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KONGSBERG DIGITAL/KONGSBERG MARITIME

Ship Hybrid Power System

Efficiency Improvement through Hybridization

10th June 2021

Pramod Ghimire/Krishna Kumar Nagalingam



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Climate urgency

Society is demanding action

Green House Gas (GHG) emission reduction will be the main concern for shipping!



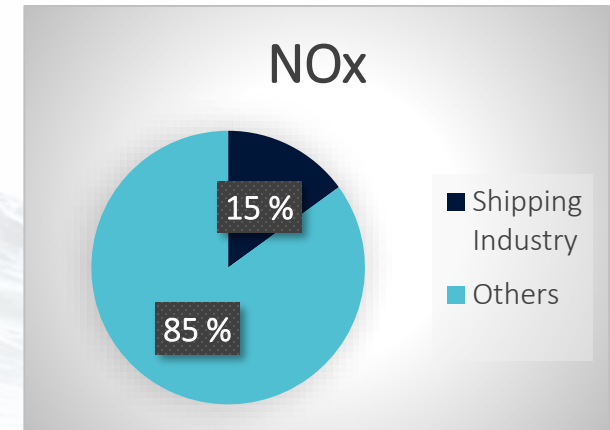
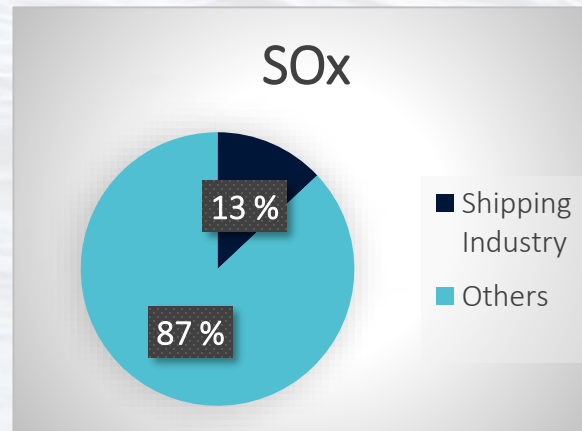
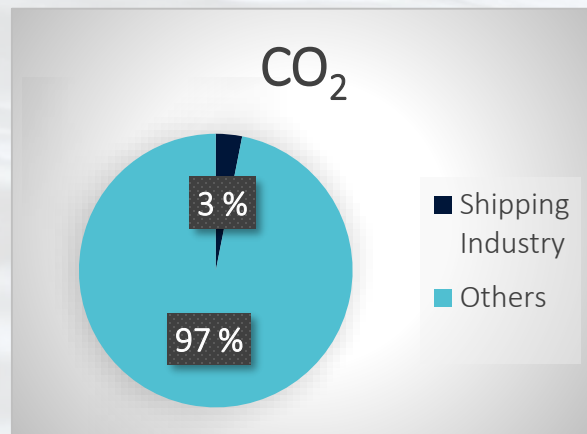
CLIMATE
CHANGE





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Emissions

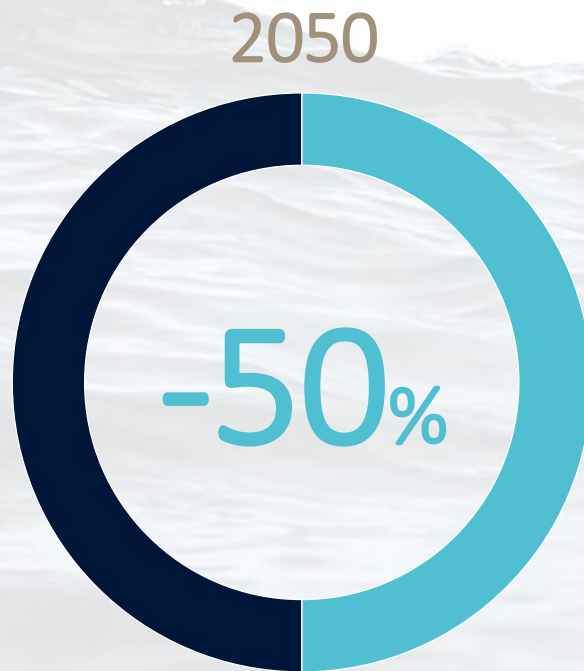




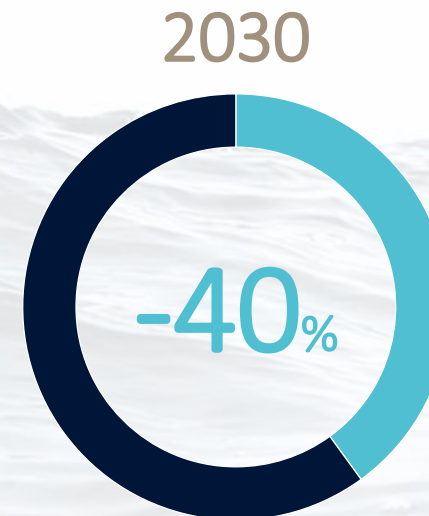
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IMO Strategy: Green House Gas emissions Reduction

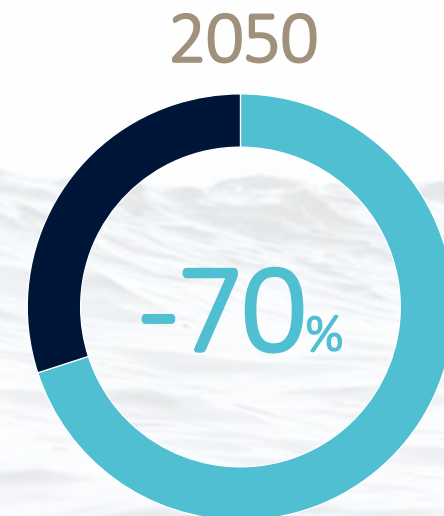
Levels of ambition compared to 2008



total annual GHG emissions from
international shipping



CO₂ emissions per transport work, as an
average across international shipping,

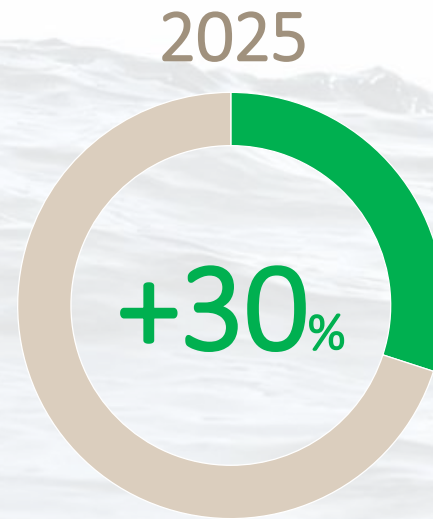




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IMO Strategy: Energy Efficiency Design Index

Ambition compared to 2014



New ship builds by 2025 should be at least 30% more energy efficient than built in 2014.



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Probable Solutions to Reduce Emission and Increase Efficiency

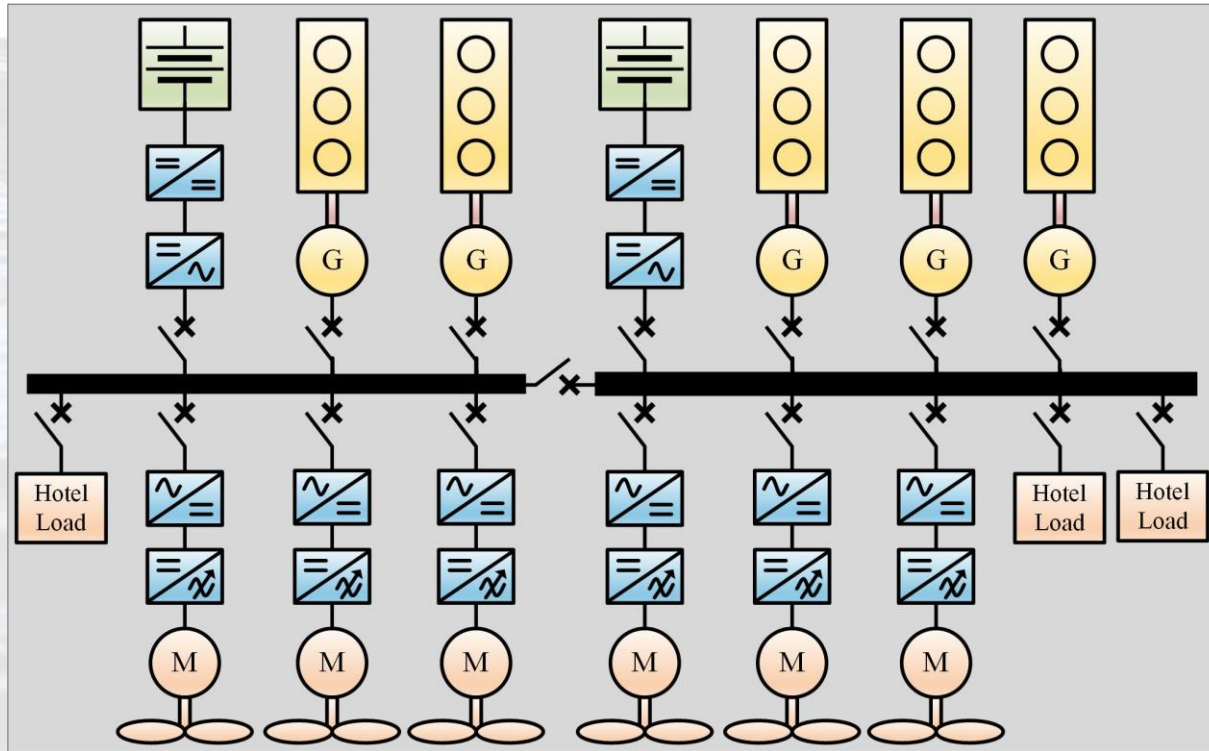
Advancement in the engine technologies
Exhaust Gas Treatment
Advancement in the Power System (Hybrid Power System)
Alternative Fuels (LNG, Bio, NH_3 , H_2)
There will be a more diverse fuel palette in the future



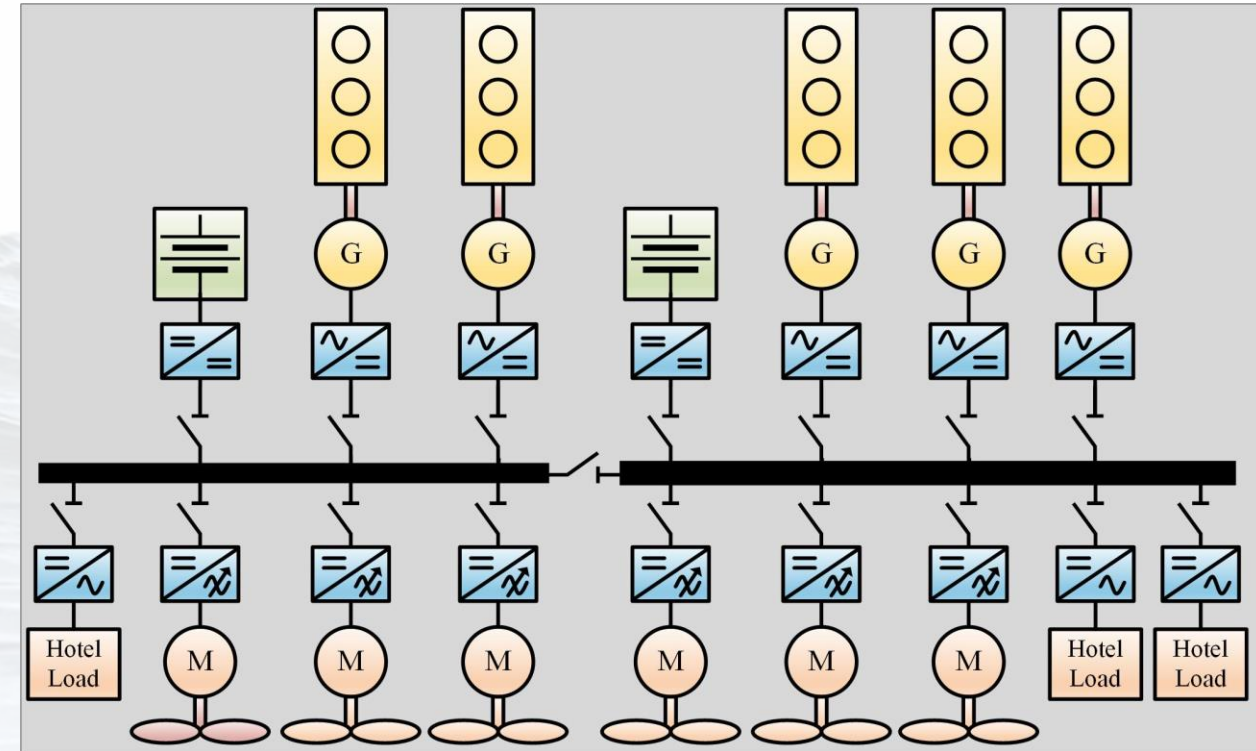


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Hybrid Power System - Architectures

