MARINE HYBRID ELECTRICAL ENERGY GENERATION SYSTEM

Elektryka Morska

The International Maritime Organization (IMO) has been continuously setting ambitious ecological targets for the shipping industry. In addition to the 2020 Global Sulphur Cap, shipowners and operators must consider the greenhouse gas (GHG) targets for 2030 and 2050. The IMO has also set an Energy Efficiency Design Index (EEDI), mandatory targets for new ships on the maximum amount of CO2 emissions allowed for different vessel types and sizes to provide the same amount of transportation. Shipowners and operators have begun exploring more fuel-efficient vessels and low carbon fuel options and the ports around the world (especially in Europe) are moving towards “green” low-emission solutions.

In response to these tendencies many global engineering companies are developing hybrid drives for the marine industry, allowing a decline of CO2 emissions and fossil fuel consumption.

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Why choose our system?

The “green drives” solutions offered by the world’s biggest industrial players are currently very expensive, therefore aimed at the wealthiest shipowners. Our innovative ship hybrid drive is dedicated to smaller ships, with the maximum power of 1MW per motor. Our system is not only an eco-friendly solution but also an affordable one, even for smaller ship owners.

What do we do?

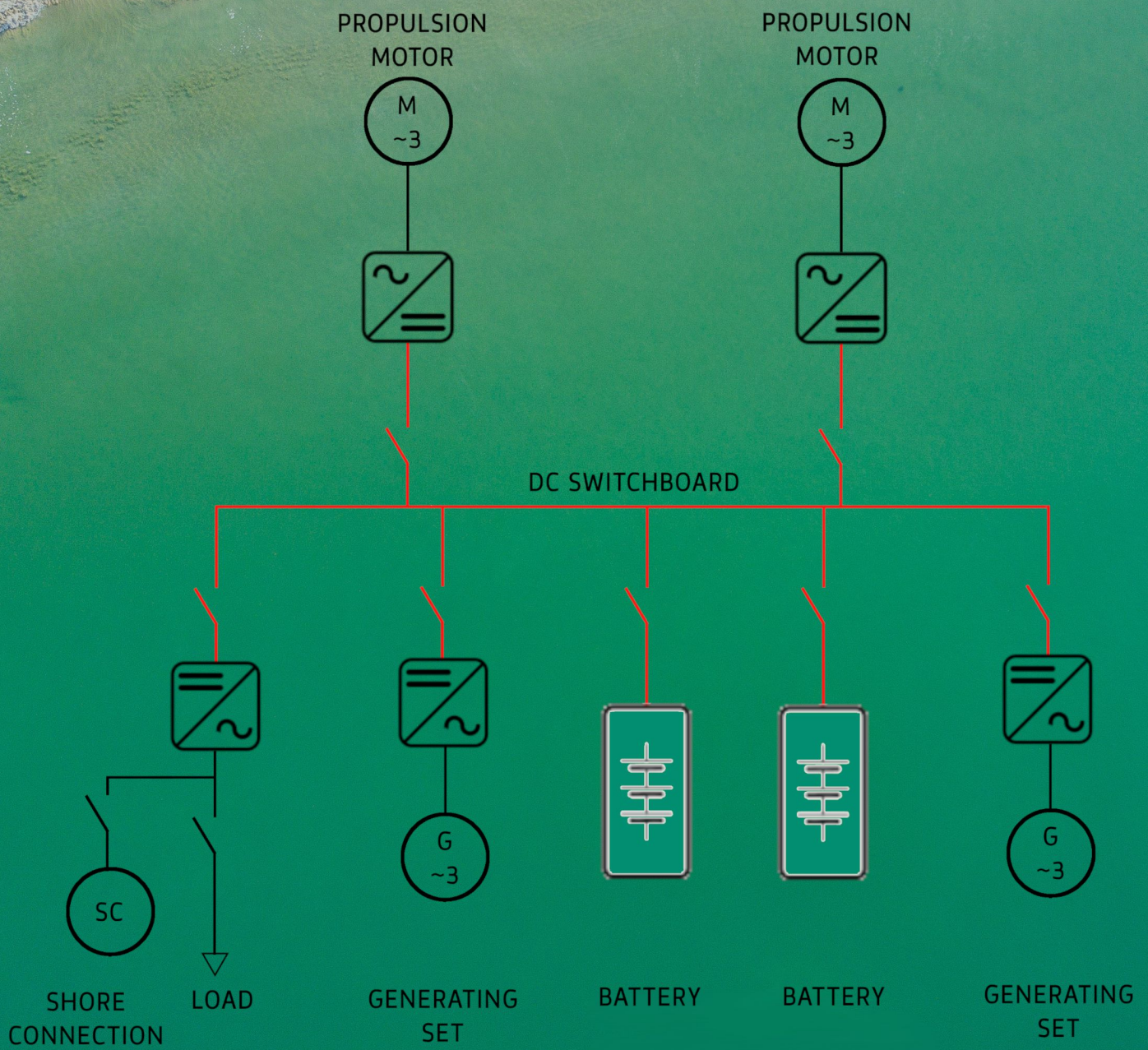
We have developed an electrical energy generation and distribution system based on DC voltage. The project was conducted together with a German frequency drive supplier and research scientists from the Maritime University of Szczecin. The system includes batteries as an energy storage system and generating sets operating at variable rpm. The main idea is to use the available power of generating sets for effective charging of batteries during the ships' voyage, as a result the engines of generating sets operate at their optimal point. When the batteries are charged to a certain level, the generators can be turned off or they will slow down and adapt their speed and power to the momentary demand of the system. It allows the batteries to work in “peak shave” mode, smoothing power fluctuations in the electrical system. This allows generating sets to work constantly at lower rpm and the revolutions is increased only when it is necessary.

