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Sound Defense For A Wind Turbine Farm

With the help of nearly 700 hours of sound recordings at the Horse Hollow Wind Energy Center, a jury recently ruled in favor of FPL Energy in a nuisance lawsuit.

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In a case closely watched by the wind energy industry, a jury recently handed down a take nothing verdict in one of the nation's first nuisance lawsuits against a wind farm. A group of landowners filed suit against FPL Energy (FPLE) asserting that the Horse Hollow Wind Energy Center created nuisance conditions.

The lawsuit claimed that the wind farm would result in a condition that would substantially interfere with the plaintiffs' private use and enjoyment of their property. Noise from the wind turbines was cited by the plaintiffs as one aspect of the nuisance condition.

A comprehensive sound monitoring program was conducted by our firm to determine the sound levels associated with the wind turbines at the plaintiffs' houses. Results from the program were presented as part of expert witness testimony during the trial. There are no federal, state or local noise regulations that apply to this facility.

Through the use of applicable noise criteria, the program demonstrated that sound from the Horse Hollow Wind Energy Center does not create a noise nuisance condition. A 12-person jury heard the evidence and agreed, finding in favor of FPLE.

Wind farm summary

The FPLE Horse Hollow Wind Energy Center is located on approximately 47,000 acres 20 miles southwest of Abilene in Taylor County and Nolan County, Texas. The facility consists of 421 wind turbines developed in three phases during 2005 and 2006.

The wind turbines include 291 1.5 MW GE Energy wind turbines and 130 2.3 MW Siemens wind turbines for a total wind farm capacity of 735 MW. The GE units have a hub height of 80 meters and a rotor blade diameter of 77 meters. The Siemens units have a hub height of 80 meters and a rotor blade diameter of 93 meters.

Plaintiff summary

Eleven plaintiffs representing a total of 18 landowners were parties to the lawsuit. The plaintiffs own parcels of land ranging in size from a few acres up to more than 100 acres. Most landowners had frontage on U.S. Route 277, Farm Road 89 or county roads and were generally on the northern or eastern periphery of the wind farm. The distance from each plaintiff's residence to the nearest wind turbine ranged from 1,700 feet (0.32 miles) to 14,200 feet (2.7 miles).

Measurement program

Our firm conducted an ambient sound level survey to characterize the current acoustical environment under typical operating conditions for the wind farm at the plaintiffs' properties. The selection of the sound monitoring receptor locations was based on a review of the noise complaints, consultation with the plaintiffs and access considerations. The program was designed to measure sound levels on the 11 plaintiffs' properties. Twenty-four sound level measurement locations were selected, with a minimum of one measurement location per plaintiff.

Since the program involved measurements on the plaintiffs' properties, a court order was issued designating a specific week when we would have access to the properties. Because we were not granted unrestricted access during the entire week, a schedule was developed outlining the approximate times when field personnel would be on a particular

property. Through coordination with the attorneys, we typically assigned a 2-hour window to each plaintiff.

Combinations of exterior continuous sound level measurements, exterior short-term sound level measurements and interior short-term sound level measurements were made during a six-day period in August 2006. Based on expanded descriptions of the noise complaints obtained through direct communication between the sound consultants and several plaintiffs during the measurement program, the program was modified on a parcel-by-parcel basis to address these concerns expressed by the plaintiffs. To address these issues, measurement times, locations and frequency of measurements varied from the initial schedule proposed.

Continuous sound level measurements were made at six properties. Each monitoring location was representative of the residence on that property. These locations were chosen based on the properties' proximity to the wind turbines and their location relative to other plaintiffs' properties. In general, these measurements were unattended, but field personnel checked the equipment daily.

Short-term sound level measurements were made near each plaintiff's residence. One-third octave band data were gathered during each of the short-term measurements to check for the presence of "pure tones" as defined by the U.S. Environmental Protection Agency (EPA). Field personnel were present during all of the short-term measurements, which were made at several of the plaintiffs' property lines. In addition to exterior measurements, interior short-term measurements were made where plaintiffs complained about noise from the wind turbines being audible inside.

