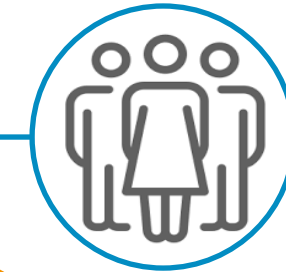


The Institute for the Energy Transition dedicated to Offshore Wind (and MRE)

Nicolas Ruiz
ORE Systems & farm optimization manager
nicolas.ruiz@france-energies-marines.org

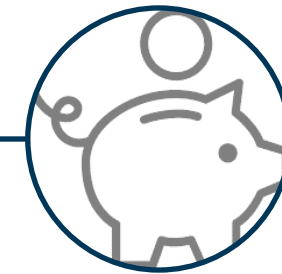
Research and Innovation
Institute for Offshore Wind
with strong Industrial,
Economic and Societal Impact



Staff **90**



Since **2012**



€10M activity in 2024



Headquarters in **Brest**
Offices in **Le Havre, Nantes et Marseille**

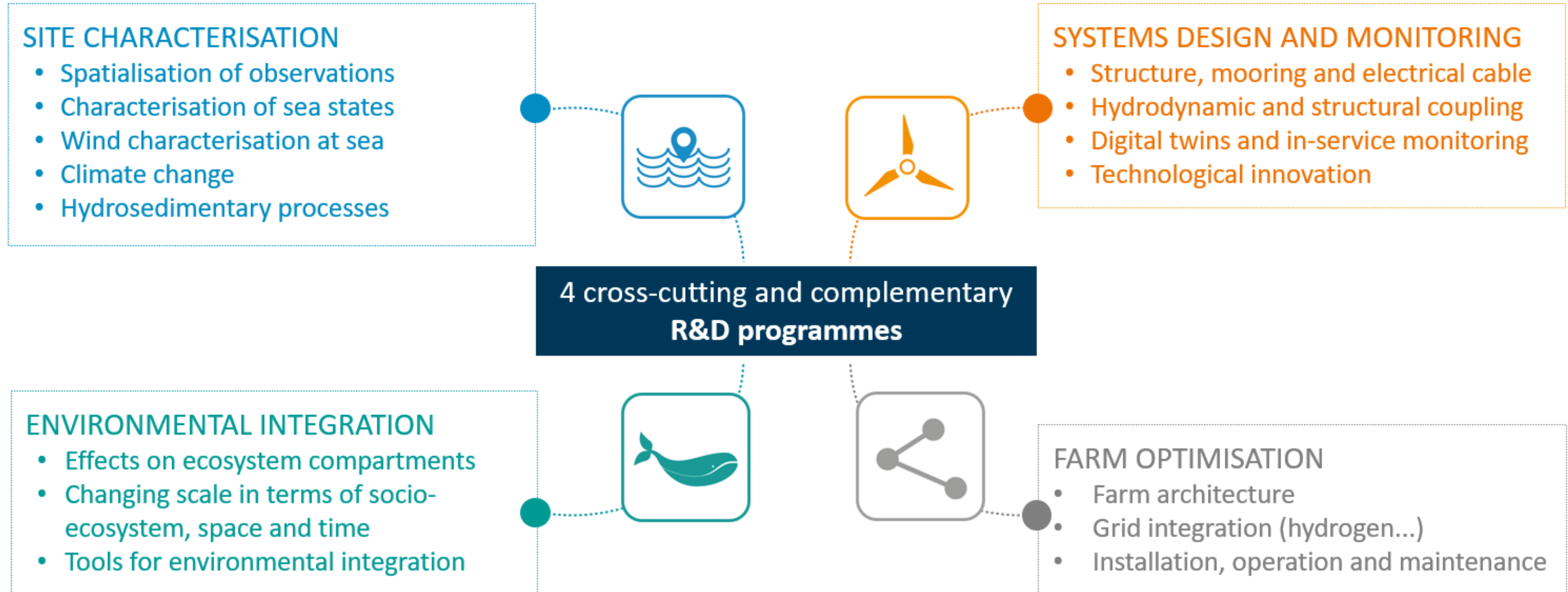


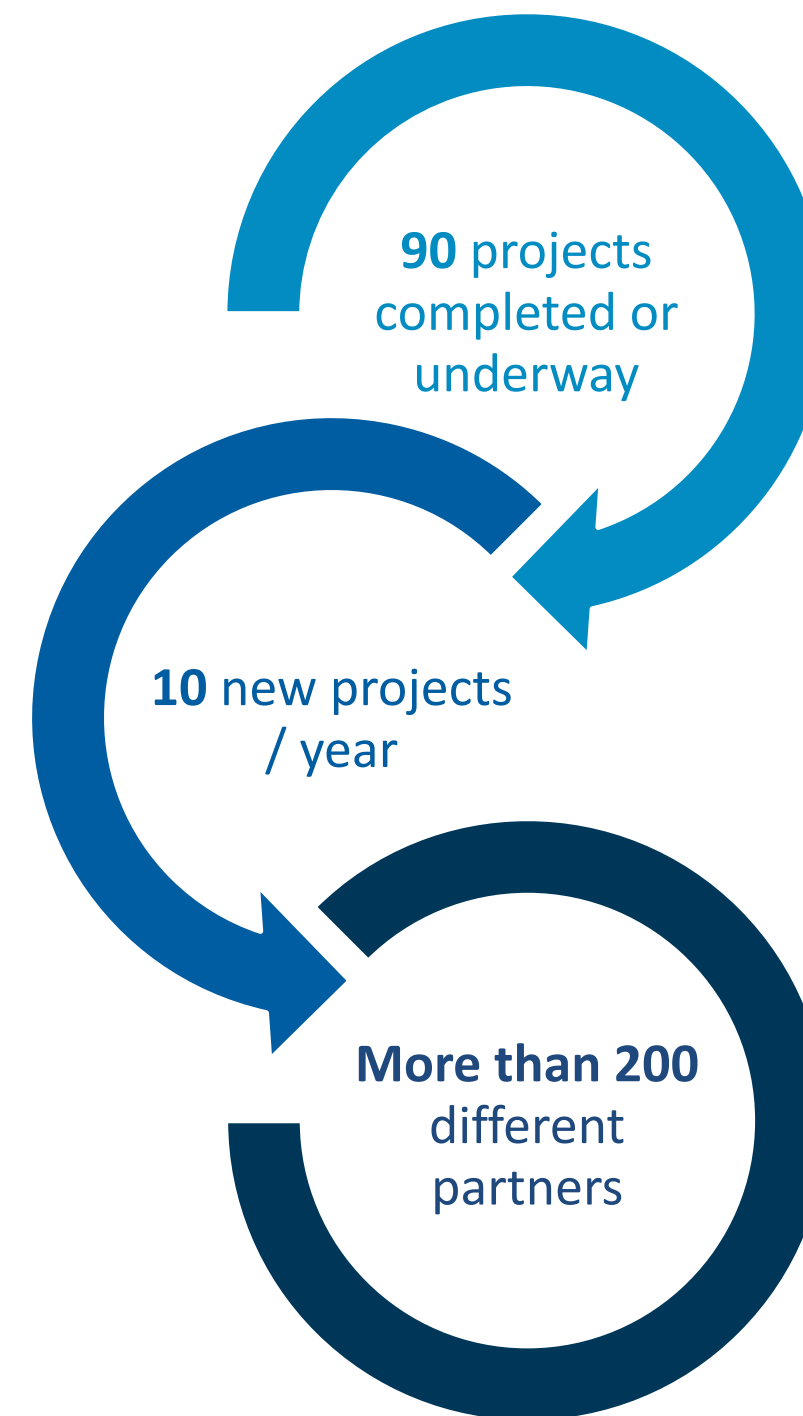
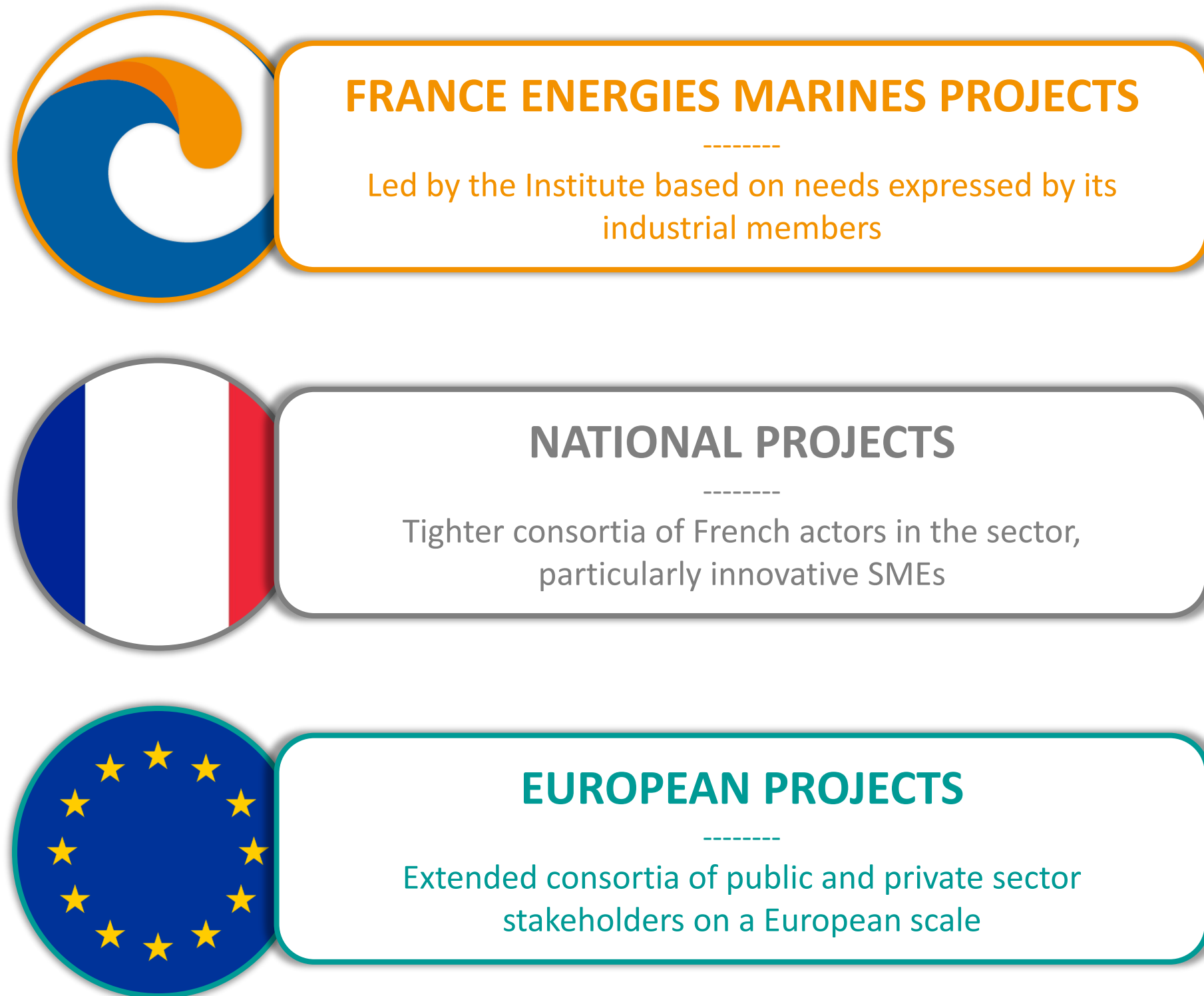
Institute for the energy Transition
supported by **France 2030** investment plan

