Bottom Fixed and Floating Wind
INNOSEA Scope of Services
AN INTRODUCTION

Independent multidisciplinary engineering company

Flexible, Comprehensive and Dedicated engineering services

Pure-player in Marine Renewable Energies operating internationally

> 30 and growing highly-skilled and experienced Offshore Renewable Energies specialist engineers & PhDs

Five Key Markets

- Offshore Wind
  - Turbine
  - WTG Foundations
  - OSP Foundations
  - Static Cables
  - Installation
  - Value chain analysis

- Floating Wind
  - Turbine
  - Floating platform
  - Mooring
  - Dynamic Cables
  - Installation

- Tidal
  - Turbine
  - Foundation
  - Installation
  - Static Cables

Corporate Core Values
Excellence and on-time Delivery
Safety Leadership
Client’s satisfaction & Dedicated Account management

INNOSEA Scope of Services - Bottom Fixed & Floating Wind
OFFICES

Operating **Internationally** - 4 locations in **Europe** and **North America**

- **Head Office:** *Nantes*, France
- **Meeting & Hot Desks:** *Paris*, France
- **UK Office:** *Edinburgh*, Scotland
- **Canada Office:** *Halifax*, Nova Scotia

**Mobile** and flexible staff

**Partnerships** with first-rate Universities and Research Departments

Privileged access to **Unique Test Facilities**
INNOSEA activity for fixed offshore wind

- **Loads assessment (Bladed / DNV GL)**
  - As Owner Engineer for design loops: support for managing loads iteration, results checking through running of independent loads iteration
  - On WTS or foundation designer side

- **Structural design of foundations (Concept Design and Detailed Design) (ANSYS / ABAQUS)**
  - Conceptual Design of monopiles, jacket & GBS foundations
  - Structural analyses of jackets

- **Offshore installation, O&M**
  - Dynamic analysis of offshore operations; definition of workable conditions
  - Installation planning based on analysis of metocean time series and workable conditions

- **CAPEX cost estimate**
  - Cost Estimate of procurement, manufacturing, installation. Inputs from client or internal database
  - Monte-Carlo analysis to provide probabilistic distribution of costs.

- **Advisory & Strategy**
  - Assessment of local benefits of wind projects
  - Support to Regional Agencies in the definition of their Offshore Renewables policies
INNOSEA activity for fixed offshore wind – Offshore Wind Foundation design

INNOSEA key strengths & references

Software, hardware & organisation capabilities
- Expert users and developers of references software tools (ANSYS, ABAQUS)
- High Power Computing capacities.
- Robust in-house organisation processes and related software tools to ensure accuracy and quality.
- Continuous internal training.

Experience gained on complex projects
- Used to design by taking into account the complex geotech (calcarenite, drilled pile, soil liquefaction, etc.).
- Used to design innovative concept for unusual conditions
- Used to design with up-to-date methodology (time-history FLS with rainflow counting, etc.).
- Detailed knowledge of offshore wind turbine standards (DNVGL)

A direct link with R&D projects
- As engineers and PhD involved in international R&D projects, we know the impact of complex phenomena on offshore substructure (cycling degradation of soil parameters, grout fatigue, etc.)
Offshore wind turbines foundation design - PREDIN software solution

- **PREDIN presentation**
  - PREDIN is a design software tool, aiming at **rapidly providing realistic foundation and CAPEX cost** (fabrication, installation).
  - PREDIN has been developed to **facilitate tender design** phases.
  - PREDIN provides a sensitive design of the foundation, based on a simple set of site and wind turbine data.
  - PREDIN is comprehensive, and integrates ocean loads, structural analysis and code checking.
INNOSEA activity for floating offshore wind

- **WTG Load assessment (Bladed / FAST / Orcaflex)**
  - WTG Model / orcaflex software coupling
  - Integrated FOWT dynamic analysis in situation of large movements & deflections
  - Independent loads iterations
  - Sensitivity analysis on floater/mooring design parameters
  - Assistance to management & follow-up of loads iterations
  - Wave tank testing

- **Dynamic Umbilical / Power Cable (Orcaflex)**
  - Cable Configuration assessment (Layout, Buoyancy sizing, Configuration Anchoring requirements)
  - Hydrodynamic coefficients assessment for dynamic riser
  - Static and Dynamic simulations (Orcaflex software)
  - Static Umbilical / Power Cable – Stability

- **Mooring (Orcaflex)**
  - Mooring Configuration assessment (Layout, Anchoring requirements)
  - Installation Support / Installation analyses
  - Static and Dynamic simulations (Orcaflex software):
    - Extreme Analysis
    - Interference Analysis (Clashing study – Floater Hull and dynamic cable)
    - Fatigue Analysis
Dynamic Power Cable – Dynamic Analyses

**INNOSEA services**

- Cable Configuration assessment (Layout, Buoyancy sizing, Configuration Anchoring requirements)
- Hydrodynamic coefficients assessment for dynamic riser
- Static and Dynamic simulations (Orcaflex software):
  - Extreme Analysis
  - Interference Analysis (Clashing study – Floater Hull and adjacent anchoring lines)
  - Fatigue Analysis (Input for Cross section components fatigue analysis)
  - Load assessment for equipment design
  - Cable / Floater interface design assessment (Bend stiffener)
  - Dynamic Cable stability assessment
- Determination of the mechanical properties of the cable (stiffness of the cable for dynamic simulation)
- Fatigue analysis on the cable components
INNOSEA Implication on R&D Projects

- **H2020 Projects:**
  - **WETFEET** addresses Low-carbon Energies specific challenges by targeting a set of breakthroughs for wave energy technology, an infant clean energy technology with vast potential. Specifically involved on array breakthrough via sharing of mooring and electrical connections between nearby devices.
  - **DEMO Tide / DEMOnstration for Tidal Industry Derisking.** Involvement on Foundation Design and French business case development.

- **France Energies Marines Projects:**
  - **OMDYN** focuses on dynamic cable hydrodynamic behaviour, mechanical response and cross section fatigue assessment through the following tasks. Provide a simplified tool for cross section calculation for dynamic cables to iterate with simulation tools for global dynamic behaviour. This tool, which allows the passage of a detailed 3D modelling of a cable section to a simplified model, will also implement lifetime prediction methods of cable components (fatigue).
  - **STHYF** : Cable stability and hydrodynamics at mudline.

- **Collaborative / Internal Projects:**
  - **InWave** : Offshore multi-body design tool developed in partnership with Ecole Centrale Nantes – LHEEA Lab. CNRS.
  - **PREDIN** : Bottom Fixed Foundation Pre-Design tool.
  - **STATIONIS** : collaborative R&D project, developing an all-in-one software program for decision making support and pre-engineering design of mooring and electrical systems for floating offshore wind farms. Involvement regarding mooring design module (Frequency domain).
KEY CONTACTS – MEET THE TEAM

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