

Danfoss Drive Solutions for Marine Hybrid & Electrification

Dong-Yeong Ryu, Leader of DPD API Marine Electrification



Dong-Yeong Ryu (DY), 류동영



Education: Naval Architech/Mechatronic with Master Degree

1992 – 1996: 2 years of overseas experiences and 2 years as engineers in Chemical company

1996 – 2010: Sales manager, ABB Korea Marine & Offshore

2010 – 2022: Two positions in Danfoss Korea

2023 – current: Sales Leader of API Marine Electrification, Danfoss Drives

Personal Ambitions and Goals for future:
Hybridization and electrification of all ships

Hobby: Table tennis and golf

Danfoss at a glance



Worldwide sales
in more than

100
countries

Three strong business segments
with leading positions

Power Solutions

Climate Solutions

Power Electronics and Drives

Leading technology
partner for our
customers who want to
decarbonize through
energy efficiency,
machine productivity,
low emissions, and
electrification

+42,000

Employees worldwide.
People are the foundation
of our business



Well on the way towards
carbon-neutral global
operations by 2030

97 

Factories in more than
20 countries

1933

Long track record within
innovation and engineering
founded by Mad Clausen in
1933

Global Marine Market



Study Period:	2018-2027
Base Year:	2021
Fastest Growing Market:	Asia Pacific
Largest Market:	Asia Pacific
CAGR:	4.84 %



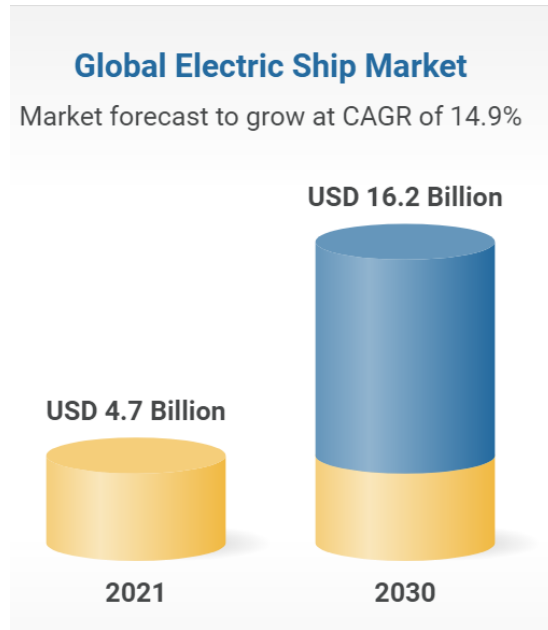
The shipbuilding market:

Value 2021 = USD 133 Billion
E. Value 2027 = USD 176 Billion

CAGR = 4,84%

Retrofit Market : >15 years old

Global Electric Ship Market



The Global Electric ship market:

