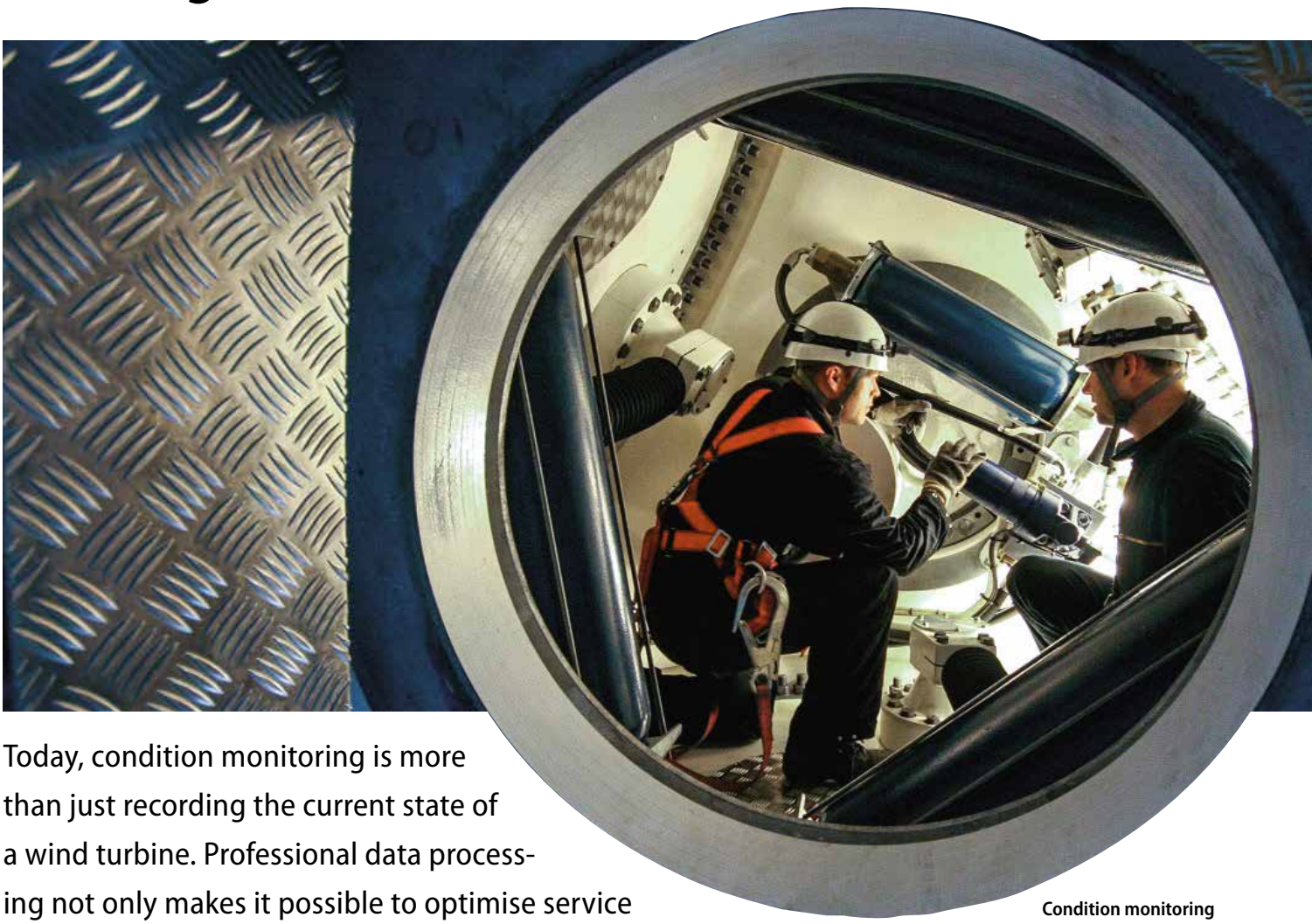
Looking at the entire service life



Condition monitoring detects abnormalities in a system that can usually only be tracked down by service technicians on site.

PHOTO: WPD WINDMANAGER

Today, condition monitoring is more than just recording the current state of a wind turbine. Professional data processing not only makes it possible to optimise service deployments but also the operation of the turbine itself.

