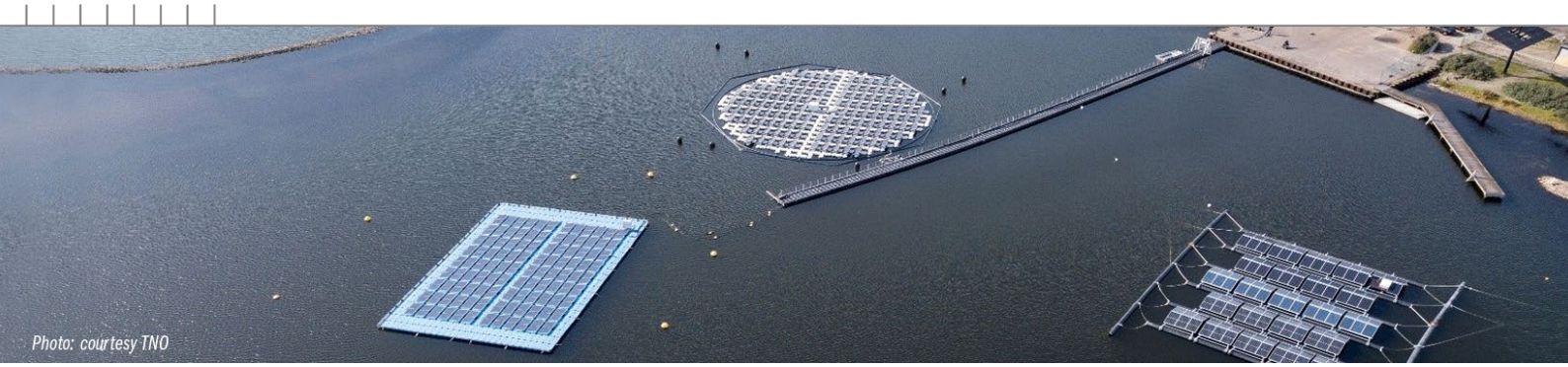


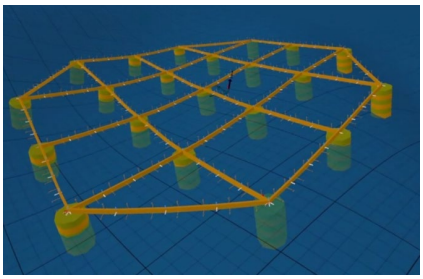
Photo: courtesy TNO

Services for floating PV systems

The acceleration of the energy transition requires the upscaling of proven systems for energy harvesting. In this respect, floating photo-voltaic (FPV) systems are now targeting deployment at nearshore and offshore sites where space is abundant. This upscaling, however, requires FPV designs to withstand the harsh environmental loading by wind, waves and current. MARIN can support FPV developers by hydrodynamic assessment of their concept at different stages of the design, through a combination of numerical and experimental modelling.

Services:

- Concept stage: preliminary design assessment through basin tests or low-fidelity numerical calculations.
- Design stage: high-fidelity time domain and/or CFD simulations to quantify motions, wave over-topping and impacts events, and mooring + interconnector loads.
- Verification stage: model tests of integrated FPV system.
- Monitoring stage: monitoring of the installed system.



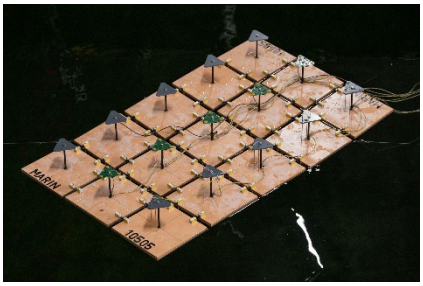
Concept stage: early stage model tests and low-fidelity simulations

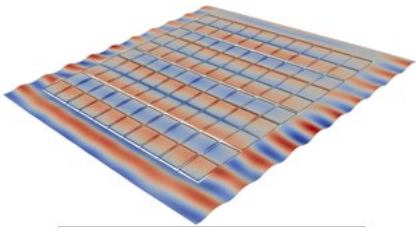
In the concept design stage, MARIN can assess the hydrodynamic feasibility of your preliminary design through early-stage wave basin tests. For sheltered environments, such as inland lakes or bays, basin tests can be performed at full scale with the actual design (up to waves with ~3 sec period). For nearshore and offshore environments, tests can be performed with a scaled-down version of the prototype. Wave basin tests give insight into motions, accelerations, and nonlinear events such as wave impacts and overtopping, both in operational and survival conditions.

As an alternative to wave basin tests, hydrodynamic calculations using low-fidelity MARIN tools (e.g. wave diffraction solvers) can provide insights into floater motions and interconnector loads for varying wave conditions. Calculations can be done for single- or multi-body FPV systems.

Design stage: high-fidelity simulations

When the floating PV design is more mature, MARIN can help improving its hydrodynamic performance and survivability through high-fidelity simulations. In this stage of design, a FPV system typically comprises multiple bodies that are interconnected through hinges or a surface mooring, and the entire system is moored to the sea bed. Hydrodynamic simulations of such integrated multi-body designs shed insights into motions, accelerations and interconnector loads under the action of wind, waves and current. MARIN time domain and computational fluid dynamics (CFD) software, validated for this purpose, can simulate both single- and multi-body systems, and both rigid and flexible floaters (see also ref [1]).





Related products:

- Determine the performance of your floating wind turbine
- Offshore support vessels
- Offshore Maintenance JIP

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Verification stage: wave basin verification tests

As an independent research institute, MARIN can perform wave basin tests for an independent verification of integrated FPV systems comprising multiple bodies, interconnectors, and (surface) mooring lines. Testing a design in MARIN's facilities subjected to wind, waves and current loading forms the closest and most accurate means of hydrodynamic design assessment before testing a full prototype in the field. MARIN has wide experience in testing floating PV systems in its basins, including both single- and multi-body systems, and comprising both rigid and flexible floaters. The modelling approach will be carefully selected by MARIN experts depending on the client's objectives and requirements.

Monitoring stage

When an FPV system is deployed, be it in inland or offshore conditions, MARIN's Performance at Sea department can monitor its performance in terms of motions and loads, by instrumenting the floaters with strain gauges and other instruments.

More information: JIPs and EU projects

NATURSEA-PV: https://www.marin.nl/en/jips/natursea-pv
Solar@SEA: https://www.marin.nl/en/jips/solarsea-iii
SUREWAVE: https://www.marin.nl/en/jips/surewave

References

[1] Otto, W.J., Bunnik, T.H.J. and Kaydihan, L. (2022); "Hydro-Elastic Behavior of an Inflatable Mattress in Waves", 9th Int. Conf. on Hydroelasticity in Marine Technology.