STATE OF VERMONT
PUBLIC SERVICE BOARD

Docket No. _____

Petition of Deerfield Wind, LLC for a Certificate	)
of Public Good pursuant to 30 V.S.A. section 248,	)
authorizing it to construct up to a 45 MW wind electric	)
generation facility, and associated transmission and	)
interconnection facilities, in Searsburg and Readsboro,	)
Vermont, and operate the same.	)

PREFILED DIRECT TESTIMONY OF KENNETH KALISKI, P.E.

ON BEHALF OF DEERFIELD WIND, LLC

January 8, 2007

Summary:

Mr. Kaliski is the director of Environmental Services at Resource Systems Group, Inc. His testimony evaluates the noise impacts of the Project. He concludes that the Project-related noise will not have undue adverse impacts on aesthetics or on human health.

Q. Please state your name and occupation.

Response. My name is Kenneth Kaliski. I am the Director of Environmental Services at Resource Systems Group, Inc. of White River Junction, Vermont.

Q. Please describe your qualifications and experience.

Response. I have a BA in Biology and Environmental Studies from Dartmouth College and a BE in Engineering from the Thayer School of Engineering at Dartmouth College. My educational experience includes coursework in sound level monitoring, noise control engineering, active noise control, indoor and outdoor acoustical modeling, vibration control, sound level meter design, and the physics and mathematics involving sound and its propagation.

I have worked at Resource Systems Group since 1986, and serve on its Board of Directors. Resource Systems Group is a member of the National Council of Acoustical Consultants.

I have worked with the noise impacts of wind projects for over ten years. These projects include a review of the proposed Boundary Region project in Maine, the Searsburg project in Southern Vermont, a review of the Sheffield Vermont project, and the Hoosick and Brodie Mountain projects, both in Western Massachusetts. My division of the company has also worked in other aspects associated with wind turbines, including air emissions offsets including Highland County, West Virginia, Reddington Wind Project in Maine, and East Haven in Vermont.

I am a licensed professional engineer in the States of Vermont and New Hampshire. I am Board Certified through the Institute of Noise Control Engineering. I am a member of the Acoustical Society of America, the Air and Waste Management Association, the Institute of Transportation Engineers, and I am a Qualified Environmental Professional as Certified through the Institute of Environmental Practice. I hold a patent for an environmental noise monitoring system.

My resume is attached as ***Exhibit DFLD-KK-1***.

Q. Have you previously testified before the Public Service Board or in other judicial or administrative proceedings?

Response. In my 20 years with Resource Systems Group, I have given testimony before all of Vermont's nine District Commissions and the Environmental Board regarding noise, traffic, air, and related impacts. Some of the most relevant Environmental Board cases where I have evaluated potential impacts from noise include John and Joyce Belter, Barre Granite Quarries, Black River Rod and Gun Club, Hannaford, John Russell Corp., McLean, and Alpine Stone. In addition, I provided testimony in the Section 248 proceeding for the Green Mountain Power Searsburg wind project and Velco's Northwest Reliability Project.

Q. What is the purpose of your testimony?

Response. I will describe the results of our analysis evaluating the noise impacts of the proposed Deerfield Wind Project.

Q. Please summarize the investigations you conducted regarding the Project.

Response. We conducted background noise monitoring at seven sites around the area. We then modeled sound levels from the proposed wind turbines in a 12,900 acre area around the site. We compared these projected sound levels to relevant noise guidelines and standards.

Q. Can you give a primer on sound and how it is modeled?

Response. Yes. ***Exhibit DFLD-KK-2*** defines "noise;" explains how sound propagates, describes the decibel scale, and gives a summary of how sound is attenuated by various factors.

In general terms, sound attenuates over distance through the actions of geometric spreading, atmospheric absorption, meteorological effects, ground absorption, and intervening terrain, barriers, and vegetation.

- The attenuation due to geometric spreading is about 6 dB for every doubling of distance over soft ground.
- Air absorbs sound. The amount of absorption is dependent upon frequency, temperature, and humidity. Low frequencies are absorbed very little, while very high frequencies can be attenuated significantly over as little as 100 meters. Our modeling uses the ISO 9613-1 standard to calculate atmospheric absorption, and assumes the most conservative temperature and humidity condition (that is, for the least attenuation).

- Temperature and wind gradients can affect sound propagation by bending sound either toward the ground or sky. Our modeling assumes a moderate nighttime inversion with winds blowing from each source to each receiver, simultaneously.
- Intervening terrain will block the line of sight and thus reduce noise to the receiver. In this case, the turbines are up high enough so that there are only a few instances of receivers where the terrain blocks the noise from the wind turbines. Our modeling takes this into account automatically by integrating digital elevation data from the US Geological Survey.
- Forest cover will reduce sound so long as it is dense enough to block the line of sight between the source and the receiver. It is not possible to conduct field checks of the line of sight over the large expanse of land evaluated for this project. Thus, we were conservative and assumed that there is no forest cover in the study area.

