Flexible trailing edge flap for blades to make wind power cheaper

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A flexible, controllable trailing edge for wind turbine blades has shown that it can reduce the loads on the turbine and in the end provide cheaper electricity from wind power.

The idea dates back to 2003 when researchers from Risø DTU was inspired by the prey's ability to maneuver in turbulent air currents, while they at the same time remained at a stable point in the air. Now a three-year project co-funded by EUDP (the Danish Programme for Energy Technology Development and Demonstration), with three industry partners, is launched and is to develop the promising technology forward to a robust and durable trailing edge which can be tested on a full-scale blade.

The fierce gusts and turbulence, such as wind turbines are exposed to constantly, contribute significantly to the cost of producing electricity from wind turbines. The turbines must be designed to resist these influences throughout their lifespan of at least 20 years since repairs are costly, especially when the turbines are located far out at sea and are more than 100 meters high. Therefore, researchers and industry are aimed at finding technical solutions that can alleviate the loads on the turbines.

"We have already had a good start of the project with our first project meeting in early March. The composition of project partners is well suited in order to solve the challenges in the project" says Research Specialist and Project Manager Helge Aagaard Madsen from Risø DTU.

With a grant of DKK 9,9 million from EUDP and an own appropriation from Risø DTU, DTU Electrical Engineering and three industrial partners on DKK 3 million the exciting technology can now take one step closer to being a commercial prototype that are to be tested on a full-scale blade. Risø DTU coordinates the project and the industrial partners are AVN Energy A/S, Rehau A/S and Dansk Gummi Industri A/S.

Robust, reliable and durable

The buzz words for the project are to develop a technology that is: robust, reliable and durable. The specific solution that has been under development at Risø since 2006, supported by funds from Region Zealand, is a flexible trailing edge of rubber or plastic. Movement of the trailing edge is achieved by elastic deformations caused by fiber reinforced cavities that run through the rear and can be pressurized with air or hydraulics. It is these controlled movements that counteract the forces from the fierce wind gusts.

"The technology has already been tested under laboratory conditions and in a wind tunnel with promising results. Now the task is to have a prototype produced by the end of project that is ready for testing on a full-scale turbine "explains Research Specialist Helge Aagaard Madsen and continues:

"We want to develop and produce prototypes in 2m-long rubber or plastic in the project, depending on what's most robust and give the best result."

The three industrial partners in the project each contribute specific knowledge in key areas. Eg AVN is already experts in the hydraulic systems that are currently used for turbine pitch systems. Since AVN develops, manufactures and sells these systems for different wind turbine manufacturers they can contribute with a unique understanding

of how the new flaps systems can operate together with the pitch system.

"The pitch system is what rotate the blades today so that they are positioned optimal towards the wind, but it costs both loads and energy to turn a 15-ton rotor blade as compared to what it will 'cost' for our small local movements with a flexible blade trailing edge that perhaps only has a weight of 1% of the blade's total weight, "explains Helge Aagaard Madsen

The other two project partners is Rehau, that among other supplies plastic parts for the car industry and Dansk Gummi Industri which manufactures molded rubber and polyurethane to the industry. Rehau will contribute to develop the new materials that the trailing edge can be manufactured from, and the Dansk Gummi Industri will work on the production side of the trailing edge also called CRTEF (Controllable Rubber Trailing Edge Flap).

No mechanical parts

The flexible trailing edge is entirely without mechanical parts and we hope completely to avoid metal parts. And this part is important. Helge Aagaard Madsen explains:

"It is important that the technologies we develop now are virtually maintenance free. It is of no use to add another component on the turbine that needs a lot of maintenance and can break. This is also why it is very important that we have a good collaboration with the industry from this early stage. In this way we can ensure that the product matches what the industry needs and wants. Both when it comes to the production and the application side. "

From Risø DTU experts in wind turbines contribute, but also the expertise of the material scientists' is in focus, as there is great need for

knowledge on fiber reinforcements and composite materials. From DTU Electrical Engineering researchers also contribute with knowledge about lightning, since wind turbines due to their height have an elevated risk of being hit by lightning. This factor must of course also be taken into account when the prototype developed.

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