

# Joint industry Project MUTANC 2

## Shared anchors and mooring lines for offshore wind farms

### MOTIVATION & BACKGROUND

The market push to reduce levelized cost of energy (LCOE) of floating offshore wind farms introduces breakthrough innovations in farm design and technological challenges. A way to achieve cost reduction is by sharing anchors, and even more by sharing mooring lines between floating offshore wind turbines.

The MUTANC project has studied shared pile anchors in sandy soil from 2021 to 2024 advocating a cost reduction from 16% to 30% for farms with 100 turbines. However, questions remain.

- What recommendations can be established between shared anchor loadings and the design of piles in sandy soil?
- Is it possible to design an efficient shared mooring line configuration while mitigating risks to integrity and production failure?
- How do installation, operation, maintenance, and decommissioning challenges impact anchor costs and operational time, and how can they be integrated into an LCOE cost model?

### OBJECTIVES

- To provide a practical engineering methodology and design tools for industry practice, based on a thorough understanding of pile behavior in sand under horizontal cyclic and multidirectional loading
- To explore the use of shared mooring line systems to ensure their integrity and prevent the potential impact of failure on production
- To improve the cost model developed in the MUTANC project with installation and maintenance specificities impacting the cost and the operational availability

Duration: 36 months | Start: 2025 | Total budget: €2,000K

### DELIVERABLES

- Optimized mooring line configurations and redundancy strategies adapted to shared anchor systems
- Advanced numerical tools and methodologies for shared mooring design, validated through physical testing
- Development of degradation laws, simplified geotechnical models and recommendations for certification, applicable to industry, concerning the behaviour of driven piles in sandy soils under cyclic and multidirectional loadings
- Definition of relevant installation scenarios for shared systems, detailing associated challenges and cost implications

# WORK PLANNED

## 1. Shared anchors layout analysis

- Definition of site-specific anchor layout considering metocean directionality and redundancy in mooring lines
- Numerical simulations to perform and compare ultimate limit state (ULS) and accidental limit state (ALS) cases for shared and unshared configurations, and mooring configurations assessment through simplified cost considerations

## 2. Shared anchor geotechnical analysis and recommendations

- Experimental geotechnical analysis
- Calibration and validation of a complex geotechnical numerical model using finite element analysis (FEA) and advanced soil constitutive model
- Validation of a simplified soil constitutive model
- Development of a simplified tool for shared pile anchor engineering practice, including the definition of cyclic degradation factors
- Parametric study and analysis of specific cases and cyclic multidirectional stochastic loadings

## 3. Shared anchor design practice for certification

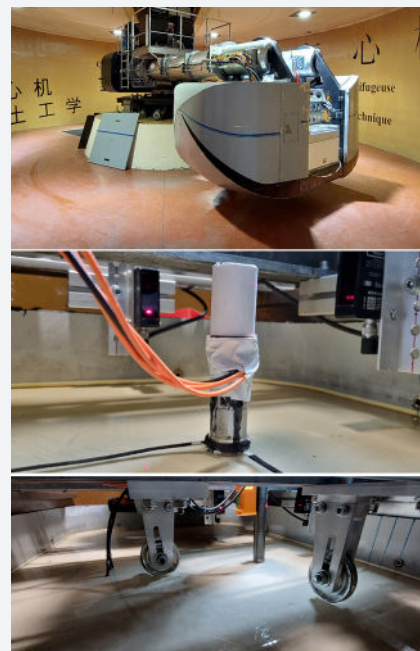
- Identification of applicable technical standards based on an overview of critical aspects for shared anchors
- Definition of a global design methodology for shared anchors
- Preparation of guidelines for certification

## 4. Shared mooring lines systems analysis

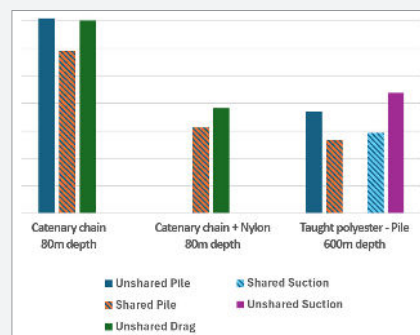
- Literature review of existing shared mooring line systems, case study specifications, and selection of designs
- Development of numerical models and application to specific shared mooring system arrays
- Validation of a shared mooring configuration through basin tests
- Risk assessment

## 5. Cost model including installation, operation, maintenance and decommissioning challenges

- Case study specifications
- Study of the impact of sharing on installation, operation, maintenance, and decommissioning scenarios
- Integration into MUTANC cost model



Centrifugal testing during MUTANC project (© Université Gustave Eiffel)



Study of the overall costs by configuration carried out during MUTANC project (© MUTANC)

# PARTNERS

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