Value 2021 = USD 4.7 Billion

E. Value 2027 = USD 16.2 Billion

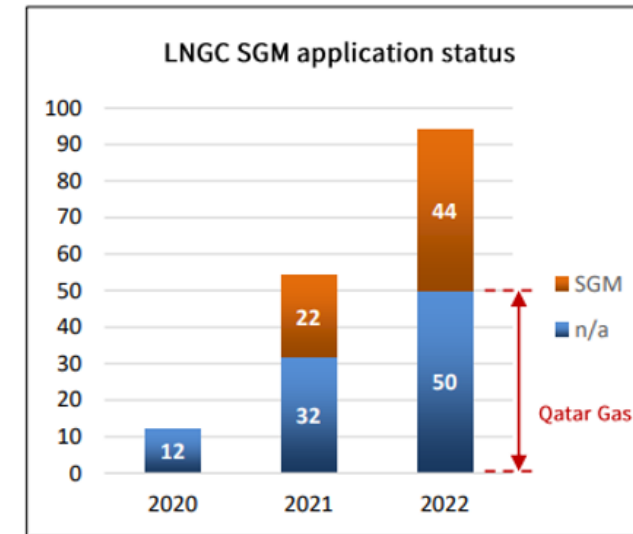
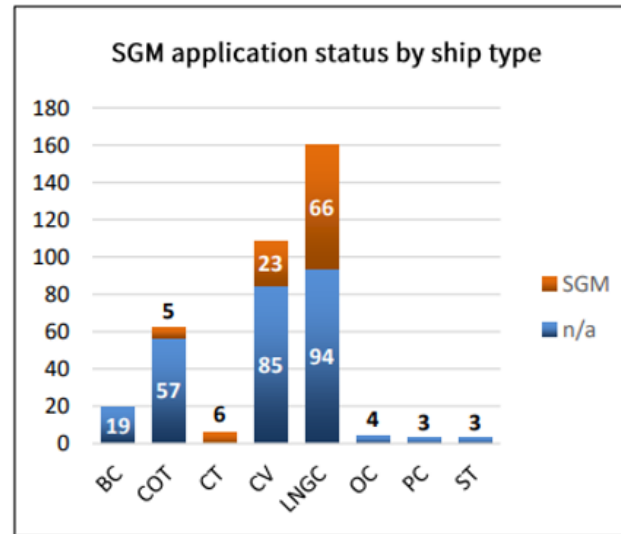
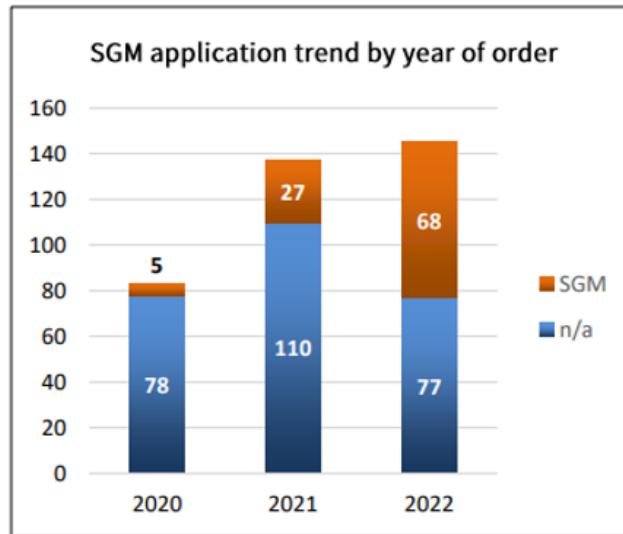
CAGR = 14,9%

Main Drives:

- Rise in conversion of propulsion system in passenger vessels / Tugboats etc.
- Increasing sea borne trade across globe and growing maritime tourism industry

	2023	2024	2025	2026	2027	2028	2029	2030
Growing with Market	100	115	132	152	175	201	231	265
Outperform market	100	120	144	173	208	250	300	360

Global Shaft Generator Market based on HSD Engine Order Book



- HSD Engine Order Book shows the trend of shaft generator demand
- The demand of shaft generator is increasing and continue to increase according to IMO regulation Phase 3-5

Which application (target application) and how can the electric energy be saved?



