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Wind safety developments

A serious wind farm accident in 2008 led to a decade long process of safety improvements in the sector and offers a casebook example of how to build understanding of safety between all those involved. Will North spoke to two of those leading the efforts, Klaus Meissner and Ton Klijn, who explain the resources available to ensure safe lifting on wind farms.

The incident that kicked things off occurred in 2008 when a large All Terrain crane overturned and collapsed while lifting a blade assembly.

Klaus Meissner was, at the time, responsible for engineering support of product safety at Terex Cranes and the company's representative on the FEM mobile crane group. He was then, and remains, even in partial retirement, the convenor of the CEN working group responsible for developing the European mobile crane safety standard, EN 13000.

The incident was not a result of the crane's design - Meissner stresses that it could have happened to any crane - but of how it was being used, due to an industry wide knowledge gap. In this case, the crane was a Liebherr, and it fell to Meissner's counterpart at the company, and fellow FEM representative, Hans-Dieter Willim to lead the manufacturer's investigation into what happened.

Two years later, after a lengthy investigation, Willim was able to explain the accident more fully and publicly. He did so at an ESTA meeting in Munich in April 2010, accompanying his presentation with a smartphone video showing the collapse.

Stunned silence

Ton Klijn, current director of ESTA and then head of its cranes group, was in the room, along with the leaders of many of Europe's largest crane companies. He said: "Willim finished his presentation, and for minutes there was absolute silence. You could tell what they were thinking: 'how bloody lucky we have been that it didn't happen to us'."

And that was the issue, not that the crane engineers, crane owners or operators, turbine manufacturers or the project's developers had failed, but that there had instead been a fundamental breakdown in how

Klaus Meissner

everyone involved understood the job and the risks entailed.

The crane engineers had carefully designed their cranes within well established parameters for wind loading. Meissner explains: "For every standard capacity chart the crane engineers use the assumption that you have per one tonne of load one square metre of sail area, which you assume with a drag factor of 1.2."

"The wind turbine manufacturers design lightweight turbine blades with a large sail area and drag factors that exceed the assumed value, because they are designed to harvest energy. The larger the rotor blade area, the higher the drag factor, and the more effective the turbine becomes."

The aims and assumptions of both sets of engineers needed to be understood by lift planners and crane operators, in order to work safely.

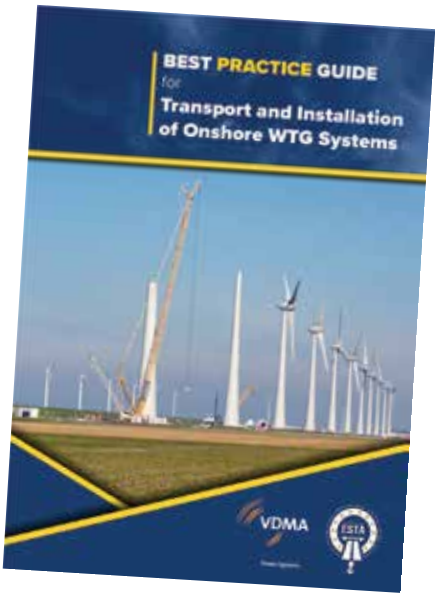
Shortly after that meeting, the FEM and ESTA put together a short - one page - safety notice alerting crane owners to the risks and the influence of wind forces during crane operation. The notice says: "Especially during lifting of loads with relatively small masses but large sail areas, the wind load has a considerable impact on the load carrying performance of the crane. The effective sail area of the load which needs to be taken into account is the result of the projected area multiplied with the C^W factor (shape coefficient for the load). The sail area and C^W factor must be known to all parties planning the lifting operation."

"Additionally, it is mandatory to request information regarding the expected wind forces including any gusts for the relevant environment from the responsible meteorological office prior to performing a lift and to take this information into account."

