MARIN

BETTER SHIPS, BLUE OCEANS

Survivability of floating PV parks in storm conditions

William Otto

Maritime Research Institute Netherlands (MARIN)

Independent and innovative service provider for the maritime sector in hydrodynamic and nautical research

Who we are

Design to Operation

Global player with Dutch roots

>85

85 years young

Wageningen, Houston, Shanghai, Sao Paulo

- **250 projects a year**
- **150 ship models a year (80% starts on computer)**
- **100 numerical projects (50% RANS)**

380 employees

€ 45 M revenue

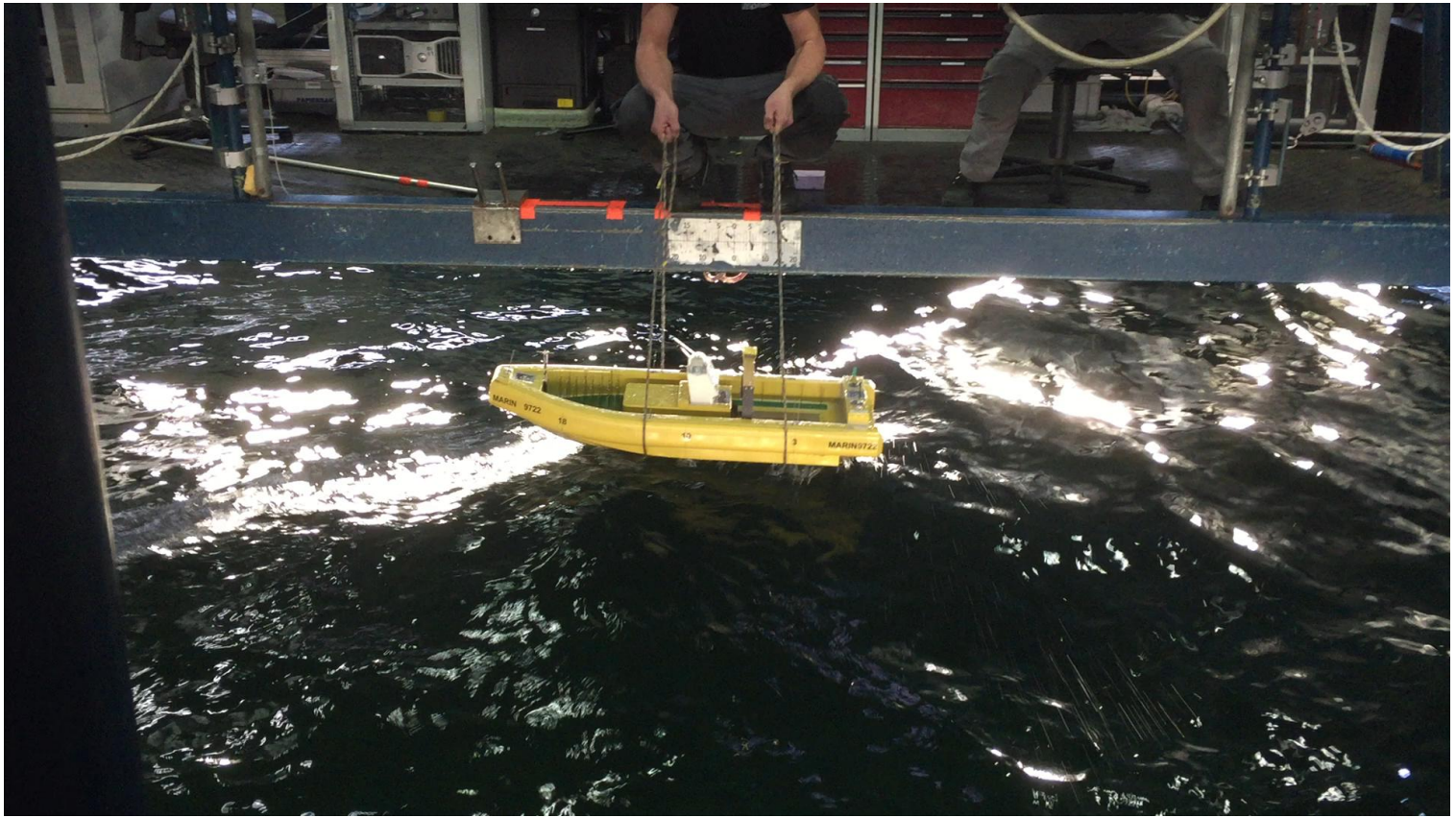
37% Dutch, 30% EU and 33% international

Active in 39 countries

Facilities

- Offshore Basin
- Seakeeping and Manoeuvring Basin
- Depressurised Wave Basin
- Deep Water Towing Tank
- Shallow Water Basin
- Concept Basin (MARIN Academy)
- Cavitation Tunnel
- Full Mission Simulators
- Tug Stations
- Vessel Traffic Simulator
- Full Scale Monitoring Systems
- Numerical Tools & Calculation Cluster