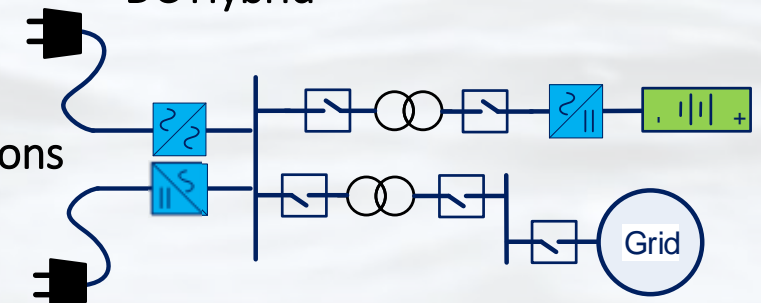


AC Hybrid



DC Hybrid

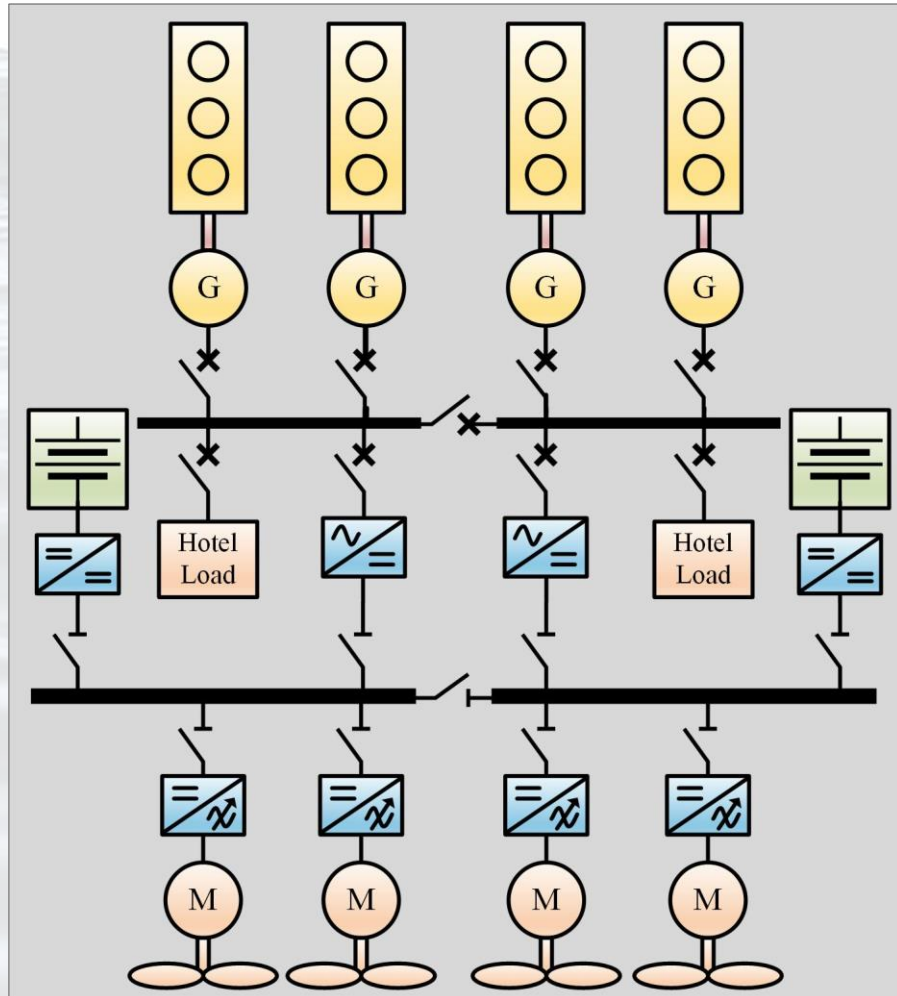
Onshore Charging solutions





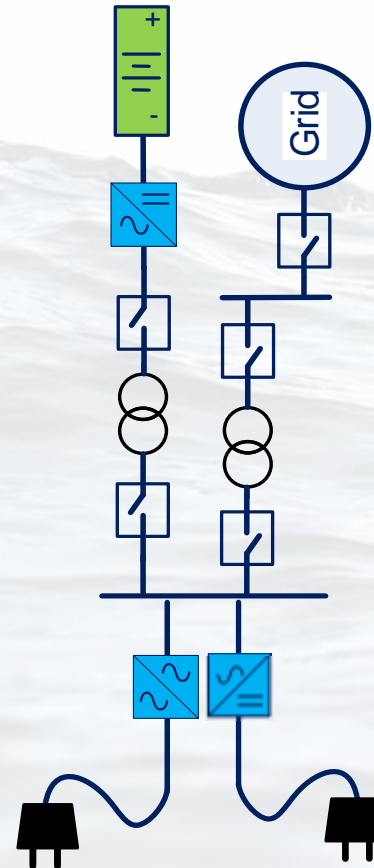
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Hybrid Power System - Architectures



