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Wind Turbines and Exposure to Low-Frequency Sound

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Wind Turbine Trends in the U.S.

Although wind power accounts for less than 2% of the total net electric generation, the total wind power capacity now operating in the United States is generating enough electricity to power the equivalent of nearly 6 to 9 million homes.[1,2] And since 1999 the wind power in the United Stated has increased exponentially from 2,472 MW to 34,863 MW in 2009.[3,4]

The harnessing of wind energy is not new. Wind was used in 500-900 A.D when the first windmills were developed in Persia.[5,6] By end of last year, there was over 35,000 megawatts of installed wind power in the United States, yet wind power accounts for less than 2% of the total net electric generation.[7,8] According to the American Wind Energy Association (AWEA) Fourth Quarter 2009 Market Report; there was an increase in 2009 of approximately 10,000 Megawatts (MW) of new wind power capacity. At the end of 2009, it was also determined that 36 states have utility-scale wind installations with nearly 39% having more than 1,000 MW of wind power capacity.[7] Furthermore, the states with the highest number of wind project installations were Texas (9,410 MW); Iowa (3,670 MW); and California (2,794 MW).[7] In addition to being the state with the most installed wind power capacity, Texas also became the home to the world's largest wind farm near Roscoe, Texas and approximately 200 miles west of Forth Worth. The Roscoe Wind Farm has an installed capacity of 781.5 MW (627 wind turbines) and spans portions of four Texas counties covering nearly 100,000 acres (40,500 hectares).[9]

Background

Dr. Nina Pierpont, a pediatrician with a Ph.D. in behavioral ecology coined the term "Wind Turbine Syndrome" in her recently published book, "Wind Turbine Syndrome: A Report on a Natural Experiment."[10] In the book she explains how a multitude of symptoms, such as headache, dizziness, and others, result from wind turbines generating low-frequency noise that "scrambles" the body's balance, motion, and position sensors. The symptoms list that she reports is based on a collection of subjective responses from ten families (37 subjects) claiming health effects from wind turbines.[11] Currently, there has not been a specific health condition or collection of symptoms documented in the peer reviewed, published literature that has been classified as a disease caused by exposure to sound levels and frequencies generated by the operation of wind turbines.

In September 2010, Salt and Hullar[12] published a review of wind turbine related literature in *Hearing Research* where they state an opinion that there is a "possibility that exposure to the infrasound component of wind turbine noise could influence the physiology of the ear." However, this article was a review and was not an epidemiologic study where risk of adverse health outcomes could be evaluated, thus resulting in the authors to conclude that "there is an urgent need for more research directly addressing the physiologic consequences of long-term, low level infrasound exposures on humans."

Neither of these publications approached the level of an objective epidemiologic study that could establish a causal correlation between wind-turbine noise and human health effects. In fact, to date, no specific health effect from exposure to the sound levels and frequencies generated by wind turbines has been documented in the peer-reviewed literature.

One example of the popular media picking up the "Wind Turbine Syndrome" story theme is a July 31, 2010, article in the *New York Times*, which reported on a wind-power producer offering nearby residents of a rural Oregon community $5,000 each in return for promising not to complain about wind-turbine noise. The article states, "Opponents say the constant whooshing from the turbines makes them anxious and that the low-level vibrations keep them awake at night. Some say it gives them nausea and headaches."

Technical Information

The noise generated by wind turbines is of two types. One is the mechanical noise produced by the gearbox, generator, and yaw motors. The other, aerodynamic noise, originates from the flow of air around the components of the wind turbine (blades and the tower, which produces a "whooshing" sound in the audio range of 500 to 1000 Hz.[13] This type of noise is typically the dominant component of wind turbine noise because manufacturers have been able to reduce. Manufacturers can control the mechanical noise to a level that is below the aerodynamic noise.[14] However, the whooshing sound is highly variable and dependent upon mechanical as well as atmospheric conditions. Hence, the sound power levels reached by wind turbines are determined by the mechanical and aerodynamic specifications. Therefore, the type and level of noise experienced by a person in proximity to any given wind turbine can vary substantially.

There is evidence, albeit nonquantitative, that some people can respond negatively to the noise qualities generated by wind turbines, but no peer-reviewed, scientific data have been produced to support a causal connection between wind turbines and specific disease or health conditions. Absent epidemiologic evidence to the contrary, the possibility remains that annoyance with the siting or operation of the wind turbines may underlie

many emerging claims of health effects. To separate the effects of simple annoyance from actual adverse physiological responses resulting from low frequency sound generated by wind turbines, additional research is clearly warranted. Wind energy companies and wind-farm developers will want to consider positioning themselves at the leading edge of epidemiological research that would allow for statistical comparison of residents exposed to wind turbines with a control (non-exposed) group.

Exponent Can Help

It is reasonable to predict an increase in health concerns when new technology is introduced and gets wide spread use. Wind energy is no exception. With the burgeoning movement for "green" energy and "sustainability," given the potential associated with harnessing wind energy, the issue of "Wind Turbine Syndrome" will be raised as a concern for residents, wind-farm developers, zoning boards, and other involved stakeholders.

Drs. Mark Roberts and Jennifer Roberts are providing assistance in addressing health concerns raised regarding wind turbines and have authored a white paper titled, "Evaluation of the Scientific Literature on the Health Effects Associated with Wind Turbines and Low Frequency Sound."[15] This white paper presents a review of the human health effects attributed to infrasound and the low frequency sound thought to be linked to wind turbines.

In addition to their focused expertise, Exponent's scientists and engineers offer diverse expertise in epidemiology, toxicology, risk assessment, and buildings and structures, as well as other disciplines, and can assist in evaluating health effects and characterizing the potential risk of exposure to sound generated by wind turbines.

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Additional Relevant Literature

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