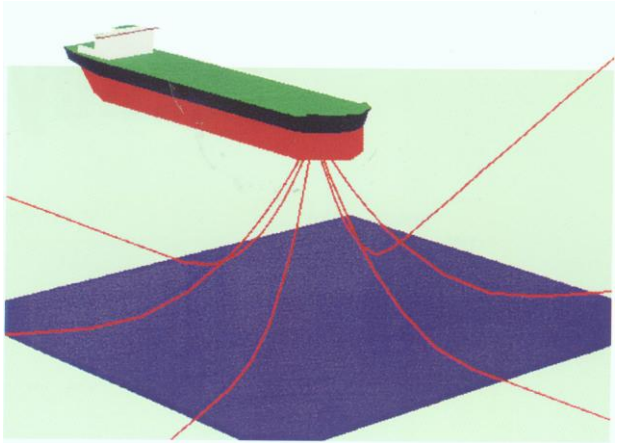
Another day at the office ...



Floating Solar

A floating solar farm is different from a moored ship;

- Light payload;
  - Panels
  - Converters
  - Cabling
  - Less than 100 kg/m2
- Payload only gives centimetres of draft
- Large lightweight construction -> flexible



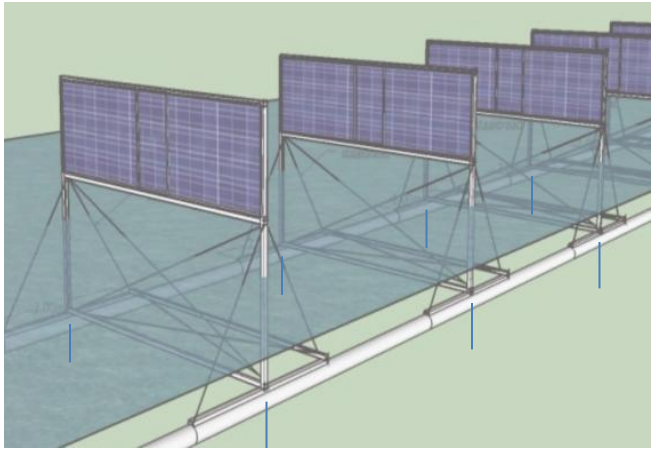
Moored tanker; meters of draft and large bending stiffness

RVO PROJECTS WITH MARIN IN FLOATING SOLAR

- **Zon Op Water**
  - SEAC, Sun Projects, Sunfloat, Wattco, Texel4Trading, MARIN
  - Field measurements on forces, wind speed and wave height
  - Area: “de slufter”
- **Submerged Solar**
  - Sunfloat, ECN, Tempress, MARIN
  - Basin scale tests and mooring simulations
  - Area: “Ijselmeer”
- **Zon Op Zee**
  - ECN, TNO, MARIN, TAQA, Oceans of Energy
  - Basin scale tests and mooring simulations
  - Area: Noordzee
- **Solar@Sea**
  - ECN, Avans, Sunray-Flex, TNO, MARIN
  - Concept: drijvende folies
  - BT testsen en aNySIM simulaties
  - Gebied: Noordzee

AN EXAMPLE, Submerged Solar

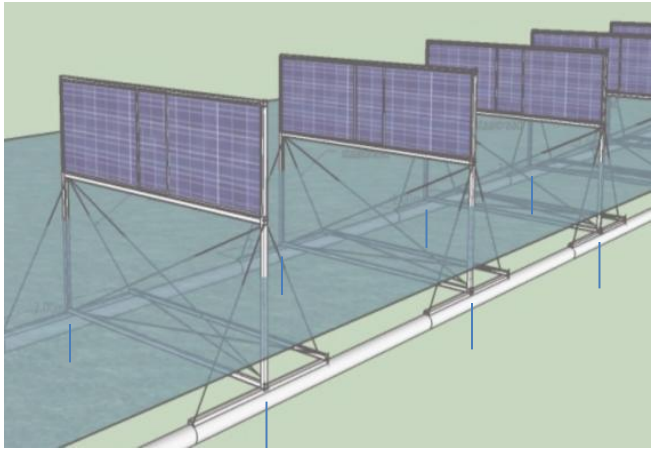
- Reducing wave loads by placing the buoyancy modules below the waves
- A large flexible platform instead of many small platforms connected
- No covering of the water surface for ecology
- Bi-facial panels for optimal energy yield



