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Heady heights

The challenges posed by the increasing height of wind turbines are being met with a range of innovations from the lifting industry. CHRISTIAN SHELTON reports

Sarens has defined a strategy for continuous growth in Western Europe and plans to extend its presence in the North American and Canadian wind market

"The hub heights of wind turbines are increasing and, as a result, the type of cranes required are changing along with this," says Helder Carvalheiro, manager of the wind division at Sarens. He's been in the role for almost seven years and during that time he's seen many developments in the turbine erection industry. "Some regions have grown while others have disappeared from the wind map. Yes, there have been many changes; wind is always moving... rather like Sarens," he muses.

The reason for the increase in hub heights is simple: the higher you go the more constant the wind. "There is less turbulence higher up and so the electricity production rate is greater and less maintenance is required," explains Carvalheiro. "There will, of course, be a limit but the general trend is towards higher turbine towers. It is our job to keep up with this and provide solutions..."

This positive approach is echoed by Carvalheiro's colleague, Rutger Kouwenhoven, Sarens regional director, Western Europe, "Now that the [wind farm]market [in Western Europe] is picking up, we see a far healthier balance between supply and demand in the crane industry. In our region, we have defined a clear strategy for continuous growth. With our ability to combine our wide range, an almost unlimited amount of equipment, and our mechanical and installation services, we can offer any engineered solution to our clients against the highest safety standards."

Certainly the size of Sarens as an organisation and all the resources it has access to means it is well placed to capitalise on an ever-changing market. As a global player it can shift its focus from one region to another, reacting to market trends. This can be seen in the company's resolve to now focus its efforts on North America and expand its presence there. "The US is the second biggest market for onshore wind turbine erection in the world [China being the largest]. We have some cranes there, around 75 at the moment, but we intend to establish our presence in the North American and Canadian wind sector much further," reveals Carvalheiro.

Out-of-the-box thinking

Sarens' 'resource pool' of expertise, equipment and available finance also means that, in addition to adopting new markets, it is well placed to adopt new methods. "Our thinking at Sarens is, if crawler cranes or pedestal cranes are no longer able to erect wind turbines due to their increased height, then the next logical step is to use a tower crane," says Carvalheiro. "We have many tower cranes in our fleet and we are looking at how to adapt them for wind. However, as the market is moving so quickly we don't have enough time to modify our existing equipment so we're currently in talks with tower crane manufacturers to see if buying their equipment provides a suitable solution.

"And if, in time, we find that freestanding tower cranes are not tall enough to do the job then why not consider attaching the crane to the tower and raising it up as the tower is constructed?" If you think this sounds fanciful, think again: Sarens is close to concluding negotiations on a wind project in Thailand where two freestanding tower cranes will be used in this way.

Hand in hand with the increasing height of wind turbines comes an increase in their weight. "Materials have started to become heavy," continues Carvalheiro. "In some countries, such as Brazil, the tendency is to use concrete towers, which are very heavy, »

or concrete and steel [hybrid] towers. From an engineering perspective this is a good combination but from our point of view it means the cranes we use need to have distinctive features to those we have been traditionally using."

Necessity is the mother of invention and it is challenges like this that have pushed Sarens to innovate. In 2014, for example, Sarens says it worked with crane manufacturer Terex in developing Terex's Boom Booster. The Booster is designed to replace the lower part of a standard boom on a CC 8800-1 or CC 3800 lattice boom crawler crane, increasing its capacity by at least 60% compared to a regular boom, making it suitable for the erection of large wind turbines.

Boom systems

In June 2017 Terex announced a new version of the Boom Booster kit, this time for the Demag CC 3800-1 crawler crane, extending its reach to a maximum system length of 183 metres (600 feet). According to Terex, the new Boom Booster kit increases the main boom stiffness of the CC 3800-1 resulting in higher lift capacities by up to 30 percent, again making this crane suitable for erecting larger wind turbines. The kit is available with new crane purchases or can be retrofitted to existing Terex Superlift 3800 and Demag CC 3800-1 models.

Also in Germany, manufacturer Liebherr has also spent time developing boom systems that will boost its cranes' capacities to assist with erecting the latest generation of wind turbines. At the end of April 2017, Liebherr launched the SX boom system designed for increasing the capability and lifting height of 750 tonne capacity lattice boom cranes (the LR 1750/2 and LG 1750) to the 1,000-tonne class to erect wind turbines. Liebherr says the new system can erect turbines with a hub height of up to 165 metres and component weights of up to 120 tonnes. Previously such lifts were only possible using cranes in the 1,000 tonne class or above.

Liebherr's new SX boom system can erect turbines with a hub height of up to 165 metres and component weights of up to 120 tonnes

The SX boom differs from previous boom systems by the fact that 3.5 metre wide lattice sections are used in the bottom area of the boom, rather than sections measuring 3 metres wide. The extended lattice sections increase the lateral stability of the boom and, therefore, deliver a higher load capacity. In addition, the weight of the lattice sections has been reduced. This means that the boom length can now be raised up to 165 metres, comprising the main boom plus the fixed lattice jib.

