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MEMORANDUM

January 22, 2008

To: Kristen Goland, Deerfield Wind LLC
From: Les Polisky, Comsearch

Subject: Response to the Duncan Cable TV Service Letter Requesting an Interference Evaluation from the Proposed Deerfield Wind Energy Project to the Duncan Headend Facility in Wilmington, Vermont

Introduction: Comsearch was contacted by PPM Energy on behalf of Deerfield Wind LLC, Vermont to determine if the wind turbines at the proposed Deerfield Wind Energy project would cause material interference; whether it be electro-mechanical, electromagnetic, electro-static or radio frequency to the reception capability at the Duncan Cable Headend facility in Wilmington, Vermont. The Duncan Headend facility receives TV programming via satellites to their earth station antennas at C- Band (3700 – 4200 MHz) and Ku-Band (11,700 – 12,200MHz) and off-air TV stations from terrestrial TV broadcasters in the region at low VHF (54 – 88 MHz), high VHF (174 – 216 MHz) and UHF (470 – 806 MHz). The off-air terrestrial TV stations generally received at a headend facility are located in and around larger cities at distances of up to 40 miles away from a cable company headend. In the Wilmington, Vermont area this would include cities like, Albany, NY, Springfield, MA and Pittsfield, MA.

Comsearch has been in the Telecommunication business since 1977. Our expertise is in providing consulting services to the telecommunication industry, including cable companies and other clients, so they can avoid interference to their operations. We have been working with the wind industry for the past eight years in helping them set up their energy facilities so that the telecommunication infrastructure in the area in which they are installing wind turbines will not be disrupted.

The Deerfield Wind Energy Facility Parameters: The wind energy facility will contain 17 wind turbines. The wind turbines will have a hub height of 80 meters and a blade diameter of 80 meters. The overall height of the structure when one of the three turbine blades is at its maximum height is 120 meters. The rotational speed of the blades will be 10 – 15 RPM. Table 1 contains the coordinates of the individual turbines that will make up the Deerfield Wind Energy Facility.

Table 1 Turbine Coordinates for the Deerfield Wind Energy Facility in Decimal Degrees Using NAD 83

Turbine ID	Latitude	Longitude
1	42.86365623710	-72.97789578280

Turbine ID	Latitude	Longitude
2	42.86576670520	-72.97862300400
3	42.86763895880	-72.98000956080
4	42.87081871360	-72.98494375470
5	42.87298770190	-72.98585500110
6	42.87531045280	-72.98971129510
7	42.87799032430	-72.99073814920
8	42.88026505150	-72.99131372080
9	42.88255761570	-72.99035277760
10	42.88507892100	-72.98579070460
11	42.85671085660	-72.96783328000
12	42.85500312170	-72.96957819130
13	42.85311167880	-72.97122543240
14	42.85079837510	-72.97228134760
15	42.84905926060	-72.96940499740
16	42.84700501710	-72.96688120430
17	42.84494984760	-72.96555129970

Figure 1 shows the map of the layout of the wind turbines at the proposed Deerfield Wind Energy facility.

Duncan Headend TV Reception Capability with Respect to the Deerfield Wind Energy Facility: Figure 2 shows the relative location of the Duncan Headend and the turbines that will make up the Deerfield wind energy facility. The separation distance of the closest wind turbine is 8+ miles from the Duncan Headend. Table 2 lists the calculated separation distance of each of the wind turbines from the Duncan Headend. These distances are extremely significant in evaluating interference conditions as will be seen in the following paragraphs when interference levels are calculated.

