

Elektrische schepen: de overtreffende trap in elektrische mobiliteit

Damen Shipyards

Piet Faasse

Peter Rampen

19 juni 2019
1931 Congrescentrum 's-Hertogenbosch

POWER
ELECTRONICS

2019



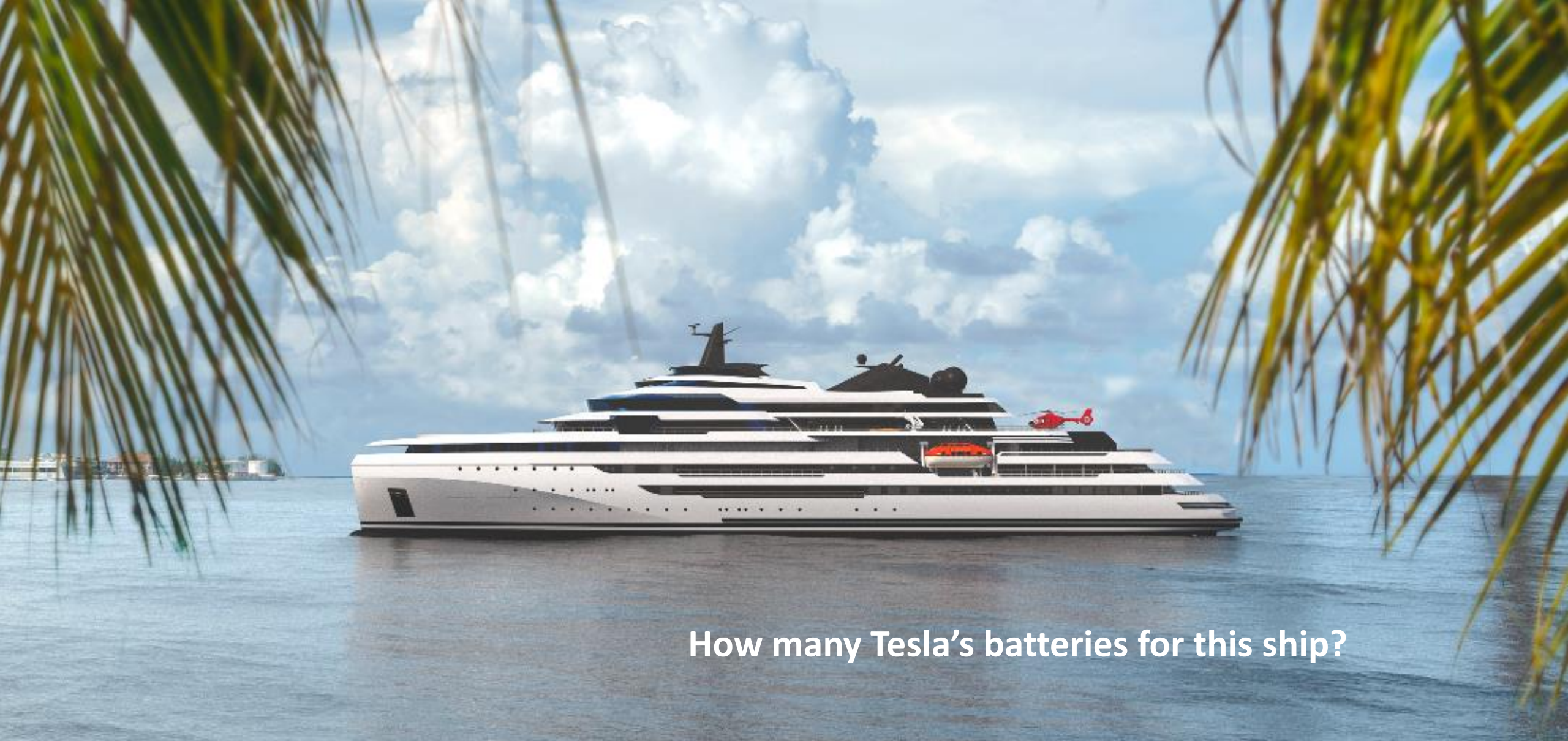
How many Tesla's batteries onboard?

4 MWh batteries



40 Tesla's

Tesla Model S: 100kWh!



How many Tesla's batteries for this ship?