Hybrid Power Generation

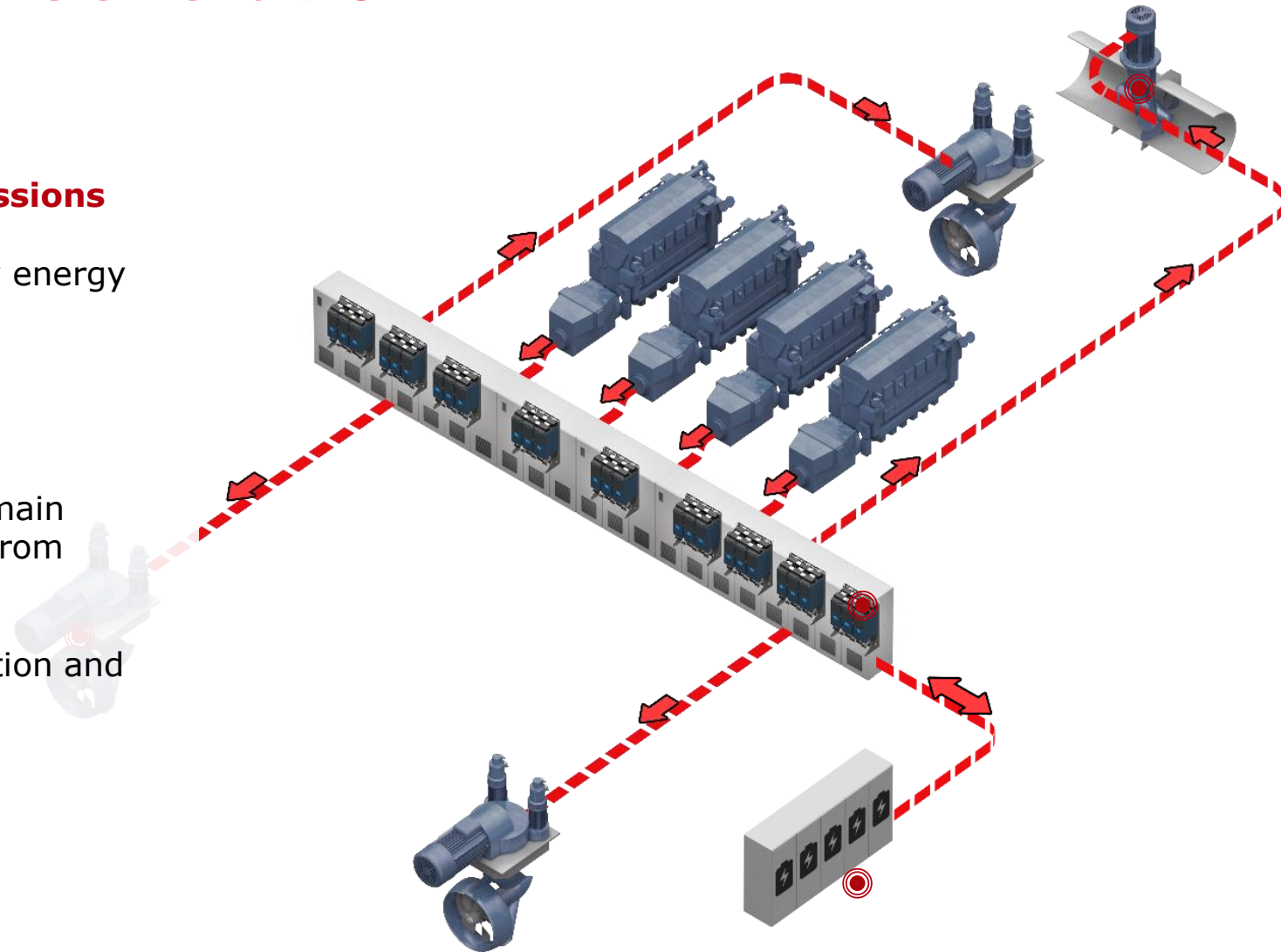
Clean air thanks to less emissions

New-build or retrofitted battery energy storage gives the vessel

- Better dynamics
- Performance optimization
- Ability to stop engines
- Downsizable main engine
- Stable average power from main engine and dynamic peaks from battery

