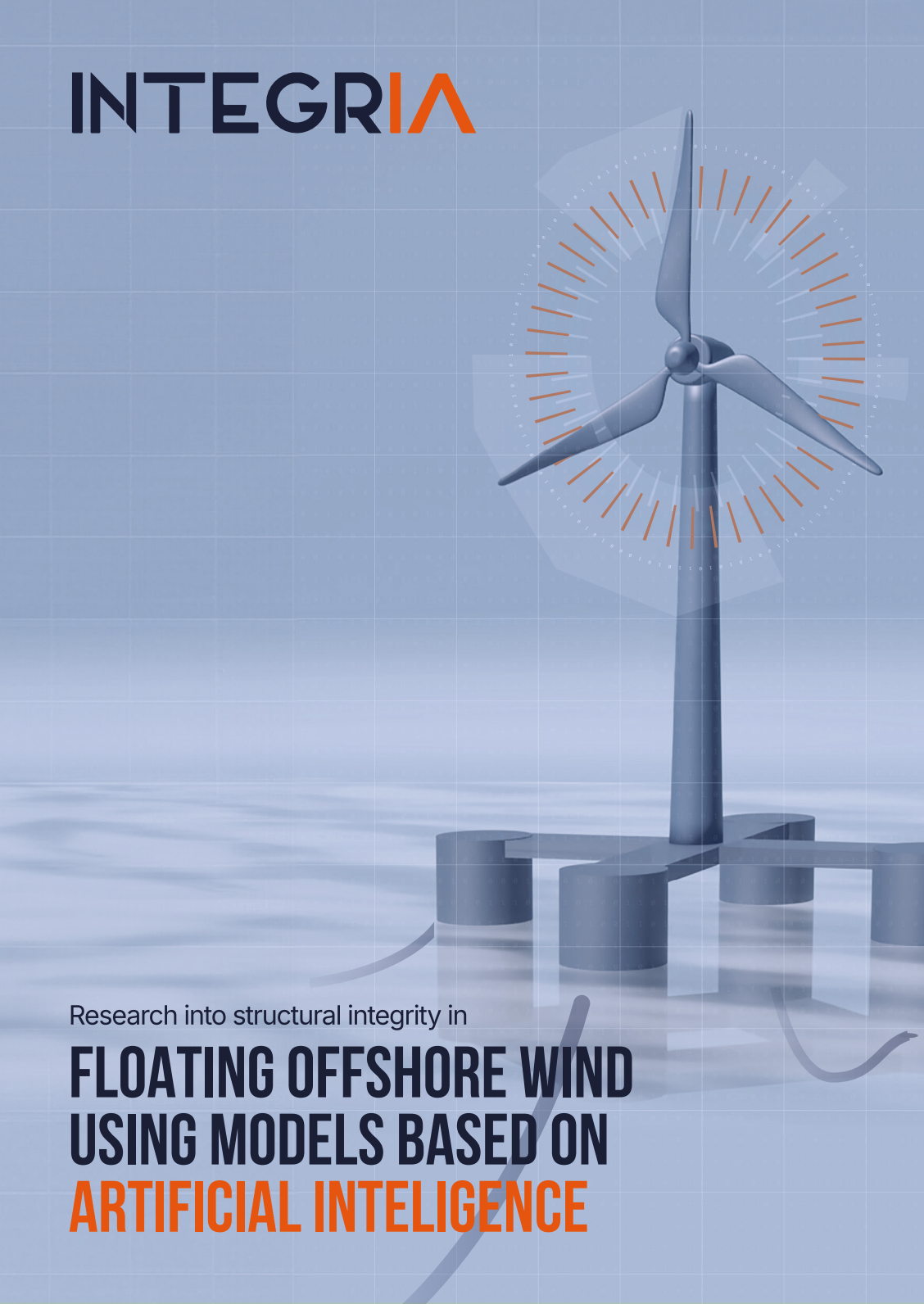
INTEGRIA



Research into structural integrity in

FLOATING OFFSHORE WIND USING MODELS BASED ON ARTIFICIAL INTELIGENCE

INTEGRIA'S aim was the research into the structural integrity of high added-value components, which would allow the companies in the consortium to access the enormous potential market of floating offshore wind turbines.

Digital models based on Artificial Intelligence AI) improved the design of critical elements:

- The elements of the structure (transition piece, TP .
- The evacuation and power supply elements.
- The corrosion and biofouling protection systems.
- The hydraulic and mechanical systems for the control of the wind turbine.

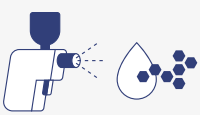
Results achieved over the three-year research project

Development of a comprehensive AI driven virtual sensing model using synthetic data generated from key Design Load Cases (DLCs) to represent experimentally challenging dynamic conditions, together with the **development of the floating wind turbine's structural model.**

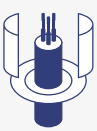
Definition of a hardware and software architecture required for the development of the data acquisition, storage, and management infrastructure of the INTEGRIA project.

The instrumented Transition Piece (TP) for structural validation was designed, manufactured, and installed at HarshLab in November 2025. It **provides real-world data** that supports the validation of the AI-based virtual sensing forecasting model.

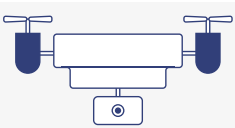
Bolting-monitoring was integrated into floating joints, supported by a new zinc-coating process using induction heating, which **produces metallurgical phases comparable to conventional galvanizing and improves overall coating quality.**



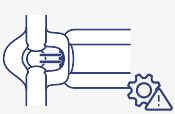
Advanced **ceramic coatings were developed and validated for long term offshore protection**, showing stable vitrified surfaces with no degradation. **Organic and hybrid coatings were also developed to improve corrosion and biofouling resistance**, with sol gel curing reduced from 60 to under 3 minutes.



A prototype of the 66 kV inter-array connector was manufactured, tensile tests were performed on its bolted connections, and **sensors were integrated into the dynamic cable** installed at HarshLab.



Development of a marinized autonomous drone for advanced wind-turbine structural monitoring, delivering AI-based corrosion detection and 3D modelling, and integrating GNC, WTG detection, automated corrective actions, optimized trajectories, PCL filtering, and advanced control strategies.



Development of advanced models and sensing methods for floating wind bearings and hydraulic systems enabled structural validation, early fault detection using the miniROCKET algorithm, and **ultrasonic based monitoring of crack initiation and propagation, significantly improving diagnostics and supporting reliable predictive maintenance strategies.**

To develop all the innovations the HarshLab - installed in **BIMEP** and operated by **TECNALIA** - served as an offshore laboratory for the validation of the research carried out in the **INTEGRIA** project.

CONSORTIUM

COORDINATOR

ayesa digital · ALERION · core marine

ditrel · ERREKA · GLUAL energy · HINE

innomat · kera-coat CERAMIC COATINGS · LAULAGUN bearings · NAVACEL Process Industries

INTEGRIA PROJECT
WWW.INTEGRIAPROJECT.COM

R&D agents

tecnalia · ceit · cidetec surface engineering · bcam · Bearlan · GLUAL INNOVA · IBERMÁTICA DE INNOVACIÓN

ELKO JAURLARITZA GOBIERNO VASCO
Europar Batasuna Unión Europea · Fondo Europeo de Desarrollo Regional (FEDER) · Eskualde Garapenerako Europar Funtsa (EGEF)

Project funded by the Department of Economic Development, Sustainability and Environment of the Basque Government (HAZITEK 2023 Programme) and the European Regional Development Fund (ERDF 2021 - 2027).

Powered by BASQUENERGY CLUSTER