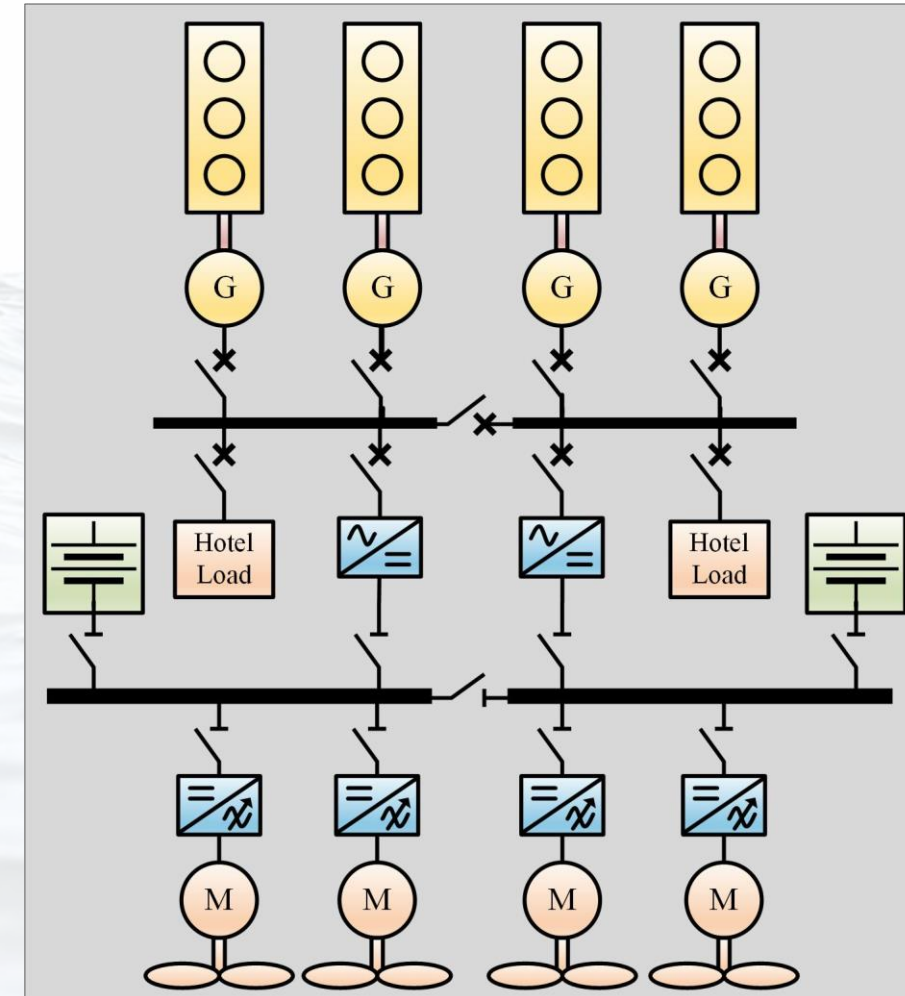
AC/DC Hybrid

WORLD CLASS – Through people, technology and dedication



Onshore Charging solutions

KONGSBERG PROPRIETARY - See Statement of Proprietary information

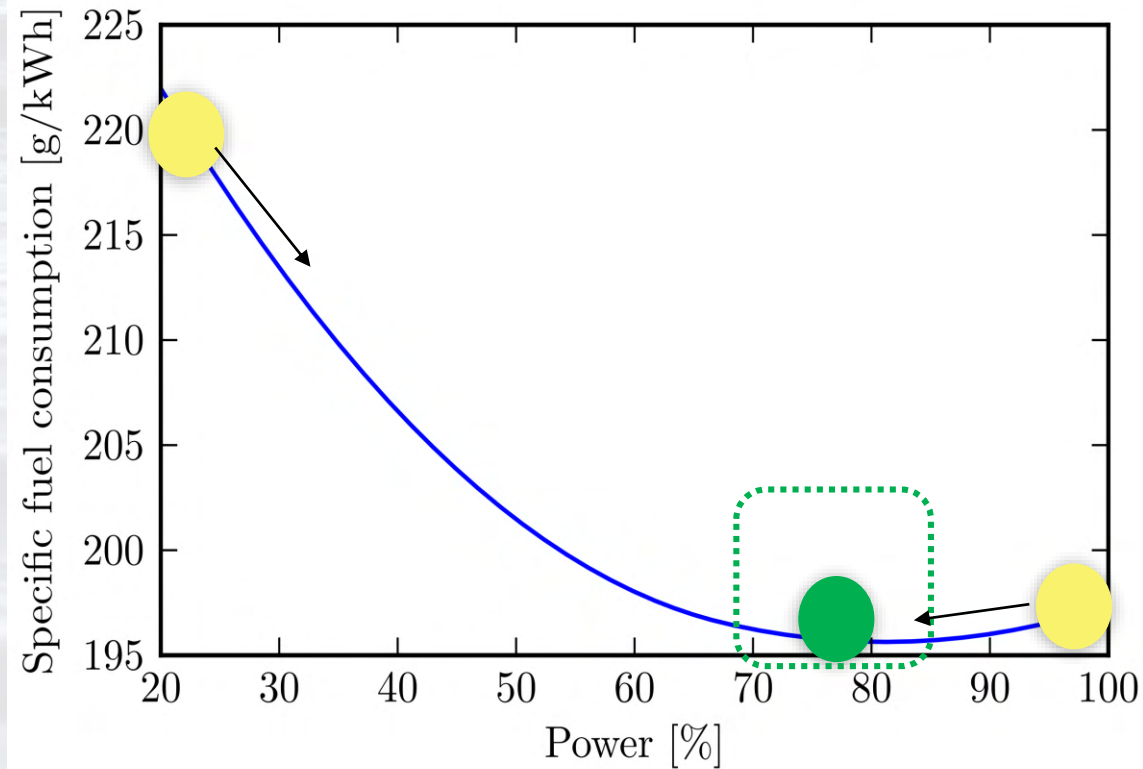


AC/DC Hybrid - Floating

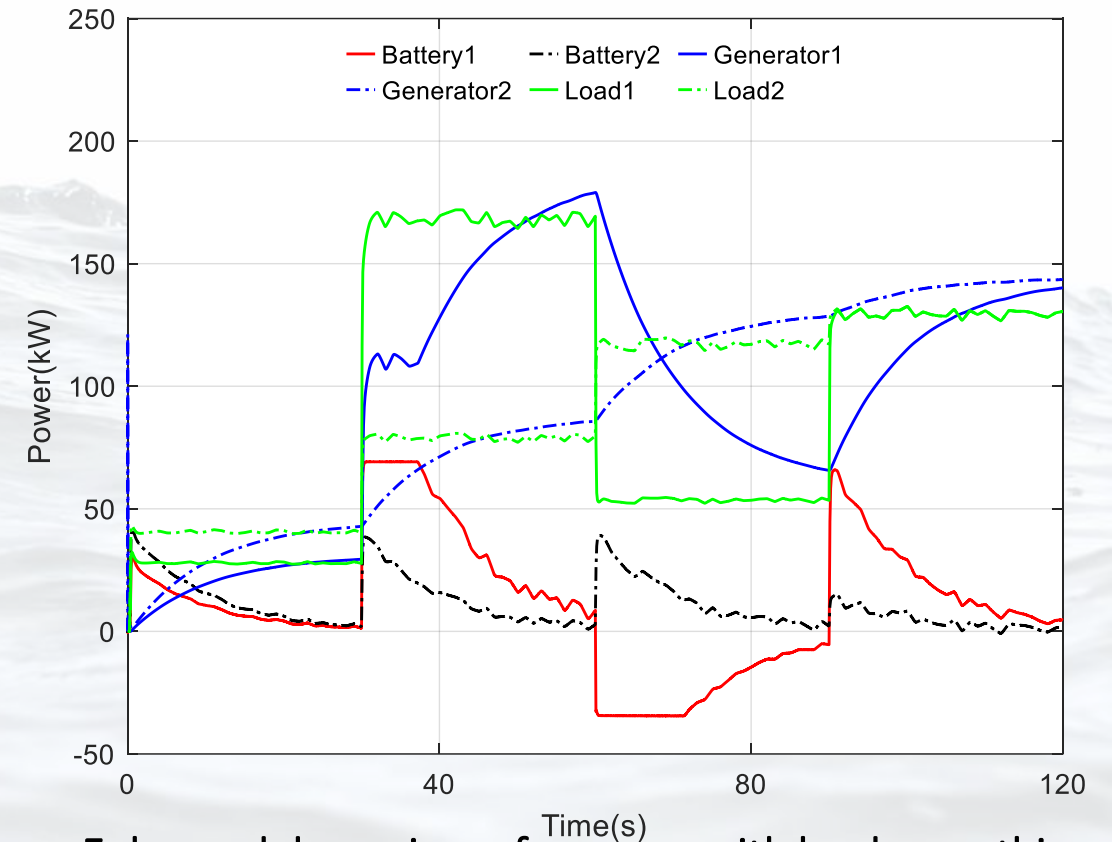


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Hybrid Power System – Battery Operation Strategy



Strategic Loading

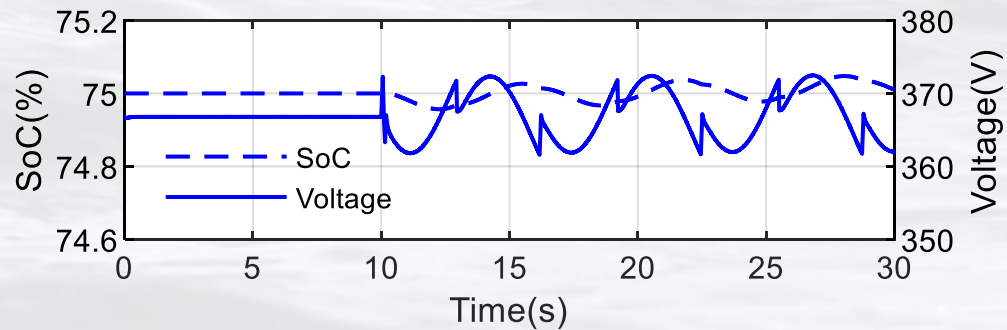
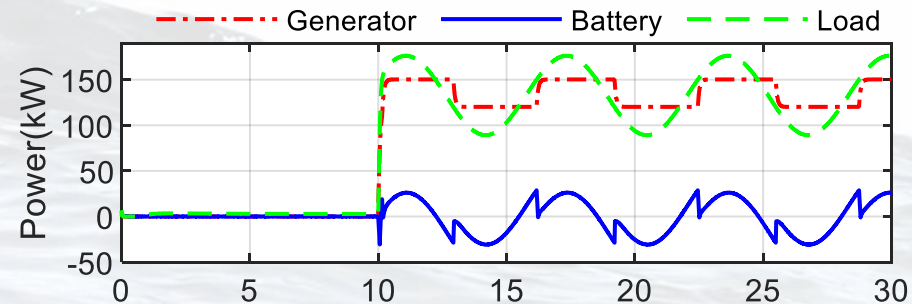


Enhanced dynamic performance with load smoothing

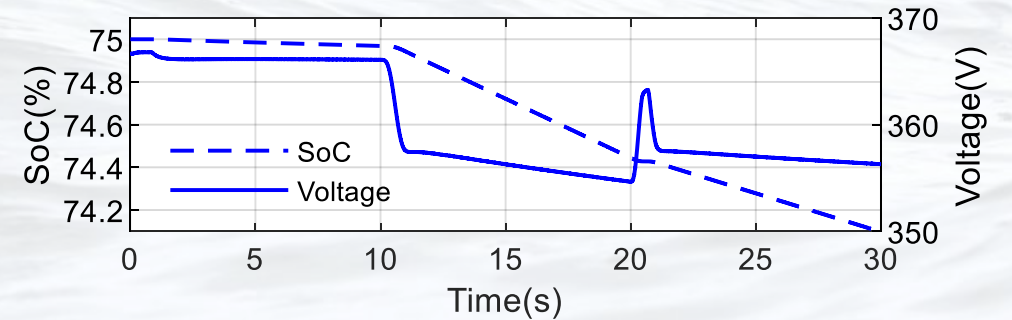
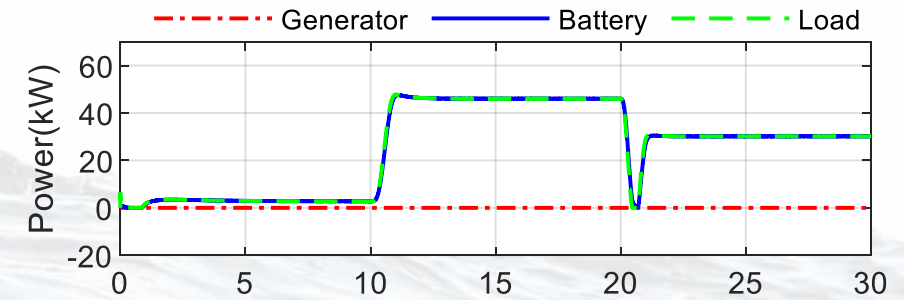


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Hybrid Power System – Battery Operation Strategy



Peak Shaving

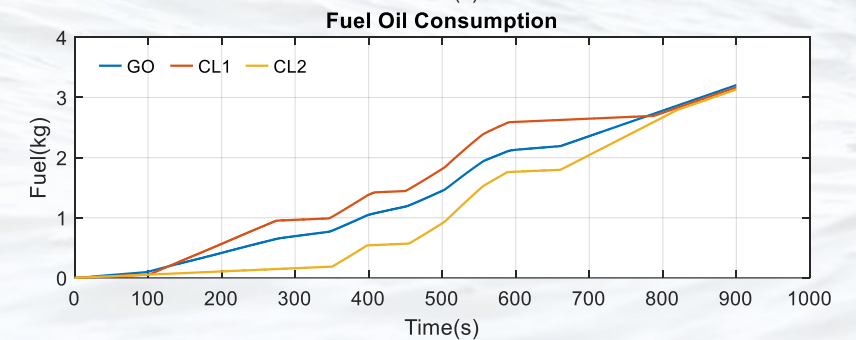
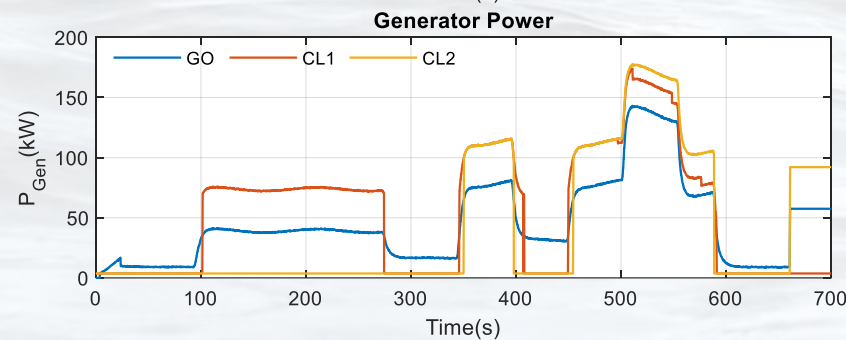
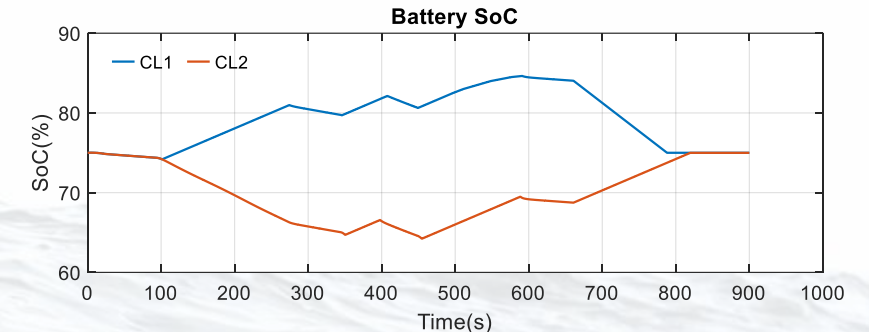
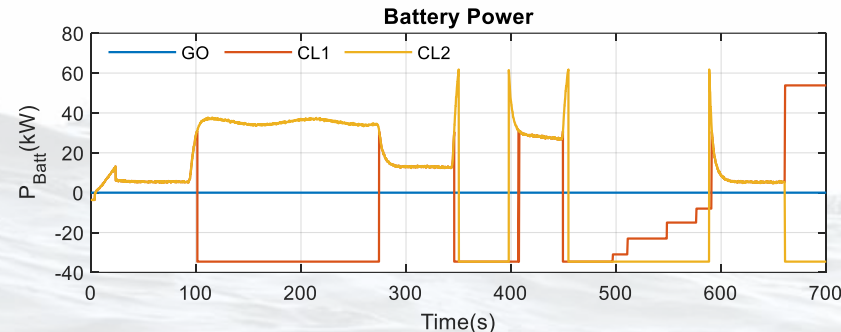
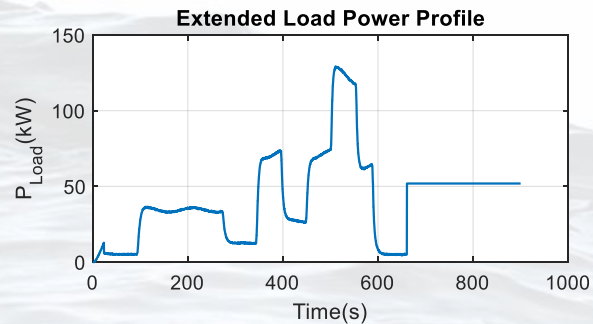


Zero-Emission



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Hybrid Power System – Efficiency Improvement



