The Growing Challenges of Wind Turbine Nacelle Covers

There are many challenges that both nacelle cover suppliers and turbine manufacturers face these days, especially given the growing interest in wind both onshore and offshore. Innovative materials and technologies are being explored in order to improve the structure of nacelle covers and make them more cost effective.

With the increased size of turbines and nacelle covers, the transportation costs are particularly problematic. In fact, in many cases, the cost of transport is higher than the cost of producing nacelle coverings. It's important for manufacturers and suppliers to find new and improved ways to transport large scale materials like the new nacelles in order to keep costs down.

Figure 1: Two nacelles on the floor (Northern Power Systems)

While prices for wind turbines have slowed in the last decade the new trend in wind turbines is increased capacity. Studies have determined that 10 MW and even 20 MW wind turbines are feasible and cost effective, so increased interest in these mega wind turbines will continue to grow as governments push for greater renewable energy production.

With larger-scale turbines comes new demands for nacelle and nacelle cover designs. Innovative technology and materials will help to increase the size of a nacelle and its cover, but it's equally important not to sacrifice the overall strength of the components. These and many other challenges are being tackled by engineers and scientists throughout the industry.

New Nacelle Designs for Achieving Greater Reliability

Typically nacelles are compact and heavy in weight. This creates challenges not only for the transport of the components, but also for the installation and later maintenance of these massive pieces of technology. Company's like Siemens are

tweaking their nacelle designs to create more lightweight, easy to transport and install systems that are also cost effective.

Given that the nacelle's gearbox is one of the more complex components of a wind turbine, Siemens has opted for a new nacelle design that actually eliminates the gearbox and instead uses a permanent magnet generator instead.[i] This innovative technology helps to expend any energy on the excitation phase

Siemens has also added an outside rotor to their nacelle design. With this feature, the spinning of the rotor occurs outside of the stator which helps to keep the nacelle smaller in size overall.[ii] This smaller nacelle design gives workers and technicians more space to operate the wind turbine by making the nacelle easily accessible, offering interchangeability in components without having them affect the operation of each other.[iii]

A market leader, Enercon, is also working on the challenge of nacelle weight and design. They have applied advanced technology from the automotive industry to design a new nacelle and nacelle cover (made of aluminum) in order to minimize installation losses that could occur during a fire. The nacelle now allows airflow to suck hot air out of the nacelle by creating an internal air circulation through its integral cooling system.[iv]

You'll see another new nacelle and nacelle cover design by Alstom Energy, based in Amarillo, Texas. Alston Energy is using a LEED silver certified assembly in their factory to produce their nacelles and covers. The new technology features a torque design that produces higher operational availability, higher gearbox reliability, and also a substantially lower maintenance cost for wind turbine owners.[v]

On the other end of the spectrum is Lantor Composites which is using a vacuum infusion process to meet the industry's need for better nacelle and nacelle covers. Teaming up with Gazechim Spain, Lantor has introduced Soric at CMC to produce the nacelle covers in infusion.[vi] Soric is a material that helps to keep a product thick and also provides a resin transport needed for the wet-out process of laminate.[vii] This has proven to be an excellent and reliable alternative to the open mold produced nacelle covers by ensuring the proper laminate build up with the vacuum infusion.

Other companies such as EDAG are focusing on the design of their nacelle and covers as well. Their design uses GRP and steel or aluminum for their nacelle covers, depending on the specifications of each and every client which they feel reaps both financial and durability rewards.[viii]

How the Industry is Evolving to Transport Larger Nacelle and Nacelle Covers

With the increase in turbine capacity there is also the need for larger turbine components. This includes the turbine's nacelle and nacelle cover. A wind turbine in general is not something you can put together at a manufacturers sight, throw it on the back of a haul truck and send on its way to be staked into the ground.

How you are able to transport a wind turbine depends largely on where it is manufactured, where you are shipping it to and its overall size and shape. With the increase in wind turbine size, there are limited ways to transport each and every component.

