OFFSHORE TECHNOLOGY: WIND ENERGY'S SPACE RACE?

NEWSLETTER

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LM WIND POWER

FEATURE

Offshore powers wind industry innovation

Just as the space aviation industry has spawned myriad new technologies and workflows in the struggle to meet the challenges of space travel, today's major offshore wind energy projects are a fertile breeding ground for innovations that offer wide-reaching benefits for the world at large. And LM Wind Power is playing a vital role in these developments.

Scan the QR code and read LM Wind Power's offshore brochure on your mobile phone. If you don't have a QR code scanner on your mobile phone, you can type reader2.mobi in your browser and download the scanner.

Offshore action

When the first, six-turbine phase of the Thornton Banks offshore wind energy project, located 28 kilometers off the Belgian coast, was commissioned in 2009, LM Wind Power's 61.5 meter blades swung into action atop REpower's impressive 5 MW turbines. As the only vendor with a proven track record in megablades, the company was an obvious choice for such a demanding project.

More to come

Given that outer space is an unlikely location for wind turbines in the foreseeable future, offshore wind energy projects present many of the toughest challenges the industry is ever likely to face. From planning to installation, operation and maintenance, teams of engineers have had to overcome obstacle after obstacle over the past two decades before the advantages of offshore locations could be realized. While work continues on this front, the action for LM Wind Power as a blade manufacturer is concentrated not on overcoming difficulties but on squeezing even more energy out of blade designs that are already highly efficient.

Making the most of wind

LM Wind Power is well positioned to provide blades and services to the offshore projects of today and tomorrow, which are strongly dependent on the ability to deploy increasingly large blades. The company was involved in the world's very first offshore wind farm project and its engineers constantly push the boundaries of blade size and airfoil shape, laying the technological foundations for blades that are expected to power future turbines of up to 20 MW.

If any company knows just how big offshore blades are becoming, it's LM Wind Power. At 73.5 meters in length, the company's latest blade is the longest wind turbine blade ever designed. Originally created for Alstom's new 6 MW wind turbines, this technological marvel required over 20,000 hours of development work as well as advanced, lightweight materials. And it put LM Wind Power firmly at the head of the size race yet again.

Perhaps the most promising area of technological innovation in such enormous blades is in finding more dynamic ways to adjust their aerodynamic properties and make the blades perform even better. Today, most blades pitch (rotate about their own axis) to regulate power production. But with very large blades, such adjustments are too complex, take too long and don't take into account the fact that wind conditions vary across the rotor area. Better localized adjustment is required. The answer is to be found in active aerodynamic devices such as flaps – mechanically simple, yet highly effective physical devices attached to a blade in a way that controls the airflow around the blade, providing the same effect as pitch.

Vast development resources

While active flaps may not look particularly impressive, vast research and development resources are poured into their design and placement. Hundreds of hours of wind tunnel testing (in LM Wind Power's own in-house facilities) are needed before the company's engineers are satisfied.

Jean-Guillaume Jérémiasz, LM Wind Power's flap project manager, is enthusiastic about the ability of these technologies to support offshore viability going forward. "We have been examining the use of active flaps to gain a little more from large, land-based blades for some time, but the type of active flaps that we are currently developing and testing may become a crucial component in future offshore power generation."

