

# ZERO JIP

Building the engine room of the future together

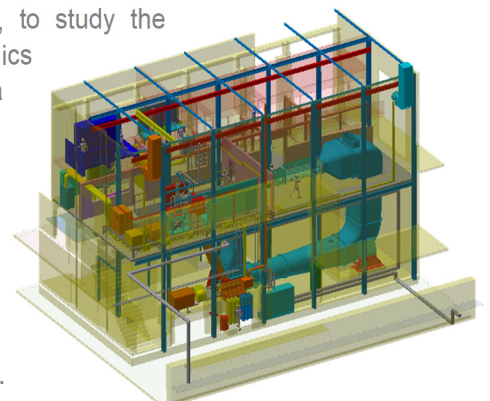
**THE FUTURE IS NOW** The energy transition and decarbonisation of the maritime sector is well underway. New (IMO and other) regulations will transform ship propulsion to carbon neutral and ultimately zero emission operations. This creates business opportunities, but is also very challenging. It raises many questions and uncertainties. Given the relatively long life cycle of ships, upcoming choices for ship owners, shipyards and naval architects are difficult to make. What will be the fuels of the next decade, how energy will be stored on board, distributed and managed, which power system will impose itself and fulfil the ambitions, which bunkering will be available in most harbours? MARIN is proposing the ZERO JIP to prepare ourselves as maritime sector for these questions together. The objective of the ZERO JIP is: *to design, build and test a prototype Engine Room of the Future to assure reliable future operations in realistic conditions.*



The ZERO JIP will consider the most relevant options in this transition. Electric motors will probably be the prime movers for propulsion, but many options remain open for the type and appearance of the energy carrier(s) and energy converters. New (synthetic) fuels, batteries, hydrogen and other energy carriers will be combined with Internal combustions engines (ICEs) or fuel cells in hybrid systems. The (electric) power system with DC distribution and the different energy carriers with their own power and energy density and consequential volume and weight will have to be considered at early design stage as they will impact the design constraints, the operations, the shipping logistics and economic feasibility.

## Building the engine room of the future

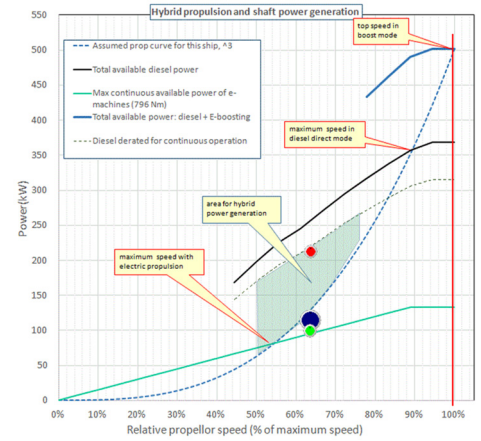
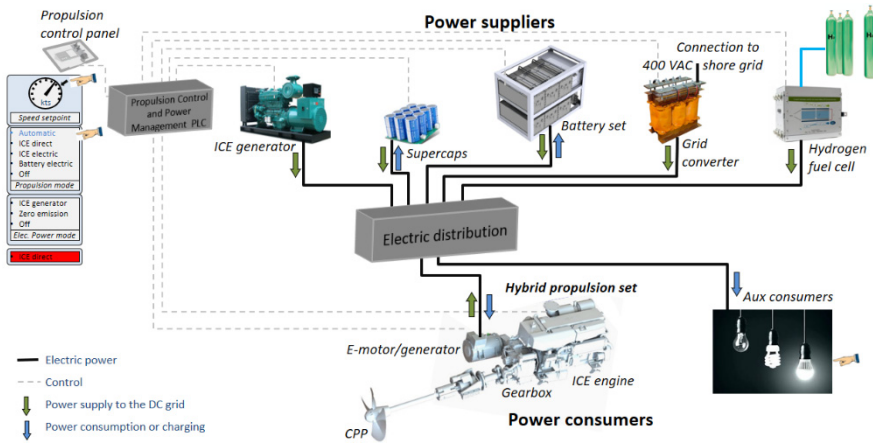
To make progress in this vital field concrete, we will build and test, together with the maritime sector, the most promising options as prototype Engine Room of the Future in MARIN's Zero Emission Lab (ZEL). This physical lab allows, as extension of MARIN's large Cavitation Tunnel, to study the interaction between hydrodynamics (dynamic and transient phenomena such as cavitation, ventilation, crash stops or manoeuvring) and power system dynamics. This ensures that solutions created will be able to operate in real-life conditions and operational profiles. MARIN will also develop and benchmark a numerical model (digital twin) of the engine room.



### JIP application is relevant for:

- Shipyards
- Ship owners
- Naval architects & Design offices
- Navies
- Power system suppliers
- Classification societies

TU Delft, TNO and HAN are research partners



Schematic overview with power system components (left) and example of speed-power curve of a hybrid system (right).

### Expertise and experience

MARIN has set-up a team of experts in electrical, mechanical, control and systems engineering and hydrodynamics, with several years of experience in marine operations, power supply systems and high power wind turbine generators.

### Time schedule

An information day for the ZERO JIP will be organised in March 2020 at MARIN. The kick-off meeting is scheduled for May in Rotterdam, during the Blue Week. The project will take two years to complete.

### Project phases

Q3-4 2020	Engineering
Q1-2 2021	Building
Q3 2021	Operational
Q4 2021-end	Test cases
2020-2021	Tool (digital twin) development

### Participation fee

€25 k per year (total €50k)  
20 Participants

## Hands on experience and sharing experience

Together with the ZERO JIP participants MARIN will select the most promising future engine room concepts and their operational profiles. These will be built in the ZEL (and numerically as digital twin) as realistic prototypes, together with the testing equipment required. During this engineering and building process, we will face the same challenges that the maritime sector will be facing for new builds or refits. MARIN will share this experience with the industry and allow you to follow our technical discussions, decisions, modelling and numerical models that will be developed in the course of this project. In this way the ZERO JIP creates an environment for you as participant to learn, understand, follow the design and operate the Engine Room of the Future. This accelerates our joint learning curve in this vital field and prevents serious risks and problems in real projects.

## Participant involvement and deliverables

The participants of the ZERO JIP will be actively involved in the performance of the JIP. The participants jointly decide which options and operational profiles will be modelled. There will be quarterly progress meetings and demonstrations. Over the two year duration of the ZERO JIP, there will be a number of practical deliverables for the participants.

### Concept tool

MARIN has developed a concept tool SPEC (Ship Power & Energy Concept tool) that allows investigating and comparing different energy carriers and power conversion systems. Generic main characteristics of selected solutions are listed, including contained energy density to derive required volume and weight, typical investment price, efficiency (power output) and emission levels. Combining this with the expected range and required power allows to make a quick scan of viable solutions that can be evaluated according to user-defined criteria. This tool will be shared during the duration of the project.

### Technical documentation and quarterly meetings

All technical drawings and documentation of our selected solutions will be shared with the participants.

### Reports of operational tests

When the Engine Room of the Future with its selected configurations is operational in the ZEL, a series of experiments will be performed for realistic operational profiles. These operational tests will be reported to the participants. Also the results of the numerical model (digital twin) of the engine room will be shared with the participants. These tools can be shared on an 'as is' basis (no detailed user interface).

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