

# RING NETWORK FOR MULTI-MEGAWATT DC POWER SYSTEM



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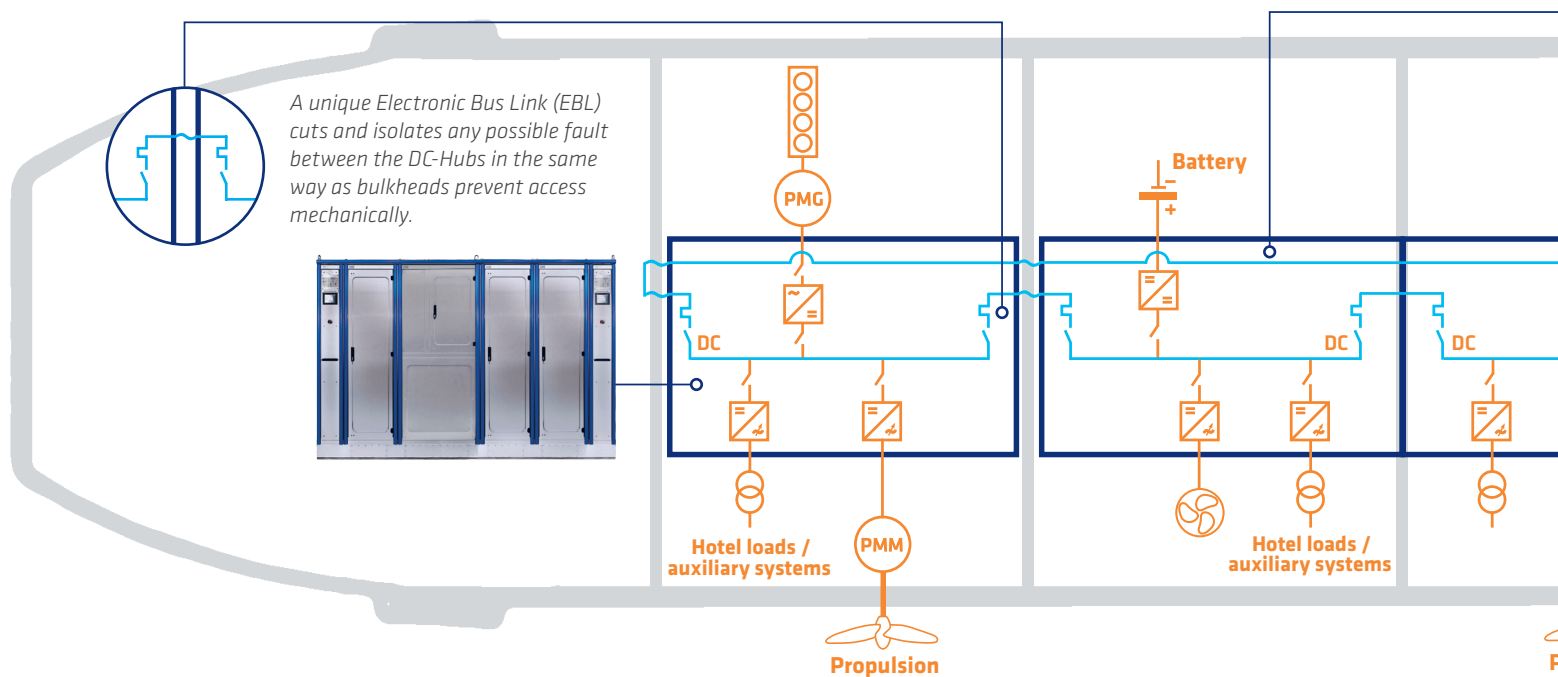


# MASTERS OF DC-HUB DISTRIBUTION

*The Switch offers the world's smartest solution for a multi-megawatt DC power system using a DC-Hub that ensures stable and secure operation for chosen consumers. The DC-Hub is an independent entity that can work alone or together with other DC-Hubs.*

*The intelligent DC-Hub concept increases system availability and redundancy, while eliminating the use of an AC main switchboard. It lowers initial system investment cost and operational expenses over the long run.*

## Is it time to rethink AC distribution on your next vessel?



### Multi-megawatt DC power distribution

The Switch's DC-Hub is built from our proven Power Drive units to provide a vessel with a flexible choice of power generation, energy storage, charging, propulsion power and clean power connected to the DC link, the backbone of the DC-Hub.

