10 March 2015
Ms. Jane Murray

Attached are my suggested revisions/additions to the draft SEC Rules of 16 December 2014, and the reasons therefore. They are for dissemination.
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These proposed edits to the proposed rules (dated 16 December 2014) follow from a detailed consideration of the meteorology, astronomy and topography of New Hampshire. In particular, once it is understood that New Hampshire wind resources are available only from sites over the tops of hills, ridges and mountains, and that these wind resources are available predominantly in the middle of the night, the subject of their harvesting is changed completely, and such harvesting is dramatically limited in scope and size, and in their value, either as an energy source in themselves, or as a substitute for carbon-based fuels. The net result of all these special factors is that New Hampshire can never harvest the legislatively required 15% wind energy, a number obviously selected without well-considered meteorological advice.

Issues and Solutions
1. Inadequate notice
2. Available sites and their cumulative effects 3. Meteorological and topographical effects on noise 4. Topographical and astronomical effects on shadow flicker 5. Inadequate icing statistics 6. Public access to meteorological data 7. The impossible 15% goal

1. Inadequate Notice
The current rule, Site 301.03(h)4 states that there will be "at least one public information session in each county where the proposed facility is to be located". The Antrim Wind Energy case shows the total inadequacy of this rule. The rule needs to be changed to include all towns and residents seriously affected by the proposed facility. Any other approach makes a mockery of the existing rule itself. The center of the Town of Stoddard, adjacent to the Town of Antrim, is closer to Tuttle Hill than the center of Antrim. Even without this glaring observation, the idea of restricting adequate notice from the residents most affected is laughable.
Suggested solution::::::::::
Add "and in any Town within 25 miles of the proposed facility". Even if the SEC is not mandated to announce these proposals to nearby Towns, whose residents who will be severely affected by their decisions, it should not feel restricted in its overall duty to these residents.

2. Available sites and their cumulative effect Usable wind energy in New Hampshire is available only over the tops of our hills, ridges and mountains. It is not useable in our valleys or from sites which are secluded and hidden from public view. The wind is sufficient only when it has traversed large, open areas (forested areas don't apply). It is mostly available in the middle of the night, with small contributions during the daytime. The effect of these limitations is to confine these giant turbines to the very tourist viewsheds for which our state is known, and to cover most/all of them! In addition, these sites will be viewable from many places, and simultaneously, and sequentially viewable. The cumulative effect of the number of turbines required to generate the required 15% clean wind energy is to cover every hill, ridge and mountain in New Hampshire.
Suggested solution:::::::::
Site 301.03(i)(1)d specifies "shall extend to a 10-mile radius". The meteorology and topography of New Hampshire require that such facilities be built on prominent, and highly visible sites, which will be viewable from very long distances. A 500' tower on a 1500' hill is equivalent to a 2000' tower on flat land and needs to be considered as such. The very long-range scenery for which New Hampshire is well known, is the basis for our well developed tourist, hiking and camping reputation. In addition, 500' turbines are required by FAA regulation to be topped

with highly visible flashing red lights. Rule 301.03(i)(1)d needs substantial revision to account for these obvious concerns. Change to "shall extend to a 100-mile radius".

3. Meteorological and topographical effects on noise The meteorology at and around an industrial wind facility affects not only the intensity of the sound which the turbines generate, but also the extent to which these sounds are broadcast to its neighbors. In the first instance, the wind speed determines the rotation rate of the blades, and their noise output. But the difference in the wind speed from the tops to the bottom of the blades, the wind shear, also affects the sound generated. In addition, the temperature and wind speed surrounding the turbines, and in particular the temperature difference between the air above and below the turbines determines the size of the area, and its intensity, over which this noise is broadcast.