Table 2 Separation Distance of Wind Turbines and Duncan Cable Headend

Turbine ID	meters	Miles
1	14033.3	8.72
2	14105.7	8.76
3	14233.5	8.84
4	14666.5	9.11
5	14766.5	9.18
6	15110.8	9.39
7	15235.3	9.47
8	15321.2	9.52
9	15287.8	9.50
10	14976.0	9.31
11	13195.3	8.20
12	13340.7	8.29
13	13481.5	8.38
14	13579.6	8.44
15	13357.3	8.30
16	13170.0	8.18
17	13084.3	8.13

Interference Level Calculations: To calculate desired signal and interference signal levels the Friis Transmission Formula is used. The following is the formula:

$$P_r = P_t * G_t * G_r * (?^2)/(4 * ? * R)^2$$

Where

P_t = Transmit Power, Watts
P_r = Received Power, Watts
G_t = Transmit Antenna Gain, Number
G_r = Receive Antenna Gain, Number
? = Wave Length of Signal Transmitted, Meters
? = 3.1416
R = Separation Distance between Transmit and Receive Antenna, Meters

This formula is idealized and will predict the maximum signal or interference signal coupled. Therefore, for practical applications the Longley Rice Model derived from the National Bureau of Standards (NBS) Technical Note 101 is used by engineers to modify the equation to account for the signal propagation over the curved and rough terrain of the Earth. Also, measurements are normally used to empirically modify the results of the formula. However, to obtain the worst case prediction of interference the unmodified Friis formula will be used to determine if interference will occur between the wind turbines and the receiving antennas at the Duncan Cable Headend.

FCC Requirements for Wind Turbine Interference Emissions: The specifications for wind turbines require that they are in conformance with all state and federal regulations. This includes the FCC regulations which specify the limits for the interference emissions from electrical devices. Every wind turbine that will be installed at the Deerfield Wind Energy facility will have FCC approval. Part 15 of the FCC Regulations cover the emissions from unintentional radiating devices, which is what a wind turbine is. The field strength limits for the emissions from unintentional radiators is given in Paragraph 15.109 of Part 15 of the FCC Regulations. The emission limits are stated for a distance of 3 meters or approximately 10 feet and are shown in Table 3.

Table 3 Radiated Emission Limits at a distance of 3 Meters

Frequency of Emission (MHz)	Field Strength (microVolts/meter)
30 – 88	100
88 – 216	150
216 – 960	200
> 960	500

Calculation of the Interference Levels: The field strength levels in Table 3 are converted to levels of power density so that the Friss Transmission formula can be used to determine the interference levels for the satellite and off-air TV Receivers at the

Duncan Headend. For satellite receivers the interference criteria for analog signal reception is -144 dBW and for digital reception is -156 dBW.

For off-air TV reception the FCC requirements for signal quality are stated in Part 73.658 of the FCC Rules and Regulations. Table 4 lists the signal quality requirements. As long as the TV receiver at the headend has a 20 dB signal-to-noise (interference) ratio above the FCC requirement it can produce cable quality video for distribution.

Table 4 Interference Criteria for Off-Air TV Reception Based on FCC Rules

Receive Antenna	Signal Quality Req.	Receive Power Req.	O. K. Interference
	dB/uV/meter	dBW	dBW
TV UHF	80	-70.7	< -90.7
TV High VHF	77	-69.0	< -89.0
TV LowVHF	74	-64.8	< -84.8

For the calculations certain assumptions were made so that all of the parameters needed for the calculation were available. In every case the values assumed would produce a worse case interference result. That is, the parameters were biased to produce worse case interference effect. Table 5 lists the parameters assumed for the calculations.

Table 5 Parameters Used in the Friss Formula for Determining Interference Level

1. Gain of the wind turbine emission in the direction all of the antennas at the Duncan Headend, 0 dB or 1.
2. Gain of the satellite antennas in the direction of the wind turbines, 0 dB or 1
3. Gain of the UHF off-air TV antennas in the direction of the wind turbines, 10 dB or 10.
4. Gain of the High VHF off-air TV antennas in the direction of the wind turbines, 6 dB or 4.
5. Gain of the Low VHF off-air TV antennas in the direction of the wind turbines, 3 dB or 2.
6. Wavelength for C-Band operation taken at 3950 MHz, 0.076 meters
7. Wavelength for Ku-Band operation taken at 11,950 MHz, 0.025 meters
8. Wavelength for UHF off-air TV operation taken at 470 MHz, 0.64 meters
9. Wavelength for High VHF off-air TV operation taken at 174 MHz, 1.74 meters
10. Wavelength for Low VHF off-air TV operation taken at 54 MHz, 5.56 meters

To determine the total interference power coupled to the antennas at the Duncan Headend the interference power from each wind turbine is calculated and then summed up to determine the total interference power. To do this the following formula was used:

$$P_{total} = \sum_{n=1}^{n=22} P_{nr}$$

Where,

P_{total} = Total interference power from wind turbines, watts

P_{nr} = Interference power determined from Friis Transmission Formula for each wind

turbine (n =1 to 22) , watts or dBW

The results of the calculation are shown in Table 6.

