CASE STUDY

EPA Wind Farm Project for Open Space and Site, Noise Evaluation and Measurement Criteria

Taiwan
Wind Energy
PULSE Platform, Hand-held Analyzer Type 2250, Microphones

As Wind Energy becomes a new strategy to reduce greenhouse gas emissions and, thereby, contribute towards reducing global warming, the Taiwanese government has decided to dramatically increase its number of wind farms. In order to understand the noise impact on the environment and its residents, The Environmental Protection Administration (EPA) has initiated a project to study the noise impact and measure wind turbine noise.

Photos courtesy of EPA Wind Energy

Brüel & Kjær

Environmental Protection Administration (EPA)

EPA is a Cabinet level executive agency responsible for protecting and conserving the environment in the Republic of China including air quality, noise control, monitoring and inspection of the environment, solid waste, recycling, sustainable development and international cooperation. It is led by the Minister for Environment, Stephen Shu-hung Shen. The Environmental Protection Agency has evolved and been part of different departments over decades. In August 1987, the Environmental Protection Administration, as it is known today, was established becoming the one-stop shop for all environmental policies, regulation, standards and enforcement.

Background

Taiwan lacks energy resources and highly depends on import, so the Taiwanese government has chosen to prioritise the development of clean, sustainable, and independent energy and achieve the balance among energy security, environmental protection, and industrial competitiveness, and reduce CO2 emissions through various strategies. As an island, Taiwan has excellent potential for developing wind energy. To capitalise on this, the Government has built a number of wind farms, which currently consist of a total of 263 wind turbines from different suppliers. These are mainly located along the west coast of Taiwan.

The Goals

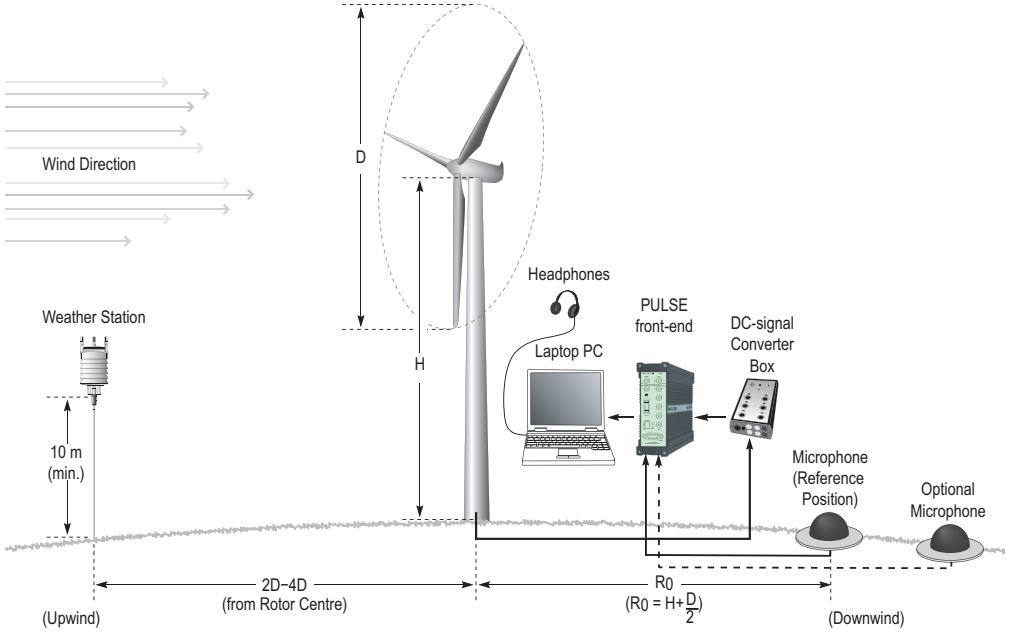
Although wind energy is renewable energy, there are shortcomings. Wind farms are often considered to be eyesores in what are mainly rural landscapes. Other worries include the noise generated by the turbines, and the resulting devaluation of nearby property.

To be able to understand the noise impact on the environment and its residents, EPA has initiated a project to study the noise impact and implement a procedure for on-site monitoring of wind turbine noise generated by operating wind farms. Phase 1 of the project, was carried out in 2009. Phase 2 of the project was started in 2010 and will continue until 2011.

The goal of the EPA project was to find out the actual noise level of wind turbines and to set up suitable noise measuring procedures for open space and site facilities. The project would also conduct noise measurement and evaluation at sensitive spots as a result of complaints from local residents.

