



K-POWER DYNAMIC HYBRID CONTROL

TURN KEY REFIT BATTERY HYBRID SOLUTION FOR OSV

Reduce cost and emissions as well as improve competitiveness of your vessel with KM refit battery hybrid solution.

Kongsberg Maritime together with strategic partners now offers a turn key solution that includes a complete energy storage system and energy control system. Our unique and patented energy control system for hybrid power systems extracts from- and shares information between all components in the digital power layer. Tight synchronized integration delivers unique features at the cutting-edge of DP technology.

Core components of the novel Dynamic Hybrid Control system includes Dynamic Load Prediction, Dynamic Inertia Control combined with an automatic start/stop strategy. Predictions of future thruster demand controls the energy production for generators and battery charge / discharge. Load dynamics shared between the batteries and generators ensures optimization for both generator limitations and battery lifetime.

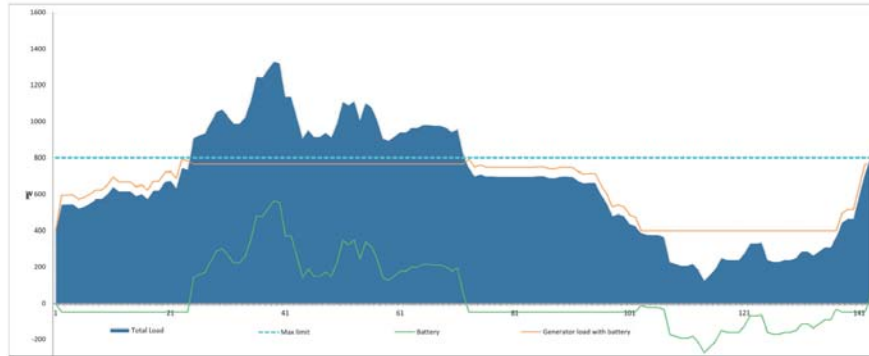
Increased redundancy, performance and responsiveness, efficient operations and reduced maintenance are some of the other benefits.

Our mission is to help our customers lower the lifetime cost and maximising their investment in hybrid power. Dynamic Hybrid Control offers significant fuel efficiency gains, reduced emissions and an economically beneficial step towards a greener and cleaner environment.

OPERATIONAL PROFILE ANALYSIS SERVICES

To ensure an optimal solution for your vessels, KM will perform an Operational Profile Analysis that includes:

- Selecting optimal type of battery
- Calculating needed battery capacity
- May support to calculating potential fuel savings
- Simulation of vessel behavior in DP operation



MODULAR DESIGN AND BENEFITS THROUGH INTEGRATION

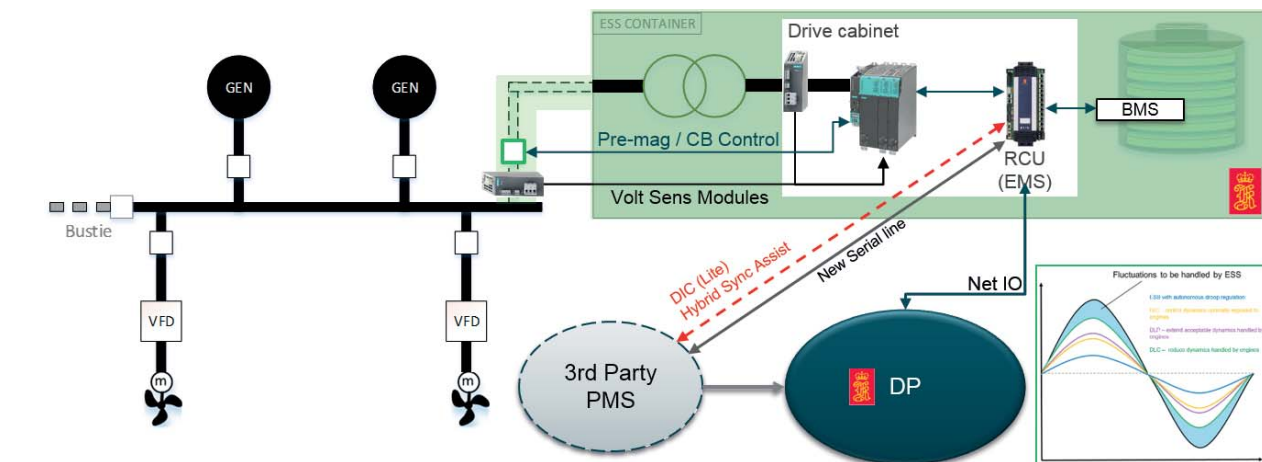
Dynamic Hybrid Control is designed with flexibility in mind and we offer optimized solutions for different vessel configurations:

- K-POS and KM Energy Storage System (3rd party Power Management System)
- K-POS, KM Energy Storage System, and KM PMS

The technological edge of the K-Power Dynamic Hybrid Control solution lies within the integration between the DP control system, power management system, and the energy storage system.

