BEFORE THE STATE OF WASHINGTON
ENERGY FACILITY SITE EVALUATION COUNCIL

In the Matter of Application No. 2006-02 **Desert Claim Wind Power Project**	**EXHIBIT 17** **PREFILED DIRECT TESTIMONY** **JULIA MEIER**

Q. Please state your name and address.

A. Julia Meier. My business address is DNV Global Energy Concepts Inc., 1809 7th Avenue, Suite 900, Seattle, WA 98101.

Q. What is DNV Global Energy Concepts Inc.?

A. DNV Global Energy Concepts Inc. (DNV-GEC) is the second-largest wind energy consulting firm in the world. Its employees have been providing technical services to the industry for more than 20 years. In the last three years, DNV-GEC conducted direct work on wind projects representing more than half of the newly-installed capacity of wind energy in the United States. Our work on these projects varies from initial site selection and wind resource assessment to power performance testing and financial due diligence for investors.

Perkins Coie LLP
1201 Third Avenue, Suite 4800
Seattle, WA 98101-3099
Phone: 206.359.8000
Fax: 206.359.9000

Q. What is your position?

A. Project Engineer in the Feasibility and Consulting Services Section.

Q. What topics will your written testimony address?

A. My testimony will describe my background and experience, and then discuss the results of the sound mapping and shadow mapping analyses of the Desert Claim Wind Project (the "Project").

<u>**Background and Experience**</u>

Q. Briefly describe your educational background.

A. I obtained an undergraduate degree (B.S.) in Biological and Environmental Engineering from Cornell University in 2005.

Q. Please describe your professional experience briefly.

A. My professional experience at DNV-GEC includes initial site screening studies, fatal flaw feasibility analyses, meteorological tower siting, visual simulations, shadow flicker analysis, and noise impact analysis of proposed wind projects; as well as wind project layouts, wind resource assessment, data validation and energy production analysis. This includes conducting site visits, meeting with clients and landowners, frequent client communication, and use of industry-specific computer modeling tools such as WindFarm and WindPro. I have performed these duties at DNV-GEC for two years.

Perkins Coie LLP
1201 Third Avenue, Suite 4800
Seattle, WA 98101-3099
Phone: 206.359.8000
Fax: 206.359.9000

Previous to my employment at DNV-GEC, I worked for one year in New York City at an environmental consulting firm that specialized in the field of real estate due diligence. My duties there included conducting environmental site assessments, supervising site remediation activities, preparing proposals, and managing projects.

Scope of Analysis

Q. What were you asked to do in connection with the Desert Claim Project?

A. DNV-GEC was retained to perform sound mapping and to estimate the sound levels at nearby residences identified by enXco. DNV-GEC was also retained to perform a shadow flicker analysis for the proposed Project and to estimate shadow flicker occurrence at nearby residences identified by enXco.

Sound Mapping

Q. At Tab 6 of Exhibit 1 is a document entitled "Sound Mapping for Desert Claim Project." What is that document?

A. This is the report we prepared and submitted as final to enXco on December 19, 2008, regarding sound mapping for the Project. It describes the analysis we performed and the conclusions we reached.

Q. Will you please summarize your overall conclusions regarding the Project's sound levels?

A. We conclude that the sound levels of the wind turbines will be 50 dBA or less at the Project boundary with non-participating residences. We also conclude that sound levels may exceed 50 dBA at the Project boundary to the west and south, but the

Perkins Coie LLP
1201 Third Avenue, Suite 4800
Seattle, WA 98101-3099
Phone: 206.359.8000
Fax: 206.359.9000

affected property is not residential and is owned by a participating landowner who has waived the sound limit.

Q. Please briefly explain what sound impacts are typically generated by wind turbines.

A. When operating, wind turbines produce a "swishing" or "whooshing" sound as their rotating blades encounter turbulence in the passing air, as well as some sounds from the mechanical parts such as the gearbox, generator, and cooling fans. Wind turbines are typically quiet enough for people to hold a normal conversation while standing at the base of the tower. At a distance of 600 to 900 feet or more, the sounds generated by wind turbines are frequently masked by the "background noise" of winds blowing through the trees or moving around obstacles. If mechanical sounds are significant, it usually means something in the turbine needs maintenance or repair.

Q. Please explain how you performed the sound mapping analysis for the Project.

A. In order to understand the potential sound impacts at the Project boundary and the incremental change in sound levels that is expected to be perceived by observers at nearby residences, DNV-GEC utilized WindFarm software assuming the REpower MM92 turbine specifications and using the IEC 61400-11 acoustic reference wind speed of 8.0 meters per second at 10 meters above ground level. The modeling software generates a sound contour map of the Project area as well as the expected cumulative turbine sound impact at each nearby residence. As background noise is not taken into account within the model, the calculated turbine sound impact is then combined with various assumed background sound levels to understand the range of

Perkins Coie LLP
1201 Third Avenue, Suite 4800
Seattle, WA 98101-3099
Phone: 206.359.8000
Fax: 206.359.9000

potential incremental changes in sound levels expected to be perceived at the residences. The model does not consider sound absorption due to vegetation or obstacles, which vegetation or obstacles may have the potential to lower expected sound impacts at the Project.

