MAHENG/2012/47805

Vol 3 Issue 11 • Pages 60 • September 1, 2015 • ₹100/- • www.eprmagazine.com

EPR

electrical & power review

Vision 175 GW
A POWERFUL PROMISE

An exclusive report on India's strive to meet renewable energy target by 2022

An I-Tech Media Publication

The Future of Wind Turbine

Explores the innovations in wind turbine technology

Wind power deployment has enhanced worldwide, especially in India where the potential is immense given the vast terrains and the country's insatiable appetite for energy. In the early 90s, the wind industry was just picking up and there were only small turbines – 220 to 250 Kw turbines. "Today in a progressing economy with the acute power shortage to account for, the emergence of newer innovations with bigger and greater capacity such as the 2 MW is no surprise. It has been a big improvement in terms of technology, efficiency as well as output," opines Ramesh Kymal, Chairman and Managing Director, Gamesa India. "Progress especially over the past five years has boosted energy yield especially in low-wind-resource sites and reduced cost of energy substantially."

Global wind energy market is poised for over 40 per cent growth in FY15 whereas India plans to increase wind capacity to 60,000 MW by March 2022. Wind technology continues to mature and hence will boost the growth of the industry. "Wind turbine manufacturers continue to access new markets through technology and innovation. Taller tower heights and larger rotor blades are gaining importance in the sector," says Duncan Koerbel, Chief Technology Officer (CTO), Suzlon Group.

Whereas Mahesh Palashikar, CEO of GE Renewables in India believes that installing a wind turbine which is designed to suit India's low wind and operating conditions is the crucial development in wind turbine technology. Wind speeds in new project sites in India are typically low and in the range of 6 to 7 m/s. Also these sites are with low air densities and low turbulence. GE's 1.7-103 turbine was custom developed for these requirements and its evolutionary design combines the prowess of GE's successful 1.5 MW platform with rotors from the 2.x platform. "Our 1.5 MW wind turbine series, also known as the industry workhorse, has an installed base of over 18,000 units worldwide and a more than 98 per cent availability record globally," Mr Palashikar claims.

"With new technologies being deployed wind energy will be at par with grid parity in the next two years," asserts Mr Koerbel.

Innovations

With wind energy increasingly becoming a preferred source of renewable energy, the industry is witnessing an increase in research and development activities to tap into new opportunities. According to Mr Kymal, some of the recent experiments that have borne fruit include increasing tower height and rotary blade length, controls, electronics and gearboxes.

The general trend in turbine design has been to increase the height of the tower, the length of the blades and the power capacity. This is done with the aim to increase overall efficiency. On an average, however, turbines have grown in height and rotor diameter more rapidly than have their power capacities.

"As the turbines grow larger and higher, the innovation focus will be rotor technology, logistics and towers design," Mr Kymal points out. He observes, "Larger rotors are challenging to transport and hence the future turbine will have segmented blades that will be connected at site before installation."

Also, logistic solutions, trailer dimension and technology will witness innovation to transport turbine components at the lowest possible cost. Current turbine towers are mainly made of tubular steel. Concrete is emerging a viable alternative atleast to replace the bottom level of tower which is the heaviest and cost much more that compared to the total cost of the tower. "Hybrid tower will drive the market for taller turbines," Mr Kyamal adds.

Newer concepts are being introduced in technology such as split blades, bladeless turbines, balloon-based turbines and also floating wind turbines. The technology in split blades is not very dramatically challenging. However, according to Mr Koerbel, the problem is more of a commercial nature as split blades increases weight and cost both. "If logistical issues can be managed, only then a split blade makes sense. Today the competition is about innovation which in this case would be how to make split blades work economically," Mr Koerbel adds.

> A major development in wind turbine technology is the way a wind farm is optimised from an asset, operations and business perspective.
>
> Mahesh Palashikar,
> CEO,
> GE Renewables, India

> Taller tower heights and larger rotor blades are gaining importance in the sector.
>
> Duncan Koerbel,
> Chief Technology Officer
> (CTO), Suzlon Group

Wind power is a dominant source of power in many countries and also a few states in India. This means that wind power will have be responsible towards the growth and stability of the larger power system. Power forecasting is critical to maintaining grid stability. According to Mr Kyamal, "Accurate forecasting tools are become critical at ensuring higher grid penetration of wind power."

The next step in this evolution will be energy storage system and hybrid systems. Large battery banks and pumped hydro are being discussed in various forums. Another alternative is to have an intelligent link between wind farms and gas or diesel power plants which together ensure a stable power output based on demand. "Various models are being evaluated and in about a decade we might be able to see atleast a few commercial ventures in this direction," predicts Mr Kyamal.