Almost everyone has heard echoes, which are a response both after a measurable time interval, at an intensity little diminished from its original level. Most people have also heard sound coming from an air duct in a building, at a surprising high intensity, considering its distance from its likely source in another room in the building. The building's air ducts are very good carriers of sound. Ducting in the air is also a well-known phenomenon, allowing, in the proper meteorological situations, to carry sound for long distances. The meteorology of sound ducting is known in broad terms, but its application to a turbine operating on undefined topography needs careful study and measurement. An "atmospheric inversion", in which the air near the ground is colder that the air above the ground forms a duct, very similar to those in a building, and, under the "right" circumstances, can carry sound over long distances. It so happens that inversions are most common at night, when the ground cools the air it contacts. When such an inversion is complemented by an underlying icy snow surface (an excellent sound reflector) and maybe some snow-covered hills on both sides, a duct could be very efficient in trapping the sound radiation from a noisy turbine, and sending it, with little diminution, to great distances. If these conditions sound like they might occur often in winter in New Hampshire, this should be a concern. The well known phenomenon of "ducting" is defined in the American Meteorological Society "Glossary of Meteorology" (1959 & 2000 editions) as "anomalous propagation of waves, electromagnetic or acoustic". Anomalous meaning propagation to far distances in particular atmospheric conditions.

The correlation between high winds and high wind shear in their generating maximum noise, their likely additional correlation with a temperature inversion and icy winter surfaces, and the quiet of a country night, appears to be not only a meteorological nightmare, but a common occurrence.

Section 301.03(i)(6)a1. describes the sound assessments, both pre- and post-construction. There is much detail on the ANSI standards for such measurements, but there is no recognition that the only sound studies which are applicable to this issue must concentrate on the issues, and the weather, that affect the nearby (and some farby) residents. Such studies have to acknowledge that the turbines are to be located on a very specific hill, ridge or mountain. There are NO two hills, ridges or mountains that have the same sound characteristics as any other. If they were all similar, there would be no locations at which echoes could be heard.

Sound measurements taken in daytime, or in meteorological situations without a temperature inversion and without ice-covered snow surfaces, etc., are irrelevant to the issue before the SEC. The net of a careful sound measurement program around an isolated hill would surely show that there are certain meteorological situations in which sound generation would be substantially enhanced, and broadcast to a selective group of residents in a particular direction from the turbines. The only relevant measurements then would be those taken in those particular weather situations. The sound measurements to date appear to have avoided these peculiar weather conditions, let alone take the proper measurements during them.

Suggested solution:::::::::::::::::

Section 301.03(i)(6)a1. needs to be rewritten first to require the developer to determine the particular weather situations in which the generation and broadcast of noise is enhanced, in which directions, and to what extent. It then needs to determine the frequency of such enhancements and the residents affected thereby. Add a section to 301.03(i)a1.(ii) as follows:

"(iv) Determine, by actual measurements taken in the middle of the night and the early morning hours, on clear night, with light surface winds, the preferred directions for the noise propagation, the extent of this propagation, whether there are gaps in the noise levels at preferred distances from the turbines, whether there is a correlation between the nights of high wind shear on the blades and this propagation, how frequently it occurs, the extent to which it is enhanced by an icy snow cover, and any peculiar topographical effects".

4. Topographical and astronomical effects on shadow flicker The shadow flicker of proposed facilities is usually presented as the output from a mathematical model. This model attempts to account for the effects of average clouds along the horizon, but ignores both the enormous difference in this assumed cloud cover as the turbine blade is seen at an angle elevated above the horizon (as it would be on a hill), and the substantial difference in the intensity of sunlight when seen elevated in the sky above a flat horizon.

It is well known that looking directly at the sun on a flat horizon causes few eye problems and can be very pretty at times. However, looking at the sun up in the sky causes blindness very quickly. This is simply a reflection of the attenuation of sunlight by the length of its path through the air. Light from the sun on a flat horizon has traversed a hundred or more miles through the air, being absorbed and scattered over those many miles. The light from the overhead sun has not been subjected to very much absorption or scattering. Therefore the difference in the intensity of sunlight increases dramatically as the sun is elevated from the flat horizon. Most of this difference in solar intensity occurs just above the horizon. That means the intensity of the shadow flicker from turbine blades also increases dramatically in intensity if the blades appear only a short distance above the horizon, as would happen when the turbines are elevated with respect to the source. Since the turbine sites in NH will always be elevated above their neighbors, the intensity of the sunlight between the shadow will be 10-1000 times stronger than similar sunlight at the same level of a flat horizon. This vast difference in intensity of the shadow/sunlight flicker will have a pronounced effect on both the human reaction thereto, and on the distance over which the effect will be discernible.

