Real-time monitoring of bearing conditions emerges

SKF introduces 'smart' bearing technology with integrated wireless sensors

At Hannover 2013, SKF unveiled a new and innovative technology that promised to revolutionise the way in which engineers use and interface with bearings. Called SKF Insight, this new technology integrated a miniature, self-powered and intelligent wireless sensor at the heart of the bearing. For the first time, this allowed engineers to monitor the operating conditions of a bearing from within a machine, in real time. As a result, bearing wear and potential failure could be planned and prevented, rather than simply being predicted, as was previously the case.

Now, 18 months later, the technology is under validation and is finding practical applications in a number of different market sectors. Before considering these in greater detail, let's first look back at what makes SKF Insight so revolutionary.

The Insight project was born from the fact that few bearings fail in service as a result of normal operating conditions. Indeed, most in-service failures result from misuse, neglect, lubrication problems or operating conditions that were unforeseen when the machine was first designed or the bearing originally specified.

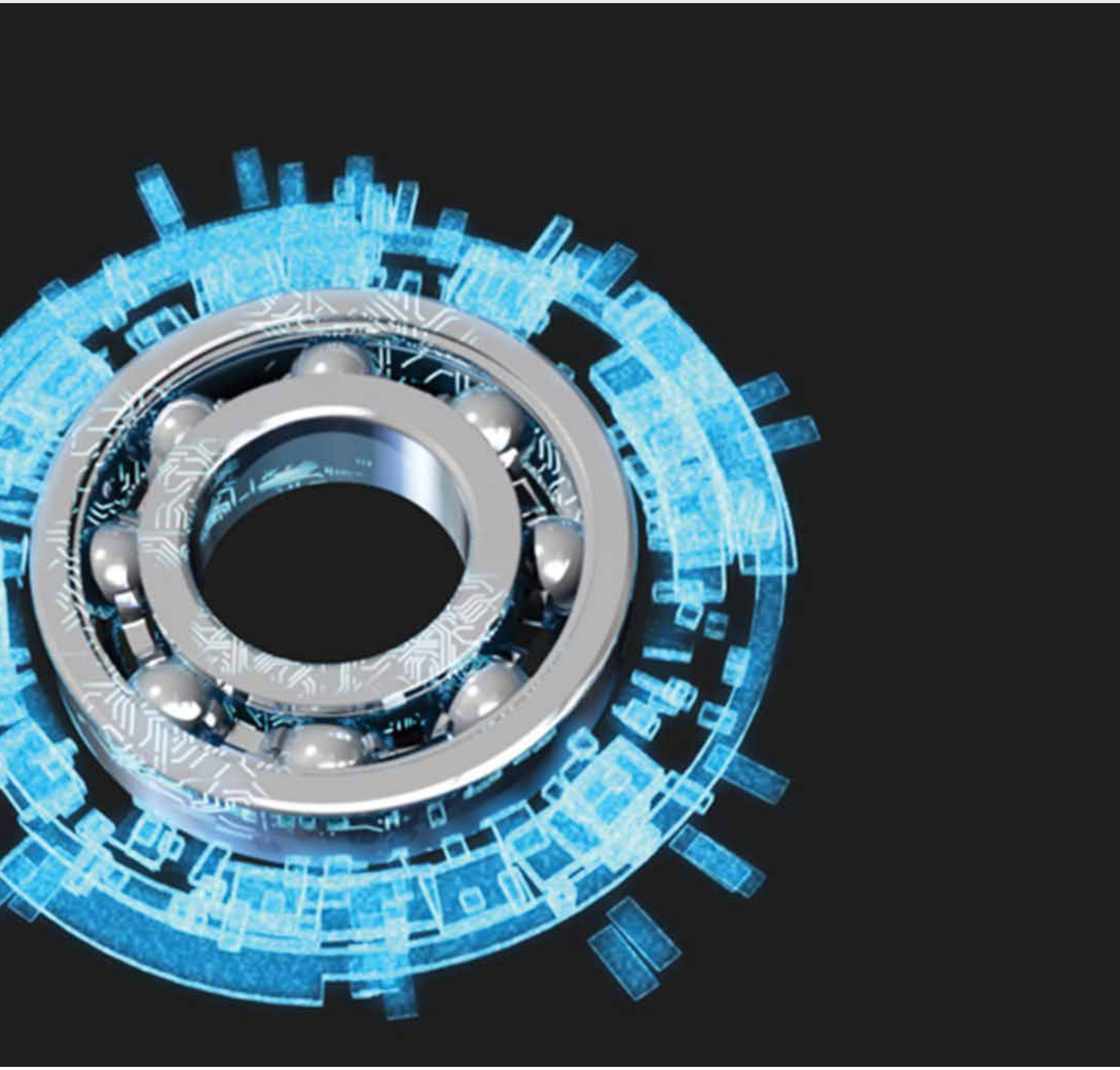
Traditionally, condition monitoring looks for early signs of failure by measuring levels of vibration. Vibration signals are normally produced when the first small fragments of steel begin to spall from the raceway surface of the rings or the rolling elements. By the time this damage reaches the stage where it can be detected using conventional sensors it is already too late, as the bearing has already suffered damage that affects its operating performance and life.

SKF engineers wondered what would happen if instead of using external monitoring devices, a bearing could detect the critical parameters affecting its immediate operating environment; and then to make this information instantly available via a wireless connection to the plant operator or machine manufacturer.

If operating conditions can be monitored in this way then potential damage can be prevented, or at least identified before it has an impact, with corrective actions being taken while machinery is working. This would ensure that expensive and disruptive failures are avoided, thereby reducing total cost of asset ownership and giving a much longer machine operating life.

The solution that has been developed uses miniature sensors and intelligent wireless components that are embedded in the bearing and draw their power from the application environment as the bearing rotates. The package is therefore completely self-contained; there are no cables required for power or sensor output, and once installed the device operates autonomously.