Artist impression of a section

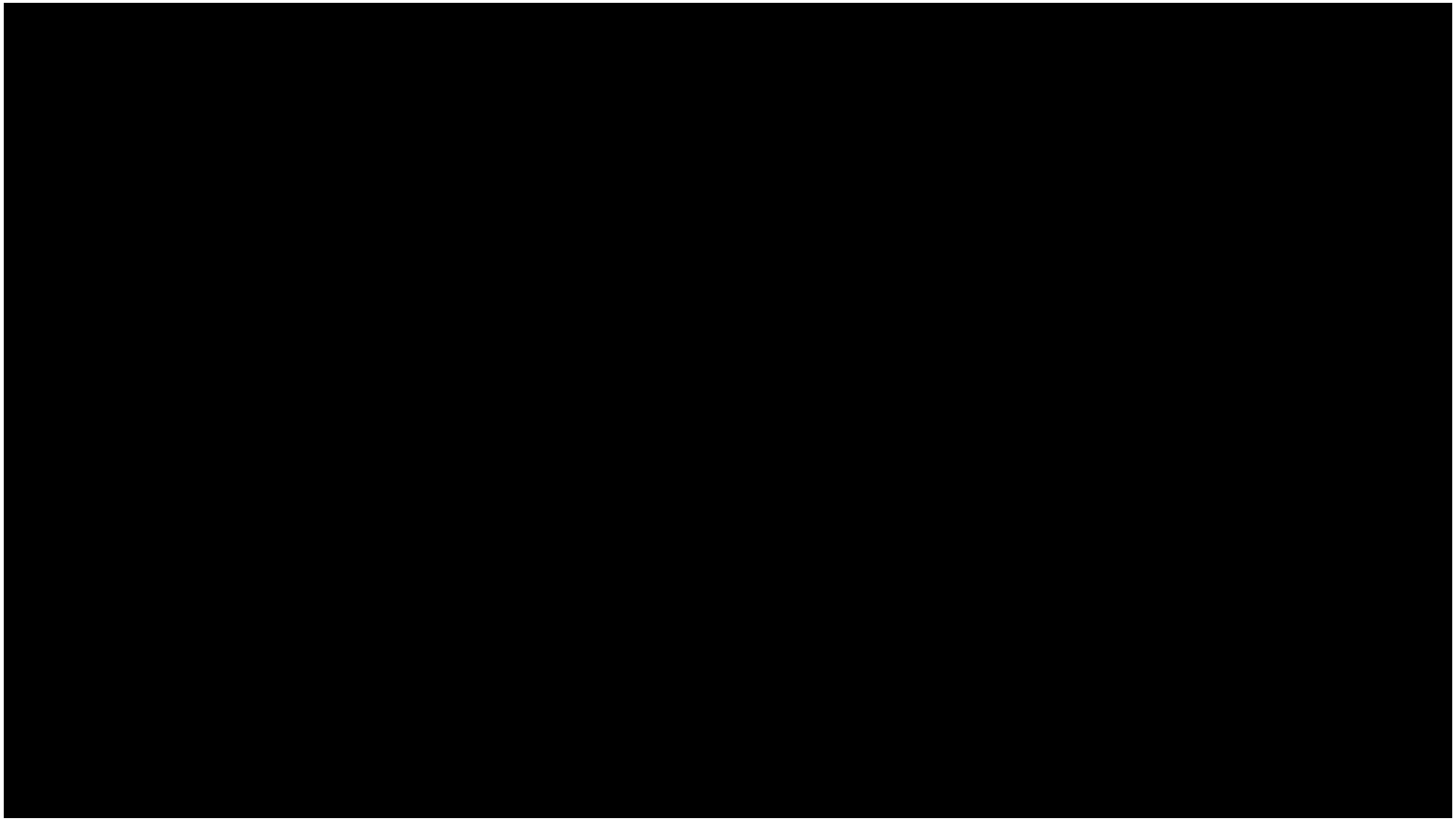
AN EXAMPLE, Submerged Solar

- MARIN Work;
  - Analyzing the environmental loads
  - Analyzing the dynamic motion response
  - Making a numerical simulation tool
  - Validating the simulations with model scale basin tests (scale 1:2.5)
  - Optimizing the design



