Offshore pile load tests in Taiwan

Six test piles driven 75 metres into the seabed in the strait between Taiwan and China

Ørsted is planning to establish an offshore wind farm in the Strait of Taiwan and wanted to optimise their design, especially regarding the wind turbine foundations and their load-bearing capacity. So, Aarsleff performed a number of advanced tests, where several of our specialist skills within offshore and design & engineering came into play.

Load tests

The main reason for the test project was to collect data about the pile load capacity in the very challenging soil conditions on site. The tests were to validate the geotechnical pile design and help optimise the foundation dimensions by means of static and dynamic tests under realistic loading conditions. Therefore, it was decided to carry out large-scale tests at two offshore locations in the strait. The test comprised a total of six heavily instrumented piles, of which three piles were 70 metres long and three piles were 80 metres long, with a diameter of 1,500 millimetres. The piles were to be driven up to 75 metres into the seabed – at a water depth of 40 metres and within very tight tolerances.

Own custom-designed equipment

We did not commence the preliminary work until 2019, and under a tight time schedule we designed, produced and tested our custom-designed installation and test equipment. This amounted to a total of 600 tons of subsea and offshore equipment with powerful hydraulic systems and a comprehensive range of instruments. Preparation and execution took place in a close collaboration between Aarsleff's specialist teams within offshore wind and marine projects, including project management and other specialist functions of our Design & Engineering department. As an example, we developed the concept and designed the large-scale test setups and the special test equipment, and we tested the instruments and the pile driving at another on-going Aarsleff harbour project in Frederikshavn. Also, we performed detailed 3D models and simulations.

Successful data collection

The design phase commenced in October 2018 and the finished equipment left Esbjerg mid-April 2019 on a coaster towards Singapore. Here, it was reloaded to the installation vessel which was ready to start the offshore work in Taiwan at the beginning of June 2019, where we had ten Aarsleff employees seconded. The installation of the six piles progressed according to plan, and our custom-designed equipment worked at optimum level for the tasks. Both during and after the installations, we collected data and carried out a number of advanced tests and handed over the valuable results to Ørsted.

After the final test on 23 August 2019, the six piles were decommissioned, and then the vessels and all the equipment were demobilised in Taiwan and Singapore, respectively. This meant that the last visible traces of Aarsleff's involvement in this complex project were gone. A large amount of data remains to be analysed by Ørsted and the experience will form the basis of the design of the future wind turbine foundations.

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Data

- 6 piles (3 piles of 70 m and 3 piles of 80 m, all with a diametre of 1,500 mm)
- 600 tons of custom-designed installation and test equipment
- 470 subsea sensors and measuring instruments used on test piles and test equipment
- 1 DP2 installation vessel from SAL with approx. 100 people on board during the offshore work
- 1 bubble curtain system to reduce noise during pile driving and testing
- 2 Subsea Remote Operated Vehicles (ROV).

Client
Ørsted Wind Power A/S

Contractor
Per Aarsleff A/S

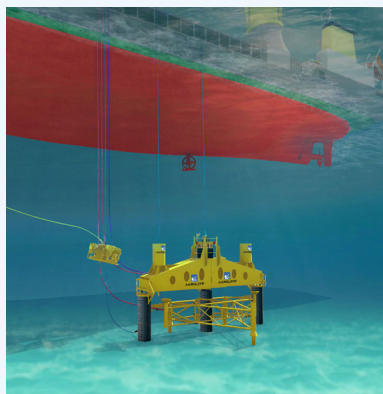## Cooperation partner
SAL Heavy Lift GmbH

Type of contract
Design & Build contract

Consultants
CDM – a collaboration between the Aarsleff companies cp test a/s, DMT Gründungs-technik GmbH and Metris Instytut Badań dla
Budownictwa Sp. z o.o.
Norwegian Geotechnical Institute (NGI)

Construction period
May 2019-September 2019

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