The result is less fuel consumption and less emissions

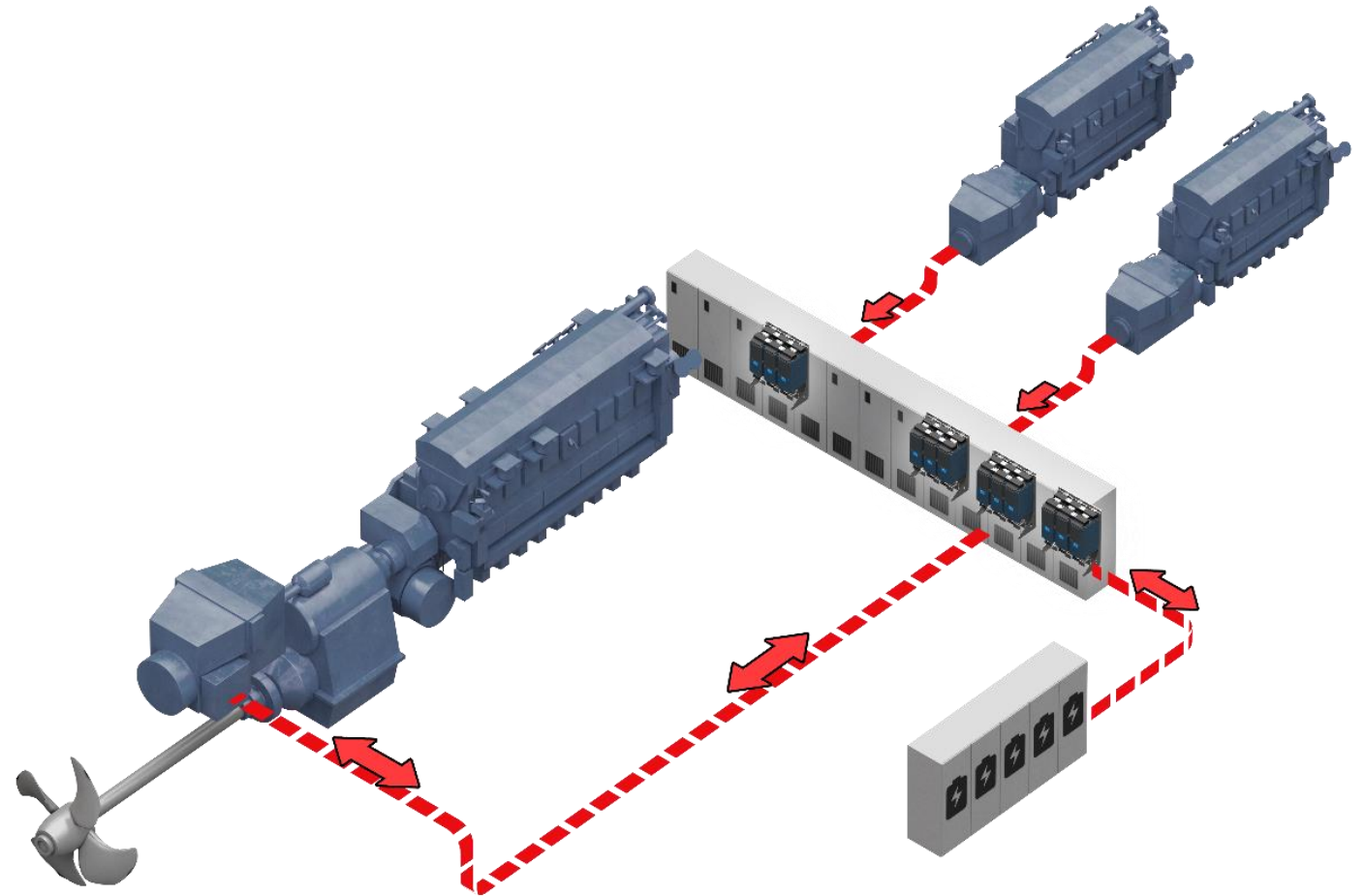
Typical fuel savings: 20-30%



Hybrid Power Generation & Hybrid Propulsion

Save up to 30% on fuel consumption

- Variable speed shaft generator/motor with **PTO/PTI** (Power Take Out, Power Take In), **Boost**, and **Take Me to Harbor** function
- **Common DC bus** optimizes power conversion
- Floating voltage/frequency **auxiliary generators** ensure maximum efficiency
- **Micro grid converters** produce clean AC power
- **Battery energy storage** peak shaving system allows smaller and more efficient engines. Typical fuel savings: 20-30%