In the generating sets we are using asynchronous motors as generators. It is the most cost effective solution.

The alternating voltage from the generator is rectified to DC voltage and the DC voltage is the basis of the electricity distribution system.

There are dedicated inverters integrated in our system that convert different voltages available for smaller consumers like 400VAC, 230VAC or 24VDC. Shore connection is also included in the system, allowing proper ship operation and battery charging during a stay at a quay (plug in hybrid).

The capacity of such a system can be different and depends on the total battery size. The complete system also includes IAS (integrated automation system) with an alarm and monitoring system, PMS (power management system) and a propulsion control system.



Electrical diagram of our system. One of the many possible system configurations that we can offer.

DC SYSTEM

AC SYSTEM

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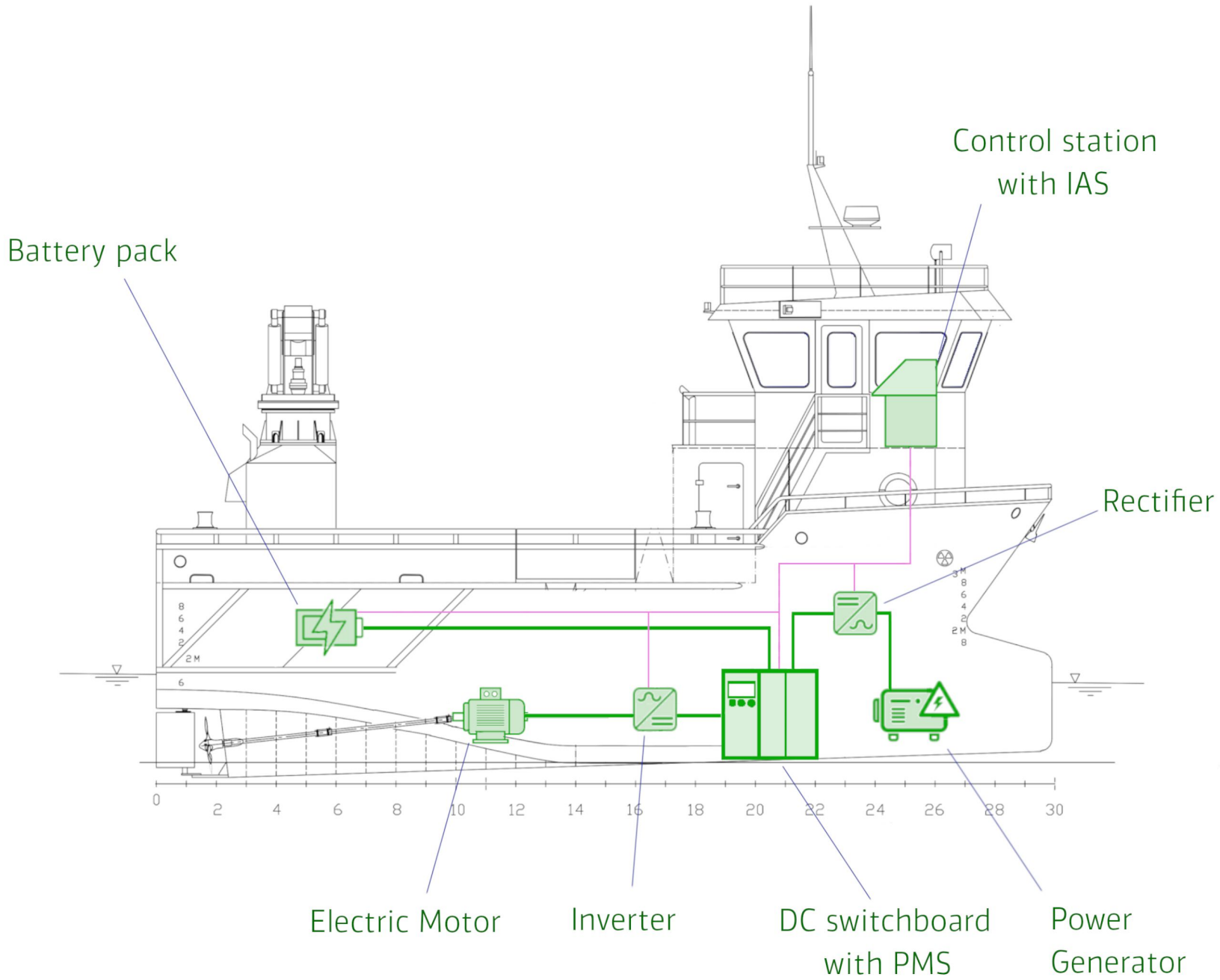
Why DC?

DC voltage has various advantages like no necessity to synchronize with other sources of power or it's relative ease in combining DC voltage with different electrical energy storage systems. Another interesting feature is that it doesn`t require using full frequency drives for propulsion, only half of the frequency drive will be used (the so called inverter part), which is also a cost effective solution.

The biggest challenge with DC systems is controlling the flow of energy between the system devices. Our innovative system allows effective and safe integration of system devices as well as optimal control of the energy flow amongst them.

