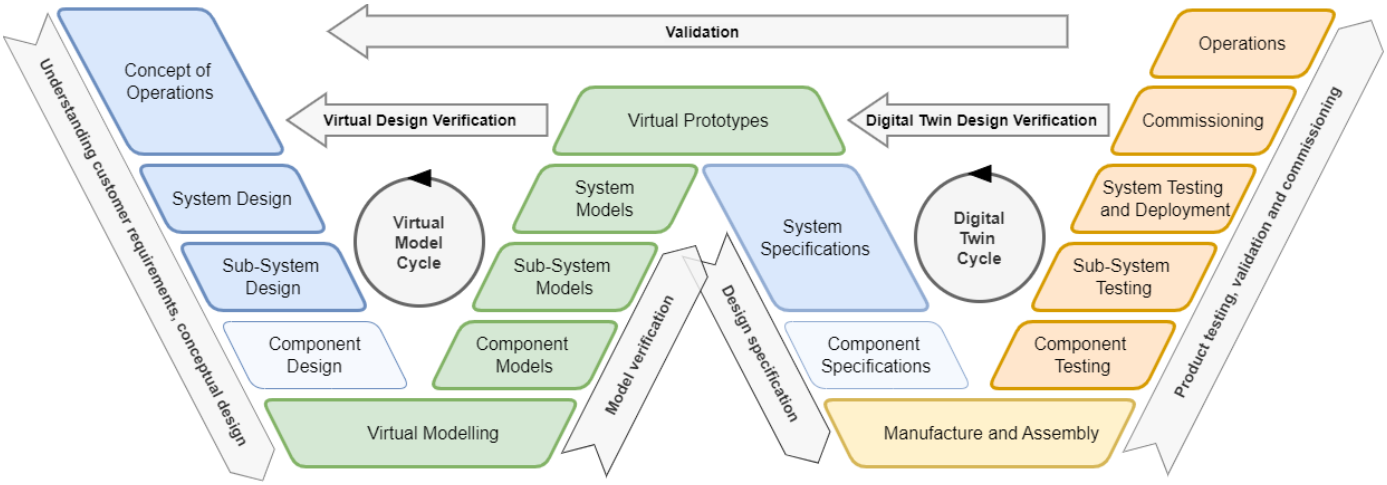
Marine Power Systems

Modelling, Simulation & Testing Services

Effective decision making on upcoming alternative propulsion, power and energy systems on ships

Design offices, shipping companies and shipyards are searching for cleaner ways to transport, but the variety of alternative energy solutions to choose from is wide and continuously developing. However, integrating new fuels and power conversion methods in ship Power, Propulsion and Energy (PPE) systems can pose considerable risks across the lifecycle. As an independent research institute, MARIN supports risk reduction across the different stages of the development lifecycle of vessels using simulation methods and testing across different facilities. Our host of Zero Emission Services assists you in decision making on upcoming alternative Power, Propulsion and Energy systems (PPE) onboard of your ships.

The use of model based simulation and testing through the life cycle of the vessel from early stage design to deployment and commissioning, is accommodated by the W-model. Our virtual models can be used to verify that designs meet requirements and can be used to refine designs accordingly when needed. Through digital twinning these models can serve to optimize the ship and its operations.



MARIN offers Simulation & Testing services across the development lifecycle of vessels

These virtual models can be of varied complexity, fidelity and behaviours depending on the needs of the intended use. The models are taken from our MARIN libraries or can be made customer specific.

Services overview

1. **Conceptual Design Verification and Evaluation**
   Reducing risks by early stage verification of the conceptual design.
2. **Virtual Vessel and Digital Twinning**
   Developing virtual test platforms and digital twins for PPE systems.
3. **System & Sub-system Testing**
   Testing systems in a simulated or lab-scale operating environment.
4. **Troubleshooting**
   Comprehensive support to tackle challenges from a system integration perspective.
5. **Training & education**
   Crews, maintenance engineers and designers learn how to handle new technologies and systems.