Suggested solution:::::::::::

Site 301.03(i)(6)a2. needs to be revised to read "Include a report evaluating the shadow flicker, including both its frequency, the time of year, the intensity ratio from bright to dark, on every non-owned property. This report can be based on a modeling program provided it takes into account the elevated source of the flicker with respect to each property, the effect of the shadows cast not only directly on these properties, but on properties which will be affected by the shadows cast on reflective snow, ice and water surfaces. This report must include data showing the effect on residents due to the substantially enhanced brightness contrast between light and shadow due to the sun's elevation above the apparent horizon of the viewer, and the drastically reduced apparent cloud cover due to their elevation".

5. Inadequate icing statistics

It is well known that icing at most weather stations, which are situated near sea level is very infrequent, and seldom very severe. It is also well known to anyone who has visited Mount Washington, or seen pictures taken on top, that icing is both a frequent, and frequently severe occurrence on that mountain at 6000' It would follow that the frequency and severity of icing on turbine blades at intermediate levels of 1500-3000 feet above seal level would be in the mid-range between these two extremes. But the actual number, which will surely vary with the height of the facility and its height above the surrounding terrain, is unknown. The determination of this number is also very much affected by the size of the blades and their speed through the air, which exceeds 100 mph. The Mount Washington Observatory Auto Road has reacted to this uncertainty by establishing weather observing sites at intermediate elevations. An analysis of these observations, and adding the effects of the 100 plus mph speed of the turbine blades, would be a good place to start in determining the frequency and severity of icing on the blades of any proposed turbine.

Suggested solution::::::::::::

Site 301.03(i)(6)a4. needs to be revised to begin with an explanation of the data, or the data from which a model has been devised, by adding at the end "this assessment must include an explanation of the data derived from observations from weather sites located at the planned elevation of the tops of the blades, and account for the very high speeds of the blades through the atmosphere".

6. Public access to meteorological data The preliminary to an application for an Industrial Wind facility is the establishment of a meteorological tower (met tower) somewhere on the proposed site. Every meteorologist is aware of the fact that the siting of this tower, and the required measurements to be made by it are very sensitive to its location on the hill and its exposure to the wind and other meteorological factors. It is well known that the highest winds on hills occur preferentially with certain wind directions. Not only does the topography of the site/hill affect the speed of the winds recorded, it affects their direction, their gustiness and their shear, all of which affect the amount and frequency of noise, shadow flicker and icing.
Suggested solution:::::::::
Add a section 301.03(i)(6)a9 as follows "All of the meteorological data collected by the meteorological tower on the site will be made available, at least a month prior to any application for a facility, in a form which can be easily analyzed by concerned residents. The location on the site, and its surrounding topography, will also be indicated, including any changes in the site or in the measured meteorological data over the period of its collection".

7. The impossible 15% goal
The topography and meteorology of New Hampshire lead directly to the siting of industrial wind energy facilities on the tops of hills, ridges and mountains, while the meteorology leads to the bulk of this energy being generated in the middle of the night. But in order to meet the legislative requirement of a 15% AVERAGE contribution from wind energy, the 1/3 to 1/4 operating efficiency of wind turbines requires that the wind turbines have a maximum output when operating of 3 to 4 times the 15%, or 45% to 60% of the total electric generating contribution of all the other sources. Since the weather data show that when one turbine is operating at or near maximum most of the other turbines on the ISO/NE grid will also be operating at or near maximum, the grid will receive a surge of historic proportions! This simple arithmetic shows the 15% average contribution is wishful thinking writ large! This arithmetic also shows that the 15% requirement will require well over 1000 turbines, covering every viewshed in our state.
Suggested solution:::::::::::::::
The SEC must completely ignore the 15% statute in their consideration of Industrial Wind Facilities. Only a few such facilities can be authorized without creating a surge in electric generating capacity many times the capacity of ISO/NE to accept. Furthermore, even the limit of about a half dozen such facilities requires that their siting within the state be compatible with, and only with the expressed permission of ISO/NE in order to avoid unacceptable localized surges in the middle of the night. Any attempt to authorize such facilities in excess of these few, and without serious consideration of their entry points into the grid is a fool's errand, and says that wind energy is technically unsuited to the state of New Hampshire.
Add to Site 301.09 the following paragraph (d) "Since the ISO/NE grid could never accept an average 15% contribution, the appellant must demonstrate either that the simultaneous addition of power by many wind facilities in the middle of the night will not overload the ISO/NE grid, or show that his facility would be one of the very few facilities properly situated in the event that ISO/NE severely limits the number of wind facilities".

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