

Using Technology and Innovation to Manage Mega-Maintenance Challenges



Imagine this as your work-week routine: travel to work, grab your tools and climb 80 to 100 metres to your job site, on occasion your climb is 160 meters. Sometimes, before you can make your climb, you take a boat or a helicopter to the job. That's the life of someone who maintains onshore and offshore wind turbines. Although the renewable energy industry presents some extreme issues for maintenance and service, every industry has uptime challenges.

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MAINTENANCE MANAGERS in any industry are looking for service and repairs at increasingly faster turnaround times as well as less costly parts. Equipment makers have to figure out how to provide not only routine service at a faster pace but also handle priority requests without slowing down the rest of their service business, at the risk of delaying other customers' repairs. The stakes are high on all sides. To illustrate that, let's explore an example from the wind industry where we applied technology and service options for more reliability and cost savings.

1 "Reliability-focused research on optimizing wind energy system design, operation and maintenance: Tools, proof of concepts, guidelines & methodologies for a new generation."

When a windfarm operator keeps a turbine free from unplanned maintenance and running at peak efficiency, it directly contributes to a company's revenue and profit. If something does go wrong, every minute matters. When a wind turbine comes offline due to unplanned maintenance, the average daily cost to a windfarm is several thousand Euros.

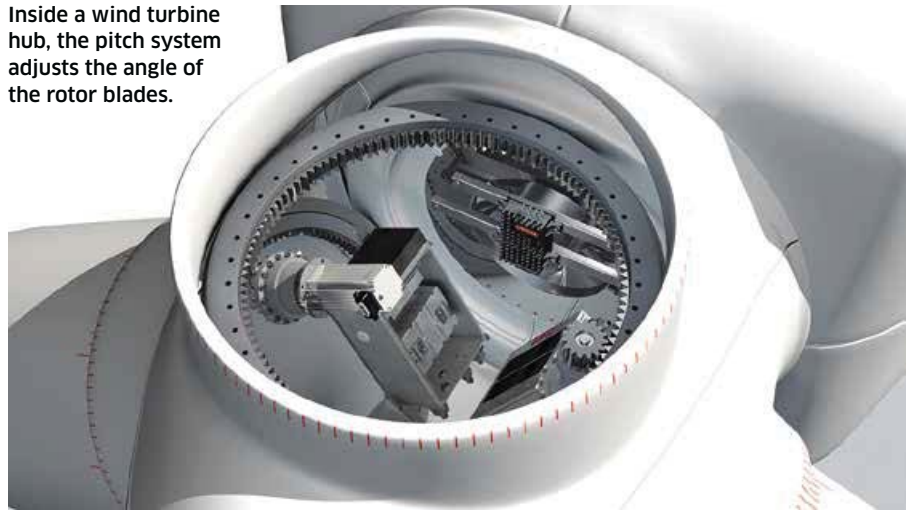
According to a 2011 ReliaWind research report, pitch system failures account for 23 percent of all downtime in wind turbines. This is more than any other component or system of the turbine. The ReliaWind report¹ goes on to note that pitch systems tallied the highest percentage of all component failures in wind turbines at more than 21 percent.

When compared to the size of a wind turbine, a pitch control system appears



A worker exits a wind turbine's nacelle and moves onto the hub to which each blade attaches.

Inside a wind turbine hub, the pitch system adjusts the angle of the rotor blades.



REDUCING THE FREQUENCY AND COST OF MAINTENANCE TAKES A COMBINATION OF NEW TECHNOLOGY AND CREATIVE OPTIONS FOR SERVICE

small. But pitch systems keep a turbine running and ensure the safety of the turbine in the event of high winds or catastrophic events. The pitch control system monitors and adjusts the inclination angle of the rotor blades and thus controls the speed of the rotor. Although these systems play an outsized role, they account for less than three percent of a wind farm's capital expenses.

I work for a global company, Moog Inc., which makes high-performance motion-control technology, including pitch systems. While we are always analyzing market trends and developing new solutions, our services business is where we reconnect with our customers, maintenance issues and technology, both legacy products and new ones.