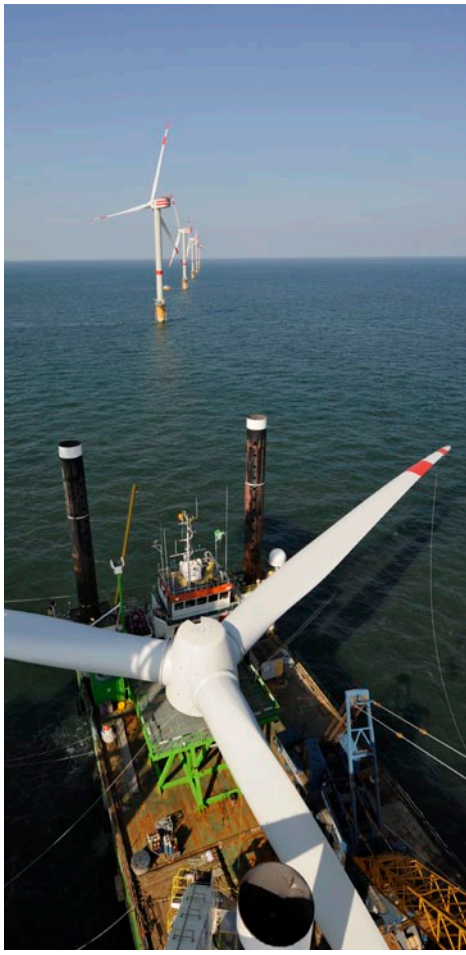
A technology bonanza

Active flaps are expected to play a significant role in the high-growth offshore sector, but they are far from the only technological developments born in such a demanding environment. Constructed from a pure fiberglass and polyester matrix, the blades themselves are marvels of modern-day engineering with a competitive weight-to-length ratio that enables wind turbine manufacturers to reduce costs when dimensioning key components such as drive trains and main shafts. Optical sensors embedded into the blade's fiber layers measure the forces exerted on the blade with very high accuracy. At the tip of each blade, tungsten receptors capture lightning strikes and channel them safely away to a conductive cable. Without such protection, the blade laminate will suffer damage from the 30,000°C lightning channel during a strike. Combined with LIDAR (Light Detection and Ranging) technology, which in the future is expected to increase the energy output from wind farms by accurately measuring wind speeds and wind turbulence, such innovations hold great promise for the powerful, intelligent blades of the future.

Chief Technology Officer Frank V. Nielsen acknowledges the importance of offshore projects for the industry – and for society at large. "Working with offshore developments is a highly significant driver of our ability to stay at the technological forefront. "

EU-funded research

Not all projects fuelling research and development at LM Wind Power are actual implementations of newly released or prototyped technologies. The EU-funded Reliawind project is a prominent example of a large-scale, industry-wide research project focused on improving turbine reliability. Among other things, it aims to increase mean time between repair (MTBR), a key parameter in the cost structure of offshore wind energy projects. Currently in its infancy, Reliawind holds great promise for ensuring the viability of offshore energy options – and participation in the project is yet another step in helping LM Wind Power to prepare blade solutions for a more sustainable future.



ON TARGET FOR OFFSHORE

LM Wind Power's leading position within multi-megawatt blades was further cemented with a deal to supply the blades for the 48 REpower 6M turbines due to be installed in phases II and III of the Thornton Bank Offshore Wind Farm during 2012 and 2013.

CLEAN AND MEAN

Why preventative maintenance is a must-make investment

Just imagine extreme weather conditions with regular hailstorms hitting wind turbine blades at more than 300 km/h. Anyone can understand the need for regular checks under such circumstances, but it's easy to overlook the fact that large wind turbines are essentially extreme structures under extreme pressures even in much milder conditions. The good news is, however, properly maintained blades will perform and last up to 20 years.

Nothing lasts forever

Of course, dirty blades will always under-perform. But blades are also a wear component. The structural life of rotor blades is based on composite materials, fracture mechanics, design margins and actual loading (operation and wind). Such complexity takes insightful preventative maintenance to ensure consistent performance and extend blade life. Proper maintenance comprises regular, complete inspections that may yield a set of recommendations, as well as a full End of Warranty inspection.

Unpredictable nature

Blades for wind turbines are made to operate in harsh conditions. But nature provides weather conditions that are not always foreseeable in design calculations. For example, in most climates, fluctuating temperatures and variable humidity can damage the blade during operation. Safe mitigation of these risks demands special attention throughout the lifetime of the blade. And effective inspections and repair require deep understanding of the blade's design.