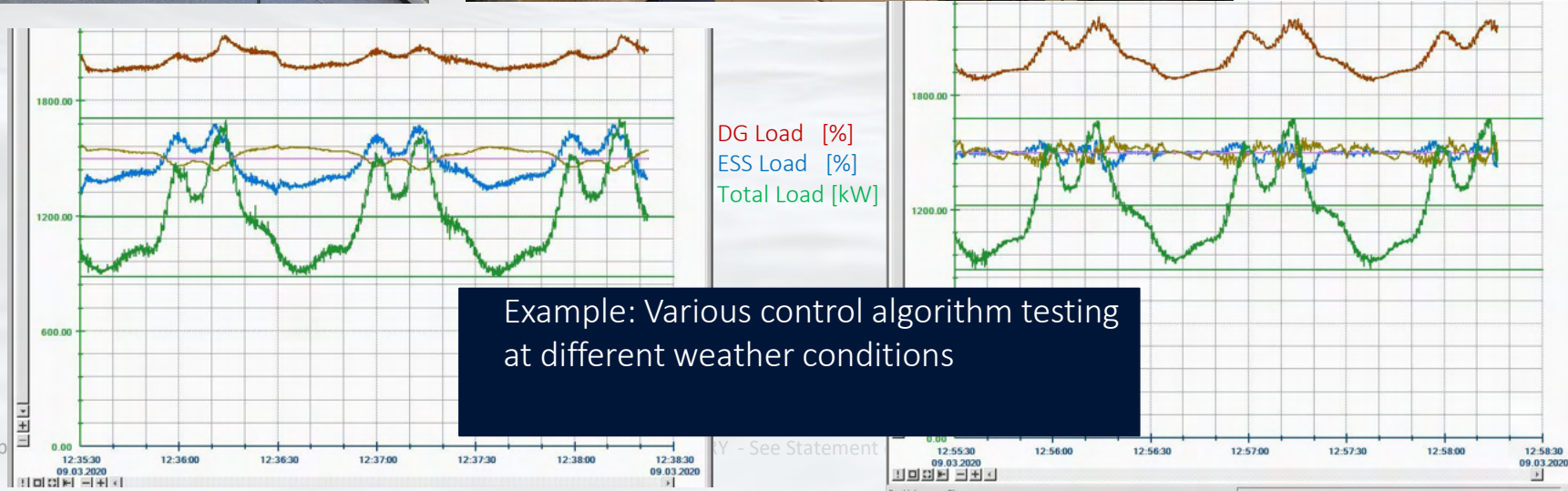
✓ Hybrid power systems are more efficient even if the battery is charged onboard using the diesel generator.

PEMS	η_e (%)	BSFC (g/kwh)	SoC (%)
Generator-only (GO)	27.7	274.49	..
Rule-based (CL1)	33.52	271.4	75
Modified rule-based (CL2)	35.97	268.31	74.99



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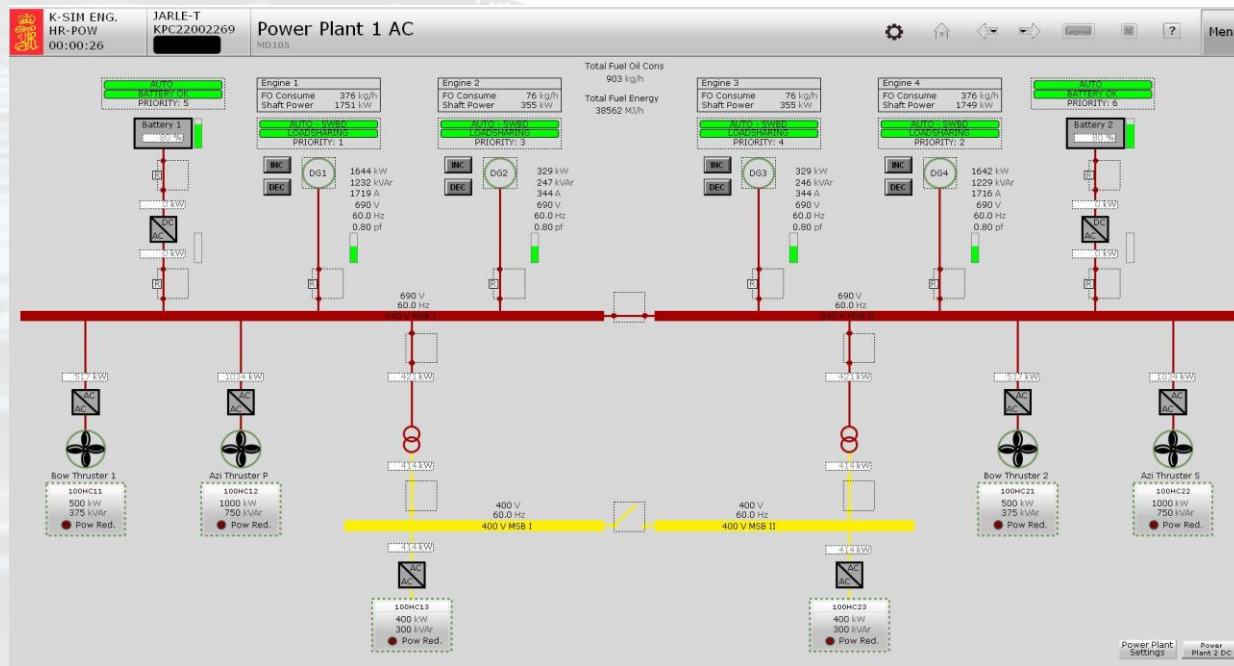
Hybrid Power System : R&D - Energy Lab



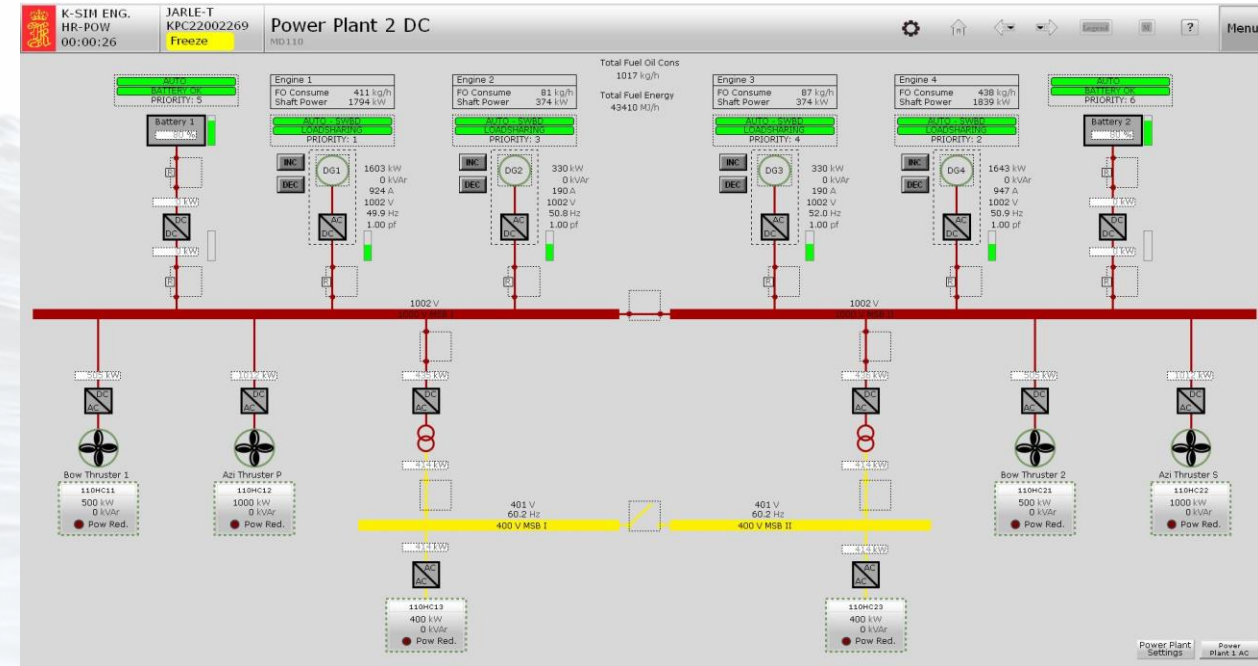


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Hybrid Power System : R&D - Simulator



AC Hybrid



DC Hybrid

Example: Different power system architecture efficiency comparison for various vessels.

A glass sphere, acting as a lens, reflects a landscape with a body of water and a distant shoreline. The sphere is positioned on the left side of the frame, resting on a dark, textured surface. To the right of the sphere, a large, dynamic splash of water erupts, with numerous droplets and streams of water captured in mid-air. The background is a soft, out-of-focus blend of teal and brown tones. The overall composition suggests a connection between nature, water, and sustainable development.

SUSTAINABLE SOLUTIONS



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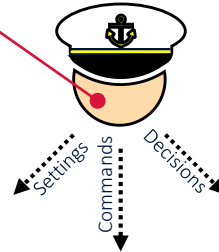
Green Initiatives

Save Fuel, Maintenance & Environment

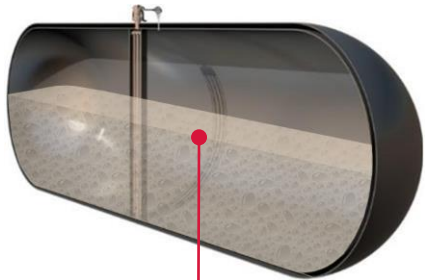
Mindset & Knowledge

- Advisory
- Electronic WSOG
- Energy Control

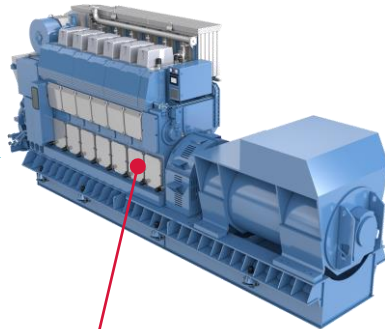
Operator & Control



Fuel Tank



Diesel Generators



Energy Flow

SWITCHBOARD DISTRIBUTION

Drilling



Drilling Optimization

- Integration with DP & PMS
- Peak Shaving (battery/flywheel/supercapacitor)
- Breaking Energy Recovery

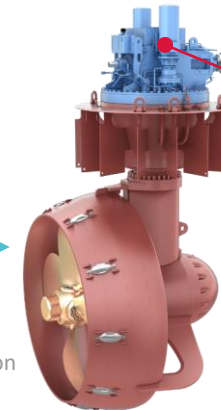
Hotel & Auxiliaries



Hotel & Auxiliaries

- VFD's on AUX Machinery
- Fast Load Shedding
- Waste heat recovery

Thrusters



Thruster & Positioning

- Optimal Thrusters (high torque)
- Re-Blading
- Green DP
- Position Mooring
- Load Compensation
- Reduce Thruster Bias

Change or Complement Energy Source

- Alternative Fuels
- Hybrid / Battery
- Shore Connection

Engine Optimization

- Scrubber
- Variable Speed
- Dual Fuel
- Remap Engines

Switchboard / Infrastructure Optimization

- Closed Bus
- 2+1 Split
- Task Appropriate Mode / DynposER
- Power Allocation / Load Transfer



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Hydrogen & Zero Emission by Kongsberg

HYDROGEN FERRY PILOT



Under construction
KM scope includes
Fuel Cells, Energy
Storage, Shore
Charging &
Thrusters

ASKO RO-RO



Fully electric and autonomous
vessel for in-shore transport of
containers

HYDROGEN VESSEL CONCEPTS



YARA BIRKELAND



Fully electric and autonomous
vessel for in-shore transport of
containers



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Today's Fuels

MGO engines are well proven and have been the workhorse in the industry for many years.

However, LNG engines are now a viable option, with infrastructure as well as proven technology. Cost of LNG is about 30% lower than MGO, but requires roughly 70% more of storage space.

Fuel cells for marine use is still not mature as a technology, nor is there infrastructure to support re-fueling of Hydrogen in place. Pressurized Hydrogen requires about 500% more storage space than MGO.



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Hybrid

Our hybrid systems are designed to support our customers in achieving their performance maximization and sustainability objectives.



OPERATIONAL EXPENSES

We intend to make sure that returns on your investments are quickly and satisfactorily maximized.



CARBON FOOTPRINT

Our systems help you meet increasingly stringent environmental laws and regulations.



REQUIRED MAINTENANCE

We thoughtfully design our systems to enable an optimal installation space, and noise and vibration reduction, hence reducing required maintenance.



FUEL CONSUMPTION

Our hybrid systems offer substantial fuel efficiency gains.



