

MEMORANDUM

Interference of Wind Turbines with Wide Area Communications

B&V Project 137450.0603

June 25, 2006

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1.0 Introduction

Black & Veatch has been asked by The Massachusetts Technology Collaborative (MTC) to provide an opinion on the potential interference impact of wind turbines located in North Eastham on the existing cellular telephone tower. The possible interference techniques are discussed below, along with their relevance to the existing cellular tower.

1.1 Possible Interference on Wireless Communication Systems

Radio waves are used to relay information in a wireless communication system. Radio service can be disrupted in one of four manners.

- *Electromagnetic Interference (EMI)*, which happens when a wind turbine creates and radiates a frequency in the radio band that is being used.
- *Near-Field Effects*, which occur when a wind turbine is located in such close proximity to an antenna that it changes the characteristics of that antenna.
- *Diffraction*, which is when a wind turbine's location causes radio wave to be partially blocked, thus causing signal loss.
- *Scattering (Reflection)*, which is when the radio waves are reflected from a wind turbines surface, usually blades.

1.2 Electromagnetic Interference (EMI)

Wind Turbines have not been reported to be significant emitters of EMI. The electric motors and generators used in the nacelle of a wind turbine emit a small amount of low frequency electromagnetic noise. Because this noise is outside of the high frequency band used by cellular telephones, it should not cause system interference.

1.3 Near-Field Effects

Transmitting and receiving antennas have a "near-field" zone, which requires freedom from any object that can conduct or absorb radio waves. The "near-field" zone for Ultra High Frequency (UHF) signals, such as cellular telephones (800MHz to 1900MHz) is approximately 20 meters (70 feet). The

location of the Eastham cell tower is approximately 115m (380ft) from the closest turbine site; thus, the wind turbine should not cause near-field effects.

1.4 Diffraction

Diffraction occurs when the wind turbine partially or totally blocks a radio wave. Diffraction effects from wind turbines can be avoided by placing them outside the first Fresnel Zone, which determines the distance of obstruction signal loss. With the turbines located 115m feet from the tower, no signal should be obstructed if the next receiving tower is within 25 miles. If the next tower is outside of that range, each turbine will have a narrow region of diffraction. In this region, slight interference will be seen in the form of loss of signal strength, as the diffraction reduces the amount of energy available at the receiver. The lowered signal strength will not always mean loss of signal and should be viewed as low risk, meaning that the impact is “unlikely to be detectable”¹.

1.5 Scattering (Reflection)

Scattering is the reflection of waves off of an object that has reflective properties. Because the tower and blades are relatively slim and curved they tend to disperse rather than obstruct the waves. Furthermore, typical “blades are made from glass reinforced plastic (GRP), which is essentially transparent to electromagnetic waves.”² A ratio of the scattered signal to the received signal is used to determine the full effect of this form of interference. The minimum signal to noise ratio (SNR) for overall impact is 12dB and 18dB for cellular (voice only) and cellular (all services) respectively. This means the signal power level must be 12 or 18 times higher than the power level of the noise, which is common for the sensitivity levels of the Code Division Multiple Access (CDMA) technology. These ratios correspond to an estimated minimum separation (between the tower and turbines) of 325 feet. The turbine location of 380 feet is outside of this range; thus, the scattering should also be viewed as low risk.

1.6 Summary and Opinion

It is the opinion of Black & Veatch that a wind farm at Eastham located 115 meters from the existing Eastham cellular telephone communication tower should not create any significant adverse effects to coverage. The possible interference techniques have been evaluated and only a low risk of interference associated with diffraction and scattering has been distinguished.

¹ According to Meridian Energy and Broadcast Communications Limited (BCL) in a July 2005 report entitled “Project West Wind: Compatibility with Radio Services.”

² AusWEA. “The Electromagnetic Compatibility and Electromagnetic Field Implication for Wind Farming in Australia.”