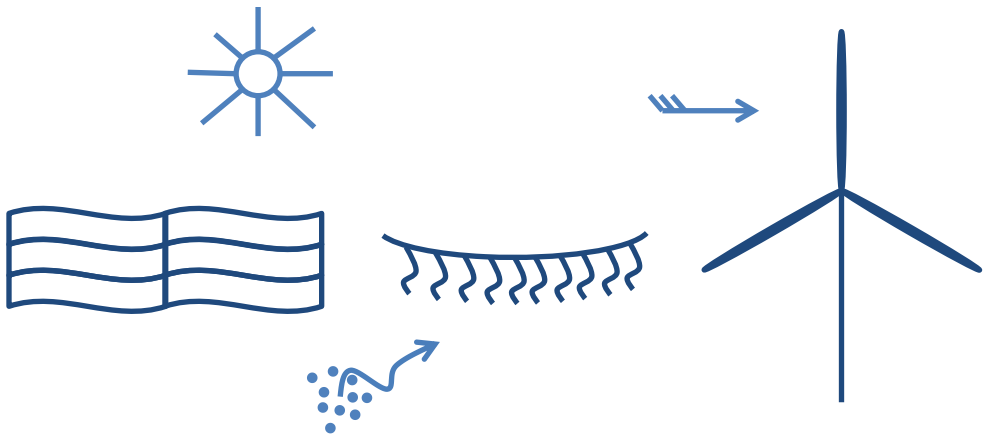
Artist impression of a section

AN EXAMPLE, Submerged Solar



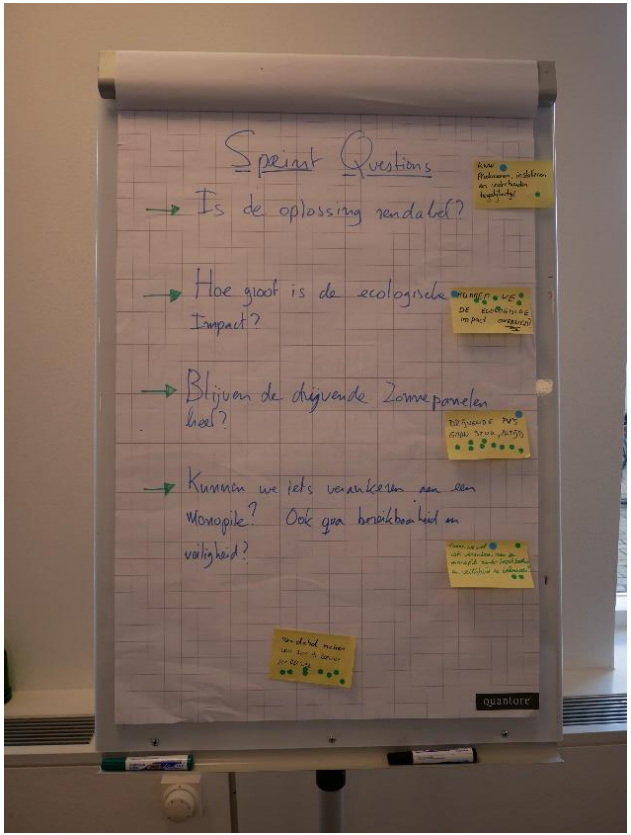
Another example: Open innovation ‘Multi-use concept’

- Design challenge in multi-disciplinary design sprint
  - Universities
  - Shipbuilders
  - Wind turbine foundation specialist
  - Biologist
  - Research Institutes
- Wind, solar, seaweed farm to be designed
- Make use of possible synergies

