

## A blueprint for *innovation*

SUNIL TAHILRAMANI explains how an increased focus on design is streamlining the wind turbine industry.

**What are the pressures currently facing the energy sector that are driving design and simulation requirements?**

**Sunil Tahilramani.** Today, globally there is an increased focus on the impact of energy consumption on the environment. This focus, along with the fluctuations in the price of crude oil and natural gas, has increased investments in the development and implementation of clean, renewable energy technologies such as solar and wind energies.

Worldwide there has been a rapid growth in wind turbine installations, which has been fuelled by government incentives, such as tax credits for clean energy initiatives. In just the US alone, wind power provided 42 percent (8500 MW) of all new generating capacity added in 2008, up from around two percent in 2004. Solid future growth has been forecast for the renewable wind energy industry.

The increasing pace of growth has put pressure on turbine designers and manufacturers to come up with innovative and reliable designs. Wind turbine designers are moving towards larger rotor diameter and blades to get very high output per turbine and avoid component failures, to increase efficiency and reduce downtime.

Components like the gearbox have been known for high failure rate defaulting in five-10 years or even less. Turbines are designed for a lifetime of at least 20 years or 120,000 operating hours, during which they must reliably withstand a wide variety of stresses and

environmental conditions. There is a need to innovate and reduce the amount of physical tests, which are not only time-consuming and expensive due to their trial and error approach, but are possible only in a very limited way due to the size of wind turbines. As a result, numerical simulation is becoming a mission critical process.

**More research and development is taking place around alternative energy initiatives. What effect does this have on energy companies? How does an increased focus on design/simulation positively affect manufacturers in this sector?**

**ST.** With increased research and development around alternative energy initiatives, energy manufacturers are trying to reduce ownership cost and provide reliability to their customers. In the case of wind energy, with the increasing size of the turbine, it must sustain dynamic forces caused by the turbulence and maintain structural integrity under high loads. Customers are investigating offshore sites, which pose the added challenge of operating under extreme conditions while maintaining design life of up to 20 years.

With an increased focus on simulation, manufacturers can overcome the numerous challenges related to the creation of ever more powerful systems. Companies can tackle the engineering challenges by performing design iterations virtually with high accuracy and reduce the cost of prototypes, which is height-

ened due to the limited yearly production rates of the turbines.

**How does software that can simulate complex mechanical systems help companies to meet and overcome these challenges?**

**ST.** With software, such as the ones provided by MSC Software, that can simulate complex mechanical systems, designers can perform a full wind turbine study, including the effects of control systems. Real-life behaviour of components and assemblies such as rotor blades, bearings, gearboxes and power trains can be accurately understood by subjecting them to different loads and boundary conditions in a virtual environment.

Structural analysis for towers, nacelle, hub, foundation and other elements helps understand the capability to sustain variable thrust forces and ability to maintain structural integrity. Companies can accurately perform the aerodynamic loads calculation and predict the life of the individual components and the system through fatigue prediction for ground as well as offshore structures.

**How do you see the sector developing in the future – which advances in design/simulation will become increasingly significant to the industry?**

**ST.** The renewable energy industry is in a growth phase, with continuing investments and we will continue to see more innovations through an increased focus on research and development. For example, in terms of gearbox, we are likely to see the movement from a traditional three-stage gearbox to direct-drive technology with integrated gearbox and generator and advanced gear designs. There will be a heightened interaction between disciplines such as structures and dynamics, and performance, safety and reliability of products will greatly influenced by the interactions between these disciplines.

In terms of simulation, we will see leveraging solutions that offer interactive analysis for coupled engineering physics such as motion-structures, systems and controls; multi-physics, such as electromagnetic; and more. ■

Sunil Tahilramani is Product and Industry Marketing Manager at MSC Software. Prior to this position, he worked in roles of pre-sales, technical support and consulting. His background includes a Masters degree in Mechanical Engineering with an emphasis on Multibody Dynamics and FEA. He is currently pursuing his MBA at the University of Michigan.



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MSC.Software accurately simulates the total wind turbine system & the interactions between its subsystem and components.

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