

Ingeteam

READY FOR YOUR CHALLENGES

www.ingetteam.com

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READY FOR YOUR CHALLENGES

INGETEAM

Marine Systems

We are the business unit within our group dedicated to Electric and Automation Engineering for the Marine sector.

INGETEAM POWER TECHNOLOGY-MARINE SYSTEMS provides the following products for the marine sector:

Low Voltage and High Voltage Electrical Plants:

- Generators.
- Main switchboards.
- Transformers.
- Electric motors.
- Frequency converters.

Automation:

- Energy Management System (Ingeship EMS)
- Propulsion control system (Ingeship PCS).
- Power management system (Ingeship PMS).
- Alarm and monitoring control system (Ingeship AMCS).
- Integrated Dredging Control System (Ingeship DMC).



INGETEAM

Marine Systems

More than
70

Complete integration solutions

More than
600

Vessels propelled with our technology

More than
900

Frequency Converters



INGETEAM

Marine Systems



1. Main and Auxiliary Propulsions
2. Dredgers
3. Silent Propulsion for Research Vessels
4. Hybrid Electrical Drives. PTI/PTO
5. Battery integration on diesel – electric ships
6. On-Shore Power Supply
7. Special Ships
8. Passenger Vessels

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Main & Auxiliary Propulsions [AFE vs DFE]

Name **B618/1 & B618/2**
Shipowner **Maritime Authorities in Gdynia**
Shipyard **Remontowa Shipbuilding S.A.**
Vessel type **Multipurpose Service Vessel**

Main advantages of the AFE Topology

- Size-Weight optimization
- Supply quality
- Grid stability
- Energy saved from the stopping of the propeller
- DC Bus regulation
- Power factor regulation
- Less cabling



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Main & Auxiliary Propulsions [AFE vs DFE]

Name **VICTOR ANGELESCU**
Shipowner **INIDEP - ARGENTINA**
Shipyard **ARMON SHIPYARD**
Vessel type **Oceanographic Research Vessel**

Main advantages of the AFE Topology

- Size-Weight optimization
- Supply quality
- Grid stability
- Energy saved from the stopping of the propeller
- DC Bus regulation
- Power factor regulation
- Less cabling



INGETEAM

Main & Auxiliary Propulsions [LV vs MV]

Name **KHANKENDI**
Shipowner **BRITISH PETROLEUM**
Shipyard **Keppel Singmarine Baku**
Vessel type **Subsea Construction Vessel**

Low Voltage

- Low-Medium Power Range
 $P < 4\text{MW}$
- More redundancy possibilities
- Usually cost effective

Low and Medium voltage selection should be made to optimize the vessel solution in terms of size, cost, weight and cabling



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Main & Auxiliary Propulsions [LV vs MV]

Name **SIMON STEVIN**
Shipowner **JAN DE NUL**
Shipyard **CNN La Naval**
Vessel type **Fall Pipe and Mining Vessel**

Medium Voltage

- Medium-High Power Range
 $P > 3\text{MW}$
- Reduced Electrical Cabling

Low and Medium voltage selection should be made to optimize the vessel solution in terms of size, cost, weight and cabling



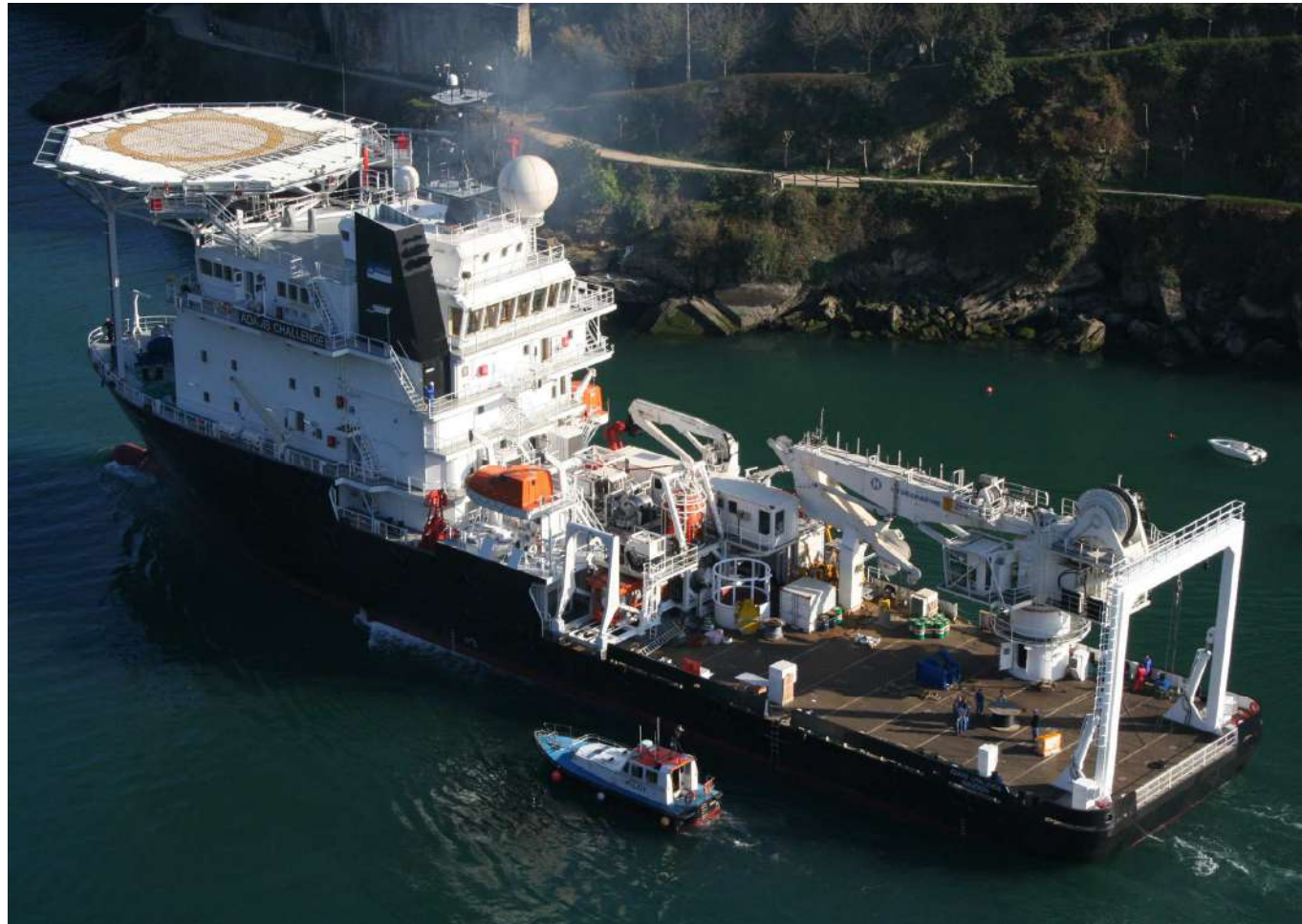
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Main & Auxiliary Propulsions [DP2 / DP3]

Name **ADAMS CHALLENGE**
Shipowner **Adams Offshore W.L.L**
Shipyard **BALENCIAGA SHIPYARD**
Vessel type **Multipurpose Diving Support Vessel**

DP2. Double SB/PS feeding

- DP2: In the event of a electrical grid black-out, the vessel has to be able to maintain its position with a given accuracy
- DP3: In addition to DP2 requirements, DP3 requires that vessel position has to be maintained in the event of flood and / or fire in the electrical room



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Main & Auxiliary Propulsions [DP2 / DP3]

Name **LIVING STONE**

Shipowner **DEME**

Shipyard **CNN LA NAVAL**

Vessel type **Multipurpose Cable Laying Vessel**

DP3. Built –in Static Converter for
Auxiliaries Feeding

- DP2: In the event of a electrical grid black-out, the vessel has to be able to maintain its position with a given accuracy
- DP3: In addition to DP2 requirements, DP3 requires that vessel position has to be maintained in the event of flood and / or fire in the electrical room



