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.*

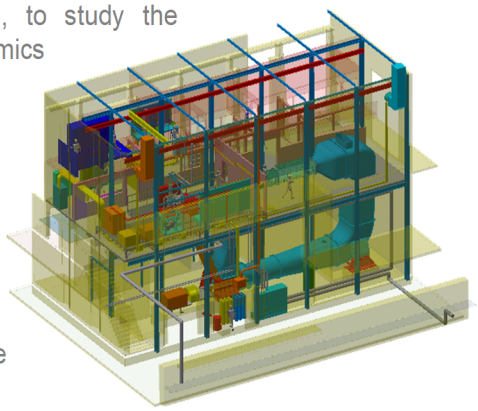
JIP application is relevant for

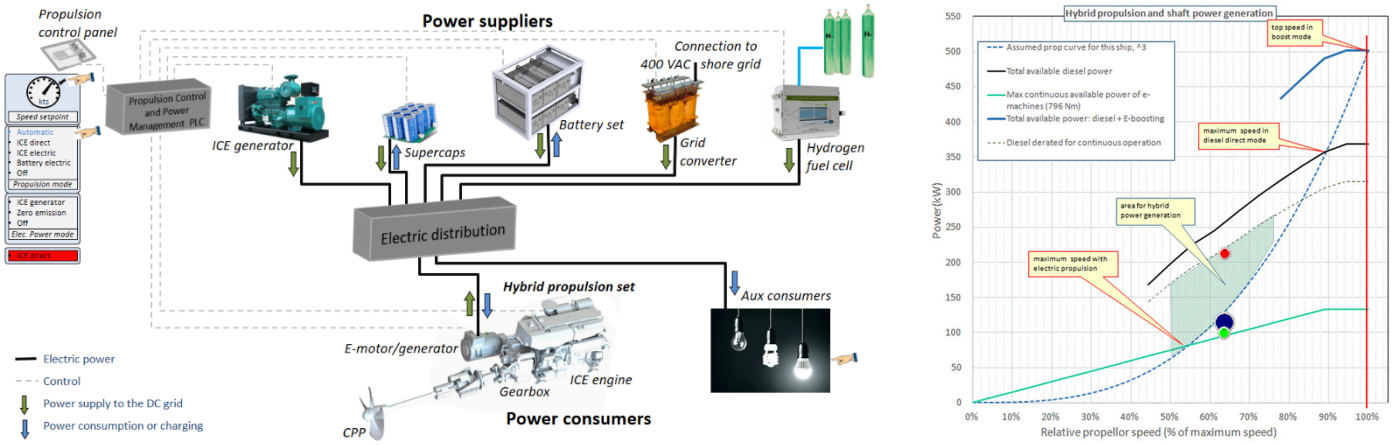
- Shipyards
- Ship owners
- Naval architects & Design offices
- Navies
- Power system suppliers
- Classification societies

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 the 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 (the v-ZEL) of the engine room.





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 was organised in March 2020 with a follow-up in June. The project kicks off in October 2020 and will take 2 years to complete. New participants are always welcome to join.

Project phases

Q4 2020	Design exploration
Q1-2 2021	Engineering
Q3-4 2021	Building
Q1 2022-end	Testing
2020-2022	Tool (digital twin) development

Participation fee
€25 k per year (total €50k), €30 k total for SME.

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Hands on experience and sharing experience

Together with the JIP participants MARIN will define ship types and operational profiles and design the most promising future engine room concepts which will be built and tested in (v-)ZEL. Model Based System Engineering will ensure clear traceability from operational requirements, to engine room solutions and performance with respect to operability and emissions.
During the 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 JIP participants will be actively involved. 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, several practical deliverables will become available for 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. This tool can be shared on an ‘as is’ basis (no detailed user interface).