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HARBOUR & TERMINAL

Our broad portfolio of vessels keeps ports and harbours safe and productive.

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OFFSHORE OIL & GAS

Damen's complete range of offshore support vessels meets the specific needs of the offshore industry.

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DREDGING AND MARINE CONTRACTING

Damen designs and builds robust and powerful dredgers and components.

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SEAGOING TRANSPORT

Damen maintains a dedicated Seagoing Transport division, giving our customers a single point of contact for expert advice and support.

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INLAND SHIPPING

An extensive range of flexible, fully customisable barges and pontoons with models to suit every type and size of waterway.

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OFFSHORE WIND

Damen has developed innovative and effective solutions to serve this challenging market.

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PUBLIC TRANSPORT

Our fuel efficient and comfortable public transport vessels can be seen all over the world.

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DEFENCE & SECURITY

Damen's range of security and patrol vessels offers unrivalled seakeeping behaviour, speed and reliability.

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ENVIRONMENTAL SAFETY & CONTROL

We cooperate with harbour authorities, vessel owners and operators to provide the products they need to safeguard the environment.



CIVIL

Damen Civil provides you with a range of maritime construction services covering the interface between ship and shore.

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FISHING

We offer a wide range of vessels to support clients who's business is fish.

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AQUACULTURE

Your partner for marine aquaculture solutions.

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YACHTING

Experience luxury at the very highest level.

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SEA & RIVER CRUISING

Damen offers support throughout the entire lifecycle of your cruise vessel.

[Discover more >](#)

- Wide product & market portfolio
- Standard products (off the shelf)
- World wide

KEY FIGURES 2018

DELIVERED SHIPS 2018

| | |
|----------------------------|-------------|
| Workboats & Tugs | 76 |
| Offshore vessels | 3 |
| High Speed Craft / Ferries | 40 |
| Pontoons & Barges | 21 |
| Dredging & Specials | 13 |
| Defence & Security | 18 |
| Yachts | 5 |
| | 176 |
| Repair & Maintenance jobs | 1300 |