SAFETY RELIABLE

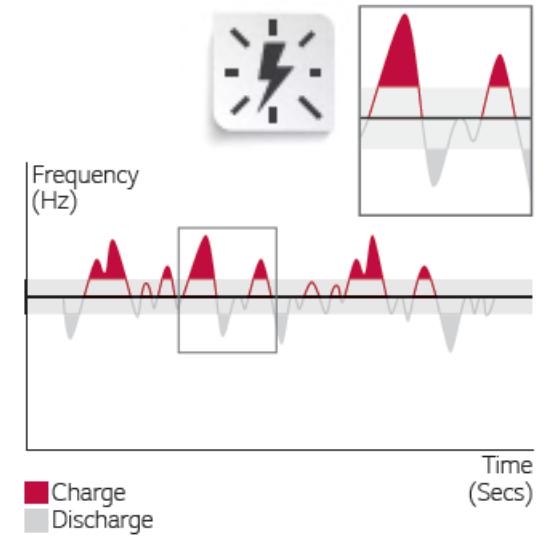
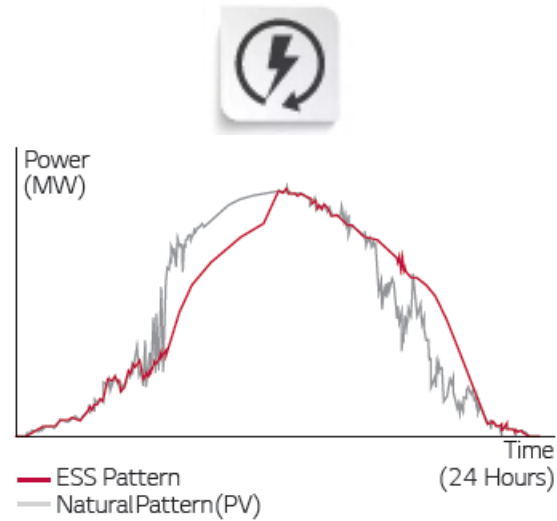
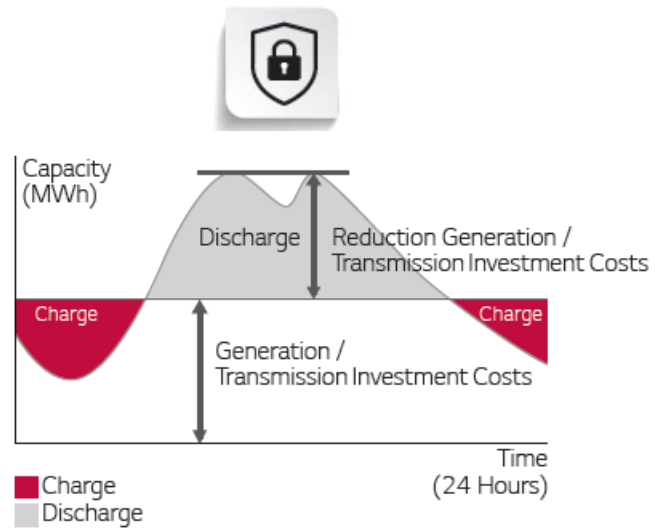
The hybrid systems are designed with safety and reliability in mind and tested beyond international marine standards.



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Battery Technology

Different Needs / Requirements



Spinning Reserve



Zero Emission



Peak Shaving





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Battery Technology & Safety

Three Battery Types



SAVe Energy +

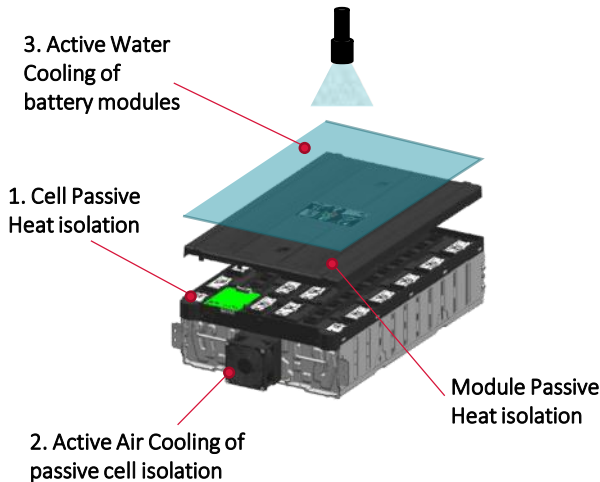
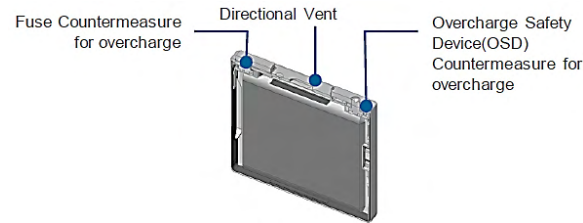


SAVe Energy



SAVe Power

Battery Safety



Designed to prevent a thermal runaway or thermal event from ever occurring and differs from other battery systems by having several safety barriers – both passive and active:

Barrier 1 – Passive Material between Cells

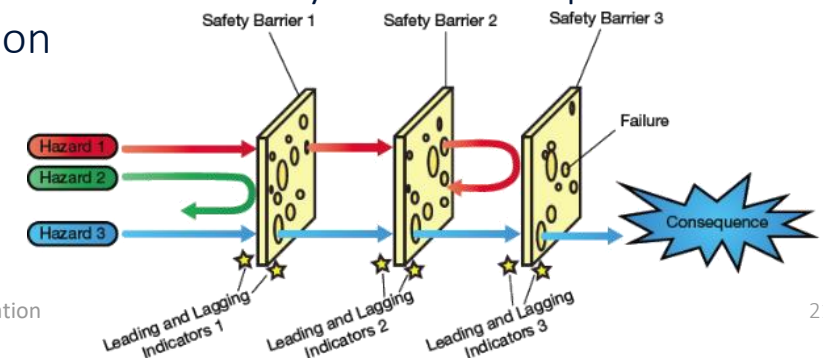
- Aluminium cooling plate transfers cell's body temperature away in opposed to next cell

Barrier 2 – Active Air Cooling of Passive Material Between Cells

- Air circulates through the module to cool down the aluminium plates

Barrier 3 – Active Water Cooling of Modules

- Water mist cools down the battery modules to prevent module-to-module propagation





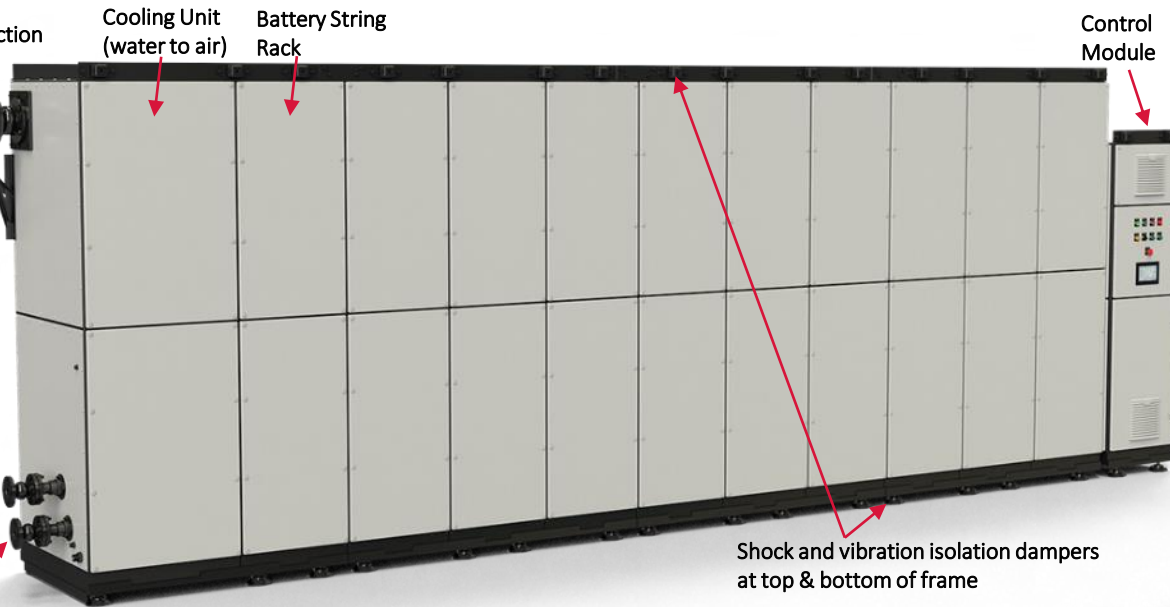
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Energy Storage System (ESS)

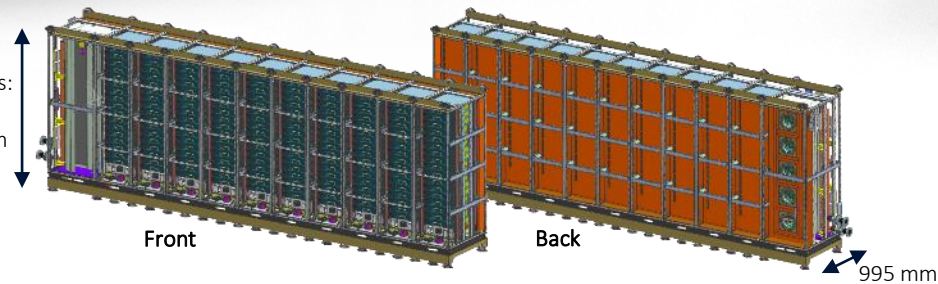
Water Chiller
(optional)



Energy Storage Unit (ESU)



Two Rack Versions:
E800 h: 2005 mm
E1000 h: 2386 mm



Energy Storage Converter (ESC)



Transformer





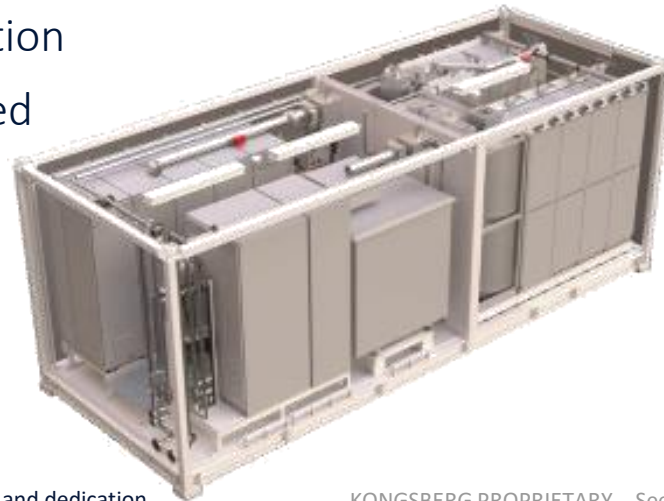
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Energy Storage System Deckhouse (ESSC)

Containerized solutions suited for retrofit in existing vessels

Solutions to fit any requirements towards charterers and regulators for reduced emissions and safe operation:

- 4 standard deckhouse sizes ranging from 20ft to 44ft
- Installed battery energy ranging up to 2240 kWh
- Drive power ranging up to 5000 kW
- Custom deckhouses and ratings available on request
- Single feed or dual feed
- Shore connection option
- Suites open and closed bus operation



