Condition-based maintenance is perfect for renewable energy

Words: Kristian Holm, VP Renewables & Utilities at Kongsberg Digital

Kristian Holm

A typical wind turbine is equipped with a huge number of sensors, signal processors, and other types of monitoring equipment to ensure that it maintains its autonomous operations. These data points provide a myriad of data which can be used to optimise the operation of the turbine, cutting maintenance costs dramatically.

Usually, sensor data are used to maintain normal turbine operation. Temperature sensors reduce or stop the wind turbine if the oil temperature in the gearbox exceeds a set permissible limit. Vibration sensors stop the turbine if the vibrations surpass a set permissible limit. However, these sensors do not simply maintain operations; they add a host of other options to the wind turbine, and these can be used for operational excellence.

Did you know that in less than a second a single wind turbine can forward up to 1500 data signals that provide information about the turbine status? If you are really smart, you'll use this information to define the current condition of the turbine. And if you are really, really smart, you'll use it to predict the future condition or the remaining useful life of the turbine. Moreover, since wind turbines hold all this information, they are perfectly equipped for mastering the biggest obstacle to condition-based maintenance: the cost of additional sensor equipment.

Taking it one step further

Today, we can use the latest developments in advanced analytics to do all of this. We can even take it one step further and use the data from the wind turbines to predict their remaining useful life. As I will explain later, a wind turbine operator can benefit from this in a number of ways.

Over the past decade, monitoring systems have become more and more advanced,


Hundhammerfjellet luft

and the best of them utilise the latest techniques for handling what we call time-series data. The data received from the sensors is typically time-series data since a sensor delivers a value at a given time. Systems such as these collect, analyse, and present the data from wind turbines easily and intuitively, making them incredibly valuable to the wind industry due to the advanced analytics. Provided they are user-friendly, they offer an amazingly effective way to cut maintenance costs and increase operational excellence, especially if they are integrated into digital platforms.

As an aside, such systems can also be expanded for use with solar power and hydropower giving them value across business sectors and industries.

Using analytics to plan maintenance

Most of this kind of analytics is done by combining imported data with a digital clone – also known as a digital twin – of a turbine. A digital twin is an excellent tool that can be used for many things, for instance replicating or simulating turbine conditions and creating different scenarios, which in turn can be used to predict future turbine behaviour or conditions. The key to this is the fact that you need to understand the physics of the turbine in order to achieve a favourable result. You also have to use a multitude of analytics methods ranging from an ordinary physics description – this is the common langue for engineers – to statistical analytical methods and methods based on artificial intelligence.

There is no doubt that information about the condition of a wind turbine or the remaining useful life of a specific component, is valuable. Among other things, it enables turbine operators to plan the maintenance schedules according to their preferences. They can change operations or increase the number of manual inspections and simple maintenance operations, and then plan the replacement of key components, such as a gearbox, a motor, or a bearing, at the most favourable point in time in terms of the weather situation, component pricing, and equipment availability.

On top of this, turbines using a system such as this can produce power non-stop, and the system can even combine analysed information from a turbine with information captured from other sources, such as energy pricing information or weather forecasts. Combining forecasts with turbine-condition data and maintenance schedules in this way improves the production forecasts and creates operational excellence. All is done fully autonomously, and the information is sent to the operator's computer, tablet, or mobile phone in an easy-to-understand format.

Other advantages to using advanced analytics

Automatic import and analysis of data from a wide range of different sources is not the only feature of these new systems. When all of the received information is combined, the best of these systems can automatically communicate the results of the analysis to a wide range of other systems.

In this way, an alert about reduced life expectancy for a bearing can automatically trigger an inspection in the associated maintenance system and in parallel establish the necessary purchase orders for the parts and services that are needed to complete the inspection in the ERP system. When the inspection is concluded,

the results will be fed back to the system and update the analytics. The operator controls how involved they want to be in this process.

It's not only the mechanical parts of a turbine that can be monitored. Power electronics such as inverters, transformers, breakers, and switches can also be monitored through the interface of such a system. Since a wind turbine, a solar power facility, or a hydropower plant are all part of a larger puzzle with different stakeholders, such as different vendors, OEMs, plant owners, plant operators, and grid owners, it is important to have analytics ready to identify where a certain issue is originating. Again, advanced analytics can help by providing the specific information that is needed.

Data collection, security, and storage

Data collection is often an issue in larger production facilities. New digital platforms have excellent capabilities for data collection, security, and storage through the internet of things and cloud interfaces. Today, data can be collected securely directly from the assets through secure encrypted connections and seamlessly stored in an easily scalable cloud environment. They can also be stored according to the operator's preference – on premises, in the cloud, or using a hybrid solution – and shared with partners such as OEMs, service providers, and other third parties.

The main idea is that the captured data belongs to the customer. If you're the customer, then you decide how your data should be utilised, whether you want to share it or utilise it through new applications. Systems and solutions like this will provide their users with truly flexible and powerful analytics environments that bring the full impact of the digital age to the electric energy business.

The future

As already mentioned, a modern condition-based maintenance system is comprised of a powerful analytics suite that can predict and estimate future behaviour like remaining lifetime and estimated production, not only for wind turbines but for all production assets. And we can utilise these analytic opportunities even more: By combining the information from all the various sources, we get an almost complete system for virtual power plants. If we combine systems like this with the state-of-the-art SCADA systems and add a separate trading module, virtual power plants are a natural next step in smart analytics.

The technology can be developed even further. Imagine operating a turbine yourself, based on your financial models, changing some simple settings to prolong the life of a turbine, or increasing the turbine output based on your preference whether it is the present valuation that is your driver or the maximum lifetime.

How to get started

We know that a data-driven approach towards condition-based maintenance is of great importance today, and it will be of even greater value in the future. However, if you're a wind farm operator, you'll understand that the timing of the implementation of such an approach must be closely aligned with your business objectives.

A condition-based approach will undoubtedly constitute a deeper change to your business processes than just buying a piece of software. It will change how you

Forside brosjyre

Hundhammerfjellet luft

conduct your maintenance business on a daily basis, leading to a change in your maintenance procedures and your business set-up for maintenance.

One common denominator is vital: You need to start collecting and storing your operational data safely. Every second you are in operation your equipment is providing information about the condition of your production assets as well as how they are producing and delivering.

Don't let this information go to waste. You might not think you need the information from your equipment today, but I assure you that the digital feedback from your equipment is both important and interesting. Moreover, at some point in the future you will most likely want to compare information for that exact point in time to historical data.

Put simply, the data from your assets is pure gold, and you need to treasure and protect it. They say that 'the devil is in the detail.' I'll be even more specific and claim that the devil is in the data. It is that important.

To get started and prepare your organisation for the future of energy, you need to do two things:

1. Make sure you own the data from your assets.
2. Decide whether your organisation should use a cloud solution, an on premises solution, or a hybrid solution. *

* Cloud solutions offer scalability, but there are good solutions for storing data locally as well. Focus on flexible and secure storage solutions, secure data connections, data integrity, high data resolution, and a storage system that organises the data properly.

Do this now to be ready for a future of operational and financial excellence where data can be migrated securely between systems.

www.kongsberg.com/kdi

www.kognifai.com