Basic Engineering of Electric & Hybrid Propulsion System

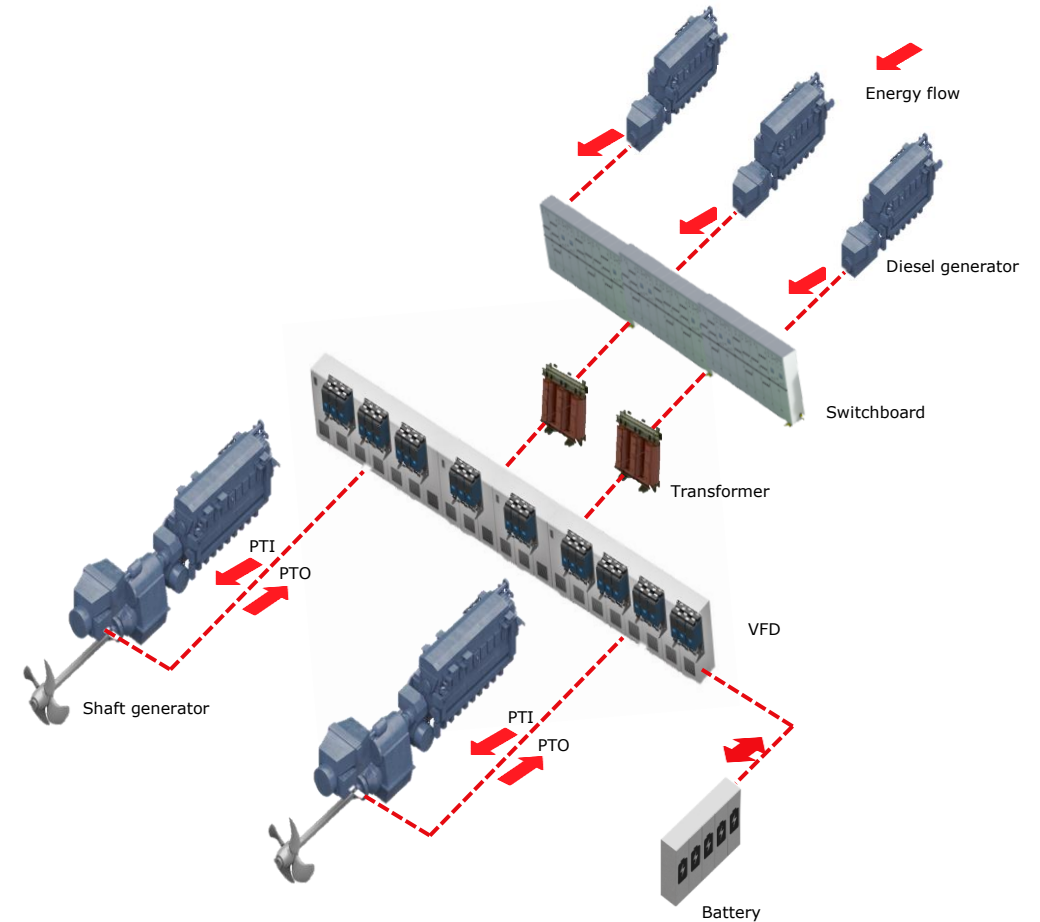
Required basic engineering?

- "Harmonic mitigation" "short circuit current" "generator dimensioning X"d, power factor (how much reactive power?)

Short circuit current = apparent power (KVA)/
(voltage x x"d)

- Decision for voltage, AC? Or DC grid? , harmonic mitigation (AFE, muti pulse?), generator, switchboard dimensioning, Drive dimensioning etc
- Dimensioning of ESS according to operation profile (Cycles?, Depth of Discharge?, etc)
- Interface between systems
- Optimised power management system