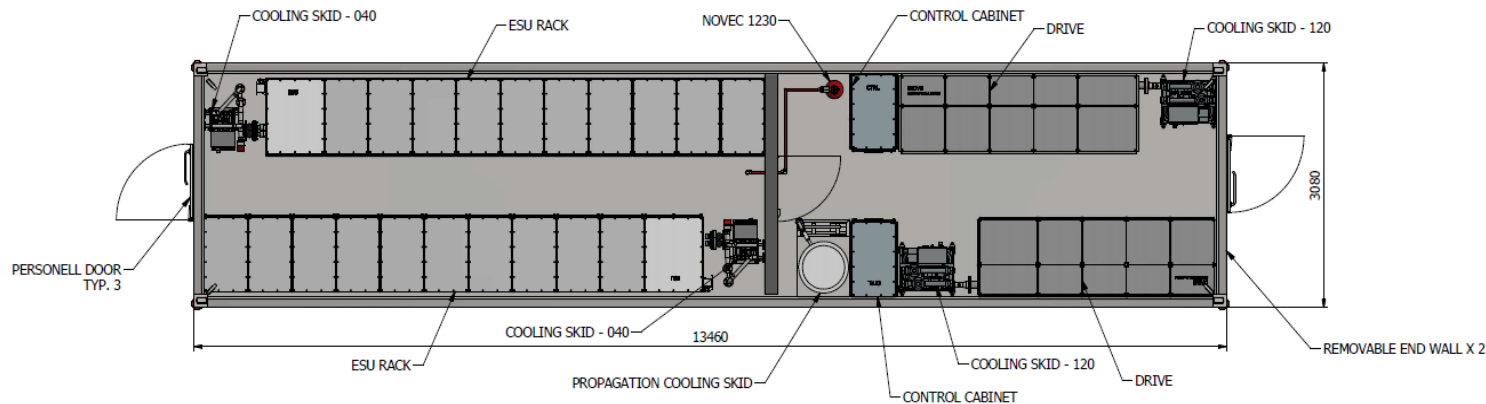


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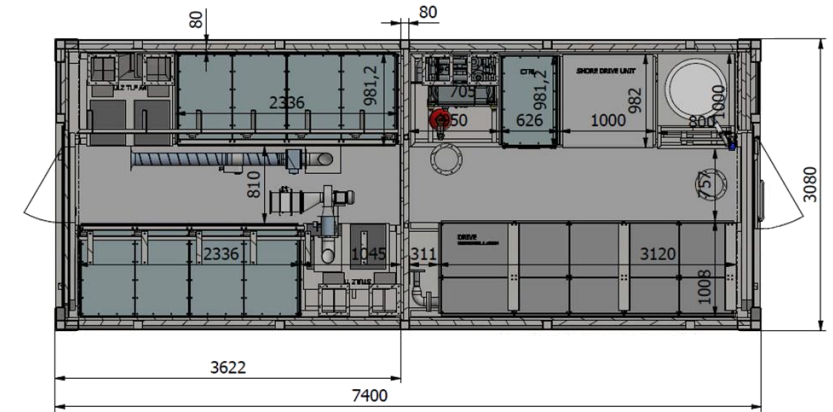
ESS Installation & Integration

Other ESS Deckhouse Alternatives

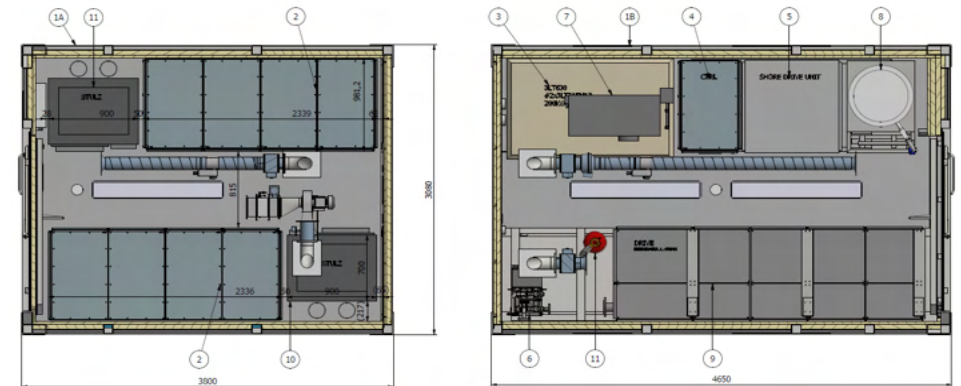
- Other alternatives available upon request
- Kongsberg can produce custom ESS Deckhouses to fit your needs
- Normally longer lead times on these versions



44 ft ESS Deckhouse up to 5000kW/2240kWh



24ft ESS Deckhouse without transformer
up to 2600kW/912kWh



24ft & 26ft ESS Split Deckhouse



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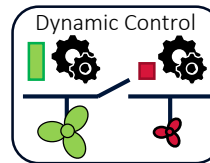
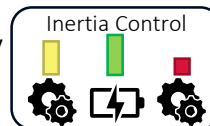
Providing Unique System Integration Opportunities

ENABLERS

- KM Energy Management System (EMS)
- Integration with KM Systems (DP, PMS & IAS)
- KM Patented functions and control algorithms

BENEFITS

- With predicted thruster loads from DP, the EMS can prepare the producers to take the load instantly when it get applied
- EMS calculate available kW per second (kW/s) capability for each producer (DG & ESS) and distributes the load optimally on each producer → Reduces power losses and protects engines from mechanical stress
- EMS send total kW/s for each SWBD segment to DP and DP will prioritize thrusters on SWBD's with high kW/s available when allocating thrust commands → Dynamic distribution of load across SWBD segments will prevent standby start of engines and let engines operate with optimal load



Energy Storage





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Integration

Examples of KM solutions for electrical integration

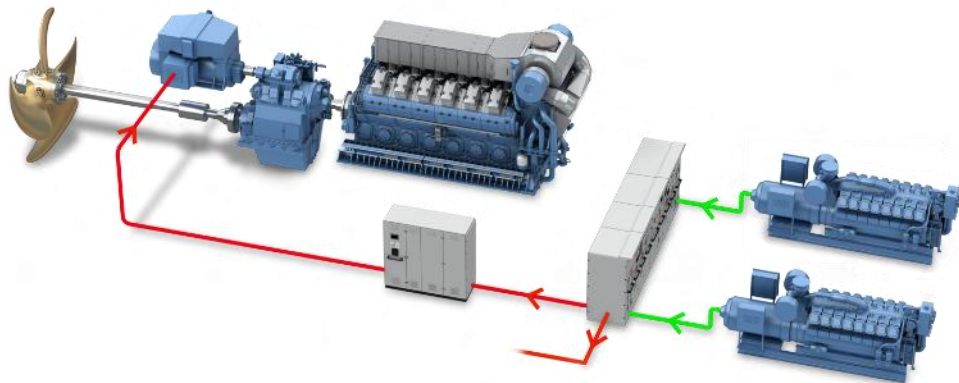
K-Power AC Switchboards



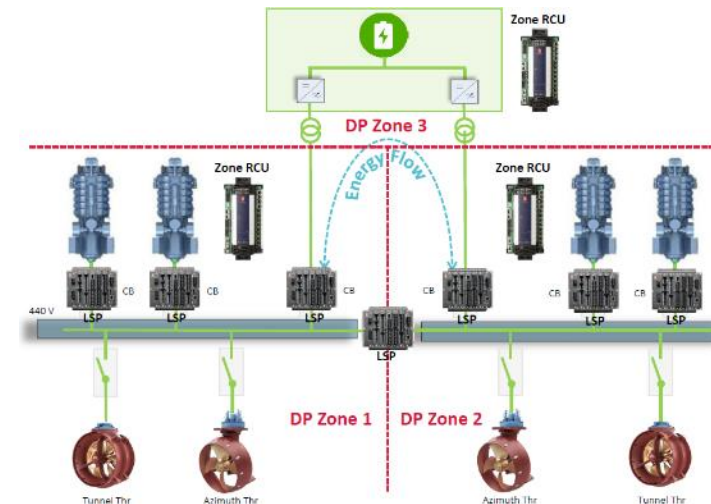
SAVE Cube DC Switchboards



Hybrid Shaft Generator (PTI/PTO)



PowerAllocator™

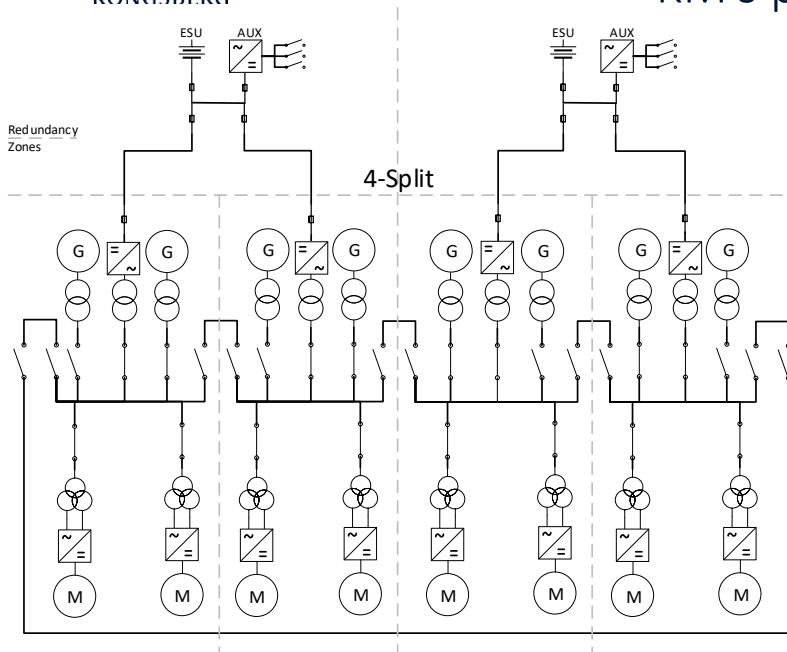




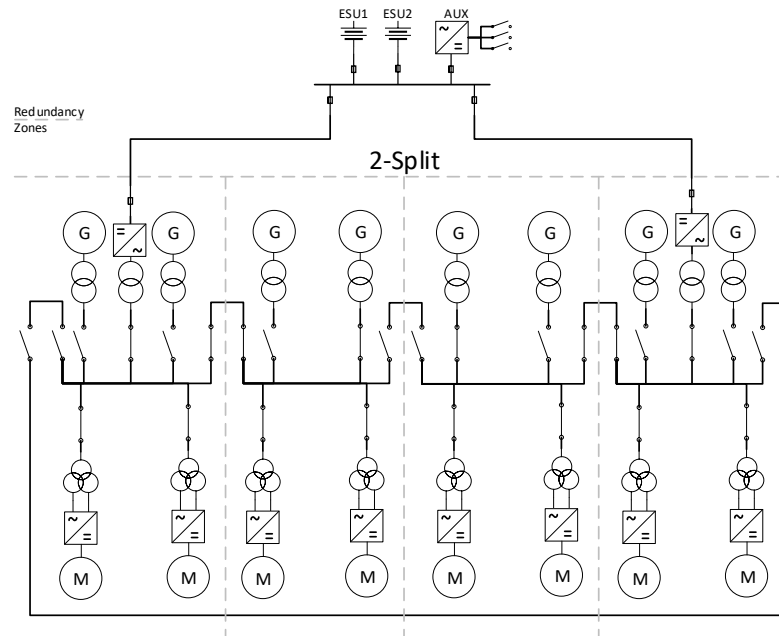
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PowerAllocator™

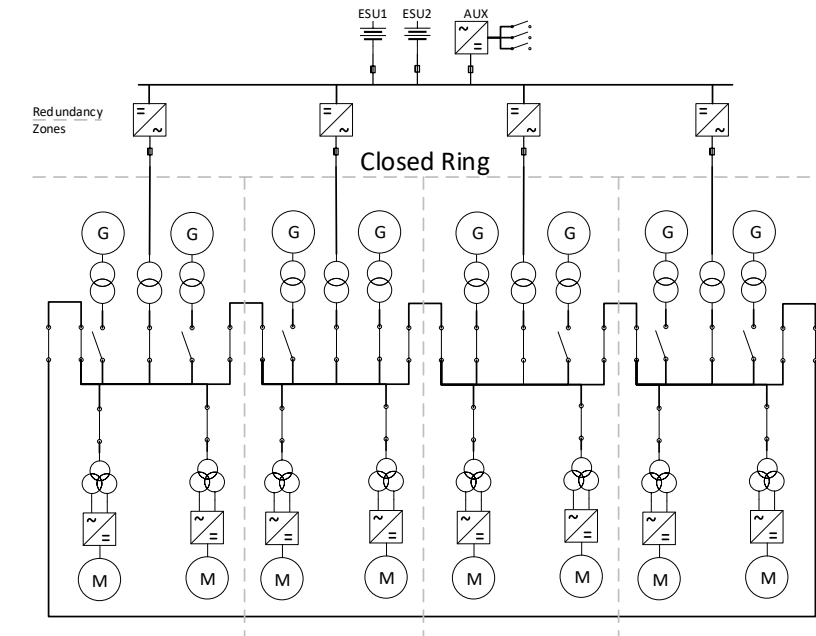
KM's patented Energy Storage Solution for DP3 Vessels



