



## Floating solar services

Floating solar enhances the abundant resource of solar energy. It enables efficient land use, experiences less shading, and increases panel efficiency due to the cooling effect of the water body below. MARIN offers hydrodynamic and nautical analysis of various types of floaters, installations and operations offshore. We have extensive experience in many facets of the design and evaluation of Floating Photovoltaics (FPV) systems and have been involved in the verification of different FPV systems with varying characteristics at various stages of development.

### Services:

- Concept exploration
- Design assessment and improvements
- Design finalisation and verification
- Monitoring of prototype and farm

From the early concept phase to the operational phase, our experts, facilities and tools can help FPV designers and operators to further develop, verify, and monitor their systems. We have an independent position as a non-profit research institute which allows for an unbiased evaluation of FPV designs and of design methodologies, reducing uncertainty and strengthening confidence in the design.

### *Concept exploration*

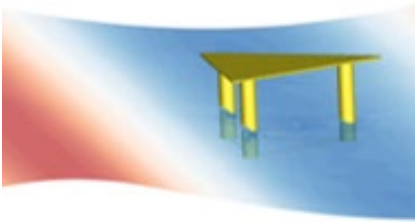
In the concept exploration phase, we can assist you evaluating different design concepts and the overall design through dedicated design reviews. Additionally, MARIN provides guidance on local environmental conditions, analyses motions and connector loads on the conceptual farm, and conducts preliminary parametric sensitivity assessments and farm sizing. These evaluations are carried out using low-fidelity numerical tools for wind load calculations and motion analysis in the frequency domain.

### *Design assessment and improvement*

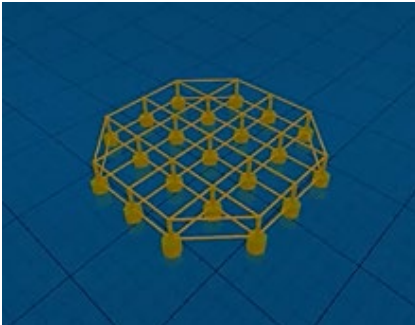
As the design progresses, MARIN offers more in-depth studies on motion and connector loads, including mooring analysis. This is achieved through improved load estimations using time-domain numerical simulations and Computational Fluid Dynamics (CFD). At this stage, early-stage basin testing can also be conducted to provide deeper insights into the motion behaviour in wind-driven waves.



Offshore Basin testing on the Merganser platform



CFD calculations on the Merganser platform



Time domain calculations on the NATURSEA-PV platform

#### Related products:

- Towing studies
- O&M logistics
- O&M vessel selection
- O&M operation training
- Solar farm traffic safety assessment

For more information contact MARIN:

William Otto

T + 31 317 49 34 22

E w.otto@marin.nl

### Design finalisation and verification

As the design matures and approaches the production phase, MARIN offers extensive basin testing to verify the farm's behaviour in waves, wind, and currents. For inland floating PV systems, designs can be tested for survival and fatigue loading at full or model scale. This can be complemented with additional numerical modelling using validated basin data ('model-the-model') and mooring optimisation.

### Monitoring of prototype and farm

In the operation phase, it is crucial that the system behaves as predicted and that the loads generated remain below the designed values. To facilitate this, MARIN offers onsite measurements of the prototype or farm, including visual inspections, measurements of motion, accelerations, connector and mooring loads.

### State of the art tools

Developed in-house, DIFFRAC and aNySIM XMF are state-of-the-art software tools for hydrodynamic frequency and time-domain simulations, suitable for modelling floating solar PV systems, including the mooring system. We use our in-house developed CFD code ReFRESKO for calculating wind loads on PV panels and perform simulations of platforms in combined wind and waves. Detailed assessments can be conducted in our high-end wave basins to gain insights into the physical interactions of the mooring system and floater under different loading conditions. These model tests are essential for proof-of-concept demonstrations and certification.

### Expertise and experience

MARIN is an independent and innovative service provider specialising in hydrodynamic assessments and investigations. With over 90 years' experience, we are fully conversant with the challenging metocean conditions in oil & gas and renewable energy projects worldwide. MARIN offers services for hydrodynamic analysis of various types of floaters, installations and operations offshore.

This expertise and experience are combined in performing hydrodynamic studies for floating solar systems. Thereby, frequency domain and time-domain simulations, model tests and on-site measurements are carried out to gain insight into the limitations of innovative systems. We have previously collaborated with Merganser (Solar Duck), SeaVolt, Zon op Zee (Oceans of Energy), Solar@Sea (Bluewater), Zon op Water Field test at de Slufter, Submerged Solar (Sunfloat) and many more.



Concept Basin testing on the bamboo platform



On-site measurements on FPV plant