12%
The Netherlands

32%
Europe

4%
Middle East

5%
Africa

19%
Americas

€2.0
billion
turnover

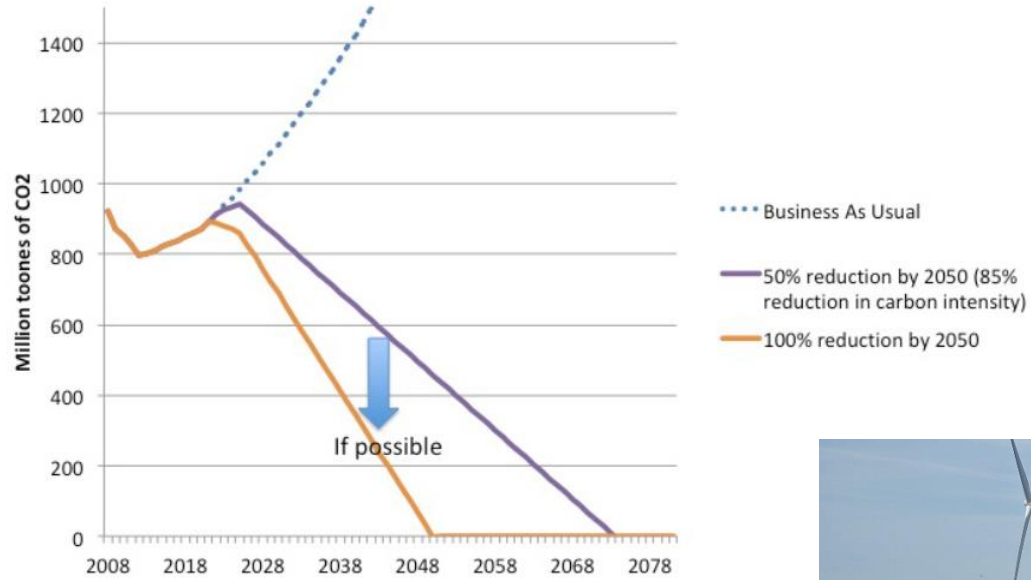
12,000
total
personnel

28%
Asia-Pacific

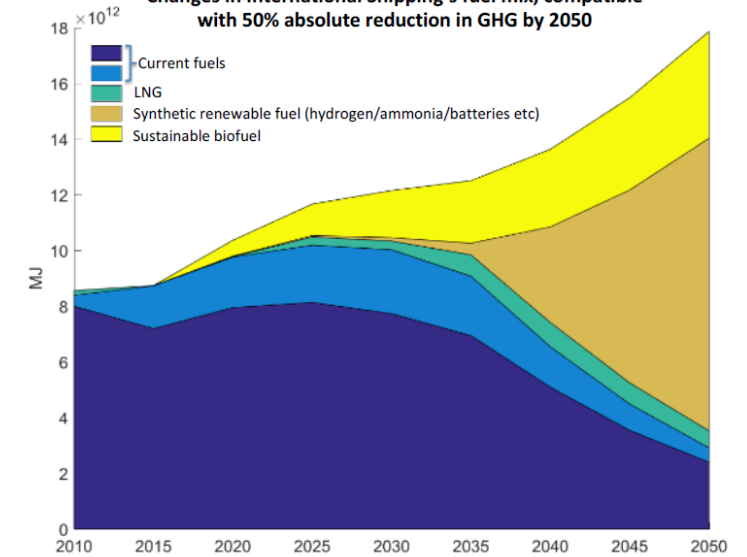
| | |
|------------------|-----|
| New Building | 59% |
| Building on site | 6% |
| Repair | 23% |
| Services | 6% |
| Components | 3% |
| Other | 3% |

We need to be green

Pathways for international shipping's CO₂ emissions



Changes in International Shipping's fuel mix, compatible with 50% absolute reduction in GHG by 2050



Smith, T., Raucci, C., Haji Hosseinloo S., Rojon I., Calleya J., De La Fuente, S., Wu P., Palmer K. CO₂ emissions from international shipping. Possible reduction targets and their associated pathways. Prepared by UMAS, October 2016, London.

Local – Air quality



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Lloyds Register:

“Commercial Ships of 2030 Will Be Smart, Green and Connected”



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Trend – OPEX becomes more important

service hubs zal daarbij helpen.

Ik denk en hoop dat onze markt meer verschuift van Capex* naar Opex**. Dat zal wellicht de druk op verkoopprijzen verlagen, omdat ik denk dat we aannemelijk kunnen maken dat onze schepen lagere operationele kosten hebben.