4-SPLIT SWITCHBOARD



2-SPLIT SWITCHBOARD



CLOSED RING SWITCHBOARD

PowerAllocator™

Benefits:

- Closed bus benefits without the cost and effort of converting the vessel to closed bus
- Free flow of energy between bus segments with Open Bus
- Will act as spinning reserve for both SWBD's with one engine running in DP2 open bus
- Supports both open and closed bus

Enablers:

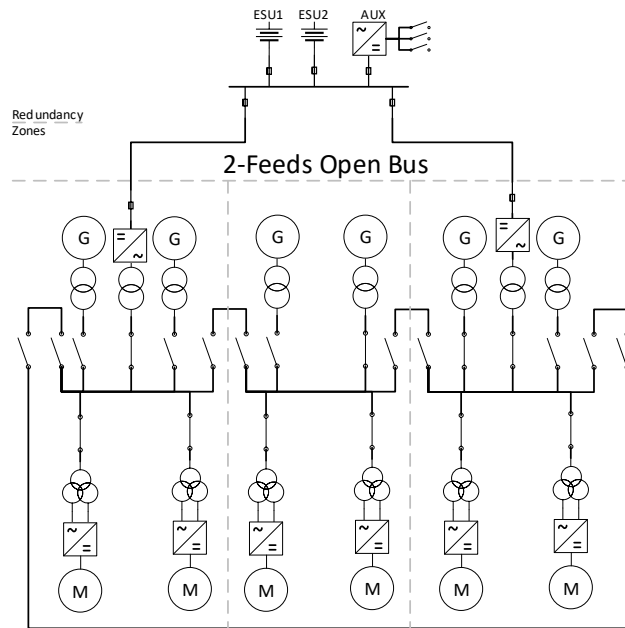
- Modifications of ESS to become a new Redundancy Group / DP zone
- Local Sync & Protection (LSP) modules in SWBD give fast AC readings to the PowerAllocator™
- Zone Protection will use LSP's for protection, will identify/trip faulty engines and segregate segments upon fault
- Energy Control methods and integration with DP & PMS will fully utilize the ESS and optimize the power available per zone



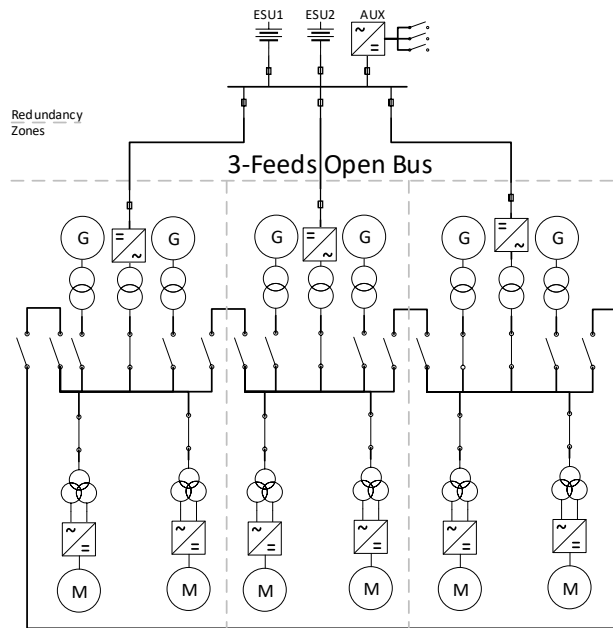
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PowerAllocator™

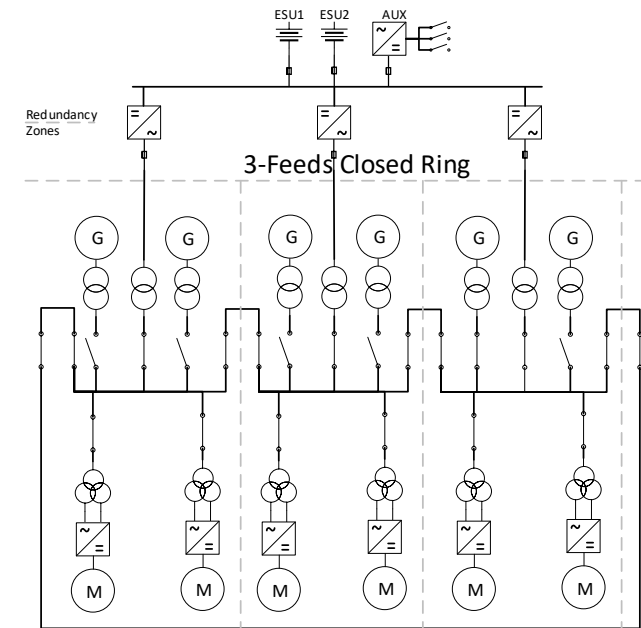
KM's patented Energy Storage Solution for DP3 Vessels



3-SPLIT/2-SPLIT SWITCHBOARD



3-SPLIT/2-SPLIT SWITCHBOARD



CLOSED RING/CLOSED BUS SWITCHBOARD

PowerAllocator™

Benefits:

- Spinning reserve on two switchboard segments
- Power transfer from one switchboard segment to another

Benefits:

- Spinning reserve on all switchboard segments
- Power transfer between all switchboard segments

Benefits:

- Spinning reserve on all switchboard segments
- AGS trips bus-ties upon failure

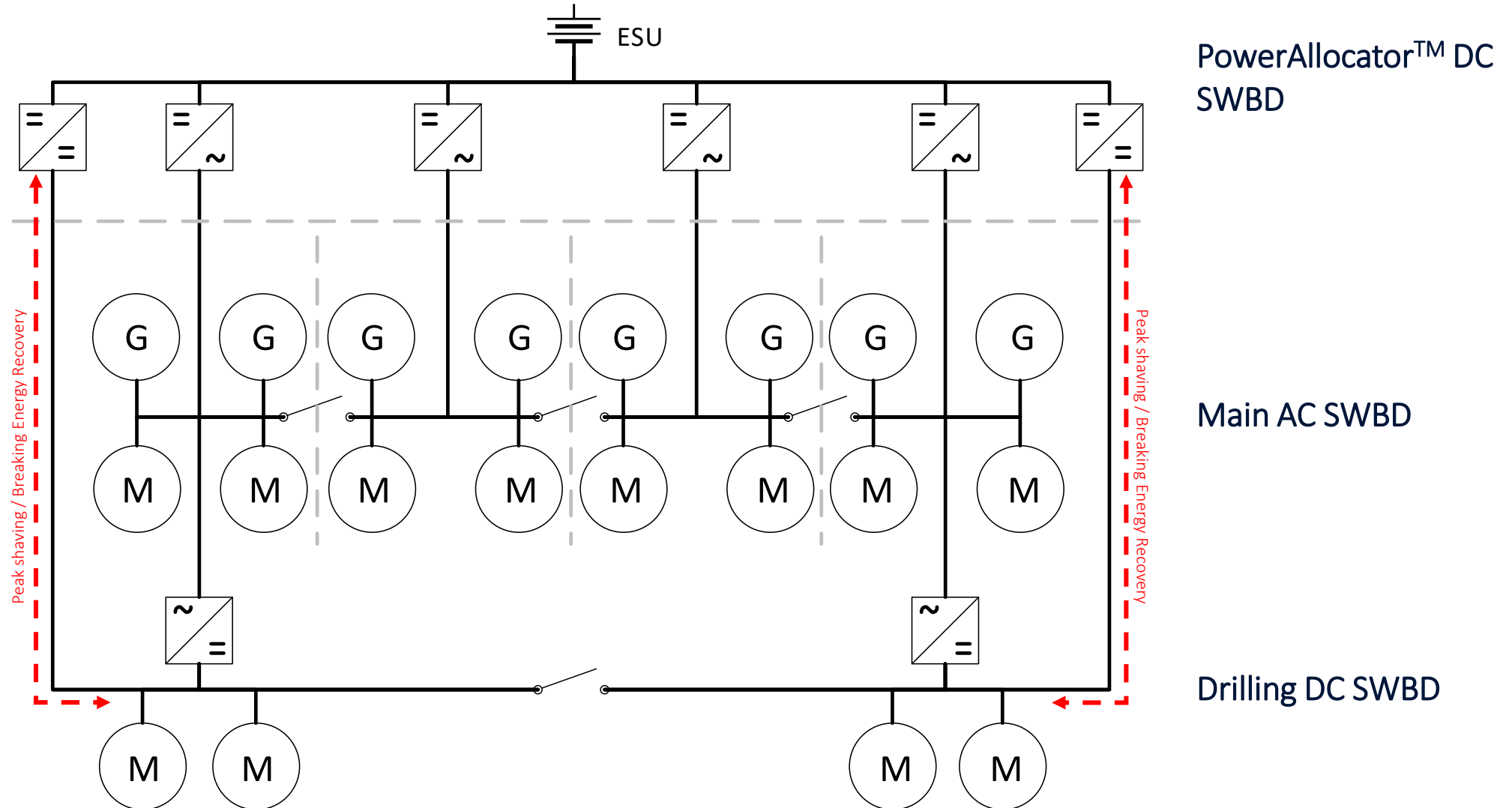
Benefits:

- Battery spinning reserve capacity never compromised upon worst case single failure (else than fault in the PowerAllocator™ itself)
- Typically 50% less cost than three dedicated Energy Storage Systems



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PowerAllocator™ with Drilling DC Link





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References

Reference List

	Vessel Name	Owner - Manager	Class	Battery type	ESSC Size	Energy Installed	Vessel Type
1	Mein Schiff 1 (Steering gear backup)	TUI Cruises		Super Capacitor	N/A	0,5	Cruise
2	Mein Schiff 2 (Steering gear backup)	TUI Cruises		Super Capacitor	N/A	0,5	Cruise
3	Mein Schiff 3 (Steering gear backup)	TUI Cruises		Super Capacitor	N/A	0,5	Cruise
4	Mein Schiff 4 (Steering gear backup)	TUI Cruises		Super Capacitor	N/A	0,5	Cruise
5	Mein Schiff 5 (Steering gear backup)	TUI Cruises		Super Capacitor	N/A	0,5	Cruise
6	Mein Schiff 6 (Steering gear backup)	TUI Cruises		Super Capacitor	N/A	0,5	Cruise
7	OV Bøkfjord – Kystverket	Kystverket	DNV-GL	Saft	Battery Room	880	Multi purpose vessel
8	Island Crusader Upgrade	Island Offshore	DNV-GL	Saft	6060x2440x2590	180	OSV
9	Sir David Attenborough - NERC	NERC	Lloyds Register	Saft	Battery Room	1450	Research vessel
10	Roald Amundsen – Hurtigruten	Hurtigruten	DnVBattery Power	SAVe Energy	Battery Room	1356	Cruise
11	Fridjof Nansen – Hurtigruten	Hurtigruten	DnVBattery Power	SAVe Energy	Battery Room	1356	Cruise
12	OV Ryvingen - Kystverket	Kystverket	DnVBattery Power	SAVe Energy	Battery Room	3000	Multi purpose vessel
13	SEACOSCO AMAZON	Seacor	DnVBattery Power	Orca Energy	8200x3080x3300	542	OSV
14	SEACOSCO NILE	Seacor	DnVBattery Power	Orca Energy	8200x3080x3301	542	OSV
15	SEACOSCO PARANA	Seacor	DnVBattery Power	Orca Energy	8200x3080x3302	542	OSV
16	SEACOSCO CONGO	Seacor	DnVBattery Power	Orca Energy	8200x3080x3303	542	OSV
17	SEACOSCO MURRAY	Seacor	DnVBattery Power	Orca Energy	8200x3080x3304	542	OSV
18	SEACOSCO DANUBE	Seacor	DnVBattery Power	Orca Energy	8200x3080x3305	542	OSV
19	NS Orla – Golden Energy Offshore	Golder Energy Offshore	DnVBattery Power	SAVe Energy	8200x3080x3306	896	OSV
20	NS Frayja – Golden Energy Offshore	Golder Energy Offshore	DnVBattery Power	SAVe Energy	8200x3080x3307	896	OSV
21	Prestfjord – Fishing vessel	Prestfjord	DnVBattery Power	SAVe Energy	Battery Room	370	Fishing vessel
22	MS Nordnorge – Hurtigruten	Hurtigruten	DnVBattery Power	SAVe Energy	Battery Room	2240	Cruise
23	MS Nordkapp – Hurtigruten	Hurtigruten	DnVBattery Power	SAVe Energy	Battery Room	2240	Cruise
24	MS Nordlys – Hurtigruten	Hurtigruten	DnVBattery Power	SAVe Energy	Battery Room	2240	Cruise
25	MS Kong Harald – Hurtigruten	Hurtigruten	DnVBattery Power	SAVe Energy	Battery Room	2240	Cruise
26	MS Richard With – Hurtigruten	Hurtigruten	DnVBattery Power	SAVe Energy	Battery Room	2240	Cruise
27	MS Polarlys - Hurtigruten	Hurtigruten	DnVBattery Power	SAVe Energy	Battery Room	2240	Cruise
28	Statsraad Lehmkuhl	Statsraad Lehmkuhl	DnVBattery Power	SAVe Energy	Battery Room	370	Sailing vessel
29	OV Hekkingen	Kystverket	DnVBattery Power	SAVe Energy	Battery Room	3000	Multi purpose vessel