Full maintenance contracts are booming, and this has led to a sharp increase in turbine monitoring using condition monitoring systems (CMS). Maintenance companies want to be informed about the condition of a wind turbine as accurately as possible so they can optimally coordinate maintenance work and ideally repair damage before it causes complete plant failure. Operators also want to know the condition of their turbines.

From a technical point of view, the opportunities for turbine monitoring are huge. Practically any component or subsystem of a wind turbine can be fitted with sensors or monitored using appropriate equipment. This includes foundations, towers, rotor blades, flanges, nacelles and generators. Even offshore foundation structures, which could previously only be inspected by divers, can now also be monitored using a CMS. Manufacturers are even working on sensors for the sensitive grout connection between the foundation and the transition piece.

Nevertheless, condition monitoring is much more than just recording measurement data. A CMS consists of hardware for capturing data as well as software that assesses, evaluates and displays that data. The resulting recommendations for action are also increasingly generated automatically by intelligent algorithms.

Using Big Data for optimisation

Big Data is now finding its way into the wind power industry. With it comes the expectation of improved optimisation, and it does not fail to deliver. Amounts of data that cannot be handled by humans due to their sheer size are automatically collected, selected and evaluated. The resulting optimisation of processes in the wind energy sector leads to a reduction in costs.

There is no denying that the increasing quantity and quality of data coming from a wind energy system allow improved operation. The challenge, of course, is to gain as precise an understanding as possible about the condition of a wind turbine from the multitude of data streams

Condition monitoring also always includes software that processes and interprets the recorded data to optimise operation.
PHOTO: BACHMANN MONITORING

from different origins and of different quality. "In addition to the standard SCADA data, some of which is highly aggregated, other sources also play an important role, for example vibration measurements of the turbine's sound, temperature measurements, bending measurements on the rotor and acceleration measurements on shafts," said Prof. Michael Schulz, Managing Director of Indalyz Monitoring & Prognostics GmbH. The company develops software solutions that optimise maintenance management.

When the recorded data is intelligently evaluated, it allows current and future damage levels of individual components to be determined and maintenance measures optimised. Big Data analysis of the operating data also allows reliable statements to be made about the performance behaviour of a wind turbine. Exact knowledge of a machine's condition in turn makes it possible to draw conclusions as to its remaining service life, the output loss to be expected in this time and the possibility of continued operation.

Actively counter wear and tear

Condition Monitoring thus becomes "Health Monitoring" This not only encompasses detecting and recording the current condition of a system but also observing and appropriately adjusting the operation of a wind turbine over its entire life cycle. "CMS and an extended CMS serve as data sources. This data can be condensed into information that ultimately makes life cycle management possible," says Holger Fritsch, Managing Director of Bachmann Monitoring GmbH.

If operators or maintenance and service companies are able to register changes to a system at an early stage due to monitoring, then this allows more than just the optimisation of service. The information also makes it possible to actively counter wear and tear by adjusting the operation of the system accordingly. If a turbine is producing suspicious data, it can be protected by switching it off during periods of strong wind until the next service visit and possibly even prevented from suffering a total loss, according to Catherine Diethelm, Head of Public Relations at Bachmann Monitoring.

In practice, opportunities are not always utilised "Our customers expect a maximum feed-in to achieve the highest possible return on their investments," says Thomas Mischke, Head of Technical Management at wpd windmanager GmbH & Co. KG. In his view, components that could theoretically be operated in a manner that subjects them to less wear and tear, such as gearboxes or generators, are wear parts anyway and will have to be replaced during the service life of a wind turbine. Extending the service life of wind turbines is of course important, but in practice the focus is on maximum yield (see interview on page 17).

Using a "digital twin" to achieve total control

Siemens LMS Engineering is also working on a method to combine data from the CMS with the SCADA data. The goal, however, is to simulate reality using a "digital twin". To achieve this, the physical system is merged with a digital twin into an intelligent overall system that can be interpreted bidirectionally.