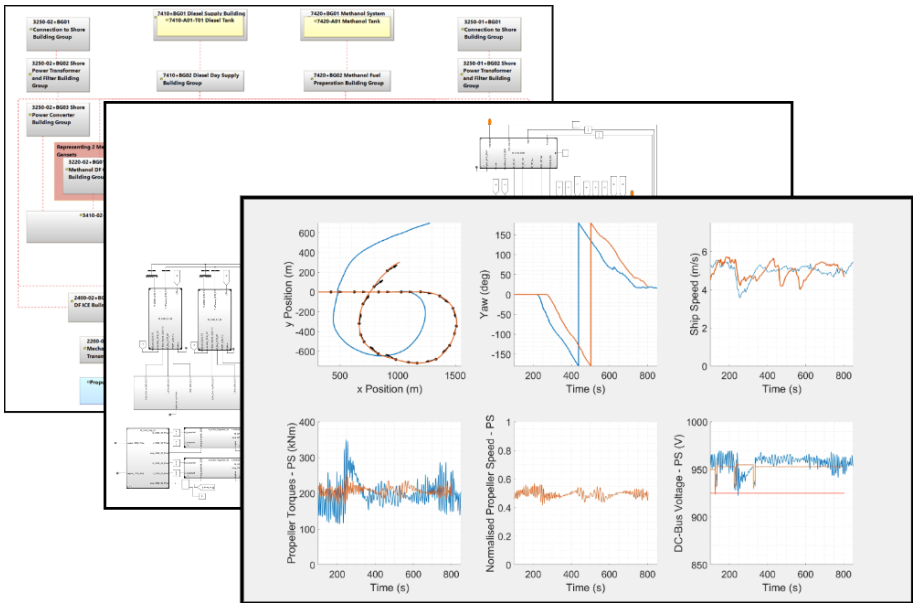
Our mission 'Better Ships, Blue Oceans'

Research institute MARIN is a provider of advanced expertise and independent research to the maritime industry. Using the newest test facilities and simulators and working together with an extensive innovation and research network we achieve our goal: the development of cleaner, safer and smarter ships and sustainable use of the sea.

Onboard trial and/or monitoring data will be used to compare against simulations.

1. Verification and evaluation of conceptual designs

The risks of integrating new and innovative PPE systems can be reduced by performing verification tests at an early (concept) design state. This identifies integration challenges and, when performed within a design methodology (Model-Based System Engineering) with clear traceability of user needs and functional requirements, enables early-stage risk reduction in the design process. The verification is performed by authoring and performing test cases based on requirements that have been developed through the conceptual design.