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References

Reference List

	Vessel Name	Owner - Manager	Class	Battery type	ESSC Size	Energy Installed	Vessel Type
30	Egil Ulvan	Egil Ulvan	DnVBattery Power	SAVe Energy	Battery Room	1120	Cargo
31	Nobiskrug	Nobiskrug		SAVe Energy	Battery Room	560	Yacht
32	Viking Energy	Eidesvik	DNV-AUTR + Battery Safety	Orca Energy	N/A	N/A	PSV
33	Star Laguna	Grieg Star	DnVBattery Power	Orca Energy			Bulk Carrier
34	Yara Birkeland	Yara	ABS DPS-2 + Battery-Li	LeClanche	N/A	6560	Container Carrier
35	Seacor Maya	MEXMAR / SeacorMarine	ABS DPS-2 + Battery-Li	Orca Energy	6700x2503x3725	497	Offshore Supply Vessel
36	Seacor Warrior	MEXMAR / SeacorMarine	ABS DPS-2 + Battery-Li	Orca Energy	6700x2503x3725	497	Offshore Supply Vessel
37	Seacor Viking	MEXMAR / SeacorMarine	ABS DPS-2 + Battery-Li	Orca Energy	6700x2503x3725	497	Offshore Supply Vessel
38	Seacor Azteca	MEXMAR / SeacorMarine	DnVBattery Power	Orca Energy	6700x2503x3725	497	Offshore Supply Vessel
39	CS60 ECO	Awilco	DnVDP2 + Battery Power	LeClanche	N/A	1906	Drilling semi-sub
40	Alfa Lift	OHT	RINA Large LithiumBattery Installations	Orca Energy			Offshore Heavy Lift / OCV
41	Hybrid Ro/Ro #1	Grimaldi Lines	RINA Large Lithium Battery Installations	LeClanche	Battery Room	5030	Ro/Ro
42	Hybrid Ro/Ro #2	Grimaldi Lines	RINA Large Lithium Battery Installations	LeClanche	Battery Room	5030	Ro/Ro
43	Hybrid Ro/Ro #3	Grimaldi Lines	RINA Large Lithium Battery Installations	LeClanche	Battery Room	5030	Ro/Ro
44	Hybrid Ro/Ro #4	Grimaldi Lines	RINA Large LithiumBattery Installations	LeClanche	Battery Room	5030	Ro/Ro
45	Hybrid Ro/Ro #5	Grimaldi Lines	RINA Large LithiumBattery Installations	LeClanche	Battery Room	5030	Ro/Ro
46	Hybrid Ro/Ro #6	Grimaldi Lines	RINA Large LithiumBattery Installations	LeClanche	Battery Room	5030	Ro/Ro
47	Hybrid Ro/Ro #7	Grimaldi Lines	RINA Large LithiumBattery Installations	LeClanche	Battery Room	5030	Ro/Ro
48	Hybrid Ro/Ro #8	Grimaldi Lines	RINA Large LithiumBattery Installations	LeClanche	Battery Room	5030	Ro/Ro
49	Hybrid Ro/Ro #9	Grimaldi Lines	RINA Large LithiumBattery Installations	LeClanche	Battery Room	5030	Ro/Ro
50	UP Agate	MEXMAR / Seacor Marine	ABS DPS-2 + Battery-Li	Orca Energy	6700x2503x3725	497	Offshore Supply Vessel
51	CS60 ECO MW 2	Awilco	DnVDP2 + Battery Power	LeClanche	N/A	1906	Drilling semi-sub
52	Oddrun With	Egil Ulvan Rederi	DnVBattery Power	SAVe Energy	Battery Room	560	Cargo
53	Bailey Tide	Tidewater	ABS DPS-2 + Battery-Li	Orca Energy	6060x2440x2590	750	Offshore Supply Vessel
54	Normand Naley	Solstad	DnVBattery Power	Orca Energy	8200x3080x3300	562	Offshore Supply Vessel
55	Normand Falnes	Solstad	DnVBattery Power	Orca Energy	8200x3080x3300	562	Offshore Supply Vessel
56	SeaDream Yacht X	SeaDream Yacht Club	DnV Battery Power	LeClanche	Battery Room	4000	Expedition Cruise
57	Island Crusader	Island Offshore	DnV Battery Power	SAVe Energy	8200x3080x3300	896	Offshore Supply Vessel
58	Island Contender	Island Offshore	DnV Battery Power	SAVe Energy	8200x3080x3300	896	Offshore Supply Vessel



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Norway's Hurtigruten launches first battery-powered cruise ship

02 July 2019

MS Roald Amundsen, the world's first cruise ship propelled partially by battery power, is set to head out from northern Norway on its maiden voyage, cruise operator Hurtigruten said on Monday.



The hybrid expedition cruise ship can take 500 passengers and is designed to sail in harsh climate waters.

The state of the art vessel features new and environmentally sustainable hybrid technology that will reduce fuel consumption and is a technology demonstrator that shows hybrid propulsion on large ships is possible.

While the engines run mainly on marine gasoil, the ship's battery pack enables it to run solely on batteries for around 45 to 60 minutes under ideal conditions, reports quoting Hurtigruten chief executive Daniel Skjeldam said.

The company estimates that the battery pack will reduce fuel consumption and save about 20 per cent in carbon dioxide emissions, compared to ships operating solely on marine gasoil.

Source: domain-b.com 2019-07-02

References

Example - New Builds

Kongsberg Package for Awilco Newbuild



A new, state-of-the-art semi-submersible drilling rig being built by Keppel Offshore & Marine for Awilco Drilling will feature an integrated equipment suite from Kongsberg Maritime.

The newbuild is the second Awilco Drilling owned Moss CS60Eco semi-submersible drilling rig being built by Singapore's Keppel Offshore & Marine, due for completion in March 2022.

The Kongsberg delivery scope includes diesel engines, high torque thrusters, mooring system, hybrid power system with advanced battery technology, thruster drives, drilling drives and energy management systems, which combined will contribute to lower opex costs and reduced fuel oil consumption and minimized CO₂ and NO_x emissions.

The operational technology package includes further cost reducing elements including condition monitoring of rotating machinery and an advanced information management system. As part of this, the rig will also be equipped with Kongsberg's ECO Advisor system with built in guidance to help operators make optimal decisions for set up of the complete power plant.

Source: Offshore Engineer Digital 2019-06-05



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SEACOR Marine Completes Installation of Hybrid Power Solution on SEACOR Maya in Gulf of Mexico; First Hybrid OSV Classed by ABS



SEACOR Maya receives Interim Class Certificate with additional notation Battery-Li from the American Bureau of Shipping (“ABS”)

New hybrid power solution will help reduce emissions and fuel consumption and increase safety

SEACOR Marine Holdings Inc. (NYSE: SMHI) (“SEACOR Marine”) today announced it has completed the installation of the first hybrid power solution on an offshore support vessel (“OSV”) in the Gulf of Mexico, following the upgrade of the SEACOR Maya OSV to hybrid lithium battery power propulsion. After a series of successful sea and failure mode effect analysis trials, the SEACOR Maya was issued its Interim Class Certificate from the American Bureau of Shipping (ABS) with additional notation BATTERY-Li, the first ever ABS OSV to have this notation. SEACOR Maya is currently operated by Mantenimiento Express Marítimo, S.A.P.I. de C.V. (“MexMar”), SEACOR Marine’s joint venture in Mexico.

“The successful installation of a hybrid power solution along with the first ever ABS OSV BATTERY-Li notation is a big milestone for our company,” said John Gellert, SEACOR Marine’s Chief Executive Officer. “We have long believed that cutting edge hybrid power technology has the potential to improve vessel efficiency, while reducing fuel consumption and emissions by as much as 20 percent. Early indications from sea trials of SEACOR Maya put us well within reach of this target and validate the success of our investment.”

“The new hybrid lithium battery system will also help us improve safety, drive energy efficiencies and reduce our overall environmental impact. As governments tighten emissions standards, this technology will be a key competitive differentiator, leaving us well placed to take advantage of an upturn in the market.”

Source: [businesswire.com](https://www.businesswire.com) 2019-06-19

References

Example - Retrofits

Rolls-Royce to deliver battery systems for two offshore vessels

Golden Energy Offshore's vessels will also receive an energy monitoring system that provides a complete overview of energy usage onboard



Rolls-Royce Commercial Marine has won an order to deliver battery-powered energy systems for two offshore platform supply vessels (PSVs) in Norway.

The delivery for Golden Energy Offshore includes the **SAVe Energy system**, which was launched by the company earlier this month and is used to deliver top-up power for diesel or hybrid ships but could be deployed for all-electric fleets eventually.

The two vessels, Orla and Frayja, will receive an upgrade of its existing ship design engineering package, along with its energy monitoring system that provides a complete overview of energy usage onboard.

Golden Energy Offshore aims to achieve environmentally friendly and cost effective operations for all its vessels and is among a few offshore ship operators globally that are fully ISO 50001 certified, which involves having a framework for measurement, registration, reporting and auditing of energy efficiency.

CEO Per Ivar Fagervoll said: “We started off by integrating sustainability into business processes and systems years ago and it has developed into a continuous journey of success with regards to energy efficiency, operational excellence and sustainability.”

Source: energynews.com 2018-08-28



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References

Systems & Vessel Types

- ❖ KM Energy Storage Systems since 2010
- ❖ 100 MWh+ delivered or in ongoing projects
- ❖ 40MWh+ of SAve Energy
- ❖ Approx. 50% of the projects are upgrades



✕ 22

Platform Supply Vessels



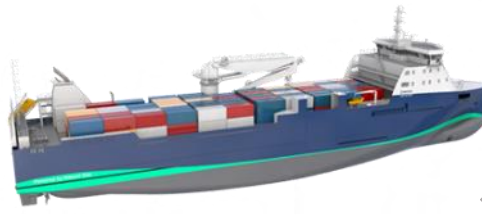
✕ 1

Fishing & Fish Farm Vessels



✕ 16

Cruise Vessels



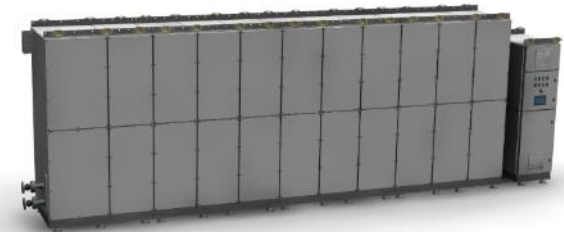
✕ 13

Container, Ro-Ro & Cargo Vessels



✕ 1

Crane / Heavy Lift Vessels



Systems
✕ 91

Vessels
✕ 60



✕ 3

Multipurpose Vessels



✕ 1

Research Vessels



✕ 2

Drilling Vessels



✕ 1

Sailing Vessels



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Thank you

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