Each unit connected to the DC-Hub can be defined to be either in load mode or source mode. In source mode, the unit participates in maintaining the DC link voltage. In load mode, the unit runs the different connected loads.

*The Switch's DC-Hub can consist of any combination below.*

### Motor inverters for propulsion, pumps, compressors, winches and more

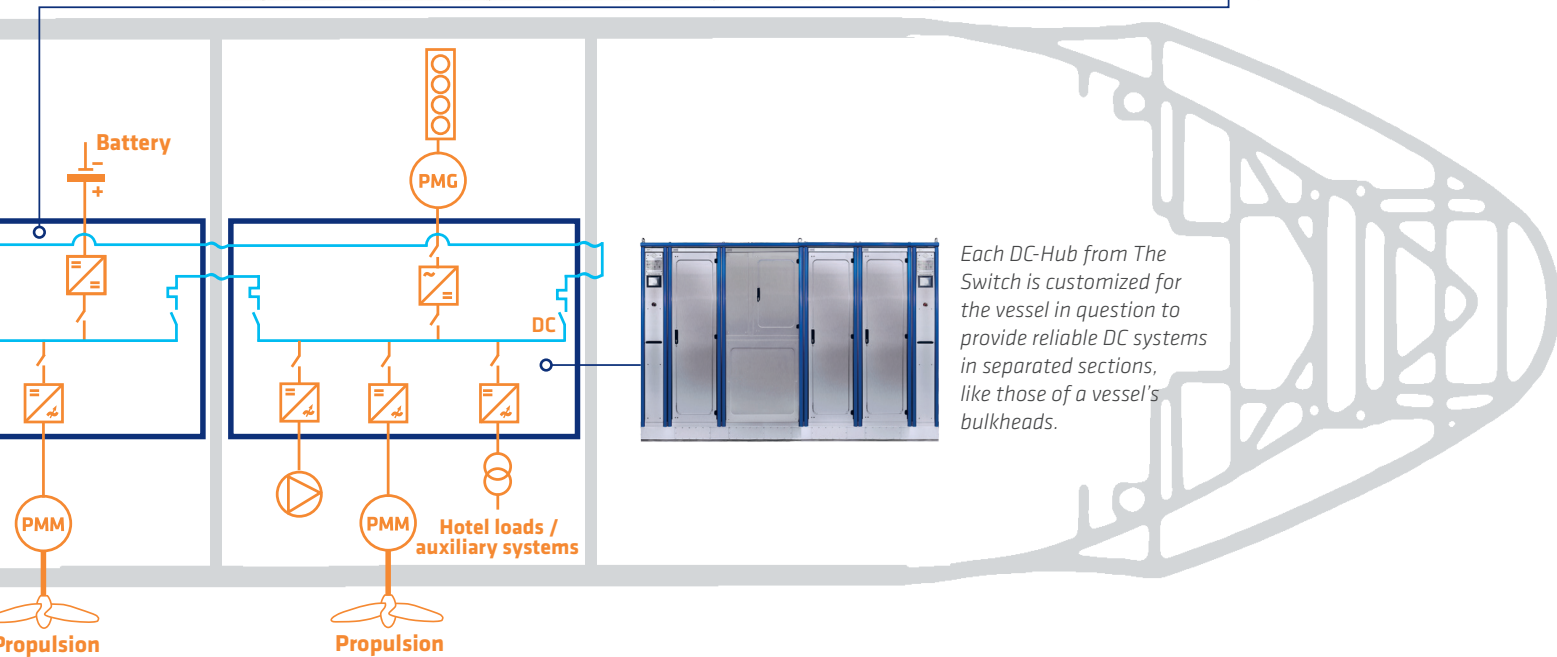
The motor inverter feeds the motors from the DC link based on load demand and the available power from the DC link. The propulsion motor can be virtually any type of motor, like an induction motor or a permanent magnet motor (PMM).