x



Shaft Generator Demo



0.75kW motor to simulate engine operation

Codesys based operation panel

24V Li-ion battery

1800rpm, 120Hz
0.75kW PM
motor(8pole) for shaft generator

Pre-charging circuit

Incremental encoder for closed loop control

Case Story 1 – KIOST Ocean Research Vessel

**5900tons RV
K-Shipyard(Ex STX)
2014**

**1st Diesel electric propulsion system
engineered locally in Korea**

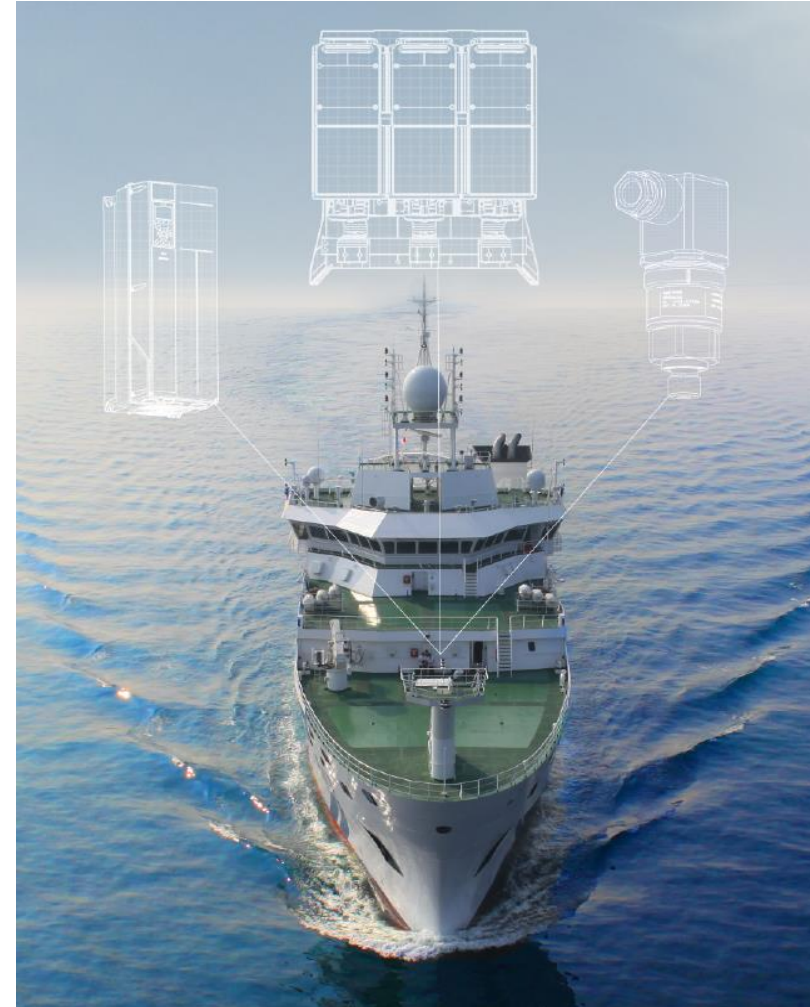
Customer : Hyundai HI

Scope of Supply

- Short Circuit calculation /THD
- Propulsion and Thruster Drives
(2x 2.5MW, 1x2.33MW, 1.35MW)
- Interfacing with Automation and thruster
controls etc

Key Winning Factors

- Listed in the vendors at concept design
- Local project management and
Engineering
- Cooperation with local system
integrators



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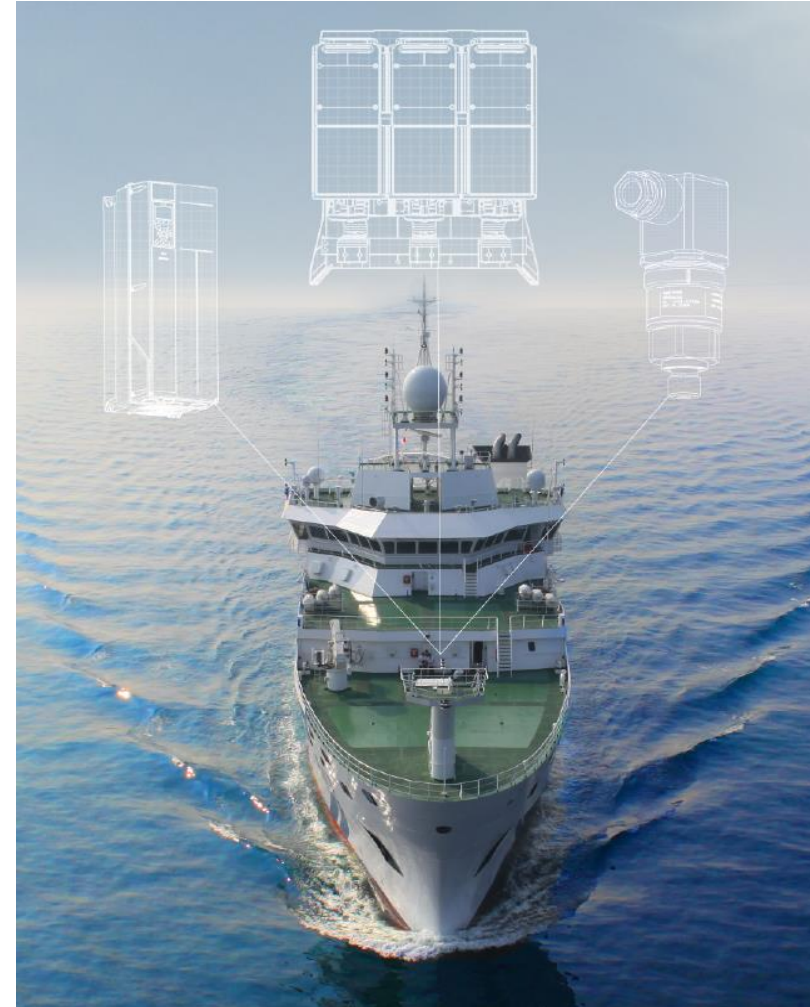
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Case Story 2 – Korea Coast Guard

