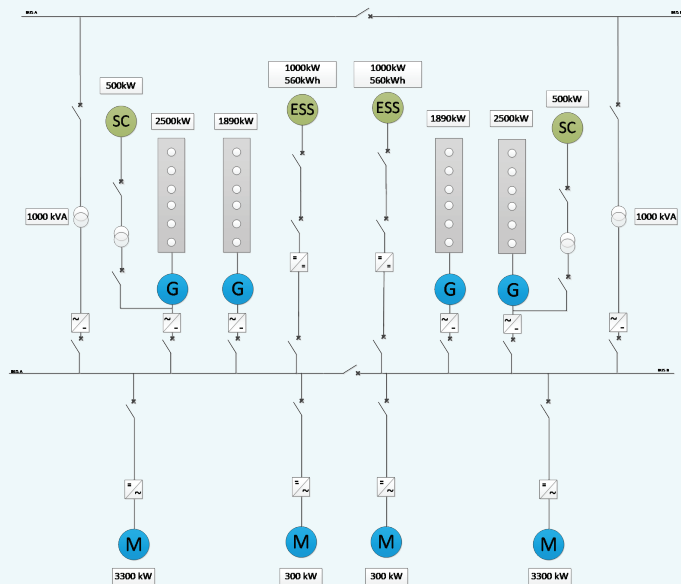


ENERGY MANAGEMENT FOR YACHTS



KONGSBERG

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Energy management system

The demand for green solutions in the maritime industry is driving an increased use of clean electrical power systems that utilize flexible energy producers. Kongsberg Maritime Energy Management System is a scalable energy solution for conventional power systems as well as complex systems.

KONGSBERG Energy Management System (EMS) is a flexible system designed to handle both conventional marine power plants and diesel electric vessels as well as complex high voltage systems.

EMS is an intelligent and dynamic energy control system. It assists with setting up sufficient vessel responsiveness during different operation modes with focus on Eco-friendliness (fuel, emissions, battery support, etc.), manoeuvring capability, station keeping precision and minimizing mechanical wear and tear.

The EMS application uses systematic methods to measure, register and analyse the energy usage of vessels in specific operation modes and is prepared for the futuristic requirements of intelligent efficiency. The objective of such a concept is to maximize the useful work obtained from the minimum amount of generated energy within the allowed regulations. Based on this objective an Energy Control System (ECS) layer has been introduced to integrate the Energy Management System application with the Power Management System and K-Pos or heavy consumer controllers.

In Battery Hybrid Power Plant control the EMS optimizes the battery charging/discharging and load sharing with other power producers. Integration with K-Pos DP or other heavy consumer controllers opens the possibility for using energy control functions for power set point feedforward, power ramp control etc. This creates a unique set of applications build into the energy control layer to optimize the performance of the power plant.

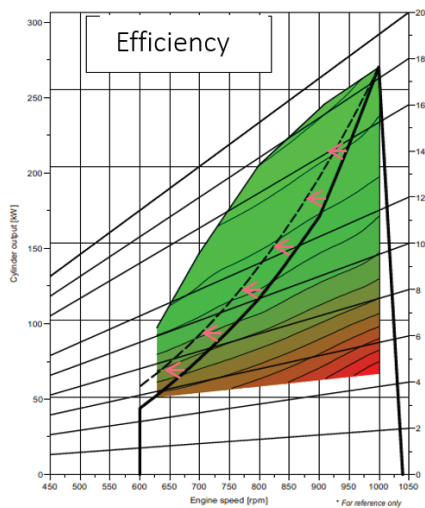


Figure 1. Efficiency Curve with energy control

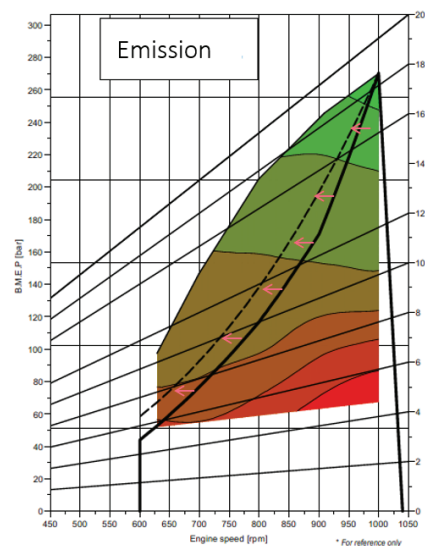


Figure 2. Emission Curve with Energy Control

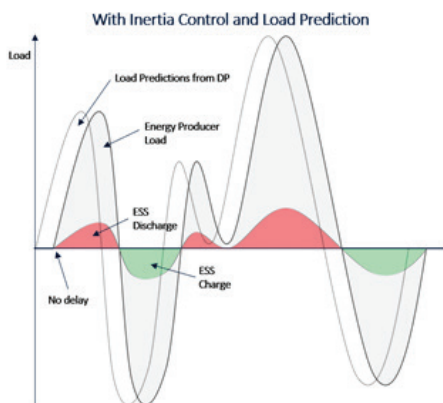


Figure 3. Energy Storage curve with Energy Control

Energy control

KONGSBERG offers a DC solution that includes an energy control system. Our unique and patented energy control system for DC solutions extracts and shares information between all components in the digital power layer.

Core components of the novel Energy control includes load prediction and inertia control combined with conventional power management system functionality. Predictions of future thruster demand controls the energy production and energy storage charge / discharge. Load dynamics shared between the energy storage and producers ensures optimization for both producer limitations and energy storage lifetime.

Increased redundancy, performance and responsiveness, efficient operations and reduced maintenance are some of the other benefits.

Energy control main functions:

- Limits load fluctuations which stabilizes the load of the producers (increases available power for propulsion and other processes).
- Load predictions used for improved handling of the load dynamics.
- Minimum SOC is set based on the calculated requirement for the operation in case of worst single failure.
- Looking at the total available inertia on the power plant in all different modes of operation. The control system will distribute the available inertia to all thrusters, matching the load ramps within the producers capability.
- Energy Control ensures green operations by configuring zero emission modes with use of ESS and alternatively shore power.

“Full Picture” additional benefits

Our “Full Picture” benefits ensure operating energy producers in the most optimal way by reducing speed and shifting operational load limits with use of load prediction and energy control.

- Our DC Solutions enables additional benefits by using Active Front End (AFE) technology for efficient variable speed operation of energy producers that gives wider range of speed operation at higher efficiency.
- Our Energy Storage implementation enables reduction of energy producers, hence increasing efficiency on remaining producers. In addition, our Energy Storage is only utilized when ramp and load demand is outside the producers capability or an energy producer is unexpectedly disconnected.
- Our Inertia Control enable shift of load limit on energy producers by utilizing load prediction that will increase efficiency and reduce emission as shown in figure 1 and 2.
- With our “full picture” integration and load prediction, the energy producer speed can be increased before the load is applied, avoiding energy storage discharge as shown in figure 3, hence decreasing energy storage size requirement and increasing life due to less usage.