The intelligent wireless communication technology inside the bearing enables it to be used in environments where traditional Wi-Fi cannot function properly. It also allows bearings to be configured in smart networks, which communicate via wireless gateways.



An SKF Insight bearing can monitor the applied load, the quality of lubrication, operating speed, temperature and vibration, and detect changes in the microstructure of the bearing steel, giving early warning signs before damage occurs at a macro-structural level. This data can then be broadcast via cloud servers either to a local operator, who can use a specialised app on a smart phone or tablet, or to a remote monitoring centre. In each case, diagnostic tools interpret the data to establish fluctuations from optimum operating conditions, including excessive loads, duty excursions and lubricant contamination, so that modifications can immediately be made to the operating conditions by adding lubricant, mitigating transient overloads and so on.

ALSO IN THIS SECTION:

As the bearings are self-contained they can be used in applications where it has previously been impossible to embed sensors within the heart of a machine. Not only does this represent an important step forward in real time condition based maintenance, it also provides a far better understanding of the operating environment so that it may be possible, for example, for a machine to be uprated to extend its life or power rating beyond the initial specification.

One of the purposes of SKF Insight technology is to make condition monitoring more widely applicable and accessible, particularly in applications where it has been previously been considered impossible or impractical. This is one reason why the technology is in testing in challenging industries such as wind power, rail and steel manufacturing.

Wind farms can be remote and difficult to access. In some offshore applications, the cost of changing a wind turbine main bearing can be so high that it undermines the business case for building the turbine in the first place. It therefore makes business sense to record loads and lubrication conditions in service and to take action to eliminate damaging conditions.

SKF is now working with customers to integrate SKF Insight technology and develop smart bearings for wind turbine monitoring. This allows dynamic bearing information to be measured in the true operating state and to be wirelessly communicated to remote monitoring centres, or to local maintenance crews. The solution currently under consideration can monitor bearing speed, vibration, temperature and lubrication and can be retro-fitted, thereby instantly enhancing the operational potential of tens of thousands of turbines around the world.

A similar solution is being developed for wheel end bearings used in the rail sector. These are safety-critical components and are normally changed at set intervals regardless of condition. By fitting SKF Insight it becomes possible to create an extremely cost effective method of collecting condition monitoring data, so that bearing life, and thus change-out intervals, can be accurately determined based on actual rather than predicted operating conditions.

Intelligent bearing technology is opening up new dimensions, both in the field of condition based monitoring and in machine design, operation and life. Innovations such as SKF Insight are now providing for the first time the critical tools and data that engineers and business managers need to maximise the efficiency, productivity and profitability of their machine assets.

— Source: SKF

Norvento's nED100 reaches milestone for medium-scale wind

100kW turbine makes history as the first of its size to certify under large wind standard

Medium-scale wind turbine manufacturer Norvento has completed the TÜV SÜD design evaluation process for its nED100 100kW turbine. In doing so it has set an industry benchmark for technical excellence by becoming the first company to achieve IEC 61400-1 certification for a turbine of this size.

The small and medium wind turbine industry has grown to play an integral role in many rural and industrial applications and is now of significant value to the UK economy. In this context, Norvento believes the industry has a duty to respond by setting quality standards on a par with those seen in other matured sectors. .

Furthermore, in light of the additional hurdles posed by planning, grid connection and tariff degression, it is becoming increasingly critical to learn lessons from the utility-scale wind sector by demonstrating a commitment to maintaining the highest possible technical and operational standards.

Nevertheless, while carrying out design assessment is standard practice for multi-megawatt turbines, medium turbine manufacturers have not typically dedicated the required time and resources to the procedure. Ultimately, this may leave turbine owners and landowners vulnerable to unanticipated performance issues in the long-term.

The TÜV SÜD Design Evaluation of nED100 is, therefore, a key quality-assurance milestone for the turbine, which is the product of a five-year research and development program that commenced in 2008, and has been in operation since 2011.

During the extensive two-year certification process, TÜV SÜD validated every single system and component of nED100. The turbine underwent the simulation of 1000 unique loads, covering every eventuality likely to occur during day-to-day operation. The data accumulated during this process was then used to verify the structural strength and lifetime of each component.

This technical testing was accompanied by a stringent safety validation, which analysed the potential effects of a wide range of internal and external conditions and resulted in a detailed calculation of the safety levels of the system as a whole, based on the performance of each individual component. The lightning protection system was validated to the same standard required for utility-scale wind turbines.

Finally, all installation, commissioning and maintenance manuals were revised according to international standards.

In carrying out this process, TÜV SÜD verified that the turbine was in compliance with the latest safety and engineering standards. In December, Norvento was issued with a Provisional Statement of Compliance, confirming this achievement.

The design evaluation complements recent testing by other accredited entities validating the electrical safety, the electromagnetic compatibility and the power quality of nED100, and will be followed by further field and bench tests to certify the power curve, load measurement and structural properties of the blade.

"While power curve certification is undertaken for some of the most recognized medium wind turbines, the IEC 61400-1 design evaluation sets a standard far beyond the usual level," said Miguel Hoyos, technical director for Norvento.

"nED100 boasts design quality, safety and reliability equivalent to modern large-scale wind turbines, underlining our unrivalled commitment to engineering excellence and setting a benchmark for the improvement of standards throughout the UK and European distributed wind sectors."

"The design evaluation is essential to ensure the safety and durability of wind turbines during their whole life cycle," added Alexander Trunz, Head of Department, Wind Turbines at TÜV SÜD. "With our provisional statement of compliance we confirm that the design of the wind turbine nED100 meets the requirements of IEC 61400-1. The same standard is applied to the assessment of large, multi-megawatt turbines.

