BEFORE THE STATE OF WASHINGTON

ENERGY FACILITY SITE EVAUATION COUNCIL

In the Matter of Application No. 2004-01: WINDRIDGE POWER PARTNERS, LLC; WILD HORSE WIND POWER PROJECT	EXHIBIT 39 (AN-T)

APPLICANT'S PREFILED DIRECT TESTIMONY
WITNESS # 20: ARNE NIELSEN

Q Please state your name and business address.

A My name is Arne Nielsen and my business address is 7660 Whitegate Avenue, Riverside CA 92506.

Q Please summarize and briefly describe your educational background and wind power project work experience.

A I hold a Bachelors of Science Degree in mechanical engineering. I have been active in the wind industry since 1983. I have worked with numerous major wind turbine manufacturers including Vestas, Bonus, and NEG-Micon in research and development, repair and retrofit,

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manufacturing, wind farm design, wind analysis, project development, sales, and construction. Since 1991 I have provided wind energy consulting services through Wind Engineers, Inc. (WEI) which specialize in environmental modeling, wind resource assessments, anemometry installation & monitoring, and wind energy project design. WEI has prepared numerous wind reports, project layouts, array-loss assessments, noise and shadow-flicker models, and visual simulation work for projects constructed throughout the USA.

Q What is your present occupation, profession; and what are your duties and responsibilities?

A I am the Chief Engineer and President of an engineering consulting firm called Wind Engineers. Our firm specializes in the engineering and analysis of wind power projects, both operating and also under development, across the USA. As the Chief Engineer, I am responsible for the review of any analyses performed and reports prepared by our technical staff. For the Wild Horse wind power project, I personally performed the shadow flicker analysis and oversaw the preparation of the visual photo simulations.

Q Would you please identify what has been marked for identification as Exhibit 39-1 (AN-1)?

A Exhibit 39-1 (AN-1) is a résumé of my educational background and employment experience.

Q Are you sponsoring any portions of the application for site certification for the Wild Horse Wind Power Project?

A Yes. I am sponsoring the shadow flicker analysis presented in Section 3.16.1.4, Health and

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Safety Impacts of the Proposed Action, Miscellaneous (Shadow Flicker.)

Q Did you prepare any exhibits to the application?

A Yes. I prepared Exhibit 9, 'Shadow Flicker Briefing Memo'.

Q Did you prepare these sections and exhibits, or, if not, did you supervise their preparation?

A Yes.

Q Are the contents either based upon your own knowledge, or upon evidence, such as studies and reports that reasonably prudent persons in your field are accustomed to rely on in the conduct of their affairs?

A Yes.

Q To the best of your knowledge, are the contents of these sections and exhibits of the Application true?

A Yes.

Q Do you incorporate the facts and content of this section and exhibit as part of your testimony?

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A Yes.

Q Are you able to answer questions under cross examination regarding this section and exhibit?

A Yes.

Q Do you sponsor the admission into evidence of this section and exhibit?

A Yes.

Q Are there any corrections or clarifications to be made to those portions of the Application that you are sponsoring?

A No

Q Please briefly explain what shadow casting and shadow flicker are.

A Shadow casting is when direct sunlight causes an object to cast a shadow on the ground or on objects. Shadow flicker caused by wind turbines is the phenomenon created by direct sunlight casting a moving shadow through the rotating blades onto the ground or onto stationary objects within the shadowed area. At any given location within the range of the shadow, a flickering effect is then observable when the shadow passes. The shadow flicker effect within a dwelling can be defined as alternating changes in light intensity on stationary objects, such as a window, a glass door or a patio at a dwelling. Shadow flicker is <u>not</u> the alternating shadow/light effect one

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experiences while moving between light and shadow as one might experience running through the woods on a sunny day.

Q To the best of your knowledge, are there any documented human or animal health impacts associated with shadow flicker from wind turbines?

A No, not from wind turbines. We did investigate the possibility of photosensitive epilepsy sensitivity from the Project. Photosensitive epilepsy is a type of epilepsy which is triggered from the flickering or flashing of light in certain people suffering from that kind of epilepsy. The Epilepsy Foundation has excellent information available which explains photosensitive epilepsy. The frequency known to trigger seizures is between 5 and 30 flashes per second. The shadow flicker frequency from wind turbines vary between 0.5 and 1 flashes per second for all of the turbine scenarios under consideration for the Project, which is considerably less than the frequency known to trigger photosensitive epilepsy seizures.

Q Under what conditions does shadow flicker usually occur?

A Unless the receptor is very close to the turbine, shadow flicker usually occurs in the morning or evening when the shadows are "long". No shadow flicker will be present when the sun seen from a receptor is obscured by clouds, fog, or by objects already casting a shadow. Also, when the turbine is not operating, or when the rotor is turned parallel to the receptor, there will be no shadow flicker. The shape of the shadow flicker area that is most affected, in terms of duration, around a turbine is shaped like a butterfly – with the longest durations and longest shadows to the northeast, northwest, southeast and southwest. The intensity is highest closer to the turbine.

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Q Please explain what is meant by the intensity of shadow flicker.

A The intensity of shadow flicker is defined as the observed difference in light intensity between being in the shadow and being out of the shadow cast by the turbine blades. The intensity of shadow flicker depends on the distance from the turbine. Closer to the turbine, the blades will tend to block more of the sun's rays as they pass through the line of sight between the observer and the sun and the shadow line appears relatively wide and dark. This is a relatively high shadow flicker intensity. At distances further away from the turbine, the blades block far less of the sun's rays to the observer and the blade shadows appear thinner and fainter. This is a relatively low shadow flicker intensity.

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

A The intensity and duration both diminish with the distance to the turbine, the effect becoming barely perceptible at about half to three quarter of a mile. Other factors are clouds, trees and other obstructions, wind direction and the locations of windows. For shadow flicker effects inside a dwelling through windows and doors, the duration and intensity depends on all of the above factors plus the size and orientation of windows and doors, blinds and curtains. Both the intensity and duration of shadow flicker is reduced when non-transparent objects are located between the turbine and the receptor – such as buildings, trees, blinds and curtains. When a room is illuminated by light from other windows than the shadowed window (such as indoor lighting), then the flicker intensity is significantly mitigated.

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Q Please explain the results of investigation of shadow flicker regarding the Wild Horse Wind Power Project.

A There is no significant impact on any potential shadow flicker receptors due to the great distance of any such receptor from the Project. The closest receptor is 1.75 miles away. This is too far away to experience any impact from shadow flicker.

Q Please explain the models used for the visual simulations prepared for the Wild Horse Wind Power Project.

A The model we used, Wind Pro, produced by EMD of Denmark, has been developed over the last 15 years and is internationally accepted. Some 560 companies and organizations hold licenses to the software, many of which are governmental permitting agencies. A list of their primary licensed customers is available on the software developer's web-site.

The visual simulation model uses photograph images that are taken in the field at a specific geo-referenced location using a GPS. The photographs were taken at specific locations based on guidance from Tom Priestley who was retained to perform a visual impact assessment for the Project. The computer model positions 3-dimensional projections of the wind turbines into the image with the correct proportions and shading to create a visual simulation of the turbines as would be seen from the specific location where the photograph was taken. The visual simulation or 'photomontage' program contains information on the earth's orbit and rotation relative to the sun. General input parameters are local topography, turbine locations, turbine color and reflection. Input for the individual visual simulations are the date and time the photo

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was taken, camera location, and direction the photo was taken. The date and time are used to create shadowed areas on the turbines and to simulate the expected reflection and color hue.

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