To achieve the goal, EPA deemed it necessary to measure 10 wind turbines in 10 noise-sensitive locations. When the measurements were completed, the wind turbine noise levels were correlated with wind speed. At high wind speeds, the noise levels exceeded 60 dB(A), and frequencies were mainly between 20 Hz and 1 kHz. Following this, 10 houses situated close to the wind turbines were selected and the noise levels measured. The results primarily showed low-frequency noise (below 100 Hz), and the difference between indoor and outdoor measurements was up to 10 dB(A).

Fig. 1
Typical overall setup



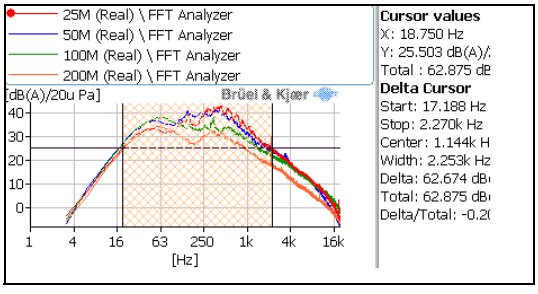
The Measurements

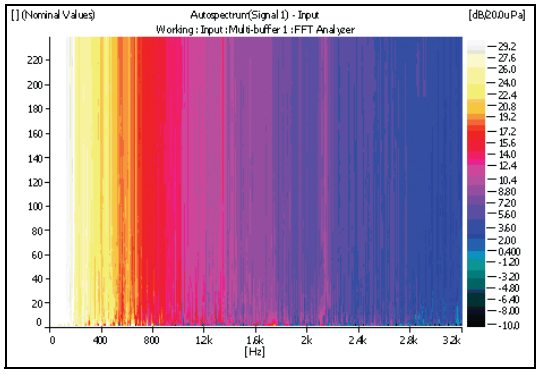
Fig. 2
Making measurements at Miaoli County Chunan Tawn wind farm. The microphone is mounted at the centre of a flat board. with its axis pointing towards the wind turbine

After discussions with EPA, it was concluded that the measurements should be made with Brüel & Kjær's Hand-held Analyzer Type 2250 and a PULSE data acquisition system. The PULSE system was configured using Brüel & Kjær's LAN-XI data acquisition hardware, PULSE LabShop software together with ½-inch Pressure-field Microphone Type 4193. The system was used to identify whether the low frequency went below 20 Hz. And although this was not a conformance test to meet IEC 61400-11:2006, there were some measurement criteria from the standard that were applicable, for example, placing the microphone on the round plate with double shield windscreen on the ground. This reduces the wind noise generated at the microphone and minimises the influence of different ground types.

Four points were measured to get the average result and each of these were also measured at distances of 25 m, 50 m, 100 m, and 200 m.

Fig. 3
The PULSE software displays the FFT analysis at four different distances (left) and a colour contour plot



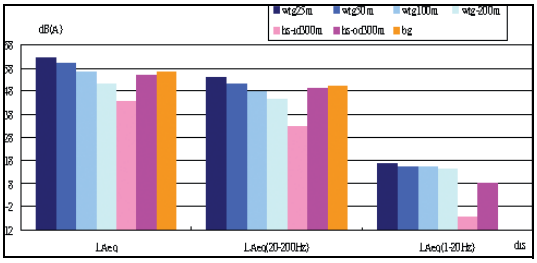


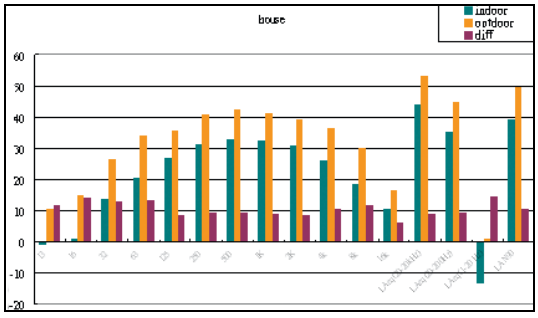
The measurement system also recorded sound data for future analysis. Mr. Y. H. Chen says, "This capability is a great feature of the LAN-XI platform, especially in the exposed, harsh working environment of wind farms. The test data and wind turbine noise were recorded for detailed post-processing". The conclusions deducted from the measurements were:

1. Wind speed dominates the measurements, so placing the microphone on the ground is a necessity.
2. A suitable windscreen is required.
3. Low frequency (1 to 100 Hz) is of concern but difficult to measure.

4. By using Type 4193 microphones, a range from 1 Hz to 20 kHz could be covered. All frequencies can be measured simultaneously using the PULSE platform and post-analysis is quick and easy.
5. Analysis tools, such as colour contour plots, can be used to identify the pure tone components. Sound Quality can be evaluated to verify the dominant frequency ranges.
6. The wind speed can also be recorded with PULSE for correlation and analysis with the noise data.

Fig. 4
Wind measurement output analysis





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