Tiny cracks – big potential problems

Most rotor blade structures are sensitive to stress concentrations from minor damage that may develop over time. Fatigue starts with micro cracking that is not visible with the naked eye but which seldom escapes the attention of LM Wind Power's specialists. Aided by decades of experience, they can quickly assess whether the situation calls for minor or major repair work. Unaddressed components will continue to wear, and tiny cracks may develop into visible ones or, in the worst case, even full-blown structural cracks.

A stitch in time...

Early analysis and repair of visible cracks through preventative maintenance is crucial to avoid larger repairs in the future. Caught in time, minor issues can be repaired with minimal downtime, and surface damage caused by erosion or lightning may be repaired at low cost.

The Service & Logistics team at LM Wind Power is always ready to examine blades and draw up a plan for their maintenance. It's certainly worth the investment!

For more information about LM Wind Power Service & Logistics, please visit www.lmwindpower.com.

Losing your edge?
A degraded leading edge profile directly impacts performance as its aerodynamic properties are crucial to determining how well the blade can extract energy from the wind. One novel solution is to restore the profile to its former state – a comparatively new, but highly effective service and maintenance offering from LM Wind Power Service & Logistics.

Quiet Success

What the wind is trying to teach us about performance and noise

There has been a lot of media coverage recently about how turbine noise impacts people who live close to wind farms. Naturally, wind turbine owners aim not only to achieve good annual energy production (AEP), but also to invest in people-friendly turbines using low noise blades so as to minimize residential noise complaints. The goal is to ensure that the green benefits of wind energy are harvested with minimal disturbance to the peace and harmony of nature.

In the early years of wind turbine industry, blades were relatively small. Flow-induced blade noise was comparable to that originating from other parts of the turbine, such as the gearbox. But, as blade size increased with the demand for larger turbines, their noise emerged as an important concern for purchasers, especially those in the market for blades exceeding 35 meters.

LM Wind Power plays a significant role in this large-blade market segment. And that's where having specialist acoustics competencies in-house really pays off. Acoustics engineer Carlos Arce located at LM Wind Power's Kolding headquarters, is charged with making sure noise doesn't get in the way for the company's customers. "Providing low-noise blades is a definite competitive edge for us, now and in the future," says Carlos. "And it is fast becoming a key parameter for long-term wind farm investors."

The company has both aerodynamic and aeroacoustic concerns. Carlos points to a philosophical analysis: "Most people believe high aerodynamic performance and low-noise aeroacoustic performance are enemies. But we're learning that they are more like twin brothers. Where we thought they were fighting, they are actually just playing together. We just need to define a route so that they can play more harmoniously," he says. "Imagine a flying owl. That's our target: efficiency and precision under the stealth of silence."

Breaking records with wind

What does it take to sail a kite-surfer faster than anyone ever before? That question is top-of-mind for veteran record-breaker Sebastian Cattelan. In 2010, his LM Wind Power-sponsored Genetrix kite and expert knowledge of the wind propelled him to a new world record of over 55 knots (103 km/h). If that doesn't sound like a big deal, remember you're standing on a 1.5 meter long board, strapped into a contraption in 40-50 knot winds. It isn't a job for wimps – and the wind energy know-how needed to make it all possible is every bit as impressive!

Visit www.sailspeedrecords.com for the full story.

The making of GloBlade®

EVERYONE LIKES TO TALK ABOUT INNOVATION – EVEN WHEN THE "INNOVATIVE" NEW PRODUCT OR SERVICE MAY JUST BE A FINE-TUNING OF AN EARLIER OFFERING. TRULY GAME-CHANGING DEVELOPMENTS OFTEN COMBINE TECHNOLOGY AND MARKETING.

In the summer of 2009, LM Wind Power came up with an idea truly worthy of the innovation label. Of course, you might have expected it was time for something entirely new to happen. For some time, manufacturers had been focused on continuing the race to design better blades, each one lighter, longer and slimmer than its predecessor. All steps in the right direction, but little news of the earth-shaking kind. Happily, things were about to change – and it started with an intense discussion among some of LM Wind Power's management team.