Zoals eerder opgemerkt, zouden we de concurrentie de baas moeten kunnen

Nor Lines and Rolls-Royce sign landmark Power-by-the-hour service agreement



Small to large



150 kW
600Vdc



4.500 kW
1000Vdc



10.000 kW
690 Vac



25.000 kW
6.600 V



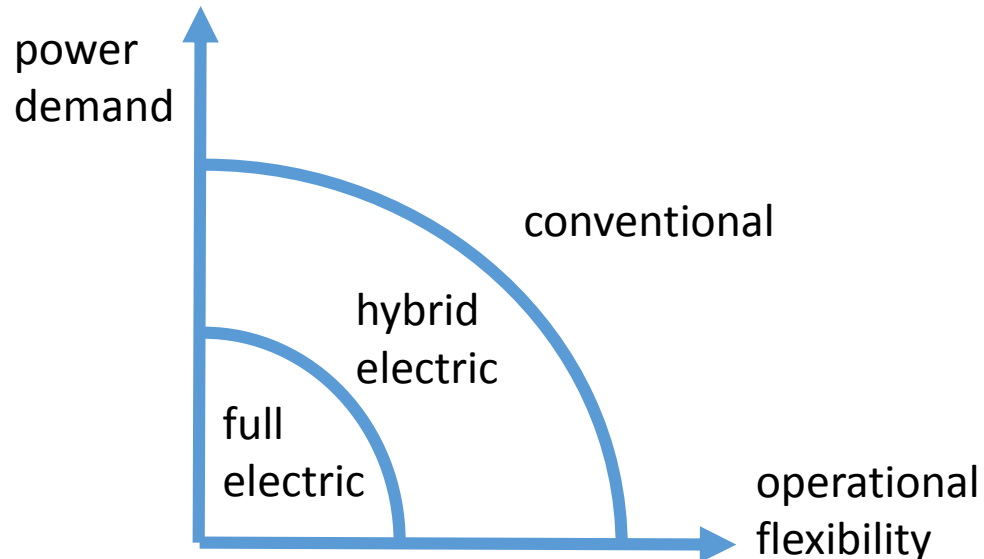
Technical trends

New topologies

- Hybrids / full electrics
- Shore power / charging

New energy onboard

- Variable speed generators
- LNG
- Hydrogen
- Fuel cells
- Electrical charging



Technical trends

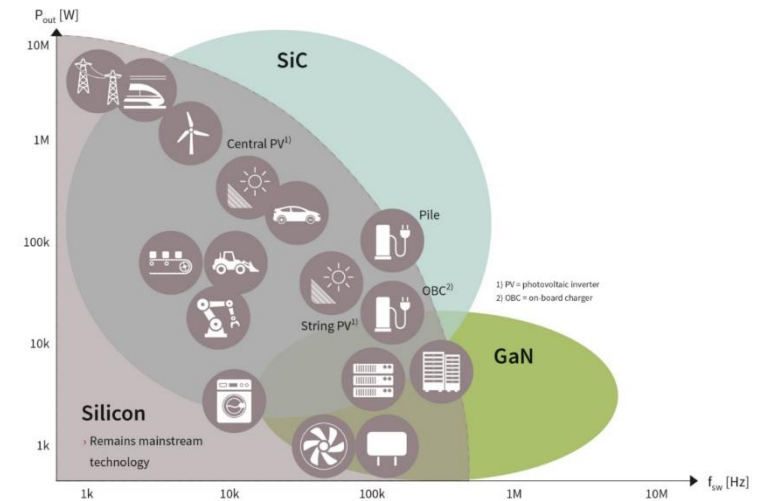
More electronic consumers

- electrical propulsion
- LED lighting
- more electric drives

New power conversion technology

- automotive electrification
- new semiconductors
- modular power electronics

Power electronics in distribution
(ship has a micro grid)



New converter types

100 KW DRIVE



| | IM with DFE (wall-mount) | IM with AFE (cabinet) | Automotive style |
|--------------------------------|--------------------------|-----------------------|------------------|
| Cooling | Air | Air | Water |
| Total Weight (kg) | 960 | 1580 | ≈300 |
| Total Volume (m ³) | 0.41 | 1.72 | 0.23 |
| IP rating | IP55+21/54 | IP55+21/54 | IP65+67 |