A key institute at the interface between private and public sectors



Our scientific and technological roadmap





2017-2020

POLYAMOOR

- Identification of a nylon cable configuration compatible with the lifetime of a floating wind farm (20-25 years)
- Identification of a generic visco-elasto-plastic rheological scheme
- Analytical formulations of the different rheological blocks adapted to nylon, then calibration and validation of these formulations by specific test sequences
- Identification of a simple long-term creep law (period > 1 year)
- Feasibility of an accelerated self-heating life prediction method

2020-2023

MONAMOOR

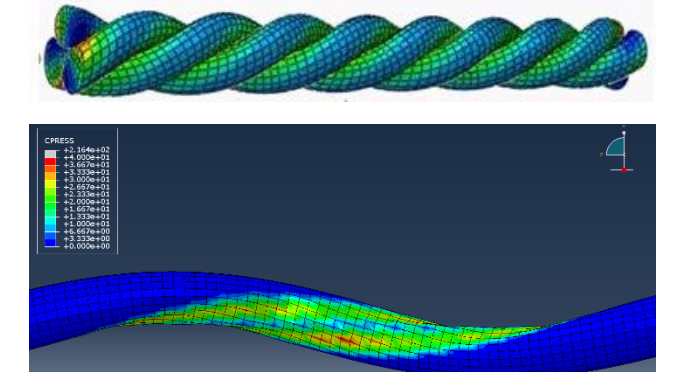
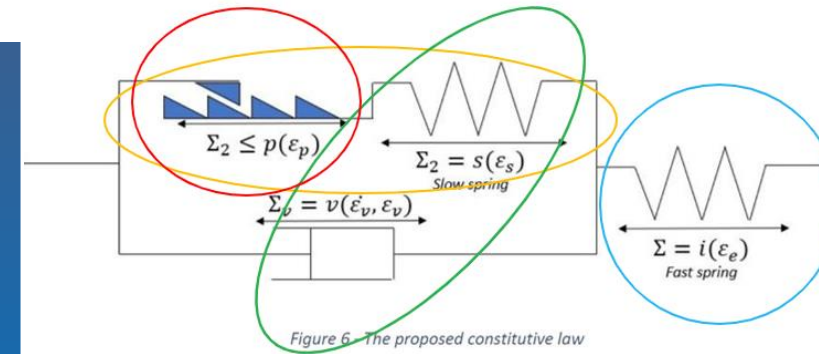
- Improvement and validation of a nylon behaviour law established during a previous project, 3D mesoscale finite element model of a subrope
- Long-term laboratory creep tests
- Develop and test sensors providing information on internal inter-strand stresses
- Develop and evaluate an integrated transducer to assess mooring performance in service
- Validate development tools, sensors and models via representative sea trials.

2023-2026

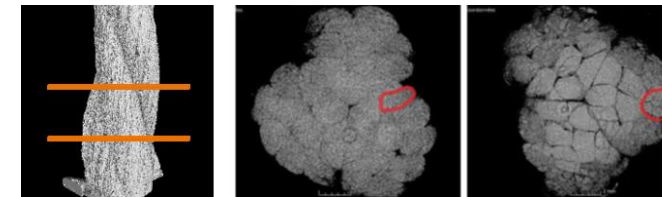
BAMOS

- Validated meso-scale model for different construction patterns
- Fatigue prediction method using self-heating approach, including a new challenged fatigue criterion
- Fatigue curve extended towards high number of cycles, and assessment of parameters influencing fatigue
- Validated polyamide rope behavior law after 1 year of mooring service, numerical study on optimizations made possible by this law
- State of the art and feedback on degradation mechanisms

THEORY

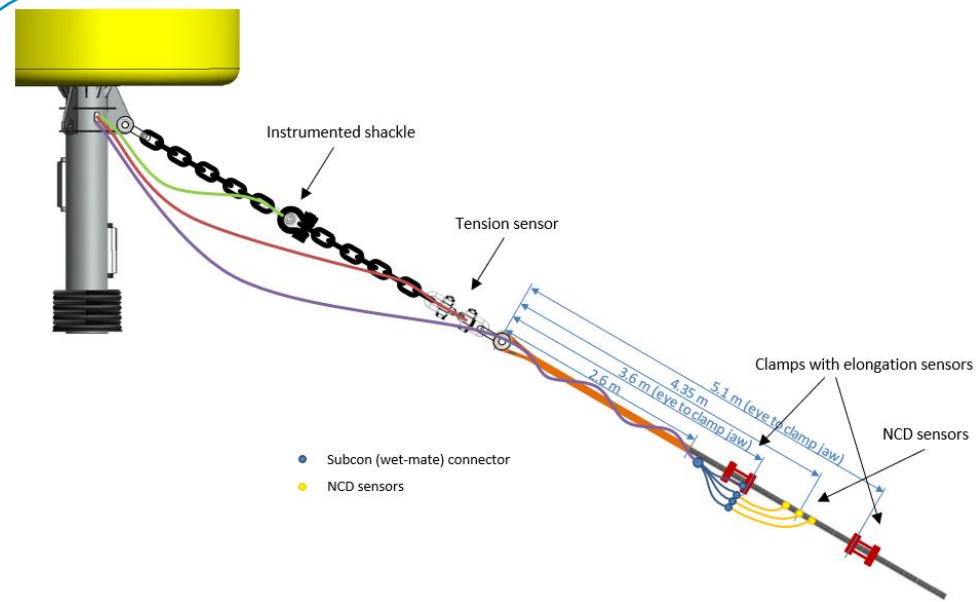


LAB EXPERIMENT



SEA TRIAL

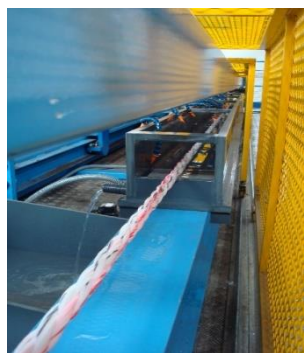
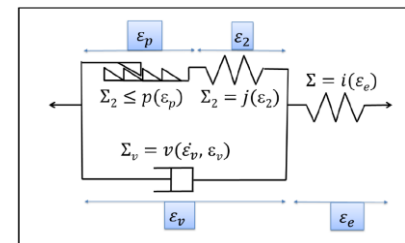