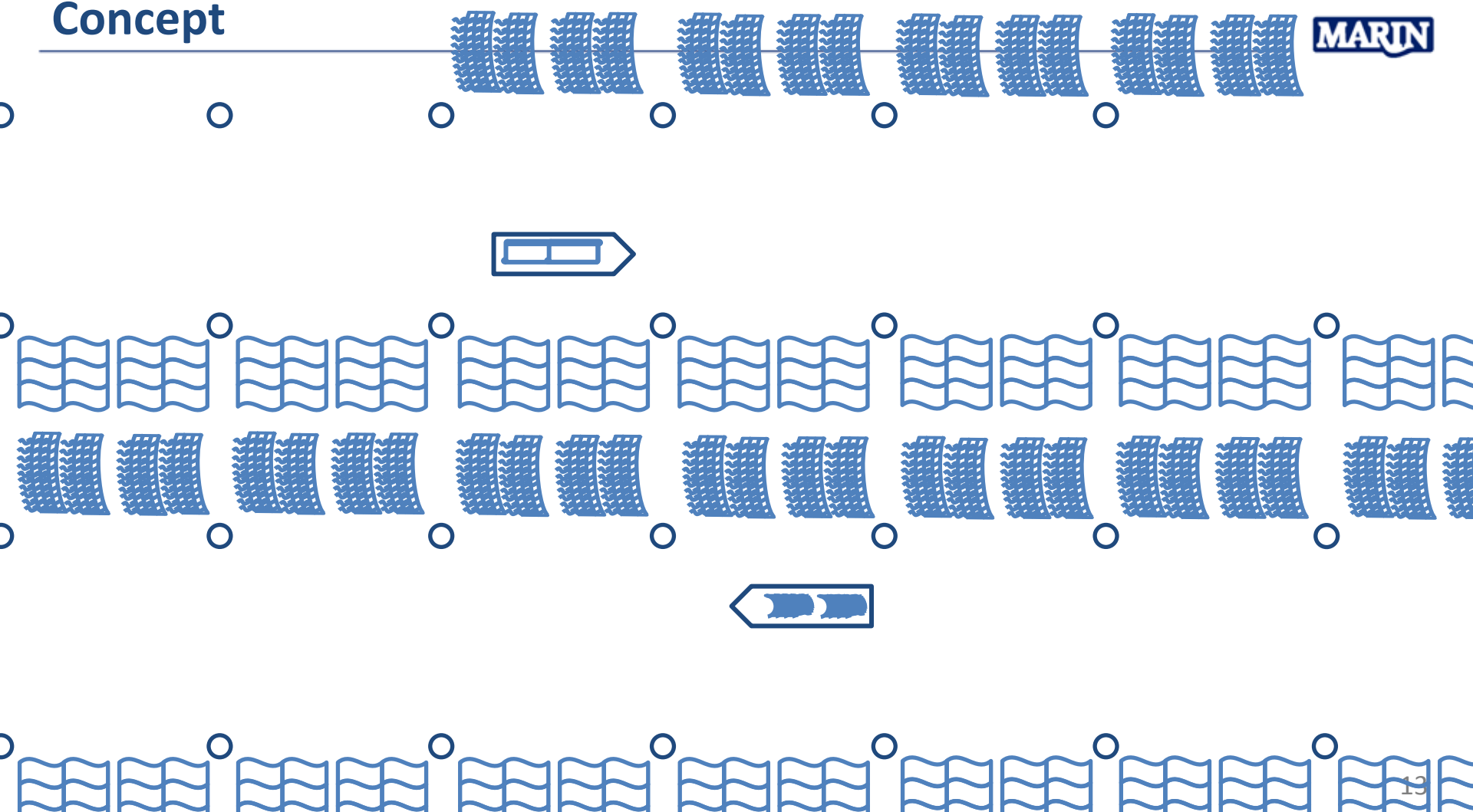


Sprint questions

- Maximize the energy and food production on the North sea per m^2
  - Is the solution viable?
  - How large is the ecological impact?
  - Will the structure stay intact?
  - Can we moor things (close to) the support structure of the wind turbine? Also taking into account safety and accessibility.

