Is it your understanding that Ruso Wind has committed to limiting shadow flicker levels at all occupied residences to 30 hours per year or less, unless the owner of the residence executes a shadow flicker acknowledgment?

A. Yes, that is my understanding.

V. CONCLUSION

Q. Does this conclude your Testimony?

A. Yes.

AARON ANDERSON, PE

Senior Mechanical Engineer

Aaron is the renewable energy business line manager and a senior mechanical engineer and project manager in Burns & McDonnell's Renewable Energy Group, a top-5 firm in the wind industry according to *Engineering News-Record*. Aaron specializes in financial and engineering analyses of wind energy projects and has directly managed thousands of megawatts of renewable energy development throughout the world. Aaron holds undergraduate degrees in Physics and Mechanical Engineering, an M.S. in Engineering Management, and is a registered Professional Engineer in multiple states.

EDUCATION

- BS, Physics
- BS, Mechanical Engineering
- MS, Engineering Management

REGISTRATIONS

- Professional Engineer (KS, IL, MI, ND)

12 YEARS WITH BURNS & MCDONNELL

14 YEARS OF EXPERIENCE

Bitter Ridge Wind Farm Permitting Studies | Confidential Client

Indiana | 2019

Role: Aaron was Burns & McDonnell's project manager on an engagement to provide permitting-related consulting services during the development of the proposed Bitter Ridge Wind Farm. These services included shadow flicker and noise assessment studies. The results of these studies were used by the client to pursue special use permits for the project. ***Responsibilities:*** shadow flicker analysis and noise assessment study.

High Bridge Wind Farm Permitting Studies | Confidential Client

New York | 2019

Role: Aaron was Burns & McDonnell's project manager on an engagement to provide permitting-related consulting services during the development of the proposed High Bridge Wind Farm. These services included shadow flicker and noise assessment studies, as well as decommissioning plans and cost estimates. The results of these studies were used by the client to pursue special use permits for the project. ***Responsibilities:*** shadow flicker analysis, noise assessment study, and decommissioning plan/estimate.

Philip Wind Farm Permitting Studies | Philip Wind Partners, LLC

South Dakota | 2018

Role: Aaron was Burns & McDonnell's project manager on an engagement to provide permitting-related consulting services during the development of the proposed Philip Wind Farm. These services included shadow flicker and noise assessment studies. The results of these studies were used by the client to pursue special use permits for the project. ***Responsibilities:*** shadow flicker analysis and noise assessment study.

Ruso Wind Farm Permitting Studies | Ruso Wind Partners, LLC

North Dakota | 2018

Role: Aaron was Burns & McDonnell's project manager on an engagement to provide permitting-related consulting services during the development of the proposed Ruso Wind Farm. These services included shadow flicker and noise assessment studies. The results of these studies were used by the client to pursue special use permits for the project. ***Responsibilities:*** shadow flicker analysis and noise assessment study.

AARON ANDERSON, PE

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Big Blue River Wind Farm Permitting Studies | Confidential Client

Indiana | 2018

Role: Aaron was Burns & McDonnell's project manager on an engagement to provide permitting-related consulting services during the development of the proposed Big Blue River Wind Farm. These services included shadow flicker and noise assessment studies, as well as decommissioning plans and cost estimates. The results of these studies were used by the client to pursue special use permits for the project. ***Responsibilities:*** shadow flicker analysis, noise assessment study, and decommissioning plan/estimate.

Prevailing Wind Park Permitting Studies | Prevailing Wind Park, LLC

South Dakota | 2018

Role: Aaron was Burns & McDonnell's project manager on an engagement to provide permitting-related consulting services during the development of the proposed Prevailing Wind Park. These services included shadow flicker and noise assessment studies. The results of these studies were used by the project company to pursue special use permits for the project and Burns & McDonnell also provided support during public hearings, including with the South Dakota Public Utilities Commission, as the shadow flicker and noise assessment studies were evaluated. ***Responsibilities:*** shadow flicker analysis and noise assessment study.

Big Sky Wind Farm Permitting Studies | Confidential Client

Illinois | 2018

Role: Aaron was Burns & McDonnell's project manager on an engagement to provide permitting-related consulting services during the development of the proposed Big Sky Wind Farm. These services included shadow flicker and noise assessment studies, as well as site layout maps. The results of these studies were used by the client to pursue special use permits for the project. ***Responsibilities:*** shadow flicker analysis and noise assessment study.