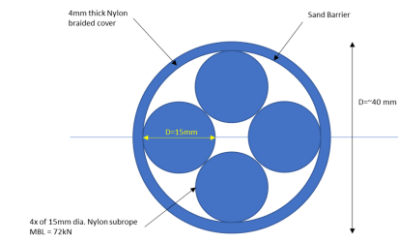
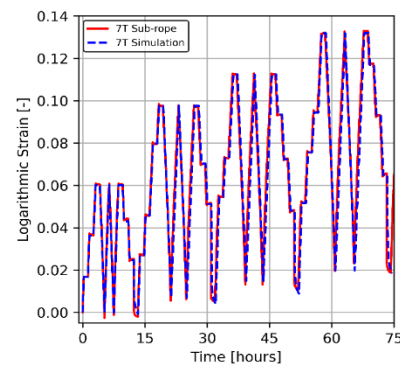
Develop tools for modelling the **mechanical behaviour of nylon fibre lines** and appropriate long-term monitoring instruments, based on an in-depth understanding of **degradation mechanisms**.

Deployed a 7Te buoy with a three-leg mooring system included instrumented mooring lines. Compared **nylon behavior law** calculations with at **sea tension / elongation measurements**.

- Motion monitoring system
 - Inertial Navigation System coupled with dual GNSS antennas
 - Post-treatment of recorded GNSS data
- Wave field measurement
 - Stereo-video acquisition system
 - Sea surface reconstruction process
 - Wave buoy data analysis, spectrum reconstruction

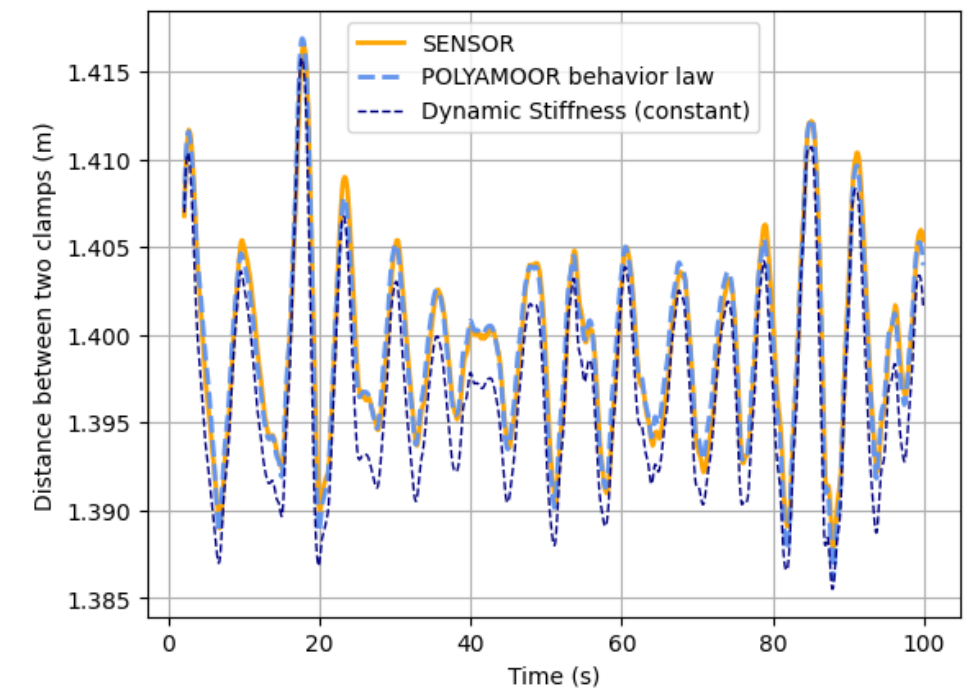
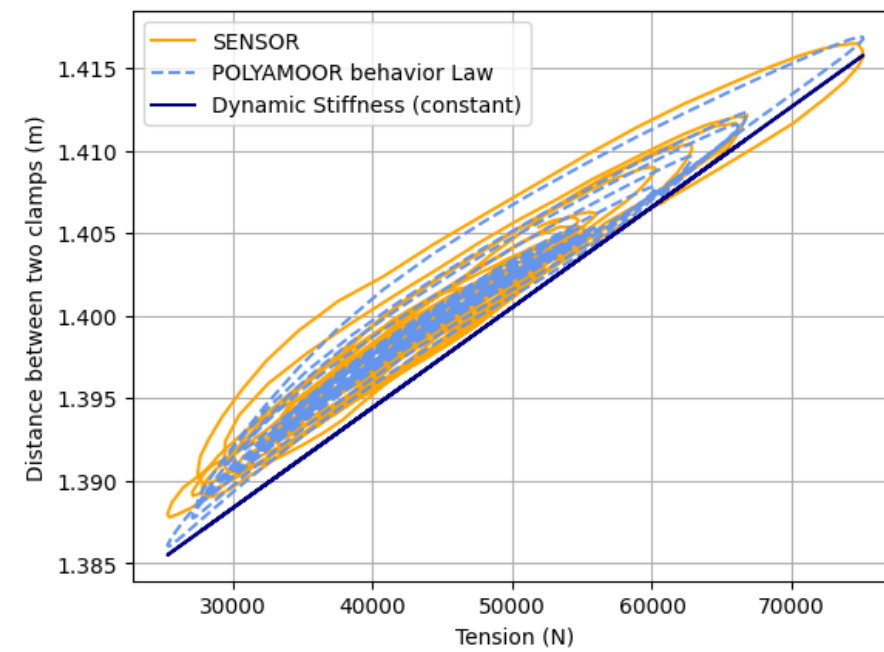