Challenges – e-ferry case

2x road bus → we can use same technology



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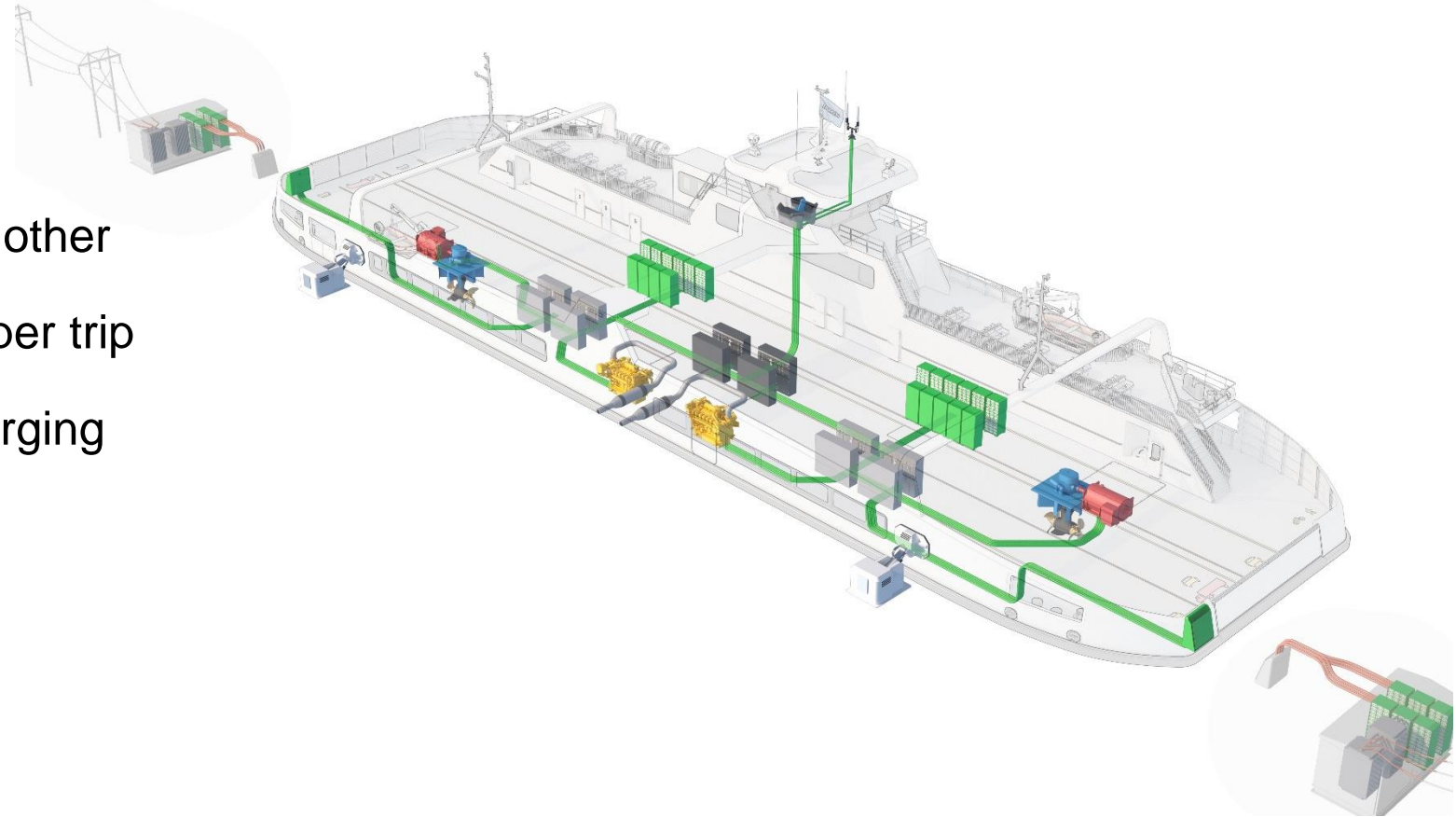
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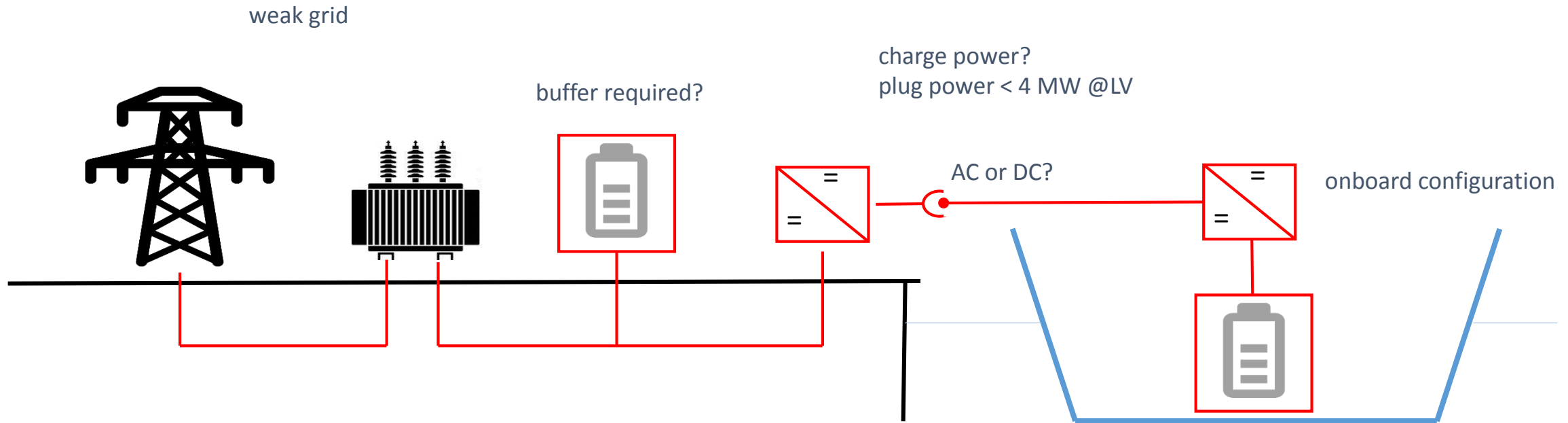
Challenges – e-ferry case