Q. What model did you use for sound mapping analysis?

A. We used the WindFarm software version 4.1.1.2 to estimate the sound levels for the Project. The model included in this software is based on the "Description Of Noise Propagation Model Specified By Danish Statutory Order On Noise From Windmills (Nr. 304, Dated 14, May 1991)" as produced by The Danish Ministry Of The Environmental Agency For Environmental Protection. The model is widely used for project planning and analysis. The WindFarm software, including the sound analysis module, was first released in 1997 with many updates thereafter.

Q. Please provide a brief summary of the potential sound levels at the residences near the Project.

A. The maximum calculated sound level along the Project boundary is 50 dBA in all locations except at the following locations:

- At one location along the North Branch Canal in the southeast of the Project area, the expected sound level at the southern edge of the canal reaches 52 dBA, but the expected sound levels will be 50 dBA or less at the non-participating properties south of the canal.

Perkins Coie LLP
1201 Third Avenue, Suite 4800
Seattle, WA 98101-3099
Phone: 206.359.8000
Fax: 206.359.9000

- The 50 dBA sound level is also exceeded at the southern boundary, southwest of the Project area, on the property of a Project participant, and extends south across the canal where it will be 50 dBA or less at the non-participating properties south of the canal.
- The third location is along the western border, southwest of the Project. The adjacent property is owned by a Project participant.

Under site wind conditions of less than 8.0 meters per second, the sound levels would be lower than the values indicated above at all locations along the Project boundary because the sound power levels emitted by the turbine would be lower.

Q. Based on your analysis and experience, do these sound levels indicate that mitigation measures are required?

A. Based on the information available to us, the capabilities of the modeling software, and our experience, we are not aware of sound impacts that would necessitate mitigation measures in order to comply with Washington's regulatory requirements.

Shadow Mapping

Q. At Tab 8 of the Revised Application for Site Certification (Exhibit 1) is a document entitled "Shadow Mapping for Desert Claim Project." What is that document?

Perkins Coie LLP
1201 Third Avenue, Suite 4800
Seattle, WA 98101-3099
Phone: 206.359.8000
Fax: 206.359.9000

A. This is the report we prepared and submitted as final to enXco on December 19, 2008, regarding shadow mapping for the Project. It describes the analysis we performed and the conclusions we reached.

Q. Please briefly explain the meaning of "shadow flicker."

A. Shadow flicker is the term used to describe the change in light intensity observed when a moving turbine blade casts an intermittent shadow upon a receptor.

Q. Under what conditions does shadow flicker usually occur?

A. For shadow flicker to occur, the following conditions are required:

- A sufficient level of sunlight – if the sky is cloudy, shadows may not (or are less likely to) be cast.
- The line of sight between the receptor and the turbine must be clear – obstructions such as vegetation and buildings will prevent the flicker from being observed. Windows need to be positioned such that flicker will actually be observable within the house.
- The turbine will need to be operating with the rotor orientated towards the receptor – if the rotor is facing perpendicular to the line between the sun and the receptor, very little (if any) flicker will be observed. Therefore, wind direction will influence the level of flicker experienced.

Perkins Coie LLP
1201 Third Avenue, Suite 4800
Seattle, WA 98101-3099
Phone: 206.359.8000
Fax: 206.359.9000

- The sun must be in the correct position – the sun's position changes throughout the day and across the year. This is a key variable in the determination of the number of shadow flicker hours experienced.

Q. What factors influence the intensity and duration of shadow flicker?

A. As the distance from the turbine increases, the intensity of the shadow cast by the turbine blade decreases. Shadows that are cast closer to the turbine are more intense as a greater portion of the sun is obstructed by the blade.

The sun's trajectory will also influence both the intensity and duration of shadow flicker. As solar radiation passes through the atmosphere it is scattered and absorbed by the air and suspended particles (known as attenuation). There is more attenuation with decreasing sun elevation, thus shadows become less sharp (more diffuse) and shadow flicker less intense the lower the sun is in the sky.

The duration of shadow flicker is dependant on the orientation of the rotor plane and the amount of time the sun's light is obstructed. The summer sun casts shadows that span a broader direction range than in other seasons, and its early sunrise and late sunset create shadows earlier in the morning and later in the evening than in other seasons. The winter sun is lower in the sky and thus casts longer midday shadows, but daylight hours are reduced.

In addition, atmospheric conditions, cloud cover, and seasonal vegetation changes can influence the intensity of the shadows cast and the perception of shadow flicker.