7tons sub-rope



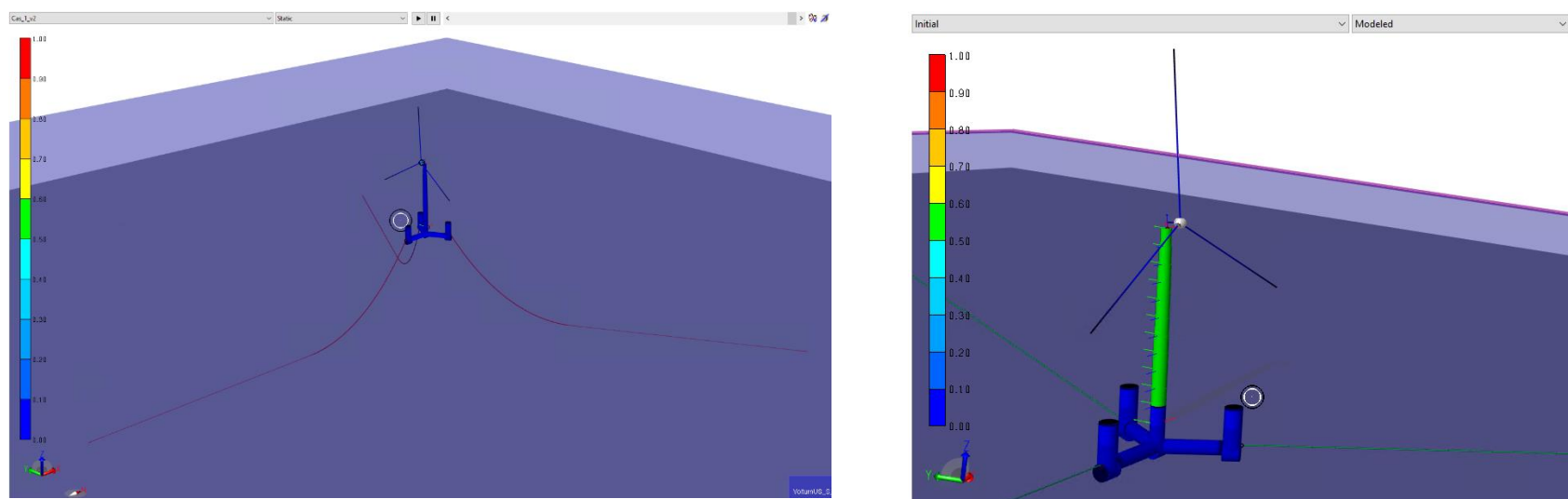
28 Tons Ropes
(4x7tons sub-ropes)

Cross validation of model behavior laws & elongation sensor measurements



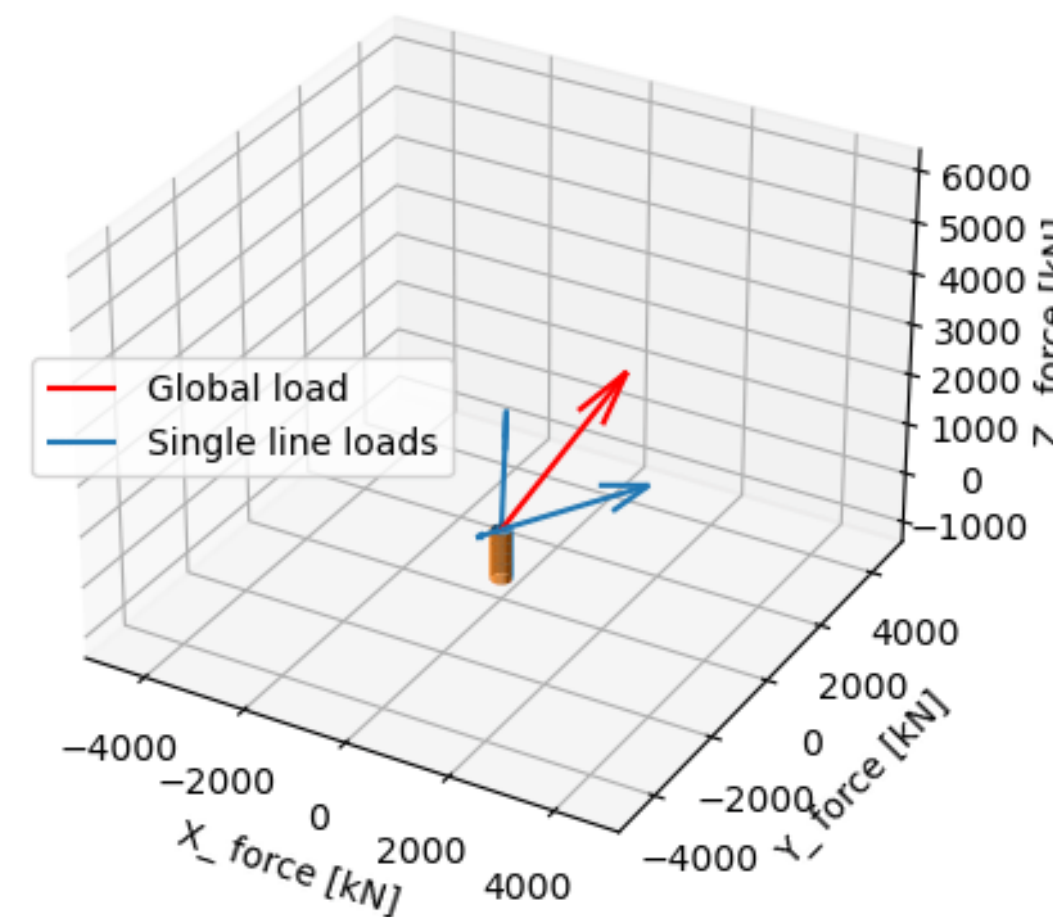
MUTANC PROJECT: ANCHOR AND MOORING LINES MUTUALIZATION

