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Transport and installation of 5 Gravity Based Foundations

Blyth Offshore Wind Demonstrator - United Kingdom

Project information

Client:	BAM Nuttall Limited & BAM Infra B.V.
Duration:	1,5 year
Date of completion:	September 2017
Contract value (EUR):	€ 10 million

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Description of the activities

Management, temporary works engineering and complete operations for the float up, offshore transportation, offshore Installation of 5 Gravity Based Foundations (GBFs) including temporary and permanent ballasting.
This scope included the water ballasting system (including re-floatation system) as well as the temporary positioning control arrangements for control of GBFs during transport and offshore installation. The GBFs are ballasted with water during instal-lation, placed on a gravel bed foundation and finally permanently ballasted with sand. The further development of the Windfarm, was performed by other contractors for EDF.

Details

Type:	Gravity Based Foundation
Total amount of elements:	5
Diameter at toe:	31 m
Height:	App. 60 m
Water depth:	40 m
Weight:	5.500 ton (floating)
Foundation:	Gravel bed
Transport distance over river:	6 Nm
Transport distance over sea:	8 Nm

Placing tolerances:

- Horizontal tolerance x and y: 2.00 m in any direction
- Tolerance on heading: +/- 5°

Limiting design conditions for installation:

- Wave height (Hs) ≤ 1.5 m
- Wind speed ≤ 15 m/s
- Current velocity ≤ 0.8 m/s

Specific information

For the Blyth Offshore Demonstrator Project five gravity based foundations for wind turbine generators were installed approximately 6 kilometres off the coast near the town of Blyth (United Kingdom).

The gravity based foundations (GBFs) were built by BAM in the Neptune dock in Newcastle. In the construction dock the GBFs were outfitted with a water/sand ballasting system developed by SImP including installation of a de-ballasting system, monitoring systems for measuring water and
sand levels and survey systems to determine the position and inclination of the GBF during all phases of the works. The design of these temporary systems was based on the requirement that no personnel was allowed to enter the GBF during operations. Therefore all systems required for transport and installation had to be pre-installed, tested, remote controlled and redundant.

After flooding the dock the GBFs were floated one by one and transported over the River Tyne to Port of the Riverside quay. The floatation was tidal dependent and could only be done during high water spring tide because of the draft of the GBF related to the depth of the dock and the river.
At Riverside quay ballast concrete was added inside the GBF to increase the draft and improve the floating stability of the GBF for installation.

Towing to the installation site was done by three tugs. After arrival on site each tug was connected to a pre-laid anchorthus forming the installation spread. For the design of the 3-tug spread model tests and numerical simulations were done to determine spread behaviour and maximum loads in the anchor lines.

After connection of the ballasting Muticat to the GBF structure, it was filled up with seawater in 6 internal clusters by remote operation of gate valves in a manifold system. This ballast system made it possible to lower the GBF in a highly controlled manner. In the event the GBF would not land within tolerances, de-ballast pumps were installed in each cluster and the shaft in order to re-float the GBF. After position acceptance the GBFs were topped off with water up and ballasted with sand to secure the structure against severe storm conditions.

The sand ballasting was executed with a special designed and built bulk vessel, in which sand bulk storage, pumping, mixing and monitoring systems were integrated. This pontoon
of 100x33x8m (LxWxH) was fitted out to act as a self-supporting vessel. The position in relation to the GBF was secured with 4x 120t mooring winches. The sand ballast operation was executed as 3-days of continuous mixing and pumping. Finally more than 41.000m^3 sand was moved into the 6 GBF's.