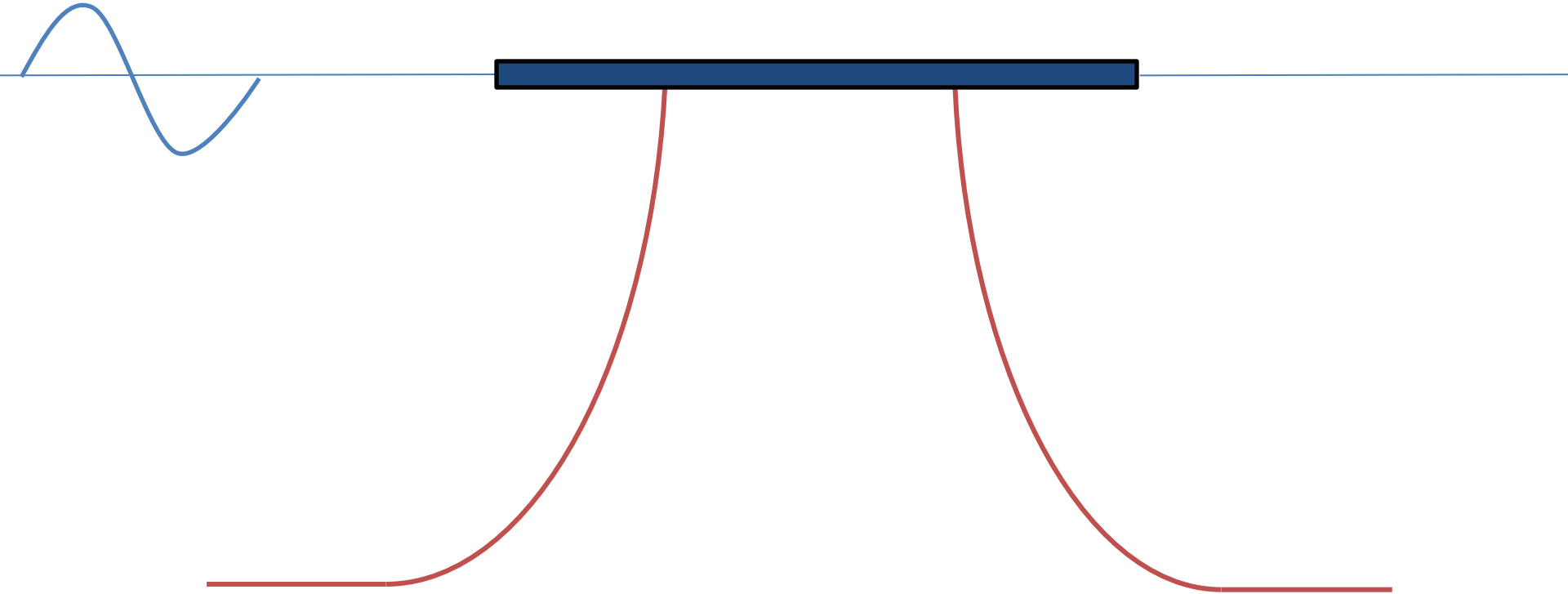


Concept

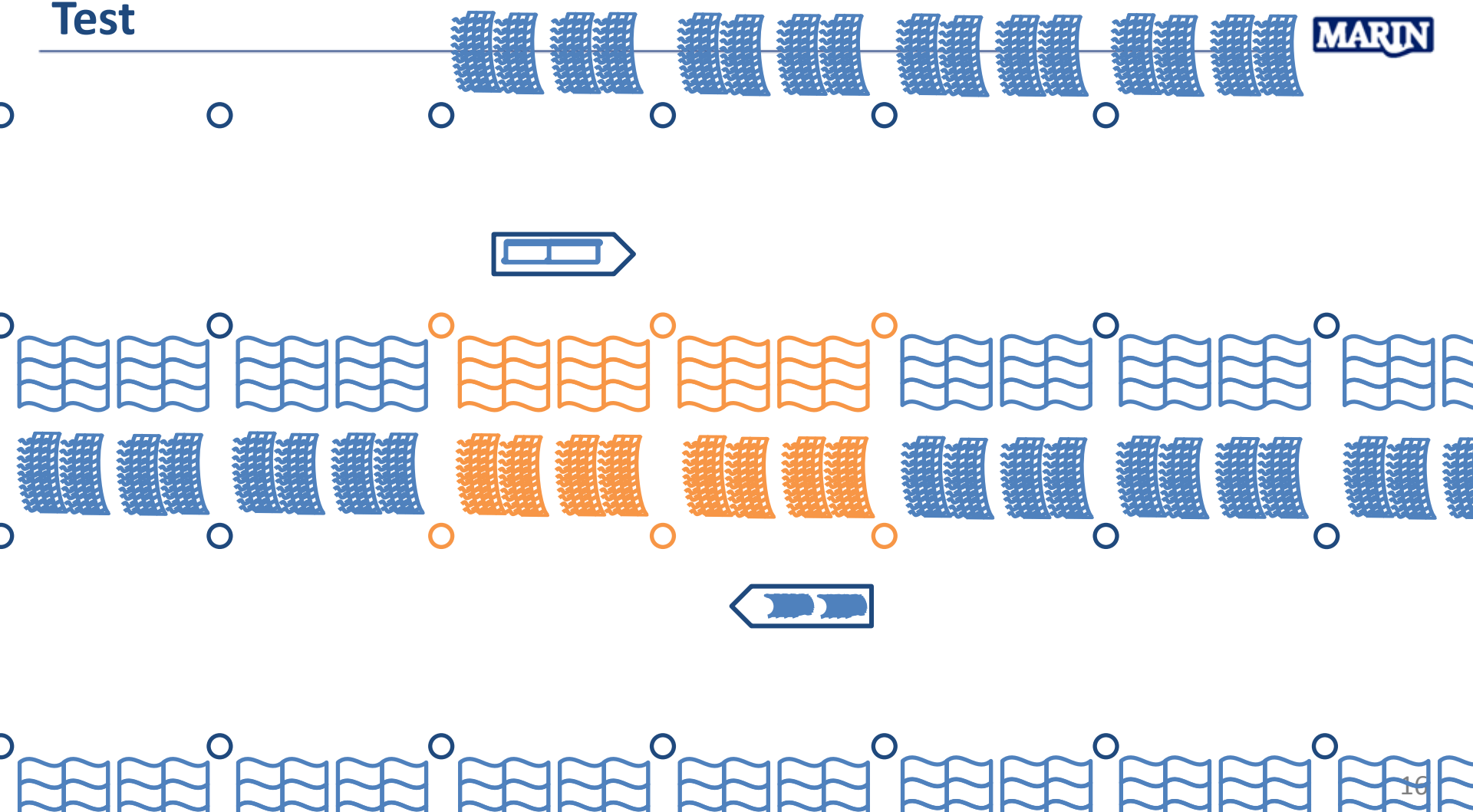