Aero-hydro-elastic numerical model

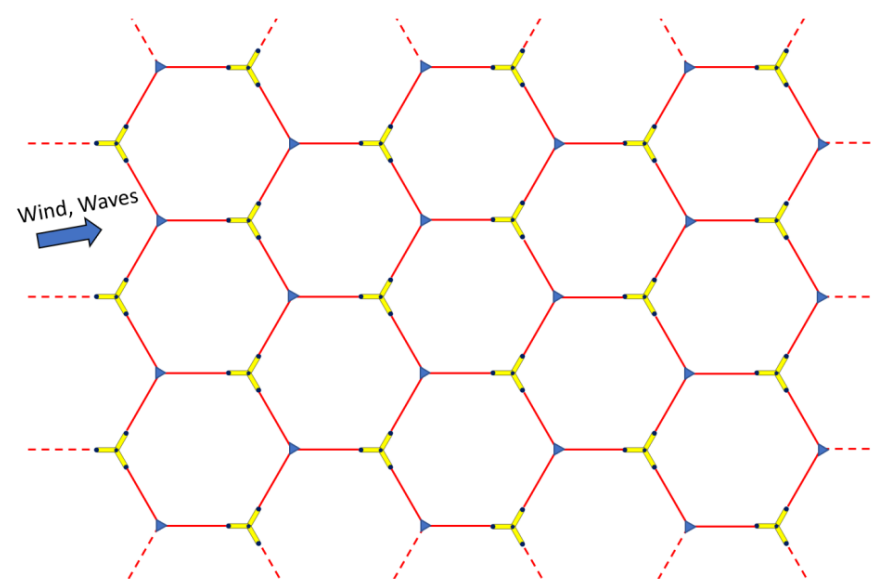
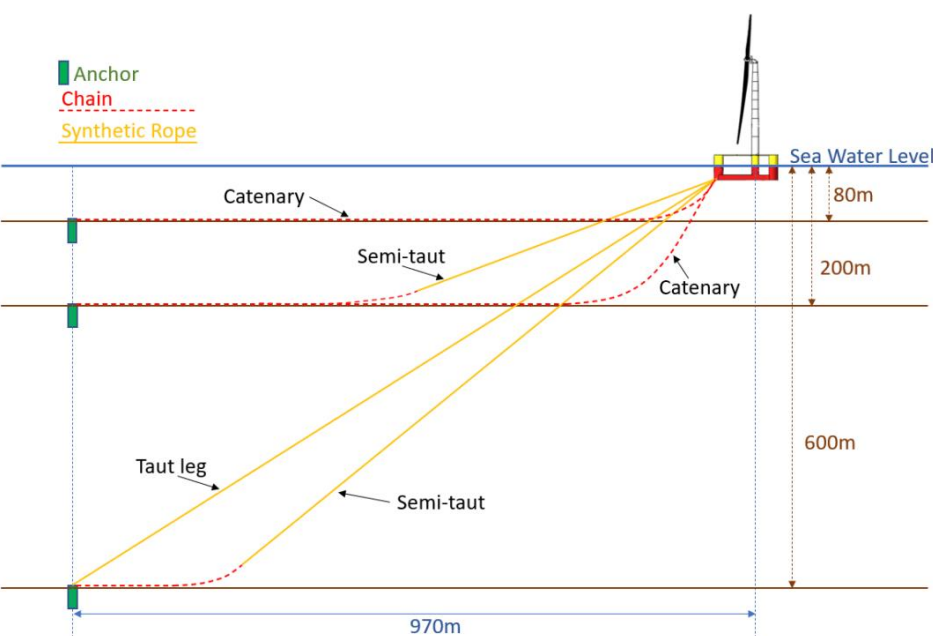


Example of anchor loading

Global force at anchor, $t = 0.1$ s



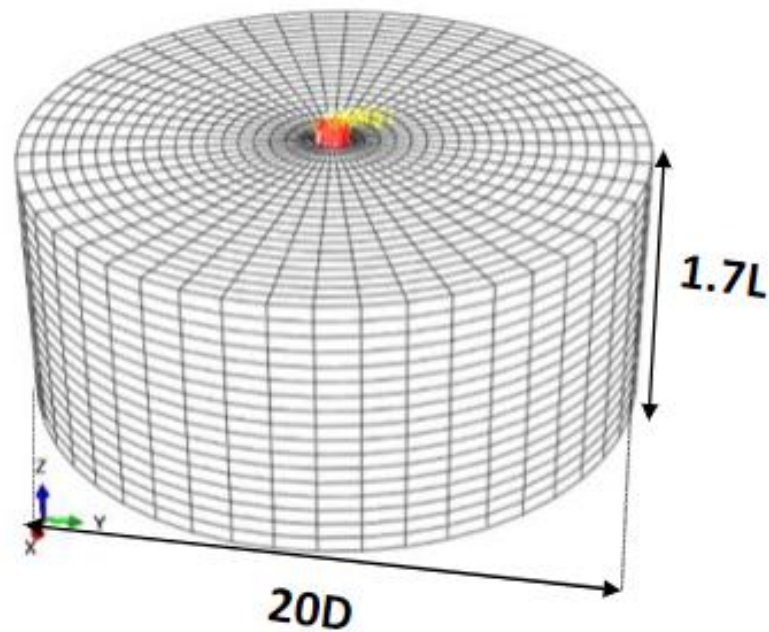
Farm architecture optimisation architecture