Q. In your opinion, what noise standard should be applied at the nearest residences?

Response. Neither Searsburg nor Readsboro has a quantitative community noise standard. In addition, there are no federal or state regulatory standards that apply to this project. The applicable standard under Section 248 is that the Project should not have an undue adverse effect on the aesthetics of the area. Therefore, to consider what is a reasonable level of noise, we must evaluate other standards and guidelines that are used elsewhere. Some of those standards include:

- The US EPA Protective Noise Level Guideline

- The World Health Organization Suggested Community Noise Criteria
- Bureau of Land Management Programmatic Environmental Impact Statement on Wind Energy Development

The US EPA Protective Noise Level Guideline was established to determine a sound level that protects the public health and welfare with an adequate margin of safety. It is not a standard and is not meant to be applied as a standard. For most residential areas, the Protective Level is 55 dBA Ldn. The Ldn is day-night average sound level, with sounds during the night weighted by +10 dB.

The Bureau of Land Management has developed a Programmatic Environmental Impact Statement (PEIS) on Wind Energy Development on BLM Lands in the Western United States. The PEIS discusses guidelines on citing wind turbines and refers to the EPA guideline of 55 dB Ldn: "The EPA guideline recommends an Ldn of 55 dB(A) to protect the public from the effect of broadband environmental noise in typically quiet outdoor and residential areas…. This level is not a regulatory goal but is 'intentionally conservative to protect the most sensitive portion of the American population with an additional margin of safety.'"

The World Health Organization's "Guidelines for Community Noise" suggests noise criteria based on the most recent scientific research on noise effects. The Guidelines, published in 1999, recommend a limit of 50 dBA, averaged over the day to protect against moderate annoyance, and 45 dBA, averaged over the night to protect against sleep disturbance.

In summary, the noise guidelines discussed above are:

Source	**Criteria**
US EPA Protective Noise Level	55 dB Ldn (or roughly 55 dBA during the day and 45 dBA during the night)
Bureau of Land Management	55 dB Ldn
World Health Organization	50 dBA average during the day and 45 dBA average during the night

Given the scientific evidence regarding sleep disturbance and other impacts that were reviewed by WHO, we propose that the Project should meet a standard of 45 dBA Leq (night) averaged over the entire night and 50 dBA Leq (day) averaged over the remainder of the day. This is equivalent to a day-night average level of 52 dB Ldn. This would be applied to areas of frequent human use during the summer months, including homes, yards, and porches. This would not apply to areas that have transient uses such as driveways, trails, and parking areas. This standard is more stringent than all of the federal standards mentioned above and is below the level that can cause hearing impairment and activity interference. This noise limit is both protective of human health and prevents any quality-of-life concerns, i.e., would not result in an undue adverse effect to the aesthetics of the area

Q. Did you prepare an analysis of noise levels from the proposed wind turbines?

Response. Yes. A detailed report showing our analysis is found in ***Exhibit DFLD-KK-3***. That report describes background noise monitoring, modeling of the noise

from both the existing Searsburg project and the proposed project, and recommendations for mitigation.

Q. Based on your analysis, what are the forecasted sound levels at the closest homes?

Response. Modeling of turbine noise was conducted using the standards set forth in ISO 9613-2, "Attenuation of Sound during Propagation Outdoors," as implemented in the Cadna A software program. The ISO standard defines a methodology for predicting sound levels at distant receivers for meteorological conditions favorable to propagation. That is, during moderate nighttime inversions with winds blowing from the source to the receiver.

The highest modeled sound level at a residence from the proposed Deerfield wind turbine strings is 41 dBA. This level would occur at the first two homes to the north of the cemetery adjacent to the Searsburg access road, which are approximately 2,600 feet from the nearest proposed turbine site. At all other homes, sound levels would be less than 40 dBA, even when combined with the background sound contributed by the existing Searsburg turbines.

Q. How do these sound levels compare with existing background levels at the closest receptors?

Response. We measured background sound levels at seven locations around the proposed wind turbines. At representative locations along VT 8 and VT 9 where residences are located, average hourly sound levels ranged from 40 dBA at night to

60 dBA during the day. The sound levels were dependent on the diurnal pattern of traffic and background wind speed.

The sound levels from the Deerfield Project will increase overall background noise (inclusive of background traffic) by less than 3 dBA at all residences. For comparison, the VTrans noise policy considers the "Effects of Increase" of 3 dB to be "None".

Q. Describe the mitigating effects of vegetation, ground absorption, topography, and wind.

Response. Given the fact that the wind turbines are elevated significantly above the surrounding terrain, and that the turbines would operate during the winter when deciduous trees are bare, we did not assume that there would be any sound level reductions due to foliage.