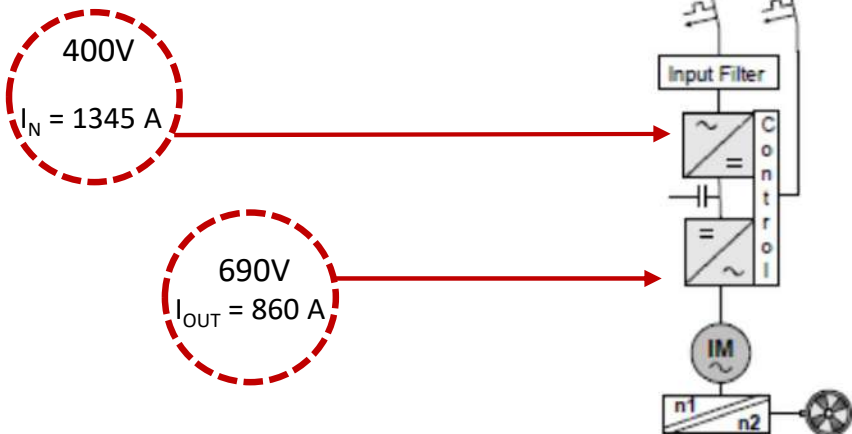
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Main & Auxiliary Propulsions [AFE Voltage Booster]

Name **NB-348**
Shipowner **BALEARIA**
Shipyards **CNN LA NAVAL**
Vessel type **RoRo Passenger Vessel**

AFE Voltage Booster

- Small Footprint
- Reduced Cabling in motor side



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Dredgers

Name **Cristobal Colón / Leiv Eiriksson**
Shipowner **JAN DE NUL**
Shipyard **CNN La Naval**
Vessel type **46.000m³ Trailing Suction Hopper Dredger**

The largest **TSHD** dredgers in the world!



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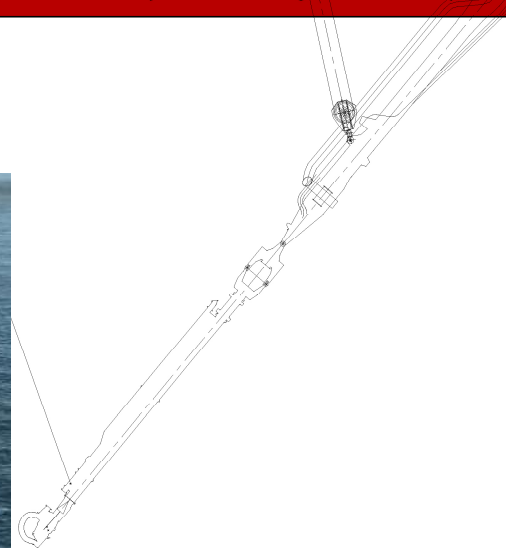
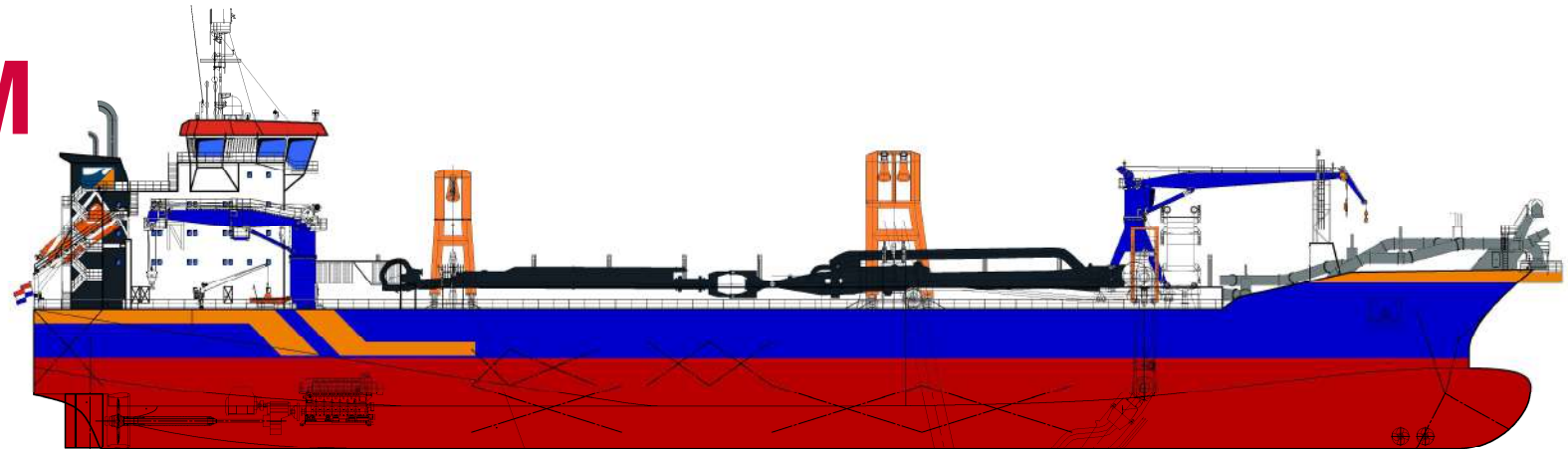
Dredgers

Name **VOX AMALIA**
VOX ALEXIA

Shipowner **VAN OORD**

Shipyard **CNN LA NAVAL**

Vessel type **Trailing Suction Hopper Dredger**



Main & Auxiliary Propulsions · **Dredgers** · Silent RV · Hybrid PTI-PTO · Battery integration · On-Shore Supply · Special Ships · Passenger Vessels

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INGETEAM – Ingeship DAS

Dredging Automation System

Name **ORTELIUS / SANDERUS**
Shipowner **JAN DE NUL**
Shipyard **Keppel Singmarine (Singapore)**
Vessel type **6.000m³ Trailing Suction Hopper Dredger**

INGESHIP DAS (Dredging Automation System)

An advanced automation system specifically developed for TSHD suction dredgers, using the latest techniques in the development of control systems.

INGESHIP DAS is a level 2 technological control (process - production), able to be coupled and complemented with any basic automation system of the dredging process (level 0 & 1).

The system is completed with a simulation model a TSHD dredger that allows the validation of the solution using vHIL techniques.



INGETEAM – Ingeship DAS

Dredging Automation System

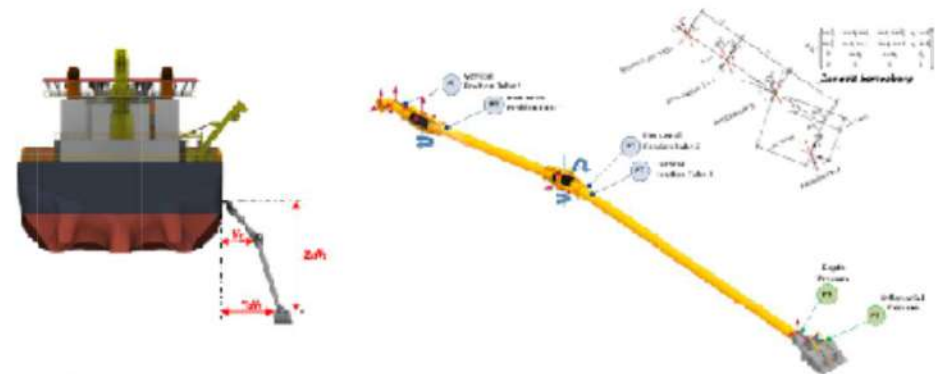
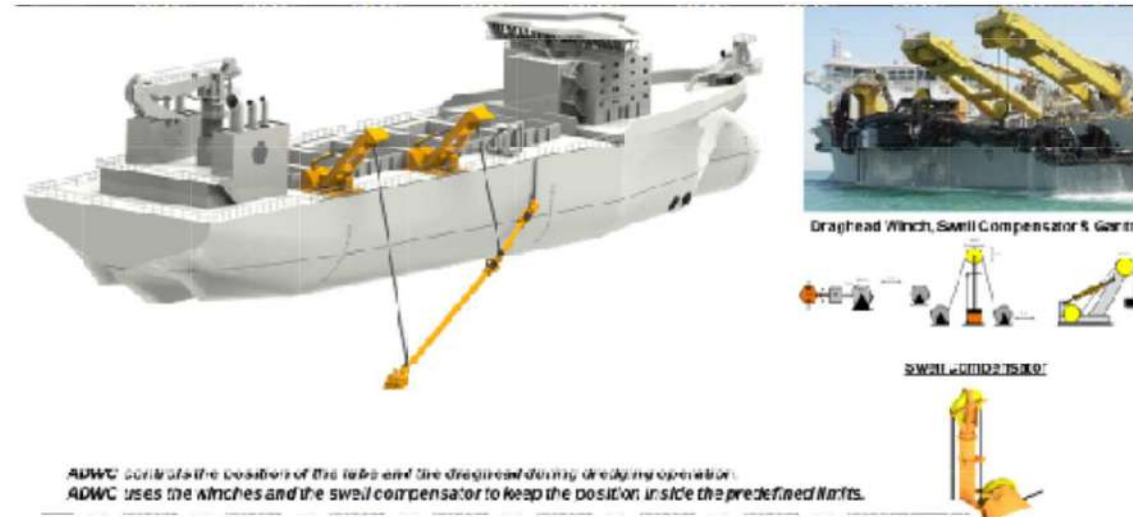
Name **8700**
 Shipowner **JAN DE NUL**
 Shipyard **COSCO DALIAN**
 Vessel type **18.000m³ Trailing Suction Hopper Dredger**

INGESHIP DAS (Dredging Automation System)

An advanced automation system specifically developed for TSHD suction dredgers, using the latest techniques in the development of control systems.