Challenge

- 4x 500kW propulsion / 100 kW other
- 20 min. sailing → 500 kWh per trip
- 5 min. charging → 6 MW charging
- weak shore grid



Challenges – e-ferry case



Challenges – e-ferry case

HOW TO GET POWER ON-BOARD

- AC / DC
- LV → large cables/connector
- HV → safety, large transformer on-board
- Inductive → large, expensive
- hf / HV switch-mode converter possible?

Side charging

Electric charging solution

- Automatic operation
- Plug and socket principal
- LV or HV solutions
- DC or AC



Top charging

Electric charging solution

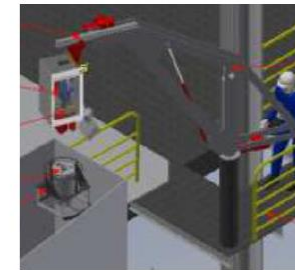
- Automatic operation
- Plug and socket principal
- LV or HV solutions
- DC or AC



Front or side charging

Electric charging solution

- Semi-Automatic charging
- Plug and socket principal
- LV or HV solutions
- DC or AC



Wireless charging

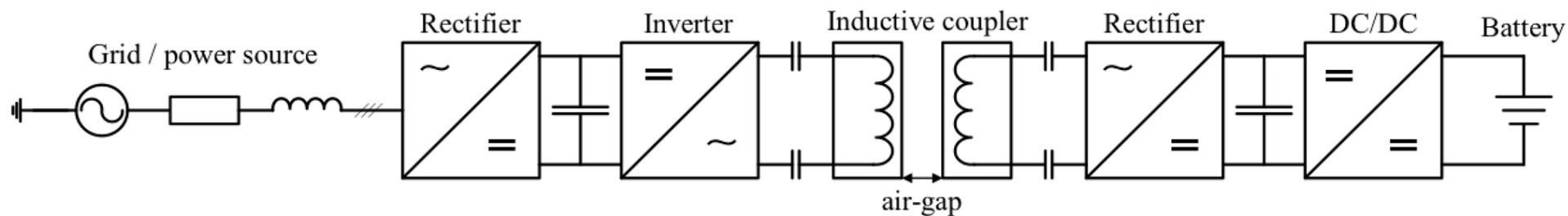
Electric charging solution

- Inductive charging
- Automatic charging
- Induction principal
- LV AC solutions