Table 6 Interference Levels Calculated at the Various Duncan Headend Antennas

Receive Antenna	Total Interference Power	Interference level
	Watts	dBW
Ku-Band Satellite	2.03E-21	-206.9
C-Band Satellite	1.97E-20	-197.3
TV UHF	2.11E-18	-1.76.8
TV High VHF	3.46E-18	-174.6
TV LowVHF	7.98E-18	-171.0

Determination of Off-Air TV Signal Level at Duncan Cable Headend: Using the Friis Transmission formula the off-air TV signal from UHF, High VHF and Low VHF terrestrial broadcast stations 40 miles away is calculated so that a determination can be made of whether enough signal will be present for cable quality video signal distribution. For the calculation the EIRP for the UHF TV Station will be 150 kWatts, the High VHF Station will be 100 kWatts and the Low VHF Station will be 100kWatts. The off-air receive antennas will have gain of 10 dB for UHF, 6 dB for High VHF and 3 dB for Low VHF.

The results of the calculation are shown in Table 7.

Table 7 Off-Air TV Received Levels at the Duncan Headend for 40-Mile Distant TV Broadcast Stations

Receive Antenna	Receive Power	Receive Power
	Watts	dBW
TV UHF	9.34E-07	-60.3
TV High VHF	1.82E-06	-57.4
TV Low VHF	4.71E-06	-53.3

Measurements performed by Comsearch at various wind energy facilities in the U. S. has shown that the maximum attenuation of TV signal strength passing through wind turbines is normally no greater than 2.5 dB. Based on this it can be seen that if the levels shown in Table 7 are reduced by 2.5 dB they will still be above the levels required to produce quality video for distribution over the cable system. Also, there is only one sector of 18.5º from the Duncan Cable Company from azimuths 262.5º- 281º that will be subject to this attenuation by the wind turbines.

Conclusions of Interference Investigation, Analysis and Calculations: The issues of potential interference raised by the Duncan Cable TV Service from the Deerfield Wind Energy facility have been evaluated in this project. The calculations show that there will be no interference to the cable operations at the Duncan Cable Headend facility. The satellite reception at C- and Ku- Band will be unaffected by the presence of the turbines.

The electromagnetic emissions from the wind turbines is limited by FCC Regulations and even if the emissions were at the FCC rule limits their emission levels at the Duncan Cable Headend earth station antennas would be many orders of magnitude below the sensitivity of the earth station receivers. There is also no possibility that the wind turbines will physically obstruct the earth station antennas' ability to have a clear view of the Geo-Stationary satellite arc.

The wind turbines will not cause interference to the off-air TV reception at the Duncan Cable Headend. The calculations show that the interference levels are well below the sensitivity and operational levels of the off-air TV receivers. There will be physical attenuation of off-air TV signals in one 18.5º sector from relative azimuths of 262.5º - 281º. The TV signal attenuation is estimated to be no greater than 2.5 dB in this sector which will have no measureable affect on the quality of the TV signal that will be received at the headend TV receiver and will be available as video for distribution on the cable network system.

The analysis and calculations in this study has shown that the Duncan Cable Headend will not be adversely affected by the presence of the Deerfield Wind Energy facility with regard to electromagnetic (radio-frequency), electro-mechanical (obstruction) and/or electro-static interference. Electro-static interference applies to systems that are in close proximity and is not an issue with regard to a Cable Headend facility that is located 8+ miles from the electrical generation equipment of the wind energy facility.