3000tons 2ships
5000tons 1ships
2014 (K-Shipyard, HHI)

1st KR Coast Guard Hybrid Propulsion ship project with Propulsion Motor Drives

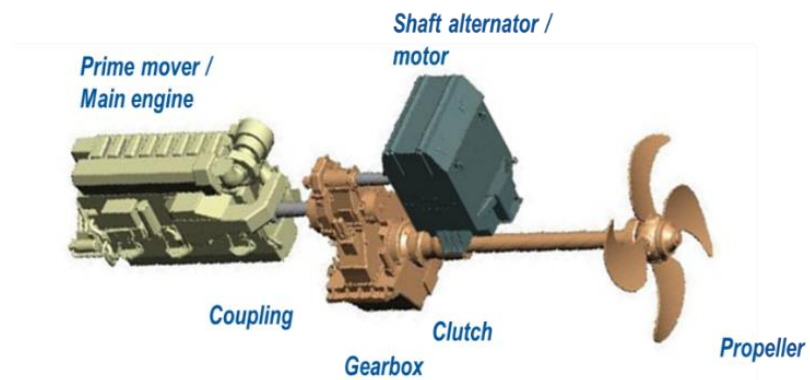
Customer : HME

Scope of Supply

-2 x 750kw Propulsion Drives(PTI)

Key Winning factors

-Local technical support
-Power Limitation functionality for fluctuating load



Case Story 3 – NIFS Research Vessel

**1400tons RV
HK Shipyard
2014**

**1st KR NIFS Hybrid Propulsion ship project
with PTI/PTO(motoring/generating)**

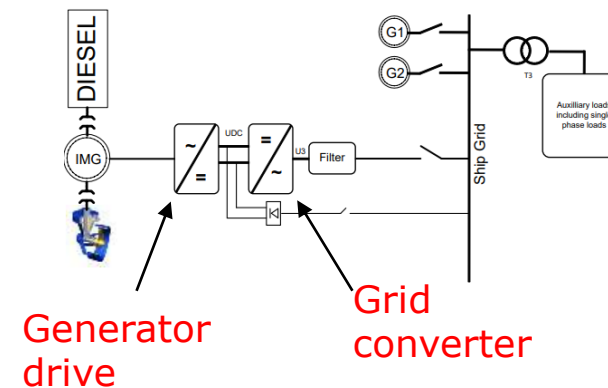
Customer : STX Engine

Scope of Supply

- 2 x 500kw Shaft Generator/motor
- 2 x 500kw Grid Converters
- Isolation Transformers
- Interfacing with Automation/CPP propeller system

Key Winning factors

- Local project management and engineering
- Demo showing PTI/PTO functionalities



Case Story 4 – Fishery Petrol Vessel

900tons 3ships
1,900tons 5ships spec in 2020

1st KR Government Hybrid Propulsion ship project with battery under construction according to Green ship K Initiatives