Meissner says: "In engineering terms it was nothing new. The risk was growing because mobile cranes were working more frequently in the wind turbine erection business. The wind turbines themselves had also grown over the years, so cranes were working at their capacity limits at all times. It was just a result of technical developments, with nobody to blame."

Fixing the problem would require more information sharing. Meissner adds: "The assumptions of the crane designer need to be taken into account by the people planning the lift, and they need to get more information from the turbine manufacturer. They also need to know the wind affected area of the rotor blades, and the drag factor of these blades."

Initially that wasn't easy. "There was some hesitancy from the turbine manufacturers," adds



ESTA's best practice guide was developed with help from across the wind turbine sector

Meissner. "Because they thought, 'this is our intellectual property'. And some of them had experiences of their intellectual property being stolen from them."

At the time Klijn was chief executive of Dutch rental firm Wagenborg. He adds: "The crane rental companies didn't realise they needed this information in the first place. So, they weren't even asking for it."

Joining the dots

The task then was to ensure that everyone in the industry was aware of the risks involved with these jobs. At the same time, the FEM representatives on the EN13000 working group were working on the tricky question of the override switch. This question is whether the crane operator should be sovereign, and able to override the rated capacity limiter at will, or whether this choice should be limited, in order to avoid misuse. EN13000:2010 adopted a compromise - a reset switch outside of the cab, and a method for booming down in an emergency.

The audience at the second ESTA Expert Summit on wind safety

With the engineers busy working on that, the next step took some time. It came in 2012, when, thanks in large part to the work ESTA director Søren Jansen, an 'Expert Summit' for the wind industry was organised. It was by any measure a resounding success. Around 200 people squeezed into the small room - twice the number of attendees expected - half of them from the crane and transport sector and half form the wind and insurance sectors.

A key achievement was making sure that everyone involved understood the importance of sharing critical safety information. But the discussions also highlighted a number of other risks that these jobs posed.

Klijn explains: "Another big problem is the movement of cranes from one tower position to the next, which is often attempted in a far too big a configuration, because dismantling the crane costs money and building it up again costs money. And so you see stupid things like people driving a rigged CC 8800 through a meadow, thinking that they can get safely to the other side."

When there is a fatal accident or injury, safety regulators and coroners become involved, and there is a chance for the industry to eventually learn what went wrong. But there is no system for recording near misses. Even when there is serious equipment damage, the investigation will seldom result in information sharing beyond the companies involved and their insurers, in fact the tendency is to suppress, what is valuable information.

Other risks were identified when installing blades. On one hand, as that first accident had shown, complete blade assemblies can catch the wind while being raised and pull the crane over. But fitting blades to the hub one at a time has its own challenges.

"First of all, we have seen issues such as blades slipping from the gripper, and some awful accidents happened. Secondly, you have more time spent working at height, increasing the risk in another way. And thirdly, you will need to align blade and hub for the assembly of each blade, which can be quite tricky and may require a power connection to turn the hub," adds Meissner.

Getting the word out

While the notice of 2010 alerted the industry and the first Expert Summit brought the various sectors together and identified other risks, the next step was to take the message to the wider industry, and to explain the information in ways that everyone could understand. This was achieved through further Expert Summits, the development of a comprehensive and comprehensible best practice guide, and through a series of practical demonstrations that Meissner made around the world.

The attendance and participation of Meissner, Jansen and others at conferences, in Beijing, Singapore, Istanbul, the USA and elsewhere led to an even better understanding of the risks and a more detailed guidance document - *Safety issues in wind turbine installation and transportation* - which was published in October 2012. While this carried a wealth of detail, it was very much targeted at engineers, experienced operators and lift supervisors.

