2nd Factsheet update

FLOTANT

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Innovative, low cost, low weight and safe floating wind technology optimized for deep water wind sites

PROJECT ACRONYM: FLOTANT
PROJECT TITLE: Innovative, low cost, low weight and safe floating wind technoloy optimized for deep water wind sites
FUNDING: EU-H2020-LC-SC3-RES-11-2018,
Grant agreement: 815289
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START DATE: April 1, 2019
DURATION: 36 months
PARTNERS: 17 partners from 8 countries
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Objectives

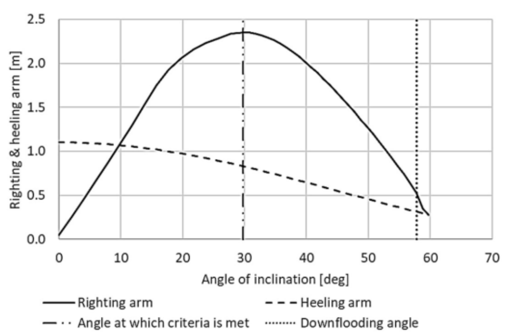
The main objective of FLOTANT project is to develop the conceptual and basic engineering, including performance test of the mooring and anchoring system and the dynamic cable to improve cost-efficiency, increased flexibility and robustness to a hybrid concrete and plastic floating structure implemented for deep water wind farms. Innovative solutions will be designed to be deployed in water depths from 100m to 600m, optimizing the LCOE of the floating solution (85-95 €/MWh by 2030).

Solutions proposed by FLOTANT

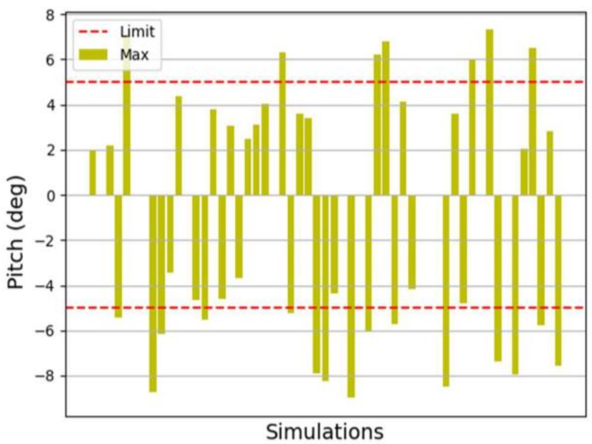
Early results

The calculations regarding the first iteration design of the Flotant concept have been completed for the two sites investigated: Gran Canaria and West of Barra. This first iteration of the design covered naval architecture topics and a reduced set of fully coupled simulations (828 simulations including DLC1.6, 6.1, and 6.2) to initially evaluate the global performance of the floating system considering two simplified mooring designs. This loop of design also considered a simplification of the floatability/active ballasting system using inflatable bags for both systems.

The static stability of several different designs was studied along with a wave interaction analysis of the floating system. Once the initial design was frozen a convenient set of design load cases was simulated to ensure moving forward with a design that behaves relatively well in terms of excursions and rotations considering the low TRL at this stage.



Curve of static stability of the early design of FLOTANT



Maximum pitch rotation during the early loop of design

An intensive and detailed study of the most suitable buoyancy materials for the floating structure has been performed, including both thermoplastic and thermosetting material from different processing technologies and with different configurations (polymeric foams, solid blocks, flexible and inflatable bags, hollow tanks, etc.).

Integrated modelling and global performance

The full loop of coupled aero-hydro-servo-elastic simulations is still ongoing. However, all the simulations regarding fatigue loads have been completed, post-processed, and the results are being integrated for subsequent structural analysis.

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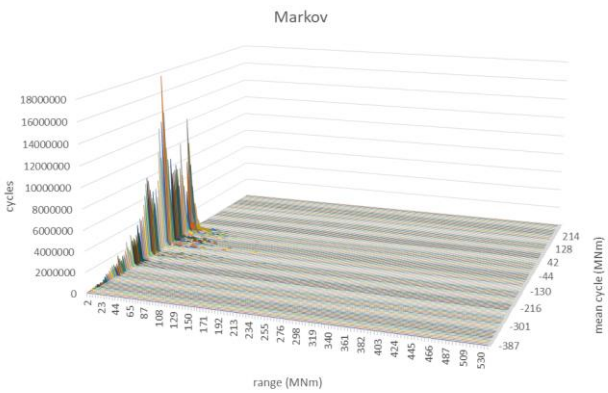
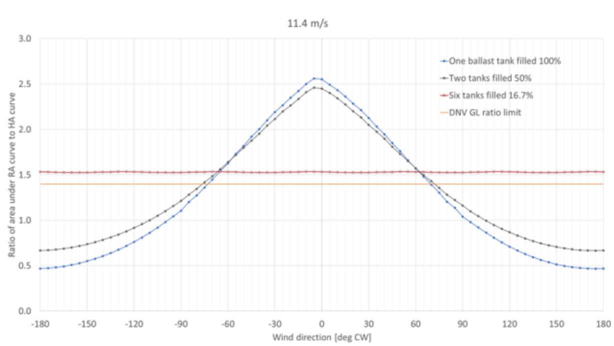


