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Innovative technologies to achieve 10 GW offshore wind farms in China

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Abstract

The plan to speed up the installation of 10 GW offshore wind farms in China was recently announced, accordingly 44 new offshore wind farms in China have been planned. These offshore wind farms have significantly different site conditions from the conditions of the offshore wind farms in Europe. There are many new challenges to rapidly install and to efficiently operate 10 GW offshore wind farms in China. This poster will review the innovative technologies developed for the first two offshore wind farms in China and address the new designs for the cost effective installation and operation and maintenance vessels.

The first Chinese offshore wind farm

The first Chinese offshore wind farm (Donghai Bridge) has 34 3-MW wind turbine units made by Sinovel. The turbines are situated approximately 8 to 13 km from shore in an area with an average water depth of 12 m. The site conditions include a high velocity ocean current (more than 3 m/s) and a soft soil layer of 25 m at sea bed. A new foundation technology consists of a concrete cap (diameter: 14 m, height: 4.5 m) and eight steel piles (diameter: 1,7 m, height: 80 m, about 68 m in the soil) was invented (see Fig. 1). The operational results confirmed that the new foundation is cost-effective and mitigates the deleterious local conditions. Furthermore, two large-scaled crane vessels, designed for Donghai bridge construction, were used to install the fully assembled wind turbine unit. Successful construction plans enabled all 34 units of the wind turbines to be connected to the electrical grid within 20 months (from September 2008 to June 2010).

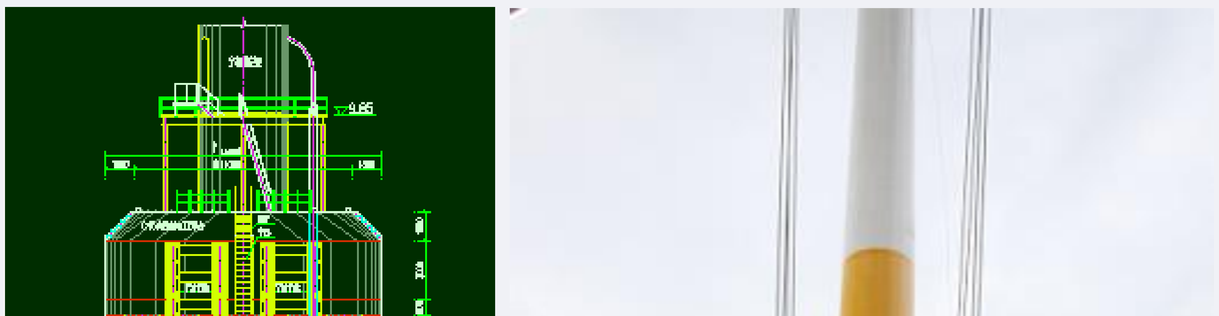

Fig. 1 New foundation (courtesy Dr. Yifeng Lin)

Rudong offshore wind farm at intertidal areas

Rudong offshore wind farm is an offshore wind farm test site at intertidal areas in China. More than 200 MW wind turbines have been installed at Rudong intertidal areas. These include 17 *3MW (Sinovel), 21*2.3MW (Siemens), and 40*2.5MW (Goldwind). At this site, the distance to shore is four to 10 km. Also, there are two daily tides which results in the water depth variation from zero to more than eight meters.

As examples, one innovative installation vessel for the intertidal area is shown in Fig. 2. The service vessels and tractors are creatively integrated for the operation and maintenance of the wind turbines.

Fig. 2 The installation vessel used for the intertidal area

Proposed new installation and service vessels

In order to achieve the installation of 44 new offshore wind farms have been planned in China in short time frames. One of the challenges is the novel and expeditious method for installation of these new offshore wind farms. The designs for cost-effective installation and service vessels have been proposed for different sites. One support structure for the completely assembled wind turbine installation is designed and one simulation to identify the maximum stress location using the finite element code (NASTRAN) is given in Fig.3.

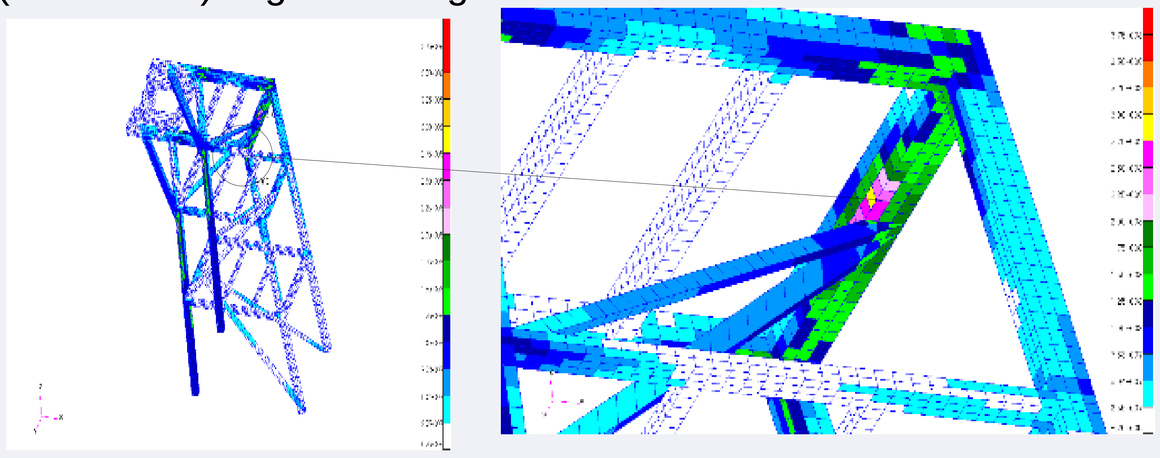

Fig. 3 Simulation tool for the support structure design

Conclusions

The Chinese offshore wind industry has learned the offshore wind experience from Europe and developed technologies to achieve cost effective solutions and to co-use ocean space to reduce the conflicts with other industries. The new design of the support structure for the wind turbine installation seems promising and has been verified by numerical modelling methods.