INGESHIP DAS is a level 2 technological control (process - production), able to be coupled and complemented with any basic automation system of the dredging process (level 0 & 1).

The system is completed with a simulation model a TSHD dredger that allows the validation of the solution using vHIL techniques.



The STHM obtains with a high accuracy the position of the table and the dredger with respect to vessel hull.
 This is done in working mode:

- PTK Mode:** Use the kinematic model with the position sensor (Dredger) to determine hull inert coordinates. Once this reference is known, then using Demand-Reference algorithm, its real position can be determined.
- Normal STHM:** Use the calculated draught at hull list as its preferences. Once this value is known the real value is PTK.
- Backup STHM:** Use the actual arm length of the dredger to estimate the vertical angles.



INGETEAM – Ingeship CCS

Cable Control System

Purpose:

Used during the **underwater cables** installation phase of the offshore projects

Used for **laying, lifting and repair** underwater cables

Cable System Equipment:

Large **turntables or carousels** which allow cables to be stored without bending it too much

Jacking systems, loading and lay tensioners, gooseneck, wheeled haulers, loading arms, catenary slack, tugger winches, etc. which allow cable to be laid and lifted in a proper way

Control Systems:

Dynamic Positioning (DP): to automatically maintain vessel's position and track

Cable Control System (CCS): to control the cable system equipment and synchronize the speed of the vessel with the speed of the cable process



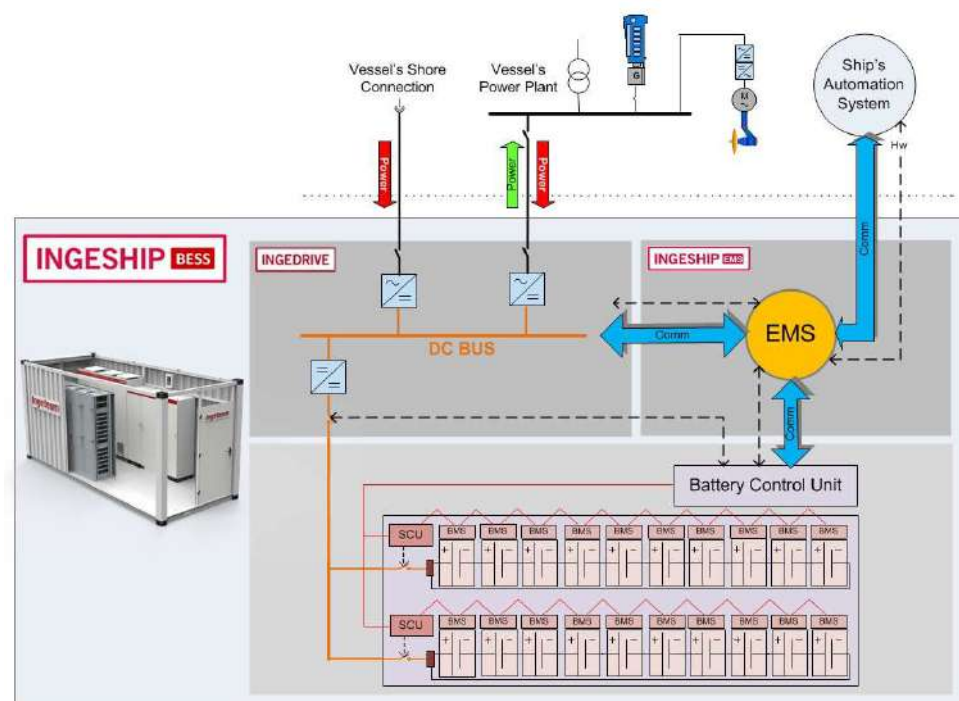
INGETEAM – Ingeship BESS

Battery Energy Storage System

Ingeteam's Containerized Battery Energy Storage System provides a high efficiency compact hybrid power solution for electric propulsion vessels.

Ingeteam's Battery Energy Storage Systems (BESS) is a compact battery storage solution controlled by an optimized energy management system that enhances vessel's power plant capabilities.

Ingeteam's BESS turns any standard electric propulsion vessel into a latest generation hybrid-electric propulsion vessel

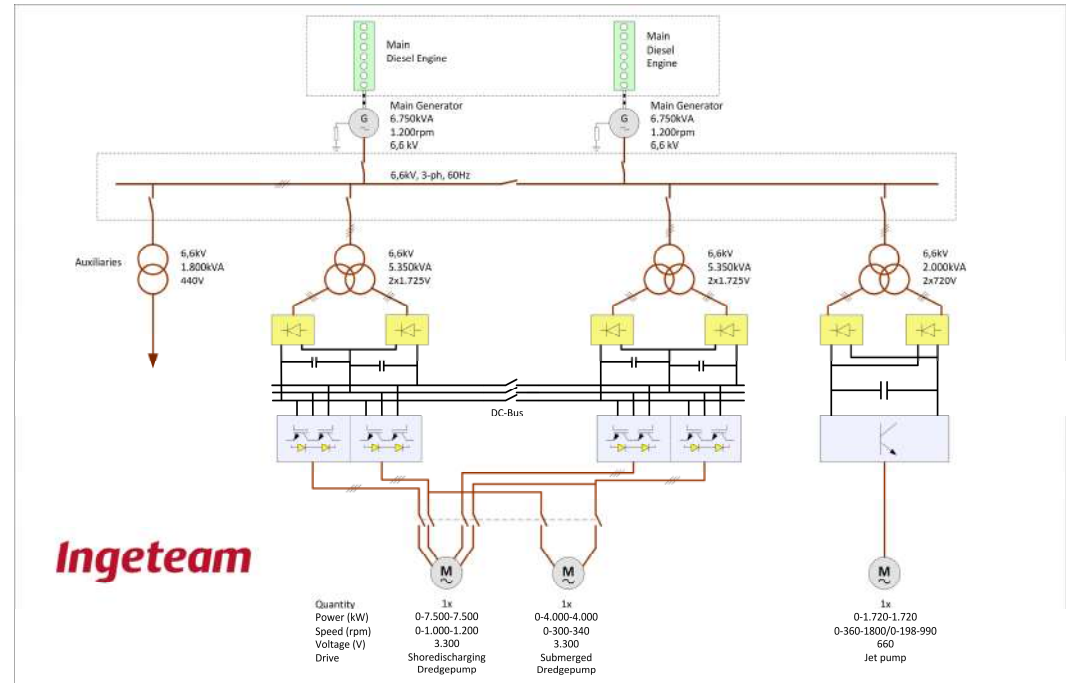


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Dredgers [Redundant Topologies]

Name **FILIPPO BRUNELLESCHI**
FRANCIS BEAUFORT
Shipowner **JAN DE NUL**
Shipyard **CNN La Naval**
Vessel type **11.300m³ Trailing Suction Hopper Dredger**

“This topology enables operation at **reduced load** so that pipes don’t get blocked if the sand dries inside”.



“Also provides a fully **redundant** and **independent** feeding of the pump, which avoids two pumps in series”.