For more information, please visit www.norvento.com

Blade Dynamics awarded funding for offshore blade development

'Advanced Blade Tip' design project aims to improve leading edge durability and increase energy yield

Blade Dynamics announces today the award of Process Technology Innovation Funding under the GROW:OffshoreWind program for a £1m Advanced Blade Tip development project, due for completion in Q2 2015.

The performance of offshore wind turbine blades in their challenging operating environment is one of the critical issues in energy cost, reliability and safety. Costs associated with repairing blades are extremely high and time consuming, causing significant operating losses due to downtime and having a significant detrimental effect on the cost of energy generated.

Blade Dynamics have created a new and highly innovative 'Advanced Blade Tip', which improves the critical outer third of a wind turbine blade. This high performance tip is designed to integrate into standard wind turbine blades, creating a 'hybrid blade' that upgrades performance whilst using existing manufacturing infrastructure. It features built-in leading edge erosion protection, has a highly accurate aerodynamic profile to enhance energy generation, is lightweight to reduce turbine loads and to allow blades to be extended in length and has an innovative lightning protection system. The Advanced Blade Tip both enhances the performance of offshore wind turbines, increasing Annual Energy Production (AEP), and reduces costs incurred through expensive downtime due to blade deterioration and the current need for frequent maintenance.

The project will refine, demonstrate and test the manufacturing technologies used in the tip solution as well as optimise the design of the interface between the tip and the rest of the blade.

"This is an exciting new technology development that can substantially reduce the long term cost of energy from offshore wind turbines and the company is proud and thankful to be supported by GROW:OffshoreWind in this work," said Theo Botha, co-founder of Blade Dynamics.

"The project is a great example of funding being provided for technologies that can have a substantial positive impact on the British economy and environment by nur-

turing sustainable, knowledge based, domestic manufacturing in the vitally important offshore wind energy sector."

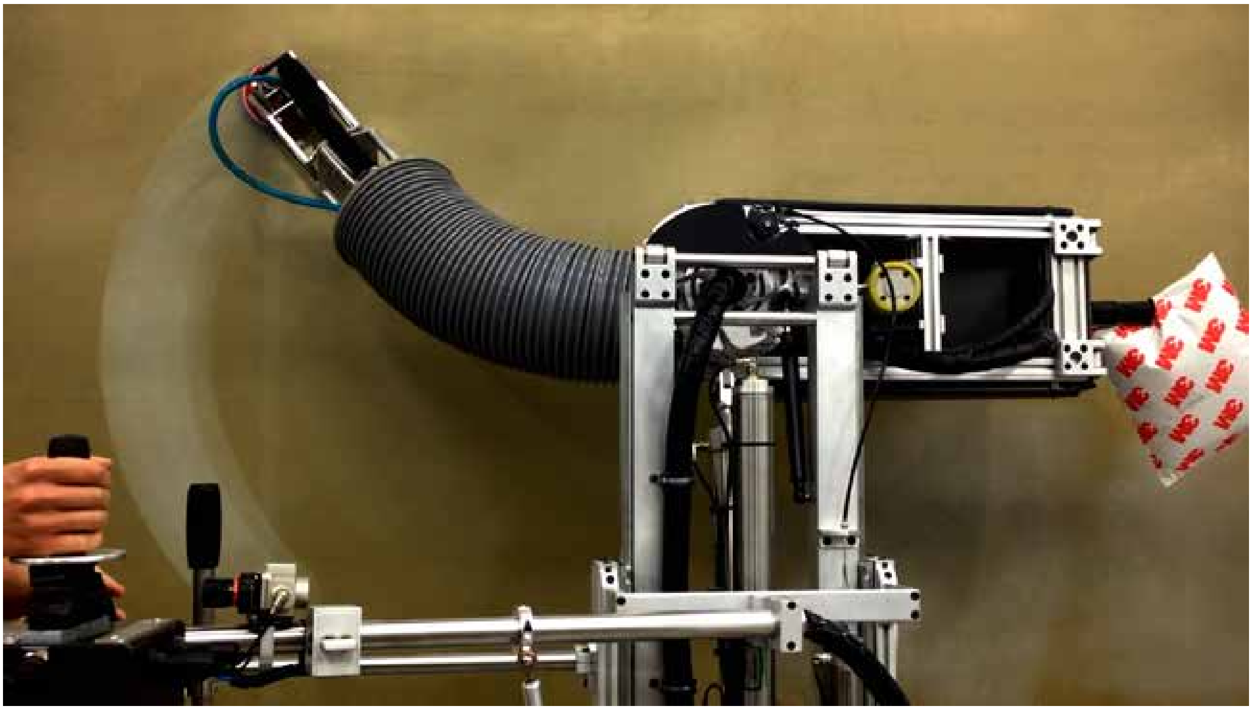
Botha went on to explain that "The outer portion of a blade produces most of the energy and the technology allows these high value blade tips to be exported from the UK and deployed on offshore wind turbines globally as well as in the domestic market."

Regarding the funding, Dominic Brown, CEO of GROW:Offshore-Wind said:

"We are delighted to support Blade Dynamics in making these important technology innovations for offshore wind turbine blades. The successful delivery of this project will provide a route for substantial financial benefits to both the purchasers of wind turbines and manufacturers, through increased blade life and significantly reduced maintenance costs, as well as a reduction in the cost of energy from offshore wind farms."

— Source: Blade Dynamics

Turbine blade sanding application borrows from aerospace industry



Growing demand for wind power creates production demand that wind blade manufacturers can address by increasing capacity in one of three ways: 1) Hire more people; 2) Build another factory and hire more people; or 3) boost productivity with current people and facilities. The last of these is worth our focus because it holds the most promise of boosting productivity with the least disruption and at the lowest cost. When discussing productivity challenges associated with large composite surfaces like wind turbine blades, sanding is one of the major issues crying out for improvement because each blade is so large, and the whole surface typically has to be sanded twice before final paint.