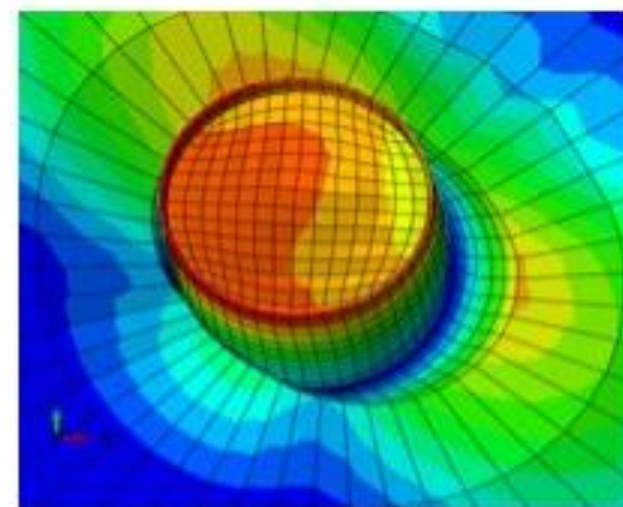
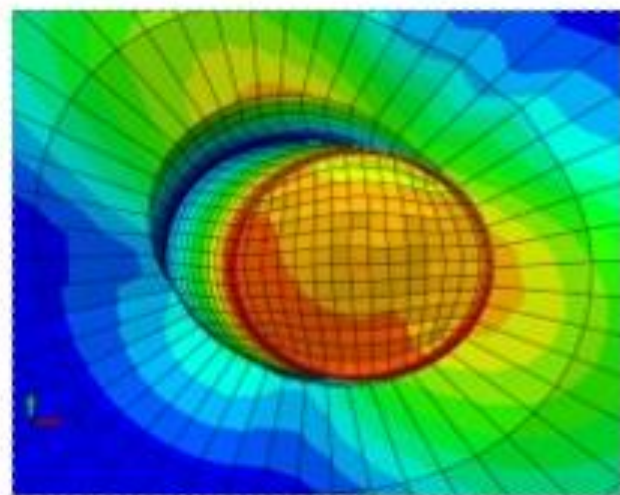
Water depth: 600 m
lines: Polyester taut
Environnement : Extrême, turbine stopped

Pile geotechnical modelling

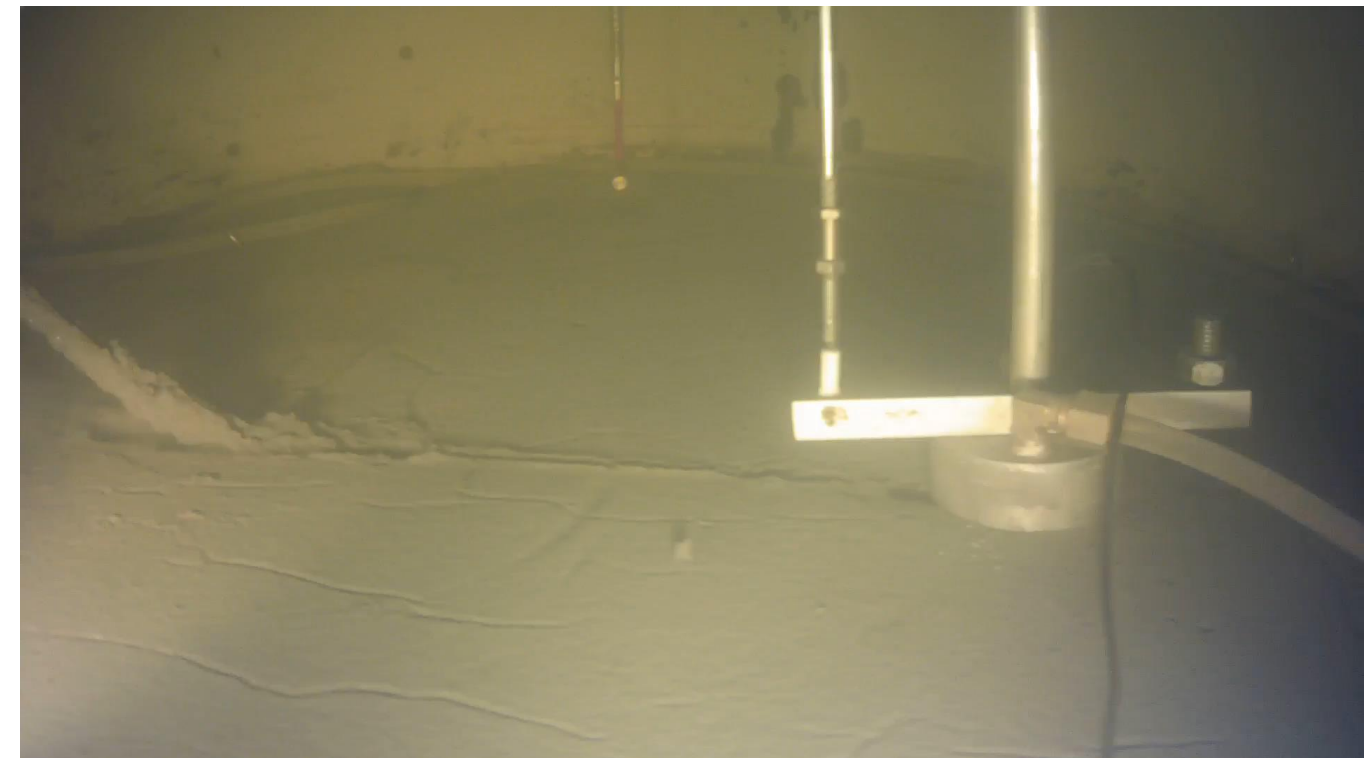
3D FE model (Abaqus)



- 3D finite element model
- Soil behavior law (SaniSAND)
- Able to simulate a large number of cases, freeing up experimental constraints



Centrifuge tests



- Small-scale experimental model
- Validation of numerical models
- Characterisation of pile behavior under cyclic and multidirectional loading

France Energies Marines looking for partners/sponsors for new JIP on shared anchors and mooring lines