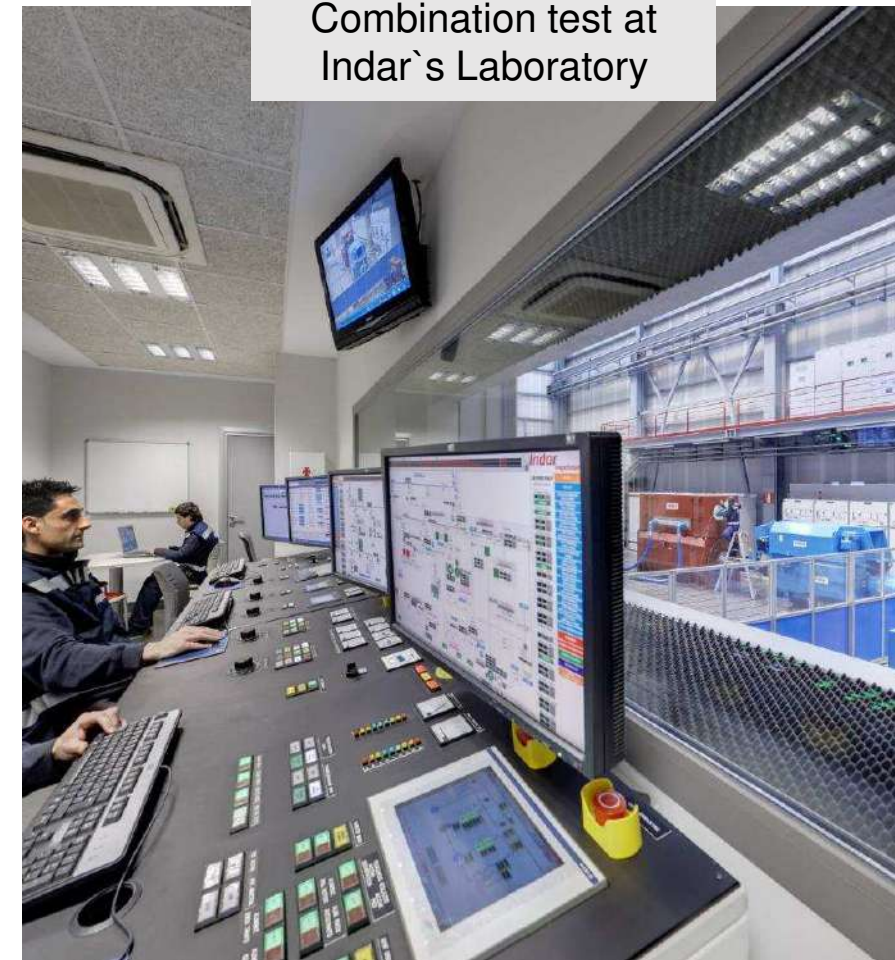
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Silent Propulsion [Research Vessel]

ICES 209

- Vizconde de Eza- SPAIN
- Miguel Oliver - SPAIN
- Ramon Margaleff - SPAIN
- Angeles Alvariño - SPAIN

- Bipo INAPESCA - MEXICO
- University of Bergen - NORWAY
- INIDEP- ARGENTINA



Combination test at Indar`s Laboratory



Main & Auxiliary Propulsions · Dredgers · **Silent RV** · Hybrid PTI-PTO · Battery integration · On-Shore Supply · Special Ships · Passenger Vessels

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Silent Propulsion [Research Vessel with DC Motors]

Name	RAMON MARGALEF
Shipowner	IEO Instituto Español de Oceanografía
Shipyard	ARMON VIGO
Vessel type	Research Vessel

Main Propulsion Topologies in DC

- **Two independent propulsion motors & propellers.**
- One propeller with two motor in tandem arrangement.



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Silent Propulsion [Research Vessel with DC Motors]

Name **ANGELES ALVARIÑO**
Shipowner **IEO** Instituto Español de Oceanografía
Shipyard **ARMON VIGO**
Vessel type **Research Vessel**

Main Propulsion Topologies in DC

- Two independent propulsion motors & propellers.
- **One propeller with two motor in tandem arrangement.**



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Silent Propulsion [Research Vessel with AC Motors]

Name **JOSE CARRANZA**
Shipowner **INAPESCA - MEXICO**
Shipyard **ARMON VIGO**
Vessel type **Research Vessel**

Main Propulsion Topologies in AC

- **Two independent propulsion motors & propellers.**
- One propeller with two motor in tandem arrangement.



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Silent Propulsion [Research Vessel with AC Motors]

Name **VICTOR ANGELESCU**
Shipowner **INIDEP - ARGENTINA**
Shipyard **ARMON VIGO**
Vessel type **Research Vessel**

Main Propulsion Topologies in AC

- Two independent propulsion motors & propellers.
- **One propeller with two motor in tandem arrangement.**



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Silent Propulsion [Research Vessel with AC Motors]

Name **FRIDTJOF NANSEN**
Shipowner **IMR NORWAY**
Shipyard **GONDAN SHIPYARD**
Vessel type **Research Vessel**

Main Propulsion Topologies in AC

- Two independent propulsion motors & propellers.
- **One propeller with two motor in tandem arrangement.**



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Hybrid electrical Systems [Topologies PTI / PTO Concept]

Grid Side

AFE for dual functionality

Circuit Breaker included

Filter included for IEEE519 and IEC60092 compliance

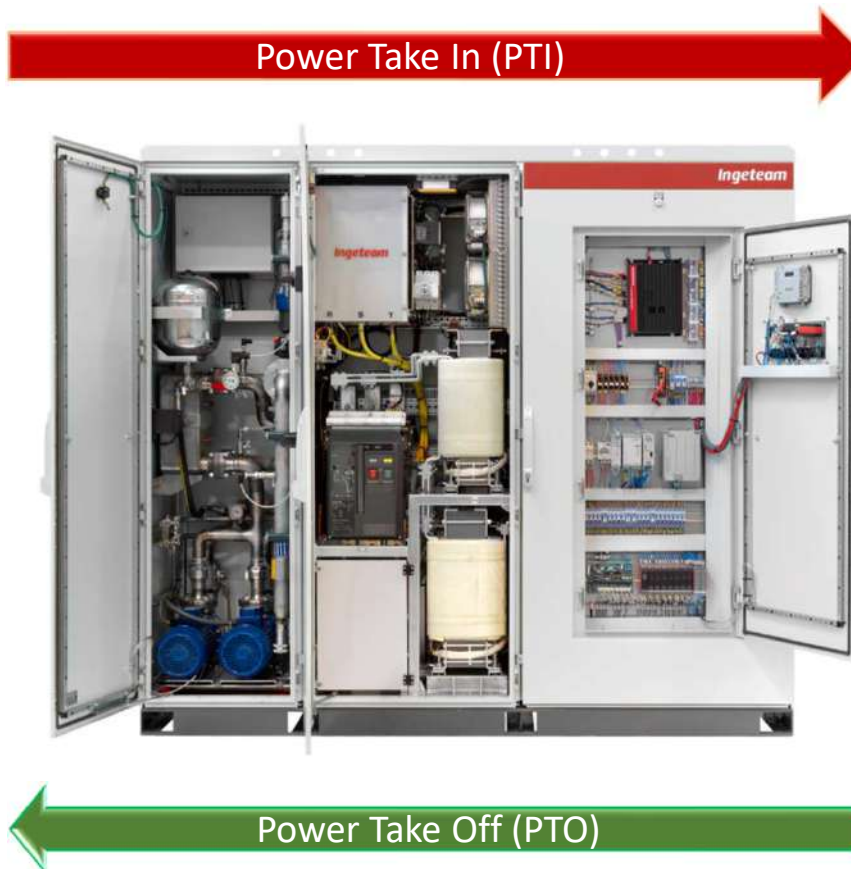
Short time overload capability: up to 300%
2 seconds

Cooling

Fully water cooled. No losses to the environment IP54

Stand by pump as standard

Power Take In (PTI)



M/G Side

Suitable for asynchronous, synchronous or PM machines

Optional Sinus Filter for standard machines (Retrofits)