While we assumed that the foliage would not block the line of sight from any receiver to the wind turbines, we did assume that the ground along the entire area of the study is "porous" and thus would absorb some sound. The amount of absorption is factored in as part of the ISO 9613-2 algorithm.

Topography generally has the greatest impact on sound propagation. The rolling nature of terrain can block the transmission path of the sound and reduce its level. Given the fact that the turbines are elevated on the highest ridges in the area, the amount of terrain reduction is minimized, but still taken into account by the model.

Wind has a complicated impact on sound levels. First, wind gradients can increase downwind propagation and decrease upwind propagation. Wind also affects metrological stability. The most stable nighttime conditions, which improve sound propagation, are under light or no winds, when the turbines would operate less. Third, wind affects the sound power of the wind turbine. Under higher wind speeds, the turbine generates more sound. Finally, higher wind speeds create higher background noise. This can mask the sound levels from the wind turbines, especially for ridgeline winds above 20 mph.

Q. Does the Project meet the standards outlined above?

Response. Yes. The Project will not cause an exceedance of the noise standards at any of the residences (although it should be noted that for some of the residences, those noise standards may already be exceeded due to traffic-related noise).

Q. Did you conduct any other modeling analyses to further confirm this conclusion?

Response. Yes. To evaluate the likelihood of sound levels exceeding a nighttime sleep disturbance level of 45 dBA $Leq_{(8)}$, we obtained one year of hourly wind speed and wind direction data from the ridgetop meteorological towers in Searsburg. We used this data to calculate stability class, and adjusted the sound output from the wind turbine based on the actual wind speed and assuming a ±2 dB confidence interval about the rated sound power level. Finally, we estimated the sound level at

this worst-case home for each hour of the year. Assuming these conditions, our results show:

1) With the proposed Deerfield turbines operating only, there would be no hours of the year that exceed 45 dBA.

2) With the combined operation of Deerfield and GMP/Searsburg, there would be a 99% probability that any hour would be at or below 45 dBA.

3) Of the hours that would exceed 45 dBA, none would occur during warm-weather months (May to September).

4) With the combined operation, there would be no period during which the average 8-hour nighttime sound level would exceed 45 dBA.

This analysis confirms that there is a very high probability that the 45 dBA $Leq_{(8)}$ standard will not be exceeded. In fact, under the above scenario, there were no periods in which the 45 dBA $Leq_{(8)}$ standard was exceeded.

Q. Will low frequency sound from the wind turbines create annoyance?

Response. No. At the closest home, our models show that noise from the turbines below 31.5 Hz will be below the threshold of human hearing and noise at the 63 Hz octave band is well below levels that can create sound-induced building vibrations.

Q. What will be the impacts of construction?

Response. Most of the construction will take place at least 800 m (2,600 feet) away from the nearest residence. At this distance, the loudest pieces of equipment would

be a rock drill and wood chipper at 54 dBA and 58 dBA, respectively. The presence of dense vegetation is likely to reduce the levels by another roughly 10 dBA. Due to the setbacks involved and the limited duration of the activities, construction noise should not pose undue quality of life concerns.

Q. Are there other sources of operational noise besides the wind turbines?

Response. There may be a transformer at the base of each turbine, similar to those at the Searsburg site. These transformers are not readily audible offsite.

At the existing GMP substation or at a new substation to the northwest of the project area, there will be another 34.5 kV/69 kV transformer installed. This transformer will be designed to meet a noise level of no more than 45 dBA at the nearest residence.

The 34.9 kV and 69 kV transmission lines associated with this project do not generate any significant noise and are likely to be inaudible. Noise from transmission lines is generally audible under certain conditions for line voltages at and above 500 kV, which is well above what is proposed for Deerfield.

The Project expects roughly two vehicle round trips each day to the Eastern and two to the Western Project Areas for maintenance and operations. The site will be accessed via a pickup truck or off-road vehicle in adverse conditions. This level of increased traffic will not create any adverse sound impacts especially considering the proximity of the nearest residences to state highways.

Q. What recommendations are you making to reduce the impacts of the Deerfield Wind Project?

Response. Based on the above analysis, we recommend:

1) Selecting turbines with a sound power level of 106 dBA or less or demonstrating that the final number and configuration of the turbines will not exceed 45 dBA, averaged over the night, at the nearest residence.

2) Selecting wind turbines with no tonality or tonality within an acceptable level.

3) Providing neighbors with a site supervisor to call so as to resolve noise complaints promptly.

Q. With these measures, will the Project create undue adverse impacts on noise aesthetics?

Response. No. The sound levels which will be generated by the Deerfield Wind Project will be below the commonly accepted WHO sleep disturbance noise standard and it can be constructed in such a way as to have no impact to health and no undue adverse impact on aesthetics.

I would further note that I believe the Project could utilize a number of different configurations (in terms of the total number of turbines and turbine models) and still stay within the noise limits recommended above.

Q. Does this conclude your testimony at this time?

Response. Yes.