Bigge has an extensive fleet of machinery to deal with a range of different wind turbine erection jobs

An additional increase in lifting capacity can be achieved by an extension to the SX system: instead of 3.5 metre wide lattice sections, two 14 metre long lattice sections (SX2 system), or three 14 metre long lattice sections (SX3 system) with a width of 6 metres are installed in the lowest area of the main boom. This, says Liebherr, provides additional rigidity to the boom system, thus increasing its load capacity. To install the 6 metre wide lattice sections in the boom there is an extension adapter from 3 metres to 6 metres on the pivot section for the turntable. At the top the width of 6 metres is reduced to 3.5 metres by a second adapter.

A challenge during the development of the 6 metre wide lattice sections, however, was the question of how they could be transported economically on public roads. To solve this problem Liebherr designed the wide boom sections in two halves which can be bolted together in the centre and separated again quickly. To transport them, the individual halves are slightly offset longitudinally and then joined so that they mesh together like teeth. This means that a practical transport width of 3.5 metres can be achieved.

The complete SX system can be interchanged between the LR 1750/2 crawler crane and the LG 1750 wheeled mobile crane, says Liebherr. To enable the higher lifting capacities of the SX system to be used, Liebherr has also developed a new fixed jib enhanced for this system. A runner is included and the head sheaves and a new hook block are designed to prevent the hook block becoming twisted.

A bigger boom configuration is what attracted US crane sales and rental outfit Bigge Crane and Rigging to invest in 12 new Tadano GR 1200XL rough terrain cranes at US trade show ConExpo in 2017. According to Esperanza Navarro, marketing projects at Bigge, "The Tadano GR1200XL is equipped with a bigger boom configuration which allows us to have more reach and capacity with less counterweight. This crane is much lighter than any other crane in its class which prevents it from getting stuck on soft soil terrains. This allows us to service wind turbines faster and more efficiently."

Bigge says the Tadano GR-1200XL was designed with industrial energy sites in mind. Its capacity is 120 US tons (109 metric tonnes), it has a maximum lifting height of 184 feet (56 metres) and it has a 144-foot (44 metre) load radius. In addition, it has Tadano's newly developed Smart Chart System that allows »

outriggers to extend to a square-shaped rated load capacity footprint, with extended 'corners' over the outriggers to increase the load radius depending on the degree to which the outriggers are extended. According to Bigge, it now has a rental fleet of more than 90 rough terrain cranes, making it the largest RT fleet in the USA.

Bigge also claims to have the largest fleet of Liebherr 1300SX crawlers in the USA, which it says are ideal for a lot of turbine repower work and are a good alternative for these kinds of jobs than larger more energy-consuming cranes. According to Navarro, "Larger wind turbines require taller and heavier equipment, as well as more time during the assembly process. With these changes, we have had to acquire an array of machinery that includes crawler cranes from manufacturers like Liebherr and Manitowoc, as well as higher capacity rough terrain cranes from manufacturers like Grove, Tadano and Link-Belt."

A different approach

Rather than boosting the capacity of existing equipment to accommodate the larger generation of wind turbines or purchasing an array of new machinery, heavy lift and transportation specialist Mammoet has developed an entirely different approach to the lifting element of wind turbine erection and maintenance. Mammoet believes its new method has the potential to shake up the industry, claiming the innovation will "eliminate the current physical boundaries of turbines and make wind turbine construction and maintenance safer and more efficient".

A pair of new cranes, the WTM 100 and

Mammoet says its new WTA 250 enables users to lift and lower components to greater heights than equipment currently used

WTA 250 from Mammoet, use the tower of the wind turbine for support. They will allow components to be both lifted and lowered to and from a greater height than current methods, Mammoet said. The company's solution is a crane for wind turbine assembly and one for wind turbine maintenance. The WTA 250 is for assembling turbines and has a capacity of 250 tonnes. It is under development with engineering company MECAL.

On the WTA 250 a guide rail running along the bottom tower section allows the crane to lift the next tower section using the tower as support. With the next section installed a guide rail is mounted on that and the crane then pushes itself up along the rail. It is a sequence repeated for all remaining sections. On completion, the guide rail can be removed and used on another tower or it can be left in place to allow maintenance in future.

The 100-tonne capacity Wind Turbine Maintenance Crane WTM 100 operates in a similar way: it uses a pair of pre-installed hoisting eyes to pull itself and the load up the turbine tower, using it for support. Claws that wrap around the tower are designed to keep the crane steady. In some cases, the WTM can be used on existing turbines.

Commenting on the new cranes, Wessel Helmens, Mammoet innovations director, says, "Both cranes are compact – the WTM can easily fit into two standard-sized containers – and the WTA only needs two transport trailers to be moved on site. This makes them easy to mobilise and relocate, and much more efficient than conventional alternatives. More importantly, both cranes eliminate the height restrictions for turbines and render both the assembly and replacement process faster and more cost-effective."

A further benefit is that the crane has no footprint and therefore requires no prepared ground, base or reinforcement. In addition, "the tower-based design also puts the crane and the operator closer to the work area, rendering assembly and maintenance both safer and easier," Helmens adds.

So as wind turbine hub heights continue to increase we can see that crane manufacturers and users alike are open to experimenting with different ideas and approaches; from using tower cranes that are raised up as the tower is constructed, to boosting the capabilities of existing machinery, to adopting entirely new technology, it's clear that the challenges of erecting ever higher wind turbines have been met with a range of innovations. ■