Control

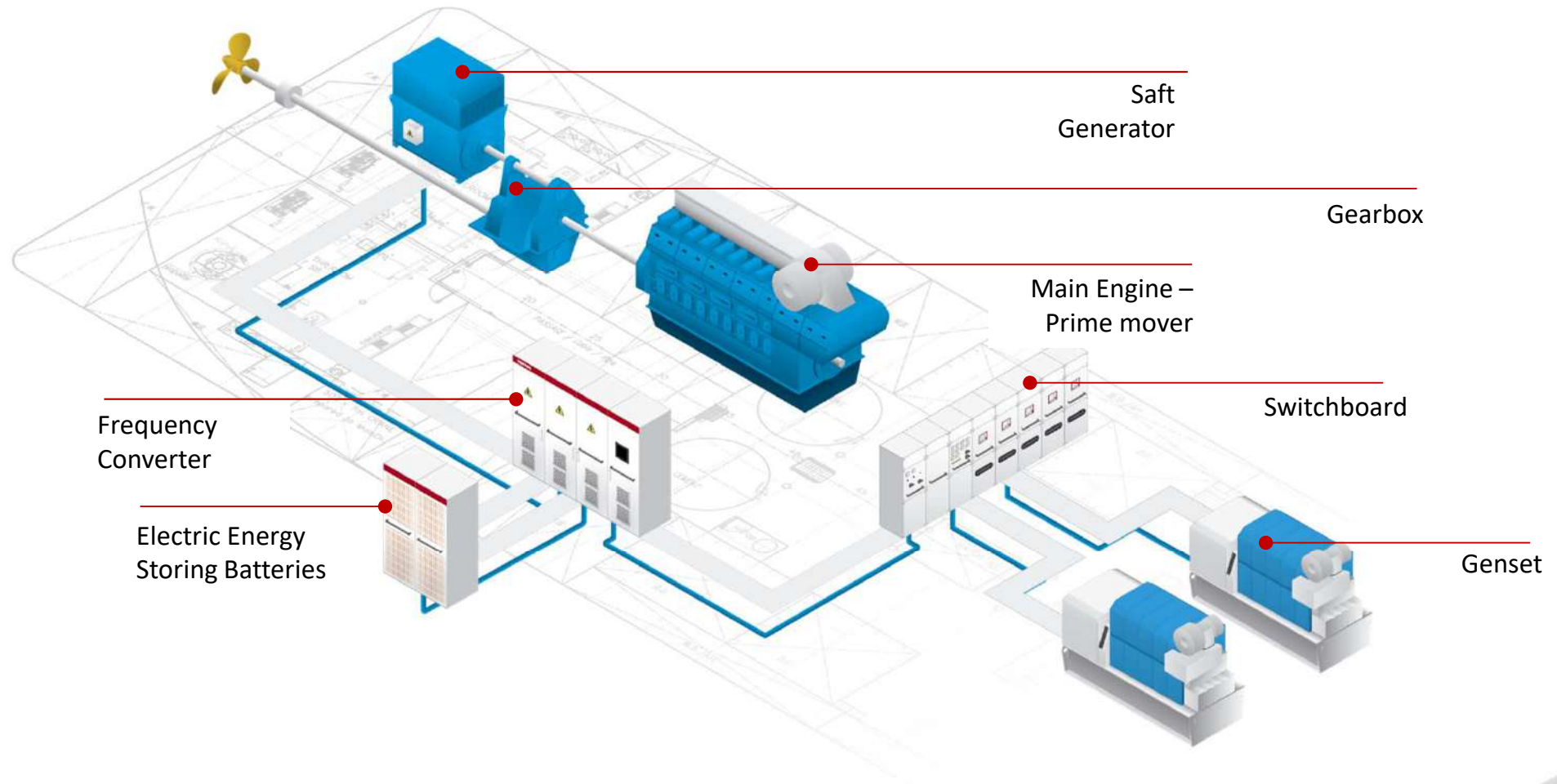
Flexible interface with customer

7" screen for operation and analysis

Remote access as standard

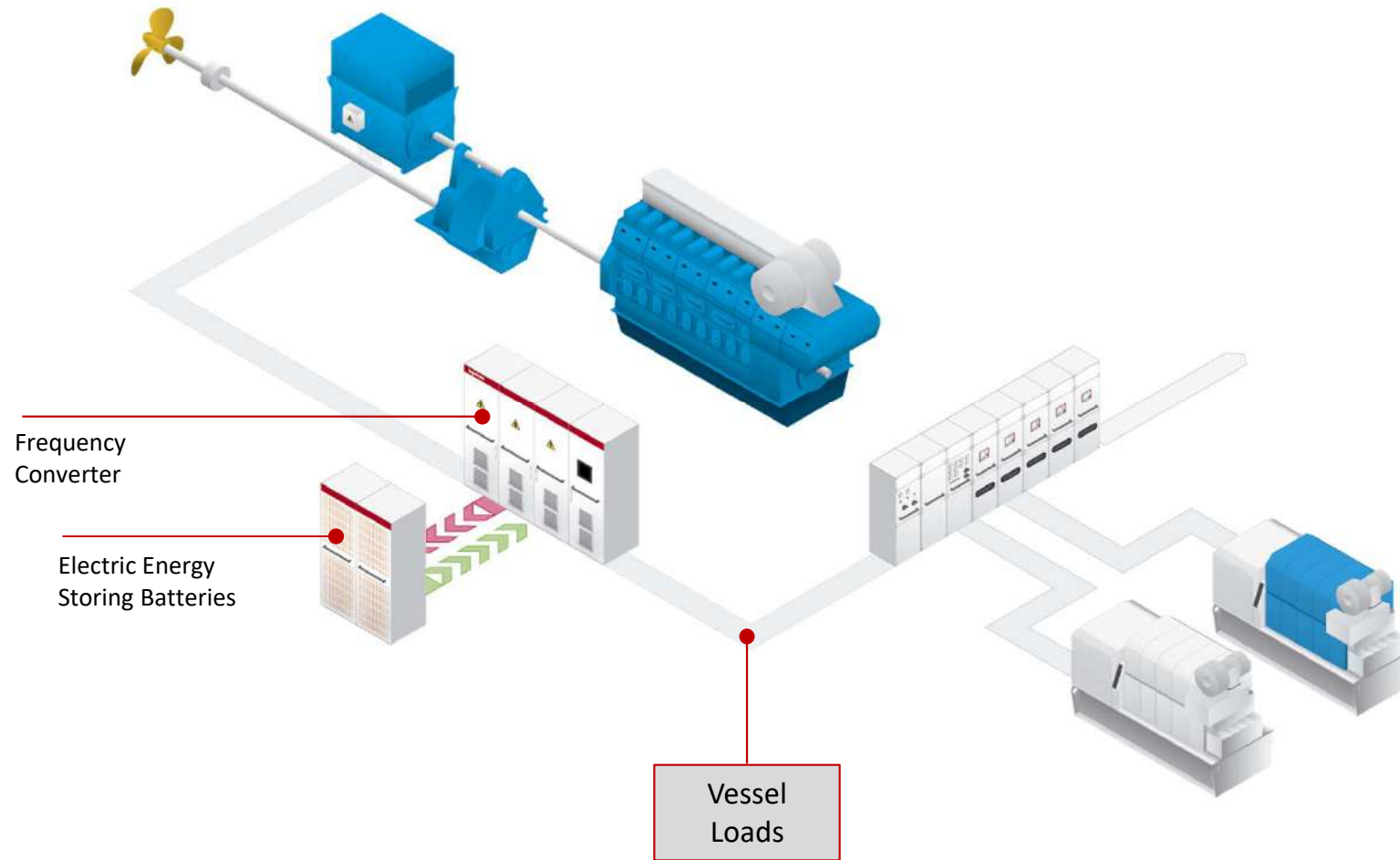
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Hybrid electrical Systems [Hybrid PTI / PTO]



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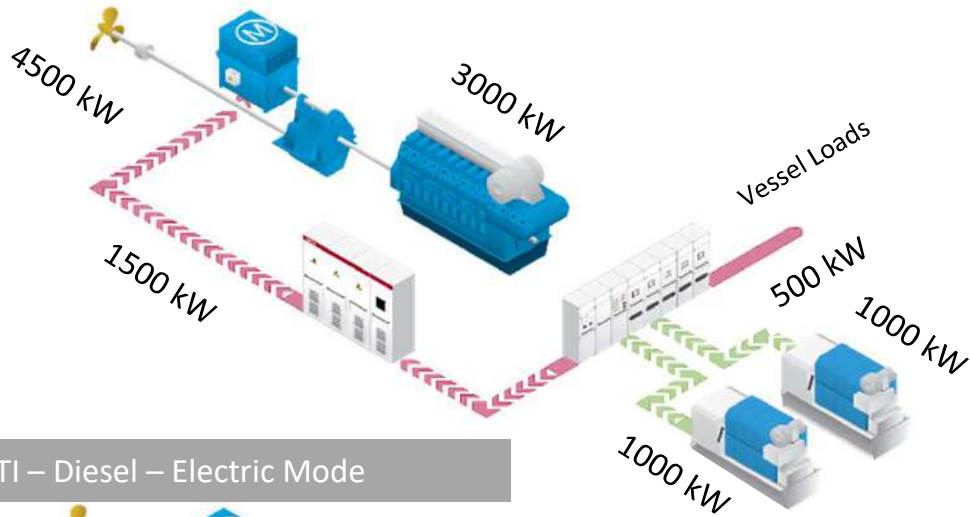
Hybrid electrical systems [Hybrid Energy Storage Systems]