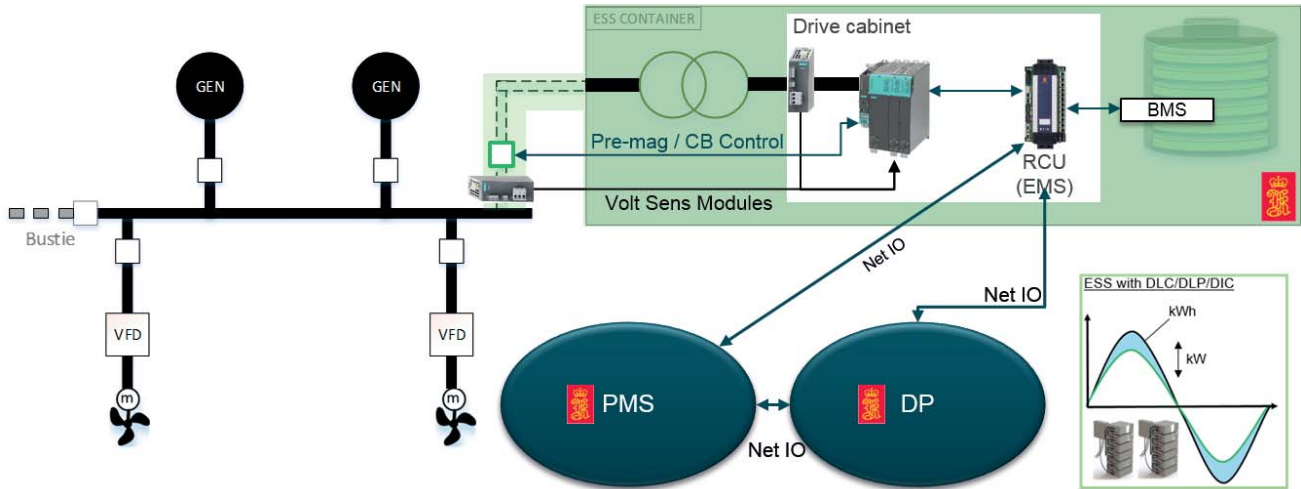
Additional benefits and functionality are unlocked as the integration between the KM products increases.

SOLUTION TOPOLOGY - K-POS AND KM ESS



| Benefits | |
|-----------------------------|---|
| Standard hardware solutions | <ul style="list-style-type: none"> Proprietary interface between ESS and DP demanding less commissioning time and improved performance |
| Energy Control functions | <ul style="list-style-type: none"> ESS as redundant power supply (spinning reserve) compliant with battery power rotation Limits load fluctuations which stabilizes the load of the main engines. Increases available power for propulsion and other processes. DL(ESS) Load predictions forwarded to EMS/ESS for improved handling of the load dynamics Minimum SOC is set based on the calculated remaining life time for batteries in case of worst single failure. *DIC (<i>Dynamic Inertia Control</i>) DIC is looking on the total available inertia on the power plant in all different modes of operation and coordinate this with DP. DP will distribute the available inertia to all thrusters, matching the load ramps with the engine performance. *Hybrid sync assist, reduces bustle sync time *Island Mode, allows power plant to run solely on battery |

SOLUTION TOPOLOGY - K-POS, KM ESS AND KM PMS



- Benefits**
- Standard hardware solutions
 - Proprietary interface between ESS and DP demanding less commissioning time and improved performance
 - Energy Control functions
 - ESS as redundant power supply (spinning reserve) compliant with battery power notation
 - Limits load fluctuations which stabilizes the load of the main engines. Increases available power for propulsion and other processes.
 - DLP(ESS) Load predictions forwarded to EMS/ESS for improved handling of the load dynamics
 - Minimum SOC is set based on the calculated remaining life time for batteries in case of worst single failure.
 - *DIC (Lite / Static ramp) DIC is looking on the total available inertia on the power plant in all different modes of operation and coordinate this with DP. DP will distribute the available inertia to all thrusters, matching the load ramps with the engine performance.
 - *Hybrid sync assist, reduces bustie sync time
 - **Island Mode, allows power plant to run solely on battery

FUNCTIONALITY OVERVIEW

| EMS Functions | K-Pos and KM ESS | K-Pos, KM ESS and KM PMS |
|--------------------------|------------------|--------------------------|
| Battery Notation | ✓ | ✓ |
| Island Mode | **✓ | **✓ |
| ESS Droop | ✓ | ✓ |
| DLP (ESS) | ✓ | ✓ |
| DLP (Gen) | N/A | ✓ |
| DIC (Full) | N/A | ✓ |
| DIC (Lite) | *✓ | ✓ |
| Hybrid Sync Assist | *✓ | ✓ |
| Genset Start / Stop | N/A | ✓ |
| Droop / Power Combi Mode | N/A | ✓ |

* Depends on info from 3rd part PMS
 ** Requires class related updates of the PMS and power plant HW

REFERENCE

| Type | Project name | Owner | Yard | Class |
|------------------------|----------------|----------------------|----------------------------------|---------------------------|
| PSV | Viking Energy | Eidesvik | Kleven + Westcon | DnV ATR Battery Power |
| Bulk Carrier | Star Laguna | Grieg Star | Hyundai Mipo + offshore retrofit | DnV ATR Battery Safety |
| Offshore Supply Vessel | Seacor Maya | MEXMAR/Seacor Marine | Tbd | ABS DPS-2 Battery-Li |
| Offshore Supply Vessel | Seacor Warrior | MEXMAR/Seacor Marine | Tbd | ABS DPS-2 Battery-Li |
| Offshore Supply Vessel | Seacor Viking | MEXMAR/Seacor Marine | Tbd | ABS DPS-2 Battery-Li |
| Offshore Supply Vessel | Seacor Azteca | MEXMAR/Seacor Marine | Tbd | ABS DPS-2 Battery-Li |



Specifications subject to change without any further notice.

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