



APPLICATION NOTE

Acoustic Imaging Provides Early Warning to Prevent Wind Turbine Gearbox Failures

As wind energy capacity grows worldwide, ensuring gearbox reliability has become essential. Acoustic imaging offers a powerful early warning solution, enabling operators to detect issues before they escalate and keep turbines running efficiently.

For any government, sourcing energy involves complex decisions that extend beyond logistics, finance, and environmental considerations to include geopolitical factors. While all of these elements have influenced the rapid expansion of wind turbines worldwide, environmental and geopolitical concerns have been particularly instrumental in driving their significant growth.

The Global Rise of Wind Energy

In 2023 the global wind industry installed a record 117 gigawatts of new capacity, a 50% increase compared to the previous year. This surge brought the total global wind capacity to over 1,000 gigawatts. China led the way in new installations, followed by the United States, Germany and India. The vast majority of wind turbines are land based, with offshore making up the remaining 7%. However, offshore is experiencing faster growth and is expected to play a more significant role in the future as more countries develop and invest in the new technology.

Looking to the future, the wind energy sector is expected to continue its growth trajectory, with an anticipated compound average growth rate of 8.8% according to the Global Wind Energy Council. Offshore wind capacity, where stronger and more consistent winds are experienced, is expected to grow tenfold from its current level by 2030¹, exemplifying the sector's staggering growth.

¹ Source: The KP Group



FLIR Si2-Pro™ Industrial Acoustic Imaging Camera for Partial Discharge Detection, Pressurized Leak Detection and Mechanical Fault Detection



The Flir Si2-Pro helps prevent failures by detecting mechanical issues at an early stage in critical components of equipment, such as gearboxes, conveyors, and other rotating machinery.

Challenges in Turbine Maintenance

The very nature of wind capture means that wind turbines are usually located in remote, hard to reach areas. Offshore windfarms clearly pose logistical challenges both in terms of construction and maintenance, but even land-based turbines often create real challenges for maintenance crews when positioned in remote mountainous terrain where wind capture is maximised.

Maintenance logistics even within the turbine itself can be a challenge. The nacelle, which houses the gearbox must be accessed via the tower with very limited space to move around. Inserting heavy components and lubricating oil into the nacelle is often difficult. For this reason, any measure that enhances the durability and reliability of key nacelle components is highly valuable to wind farm operators.

One of the critical components of a wind turbine is the gearbox. It is responsible for increasing the rotational speed from the blade shaft to the electrical generator, decreasing torque and increasing speed. Many designs incorporate planetary gearbox systems, given the efficiency of these systems to increase speed from the shaft. Containing an array of helical gears and multiple bearings these gearboxes are both intricate and expensive. Failure can prove extremely expensive both in terms of replacing components, but also in turbine downtime, as logistical challenges of getting replacement parts often proves difficult. For these reasons, proactive condition monitoring of critical components is essential. Early detection of potential issues allows operators to address problems before they escalate, reducing costly downtime and extending the lifespan of the turbine.

Acoustic Imaging as an Effective Early Warning System

Flir have introduced a series of advanced acoustic imaging cameras capable of detecting abnormal sounds that occur when a bearing is showing early signs of failure. These handheld cameras are non-obtrusive and can pick up sounds from a significant distance, keeping the operator safe and allowing for inspections without halting operations. The **Flir Si2-Series** features a 12 MP camera that captures sound, and the signal is displayed on a 5-inch, 1280 × 750 high-definition colour screen providing clear, concise, real-time results.

These lightweight, cutting-edge devices are designed to provide an early warning system for preventative maintenance. Detecting abnormalities in bearings and gearbox systems is just one of their many applications. They can also identify leaks in compressed air or gas systems and detect partial discharge in electrical systems, offering not only significant cost savings but also ensuring health and safety in potentially hazardous environments.

For more information or a demonstration of the Flir Si2 acoustic camera, please contact your local Flir agent or distributor.



To learn more about acoustic imaging cameras, please visit:
www.flir.com/instruments/acoustic-imaging



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