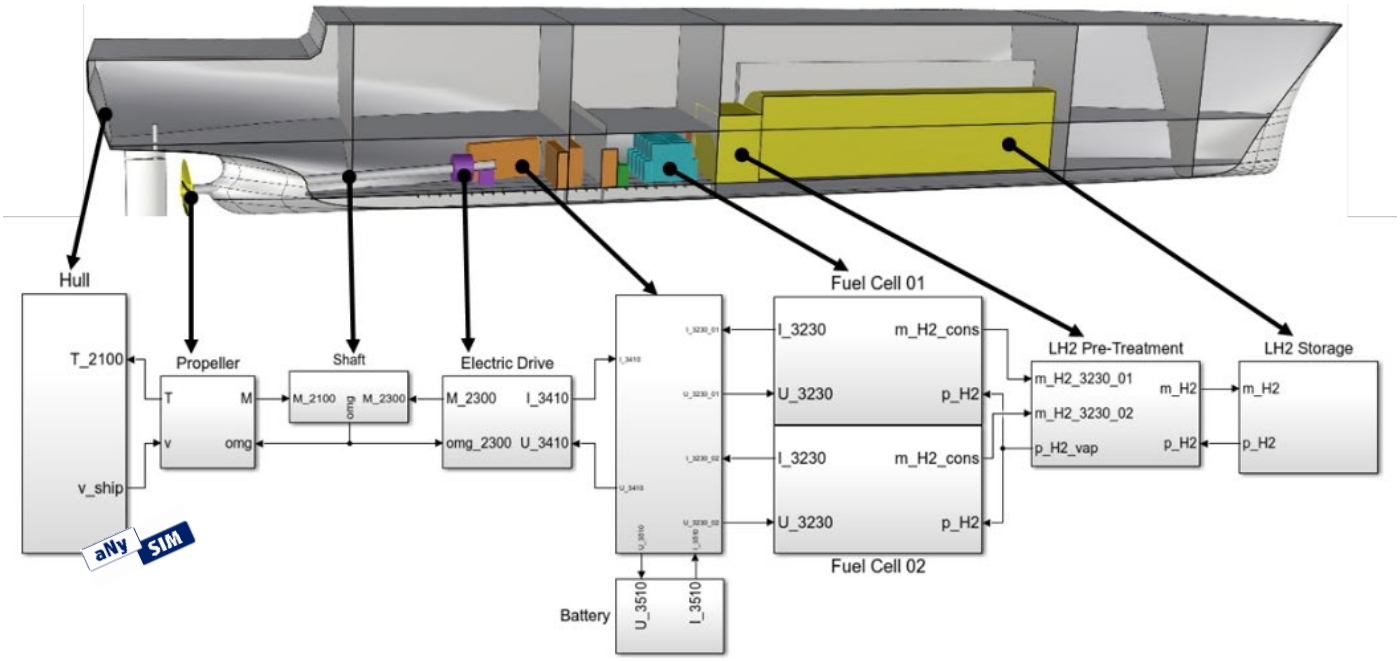


The physical architecture of the concept design is used to generate a simulation model of the PPE system and the requirements are used to author the test cases to be performed.

The developed models can be used to offer design refinement advice by analysing the performance of the system against defined benchmarks. A result of these analyses is the refinement of design specifications for systems that can serve as a starting point for further detailed engineering and design.

2. Virtual vessel and digital twinning

A virtual representation of a vessel i.e., a virtual vessel consisting of digital models, can be used by designers and operators to study the performance of the vessel. This serves as a virtual platform where new control approaches, design adaptations and operation methods can be tested before they are implemented in the real world vessel. During the operational phase of the vessel, the virtual vessel can be used by operators to plan operations, perform mission management, and provide decision support to the crew.