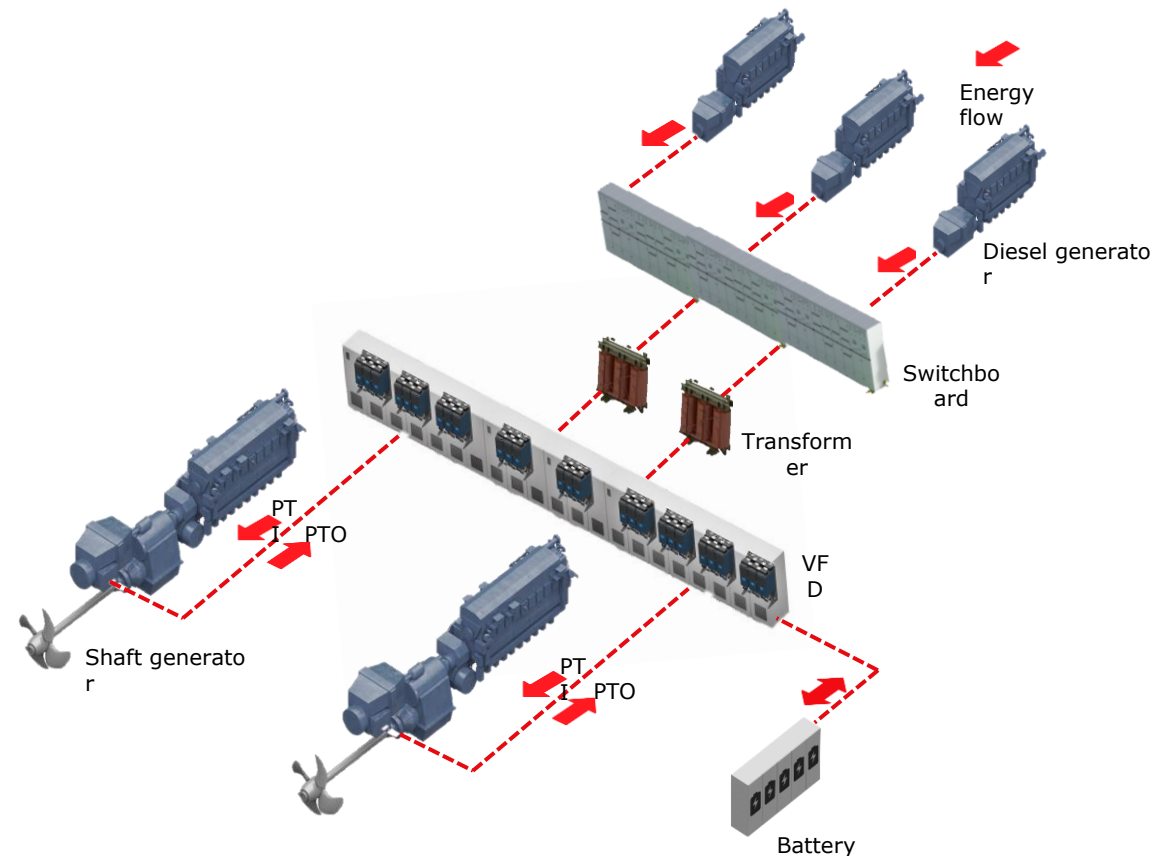
1st local engineering and project management in Korea

Scope of Supply

- 2 x 500kw shaft generator/motor
- 2 x Grid converters and DC/DC converters
- 2 x Marine ESS(490 Kwh)
- Power Management System

Key Winning factors

- Local engineering & project management
- Locally made hybrid demos which verify local competency
- Proven references in Europe



Major References for GreenShip-K Initiatives from Danfoss Partners

References (2020-Current)

- 5ships for 170T Purification ships
 - Application: 150kW Shaft generator with Li-Ion battery
- 2 x Hospital ships for Jeonlanam-do & Chungchungnam-do
 - Application: 250kW Electric propulsion with Li-Ion battery
- Bukhan-gang Tourist ship
 - Application: Pure electric propulsion with 2000kW Li-Ion battery
- 420T Car-ferry ship
 - Application: Pure electric propulsion with 2000kW Li-Ion battery
- Island Reaserch vessel
 - Application: 100kW Shaft generator with 200kW Li-Ion battery
- Chung-ju lake Figher-fighting vessel
 - Application: 100kW Shaft generator with Li-Ion battery
- 4 x 130T Harbor Naviator ships
 - Application: 150kW Shaft generator with Li-Ion battery
- DSME Shaft Generator for LPG/LNG, VLCC, Container(15+10 sets)



Key takeaway

1

Electric/hybrid
ship market is
increasing
globally

2

Danfoss is willing
to share system
knowledges with
customers

3

Hybrid
Demo(test
bench) is the
Must to veriry
new emerging
projects

4

Danfoss
suppports our
partners &
customers with
feasibility study
before making
decision

Q & A Session