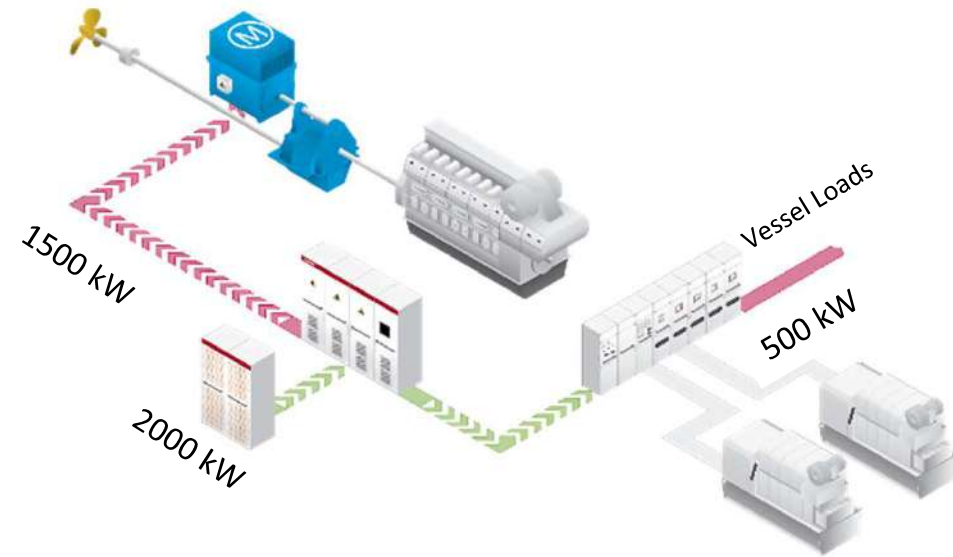
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Hybrid electrical systems [Power Take in - PTI]

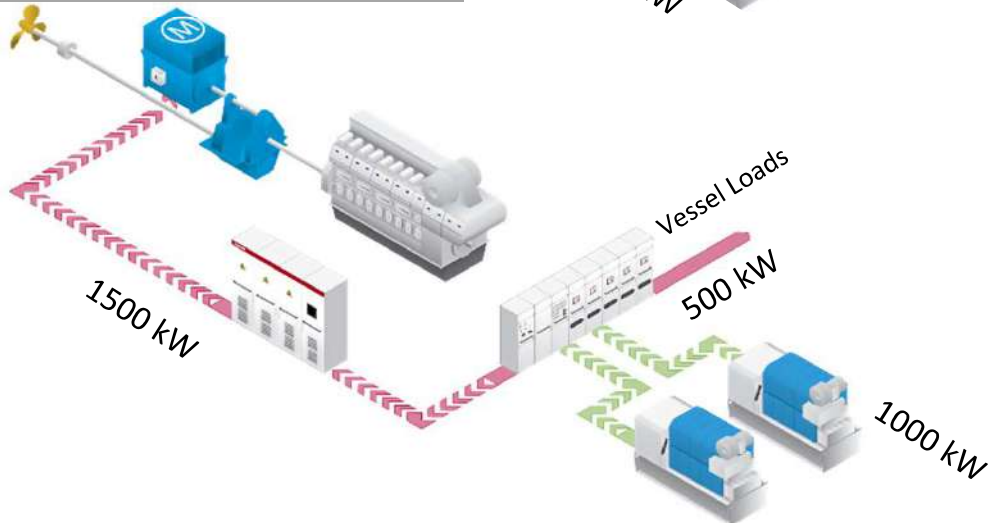
PTI – Booster Mode



PTI – Fully Electric Mode



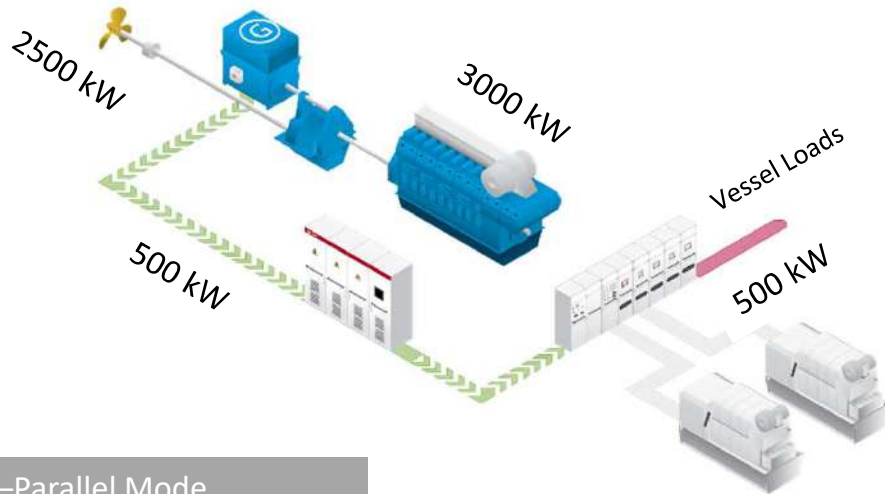
PTI – Diesel – Electric Mode



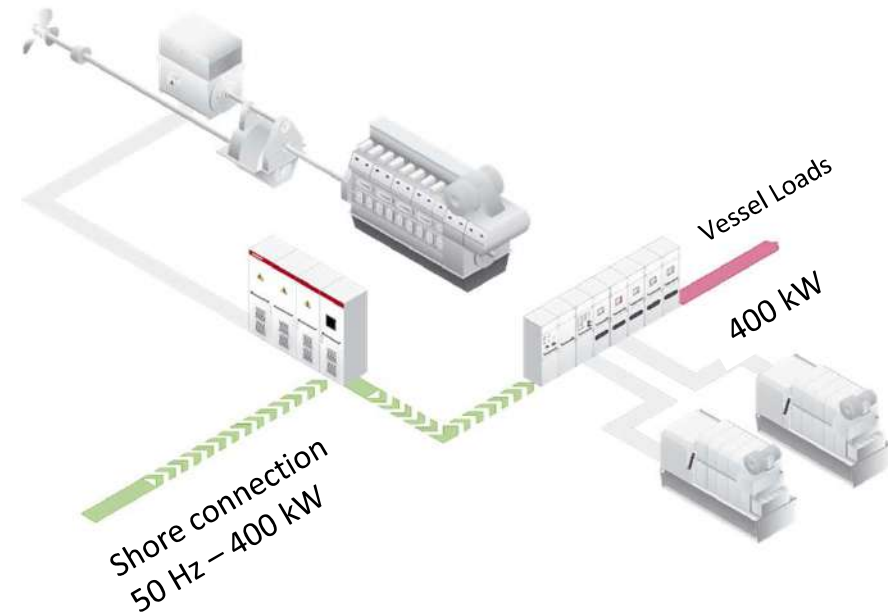
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Hybrid electrical systems [Power Take Off - PTO]

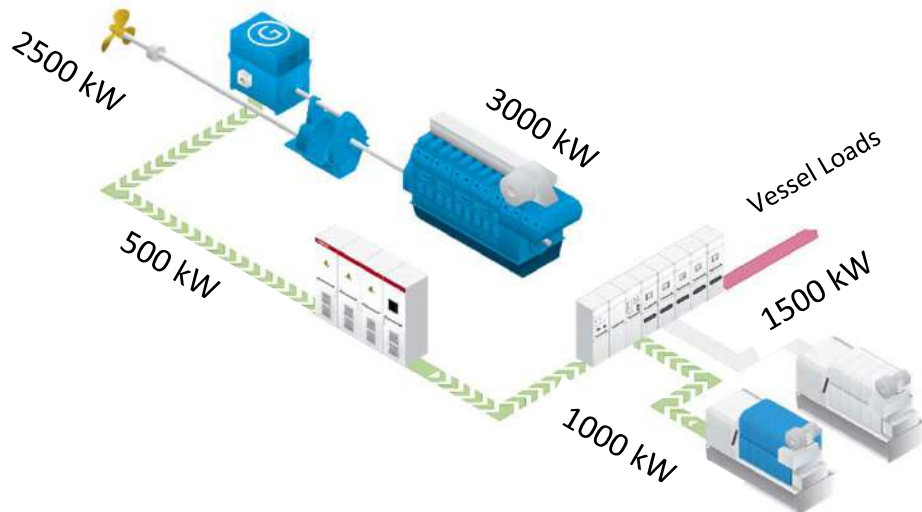
PTO – Transit Mode



PTO – Shore Connection Mode



PTO – Parallel Mode



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Battery integration on diesel electric ships [Advantages]