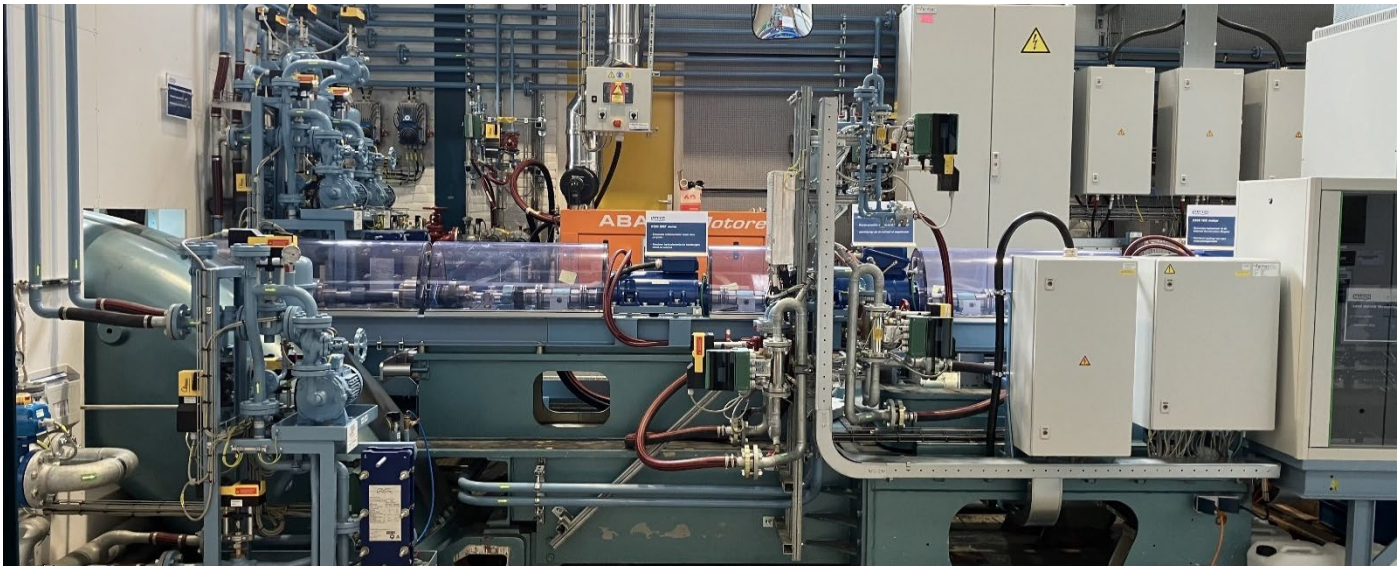


Simplified example of a virtual vessel model

When connected with data streamed from physical systems, the virtual vessel can be turned into a digital twin of the system. This allows an up-to-date representation of the real vessel or system which can then be used to optimise operation. For example, the digital twin can be used to update control specifications based on the actual performance of the different power sources, or to identify the health of different systems to enable predictive maintenance or health-aware control strategies. The digital twin can also be used to optimise operations at a mission management level.

3. System and Sub-system testing

With the virtual vessel or digital twin as a base, ship designers and owners can test systems and sub-systems in a simulated operating environment. This helps selecting the right system for the right operation. It can also help to identify optimal control strategies for systems and sub-systems.
When a virtual model or digital twin is used in conjunction with MARINs Zero Emission Lab, Hardware-in-the-Loop tests can be performed on physical systems with the virtual model providing load profiles based on a simulations of operating conditions.



The physical Zero Emission Lab, having a mechanical electric propulsion drive, containing sophisticated electrical power distribution powered by a PEM fuel cell, a modern dual fuel generator set and super capacitors.

An example of measurements on a system suffering from common mode issues and the simulation model built to identify solutions.

Why choose MARIN?

- Independent advice.
- Holistic approach.
- Proven MBSE-methodology.
- Almost 100 years of experience.
- Integrated hydrodynamic expertise.
- International research network.
- State-of-the art test facilities.
- Multidisciplinary team.

For more information and to discuss how to use these services for your projects, research or training, please contact:

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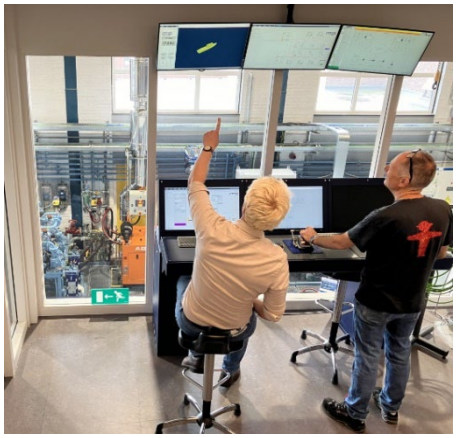
4. Troubleshooting

Future proof PPE systems involve intricate high-tech subsystems demanding top-tier integration across mechanical, electrical and automation & control boundaries. MARIN offers comprehensive support when problems arise. With our team of naval architects, mechanical, electrical, engine, control & automation specialists as well as our on-board measuring and hydrodynamic experts, we specialise in a multi-disciplinary approach, tackling challenges from a system integration perspective. We address your queries and issues through measuring, modelling, virtual and physical testing, analysis, consultation and reporting and are able to demonstrate the proposed solution.

5. Training & education

The machinery and bunker spaces of the future contain new technology that require education and training. A striking example is the introduction of modern electrotechnology and advanced control and automation. New fuels and energy carriers come with new properties and safety precautions.

In the recent years, MARIN has developed design, simulation and test skills for those new systems. With its Zero Emission Lab, MARIN even provides a physical laboratory, containing a fuel cell, hydrogen, a modern dual fuel generator set, and sophisticated electrical power distribution. Crews, maintenance engineers and designers are able to experience there how these modern systems work, feel, sound and smell and what procedures they have to follow to operate them safely. MARIN's design, simulation and test capabilities offer excellent possibilities for education and training.



Control Room of the Zero Emission Lab

When combined with MARINs Seven Oceans Simulator centre (SOSc), the crews can experience what it is like to sail a vessel with an alternative PPE system. These trainings allow crews to experience the performance of the PPE system and its effect on the handling of the vessel in different operating conditions.

The Large Motion Simulator (on the left) in the SOSc with a moving bridge of 4 x 5 m on a hexapod and the Full Mission Bridge Simulator (in the middle).