TCC
PreFiled Testimony
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Energy Facility Site Evaluation Council
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To whom it may concern:

My name is Richard Simon, and I've been working as a wind resource consultant to the wind energy industry since 1978, at which time I co-authored the first formal study of wind power potential for the California Energy Commission. I have a BA degree in Geography from the University of California at Berkeley (1973) and a MS degree in Meteorology from San Jose State University (1976). I am the owner and president of Simon Wind, Inc. (www.simonwind.com). My *Curriculum Vitae* is attached.

Over the course of my 45 years working in the wind industry, I have personally sited and/or performed financial due diligence on more than 40,000 megawatts of operating wind turbines across the world. This includes most of the wind farms straddling the Washington side of the Columbia River, plus others near Ellensburg and Walla Walla.

~~I have also processed and analyzed historical wind data collected from 2007-2010 in the western half of the proposed Horse Heaven wind farm, plus 16 years of wind data at BPA's~~

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~~Kennewick measurement tower. Thus, I am very familiar with both the general wind regime of the Horse Heaven Hills, as well as its specific wind regime.~~

Tri-Cities CARES has asked me to review the proposed Horse Heaven wind farm from a wind resource perspective. Three topics are identified and discussed below. ~~Six~~

Turbine Technology. The developer, Scout Clean Energy, has filed with the FAA for 248 wind turbine locations. From the EFSEC application for site certification, they have listed four potential wind turbine technologies, two with 244 turbines rated at approximately 3 megawatts each, and two with 150 turbines rated at approximately 6 megawatts each. The 3-megawatt turbines would have maximum "tip heights" (tower plus blade in the vertical position) less than 500 feet, and the 6-megawatt turbines would have maximum tip heights or approximately 665 feet. A specific list of which turbine locations would be utilized has not been furnished.

Also, it now sounds like Scout in their more request for interconnection to BPA is proposing 248 GE turbines rated at 3.4 megawatts (my best assessment of the options presented), which is a project total of 843 megawatts. To this should be added to the 300 MW for the proposed co-located solar energy generation facility, thus a total of 1143 MW. Scout wishes to make a final decision on turbine technology and locations after the adjudication is complete and they receive their ASC from EFSEC.

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In my four decades of working with project developers, all permits are granted for a specific turbine array plan, which includes the number and exact locations of all turbines, their technology (turbine manufacturer and model) and heights, as well as environmental reviews, community impacts, and complete sets of electrical and construction drawings. In lieu of such complete and specific documentation it would be unprecedented for permitting agencies to issue open-ended permits for Horse Heaven.

Wind Farm Size. There are very few wind farms at close to 1000-megawatt capacity in the United States, and none larger than 343 megawatts in the state of Washington. And for Horse Heaven, turbines are planned along a 25½-mile stretch of the escarpment overlooking the Yakima and Columbia River valleys from Benton City in the west to east of the city of Kennewick. Such a large project would completely change the landscape for the roughly 250,000 people living in the Tri-Cities area, of whom many would be within 6 miles of the wind farm.

I am not aware of any existing large wind farm in the United States that impinges so significantly on such a large population as Horse Heaven would to the Tri-Cities.

~~**Wind Resource Potential**. Since I have sufficient wind data from four meteorological towers in the proposed Horse Heaven wind farm footprint, I am able to prepare a basic wind energy resource assessment for it. It would be better to have current data from Scout's met towers.~~

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These meteorological data were requested as part of the discovery request, but Scout has refused to provide it. It is intended to make a motion to compel production of these and other data.

Based on the various filings, I evaluated the GE-3.4 megawatt turbine. One of the models used in Scout's application was an option for a GE-3.03 megawatt turbine. That model, to my knowledge, is no longer available, and has been replaced by the 3.4-megawatt model. It has a 140-meter rotor diameter. To keep the tip height under 500 feet, the maximum tower height would be 82 meters, which is what I used for the energy simulations.

The wind resource assessment process has four key components, summarized below. Prevailing wind directions are from the southwest:

Establish long-term average annual wind speeds at the on-site met towers and extrapolate those speeds to the proposed turbine hub height. Of these met towers, two were 50 m (164 feet) tall and one 60 m (197 feet) tall. Winds were measured at multiple heights above ground, and the calculated wind shear (increase of wind speed with height) was used to extrapolate speeds up to 82 m above ground. The fourth tower is the historical BPA monitoring station on Jump Off Joe within the Nine Canyon wind farm, with one measurement level at 26 m (85 feet). This is a very steep hill with an atypical terrain that accelerates the low-level winds much more than would be expected at any of the Horse Heaven wind turbine locations.

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The results showed strongest winds atop the steep escarpment in the northwest with an extrapolated long-term 82-m wind speed of 7.85 meters/second, which is equivalent to 17.6 mph. And the wind shear at this site is very low—almost no increase of wind with height. The second met tower was also located in the western half along the escarpment but with less dramatic terrain, and its extrapolated long-term wind speed at 82 m is 7.1 meters/second (15.8 mph). The third met tower is approximately 2 miles upwind (southwest) of the escarpment, and its extrapolated long-term 82-m wind speed is 6.7 meters/second (15.0 mph). BPA's Kennewick station had a 15-year average wind speed of 8.2 meters/second (18.3 mph), and likely its winds will decrease with height. NREL's Washington wind speed maps confirm that Jump Off Joe in the center of the Nine Canyon wind farm is the windiest location in the current area of interest.

Evaluate long-term average annual wind speeds for the project in aggregate. The escarpment should have the best winds of the project area due to its ability to accelerate winds blowing over it. At most half the turbines are planned along the escarpment, many of the west on the upwind side, and a few on the downwind side. The range of winds measured at the four met towers should bracket those across the turbine array. Informal modeling predicts the range for individual turbines to be roughly 6.6 – 8.0 meters/second (14.8 – 17.9 mph), with a likely aggregate speed between 7.0 – 7.5 meters/second (15.7 – 16.8 mph).