### Permanent magnet generator

Permanent magnet generators may be connected to the DC link by using an inverter and a circuit breaker. A power management system (PMS) or energy management system (EMS) decides how to distribute the power production between the generators. The PM generator can charge the DC link inside the DC-Hub during startup.

### Battery and DC/DC converter

Batteries are an essential part of every DC-Hub due to their valuable redundancy and increased efficiency for the total system. They can be connected to the DC link using a DC/DC converter. This ensures constant DC voltage on the DC link of typically 1,050 V. Battery size and type varies based on the vessel size, operational profile and life-cycle calculation. The battery can be disconnected from the grid using a circuit breaker.



### Electronic Bus Link

An Electronic Bus Link (EBL) can be fitted between two DC-Hubs to isolate any possible fault. This ensures an ultra-rapid split of the grids in microseconds, regardless of what kind of fault has occurred, to ensure that the other DC-Hubs are not affected.

### Connector charging

The other charger concept is based on the use of a 3-phase connector. Optional transformers can be installed on board to provide galvanic insulation and voltage adaption, which can be used to increase the power transfer for a plug or connector. The 3-phase voltage is converted to DC voltage on board.

### Hotel load supply

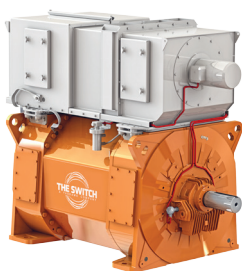
An active rectifier to deliver hotel power is connected to the DC-Hub with a circuit breaker. A transformer may be included to ensure the correct distribution voltage.

### Wireless charging (not shown)

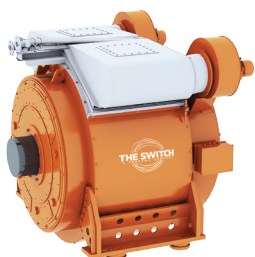
Together with Wärtsilä, The Switch can deliver a wireless charging solution. This concept uses a frequency converter to transform the 50 Hz 3-phase system into a 1-phase voltage of several kHz. The voltage feeds a transformer with the primary winding on the shore side, while the secondary winding is mounted on board the ship. The high-frequency voltage is then converted to DC voltage on board. This system can transfer up to 2 MW with a distance between the coils of 150–500 mm.

### Induction motor and synchronous generator (not shown)

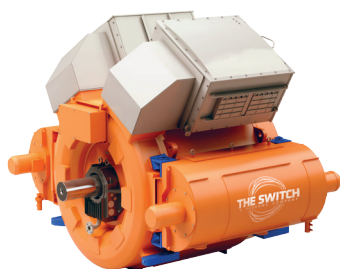
Both induction motors and synchronous generators can be connected to the DC-Hub concept.



- Geared shaft generators
- Propulsion motors
- Thrusters
- Gensets



- Direct-drive shaft generators
- Direct-drive propulsion motor



- Gensets
- Propulsion motors (Z-drive)

## PERMANENT MAGNET MACHINE RANGE

When using a permanent magnet machine from The Switch as part of a DC-Hub, you get an advanced electrical drive train that offers world-class performance. The PM machine can function either as a generator (PMG) or a motor (PMM).



We are advancing the world with electrical drive trains. Collaborating with The Switch enables you to deliver solutions that produce profitable power generation, optimized processes and efficient energy use.

## REFERENCES

### Battery hybrid references with Wärtsilä

Vessel type: Fish factory vessel  
Owner: Wärtsilä ship design

Vessel type: Passenger ferry  
Owner: Wightlink Ltd

Vessel type: Viking Lady OSV-DP2  
Owner: Eidesvik Shipping

### DC-Hub references with Wärtsilä

Vessel type: Dalian deepwater development drillship

Vessel type: Sapura heavy lift vessel / pipelayer  
Owner: Larsen & Toubro

Vessel type: Aker H-6e semi-submersible drill rig  
Owner: Transocean

### Shaft generators references with Wärtsilä

Vessel type: Deep Sea 1  
Owner: Otto Marine Limited

Vessel type: Go Phoenix  
Owner: Otto Marine Limited