Proactive game-changer

Ian Telford, the company's new Vice President of Sales and Marketing, teamed up with Chief Technology Officer Frank Nielsen and went on a campaign to convince their colleagues to do something unprecedented in the history of LM Wind Power's blade manufacturing. They were picking up on a challenge put forward by CEO Roland Sundén. Roland was looking for a proactive game-changer – an idea that could bring new value to customers and widen the gap between LM Wind Power and its competitors, particularly in the fiercely competitive Chinese market.

Breaking the mold

Conventional wisdom holds that wind turbine blades should be manufactured to customer requirements and distinct turbine specifications. And that the company should invest in current mold technology, namely LM 40.3 for 1.5 MW, rather than creating new blades in advance of customer demand.

But what Ian and Frank proposed, a concept they called GloBlade® (a compression of the words 'global' and 'blade'), would turn this philosophy on its head. They wanted to provide an off-the-shelf portfolio of blades, available in every region, that could be plugged into existing turbines for Class III applications, starting with the GloBlade®1 LM 42.1 P for most of the world's 1.5/1.6MW wind turbines.

Achieving this ambitious aim would, for example, significantly extend the life-cycle of existing turbines. The extra energy generated through a larger rotor would also pay for the rotor set over the lifetime of the turbine. It was an idea so compelling that the duo was quickly able to gain wide support within the company and the project was given the green light.

Pioneers under pressure

The brave new approach of building ahead of demand was one thing, but translating this ambitious idea into an actual wind turbine blade was another. It would require a cascade of new solutions that balanced sophisticated aerodynamic design with reliability and ease of installation. Pioneering enthusiasm would need to be combined with decades of expertise to ensure success. Luckily, neither were lacking at LM Wind Power's Kolding headquarters.

The project was entrusted to Michael Lund-Laverick, a senior project manager, and his product development team. The first GloBlade®1 LM 42.1 P would be designed for high performance in wind class III.

A star is born
Expectations were high, and to meet them, the team pushed the scope of aerodynamics and engineering to the next level. LM Wind Power's pre-bend technology, choice of materials and profile design were put to good use to develop aerodynamic designs that could be maximized in the company's wind tunnel.

By April 2010, the first LM 42.1 mold, made in China, had been produced in record time. And less than a month later, the first GloBlade®1 LM 42.1 P finally saw the light of day, de-molded at our factory in Tianjin.

To this day, Globlade® remains the most advanced wind turbine blade for the 1.5/1.6 MW segment yet. Testing showed that not only does it outperform every other blade in its segment, but GloBlade® also combines high performance with great reliability to boost Annual Energy Production (AEP) by up to five percent.

Game changed
The GloBlade®1 LM 42.1 P was an overnight success with the company's customers. Over a six-month period, production started up in most of the Chinese factories, some of which were expanded to meet demand. In addition to expansions at existing factories, two new facilities have been constructed to handle the unprecedented throughput. The positive response isn't just a testimony to superior design and technology. It is also a clear indicator of the value of thinking outside the box – answering the needs of an industry hungry for true innovations that can offer greater efficiency and profitability.

DID YOU KNOW?

ALIGNING THE STARS

LM Wind Power's Vice President, Sales and Marketing, Ian Telford, often talks about 'aligning the stars' in order to execute a successful blade. Not only does the blade have to be great, it has to fit the customer's wind turbine, that turbine has to be competitive against others, the market in the country needs to be supported by legislation and there has to be sufficient manufacturing capacity. Without such alignment, the product cannot be effectively brought to market.

A HEAVY LOAD

Like everything else with GloBlade®, transportation to the test facility at the company's Technology Center in Lunderskov, Denmark was just as dramatic and record-breaking! The first blades were flown using the Antonov 225, the largest aircraft in the world, and the GloBlade®1 LM 42.1 P holds the unofficial record as the longest object ever transported by air.

