Improving turbine maintenance efficiency

Optimising turbine maintenance continues to drive innovations in tool design and ergonomics. Stimulated by the 'need to maintain' rather than 'nice to maintain', the focus is on identifying priority maintenance areas and equipping engineers with the tools to do the job as quickly and safely as possible. Erik Roos, Director Wind Industry Products & Solutions (EMEA) at Enerpac, believes that developments in tool portability, data logging, battery powered tools and tool deployment systems are key to improving turbine maintenance efficiency.

Precise bolting lies at the heart of the successful maintenance of wind energy structures. The need for accurate torquing and tensioning is a given. Maintenance teams must also contend with height and accessibility issues, exposure to extreme weather conditions and complex turbine structures and components. Add limited weather windows and the high cost of vessels, and the efficiency of maintenance procedures begins to have significant financial implications.

The maintenance tools industry has responded to these environmental and practical challenges. Overcoming height and accessibility issues has led to torque wrench designs that improve safety, versatility and ease of use.

Lightweight aluminium designs can reduce tool weight, while an enclosed square drive helps protect technicians' hands from moving parts. A compact design and an optimised weight-to-output ratio can also help reduce operator fatigue.

Turbine maintenance involves an array of special tools, depending on the turbine type and maintenance and repair requirements. Technicians rely on torque wrenches, bolt tensioners, cylinders and hydraulic pumps.

Depending on its design, a wind turbine installation may contain as many as 25,000 bolts. Only a proportion require regular maintenance. Typical maintenance locations include bolted joints within the nacelle and at the blade-to-hub connections.

Portable pumps for intermittent bolting

Focusing on the 'need to maintain' often translates into intermittent bolting. This involves periodic or on-demand bolting in response to maintenance monitoring, such as routine torque checks and servicing a limited number of bolts across multiple sites.

Traditionally, maintenance teams have had to transport heavy, continuous-duty industrial pumps for these quick, routine checks, a laborious, time-consuming and sometimes hazardous procedure. Enerpac developed the LU-Series electric torque pump for these intermittent tasks, providing the power required for standard maintenance in a smaller, lighter package.

Developed in close collaboration with operators, original equipment manufacturers (OEMs) and contractors, its design addresses how crews interact with equipment in working conditions. Weighing 15 kg empty, the pump has balanced lifting points and multiple carry points to aid handling in restricted spaces. A front shield helps protect critical components against impact and damage in demanding working environments.

'The Enerpac LU-Series electric torque pump provides a compact, right-sized solution that simplifies the workflow for field technicians and maintenance teams,' says Angie Wallace, Global Product Manager, Enerpac.

'Feedback from MRO teams has included: lightweight and easy to transport thanks to the exposed frame design and multiple secure grip points; responsive and easier to operate remote control even with gloves on; a perfect combination of simplicity, size and weight.'

Here, MRO refers to maintenance, repair and operations.

Automatic torque data logging

Maintenance schedules for wind turbines are dictated by the turbine's OEM. For bolting, maintenance contractors generally work to a predefined schedule or respond when monitoring or inspection identifies a potential problem with a bolted joint.

Tightening requirements, torque specifications and the complexity of turbine structures and components mean there are significant variations in bolt types, sizes and torque and tensioning requirements. Confidence in torque wrench accuracy is fundamental to reliable record keeping throughout maintenance cycles.

Responding to the growing demand for torque data capture, the Enerpac ZU4T Connect torque pump records bolting operations through integrated data capture. According to the company, this creates a traceable record that helps reduce rework risk and supports compliance requirements.

Based on the Z-Class electric torque pump, the system records torque operations without the need to complete manual paperwork.

ZU4T-Series pumps are built to power small to large torque wrenches. The patented Z-Class pump technology provides high bypass pressures for applications using long hose runs and circuits with high pressure drops, making the pump suitable for a range of turbine construction and maintenance projects.

Used with the Enerpac Connect app on Apple and Android devices, the system allows bolting records to be documented and shared. Data is transferred from the pump via Bluetooth without additional cables or hardware.

As well as recording completed bolting jobs, the app allows job configurations to be created on the user's device to support consistent tool setup.

Maintenance contractors can define the wrench type, number of bolts and passes, target torque per pass and job conditions such



as lubrication. Programming these requirements before deployment gives operators access to job-specific settings and supports traceability.

Access to these settings can reduce setup times, while the data collected for each bolt can be used for subsequent analysis. Where records are linked to individual joints, they can support a maintenance history and help teams plan future scheduled shutdowns.

Battery powered tools

The introduction of the company's first data logging torque pump is the latest in a series of developments designed to equip turbine construction and maintenance teams with tools to do the job safely and efficiently.

Battery powered tools have become more practical as power output and battery capacity have improved. Cordless operation removes the need for extension leads to the tool, reducing associated trip hazards.

Where battery powered equipment replaces equipment supplied by a generator, it can also reduce local noise and exhaust emissions. Maintenance teams can carry charged battery packs to support work in locations where a mains supply is unavailable or difficult to access.

One maintenance company describes the expected productivity benefit of switching to Enerpac battery powered tools:

'Using battery torque wrenches, we're looking to double the productivity of our bolting teams. The handheld and portable wrench can be operated by a single operator rather than the two operators needed previously. Moreover, we can more easily reach places where space is limited without the need for awkward tool set-up.'



Accuracy remains important alongside portability. The company states that its BTW-Series battery torque wrenches achieve accuracy within plus or minus 5% across their operational range.

Pumps, too, are benefiting from developments in high-capacity battery technology and the switch from brushed to brushless motors. According to Enerpac, XC2-Series pumps offer higher speeds and longer battery runtimes. Greater oil capacity also supports larger tools and applications using multiple cylinders on a single charge.

This is an important development for maintenance teams performing a gearbox changeout, where multiple hydraulic cylinders are needed.

It is not all about the battery, of course. On XC2-Series manual valve models, a variable speed trigger provides greater control of tool or cylinder movement. The bladder reservoir design also allows pump operation in different orientations, helping teams work where access and space are limited.



Improving tool storage and deployment

Time is of the essence when constructing and maintaining wind turbines. Equipping engineers with the tools they need also means organising, protecting and transporting those tools efficiently.

Developed by Enerpac, the Armor Stack tool storage system combines protective cases with a modular, stackable design. Multiple cases can be locked together and deployed as a single integrated system.

Companies sending maintenance and construction teams across multiple sites face significant logistical and practical challenges. Traditional heavy-duty toolboxes operate as standalone units. A modular system allows teams to assemble job-specific tool configurations and adapt them as requirements change.

Cases can be separated for individual tasks or combined for transport between locations.

Portable pumps, data logging, battery powered equipment and modular tool storage each address practical challenges faced by turbine maintenance teams. By matching these developments to the task, teams can improve access, reduce handling demands and maintain clearer records of completed work.

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