The RBC-D rotor blade yoke during single-blade installation

A more flexible approach to single-blade installation

As repowering and component replacement activity increases, access to specialised lifting equipment is becoming an important consideration for service providers. Rental models, adaptive blade-handling systems and improved monitoring are widening the options available for single-blade installation and repair.

As wind turbines become larger and the installed fleet ages, blade installation is no longer limited to new-build projects. Repowering, component replacement and major repair work can require specialist lifting equipment, often for individual projects rather than continuous use.

For service providers, that creates a practical question: when does it make sense to own specialist equipment, and when is access to it more important than ownership?

Rental is one response. It can give contractors access to equipment for specific projects without requiring the capital investment or storage associated with permanent ownership. It can also be useful where projects involve different turbine platforms and blade configurations.

One example is the RBC-D rotor blade yoke developed by ematec, which is designed for single-blade installation and uses an adaptive gripping system. The current system is rated for blades weighing up to 50 tonnes.

Matching equipment to the blade

The challenge with single-blade installation isn't simply lifting a heavier component. Blade geometry, weight distribution and centre of gravity all affect how the load behaves during lifting and positioning.

An adaptive gripping system allows the yoke to accommodate different blade configurations. The centre of gravity also needs to remain controlled as the blade is tilted, pitched and eventually released at the hub.

The RBC-D uses two counterweights on its yoke wings to compensate for the blade's centre of gravity. Its curved geometry allows the system to remain aligned with the centre of gravity when tilted by up to ±30 degrees, while blade pitching of up to ±8 degrees can also be accommodated.

For contractors working across different projects, this adaptability can reduce the need to match each blade platform with a separate lifting configuration.

Reducing installation time

Installation time is another consideration, particularly where cranes and other heavy equipment are working on the project's critical path.

ematec says use of the RBC-D can reduce construction time by up to three days per turbine, depending on the project. The potential benefit comes from the way the yoke supports single-blade handling and the associated installation sequence.

The relevance of such savings depends on the project, however. Site conditions, crane availability, weather and the turbine design all influence the overall installation programme.

Monitoring side pull during lifting

Control of the suspended load becomes particularly important during the final stages of installation.

A crane hook that is not vertically aligned with the load can introduce side pull. The Diagonal Pull Sensor (DPS) developed by ematec is designed to monitor this angular deviation on two axes.

The sensor transmits measurements wirelessly to a ground unit, with the information also available through a tablet. This gives the crane operator real-time information about the position of the suspended load.

One application is the release of the blade yoke after the blade has been attached to the hub. Before releasing the lifting equipment, the operator needs to know that the hook block is correctly aligned with the centre of gravity. Monitoring the angular position provides an additional indication that the load has returned to the required position.

The underlying principle is relatively simple: better information about the position of the load can help the operator make the release decision based on the actual condition of the lifting system rather than visual judgement alone.

Ground-based blade repair

Blade handling does not end once a turbine is commissioned. As fleets age, repair work can require blades to be accessed, repositioned and inspected on the ground.

A blade turning device provides one option for this type of work. It allows the blade to be rotated around its longitudinal axis while on the ground, giving technicians access to different sections without repeatedly repositioning the blade using conventional lifting equipment.

Depending on the repair required and the site setup, this can allow work to be completed at the turbine site rather than transporting the blade to a separate repair facility.

For operators and service providers, the potential benefit is primarily logistical. Keeping repair work onsite can reduce additional transport and handling requirements where the necessary facilities and equipment are available.

Installation without ground-based guide ropes

The combination of the RBC-D with an autonomous positioning system (APS) from Seasight Solutions addresses a different installation constraint: the amount of ground infrastructure required during blade lifting.

The system can be used without guide ropes, removing the associated requirement for ground-based winches. That can be relevant on sites where there is limited working space or difficult terrain.

A project near Freiburg in Germany's Black Forest provides an example. The steep and forested terrain around the Taubenkopf wind farm restricted the available installation area. According to ematec, the combination of the blade yoke and APS was used because conventional installation methods were not suitable for the site.

The RBC-D is designed for handling large rotor blades, including those used on 7 MW turbine platforms

The example illustrates a wider point about blade installation: equipment selection is increasingly influenced by the conditions around the turbine as well as the characteristics of the blade itself.

Working within changing weather conditions

Wind speed is another factor that can determine whether a lifting operation can proceed. ematec says the RBC-D/APS combination can be used for blade installation at wind speeds of up to 10 m/s, compared with around 8 m/s for the conventional methods referenced by the company.

The difference does not remove the need for project-specific weather assessment or operational controls, but a wider operating window can provide additional flexibility when scheduling lifts.

The RBC-D and autonomous positioning system support blade installation where ground access or working space is restricted

Choosing access over ownership

As the wind industry moves further into repowering and life extension, the requirement for specialist lifting equipment is likely to become more varied. A contractor may need a particular yoke or blade-handling system for a limited number of turbines, rather than enough work to justify permanent ownership.

That changes the equipment decision. The question is not simply which system offers the greatest capability, but how that capability can be made available when and where it is needed.

Rental is one part of that equation. Adaptive gripping, load monitoring, ground-based blade handling and positioning systems address different parts of the installation and maintenance process. Together, they point towards a more flexible approach to specialist equipment, particularly as projects become more varied and site constraints increasingly influence how work is carried out.

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