Robotics: the key to the future of offshore wind

When wind turbines were first placed in the sea off the Danish island of Lolland in 1991, it was the start of a global journey which would see wind power as the backbone of a sustainable future. Fast forward 30 years and those 11 turbines off Vindeby have transformed into more than 160 offshore wind farms worldwide. But while innovation has created bigger and more efficient turbines, the question of just how to maintain and protect these assets has never been more important.

While offshore wind is a relatively new industry in energy generation, it is expanding at a phenomenal rate. A recent report[1] revealed offshore wind could be worth a staggering 10 billion Euros by 2029. Those responsible for maintenance have to balance the costs of power outages with repairs, and yearly inspections are by far the preferred method of assessing any potential damage. But inspections bring about their own questions, not least the cost and safety of carrying them out.

Chris Cieslak, Founder and CEO of BladeBUG, says: 'It's astonishing really when you consider how much downtime affects the output of wind farms, and that maintenance is by the far the largest expenditure within offshore wind O&M. Focusing on how to solve those problems for everyone is just common sense.'

Offshore wind remains a person-first industry, relying heavily on vessels, rope access technicians and labour to carry out a wide range of maintenance and repairs. But this approach has significant cost and safety implications which are simply not sustainable long term, especially when we take the predicted growth of the industry over the next decade into account.

As offshore arrays are built further from shore, O&M strategies have needed to adapt to the evolving challenges and hurdles which come with these larger distances. These include safety and regulations, availability of vessels and repair technicians, and weather conditions.

While humans have been doing the job alone until now, keeping an increasingly large offshore wind fleet operating at maximum capacity, particularly in extreme environments like the North Sea, is too big a task. The scope of offshore wind generation is widening to include floating offshore wind and operators are facing increasing pressure to provide alternatives to human-only inspection and maintenance. The only practical option cost-wise is the widespread adoption of assistive repair and maintenance robots, which can be operated remotely, or even autonomously.

Cieslak says: 'Over the last several years global investment into robotics has topped $135 billion. As the first repair and maintenance robot designed specifically for the offshore wind industry, BladeBUG has been at the forefront of this work.

'For the past five years, we've been working with the Offshore Renewable Energy Catapult to establish the potential for autonomous vehicles in the offshore environment. For the first time, we have a clear picture of the opportunities, potential and timescale of autonomous vehicles working in the extreme offshore environment.'

BladeBUG is a six-legged crawling robot which inspects and repairs turbine blades by walking on them, a task that currently requires human technicians to be exposed to hazardous conditions.

The deployment of robots can directly lower the cost of maintenance in several ways. One such way is the allocation of resources; using robotics enables personnel to focus on other, larger repair and maintenance tasks, whilst robots, like BladeBUG, can scan and assess blades and complete low grade repairs. This means engineers potentially spending less time outside the relative safety of the nacelle and an increase in productivity in terms of checks and repairs per trip.

Another benefit relates directly to the issues around maximising power generation. If inspection and repair robots can carry out detailed analysis of damage on blades and feedback images and data, operators have information to make proactive and informed decisions around maintenance. This can reduce the downtime of turbines and, as a result, increase the generational power of an offshore array.

With the second largest offshore wind fleet in the world comprising 2,000 wind turbines and a power generating capacity of 10GW, the UK has an opportunity to lead on the adoption of robotics across the repair and maintenance sector.

Cieslak continues: 'Harnessing robotics to assist technicians in the inspection and repair of turbine blades is just the first step, but a crucial one. It does away with the need for rope access, making maintenance instantly safer by not exposing technicians to harsh conditions. For instance, BladeBUG's crawler robot can be operated out of line of sight, so technicians can remotely carry out maintenance.'

But for BladeBUG, robotics can go even further. While maintenance of wind turbines has up until now focused primarily on necessary repairs, the company believes the shift now needs to be more towards preventative maintenance.

Therein lies another problem with reliance on human workforces, as they are costly and have limitations when it comes to challenging weather. Only through the use of robotics can the offshore wind industry rapidly and easily deploy solutions to ensure wind turbines are kept to an optimal level no matter the weather, and as a result, decrease downtime and increase output. In a world which has such high, and necessary, targets to reach net zero by 2050, increasing the

output of offshore wind turbines by ensuring they are running as often and as efficiently as possible is as important as creating more wind farms.

It is a point BladeBUG made well last year with the world's first robotic 'blade walk'. The three-day trial saw the robot controlled from the nacelle using its onboard cameras, performing checks and tasks beyond the sight of the rope operator. The robot carried out a Lightning Protection System check, which is a routine task for offshore wind rope access technicians. But if applied to all future routine maintenance checks, it will cut offshore wind maintenance costs and allow for better efficiency, not to mention safety measures by removing the need for such hands-on human activity.

Cieslak says: 'BladeBUG walked the entire length of the 80m blade as well as carrying out the routine tests, all out of line of sight. It was a remarkable achievement, and one we knew the robot was more than capable of. But to have that proof and to see it happen was so exciting.

'Of course, while BladeBUG carried out the Lightning Protection Systems check, that isn't the robot's endgame. It is just one piece of a huge array of tasks the robot will be capable of performing during offshore wind turbine maintenance and inspection going forward. And this is where the power of robotics in the industry lies; in the whole picture.'

BladeBUG is already working towards this future by focusing on increasing the robot's capabilities. Its engineers have been turning their attention to adding a suite of industry-standard tools and functionalities so O&M teams can treat defects before it would be viable to use a traditional rope access team. Not only will this increase the efficiency of the turbine but it will also maximise the low carbon energy generated.

But while it may seem like a robotics future is a long way off to some, the fact is it is happening now. And the outcomes will have a huge impact on the offshore wind industry as a whole.

Cieslak says: 'While new offshore wind farms are being approved and created all the time across the globe, and in ever increasing frequency, we have an ageing wind turbine fleet to consider too. Wind turbines have a life of around 25-30 years (new ones now are 30) years and many are coming to the end of that life.

'As assets age you expect them to need ever-increasing amounts of maintenance and repair, and wind turbines are no exception. That means more human hours and more costs to keep the same level of output. It's not sustainable and it's just another reason where robotics can offer a much-needed solution to a problem which is only going to get worse as the decades go by. If the small number of wind farms in operation 20 years ago are already facing this challenge, it is going to be a much larger problem by 2045.'

So, what's next for BladeBUG? While the team is very much still coming to terms with its latest high of showing just how important their robot is to the future of offshore wind, they're not having a break. Its Early Adopter Programme is proving incredibly successful with organisations and customers looking to make the most of the new technology they're offering as soon as possible.

And as with any solution, BladeBUG is being continually adapted and improved to provide a huge array of capabilities for the ever-growing sector, and moving from semi-autonomous to full autonomy is certainly on its radar. One thing is for certain, the capabilities of offshore wind are going to expand exponentially in the next decade and beyond thanks to robotics.

[1] Wood MacKenzie report

www.bladebug.co.uk