N/Ref : FEM/2018-470

Object

Internship – **Techno-economic assessment of floating offshore renewable energy systems**

Company Description

FRANCE ENERGIES MARINES (FEM), the national reference institute dedicated to research in the field of Offshore Renewable Energies (ORE), supports the nascent ORE industrial sector with the means and skills that increase competitiveness by mutualizing research and development costs, reducing risks and accelerating the acquisition of data and knowledge. The principle of this structure is based on a broad public-private partnership involving numerous members including industrials, SMEs, regional authorities, advanced research and training institutions and competitiveness clusters. The headquarters of FEM are located in Plouzané near Brest, France.

As part of its program "ORE array layout and network integration", FEM is opening an internship position « Techno-economic assessment of floating offshore renewable energy systems ».

Context

Many applications and R&D projects under development at France Energies Marines deal with a techno-economic approach, used to quantify the benefices of certain technical solutions from the economic point of view. This is the case of the LISORE project dealing with the techno-economic assessment of innovative sub-station and the 2 projects VALARRAY and DTOceanPlus dealing with ORE farm optimisation and design. The quantified estimation of economic indicators is key to the selection and prioritization of R&D actions and technologies. To do so, one needs to find the relationships between the technical parameters and the economic quantification, the cost functions. Variability in key parameters driving the costs is also a common behaviour o account for in engineering, both technically and economically. The proposed internship is located at the interface between the technical and economical aspects, with a mathematical approach to deal with uncertainties/variability quantification.

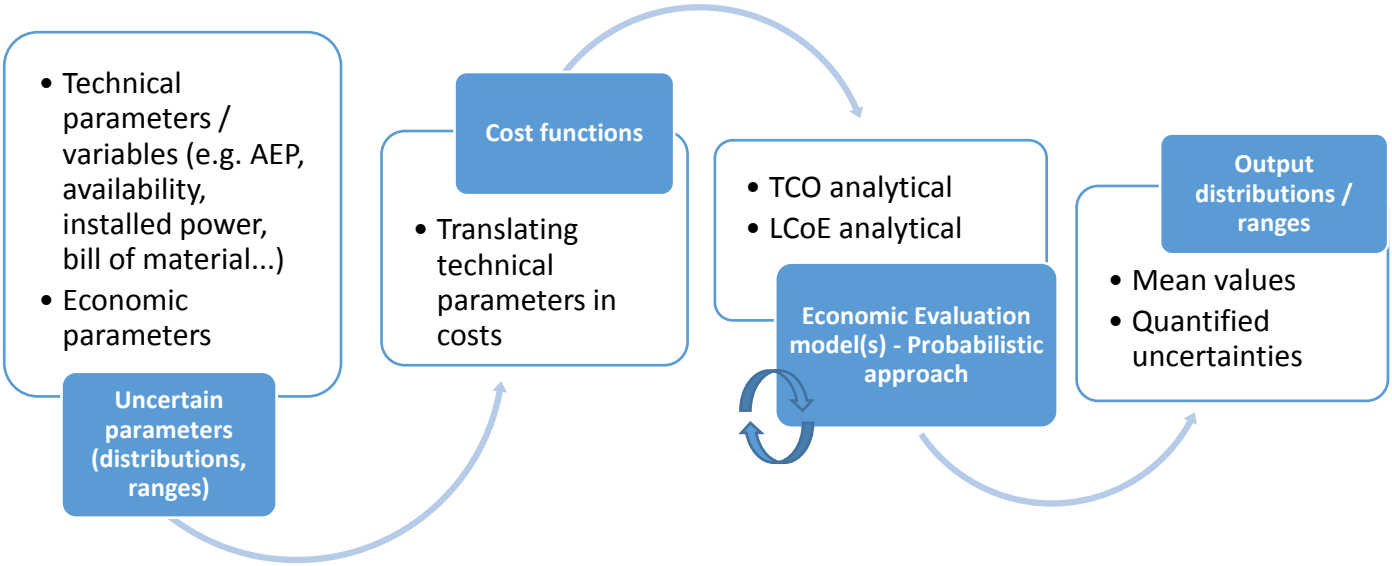
Internship Objectives

Techno-economic approach of ORE systems (with a focus on electrical sub-stations and floating offshore wind farms).

Main tasks are:

- Perform a system engineering approach of ORE farm systems (including the sub-station), which means the identification of the various technical disciplines and of the associated main key parameters driving the major costs (or KPI / proxi) to be economically modelled. This will be done in close collaboration with the LISORE project

- Review of publicly available cost functions for the various sub-systems and components of an ORE farm (offshore wind and floating offshore wind, offshore sub-stations sub-components). Again, support from the LISORE project consortium is expected
- Review of economic indicators applicable to ORE farm system evaluation, for instance Total Cost of Ownership, Levelized Cost of Energy, Net Present Value, Return on Investment...
- And their input data such as economic parameters (discount rate...), technical ones such as "P50" value of Annual Energy Production (AEP), costs of the various sub-systems - by category - such as CAPital EXpenditures, OPerational EXpenditures...
- Review of the statistical methods applicable for uncertainty quantification / propagation, e.g. Monte Carlo method…
- Selection of the method(s) and the influential parameters/variables to be included in the techno-economic evaluation
- Test case definition. A realistic scenario will be constructed, with ranges of input values defined to feed the uncertainty propagation method
- Coding of a techno-economic assessment tool (in Python) and possible links with DTOcean suite of tools
- Application of the above to some techno-economic assessment of farm systems, computing for instance TCO or LCoE for the varying input parameters



$$LCoE = \frac{\text{sum of total costs over lifetime}}{sum\ of\ electrical\ energy\ generated\ over\ lifetime} = \frac{\sum_{t=1}^{N} \frac{CAPEX_t + OPEX_t}{(1+r)^t}}{\sum_{t=1}^{N} \frac{AEP_t}{(1+r)^t}}$$

$CAPEX_t$	Capital expenditures in the year t
$OPEX_t$	Operations and maintenance expenditures in the year t
AEP_t	Annual electrical Energy Production generated in the year t
r	Discount rate
N	Expected lifetime of system or power station

Candidate Profile

➢ **Education:**	➢ **Specific skills:**
Candidate of an ▪ Engineering degree or ▪ Advanced Master's degree or ▪ Specialized Mastère degree in Offshore Renewable Energy, Mechanics, Energy or General	▪ ORE culture at the farm level, broad and systemic approach of the energy production chain ▪ Energy yield and LCoE evaluation ▪ Scientific programming (Python, Matlab, Fortran…) ▪ Probabilistic approaches, uncertainty quantification
➢ **Professional experience:**	➢ **Personal qualities:**
▪ Previous internship in the ORE field, O&G industry or in a research lab with similar activities, and/or ▪ Significant student project(s) in the field of the present study would be a definitive advantage	▪ Strict scientific rigor ▪ Spirit of initiative and multidisciplinary interests ▪ Taste for applied (industrial) research ▪ At ease in expression, argumentation and communication in a collaborative context ▪ At ease in writing and speaking English

Practical Information

The internship duration is approximately 6 months and the starting date is beginning of 2019 (January / February).

The intern will be hosted at France Energies Marines headquarters, located at:

525, avenue Alexis de Rochon
Technopôle Brest-Iroise
Pointe du Diable
29280 Plouzané

Application process: send your CV and a Cover Letter to the following electronic address by January 18th 2019: contact@ite-fem.org