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Convert average wind speeds to gross energy potential. Wind turbines produce a specific amount of power at a given wind speed, and this relationship is known as the power curve for that turbine. One also has to take into account the density of the air, which decreases with elevation. The "gross" energy potential is calculated by combining the annual wind speed frequency distribution (how many hours per year at a given wind speed) by its corresponding power output at that speed. (Gross energy does not take into account various discount and loss factors, which are discussed next.)

Such calculations are done in metric units. For Horse Heaven, we have scaled the annual wind speed frequency distributions to 7.0 and 7.5 meters/second, which, from the evaluation above, bracket the expected aggregate long-term average annual 82-m wind speeds for the Horse Heaven turbine array. Here are the resulting gross annual energy projections for the GE-3.4/140 turbine. "MWh" stands for megawatt-hours:

Average Speed (m/s)	Gross MWh/turbine	Gross Capacity Factor (%)*
7.0	12155	40.8
7.5	13099	47.1

**capacity factor is defined as the ratio of computed energy for a site to the amount of energy that would be produced if a turbine were at full capacity (3.4 MW in this case) each hour of the year.*

Convert gross to net energy projections. The gross energy projections above are theoretical, in the sense that they don't include various discount factors always present in wind farm operations. There are seven major categories for such discounts used in the wind industry.

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Without site-specific engineering and contractual information, many of these discounts are not known. However, "typical" industry discounts are listed below in such cases.

Discount Category	Estimated Loss (%)	Remarks
Turbine Availability	4	Over the lifetime of a typical wind farm
Electrical Losses	3	Typical value for a large wind farm, could be higher
Wake Losses	10	This is a very compact wind farm with relatively tight turbine spacing and tendency for very stable air flow. Compact turbine arrays create more wake loss than open arrays.
Turbine Performance	4.1	Combined discounts for turbulence (1%), high-wind hysteresis (0.2%), sub-optimal operations (1%) and power curve inaccuracy (2%)
Environmental Items	2.9	Combined discounts for blade degradation/soiling (1%), icing (1.5%), extreme weather (0.2%), and site access (0.2%)
Curtailment	0: however, if there are transmission, or other curtailment scenarios, this discount would not be zero.	Potential curtailment from manufacturer's operating restrictions for the turbines, curtailment for birds, off-taker curtailment, and other factors. We have assumed zero, but do not know if this is correct.
Balance of Plant	1	Typical industry value

One combines the above discounts through a product of their "efficiencies" (100% minus the discount). With the above discounts, the combined total efficiency is 77.2%, and thus the total discount is 22.8%.

Long-term average annual net capacity factor projections are simply the gross projections reduced by the discounts:

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- At an average speed of 7.0 m/s, the annual net capacity factor would be 31.5%
- At an average speed of 7.5 m/s, the annual net capacity factor would be 34.0%

These net capacity factors are much lower than modern wind farms are producing in the solid wind zones across the United States—basically Montana, Wyoming, the Upper Plains and Midwest. Typical long-term average annual net capacity factors in these zones range from the mid-40% to lower 50% range.

Economic feasibility. Since turbine pricing isn't reduced for lower wind sites, it is not evident how Horse Heaven will be economically viable. For such a large project, Scout should provide evidence of their economic justification, which would include predicted annual energy production and revenue (the latter with some levelized annual price per kilowatt-hour), whether there is a Power Purchase Agreement with a private or public off-taker, and whether Horse Heaven is planned to be a merchant plant (with no guarantee of sales price. Such details are outside my meteorological area of expertise, but the concept is appropriate based on my 45 years of experience—no project of this size should be approved without a guarantee of its financial health. One of the criteria of the governing statute, RCW 80.50.010(1) is that a project provide "abundant clean energy at reasonable cost."

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~~**Grid availability**. Scout has applied for 800-1150 MW, of which 850 MW could be wind, and apparently BPA has indicated that a grid injection capacity applies such that only about 850 MW could be added to their transmission lines at a time. It is likely that this curtailment would apply in the spring season when hydroelectric power is maximized. This is certainly an issue for EFSEC as amendments to RCW 80.50.010 now include the "integration of clean energy sources" as a part of the Council's responsibilities.~~

~~In fact, the windiest months of the year at Horse Heaven are March and April. Summer is the least windy time of the year. BPA has expressed a lack of enthusiasm for more wind with that kind of seasonal profile. And Pacific Northwest Investor Owned Utilities are increasingly adding Wyoming and Montana winds (different seasonal pattern) for better integration into the grid.~~

~~And in the spirit of having dispersed resources, packing roughly 850 MW of wind reduces that potential to add other renewable energy in other parts of the state or the Pacific Northwest. There are many such wind farms being planned at this time, and they might be a better fit to the grid system.~~

Impact on Nine Canyon. The eastern end of the proposed Horse Heaven wind farm is close to (and upwind of) the existing Nine Canyon wind farm, which is owned by a consortium of public utilities. Wakes from Horse Heaven would reduce the energy production from Nine Canyon. A quantitative determination of the potential wake impact would normally be required for

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evaluating the merits of a new wind farm, and in this case, it is public power that would be impacted. Has wake modeling been done?

Conclusion. From my professional perspective, there are conditions regarding the proposed Horse Heaven wind farm that may not be desirable~~, both from a strict wind resource perspective, true value to the Pacific Northwest energy grid, and visual impacts on a highly populated region. There are many other locations with suitable wind regimes elsewhere in the Northwest, and it may not be in the best interest to put all one's eggs in this single basket~~.

Respectfully submitted,

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President

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