SUSTAINABLE SENSE

The UN Global Compact is the world's largest corporate sustainability initiative with over 8,000 signatories worldwide. By signing up, an organization commits to integrating ten universally accepted principles governing human rights, labor, environment and anti-corruption principles into its operations and day-to-day culture. Signatories are also required to submit an annual progress report known as the CoP (Communication on Progress).

Are we green enough?

BY ROLAND SUNDÉN, LM WIND POWER'S CEO

As a key player in the international wind energy industry, you might say we're already one of the 'greenest' companies in the world. Over the past 30 years, we have produced more than 140,000 wind turbine blades corresponding to approximately 49 Gigawatts (GW) of installed wind power capacity. Annually, this effectively replaces approximately 83 million tonnes of the CO_2 emissions widely agreed to be a major contributing factor to global climate change.

That's positive, of course, and more than most companies have done. But it's still not enough.

We believe we can do more to become greener and cleaner throughout our operations while keeping firm control over costs. This viewpoint has led us to roll out a new global sustainability strategy and is behind our recent signing of the United Nations Global Compact.

Right now, we're taking a good look at the way we conduct our business in all areas. We already comply with the business ethics and humanitarian requirements of the UN Global Compact, but our new corporate strategy renews commitments on safety, industrial hygiene, emissions, waste and all aspects of environmental impact. It's not about philanthropy or looking good. It's about confronting the environmental and social challenges we face in our business and achieving real change for greater long-term viability. That simply makes good business sense.

