Lufft VENTUS wind sensor: Buffalo Gap, TX, USA

Lufft ultrasonic replace mechanical sensors at the world's 7th largest wind farm

Challenge

Mechanical wind sensors are inexpensive, but do not have a long life. So, the AES Corporation looked for a more durable alternative to monitoring its wind farm in the Buffalo Gap, Texas including 296 turbines.

Solution

The choice fell on the ultrasonic wind sensor VENTUS from Lufft. It consists of a robust metal housing and has no moving parts, making it maintenance-free. It was purchased directly from Lufft USA.

Benefits

With the new technology, the engineer in charge ensured that the monitoring was carried out continuously and reliably and that the performance of the turbine fleet was optimized.

> **"Based on this assessment, engineers replaced the wind measurement mechanical sensors with a single ultrasonic sensor"**
>
> *Michelle Foese, Editor of Windpower Engineering & Development*

Meteorology Division of OTT HydroMet

Technologies used

Lufft

LUFFT VENTUS

Ultrasonic Wind Sensor

Precise and maintenance-free measurement of wind speed and wind direction even in extreme cold.

Case Study

Improving wind turbine performance with Programmable Logic Controllers monitored by-Lufft Ultrasonic Wind Sensors.

LUFFT VENTUS on a turbine in Buffalo Gap.
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The wind farm

The 296 turbines at AES Corporation's Buffalo Gap wind farm in central Texas were built in three phases from 2006 to 2008. Phase one comprised 67 Vestas V80 1.8 MW turbines, phase two 155 GE 1.5 MW turbines and phase three a total of 74 Siemens 2.3 MW turbines. Now, the wind farm has a capacity of 524 MW, making it currently the seventh largest wind farm in the world. It generates more than 1,600,000 MW/h (1.6 TWh) of clean energy annually. Although quality wind turbines from leading suppliers are installed, they haven't been immune to sensor problems.

LUFFT VENTUS on a turbine in Buffalo Gap.
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296 Turbinen der AES Corporation befinden sich am Buffalo Gap, TX, USA

Most wind farms use mechanical anemometers and wind vanes for monitoring. The collected data, including wind speed and direction, are then sent to the turbine controllers. The data helps to optimally align the wind turbine blades to maximize wind energy generation. However, these existing OEM monitoring and control systems are vulnerable, which can lead to higher maintenance costs and poorer turbine performance. The main problem is that the sensors contain moving parts.

Physical inspection of a large number of turbine sensors on large wind farms such as those in Texas is a major challenge. Most of the degradation and failures have been related to bearing problems leading to a deterioration in accuracy and reduced instrument life. The increased rolling resistance of the bearings affects the accuracy of the wind measurement and thus the efficiency of the turbine, as this data is used to optimize the turbine performance. Winter also affects the wind farm: The cold weather has a negative impact on turbine performance, freezing the exposed mechanical components of the sensors.

The rolling resistance in anemometer bearings typically increases over time until they come to a standstill. Ideally, if a turbine detects an abnormal load due to increased rolling resistance, it will show an error before it comes to a complete standstill. But in many cases a turbine doesn't detect the problem at all. This partial anemometer failure is more dangerous than a complete one because it can destroy a turbine's drive train.

The turbine control system adjusts the blade pitch and rotor speed differently depending on the degree of turbulence. This is done to protect the blades and the drive train from fatigue. Poor or inaccurate anemometer measurements lead to incorrect settings and increased fatigue. In addition, precise measurement of the wind direction is important.

At the Buffalo Gap wind farm, power output decreased significantly when the turbines had a yaw offset of more than ± 10 degrees.

During research at the Buffalo Gap Wind Farm, engineers found that ultrasonic instruments may be more accurate and reliable than mechanical instruments. As a result, they replaced the mechanical wind sensors with one single LUFFT VENTUS ultrasonic sensor and. An programmable logic controller (PLC) from IDEC converts the signals from the sensors to provide better control of the wind turbines.

> **“The increased turbine efficiency is enough for AES Corporation’s to evaluate integration of the devices into the rest of their U.S. wind turbine fleet”**

Tristan Lee, Performance Engineer, AES Corporation

LUFFT VENTUS Ultrasonic Wind Sensor monitors Buffalo Gap Windpark. Copyright: AES