



MARITIME

HYBRID-ELECTRIC PROPULSION SYSTEMS

Model-based assessment and optimization of the design and operation of battery-powered hybrid-electric propulsion systems

Background

Over the last decades, electrical propulsion has been utilized for specific ship types. In the last few years, hybrid-electric solutions, for example electrically-driven propulsion and machinery equipment/operations combined with energy storage such as batteries, have been developed. Currently, the market is showing a high degree of interest in getting the most out of the utilization of batteries.

Some of the important questions that need to be answered are:

- For which ship types and operations are batteries relevant?
- What are the expected savings in fuel and emissions?
- What are the optimal configuration and management strategies?

- How to size the battery and power electronics?
- What retrofit solution is possible for improving fuel consumption?
- What is the overall financial benefit that can be achieved?

DNV GL contribution

The simulation tool DNV GL COSSMOS can provide solid answers to the above questions. By developing the model of the proposed system topology, we can perform simulations based on actual operating profiles of the vessel. In that way, various operational strategies can be assessed to quantify the fuel savings and air emission reductions, to arrive at an accurate techno-economic analysis and provide solid decision support.



Operating profile identification

Based on an existing vessel, an accurate annual operating profile is identified - in other words, the actual amount of time spent per year in each operating mode, for instance sailing, port, dynamic positioning, stand-by. In addition, a data acquisition system may provide real power demand profiles during each mode.

Model building

A detailed model is built in DNV GL COSSMOS to describe the conventional system. A similar model is also developed for the hybrid-electric system. Both models are customized and calibrated using manufacturer's data, commissioning tests and sea trial reports from similar vessels and systems.

Simulations

The model is used to perform simulations based on the proposed operational strategies. The results demonstrate the optimal way to operate the system to achieve the largest benefit.

Techno-economic appraisal

The simulation results combined with the operating profile are used to perform a complete techno-economic analysis that will reveal the economic aspects of such an installation investment.

Project result

The project produces two main documents:

- A project report describing the proposed system topologies and operational strategies. It also includes the assumptions that were made and the requirements and constraints determined by the customer.
- A final report that includes all simulation results, the comparison of the alternative configurations, the potential annual benefits with respect to fuel consumption and air emissions, and the techno-economic assessment of the investment.

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