Two CEL Instruments model 593.C1 precision sound level analyzers were used to collect broadband and one-third octave band ambient sound pressure level data. The instrumentation meets the "Type 1 - Precision" requirements set forth in American National Standards Institute (ANSI) S1.4 for acoustical measuring devices. Three Larson Davis 820 sound level meters, two Larson Davis model 812 sound level meters and one RION NL-32 were used for the continuous monitoring. These meters meet Type 1 ANSI S1.4-1983 standards for sound level meters. During the short-term measurements at each property, hand-held wind speed measurements were made with a Davis Instruments TurboMeter electronic wind speed indicator.

Horse Hollow Wind Energy Center, 20 miles southwest of Abilene in Taylor County and Nolan County, Texas. Photo courtesy of Epsilon Associates Inc.

The coordinates for the sound level measurement locations were obtained by our staff in the field using a Garmin 12 global positioning system (GPS) instrument with an accuracy of 15 meters (approximately 50 feet). Field personnel were provided with figures showing each of the plaintiffs' property boundaries overlaid onto aerial photography. These figures were created in-house using ArcView version 9.1. These figures depicted turbine locations, which were provided by FPLE. At the conclusion of the program, FPLE provided kilowatt (kW) output data for the nearest wind turbines as well as hub height wind speed data.

Sound level environment

Following the measurement program, the approximately 675 hours of sound level data were tabulated and/or plotted. Noise sources at the plaintiffs' properties included insects, wind noise, aircraft, vehicular noise, birds and wind turbines at some locations. Time of day, wind speed and the proximity to the noise source were factors in the sound levels measured at each of the locations. The noise associated with the wind turbines consisted primarily of an aerodynamic "whoosh" and, to a lesser degree, mechanical noise from components in the nacelle. This is typical for modern upwind design turbines.

Sound level data

Sound level data were analyzed using several techniques, including comparing the sound level data to wind turbine power output, comparing sound levels under high and low wind turbine output, and comparing the sound levels to generally accepted criteria. This type of evaluation was necessary since there were no regulatory standards for noise that applied to the Horse Hollow Wind Energy Center.

Continuous sound level data were plotted with concurrent wind turbine output data (kW) from the closest turbine. If the sound levels were strongly influenced by the operation of the wind turbines, it would be expected that a consistent and repeatable pattern would exist of sound levels rising and falling as the wind turbine power rose and fell throughout the day or night.

In general, sound levels did not closely follow the changes in wind turbine output at most of these locations. For each of the locations, sound levels during high and low output were compared. At times, sound levels during high output were lower than the sound levels during times when output was low or nonexistent. These analyses indi-

Sound monitoring equipment measures noise at Horse Hollow.
Photo courtesy of Epsilon Associates Inc.

cated that there were other natural or man-made sources which were, at times, the primary sources influencing the sound level environment.

The measured sound levels can be put in relative perspective through the use of generally accepted guidelines. Two applicable guidelines were used for this project. The first guideline document is the "Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety" from the U.S. Environmental Protection Agency's Office of Noise Abatement and Control – March 1974.

This document, often referred to as the "Levels" document, can be used as a way of ensuring normal speech communication and protection against sleep interference inside a home with the windows open.

The second guideline is the "Guideline for Community Noise" from the World Health Organization – 1999. This document is a guideline for preventing annoyance at a residence from a steady, continuous noise and sleep interference inside a home.

Even under peak wind turbine power output conditions, the highest combined sound levels from both the wind turbines and the wind itself were below daytime and evening guidelines for outdoor living areas at all locations. Under peak wind turbine power output conditions, the highest combined sound levels from both the wind turbines and the wind itself were below sleep disturbance guidelines outside bedrooms with the windows open at all locations except one.

At the closest residence, the worst-case sound levels were slightly above the sleep disturbance guideline; however, a significant portion of this noise was due to the wind itself rather than the wind turbines.

Trial highlights

The case went to trial in December 2006 in the 42nd District Court in Abilene. The trial lasted two full weeks, with FPLE presenting the results of the sound level impact study over the course of two days. A wide range of demonstratives were used during the course of the trial in order to break down a technical, scientific topic for a layperson audience.

At the close of trial, the judge issued directed verdicts in favor of FPLE against two plaintiffs, and after two days of deliberations, the jury found in favor of FPLE in the claims of the nine plaintiffs remaining in the case. Feedback gained from post-trial interviews found that the demonstrative exhibits were very helpful to the 12-person jury. NVP

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