Some of the smartest investments in technology start by asking what other markets — in this case other composite-intensive markets like aerospace and marine — have proven works well to address the same problem. One aerospace technology now available to improve wind blade finishing operations was born at Boeing more than ten years ago, and is currently deployed by almost every major aerospace manufacturer – EMMA™ Sanding Systems from Temple Allen Industries.

EMMA was created in 2003 focused on the needs of the upcoming 787 program to prepare composite surfaces prior to the application of final paint. A major driving force behind the development of EMMA was the poor ergonomics of manual sanding. Humans are simply not built to wield a heavy vibrating tool for an eight-hour shift, particularly out in front of the worker or over their head. With EMMA, workers stand comfortably and wield a joystick, and the EMMA Arm applies a consistent force against the surface to be sanded while the End Effector — deploying virtually any desired sanding or grinding tool — keeps the abrasive disc flat on the surface minimizing dust exposure and maximizing finish quality. Particulates are routed into a disposable 3M Clean Sanding Filter Bag, keeping the workplace clean.

For Wind Turbine Blade surface finishing operations, the EMMA configuration getting the most traction is their Telescoping Stand System (EMMA TSS). For times when the blade is held vertically or diagonally, the TSS configuration allows operators to conduct edge grinding or full surface abrasion, from near ground level to about 10' high.

The first EMMA installation was in the 737 Rudder Shop in Renton, Washington where they conducted sanding operations that were known to put workers at risk of injury. Since EMMA was installed, there have been no process-related injuries, and workers injured while working elsewhere in the facility have sometimes been reassigned to the Rudder Shop in order to heal. Process time for each sanding step has also been reduced. In addition to the health and safety gains, the EMMA-equipped shop was able to seemlessly accommodate Boeing's regular rate increases for the 737 program — which is now building more than 40 aircraft a month, up from approximately 18 a month the year EMMA was installed.

Management considerations of new technology always include questions about implementation. Unlike full-automation initiatives (e.g. installing robots) which often require shutting down a process line for days or weeks and require significant facility modifications, EMMA rolls out onto the factory floor, plugs into an air line, and is ready to go to work, and an operator can be fully trained in a matter of hours.

As capital equipment, EMMA TSS units are particularly flexible — nothing is bolted to the floor and EMMA can simply roll from one process line to another as required. They are also dramatically less expensive than robots configured for surface treatment operations.

For more information, visit Temple Allen Industries online at www.templeallen.com, or call (301) 541-3662.

— Source: Temple Allen

AWS Truepower adds to wind energy technology portfolio with aquisition of Windographer software

Agreement reinforces AWS Truepower's strategic focus on providing integrated analysis and development tools to serve the global wind industry

Continuing its strategy of creating and delivering exceptional wind analysis and development tools, AWS Truepower, LLC, an international leader in renewable energy consulting and information services, has purchased the Windographer software from Mistaya Engineering, Inc.

Windographer is the market-leading software for analyzing, visualizing, and validating wind resource data from meteorological towers and remote sensing systems. These data are fundamental to accurately estimating the amount of energy that will be produced by wind projects.

Windographer complements AWS Truepower's suite of wind analysis and development tools, which include the wind project design and optimization software Openwind® Enterprise, and the web-based Wind Site Assessment and Wind Data Management dashboards. Tom Lambert, previously CEO of Mistaya and chief architect of Windographer, will lead the Windographer team from AWS Truepower Canada, a new subsidiary based in Calgary, Alberta.

"Windographer's success in the market reflects the innovation and passion of Tom and his team," said Bruce Bailey, CEO of AWS Truepower. "They have created an elegant and useful product for the wind industry, and we are happy that they are joining us to continue to expand its development as part of AWS Truepower."

Michael Brower, President and Chief Technical Officer at AWS Truepower added, "With Windographer joining AWS Truepower, we will be able to provide the full range of wind software, online services, and data to our customers, who will benefit from more powerful tools and greater cross-platform integration and compatibility. At the same time, existing Windographer users will see continuity and growth in the product they already value."

"The Windographer team is thrilled to be joining AWS Truepower," said Tom Lambert. "The vision AWST has for their software suite aligns very well with ours, and their expertise will allow us to advance Windographer farther and faster than we could on our own."

"It makes sense to all of us as a natural progression in building a world-class suite of wind development tools," he added.

With the closing of AWS Truepower's acquisition of Windographer software on November 28, 2014, AWS Truepower will provide the wind industry's most comprehensive portfolio of advanced wind monitoring and modeling software tools.

AWS Truepower provides renewable energy project development, engineering and operations solutions.

Energy developers, investors, utilities, system operators, and governments rely on the company's 30 years of experience, expertise and technology to reduce uncertainty, mitigate risk, and maximize return on their investments. AWS Truepower's suite of consulting and engineering services, software, maps, and data products support the complete wind and solar project development lifecycle.

— Source: AWS Truepower

Windlab utilizing Vaisala's Triton remote sensing equipment in South African site selection

Vaisala, global leader in environmental and industrial measurement, has announced that wind energy developer, Windlab, is using the Vaisala Triton Sonic Wind Profiler, a ground based remote sensing system, to assist with ongoing and critical site selection work in Africa.

With the continent registering a boom in renewable energy deployment in a number of countries, and South Africa in particular working to reduce its dependence on coal fired power plants, developers must quickly and efficiently make key site selection decisions for development.

The Vaisala Triton can be used either in locations where meteorological masts might be inappropriate or difficult to install, or used in conjunction with these masts to identify site suitability issues and gain a more detailed assessment of a project's resource potential. Tritons are also able to operate autonomously, powered in most cases by on-board solar panels, enabling them to be used in remote areas with no access to the power grid.