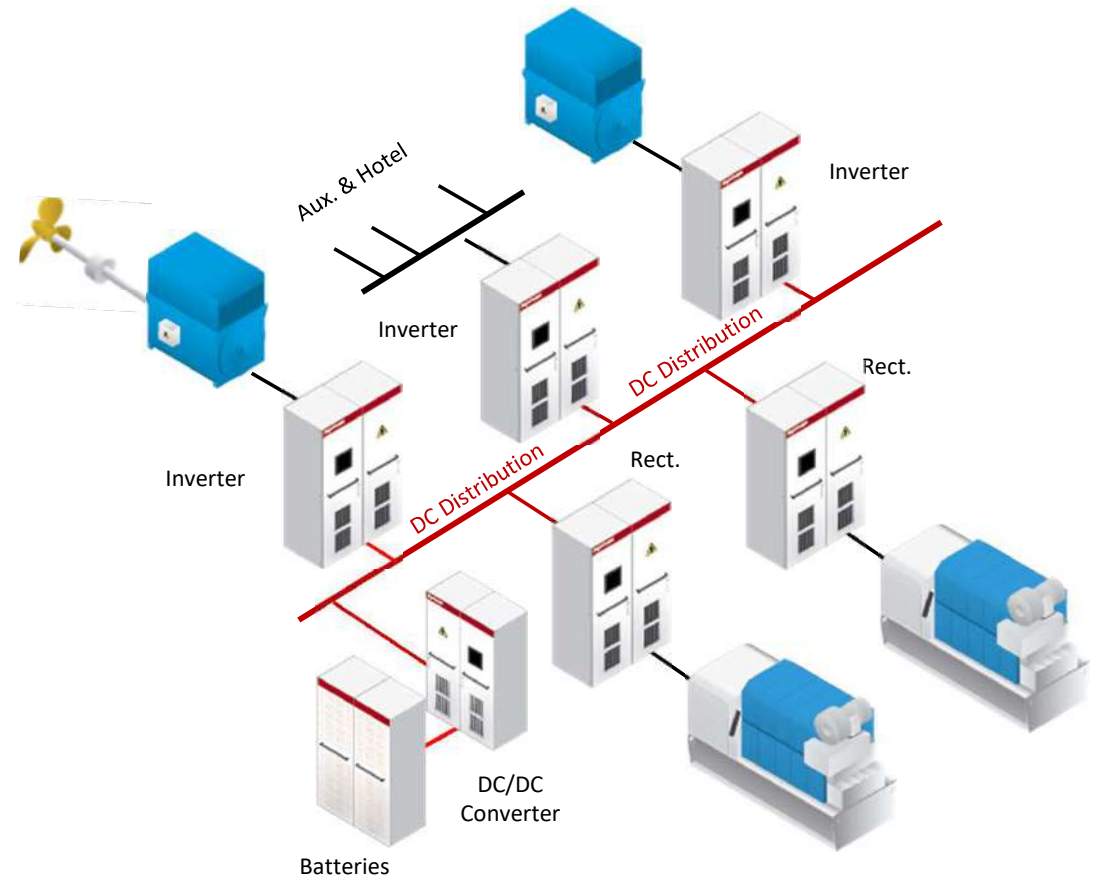
- › The use of batteries as *spinning reserve* resources (Virtual Gensets) allows to *reduce number of Gensets* running in DP modes
- › The use of batteries as smart *storage* load permits the operation of the connected Gensets in *better specific fuel consumption* operating points
- › The use of batteries for *grid support* allows to perform *peak shaving, simplifying the connection of big DOL loads in AC*
- › The use of batteries for *grid stabilization* allows to make grids stronger, avoiding possible resonances, *especially in DC grids*
- › The use of batteries allows to *improve vessel dynamics*, specially when *variable speed generation* is used



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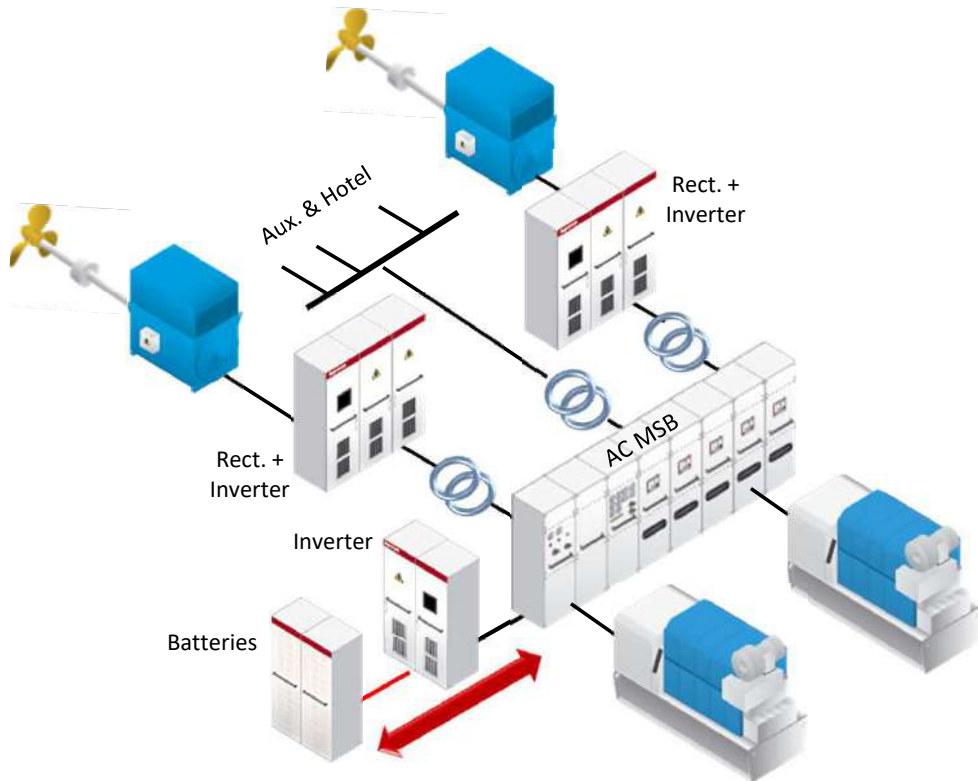
Battery integration on diesel electric ships [DC Distribution]

- › Improves *dynamic response* of the vessel due to batteries capability to supply *energy during Genset acceleration*
- › Helps to *stabilize the DC distribution grid*
- › Reduces *Variable Speed Generation* benefit due to the fact that *spinning reserve* allows to reduce the number of gensets connected
- › Batteries can be connected directly to the DC distribution grid or through a DC/DC inverter
- › Advantages of using a *DC/DC inverter*:
 - › Better control of the power flow through the batteries
 - › Fault current limitation and enhanced redundancy by segregation of the batteries
 - › Constant DC distribution voltage regardless battery voltage



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Battery integration on diesel electric ships [AC MSB]



