Final report

1.1 Project details

Project title	Vertical Installer
Project identification (program abbrev. and file)	Project id: 64018-0092
Name of the programme which has funded the project	Programme for Development and Demonstration of Energy Technology – EUDP 2018-I
Project managing company/institution (name and address)	Maersk Supply Services A/S
Project partners	Vestas A/S MHI Vestas A/S
CVR (central business register)	31414377
Date for submission	14. February 2020

1.2 Short description of project objective and results

English
The project objective was to develop a new technology for installation of Offshore Wind turbines, which was up to 35% more effective than existing solutions and also solving for an increased demand for being able to install larger and larger Towers.

We managed to develop and design a crawler crane, that was handshaked to the tower from a craned barge pushed by a tugboat. Unfortunately, the solution surpassed the forces that could be imposed on the towers, resulting in collapse of the towers

To solve for this a new solution was developed with a special purpose handshake adaptor enabling to handshake a crane to the transition piece and from there do the installation.

The Industry however did not like the concept as high forces was imposed on the tower structure which could result in increased fatigue issues as well as risk from damaging WTG components by lifting from a floating barge.

Based on these findings the original project was abandoned and our 2 partners decided to withdraw from the project

Danish
Projektets formål var at udvikle en ny teknologi til installation af offshore vindmøller, som var op til 35% mere effektiv end eksisterende løsninger og som samtidig kunne imødekomme behovet for installation af større og større havvindmøller.

Vi fik udviklet en crawler kran, der kunne overføres til vindmølletårnet fra en kran barge, der blev fremdrevet af en tugbåd. Desværre vidste det sig umuligt at reducere kraftpåvirkningen på tårnet til et niveau, der ikke fik tårnet til at kollapse.

For at løse dette udvikledes en løsning med en særlig adapter, der blev overført til transition piece, hvorpå en dobbelt bommet kran blev indstalleret også fra en kran barge. Herefter kunne tårnet og øvrige komponenter indstalleres stående på vindmøllens transition piece.

Industrien brød sig dog ikke om denne løsning, da det var vanskelligt at undgå skader på komponenter ved løft fra en flydende barge og ligeledes var Industrien forbeholden overfor de fatique påvirkninger, som det ville have at montere en kran på transition piece.

Projektet blev derfor skrinlagt med virkning fra slutningen af Maj 2019 og vores 2 projekt partnere valgte at trække sig fra projektet

1.3 Executive summary

We learned in the project, that lifting from a fixed foundation was key for the Industri and that future solutions should solve for that. In addition the Industry had reservations against installing the towers in more than 1 piece, which was a requirement for our solution.

We have utilized these results to develop a new solution based on traditional jack-ups and feeder barges but given, that this was far away from our original ideas this is seen as a new project. We have not yet decided whether we wish to apply for funding to this project from EUDP

1.4 Project objectives

The objective with the crawler crane was to develop a solution, that could be handshaked to the tower and be able to elevate itself up the tower by utilizing friction between crane and tower. Several issues were solved for:

1. How to create the right level of friction?
2. Optimization of friction against OEM's coating on tower
3. Design for the limits of forces that tower could withstand

We solved for the friction by developing a friction testing model with input from Goodyear and their understanding of high friction tires. By having 256 tires in the crawler crane would provide the right level of friction against the tower to enable crawling up the tower and at the same time lift 1/3 of a full tower

We obtained samples of coating from the various OEMs and were able to test our friction ratios against these

In order to create the right amount of friction the crawler crane in itself grew in size to such a degree, that the crane itself became a very heavy structure to handle. The forces that the crane would impose on the sides of the towers would cause the towers to collapse.

Another challenge was to lift components from a floating barge and several solutions were tested and investigated. One of the more promising were hydraulic solutions with a 3d motion compensated deck already under testing by other suppliers.

These solutions were tested through modelling of realistic weather scenarios involving wave heights, swell, current and wind interactions. Actual data from existing windfarms were used. The conclusion was, that it was difficult to fully remove the wave ef-

fects by using a 3d compensated platform as well as the reaction speed of such solutions were not always adequate to compensate for the waves.

We finally and in agreement with the OEMs decided to abandon the project.

1.5 Project results and dissemination of results

Due to the lack of technical feasibility we did not manage to get tangible commercial results from this project neither through increased revenue, hiring of FTEs and export. The original assumption to develop a solution for onshore wind did also not materialize as we couldn't solve the issue with the forces, we imposed in the towers resulting in collapse.

1.6 Utilization of project results

During the project we filed 11 patents primarily on handshaking methodology, crawler crane and its functionality. As during the project realized, that the project were not feasible it was decided to withdraw the patent applications as a potential patent grant would be of no value.

We did however learn a lot about the Industry during the project and we have from the latter part of 2019 focused on developing a new solution based on a traditional jackup and a feeder barge. This solution solves for the issue with lifting from a fixed to a fixed solution and maintain the advantages from a feeder solution.

Our new solution can basically reduce the logistics around WTG installation significantly and still obtain the 35% efficiency, that was the original objective

1.7 Project conclusion and perspective

The development we did regarding crawler crane and handshaking was not wasted albeit we now foresee a solution, that is far away from the original idea. We will still be dependent on traditional jackup capabilities with increasingly taller and more capable cranes. We have however solved the issues in such a way that we can lift from a barge without any effects from waves and weather. In addition, we can save the developer up to 35% through efficient logistics.

We are much closer to commercial reality as we are in dialogue and tenders with the 3 major global developers of offshore wind parks.

This solution is in fact the optimal solution for installation of offshore wind in US, where the market is foreseen to grow +30 percent in the next 10 years.

We are very optimistic about the future and can foresee substantial export and job creation in 3 years from now. We have been granted patent in Denmark and US and have patent pending in China.

The development and failure to commercialize a crawler crane concept has been instrumental in bringing us in the right direction.