These capabilities allow Vaisala to better assist developers and investors in unlocking growth in emerging markets, and gain improved perspectives on project risk.

Having previous experience using the Vaisala Triton in its global operations, Windlab clearly understood the strategic advantage of deploying them in a market like South Africa. Several potential sites were initially identified in the region through early stage wind modeling. However, in order to finalize development and investment decisions, it was necessary to characterize the wind profile of these sites in more detail, gather wind measurement data over large distances, and monitor multiple locations simultaneously. For this the Tritons were invaluable.

"Our Triton equipment has proven time and again to have the versatility needed for emerging markets," said Lee Alnes, Key Account Manager at Vaisala. "Working with Windlab in South Africa to assist the firm in reaching its development targets, we've demonstrated that Tritons offer an efficient way to open up new clean energy markets."

Shane Quinnell, Project Engineer, Windlab, added, "The Vaisala Triton was instrumental in streamlining our site selection process, quickly enabling us to select the best and highest performing project sites in South Africa."

"By placing the Tritons we own in strategic locations at each prospective site, we gained a strong understanding of potential site performance, while eliminating the cost and consenting challenges typically associated with meteorological masts," he said.

"As a direct result, and coupled with the fact that we can deploy the equipment in rugged and remote locations, we intend to continue using Vaisala Tritons and technical support in the future."

— Source: Vaisala

LEEDCo LAUNCHES ENGINEERING AND DESIGN EFFORT FOR OFFSHORE TURBINE FOUNDATIONS

Project aims to solve facilitate fabrication of monopiles in the U.S.

The Lake Erie Energy Development Corporation (LEEDCo) recently announced that it is leading an international engineering team to design an offshore wind turbine foundation optimized for fabrication in the United States. The design will catalyze domestic manufacturing growth by removing barriers to entry faced by U.S.-based steel fabricators that want to supply foundations for the offshore wind industry.

LEEDCo developed the conceptual design of the foundation system last year through a U.S. Department of Energy (DOE) competition. A new DOE award of $2.8 million was finalized today to complete the detailed engineering.

"This will be the first monopile foundation designed from the ground up to be built by American companies and installed in American waters," said Dr. Lorry Wagner, President of LEEDCo. "Monopiles have proven to be the most cost-effective solution for the vast majority of offshore wind projects in the world. This design will enable American fabricators to compete against their European counterparts that already have decades of experience in this industry."

LEEDCo has partnered with GLWN, a leading wind industry supply chain adviser, to engage local and regional fabricators. GLWN is an initiative of WIRE-Net, a Cleveland-based manufacturing support organization. With their help, LEEDCo selected American Tank & Fabricating (AT&F), a Cleveland-based steel fabricator, as a partner to represent U.S. fabricators during the design process. AT&F is the leader among several U.S. companies with the sophistication necessary to fabricate monopiles of the scale and complexity needed for use in the offshore wind industry.

"AT&F has over 70 years of experience providing quality steel products, and we are excited about the opportunity to extend our expertise for use in the offshore wind industry," said AT&F CEO Michael Ripich. "Offshore wind in Lake Erie has huge potential, and we look forward to collaborating with LEEDCo on this project. Bringing manufacturers on board at this early stage is the best way to develop the most cost-effective design."

LEEDCo will work with several other key project partners. A team at Case Western Reserve University led by Professor David Zeng, Chair of the Department of Civil Engineering, will conduct laboratory testing to validate the design; Offshore Design Engineering, a U.K.-based company that has designed and installed several European offshore wind projects, will lead the detailed engineering of the foundation; the Cold Regions Research and Engineering Laboratory, located in Hanover New Hampshire and part of the U.S. Army Corps of Engineers' Engineer Research and Development Center, will characterize ice formations in Lake Erie to inform the loads analysis; Sound and Sea Technology, an ocean engineering firm based in Lynnwood, Washington, will perform geophysical and geotechnical analysis.

The foundation design will be used first for LEEDCo's Project Icebreaker, a six-turbine offshore wind demonstration project planned for the Ohio waters of Lake Erie seven miles north of downtown Cleveland. The design team will collaborate closely with Fred. Olsen Windcarrier, LEEDCo's key partner for developing an installation strategy for offshore wind the Great Lakes.

Cleveland Mayor Frank G. Jackson and Cleveland Foundation President and CEO Ronn Richard, longtime supporters of the Icebreaker project, voiced their enthusiasm for this latest development.

Mayor Jackson said, "The Department of Energy's further support of Project Icebreaker will provide the initiative with continued momentum to create a freshwater wind industry built upon our current economic assets. The transition to a clean, renewable energy economy is a key part of my Sustainable Cleveland initiative."

Mr. Richard, who also chairs LEEDCo's board, said, "This engineering initiative is hugely exciting because it is one more step on the path to creating a new advanced energy economy in Greater Cleveland. Building offshore wind projects in Lake Erie sets our region on a path to creating jobs and protecting one of our country's most important freshwater resources."

2015 Turbine Directory

GE Energy

GE Energy
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Schenectady, NY 12345

(518) 385-2211
www.ge-energy.com/wind

@GE_Energy
gepowerandwater

GE chosen to supply turbines for wind project in Poland

GE announced that it will supply Lewandpol Company with 27 GE 2.5-103 wind turbines for the Galicja Wind Farm in Poland. Ten of the wind turbines are currently under construction, with another 17 planned to begin construction in 2015. Once operational, the 120 MW Galicja Wind Farm will generate the equivalent energy needed to power approximately 52,000 Polish homes for a year.

Galicja is GE's first wind farm in the southern Polish region of Podkarpackie and will be one of the country's largest wind farms.

"GE's wind turbines are well suited to our sites," said Andrzej Lewandowski of Lewandpol Company. "Foundation works started beginning of December and we are pleased to be working closely with GE as construction at the site progresses."

