Assessment of the hydrodynamic effect of nature inclusive design in floating wind platform dynamics

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The transition to renewable energy is essential to achieving global climate goals, with offshore wind energy emerging as a rapidly expanding sector poised to play a significant role in the global energy matrix. Over the past two decades, offshore wind technology has matured, but integrating nature-positive solutions to mitigate biodiversity loss driven by climate change remains a significant challenge. Nature-Inclusive Design (NiD) approaches, which aim to enhance biodiversity and ecosystem resilience, are being evaluated for both bottom-fixed and floating wind systems.

A particularly promising NiD solution involves optimized scour protection systems for monopiles, anchors, and submarine cables. Additionally, integrating artificial reef units, either deployed on the seabed or attached to wind turbine foundations, has been proposed to provide shelter for fish and other marine species. While the deployment of artificial reefs on the seabed has been extensively studied, research on their use as add-on structures, particularly for floating wind foundations, is still limited.

When attaching artificial reef units to floating wind foundations, it is crucial to consider not only the biological factors but also their impact on the dynamics of the foundation. For bottom-fixed foundations, additional loads must be factored into the structural analysis. However, for floating wind foundations, these added loads influence the platform's behavior and, consequently, the system's energy production. Therefore, incorporating artificial reefs into the design stage of floating wind platforms is essential and presents challenges to the existing modelling techniques used to analyse these systems' dynamics.

This research, conducted within the EU INF4INITY project, focuses on studying the hydrodynamic effects of artificial reefs on a Tension Leg Platform (TLP) floating wind system. A methodology combining numerical and physical modelling is proposed to assess the loads and identify their crucial design parameters. The Smoothed Particle Hydrodynamics (SPH) method is employed to design the experiments that will be performed at the Coastal and Ocean Basin Ostende (COB), where various NiD solutions will be tested under both operational and extreme environmental conditions. These results will be critical for understanding the use of artificial reefs in the offshore wind industry by identifying key variables to consider when designing or selecting NiD solutions for integration with these systems.

Keywords
Floating Wind, Nature Inclusive Design, Physical Modelling, SPH Method