Mountain Breeze Wind Farm Permitting Studies | Confidential Client

Colorado | 2018

Role: Aaron was Burns & McDonnell's project manager on an engagement to provide permitting-related consulting services during the development of the proposed Mountain Breeze Wind Farm. These services included shadow flicker and noise assessment studies. The results of these studies were used by the client to pursue special use permits for the project. ***Responsibilities:*** shadow flicker analysis and noise assessment study.

Nimbus Wind Farm Permitting Studies | Scout Clean Energy

Arkansas | 2018

Role: Aaron was Burns & McDonnell's project manager on an engagement to provide permitting-related consulting services during the development of the proposed Nimbus Wind Farm. These services included shadow flicker and noise assessment studies. The results of these studies were used by Scout to pursue special use permits for the project. ***Responsibilities:*** shadow flicker analysis and noise assessment study.

AARON ANDERSON, PE

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Thunder Spirit **II Wind Farm Owner's Engineer** | ALLETE Clean Energy

Adams County, North Dakota | 2018

Role: Aaron was Burns & McDonnell's project manager on an owner's engineer assignment for ALLETE Clean Energy during the development, design, and construction of Phase 2 of the Thunder Spirit II Wind Farm. ***Responsibilities:*** shadow flicker study; noise assessment study; preparation and administration of the balance-of-plant contractor RFP; commercial negotiation support; contract exhibit preparation, including scope and specification development; detailed engineering reviews; project controls support; construction management support and power curve testing support.

Lone Tree Wind Farm | Leeward Renewable Energy Development

Illinois | 2017

Role: Aaron was Burns & McDonnell's project manager on an engagement to provide various consulting services to Leeward during the development of the proposed Lone Tree Wind Project. These services included shadow flicker evaluations, noise assessment studies, wind turbine siting support, transmission interconnection evaluations, and decommissioning evaluations. Burns & McDonnell also provided support during public hearings as the shadow flicker, noise assessment, and decommissioning studies were evaluated. ***Responsibilities:*** shadow flicker analysis; noise assessment study; GIS support and transmission interconnection studies; and decommissioning studies.

Mendota Hills Wind Farm | Leeward Renewable Energy Development

Illinois | 2017

Role: Aaron was Burns & McDonnell's project manager on an engagement to provide various consulting services to Leeward during the proposed repower of their existing Mendota Hills Wind Project. These services included shadow flicker evaluations, noise assessment studies, wind turbine siting support, transmission interconnection evaluations, and decommissioning evaluations. Burns & McDonnell also provided support during public hearings as the shadow flicker, noise assessment, and decommissioning studies were evaluated. ***Responsibilities:*** shadow flicker analysis; noise assessment study; GIS support and transmission interconnection studies; and decommissioning studies.

Milligan Wind Farm Permitting Studies | Aksamit Resource Management

Nebraska | 2016

Role: Aaron was Burns & McDonnell's project manager on an engagement to provide permitting-related consulting services during the development of the proposed Milligan Wind Farm. These services included shadow flicker and noise assessment studies. The results of these studies were used by Aksamit to pursue special use permits for the project. ***Responsibilities:*** shadow flicker analysis and noise assessment study.

Broken Bow 2 Wind Farm **Owner's Engineer** | Sempra U.S. Gas & Power

Custer County, Nebraska | 2015

Role: Aaron was Burns & McDonnell's project manager on an owner's engineer assignment for Sempra U.S. Gas & Power who was developing a 75-MW wind energy project in central Nebraska. ***Responsibilities:*** noise assessment studies; shadow flicker analyses; preparation and administration of the balance-of-plant contractor RFP; balance-of-plant evaluation and contractor selection; commercial negotiation support; contract exhibit preparation, including scope and specification development; detailed engineering reviews on all aspects of the project, including all engineering drawings and studies; project controls support; construction management support; and power curve testing support.

AARON ANDERSON, PE

(continued)

Tucannon River Wind Farm **Owner's Engineer** | Portland General Electric

Columbia County, Washington | 2014

Role: Aaron was a key technical and commercial consultant on an owner's engineer assignment for Portland General Electric who was developing a 116-turbine, 267-MW wind energy project in Columbia County, Washington. ***Responsibilities:*** contractual negotiations support for the turbine supply, balance of plant, and service & maintenance agreements; detailed engineering reviews on all aspects of the project, including all engineering drawings and studies; shadow flicker evaluations; project controls support; and other related activities.

Stoneray Wind Farm Shadow Flicker Study | EDF

Nebraska | 2013

Role: Aaron was Burns & McDonnell's project manager on an engagement to provide a shadow flicker evaluation during the development of the proposed Stoneray Wind Farm. ***Responsibilities:*** shadow flicker analysis.