Crido Legal operated with the Lewandpol Company as the legal and financial advisor for the transaction. "We are very excited that we provided our extensive knowledge and experience in the purchasing phases and make such a relevant investment possible," said Filip Grzesiak, senior associate, Crido Legal, the legal firm advising Lewandpol Company.

"We are delighted that Lewandpol Company has chosen GE wind turbine technology," said Cliff Harris, general manager for Africa, Europe, and the Middle East for GE's renewable energy business. "This agreement highlights our commitment to Poland's wind energy development."

In 2013, Poland installed 894 MW of new wind capacity, ranking the country eighth highest in the world in terms of annual wind capacity growth, according to the GWEC's Global wind report. At the end of 2013, Poland's total installed capacity was 3.4 gigawatts (GW), nearly half of the of the 6.5 GW wind target by 2020, as defined in its National Renewable Energy Action Plan. Under its current energy policy, the Polish government forecasts additional wind growth reaching up to 13 GW by 2030 and 21 GW by 2050.

"GE is excited to help our customers in Poland work toward its goals for renewable energy growth in the country," said Beata Stelmach, GE chief executive for Poland and the Baltics. "With an increasing electricity demand at 0.9 percent per year and aging power infrastructure, Poland needs to invest in modern, low-emission energy sources, and it has huge potential for wind energy."

GE will ship the turbines from its manufacturing facility in Salzbergen, Germany, and the wind farm is expected to begin commercial operation by the end of 2015.

Photo: GE Energy

GE					
	1.7-100 / 103	1.85-82.5 / 87	2.3-107	2.75-120	3.2-103
Rated Power (kW)	1,700	1,850	2,300	2750	3200
Wind Class (IEC)	IIIs	IIs	IIs	IIIs	IIb
Rotor Diameter (m)	100 / 103	82.5 / 87	107	120	103
Hub Height (m)	80, 96 / 80	80, 65, 100 (1.6MW)/ 80	80	85, 110; 139 (hybrid)	70 - 98
Swept Area (m^2)	7,854 / 8,332	5,346 / 5,945	8,902	11,310	8,332
Generator Type	DFIG				
Rated Voltage (V)	50/60				50
Drivetrain	Gearbox				

VESTAS

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Portland, OR 97209

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Vestas

VESTAS 2MW PLATFORM						
	V100-2.0 MW	V90-1.8/2.0 MW		V100-1.8/2.0 MW		V110-2.0MW
Variant/application		1.8 MW	2.0 MW	1.8 MW	2.0 MW	
Rated Power (kW)	2,000	1,800 (50 Hz); 1,815 (60 Hz)	2,000 (50 Hz)	1,800 (50 HZ)	2,000 (60 HZ)	2,000
Wind Class (IEC)	Ia	IIa	IIIa	S (IIIa average wind/ IIa extreme wind); IIb		IIIa
Cut-in Wind Speed (m/s)	3	4		3		
Cut-out Wind Speed (m/s)	22	25		20		
Rotor Diameter (m)	80	90		100		110
Hub Height (m)	80, 95, 120 (IIb)	80, 95, 105 (50 Hz)	80, 95, 105, 125	80, 95, 120 (IIIa)		95, 125 (50Hz); 80, 95 (60 Hz)
Swept Area (m²)	7,854	6,362		7,854		9,503
Generator Type	4-pole (50Hz)/6-pole (60Hz) doubly fed generator, slip rings					
Rated Voltage (V)						
Drivetrain	gearbox; 2 helical stages and one planetary stage					

VESTAS 3MW PLATFORM					
	V105-3.3 MW	V112-3.3 MW		V117-3.3 MW	V126-3.3MW
Variant/application		IIa	Ib		
Rated Power (kW)	3,300				
Wind Class (IEC)	Ia	IIa	Ib	IIa	IIIa
Cut-in Wind Speed (m/s)	3, 23 (re-cut in)				3, 20 (re-cut in)
Cut-out Wind Speed (m/s)	25				22.5
Rotor Diameter (m)	105	112		117	126
Hub Height (m)	site specific	84, 94 (IEC IIa); 119, 140 (IIIa)	site specific	91.5, 116.5	117 (IIIb); 137 (IIIa)
Swept Area (m²)	8,659	9,852		10,751	12,469
Generator Type					
Rated Voltage (V)					
Drivetrain	gearbox, two planetary stages and one helical stage				

Mitsubishi

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mitsubishi-power-systems-americas

MITSUBISHI WIND TURBINE MODELS					
	MWT62/1.0	MWT92/2.4	MWT95/2.4	MWT100/2.4	MWT102/2.4
Rated Power (kW)	1,000	2,400			
Wind Class (IEC)	IIa				
Rotor Diameter (m)	61.4	92	95	100	102
Hub Height (m)	50, 60, 69	80			
Swept Area (m^2)	2,960	6,648	7,088	7,854	8,171
Generator Type	Induction generator (4-pole)	Doubly fed asynchronous generator + IGBT converter			
Rated Voltage (V)	690 (50Hz), 600 (60Hz)	690			
Drivetrain					

MHI Vestas Offshore Wind

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MHI VESTAS		
	V112-3.3 MW	V164-8.0 MW
Rated Power (kW)	3,300	8,000
Wind Class (IEC)	Ib / IIa	S
Rotor Diameter (m)	112	164
Hub Height (m)	84 -140; Site specific	Site specific
Swept Area (m^2)	9,852	21,124
Generator Type		permanent magnet
Rated Voltage (kV)		33-35 or 66
Drivetrain	Gearbox	


