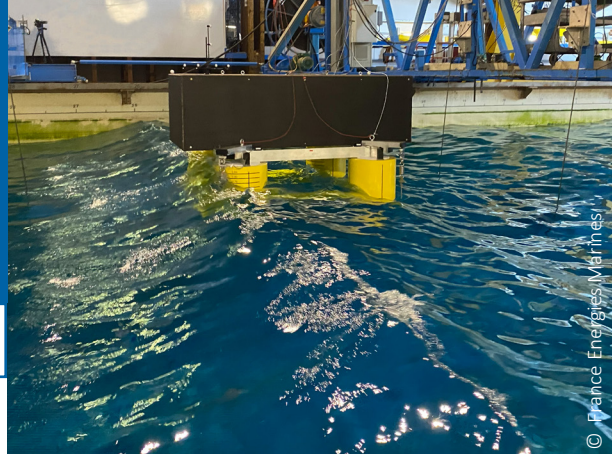
AFOSS-DC

Architecture and design of floating offshore substation for direct current applications

DURATION: 36 months (2022-2025) | **BUDGET:** €1 600K



CONTEXT

The increasing distance of future offshore wind farms from the coast, combined with the energy losses inherent in this type of installation, make high-voltage direct current (HVDC) a competitive alternative. The design of floating electrical substations operating with this technology raises a number of issues that require R&D work. It is necessary to define the electrical components for HVDC applications in terms of weight, volume and sensitivity to the movement of the floater, whilst estimating the typical movements and vibrations of the structure. It is crucial to correctly design the HVDC dynamic cable and its connection system.

OBJECTIVE

To study the HVDC floating offshore substation as an integrated system through analyses of functional requirements, integration constraints, risk and reliability

MAIN ACHIEVEMENTS

- Design of electrical systems and topside layout
- Design of a semi-submersible platform and a tension-leg platform (or TLP) and motion analysis
- Hydrodynamic tank tests using a 1:50 scale model of the TLP
- Thermal and electrical design of the cross-sectional area of dynamic electrical cables and determination of their configuration
- Analysis of the system's reliability, CAPEX and OPEX
- Roadmap for the qualification strategy for such a system

CONCLUSION

AFOSS-DC has enabled the identification of the main failure modes of a floating HVDC substation and the assessment of its reliability. The different critical components (electrical architecture, semi-submersible and TLP floaters, moorings and dynamic cables) have been designed, incorporating a motion analysis. Wave basin tests were conducted to study this aspect in practice on the TLP platform. On this solid basis, a CAPEX and OPEX assessment was carried out and a roadmap for qualifying such a system was drawn up.

TECHNOLOGIES

STAGES OF THE VALUE CHAIN

Preliminary studies | Deisign | O&M

RESOURCES GENERATED

- **Design:** topside with electrical architecture, semi-submersible platform, TLP platform, dynamic cable cross-section, dynamic cable configuration
- **Data bases:** hydrodynamic basin tests on a TLP model, monitoring the structure's motion, wave-induced forces, relative wave height and tension in the moorings
- **Cost-related analyses:** reliability, CAPEX, OPEX
- **Recommendations:** validation and qualification strategy for a floating offshore HVDC substation

PARTNERS

France Energies Marines, Atlantique Offshore Energy, Centrale Méditerranée, ENSTA IP Paris, Ifremer, RTE Le réseau de transport d'électricité, RWE, SuperGrid Institute, TotalEnergies

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