Sound Power Levels

The International Energy Agency's model, for example, uses the acoustic energy generated by the wind turbine. Acousticians use field measurements of *sound pressure levels* (SPL), or L_p, to calculate the *sound power levels*, or L_w emitted from the wind turbine. As if the similar-sounding names were not confusing enough, both measures use the same units, dBA. While sound pressure levels will always be specified at some distance from the turbine (or implied), the sound power level will always be presented at the source: the wind turbine itself.

The distinction is important. The sound power level of most wind turbines varies from 90 dBA to more than 105 dBA. For those familiar with sound pressure levels, this appears alarming. Yet a wind turbine emitting a sound power level of 100 dBA can meet a 45-dBA noise limit in sound pressure level, given sufficient distance from the wind turbine. The sound power level can be found by

$$L_w = (L_p\text{-}6\ \text{dB}) + 10 \log (4\pi R^2)$$

where R is the slant distance from the turbine to the sound level meter, L_p is the sound pressure level measured by the meter and -6 dB is a correction to the meter reading to account for using a reflective sound board (see Figure 15-11. Small wind turbine noise measurement).

Sound power data (the emission source strength) on many large wind turbines was publicly available throughout the 1990s. Until recently, there was little comparable data on small wind turbines. Fortunately, within the past decade data on micro wind turbines first became publicly available from the Wulf Test Field and subsequently on household-size turbines from NREL and other independent testing laboratories (Figure 15-12. Noise measurement of micro turbine). Today, the Small Wind Certification Council in the United States publishes summary noise reports on certified small wind turbines designed for interconnection with the utility. Similar data is also available in other countries.

Noise measurements on wind turbines are recorded for two conditions. One condition is the turbine plus ambient; that is, the wind turbine operating as intended (Figure 15-13. Measured Air 403 plus ambient noise). At the Wulf Test Field,

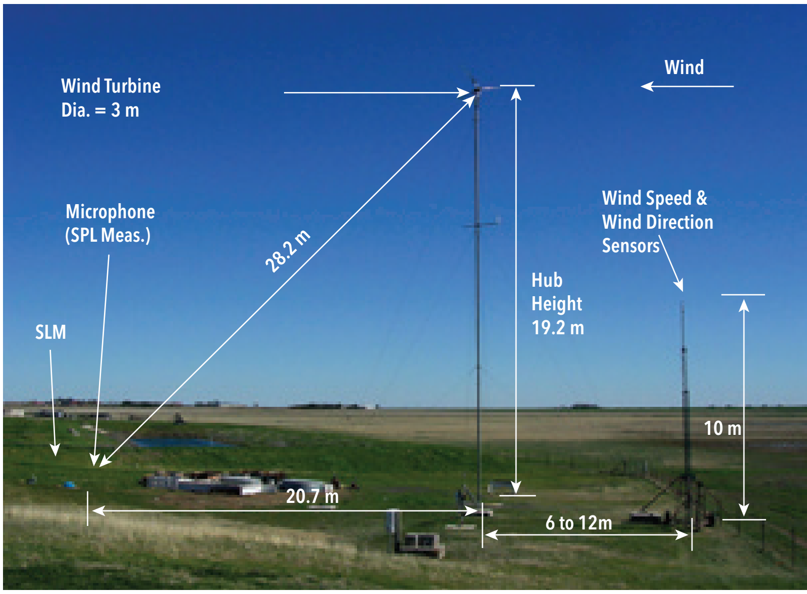

Figure 15-11. Small wind turbine noise measurement. Sound pressure level measurement of a Whisper H80, a 3-meter (10-foot) diameter off-grid, water-pumping, mini wind turbine in 2006 at Bushland, Texas. The sound level meter microphone is placed downwind of the turbine on a reflective soundboard. The distance downwind and the tower height give the slant distance from the turbine to the microphone. This distance is used to calculate the emission source strength–the sound power level–of the turbine at various wind speeds. A similar technique is used for large wind turbines. (Brian Vick, USDA-Agricultural Research Service)

Figure 15-12. Noise measurement of micro turbine. Beginning a sequence of noise measurements downwind from an Ampair 100 at the Wulf Test Field. The recording sound level meter is being inserted into the secondary wind screen mounted on the reflective soundboard. The sound pressure levels measured by the meter are used to calculate the strength of the noise emitted by the wind turbine–the sound power level. In this case, the Ampair wasn't sufficiently noisy at low wind speeds to measure its noise above the background or ambient noise. Late 1990s.