A model is generated using all of the recorded data of a wind turbine, thereby creating a digital image of the actual installation. If the values measured by sensors deviate from those predicted, then this means one of the components is probably defective. Furthermore, digital twin defects can be simulated and their effects compared with actual operating fault characteristics. In addition, an algorithm predicts the remaining lifetime of a turbine.

Siemens is planning to use this technique to digitally map all wind turbines at a wind farm. If the manufacturer's recommendation is followed, each individual turbine should be equipped with a few, simple sensors rather than just a few turbines being equipped with expensive high-tech sensors. Existing turbines will only need to have a small box installed that collects data from the various sensors. Combining this with SCADA's operating data is hardly a challenge for Siemens. The digital twin is verified using real operating data from the wind turbine's past.

What first comes to mind when bundling system data in this manner is the question of the subsequent availability of the data. For many years, one of the industry's most heated arguments has been that operators are not able to access the operating data of their own turbines because manufacturers stonewall and keep it under lock and key on their own computers. Without a bit more flexibility, there will probably never be any progress on this point. Operational management can only be optimised if all available data is collected, sorted and evaluated.

Katharina Garus

"The focus is on maximum yield"

SUN & WIND ENERGY spoke to Thomas Mischke from the operating company wpd windmanager on the subject of condition monitoring and life cycle management.

S&WE: What is your company's strategy for condition monitoring?

Thomas Mischke: Condition monitoring can be a crucial indicator of system faults and is directly intended to complement our other conventional maintenance methods. As an operating company, however, we are in a market environment with manufacturers, insurance companies and investors. The importance of condition monitoring depends very much on market conditions and on the interests of the respective stakeholders. Rapid, preventive replacement of components is not always top priority for all parties involved.

S&WE: How can low-wear operation be ensured and monitored?

Mischke: From our point of view, it is important to start as early as possible. We attach great importance to quality when selecting all components of a wind turbine to proactively prevent damage. Reliable components, regular upgrades and high-quality operating materials such as oils or lubricants enable us to gain years of service life. Certainly there is always the option of restricting the output of a turbine in order to take the strain off of a certain component of the installation. In practice, however, this only happens if continued operation of a system would be jeopardised by a component failure. The amount of time gained this way is usually only a few months.

S&WE: Do you see approaches to extending the life of a system by accepting deliberate cuts in its maximum energy generation?

Mischke: Our customers expect maximum feed-in to achieve the highest possible return on their investments. There is also a great interest on the part of the manufacturers to operate the turbines at full capacity, especially if they have a financial interest in the amount of energy that is fed into the grid. Upgrades from manufacturers sometimes utilise power reserves in the turbines to increase performance and thereby increase the return for the operator. Maximum energy generation generally has no influence on the life span of the entire system. Heavy, non-replaceable components such as the tower, the foundation or the rotor blades have a much greater influence on the service life. Gearboxes or generators, on the other hand, are wear parts and can be exchanged relatively easily in the course of the service life of a system.

Thomas Mischke is responsible for technical management at wpd windmanager GmbH & Co. KG.

PHOTO: WPD WINDMANAGER

S&WE: Are there other ideas to deliberately extend the life of an installation?

Mischke: As already mentioned, the service life of a system mainly depends on components such as the tower, the foundation or the rotor blades. Here, of course, there are different approaches to ensure the stability of a turbine. For example, we have developed our own foundation measurement system. This enables us to detect damage in the foundation at an early stage and minimise the costs of refurbishment measures. It allows us to keep the foundation in good technical condition, but we can also determine the exact loads that the foundation has been subjected to when we evaluate the remaining useful life at the end of the design life of the wind turbine.

S&WE: What is the expectation of the operators for which you undertake operational management: maximum profitability or long-term operation of the system? Is this even a case where one has to be chosen over the other?

Mischke: From a technical perspective, you should not have to choose. Long-term operation of the turbines is important, of course. In practice, however, the focus is on maximum yield. Investors expect to receive the calculated returns. The goal is to be paid for as close to 100 % of the power generated as possible. The task of the technology is to achieve maximum yield, primarily by leveraging latent power reserves and ensuring optimum operation of the wind farm. Extending the service life of the turbine through low-wear operation is currently of secondary importance.

The interview was conducted by Katharina Garus.