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Hydrodynamic analysis of a floating solar PV farm with breakwater protection

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ABSTRACT

Within the EU project SUREWAVE a new concept for the upscaling of floating PV to offshore environments is developed. The new concept integrates an existing floating PV design with a floating breakwater ring that provides shelter against extreme wave loads. The system is designed for harsh offshore conditions at sites in the Baltic, Mediterranean and North Seas. A series of model tests was performed with a simplified setup of a 3x5 array behind a breakwater. These model tests showed deficiencies in the design of the hinge connections between panels (sensitive to buckling) and lead to an improved hinge design.
The model tests have been used to validate a numerical model of the system based on linear diffraction analysis. The validated numerical model has been used to scale up to the real 2MW system and investigate the effectiveness of the breakwater ring in reducing motions and hinge loads of the panels. That shows that the breakwater is capable of reducing the short-wave energy inside the breakwater ring and the related large hinge loads. Longer waves are not affected but due to the flexibility of the PV system it follows the wave motions which does not result in high loads.
The challenge in these simulations is the number of floating objects and degrees of freedom (several thousands) and the amount of mesh elements in the Boundary Element Method (0.6 Million). A new GMRES solver for the dense linear system of equations with MPI-based distributed memory was implemented and a High Performance Computer was used to complete the simulations.

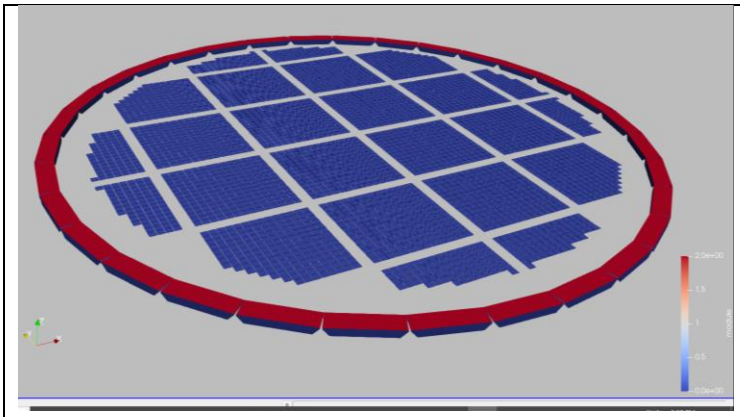

Figure 1: 2MW system numerical model.

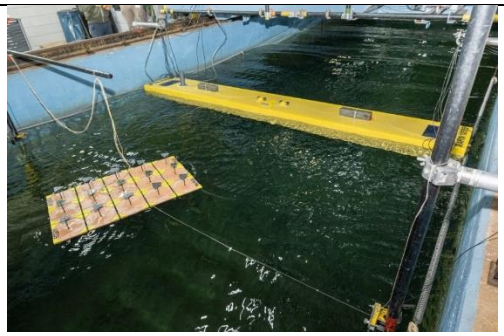

Figure 2: Basin tests with a 3x5 array and breakwater.

References

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