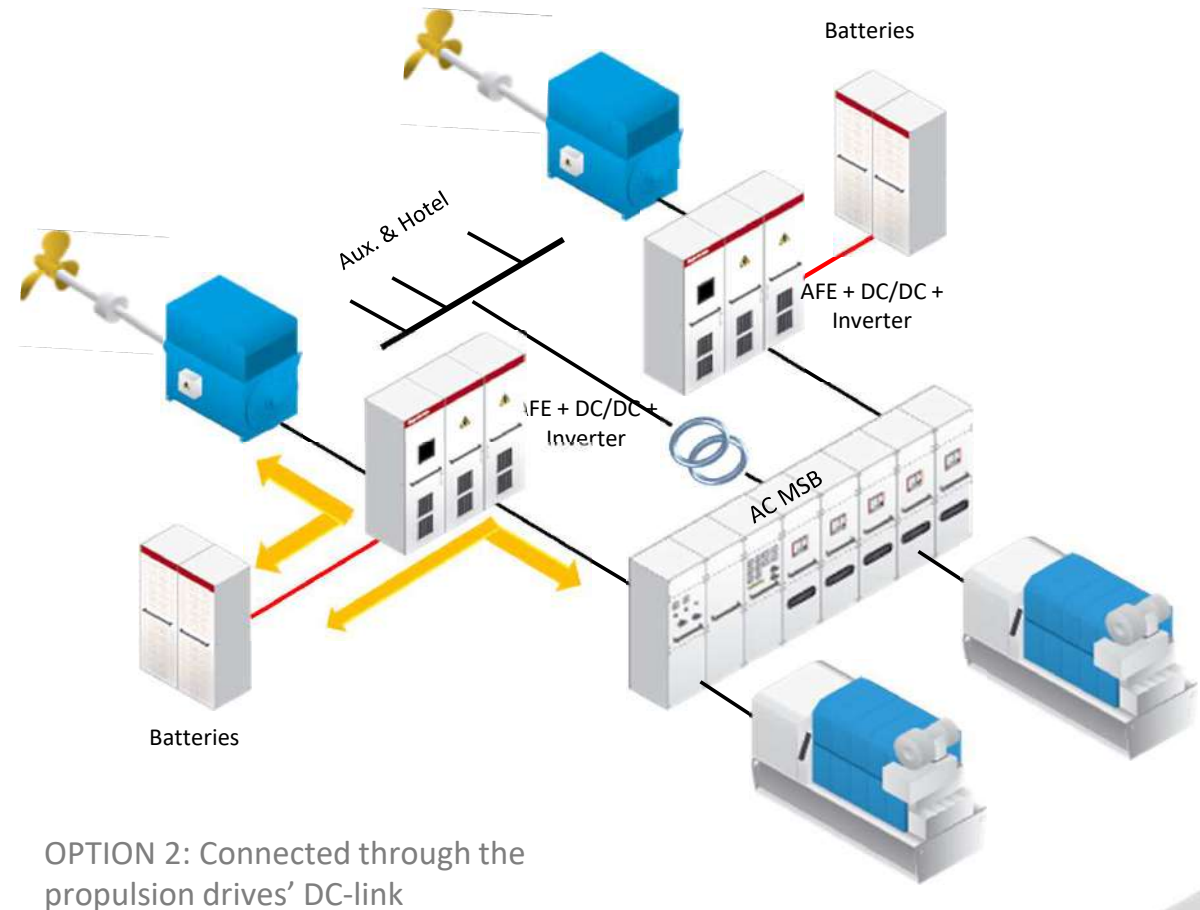
OPTION 1: Connected to the AC-MSB

- › Batteries and inverter act as an *autonomous* subsystem connected to the main AC-MSB
- › The system operates as an *emulated Genset*, participating in the voltage & frequency control and simplifying the *peak shaving* and *spinning reserve* functionalities
- › Usually, all the stored *energy is concentrated* in one point, thus presenting more risk, and *less redundancy*
- › In case of Black-Out of the diesel Gensets, *seamless transfer to full electric* is possible
- › Allows *Full Electric Propulsion* but is *less efficient* than the others because there are 3 conversion stages between the batteries and the motor
- › Best and *simplest solution for retrofits*

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Battery integration on diesel electric ships [AC VFD DC-Link]

- › Operation as an *emulated Genset through the AFE* with the same functionalities
- › The system operates in *Voltage / Frequency* control mode, simplifying the *peak shaving* and *spinning reserve* functionalities
- › The stored *energy is distributed* along the main drives, thus presenting less risk, and *more redundancy* possibilities



OPTION 2: Connected through the propulsion drives' DC-link



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Battery integration on diesel Electric ships [AC VFD DC-Link]

TESO

Name **Texelstroom**
Shipowner **TESO**
Shipyard **CNN La Naval [Spain]**
Vessel type **Passenger /Ro-Ro Cargo Ship**

- › Length 135.4 m, Beam: 27.9 m
- › Double End Ferry for 1,750 passengers and 350 vehicles
- › In operation since 2016
- › 4 x hybrid propulsion drives including:
 - › Inverter for 1,8 MW thruster
 - › DC/DC to control 409 kWh batteries
 - › AFE to connect to the AC-MSB
 - › 400kVA Static Inverter for thruster auxiliaries



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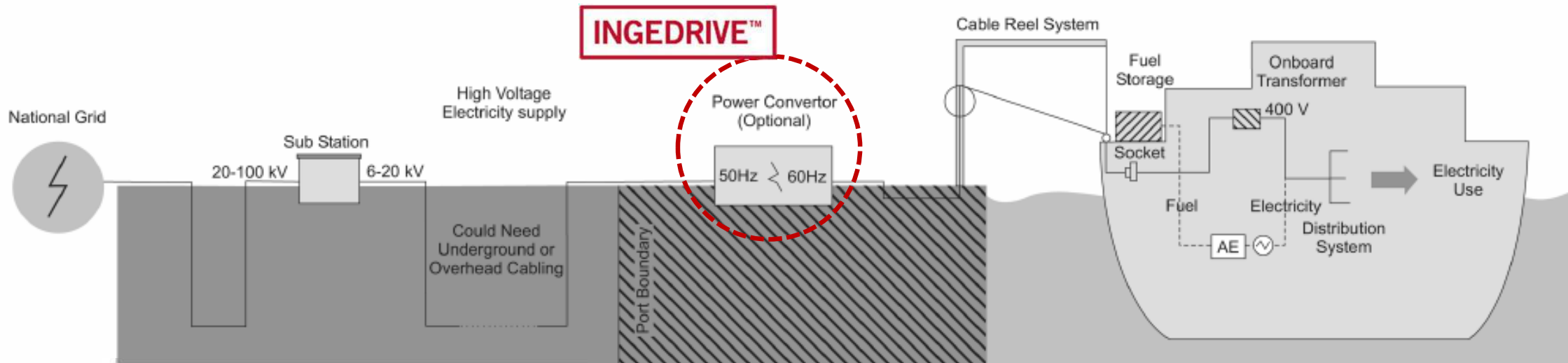
Battery integration on diesel Electric ships [Conclusions]

- › In hybrid vessels, when batteries are used, equivalent fuel savings to those obtained in DC distribution systems can be achieved with AC distribution systems
- › When AC distribution systems are used, battery integration through the drive DC link presents important advantages:
 - › Makes system integration easier, defining clearly the borderlines between system integrator and drive manufacturer
 - › Improves simplicity and competitiveness by minimizing the number of systems required
 - › Improves redundancy and safety by the ability of distributing the battery energy between the different frequency drives existing in the vessel



INGETEAM

On-Shore Power Supply



Solutions up to 4 x 11MVA



INGETEAM

On-Shore Power Supply

BENEFITS On-shore Power Supply

No
Emissions



No
Noise



No
Vibration



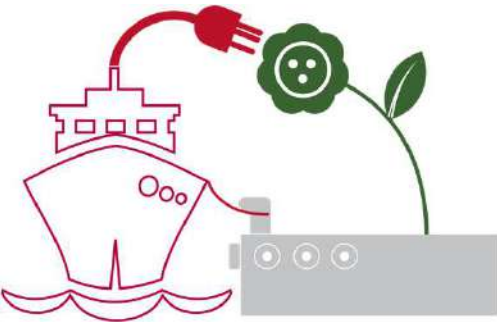
Savings in
maintenance
costs



Savings in
operation costs



Commercial
opportunities
for ports



INGETEAM services



Ingeteam partners with you from the beginning

INGETEAM services

After sales Services



Training and learning:

- Specialist for customers training courses at Ingeteam.
- Investment in professional training improves productivity.



On-Site Technical Support:

- Skilled engineers will support customer on-site for troubleshooting and technical assistance.
- Quick reaction time.



Emergency Technical Support:

- 24/7 immediate phone access to a specialized engineer with problem-solving capabilities.



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Marine References



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INGETEAM MARINE SECTOR

By the numbers



>45

Years of Experience
In Integration
Solutions



70

Vessels with complete
Integration solutions



22

Presence In Number
of Countries



3

Production across
Number of Continents



3,900

Employees Worldwide



5%

Annual Investment
of Turnover In R&D



INGETEAM Marine Systems

Why leading companies like yours are partnering with us?



PRODUCT RANGE:

We offer a comprehensive range of proven and reliable electrical equipment for many sectors.



R&D:

We are committed to innovation and development of full in-house technology.

R&D expenditure accounts for 6% of net sales.



FLEXIBILITY:

Our engineering teams can provide you with flexible solutions tailored to meet your project needs.



WORLDWIDE:

We have manufacturing facilities and service centers strategically located in Europe, Asia, North and South America to deliver the most efficient support and service to you.



EXPERIENCE:

We have 20+ GW of installed power capacity worldwide and 20+ years of experience in the Industry.



PARTNERSHIP:

We are partners, providing you active support for each specific project throughout the entire product life cycle.