Mooring

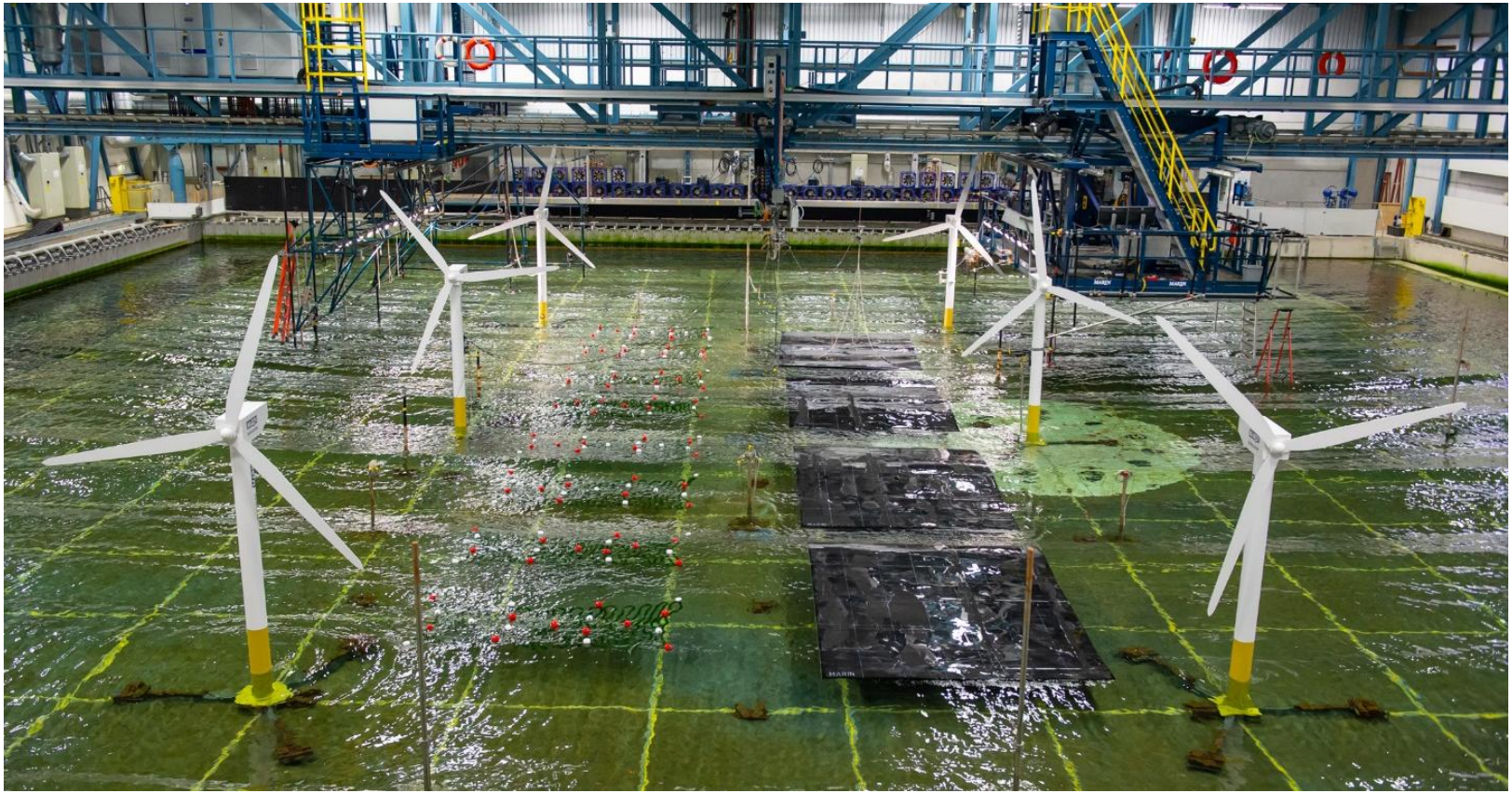