Challenges – e-ferry case

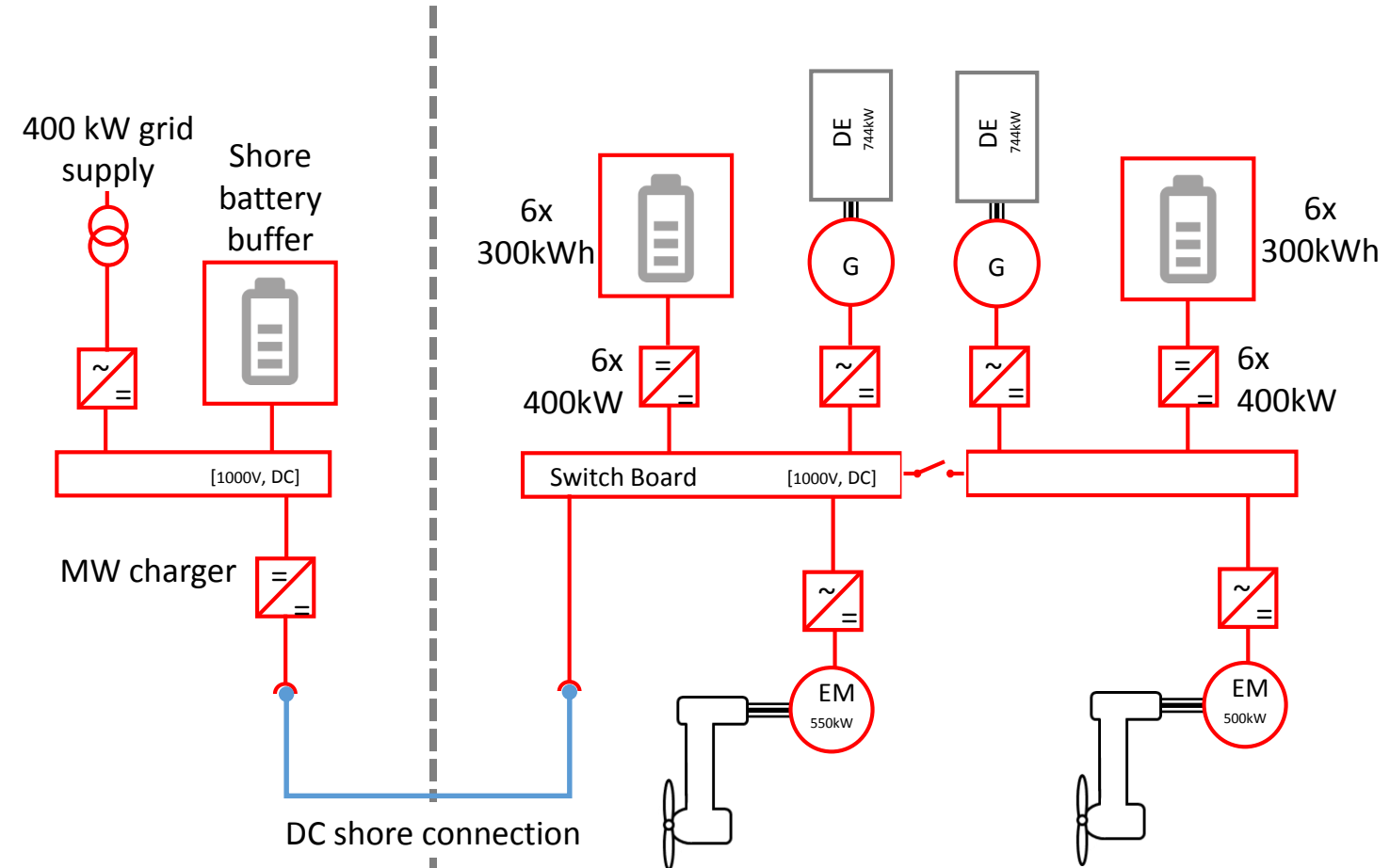
- by Wärtsilä / Syntef
- Power: 2.8 MW
- Distance: 150...500 mm



Challenges – e-ferry case

Configuration challenges

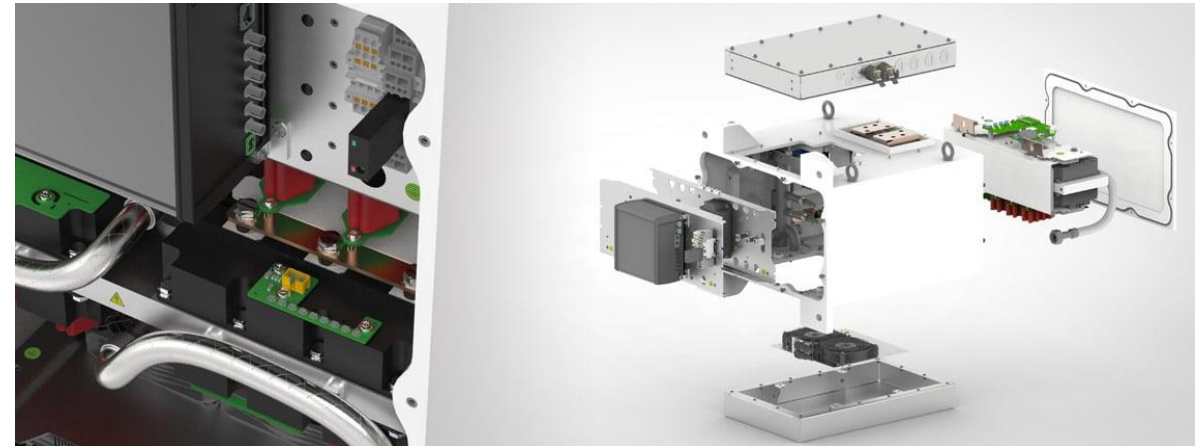
- onboard bus
 - DC / AC
 - floating / fixed
- DC power quality
- EMC
- Earthing (ship/shore)
- How to protect DC bus