Figure 2: Transport of a nacelle in Brande, Denmark (Siemens Global website)

Most turbines are broken down into different sections in order to minimize the weight of the load. Components such as tower, generator, nacelle, hub and blades all need to be their own loads. Specialized carriers, racks and lifting and clamping points need to be made for each component's load.

Keeping transportation costs down is another critical factor in wind turbine production. Where they are initially built, how they are moved from manufacturer to different factories or base ports and then to the area where they will be placed is key in keeping costs low.

In the United States a company called Vestas has its own customized railroad wagons in order to transport components of wind turbines from its factory in Windsor, CO to its base port in Houston, TX.[ix] These wagons clamp sections of one component to one wagon, while letting long components like the tip of a blade

freely overhang. This allows the wagon to get through tight turns without losing its load or running into obstructions.

Enercon has found an innovative, yet simple way of transporting by road. They fold their 63 meter blades in half and deliver their nacelle in several sections. "We deliver the nacelle in sections and it's very easy to commission on-site. It's a matter of design, at the end of the day," commented Enercon's head of UK sales. The turbine components are then assembled on site.[x]

Another approach both foundation and wind turbine companies are considering is deepwater ports.[xi] This makes it easier to transport finished products right onto freights to the deployment sites. However, finding the most ideal location for manufacturing the turbine's components is essential in keeping the overall transportation costs down.

It's important to also consider when and where to assemble the components as a whole. Many cases call for assembly right on site, however, the more you move a component and the more components you have to transport, the higher the overall costs. Weather, time of year, depth of water from the initial deep port manufacturing site and distance to the port are all factors for each turbine.

Manufacturers are always looking for new innovations to help transport their wind turbine components safely and efficiently. The weight of certain components, such as the nacelles and the foundation can weigh hundreds of tons.

Specialized equipment is needed to place components onto trucks, vessels and railroad wagons. Today the use of cranes is very popular for the purposes of installing wind turbines at their project sites and also to load them onto their means of transportation.[xii]

Siemens (already mentioned) has an easy way to transport their new innovative nacelle design: design components that fit onto conventional trucks. In the case of their nacelle, the length is approximately 6.8 meters, a diameter of 4.2 meters and an overall weight of 73 tons.[xiii] With the dimensions and weight, the nacelle can be easily carried on trucks.

The dimensions also offer flexibility in transportation of roads and offer bridge and tunnel clearance. Another added bonus to this innovative design is the opportunity

to carry the nacelle on truck all in one piece. This helps to reduce the added transportation expenses that can accompany nacelle designs and also the risk of incorrect on-site assemblage of key nacelle components.[xiv]

Other companies are looking to the sky for help transporting their nacelle and nacelle covers. This past year Goodrich Corporation signed a service agreement with LOT Polish Airlines in order to have support transporting nacelles and thrust reverses in the airline's Embraer 195 aircrafts.[xv]

The agreement will be managed through Goodrich's Scotland center and the company will provide maintenance, overhaul and repair to the nacelle and other components. The airline will assist Goodrich in transporting nacelle and it's components to different regions in the area. The hope with this agreement is to provide customers with money saving transportation and also a time saving opportunity for their wind turbine projects.[xvi]

Fyns Kran Udstyr has developed a hydraulic yoke in order to better lift, move and mount wind turbine nacelles onto carriers for transportation and also at the wind farm site for installation. The purpose of the yoke is to reduce risk and operational costs while also increasing safety for workers and nacelle components.[xvii]

Greater Innovation Required to Continue Bringing Nacelle Costs Down

Certainly a lot has been accomplished in recent years to create nacelles and covers that are both cost-effective, smaller and more lightweight, and well as easy to transport. But more has to be done if the wind industry is to meet the larger-format wind turbine demands that are coming online in the coming decades.

Images via Flickr: Northern Power Systems Figure 1 and Siemens Global Figure 2

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