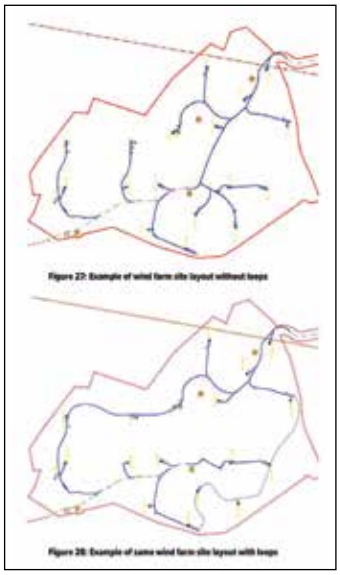
The second ESTA Expert Summit, in Hamburg in 2016, gave everyone a chance to recap and share what they had learnt. ESTA's president, David Collett raised another key risk factor: the layout of roads on site. He pointed out a series of issues, roads are typically laid out with the goal of reducing site preparation costs. They may be too narrow, or too weak to handle ground bearing pressures of a travelling crane or transporter. Very often, they take tight turns that challenge and delay transport and are also linear, meaning that transporters have to return along the same route they entered.

Beyond delays, this poses serious risks. Cranes and transporters can and do slip off of narrow roads. If an accident does happen, poor layout can have life or death consequences. With a crane collapsed, and transport vehicles blocking the road behind it, an ambulance cannot get directly to any injured personnel. Instead, Klijn says, you may have to carry them a hundred metres or more to the ambulance.

Collett stated that the answer was to design a looping road layout around the site that is wide and well prepared enough to support cranes and vehicles travelling on it, and that take into account the turning needed by long transporters.

Lifting single blades or fully assembled rotors each has its own risks

Klaus Meissner giving his elegant, practical, demonstration of the risks posed by wind loading, using a model crane



An example of the illustrations included in the guide, showing the benefits of a looping route around a wind farm.

That Aha! moment

The same summit discussed the development of a best practice guide that would clearly explain the risks and how to overcome them for non-engineers. This came out last year and offers a wealth of information running to more than 50 pages, with specialised terms and concepts explained with detailed, informative illustrations.

Meissner's demonstration, which he has given to more than 3,000 people around the world, offers another easily understood explanation of the risks. It is a truly elegant approach, both simple and effective. Using different shaped forms and a hairdryer, he demonstrates how the form affects the drag factor, leading to accidents, like the one in 2008.

It makes an impact. He says: "It very often produces an 'Aha!' moment for lots of people, this simple experiment demonstrates that the drag factor is not rocket science, maybe they were not recognising it before, but in the very moment they see it they understand it."

An ongoing project

Much remains to be done. As regular readers of Cranes & Access and Vertikal.net will know, terrible accidents still occur on wind farms.

Klijn has pushed for insurers and wind farm owners to adopt and use the guide on all wind farm projects. The response, he says, has so far been a resounding 'No!'.

This urgently has to change. As well as the human cost of fatal accidents, when the next such incident happens, politicians may step in, with a bureaucratic and costly response that adds to costs, delays projects, and ignores the industry's expertise and experience.

For now, it falls to crane and transport companies, their operators, and other staff, to hold the line, and refuse to take on projects or continue working, when project owners refuse to follow or fully adopt the safety guidance.

Safety resources

Influence of wind forces during crane operation was published by ESTA and the FEM in 2010, alerting crane owners to the risks of lifting loads with a relatively low mass but high sail area.

http://www.fem-eur.com/wp-content/uploads/2016/01/CLE-N-0219.pdf

Safety issues in wind turbine installation and transportation builds on the notice issued in 2010, explaining over 25 pages, with diagrams and flowcharts, how to consider risks like wind loading and travel of partially erected crawlers.

https://www.fem-eur.com/wp-content/uploads/2016/03/CLE-5016-EN.pdf

The ESTA *Best practice guide for transportation and installation of onshore WTG systems* brings together knowledge from across the wind turbine, lifting and transport sectors in a comprehensive and comprehensible way, and should be considered essential reading for anyone working in the sector. It is, for now, available for free from the ESTA website.

http://estaeurope.eu/BPGwind