Contact: nicolas.ruiz@france-energies-marines.org

2016
-
2017

OMDYN

- Constitutive components mechanical characterization
- Numerical modelling of hydro-mechanical behavior
- Experimental characterisation of thermo-mechanical fatigue

2018
-
2021

OMDYN2

- Electro-mechanical behavior
- Numerical models for service life prediction
- Bio-fouling impacts on hydrodynamic and thermal loads
- Lifetime fatigue monitoring methods

2020
-
2023

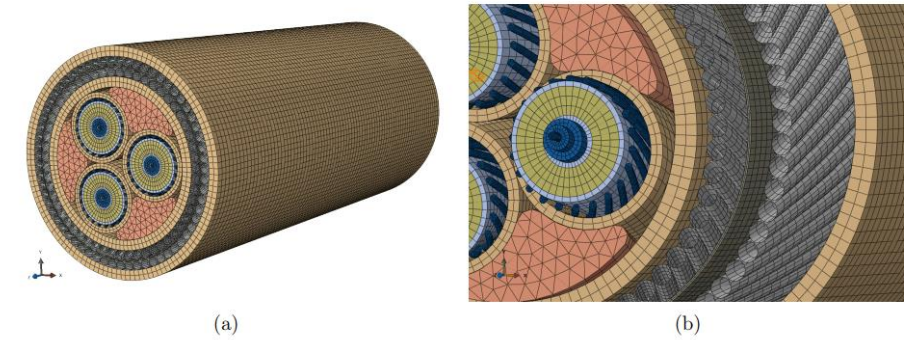
DYNAMO

- Database of local failure modes, associated physical parameters
- Analysis grid of sensor technologies for in-service monitoring
- Laboratories tests
- Roadmap for the development of future sensor technologies

2023
-
2026

HT20MW

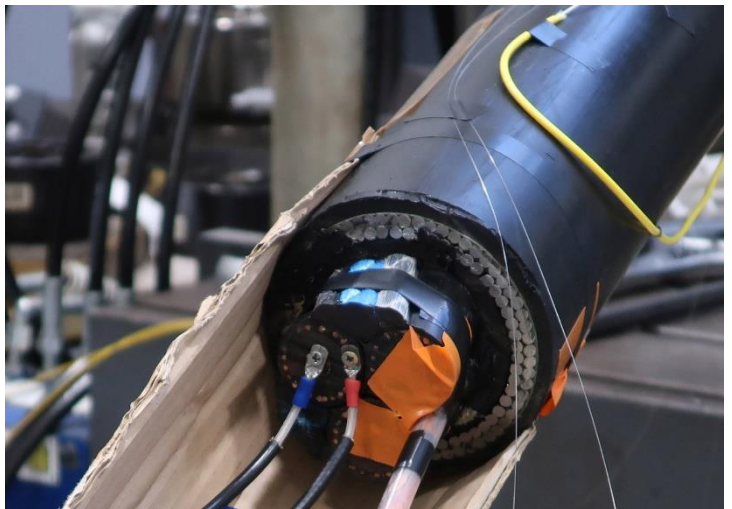
- Qualification of dynamic cable monitoring technologies
- Sea trial experiment to monitor dynamic cable shape and motions
- Data acquisition and analyses: model/measure comparisons



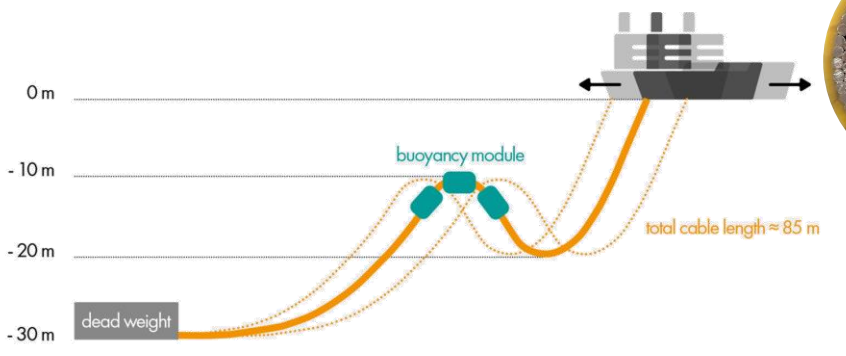
OMDYN2 - Thesis F.Ménard



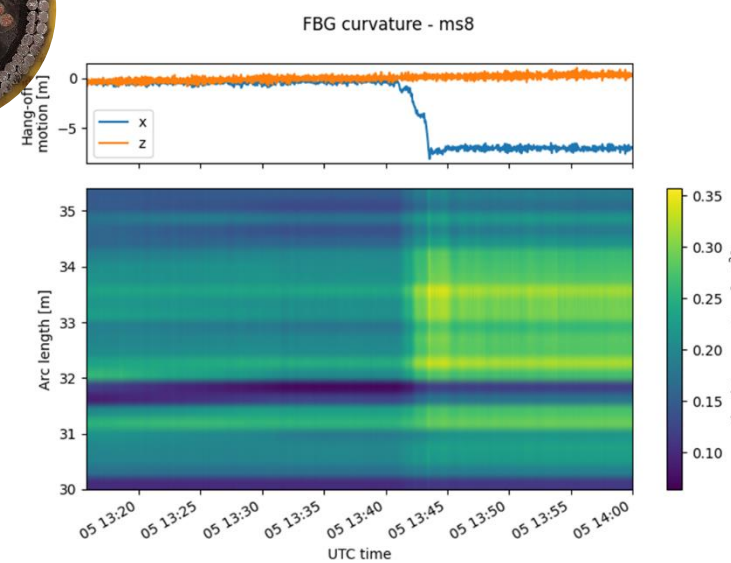
OMDYN2 - TDHVL



DYNAMO - ENSTA Bretagne



HT20MW - EOLINK





[Recommendations-health-monitoring-dynamic-cables-for-FOWT-FEM-Editions-BD.pdf](#)

Thanks.