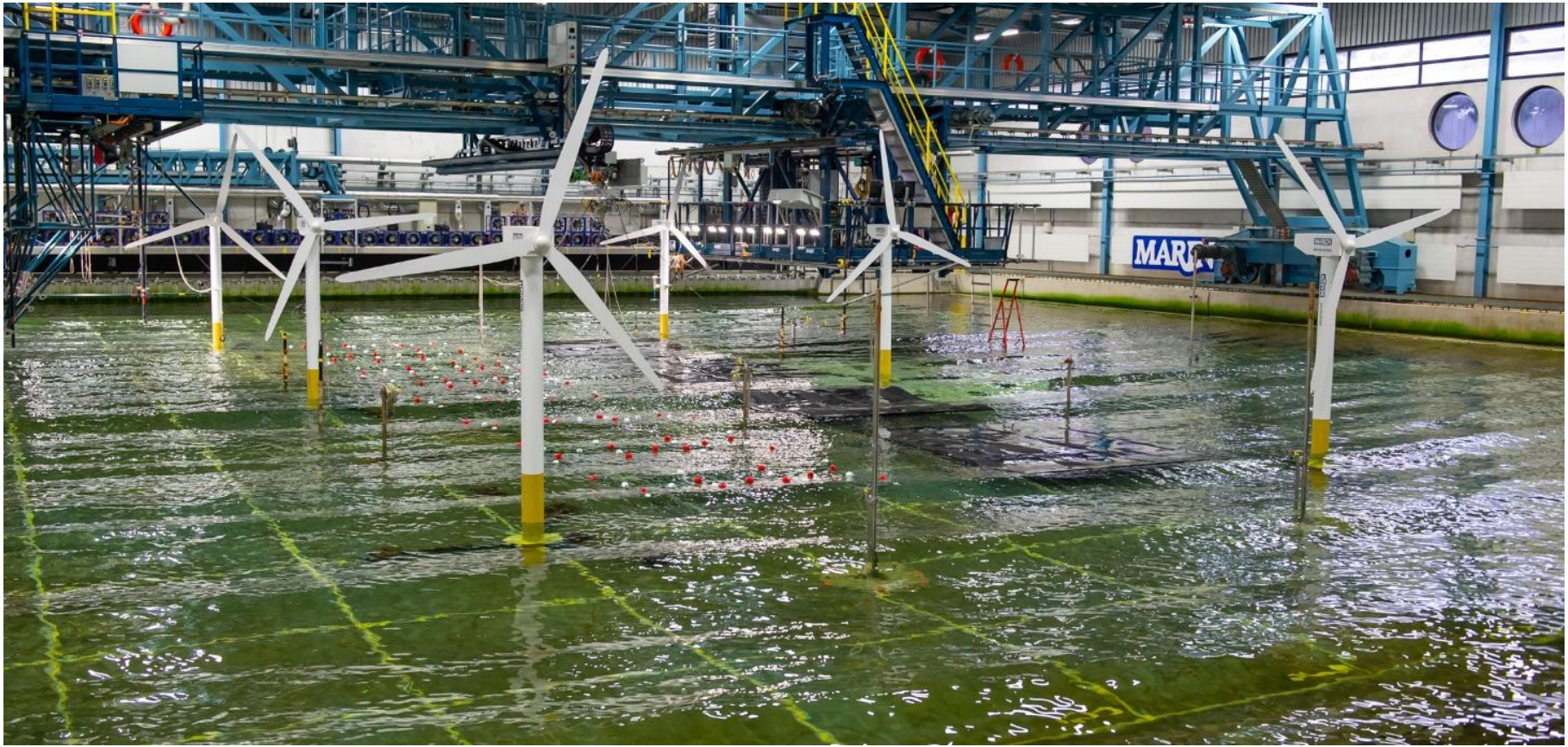
Mooring



Test



Tank



Thank you!