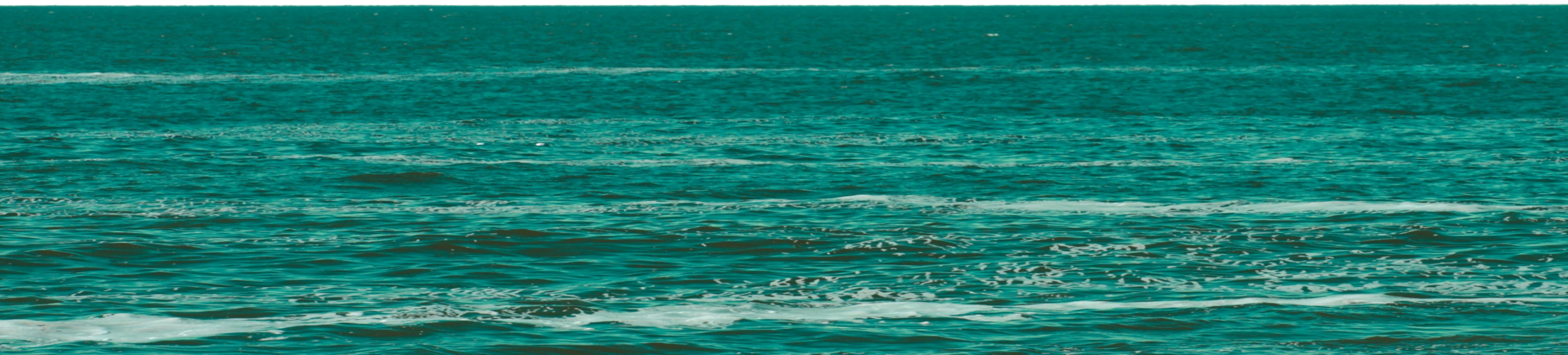

Battery pack
Control station
with IAS
Rectifier
Electric Motor
Inverter
DC switchboard
with PMS
Power
Generator

A few words about the prototype

Our prototype was built to scale. We have applied two generating sets 55kVA, two propulsion motors 45kW and two battery sets 60kWh each. We conducted research and tests in this configuration.

Ultimately our system is dedicated to ships with one or two propulsion motors 1MW each and one or two side thrusters 0.5MW each.

We successfully completed this project in 2023. Work on the prototype inspired us to continue research and development. We are currently developing an innovative method using the analysis of acoustic emission signals to condition power electronic systems and energy storage systems used in vessels. Simultaneously, we are working on medium voltage battery systems for vessels.



What can we offer?

Our system allows us to offer our clients various options, such as:

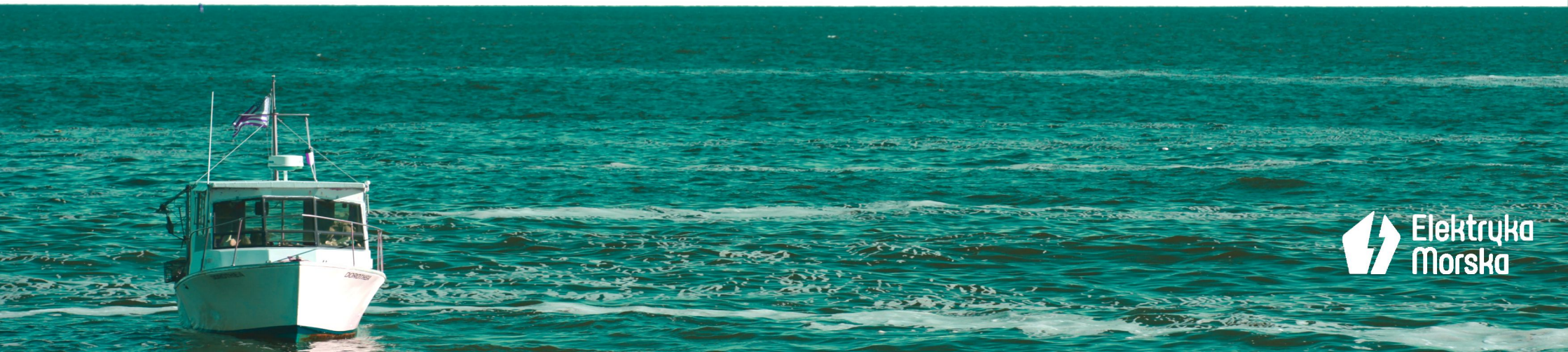
- Optimizing Energy Efficiency Design Index for systems based on traditional generating sets by installing energy storages

- Delivering a complete system of generation and distribution of electric energy based on DC voltage

- Delivering a complete electrical installation for hybrid vessels using energy storages

- Delivering a complete system for fully electrical vessels

Our system is modular and flexible, therefore it can be adjusted to the clients' expectations and budget.



Looking ahead

Our system offers a “future proofed” solution, as using the DC grid allows our system to be integrated with alternative energy sources, such as H2 cells or photovoltaic cells. It responds to not only current, but also future trends in maritime industry.

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www.elektrykamorska.com

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