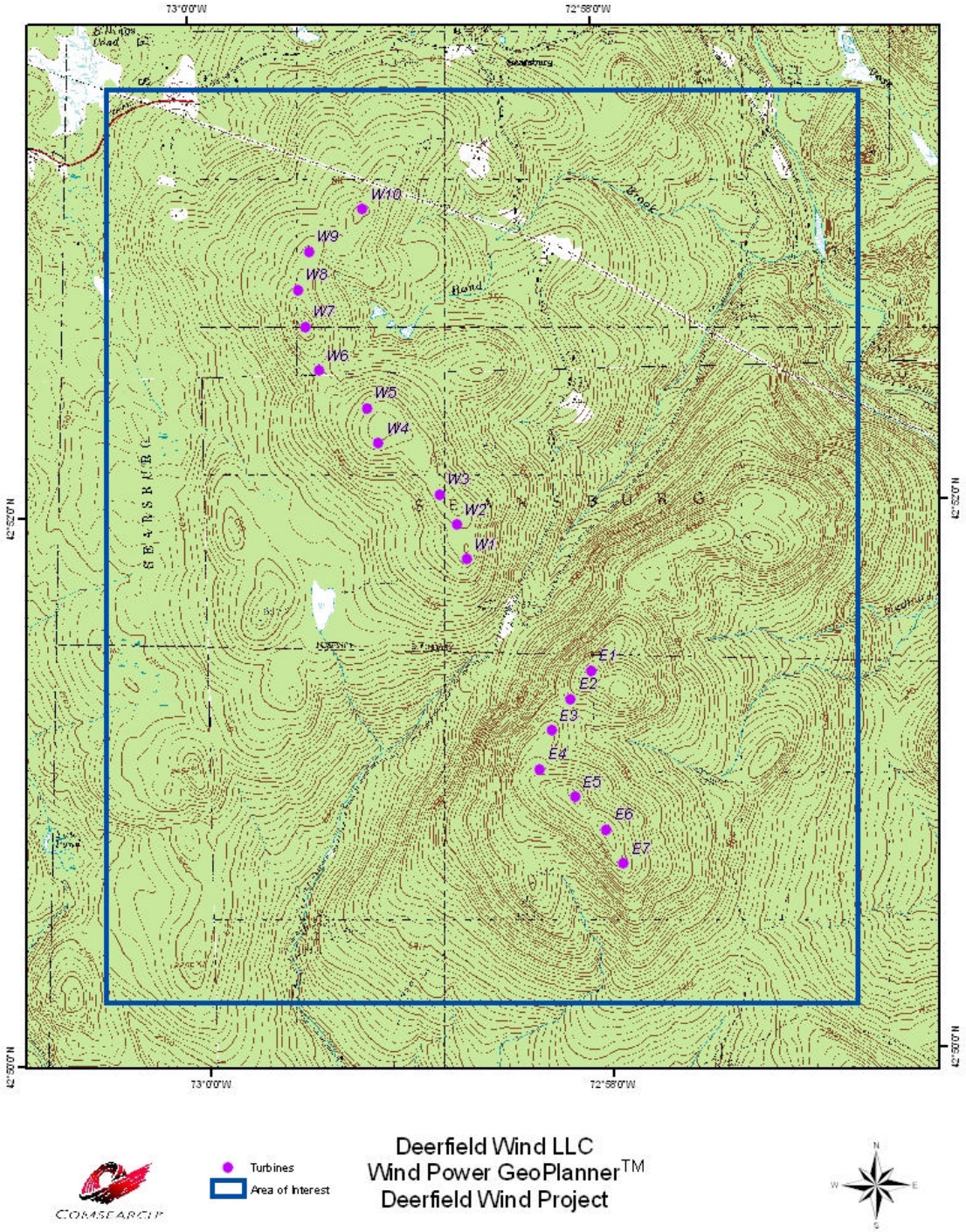

Figure 1 Deerfield Wind Energy Facility Map

Figure 2 Relative Location of the Deerfield Wind Energy facility and the Duncan Cable Company Headend