Photo: MHI Vestas Offshore

SIEMENS

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siemens

D3 (DIRECT DRIVE)							
	SWT-3.0-101	SWT-3.2-101	SWT-3.0-108	SWT-3.2-108	SWT-3.0-113	SWT-3.2-113	SWT-3.3-130
Rated Power (kW)	3,000	3,200	3,000	3,200	3,000	3,200	3,300
Wind Class (IEC)	Ia				IIa		
Rotor Diameter (m)	101		108		113		130
Hub Height (m)	74.5 - 99.5		79.5		79.5 - 142		
Swept Area (m²)	8,000		9,144		10,000		13,300
Generator Type	Synchronous, permanent magnet						
Rated Voltage (V)	690						
Drivetrain	Direct drive						

D6 (DIRECT DRIVE OFFSHORE)	
	SWT-6.0-154
Rated Power (kW)	6,000
Wind Class (IEC)	Ia
Rotor Diameter (m)	154
Hub Height (m)	Site-specific
Swept Area (m²)	18,600
Generator Type	Synchronous permanent magnet
Rated Voltage (V)	690
Drivetrain	Direct drive

G2 (GEARED)		
	SWT-2.3-101	SWT-2.3-108
Rated Power (kW)	2,300	
Wind Class (IEC)	IIb	
Rotor Diameter (m)	101	108
Hub Height (m)	Site specific	
Swept Area (m²)	8,000	9,150
Generator Type	Asynchronous	
Rated Voltage (V)	690	
Drivetrain	3-stage planetary/helical gearbox	

G4 (GEARED OFFSHORE)			
	SWT-3.6-120	SWT-4.0-120	SWT-4.0-130
Rated Power (kW)	3,600	4,000	
Wind Class (IEC)	Ia		Ib
Rotor Diameter (m)	120		130
Hub Height (m)	Site-specific		
Swept Area (m²)	11,300		13,300
Generator Type	Asynchronous		
Rated Voltage (V)	690		
Drivetrain	3-stage planetary/helical gearbox		

Goldwind

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GW 2.5MW			
	GW 100	GW 109	GW121
Rated Power (kW)	2,500		
Wind Class (IEC)	IIIa	IIa / IIIa	IIIb
Rotor Diameter (m)	100	109	121
Hub Height (m)	Site specific		
Swept Area (m²)	7,823	9,516	11,595
Generator Type	Permanent Magnet Direct Drive Synchronous Generator		
Generator Output (V)	690		
Drivetrain	Direct Drive		

GW 1.5MW				
	GW 70	GW 77	GW 82	GW 87
Rated Power (kW)	1,500			
Wind Class (IEC)	Ia	IIa	IIIa	IIb
Rotor Diameter (m)	70	77	82	87
Hub Height (m)	Site specific			
Swept Area (m²)	3,886	4,649	5,325	5,890
Generator Type	Permanent Magnet Direct Drive Synchronous Generator			
Generator Output (V)	620 (air-cooled) or 690 (water-cooled)			
Drivetrain	Direct drive			

Siemens releases Environmental Product Declarations on turbine portfolios

Siemens Wind Power and Renewables has published four new Environmental Product Declaration (EPD) brochures, each representing one of the company's four product platforms, covering both geared and direct drive wind turbines for offshore and onshore projects. The figures are based on Life Cycle Assessments (LCA) of four defined wind power projects—two offshore wind plants with 80 wind turbines and two onshore wind projects with 20 wind turbines. The new brochures offer valuable figures of the environmental performance of Siemens' products.

Central to LCA is the energy payback time calculation. This is the length of time the wind power plant has to operate in order to produce as much energy as it will consume during its entire lifecycle. In an onshore wind power plant with an average wind speed of 8.5 meters per second, the energy payback time of a Siemens SWT-3.2-113 wind turbine is 4.5 months.

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SUZLON							
	S52	S66 MARK II	S82	S88	S95	S97	
Rated Power (kW)	600	1,250	1,500	2,100			
Wind Class (IEC)	IIa	IIIa	IIIa	IIa	IIa	IIIa	IIb
Rotor Diameter (m)	52	66	82	88	95	97	
Hub Height (m)	75	74.5	76.8	80,100	80, 90, 100	80, 90, 100, 120	90
Swept Area (m²)	2,124	3,421	5,281	6,082	7,085	7,386	
Generator Type	Single speed induction generator	Dual speed induction generator	Induction generator with slip rings, variable rotor resistances		Asynchronous 3-phase induction generator (DFIG)		
Rated Voltage (V)	690						
Drivetrain	Gearbox, one planetary stage and two helical stages						

ACCIONA

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AW1500			
	AW 70	AW 77	AW 82
Rated Power (kW)	1,500		
Wind Class (IEC)	Ia	IIa+	IIa
Cut-in Wind Speed (m/s)	4	3.5	3
Cut-out Wind Speed (m/s)	25		
Rotor Diameter (m)	70	77	82
Hub Height (m)	60, 80 (steel)	60, 71.5, 80 (steel); 100 (concrete)	80 (steel)
Swept Area (m²)	3,848	4,657	5,289
Generator Type	6 poles, double feeding		
Generator Output (V)	12,000		
Drivetrain	3-stage gearbox: 1 planetary, 2 parallel (helical)		

AW3000				
	AW 100	AW 109	AW 116	AW 125
Rated Power (kW)	3,000			
Wind Class (IEC)	Ia	IIa+	IIa	IIIa
Cut-in Wind Speed (m/s)	4	3.5	3	3.5
Cut-out Wind Speed (m/s)	25			
Rotor Diameter (m)	100	109	116	125
Hub Height (m)	100 (concrete)	95.5 (steel); 100 (concrete)	92, 120 (steel); 100, 120 (concrete)	87.5, 120 (steel); 120 (concrete)
Swept Area (m²)	7,864	9,360	10,568	12,305
Generator Type	6 poles, double feeding			
Generator Output (V)	12,000			
Drivetrain	3-stage gearbox: 2 planetary, 1 parallel (helical)			