Perkins Coie LLP
1201 Third Avenue, Suite 4800
Seattle, WA 98101-3099
Phone: 206.359.8000
Fax: 206.359.9000

Q. Please explain how the shadow flicker analysis for the Project was performed.

A. For this analysis, shadow flicker modeling software was used to simulate the path of the sun over the course of the year and assess at regular intervals the possible shadow flicker at a receptor. The receptor and turbine locations were imported into the modeling software along with turbine dimensions and a digital terrain model. By identifying where the Project is on the earth, the sun's trajectory can be modeled, enabling calculation of the amount of time during which the sun, turbines, and receptor are correctly aligned to result in potential shadow flicker conditions. The percent of cloud cover and expected turbine rotor orientation and operation are also taken into account.

Q. What model did you use for the shadow flicker analysis?

A. We used WindPRO software (version 2.6.0.235 released August 2008). This software is a widely accepted industry tool, with over 1,100 world-wide license holders, and is used to model various aspects of turbine operations and project impacts. The calculation engine in the shadow flicker analysis model performs a complete simulation of the sun's path throughout a whole year at the Project latitude. The WindPRO software does not evaluate shadow flicker intensity, but rather focuses on the total amount of time (hours and minutes per year) that shadow flicker may occur at a selected location.

We ran the shadow flicker calculation module in WindPRO with following inputs and assumptions:

Perkins Coie LLP
1201 Third Avenue, Suite 4800
Seattle, WA 98101-3099
Phone: 206.359.8000
Fax: 206.359.9000

- All 95 turbine locations and nine residence locations within 2,500 feet of a turbine, as provided by enXco.
- Turbine rotor diameter and hub-height for the REpower MM92 turbine.
- USGS Digital Elevation Model (DEM).
- The sun must be 4 degrees above the horizon.
- Monthly sun exposure probability based on long-term climatic data from Yakima, Washington obtained from the National Climatic Data Center (NCDC).
- Estimated turbine operational time by direction based on onsite meteorological tower data.
- The receptors defined as a one (1) square meter window one (1) meter above ground level. The model assumes an omni-directional approach which produces shadow flicker results at the receptor regardless of the direction of the actual windows.

The results of our analysis are based on these assumptions and inputs. No site-specific assessments have been made to confirm the shadow-flicker model results. There are several scenarios not reflected in our analysis that may result in less shadow flicker impacts:

- The WindPRO model does not account for obstructions such as vegetation or buildings between the residences and potential shadow impacting turbines, which if present, could further reduce the shadow flicker impacts.

Perkins Coie LLP
1201 Third Avenue, Suite 4800
Seattle, WA 98101-3099
Phone: 206.359.8000
Fax: 206.359.9000

- The model incorporates cloud cover as an average (hours per day). In most areas cloud cover, if present, is likely to occur in the morning and evening hours rather than during the day, thus the analysis may underestimate this reduction in shadow hours as most of the shadow flicker impact on the residences is in the morning and evening hours.
- Again, since the model does not evaluate shadow flicker intensity, potential shadow flicker is calculated whenever there exists a clear line of sight between the sun, turbine and receptor. No distinction is made between shadow flicker that is clearly visible or barely noticeable or even flicker that would not be noticeable.

Q. Will you please summarize your overall conclusions regarding the Project's shadow flicker?

A. The results of the shadow flicker calculations indicate that eight of the nine residences located within 2,500 feet of a turbine, as identified by enXco for this study, have the potential to observe shadow flicker. The shadow flicker impacts will be limited to hours early and late in the day. The maximum expected impact is calculated to be 26 hours of shadow flicker per year at Receptor 3 (the closest residence to the Project). The remaining seven residences are expected to experience less than 20 hours of shadow flicker annually.

Q. Based on your analysis and experience, do these levels of shadow flicker indicate that mitigation measures are needed to reduce the impacts?

Perkins Coie LLP
1201 Third Avenue, Suite 4800
Seattle, WA 98101-3099
Phone: 206.359.8000
Fax: 206.359.9000

A. Based on the information available to us, the capabilities of the modeling software, and our experience, we are not aware of shadow flicker impacts that would necessitate mitigation measures. A commonly used threshold for the acceptable amount of shadow flicker is derived from a German court decision which determined that the maximum allowable shadow flicker from a wind project is 30 hours per year. Based on the results of our analysis, no residence is expected to experience more than 26 hours of shadow flicker per year. Thus we believe that the Project complies with generally accepted industry norms.

Nonetheless, if non-participating residences experience shadow flicker, enXco has stated in its application that it will stop the blades of the wind turbine that causes the shadow flicker during those hours and conditions when shadow flicker occurs, or offer a voluntary waiver agreement to the landowner in lieu of stopping the turbine.

Q. Does that conclude your testimony at this time?

A. Yes.

Perkins Coie LLP
1201 Third Avenue, Suite 4800
Seattle, WA 98101-3099
Phone: 206.359.8000
Fax: 206.359.9000