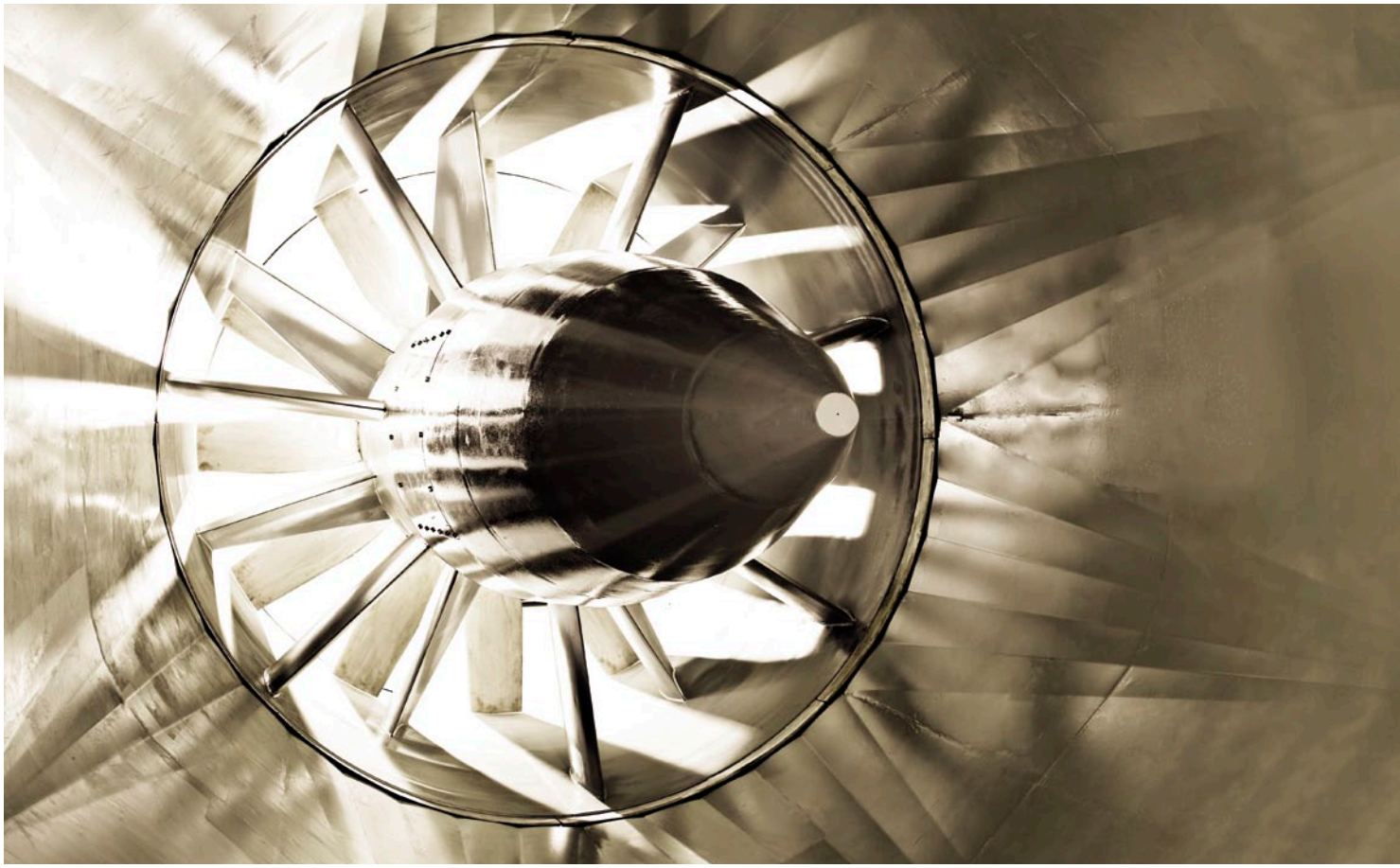
It's now – or maybe never

In September 2010, the EU slapped temporary tariffs as high as 43.6 percent on imported Chinese glass fibres. Now, wind energy manufacturers are worried about negative impacts on their business viability from a ruling that was initially aimed at safeguarding their competitiveness! Their raw material costs will be permanently higher – particularly in comparison to those of non-Eurozone competitors. At worst, the viability of some EU producers may be compromised, with resulting loss of revenue and jobs.

The tariff also directly contradicts EU environmental policies, which call for increased investment in renewable energy forms and champion reduced CO_2 emissions, the majority of which are produced by energy sources.

Now a decision is being made on the level of a tariff between 7.3 and 13.8 percent, to remain in place for five years unless repealed.

Christopher Springham, LM Wind Power's Vice President of Global Communications, has issued a rallying cry to the industry. "More action could be taken," he says. "A number of key players who could help to influence the situation have unfortunately remained passive. Now is the last opportunity for them to make their voices heard and help to save the day. It is imperative that all parties affected by this, particularly in wind energy, get together to explain to EU country representatives the perverse impacts of AD549 as a long-term measure".



Wind tunnel wildness

It's a rare event for LM Wind Power's advanced wind tunnel at Kolding, Denmark, to be used for anything other than the serious business of blade design and testing. But recently, an exception was made for the two hosts of Danish TV show Big Nerd (Store Nørd) to take over the facilities to film an unusual competition. Aimed at teenagers, the zany show focuses on learning cool stuff about science and technology.
The competition was a face-off between an ordinary bicycle and a pedal car – first in their original forms, then altered to improve aerodynamics.

Blasted by winds of up to 25 m/s (approximately 70 km/h) and secured by safety wires, a stripped-down version of the bike with its rider crouched low was declared the wind-resistance winner despite the pedal car's aerodynamic fiberglass cover. Wind tunnel engineer Poul Kramer oversaw the event. "Not bad," he says with a grin, "but we could teach them a thing or two!"

TIPS

FIVE WAYS TO STREAMLINE YOUR PEDAL CAR

1. Design a shell that's smooth, has no edges, and which tapers to a point at the rear
2. Make sure the shell isn't mounted below floorboard level or air resistance will be created underneath
3. Put foam inside the cockpit around the driver to stop wind from rushing in and creating turbulence
4. Slightly turn any hex bolts on the outside of the cart so that their flat surfaces don't face the wind
5. Tape the driver's helmet straps down to stop them flapping

Licensed for lightning

Certified insurance

LM Wind Power has become the first in the industry to obtain a Germanischer Lloyd component certificate for a lightning protection system according to the latest guidelines and the new IEC 61400-24 Ed.1 standard.

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