NORDEX

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NORDEX GENERATION GAMMA			
	N90/2500	N100/2500	N117/2400
Rated Power (kW)	2,500		2,400
Wind Class (IEC)	Ia	IIa	IIIa
Cut-in Wind Speed (m/s)	3		
Cut-out Wind Speed (m/s)	25		20
Rotor Diameter (m)	90	99.8	116.8
Hub Height (m)	65, 70, 80	75, 80, 100	91, 120, 141
Swept Area (m²)	6,362	7,823	10,715
Generator Type	Double-fed asynchronous		
Generator Output (V)	660		
Drivetrain	Combined spur/planetary gear or differential gearbox		

NORDEX GENERATION DELTA			
	N100/3300	N117/3000	N131/3000
Rated Power (kW)	3,300	3,000	
Wind Class (IEC)	Ia	IIa / IIIa (141m)	IIIa
Cut-in Wind Speed (m/s)	3.5	3	
Cut-out Wind Speed (m/s)	25		20
Rotor Diameter (m)	99.8	116.8	131
Hub Height (m)	75, 85, 100	91, 120, 141	99, 114
Swept Area (m²)	7,823	10,715	13,478
Generator Type	Doubly-fed asynchronous		
Generator Output (V)	660		
Drivetrain	Combined spur/planetary gear		

GAMESA

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GAMESA 5.0 MW CLASS					
	G128			G132	
	ONSHORE		OFFSHORE	ONSHORE	OFFSHORE
Rated Power (kW)	4,500	5,000			
Wind Class (IEC)	IIa	Ia / IIa	B	IIa	
Rotor Diameter (m)	62.5			64.5	
Hub Height (m)	81, 95, 120, 140		80–94; also project-specific	95, 120, 140	Project speciic
Swept Area (m²)	12,868			13,685	
Generator Type	Permanent magnet synchronous generater with independent modules in parallel				
Generator Output (V)	690				
Drivetrain	Gearbox; 2 planetary stages				

GAMESA 850 kW CLASS		
	G52	G58
Rated Power (kW)	850	
Wind Class (IEC)	Ia	IIa / IIIb
Rotor Diameter (m)	52	58
Hub Height (m)	44, 55, 65	44, 49, 55, 65, 74
Swept Area (m²)	2,214	2,642
Generator Type	Dual power fed	
Generator Output (V)	690	
Drivetrain	3 stage gearbox: 1 planetary, 2 parallel	

GAMESA 2.0–2.5 MW CLASS							
	G80	G87	G90	G97	G106	G114	
Rated Power (kW)	2,000				2,500	2,000	2,500
Wind Class (IEC)	Ia	Ia, IIa	Ia, IIa	IIa, IIIa	Ia	IIa, IIIa	IIa
Rotor Diameter (m)	80	87	90	97	106	114	
Hub Height (m)	60, 67, 78, 100	67, 78, 90, 100	67, 78, 90, 100	78, 90, 100, 120	72, 80, 93, site specific	80, 93, 125, site-specific	93, 120, 140, site-specific
Swept Area (m²)	5,027	5,945	6,362	7,390	8,825	10,207	
Generator Type	Doubly-fed machine						
Generator Output (V)	690						
Drivetrain	1 planetary, 2 parallel stages					2 planetary, 1 parallel stages	

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MM PLATFORM			
	MM82	MM92	MM100
Rated Power (kW)	2,050		1,800 / 2,000 (50Hz)
Wind Class (IEC)	up to Ia	up to Ib	S (IIIa annual; IIa extreme)
Cut-in Wind Speed (m/s)	3.5	3	
Cut-out Wind Speed (m/s)	25	24	22
Rotor Diameter (m)	82	92.5	100
Hub Height (m)	59, 69, 80, 100	68.5, 80, 100	80, 100
Swept Area (m^2)	5,281	6,720	7,854
Generator Type	Double-fed asynchronous; 4-pole (50 Hz, 6 -pole (60 Hz)		
Rated Voltage (V)	690 (50 Hz); 575 (60 Hz)		
Drivetrain	Combined planetary/spur wheel gearbox		

3.XM PLATFORM				
	3.0M122	3.2M114	3.4M104	3.4M114
Rated Power (kW)	2,970 (MV-side), 3,000 (LV-side)	3,170 (MV-side), 3,200 (LV-side)	3,370 (MV-side), 3,400 (LV-side)	
Wind Class (IEC)	IIIa	up to IIIa	up to Ib / IIa	IIa / III a
Cut-in Wind Speed (m/s)	3		3.5	3
Cut-out Wind Speed (m/s)	22		25	22
Rotor Diameter (m)	122	114	104	114
Hub Height (m)	139	90–93; 120–123; 140–143	78–80; 93; 96.5–100; 125–128	90-93; 119-123; 140-143
Swept Area (m^2)	11,690	10,207	8,495	10,207
Generator Type	Asynchronous doubly-fed generator			
Rated Voltage	10/20/30 kV			
Drivetrain	Three stage planetary/spur-gear system			

6.XM PLATFORM		
	6.2M126	6.2M152
Rated Power (kW)	6,150	
Wind Class (IEC)	Ib (offshore); Ib, IIa (onshore)	S (offshore); Ib (onshore)
Cut-in Wind Speed (m/s)	3.5	
Cut-out Wind Speed (m/s)	25 (onshore); 30 (offshore)	
Rotor Diameter (m)	126	152
Hub Height (m)	100–117 onshore; apprx. 85–95 offshore (location-dependent)	121, 124 onshore; apprx. 95–110 offshore (location dependent)
Swept Area (m^2)	12,469	18,146
Generator Type	Double-fed induction	
Rated Voltage (kV)	20, 30, 33	20, 30, 33, 66 (upon request)
Drivetrain	Three-stage planetary/spur gearbox	