E-technology moves to new level

The introduction of the E-nacelle in the EP5 programme represents the next major milestone on ENERCON's technology and product roadmap towards the sustained reduction of the cost of electricity. The forerunner is ENERCON's new E-160 EP5 E3 model.

The introduction of the compact nacelle about two years ago has fundamentally changed the appearance of ENERCON's wind energy converters. The move away from ENERCON's former iconic egg-shaped machine houses towards a highly functional, cost-optimised compact design makes it immediately clear which demands of the market are driving the engineering development today.

The switch to the compact design was the first major milestone on ENERCON's technology and product roadmap towards the sustained reduction of the cost of energy (CoE), and it has been followed by more steps in this direction. And the look of new ENERCON wind energy converters will again change dramatically with the realisation of the next major CoE milestone: the E-nacelle. Development is currently working on the E-160 EP5 E3, the first machine type that will be fitted with the new E-nacelle.

Next development stage in the CoE programme

The E-nacelle will also house the electrical systems that convert the electrical energy produced by the generator. The E-module located in the tower base that was previously used in ENERCON wind energy converters thus becomes obsolete; the power conversion is performed at hub height. The inverters and the transformer required for this purpose are placed into a new section at the rear of the E-nacelle. The machine house will therefore have to be significantly longer: Compared to the E-160 EP5 E2, the length of the E-160 EP5 E3 machine house will double from 7 to 14 metres. The height of the nacelle will be slightly reduced, while the width remains below 5 metres to facilitate transport. With regard to weight, the developers are shooting for a transport weight of 80 tons.

"Our primary focus in on optimising production, transport, and installation," says Ihno Coordes, Head of the Casings & Sub-Components division at ENERCON's Research & Development company WRD. "Our plan is to manufacture components that are fully equipped with all mechatronic systems at the factory. This will make the machine house fully plug & play enabled." The advantages for installation are clear: No more time needs to be allocated to the installation of the E-module at the construction site. Likewise, no more separate transports will be required for the E-module, which was previously a separate component. On top of that, the new design will simplify cable installation in the tower.

E-160 EP5 E3

Nominal power: 5.56 MW
Annual yield at 7.5 m/s average wind speed at hub height: 21.709,85 MWh
Hub heights (project-specific): 98m, 114m, 120m
Generator: direct-drive permanent magnet generator (PMG)

Technology benefits

Then there are the technological benefits of the new design, explains Sascha Exner, EP5 Platform Manager at WRD: "Because the transformer is located directly behind the generator in the machine house, we can reduce cable losses and achieve higher yields." In the new design, the inverted electrical energy runs through one medium-voltage cable down the tower; the previous design required 48 low-voltage cables to carry the energy from the nacelle down to the E-module. This simplified cabling also reduces the costs for the corresponding materials.

The design engineers also accounted for servicing and even the replacement of major components where necessary. "All replacements, whether of sub-components or of entire transformers, can be performed using the familiar tools and aids. The new location at hub height does not change this," says Frank Knoop, Nacelle Division Manager at WRD. The transformers do not contain conventional mineral oil but instead a special synthetic oil that has better environmental properties. Still, the E-nacelle is fitted with an oil tray in order to safely catch any leaks or spills. This tray is built into the floor of the machine house. A particularly nifty feature: For servicing, the floor including the transformer can be winched down to the ground – and winched back up after being fitted with a new component.

"In addition, the E-nacelle casing has a modular design that provides Service personnel with more options. If necessary, individual sections can be removed," adds Ihno Coordes. The developers are currently still putting the finishing touches on the casing, which will also be containerised: The components will be transported to the assembly plant using standard shipping containers.

Benefits for production optimisation

The new nacelle design provides substantial benefits for production, too, because the E-nacelle can be manufactured using an integrated manufacturing process. "The machine house is fitted with all mechanical and electrical components at the factory, undergoes functional testing and is then transported to the construction site ready for installation. The entire process chain of 'production, transport and logistics, installation, commissioning' is simplified significantly. This saves time and money, which fits right in with our overarching goal of CoE optimisation," says ENERCON CTO Jörg Scholle.

The design concept is already reflected in the way ENERCON is restructuring its production network. For example, a new mechatronics centre of excellence is being created at ENERCON's manufacturing hub in Aurich. This is where the E-nacelles will be built using efficient and process-optimised production lines. The production steps for the mechanical and electrical components will be combined in a new, specialised production facility that will function as the new primary plant in ENERCON's global supply chain.

ENERCON's goal is to create state-of-the-art manufacturing technology at this centre of excellence – including automation and the latest processes and methods. A close cooperation with WRD will help realise fast ramp-up times. In addition, the team is hoping to contribute even more to the CoE programme after manufacturing has started by jointly driving the cost-out processes for production optimisation. "To this end, we will intensify our cooperation with the centre of excellence even more," says Frank Knoop.

Additional turbine types to follow

After starting with the E-160 EP5 E3 model, ENERCON is planning to successively switch more turbine types of the EP5 and EP3 platforms to E-nacelles. "We will introduce this fundamental new technology in both platforms as well as our future model series," emphasises ENERCON CTO Jörg Scholle. "This is another example of how we apply technological progress in our CoE programme across platforms: We keep advancing our EP5 and EP3 projects and share the best new features among them. Both platforms are characterised by their modular approach. This makes it relatively easy to introduce the E-nacelle for both platforms." While WRD is shooting for Q3 of 2021 for the E-160 EP5 E3 prototype stage, the first EP3 model with E-nacelle, the E-138 EP3 E3, is scheduled for Q4 of 2021.

And on top of that, the E-160 EP5 E3 will have some more new features. These design changes include the yaw brake. To anchor the nacelle in alignment with the wind direction, ENERCON will switch from the hydraulic system previously used in the E3 to ENERCON's own yaw clamping system, where the nacelle is locked using a counter-directional clamping effect. In addition, the yaw bearing will have internal teeth and thus internal drives.

The series start-up phase of ENERCON's E-160 EP5 E3 will initially use three project-specific tower types: a 98-metre tubular steel tower, a 120-metre tubular steel tower and a 114-metre hybrid steel tower (HST, see Technical Lexicon page 13). "These tower types are tailor-made to the wind conditions at specific sites; initially they will only be available for certain large-scale projects. While they may be usable at different sites in exceptional cases, the towers will initially not be generally approved for series production," says Platform Manager Sascha Exner. "Developing our standard towers is the next step. These series towers will be designed for 20 years of service life according to rated wind conditions of the E-160 EP5 E3 for wind class IEC IIIa respectively for 25 years for wind class S."