N/Ref: FEM-2018-480

Object: Internship- ***Floating Wind Turbine & Buoy models for bottom to surface links studies***

Context:

France Energies Marines (FEM) and its members have identified the bottom-to-surface links as critical components of any floating Marine Renewable Energy (MRE) convertor.

This is especially the case for the Floating Wind Turbine (FWT) technology.

The turbine detailed performance characteristics are highly confidential but are crucial to recover the global system natural modes and therefore the system dynamic responses. Since subsea components are highly driven by the floater motions, a numerical model addressing these components needs realistic mechanical definition of the whole system.

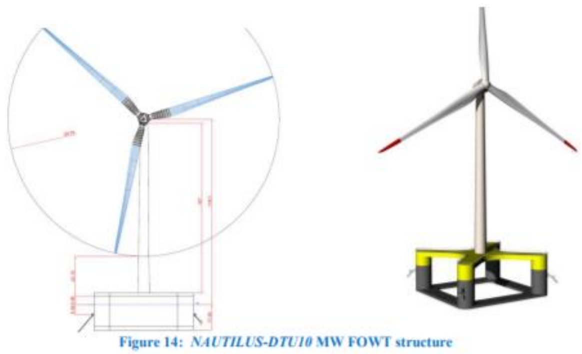
This is the reason why some collaborative and academics projects have proposed generic models which can be used for any sensitivity study based on recognized models. Up to now, these models (OC1-2-3-4-5 projects for example) deal with turbine of moderate capacity (previously 2MW and now 5-6MW).

In parallel, in order to reach the Levelized Cost Of Energy (LCoE) reduction objective imposed by the competitiveness of the actual energy market, the individual generator capacity is increasing. The very next generation is about 10 to 12MW. The recent European Life 50+ project proposes two generic floater designs for a 10MW turbine.

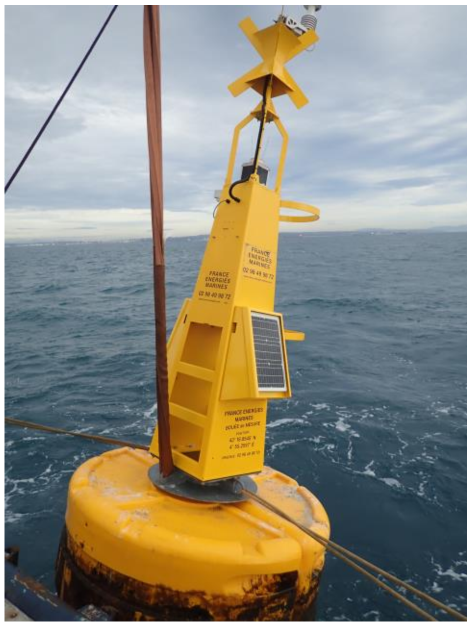
FEM needs to build a generic model in order to perform research investigations on the subsea components within the OMDYN2 and MHM-EMR projects.

These projects are respectively focusing on:

- the export dynamic cable composed of numerous internal components and materials which will be loaded with a new level of couplings among thermal, electrical and hydro-mechanical stresses;
- the definition of an hybrid methodology to follow-up and update engineering models of life prediction of mooring lines components along the service life;



Source: Life 50+ Project – Generic floater definition for a 10 MW turbine



Source: France Energies Marines – Measurement buoy (special mark) moored on the Mediterranean test site MISTRAL

This global FWT model has to be designed and adapted to a specific site and associated meteo-ocean data, characteristics of the next French pilot farms. In addition, a dynamic cable layout has to be defined accordingly using FEM data.

A complementary mission is also targeted in the internship:
The built-up of a numerical model of the measurement buoy of FEM on the Mediterranean test site MISTRAL. The objective here, is to built-up a numerical model able to reproduce accurately the buoy dynamic in waves accounting for its mooring line layout. The main objective is to well characterize the buoy dynamic in the "as-installed" configuration in order to be able to further identify any influencing parameters such as the biofouling colonization. This will serve several projects focused on the evolution of the subsea components in the marine environment such as ABIOP+ following the first phase project ABIOP but also MHM-EMR and others projects which are currently in construction.

Internship Objectives:

FWT model

This model will be firstly used for investigations on subsea components.
This is the reason why in the first approach, the model will assume some simple hypotheses for the aerodynamic part in insuring that the turbine modes are out of the global system natural modes.
Following a technical argumentation according to the targeted technologies (semi-submersible and barge) and the available numerical models, a hydrodynamic model approach should be first identified among full potential, full Morison and an hybrid model. In this first stage, the water depth specified by the European Life 50+ project will be assumed in order to validate the model build-up in comparing the global natural modes.
Then a lower water depth and meteo-ocean data typical of the next FWT French pilot farms will be assumed. Therefore, the mooring layout will be adapted. A new mooring solution could be adopted depending of the sensitivity to the water depth.
As a first step, a global dynamic cable layout will be proposed, able to sustain extremes events (no fatigue analysis will be conducted) according to some cable characteristics of a 33kV cable defined within FEM projects.
If some remaining time are available by the end of the internship but depending also on the evolution of the second part of the internship, a more refined aerodynamic model including a B.E.M definition could be considered.

Buoy Model

Since a buoy is a non-Archimedian floater, the hydrodynamic numerical model is not trivial to set-up. Nevertheless, some dedicated methodology has been set-up for the design of export buoy in the Oil and Gas industry (CALM Buoy JIP) aiming at proposing a Single Point Mooring system insuring in the meantime the export of oil from a FPSO (Floating Production and Storage Oil) to a tanker. FEM staff has been previously involved on similar study and will advise the student to identify the most appropriated model.
The validation of this model will be insured by real recording data (motions, wind) of the special mark buoy of the MISTRAL test site which has been deployed in the summer 2018. To proceed, some signal processing work will be required first in order to enable comparison between the real case and the model. A wave buoy is also accompanying on the test site the special mark since December and its data will be exploited too to characterize the environment.

References:

Guillaume Damblans is the manager of the department of Research on technological components at France Energies Marines. He previously worked for 10 year in the engineering research company

PRINCIPIA as hydrodynamicist, specialized in fluid-structure interactions and instabilities in the field of Offshore applications from Oil an Gas industry to the different EMR applications (floating wind turbine, OTEC, tidal turbine etc…).

Nicolas Germain is responsible within FEM for the exploitation of the Mistral test site. He previously worked 10 years with Bureau Veritas on ships and floating offshore systems design (structure, hydrodynamic, metocean and mooring analysis).

Skills:

Hydrodynamic and Mooring: theories and numerical models.

Signal processing: Basic knowledge for measurements post-treatment and analysis

Subsea-components: Basic knowledge of mooring (typology and components), material and rheology

Signal processing: Analysis by discrete Fourier transform, spectral analysis and parameters, statistics

Tools:

Finite Element Model for marine slender structures: Deeplines™ & Deeplines Wind™

Seakeeping: NEMHO

Programming: Python, visual basic

Internship supervision:

This internship will be supervised by Guillaume Damblans who is the project manager of the MHM-EMR and OMDYN2 projects.

Apply deadline: **18/01/2018**

Duration and location:

The internship duration is approximately 6 months and the starting date will be ideally in February, possibly in April 2017.

The intern will be hosted at France Energies Marines, located at:
Bâtiment Cap Ocean
525 avenue Alexis de Rochon
29280 Plouzané

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