In Europe, where availability of land is a major challenge, offshore market is growing and a lot of technology leaps is being witnessed in turbine size, foundations etc.

According to Mr Palashikar, a major development in wind turbine technology is the way a wind farm is optimised from an asset, operations and business perspective.

Asset optimisation

Asset optimisation enhances the output of turbines to improve investor returns. "At GE, we articulated our vision for the industrial Internet sometime back. We use its big data and analytics capabilities to improve turbines' Annual Energy Production (AEP) by up to 5 per cent through our Wind PowerUp Services. We also back it up with innovative commercial models and comprehensive services, sharing the risks and rewards of such improvements," explains Mr Palashikar.

GE has recently demonstrated a pilot project for this service where its customer realised a 4.8 per cent increase in AEP, versus 3.5 per cent that was initially estimated.

Operations optimisation

Operations optimisation requires that the availability and reliability of installed turbines is high, so turbines are available to generate power when winds blow. This requires


Suzlon

> Small wind turbines complement solar in wind solar hybrids by generating extra power in monsoon when clouds reduce solar power output.
>
> Rajarshi Sen, Founder Director and CEO, Luminous Renewable Energy Solutions

superior operations and maintenance processes, coupled with an excellent Environment, Health and Safety (EHS) record.

Business optimisation

Business optimisation deals with how the wind farm interacts with external stakeholders such as the power grid. With increasing penetration of infirm power such as wind power in the grid, regulators demand a higher level of discipline for dispatch. One such requirement is that of scheduling or forecasting, which could result in severe commercial impact for wind farm operators for non-compliance. "GE's Industrial Internet application for wind power forecasting is based on our Predix platform, and it offers industry-leading forecast accuracy. It significantly reduces wind farm operator's commercial impact. This in turn facilitates larger integration of wind power in the grid," asserts Mr Palashikar.

Innovations in small wind turbines

Small wind turbines are those with rotor or blades less than 16 metres diameter and capacity ranging from 400 W to 50/100 KW. The most popular sizes are 1 KW to 10 KW with hundreds of thousands of them installed around the world. According to Rajarshi Sen, Founder Director and CEO of Luminous Renewable Energy Solutions, "At windy areas, small wind turbines can provide much more energy compared to solar PV. The footprint area is also much less." Luminous Renewable Energy Solutions Pvt. Ltd. is presently known as WISH Energy Pvt. Ltd.

Mr Sen claims, "Small wind turbines complement solar in wind solar hybrids by generating extra power in monsoon when clouds reduce solar power output." Such turbines are used successfully for off-grid rural electrification projects and can also work as grid connected rooftop power plants. Thousands of small wind turbines are operating submersible water pumps at un-electrified areas of Asia and Africa. Small turbines provide electricity to hundreds of offshore oil platforms and they are also installed on telecom towers for powering the BTS. WISH Energy's 1KW turbines are installed in high altitude army posts at Leh and Siachen.

Small wind turbines are possibly the newest entrants in the renewable energy field but technology development has been rapid since it started in the 1980's. Mr Sen highlights the technology development in the field of small wind turbines as:

- Use of Carbon fibre composites allows much lighter blades that start up in low wind speeds and survive extreme wind force as well.
- Availability of high power Neodymium magnets has

Continued to 22 →

The Future of Wind Turbine
Continued from 20 ←

> As the turbines grow larger and higher, the innovation focus will be rotor technology, logistics and towers design.
>
> Ramesh Kymal, CMD, Gamesa India

reduced the size and weight of turbine generator to half. With these improvements, a 10KW wind turbine weighing less than 300 kgs, can be installed by 2 technicians without using mechanised equipment.

- Each wind turbine provides maximum power at its ideal tip speed ratio (ratio of blade tip speed to wind velocity). If blades move slower than this ideal speed, wind passes through the blades without generating power and if blades move faster, they create wind turbulence and power loss.

Latest power electronics allows monitoring of wind speed and regulation of rotor speed continuously to maintain ideal tip speed ratio. Increasing or decreasing the electrical load on the alternator achieves speed control.

