The Project

In September 2014, Universal Foundation completed a trial installation campaign across three major Round 3 offshore wind sites (Dogger Bank, Dudgeon and Hornsea) in the UK North Sea.

The trial installation project focused on penetration ability, verticality, water injection impact on soil plug, forces and stress in skirt structure and internal soil levelling capability.

A scaled down version of the Mono Bucket measuring 8m in diameter with a 6m skirt, as well as a reference structure of 4m diameter with a 6m skirt, was used in the trial installation campaign.

The Partners

The project was undertaken as part of The Carbon Trust’s Offshore Wind Accelerator (OWA) programme, which Universal Foundation has been part of since 2009, when they became one of four novel cost reducing foundations to be shortlisted following an international competition run by The Carbon Trust’s OWA to discover world leading innovation in this area.

The project was managed by Statoil and delivered by Universal Foundation, in partnership with The Carbon Trust, Statkraft, EON and DONG Energy, in close cooperation with Aalborg University. It also received funding from EUDP – a part of the Danish Energy Agency.

The Process

Fred. Olsen Windcarrier’s installation vessel Brave Tern departed from Frederikshavn, marking the start of the campaign. The trial installations took place in the North Sea and tested a wide range of different locations all meticulously and individually selected by the developers due to their challenging and varying soil properties. Soil characteristics within the three sites varied from soft clay, moraine clay, boulder bank clay – with sand spikes and layers, clay crust, sand and silt. Within the 24 day campaign, 29 installations were achieved between the two structures.

The Mono Bucket Performance

The trial installation demonstrated that the performance of the Mono Bucket exceeded
the predictions and that the suitability of the concept goes beyond the expected limitations. Further, with 24 days of a constant "installation, retrieval, installation" cycle the Mono Bucket showed incredible robustness and flexibility in its performance. "Even with very sticky to stiff and hard clay conditions and with combinations of layered soil profiles, the Universal Foundation Mono Bucket performed beyond expectation and penetration resistance was lower than predicted", confirms Søren A. Nielsen, Director of Technology.

It was possible to install and control the verticality of the Mono Bucket across all installations and an inclination below 0.1 degree off perfect verticality confirms the ability to stay well within the typical 0.25 degree limit. The campaign demonstrated the various simple installation control measures integrated into the Mono Bucket design, including the water pulse nozzle system used to lower soil/structure friction during installation, and the clay chambers' strength in working like pistons during installation."Our control system ensured that the final installation depth far exceeded our predictions", Jens Sten Nielsen, Installation Manager at Universal Foundation, reports.

Lars Kjuul Kristensen, Project Manager from Universal Foundation, adds to this that "the structures were successfully installed and retrieved in some of the most challenging soil conditions experienced by the participating developers. The Mono Bucket exceeded penetration predictions and achieved 0.1 degree inclination or less, and the functionality of the internal top soil levelling system has been proven. This marks a major step forward in the de-risking of suction technology."

Dedicated to reducing the LCoE

To all participating parties in the project this marks a milestone in the development of the Mono Bucket and the introduction of suction technology in offshore wind in general. The campaign follows on from the successful installation of two meteorological masts supported by Mono Buckets at Dogger Bank in 2013. Jan Matthiesen, Director of Innovation at The Carbon Trust, said, "The results from this latest trial further establish the suction buckets as a very promising foundation solution. Universal Foundation has shown a unique persistence to bring the Mono Bucket to the market, and key players in the industry have recognized the significant cost-out potential behind the technology. The impact on Levelised Cost of Energy looks to be significant and the Mono Bucket from Universal Foundation will be a real game changer for the industry."

“For Statoil the trial extends more than 25 years of suction technology experience from oil & gas. To us and the partners it has been a key step towards de-risking the Mono Bucket and other bucket based concepts for offshore wind, and we now follow Universal Foundation closely towards deploying a multi-MW WTG with the Mono Bucket as support structure. The trial installation project proves installation is achievable across a range of challenging seabed conditions in the North Sea and is a major step forward for Suction Bucket technology” says Jan-Fredrik Stadaas, Renewable Energy Technology Manager.