Post-processing of the fatigue load: Markov matrix

The full loop of simulations includes all the DLCs relevant for floater and mooring behaviour and contrarily to the early loop of design, it contains a detailed mooring model developed in OrcaFlex capturing the complexity of the mooring design which is one of the novelties introduced by the Flotant project. Another improvement, when compared with the early loop of design, is the evolution and refinement of the floatability system which is achieved in this loop of design by filling the inner structure of the floater with XPS foam.

Stability summary

Finished the early loop of design, a comprehensive stability check was performed including static stability of the Flotant concept in several conditions encompassing specific checks for different stages during the construction of the floater, installation, maintenance, and towing operations, and damage stability. Figure 3 below presents the results of the static stability calculations of the floating system during production. Several ballasting configurations were tested to ensure the safety of the floating system even during a hypothetical malfunction of the active ballast system and to identify the condition leading to the shut down of the wind turbine.



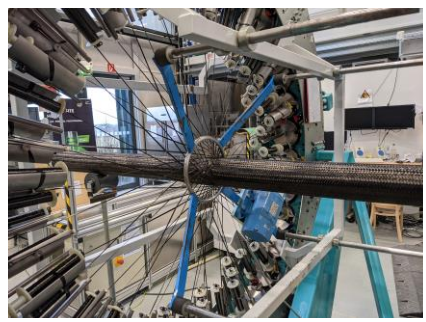
Stability results for in-service condition (power production) in West of Barra

Floating substation

One of the tasks within the Flotant project was related to the early development of a floating substation and its evaluation against its bottom based counterpart. The task aims to provide an initial design of the platform and mooring system of the floating substation and defining its behaviour under the very demanding condition shown in West of Barra. Behaviour. The economics of this ‘standard’ semisubmersible approach for developing a floating substation are going to be compared with an adapted Flotant floater concept design and its bottom fixed counterpart.

As performed before for the Flotant concept floater, a complete static stability analysis along with the fully coupled simulations of the semisubmersible floater and a simple catenary mooring system were conducted to ensure the feasibility of the system from the technical point of view.

Development of novel outer armouring and in-process integration of fibre optic sensors for strain monitoring of a dynamic cable demonstrator



The radial braiding process was implemented to develop a novel outer armouring solution based on fibre-reinforced composites. For this, a 3 m long dynamic cable demonstrator was braided with carbon fibre tows (see Fig. 1); fibre optic sensors were integrated during the braiding process in between braided plies. Furthermore, the braided reinforcement was infiltrated with epoxy resin and the composite was consolidated. In order to contact the integrated sensors, a splice casing was designed, constructed and applied to one end of the demonstrator (see Fig. 1); this splice casing contains the terminals of the integrated fibre optic sensors. The integrated fibre optic sensors are expected to provide information about the internal strain distribution and failure mechanism of the outer armouring during fatigue tests of the demonstrator.

Preliminary results of antifouling and anti-bite polymers

Different polymeric materials have been developed for mooring cables, power cables and floater. These materials have been tested in a preliminary evaluation in real sea conditions, and the results of this assessment show an improvement of the antifouling behavior.

This fact has made possible to select the most suitable additives combinations for the full antifouling and anti-bite evaluation, that is being carried out following a methodology based on the standards ASTM D3623 and ASTM D6990.

Mooring line demonstrators manufacturing

A total of four mooring line cable demonstrators were delivered. Therefore, this 4 meters cables with nominal strengths of 20 Tones (x3) and 100 Tones (x1) featured antifouling and antibite additives embedded in the carbon fibre/epoxy structural rods, strain and temperature fibre optic integrated sensing for compensated continuous load monitoring and were manufactured following the novel concept for long-span multistrand composite mooring lines.

Mooring line demonstrators' dynamic and fatigue testing

The mooring line demonstrators were tested at the DMaC laboratory in the University of Exeter. The tests involved a dynamic characterisation under ISO/TS 17920:2015, a fatigue test under Gran Canaria's and West of Barra's sea-states time series and a TCLL (Thousand Cycle Load Limit) test followed by a final residual strength test.