With the ReliaWind report above as context, we saw that windfarm operators were struggling with a variety of manufacturers' pitch systems. With a goal of alleviating maintenance and service issues as our focus, we set out to develop a new pitch system that required 50

percent less maintenance than products already on the market made by other manufacturers and wind turbine designers. Our new system had fewer working parts, and we improved the design through using ultra-capacitors, instead of batteries, to eliminate backup power failures and periodic maintenance. By selecting AC synchronous motor technology (i.e., brushless, no fans for cooling), our engineers improved pitch system motor reliability and reduced periodic maintenance compared with the AC Induction or DC motors currently used by the wind turbine OEMs. These improvements are helping these new pitch systems increase reliability over existing industry designs by a remarkable 223 percent.

Case in Point

Reducing the frequency and cost of maintenance takes a combination of new technology and creative options for service. For example, one of our pitch system clients had a maintenance issue in Brazil, a country with government regulations that can sometimes create challenges when procuring parts. Some of the wind turbines in Brazil are located in extremely remote locations. So our plan was to do everything possible to eliminate unscheduled service and be

prepared should something happen. The customer simply couldn't afford to wait weeks for new parts and repairs made from Europe. All parties concerned realized it was cheaper to scrap the parts in Brazil and send a part via a local, authorized supplier. Our local office in Brazil worked out a service agreement with our customer in Brazil to send rotatable parts as clients needed them, and we, in turn, would keep an inventory of 15 to 30 core components of the pitch system for the customer to have on hand. As part of the plan, if we learned there was a critical volume of parts and repairs needed, we would organize a cost-efficient way of repairing the broken parts. We would do this by calling on either a localized partner or Moog technicians with technical assistance from our global support team.

As our customer's inventory of reworked, rotatable parts is depleted and new requests come in for repairs, we have a trigger point at which we repair any damaged parts and return them to our original factory standard. The repairs are not immediately made to the client's damaged parts; instead the client receives a refurbished, like-new item that our local supplier may have received weeks before from another customer. By eliminating the need to handle separate components inside each pitch system,

we have expedited service and enabled our clients to get their wind turbines back online much faster. This improves the Levelized Cost of Energy, or the net cost to install and operate a wind turbine against expected energy output over the course of the turbine's lifetime (incentives excluded). And with rotatable stock, we have enabled our customers in places like Brazil and elsewhere to reduce inventory.

Tips and Strategies for Service

Whether you are a maintenance manager relying on service or a manufacturer providing service, improving repairs takes flexibility. There has to be a willingness on all sides to think along new lines if you want to improve the way you deliver service and make repairs. Due to the challenges of wind turbine maintenance on a global basis, we analyzed ways we could better meet our wind energy customers' expectations.

We sat down with our customers to look for innovative ways to help them. In our case, we looked at the problem in two ways: First, how could we and our supplier solve the service problem in a way that best helped our customer? And,

second, in what ways could we do this to ensure greater reliability of our systems and save maintenance costs.

To help those customers not ready for an entirely new system, we are also providing retrofits using the ultra-capacitors and have seen vast improvements in less downtime due to backup failure as well as maintaining old battery systems. As a company we take what we learn on new systems and try to provide the same benefits for our retrofit customers.

An additional service offering that Moog has made available to its clients is hands-on training on the exact system in the turbine, and on a scale that would truly make them capable of solving many of their own challenges and problems in the field without the need for Moog service personnel on-site. Our 800-square-metre facility in Unna, Germany, provides technical training programmes to Moog's global wind energy customers. At the centre, a team of expert trainers delivers customer training programmes ranging from a basic introduction to more advanced and focused engineering courses on products and systems. It is an investment that pays off for both our clients and Moog. A trained technician can


diagnose, repair and restore a wind turbine to full operation in a fraction of the time it might take to remotely support an untrained technician. Overall, that will reduce the turbine's downtime.

In conjunction with the training centre, we also offer an around-the-clock help line. But even the help line is more efficient when the client placing the call has received a level of training that helps our services staff pinpoint a problem much faster.

The training approach to service and maintenance has been so successful that we introduced a similar concept for our clients in China. We have been able to help our clients reduce downtime and the cost of energy by:

- introducing new technologies like our latest pitch system, which is easier to maintain and can be monitored remotely;
- adopting the concept of rotatable stock and on-site support; and
- providing quality training.

And, ultimately, that spells an approach to maintenance and service that adds up to a reduced cost of producing energy for our customers. ■



WHEN A WINDFARM OPERATOR KEEPS A TURBINE FREE FROM UNPLANNED MAINTENANCE AND RUNNING AT PEAK EFFICIENCY, IT DIRECTLY CONTRIBUTES TO A COMPANY'S REVENUE AND PROFIT.