Challenges – e-ferry case

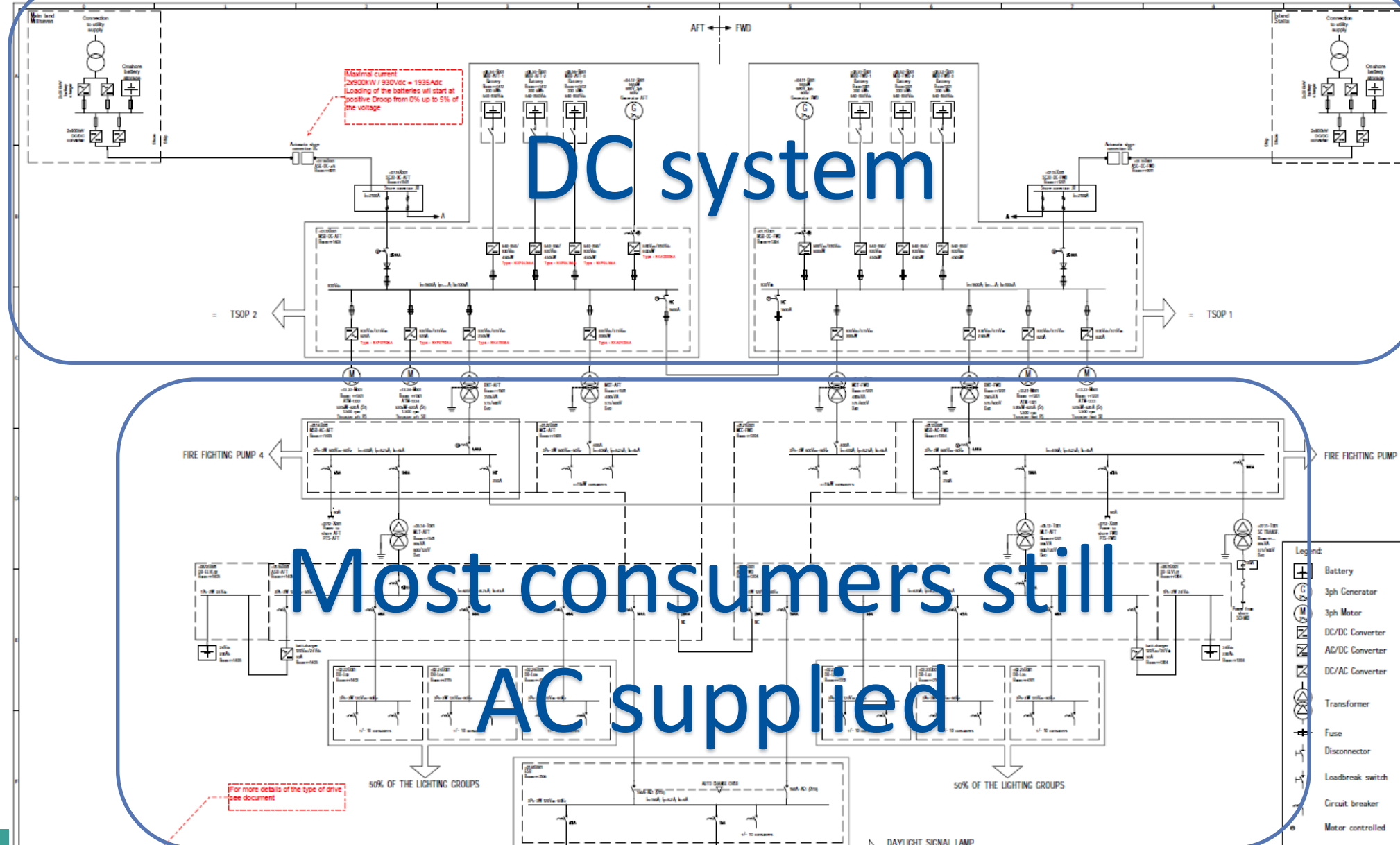
DC protection

- capacitive grid
- bus-tie semi-conductor circuit breakers
- other still by fuses
- no standards



DC system

Most consumers still AC supplied



Power electronics is enabler for future more electric ships



QUESTIONS?

Contactgegevens

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