FRP Offshore Structure Connections Optimization and Validation by Classification Society standards

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Offshore renewable energy devices are expected to be increasingly used to reduce CO2 emissions and meet climate targets set by regulators. Although a lot of offshore wind structures have already been commissioned, they are mainly built with steel. Using steel is something well-known, and design and manufacturing procedures have been used for decades, however steel has some major drawbacks: it's very sensitive to corrosion (even more so at sea), related costs get up to 60% of total maintenance amount and reduces operating life. To avoid the main drawbacks of steel, the extensive use of Fiber-Reinforced Polymers (FRP) was proposed in the framework of the European research project Fibregy.

One of the aims of the Fibregy project was to develop guidelines and technical procedures to demonstrate that the design of a semisubmersible offshore platform using FRP materials is perfectly achievable. So, the design of a platform capable to stand two wind turbines and a tidal generator was carried out, but it was quickly realized that the design of the structure needed to be adapted to new FRP materials.

Due to the newness of this type of marine structures using FRP, there were some points that needed to be worked on, for example, the connections between the main columns and the lateral bracing. Connections were re-designed to find the optimal configuration concerning shape to improve stress distribution, but always in agreement with current manufacturing techniques and procedures. FRP laminates layouts were proposed as well.

The analyses were carried out using finite element analysis methods. The composites were characterized using serial/parallel mixing theory. A Tsai Wu failure criteria analysis was used to test the Bureau Veritas failure criteria and the applicability of this standard to offshore structures.

The results obtained from the analysis have shown that, from a structural point of view, it is possible to replace steel for FRP materials in offshore wind structures. This replacement will bring, among others, advantages in terms of durability and maintenance that are expected to facilitate the achievement of the climate objectives set.