- Grid connected small wind or solar are easier to design than the off grid battery charging systems. In grid tied small wind turbines, excess power output can always be passed on to the grid, but in battery based systems, when the wind speed is high and turbine generates high power that the battery cannot accept, the excess power has to be dumped. WISH Energy is working on a type of system that will allow very high current to be pumped into the battery in the form of positive and negative pulses without power wastage.
- Nowadays, a small wind turbine can be connected a domestic electricity line, simply by using a wind grid tie inverter (different from a solar grid tie inverter) which can also be switched to off grid mode for battery charging for backup power supply during power cuts. No wastage of power.
- GPRS-based remote monitoring and control are available as an option.

Small wind turbines are now available with certification for power performance, safety and expected service life as per IEC 61400-12 international standards. National Institute of Wind Energy does the testing and certification in India at their Tamil Nadu test site. It's at par with international test houses at USA and Europe.

A few Indian companies have been manufacturing and installing small wind turbines since last 10 years and most of the models have received required IEC certification. India is a frontrunner in small wind power. "Our company has been exporting small wind turbines from 400 W to 5 KW capacity to 50 countries in North and South America, Europe, Africa, Asia, Australia and Africa," informed Mr Sen.

Focus on O&M

The operations and maintenance (O&M) activities play a vital role in keeping the produced energy as close to the producible energy and lot of innovations are also happening in this space.

With the advent of sophisticated SCADA systems now it is possible to remotely monitor various turbine performance parameters and control setting to optimise performance and ensure high turbine uptime. SCADA also allows for analysis of large amount of real time data and derive actionable points based on the years of operational experience. The Big Data analysis helps us to understand and closely monitor the performance of the turbine as a whole and also at the component levels. Operational experience gained by the OEM over the years from their installations world over can be integrated with the Big Data and a fair amount of artificial intelligence and automated analysis could be made available for fast and accurate decision making. With all these, the detection of the faults at the very initial stages is possible thus saving cost and downtime of turbines. Gamesa's O&M philosophy and Condition Monitoring Systems are derived from the above, Mr Kyamal informed.

"GE Renewables India plans to launch an advanced version of 1.7-103 turbine soon that will maximise the efficiency of the wind farm and optimise the O&M costs," Mr Palashikar said.

Wind giants

Gamesa, in India, over the last five years has come a long way. "It was in 2010 that we inaugurated our assembly cum manufacturing facilities and since then there has been no looking back," states the proud CMD of Gamesa India Mr Kymal.

Small wind turbine at ONGC offshore oil platform

One of Gamesa India's greatest innovations is the G97-2.0 MW wind turbine – custom-designed for the low wind speed sites typical of India. "Today, having achieved 85 per cent Indigenisation in the G97-2.0 MW platform, we have emerged as the market leader capturing 28 per cent of the India market," claims Mr Kymal.

A member of the 2.0 MW platform and tailor-made for low wind speed sites, the G114 consists of longer blades and taller towers, thereby increasing the efficiency. With a rotor spanning 114 metres, the G114's rotor swept area is 38 per cent greater than that of the current G97-2.0 MW, while it produces 20 per cent more energy. The turbine is also suited for Indian conditions such grid volatility, high temperature and dusty environments. Today, seeing the thrust for renewables, Gamesa has commissioned its latest innovation, the G114 2.0 MW turbine claims to be a game changer in the wind space.

"The 1.7-103 wind turbine from GE with its 103 metres rotor is the highest capacity wind turbine in the India region, providing a 30 per cent increase in annual energy production compared to its predecessor, the 1.6-82.5 turbine," avers Mr Palashikar from GE Renewables. GE also offers low to medium wind speed turbines of 1.6 MW with an 87 metre rotor in the Indian market.

"Technology is the key enabler for any company to be a market leader," considers Mr Koerbel. Suzlon's sophisticated R&D capabilities in the wind energy space have led to the development of a comprehensive product portfolio, ranging from 600 kW to 2.1 MW wind turbines.

The company's R&D centres are based in Germany and Denmark, aerodynamic development in The Netherlands and India, and process engineering in India.

Suzlon Group offers an extensive range of robust and reliable products that are at the cutting edge of technology. Suzlon continues to leverage on its technological edge to develop and deploy the best suited technology to meet every requirement.

In June 2012, the company introduced S111 - 2.1 MW wind turbine designed for low wind speed sites. Taking a step forward, on 6th Nov 14, Suzlon launched S97-120m, the world's tallest hybrid WTG (Wind Turbine Generator) designed to harness the wind energy across low wind sites.

In future, Suzlon looks at tapping both solar and wind as they both complement each other. "It will optimise grid infrastructure and increase the normative plant load factor in the range of 35-40 per cent against the present 25 per cent," informed Mr Koerbel.