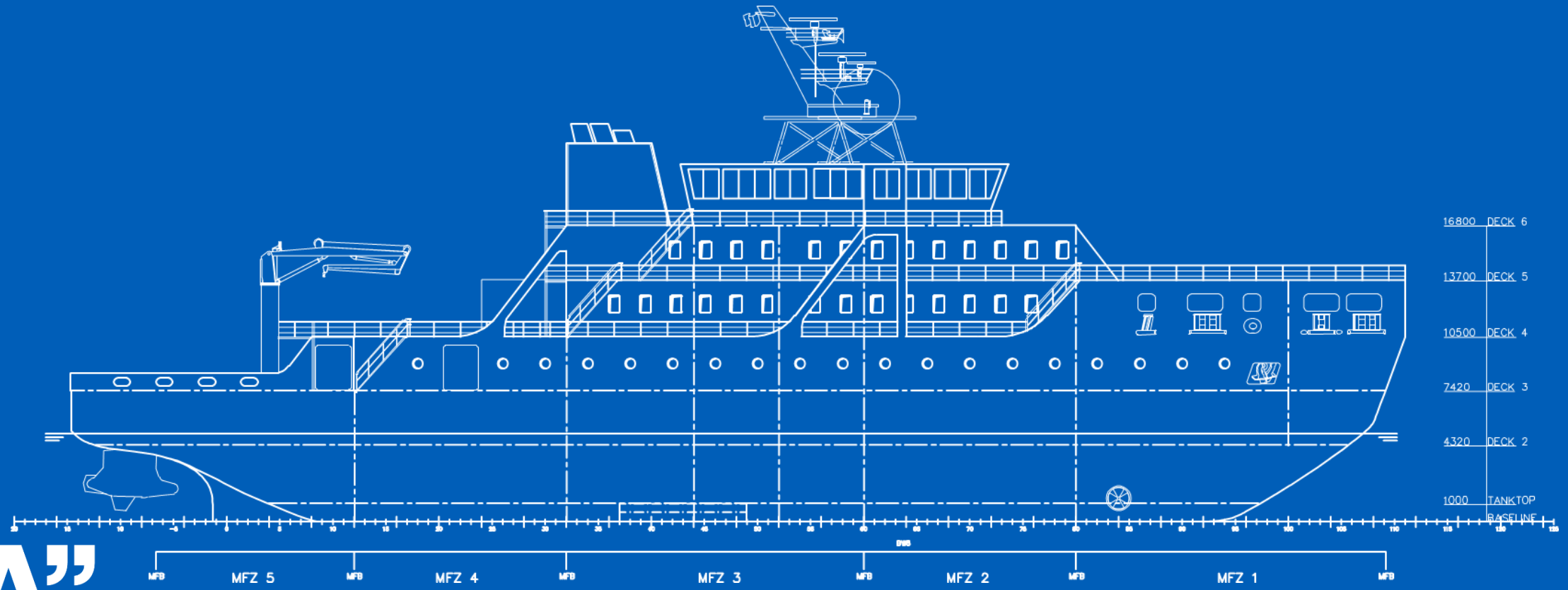
Marine technology gala 30.11.2022

# RV NAHKIAINEN

## New generation Baltic Sea research vessel

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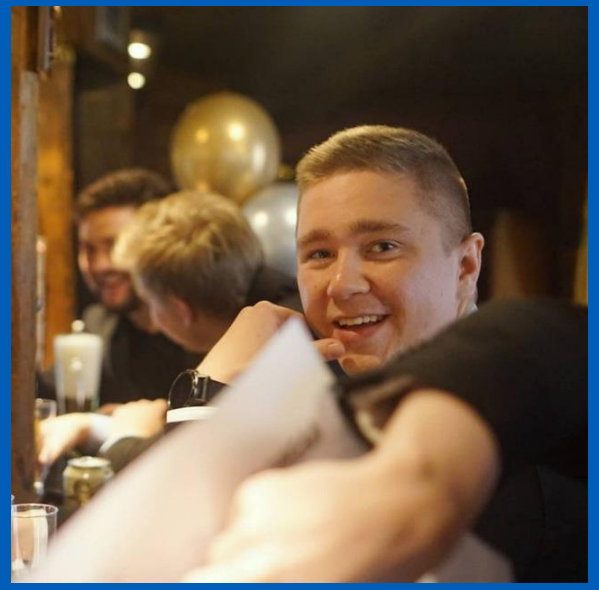
Otto Hiltunen, Amin Ibrahim, Miku Sevón, Ville Talonen

# Team introduction

## Amin Ibrahim

**Bachelor's degree in maritime engineering**

**Experience in crew operations and ship systems**



## Otto Hiltunen

**Bachelor's degree in marine engineering**

**Experience in ship theory, weight, safety**

## Miku Sevón

**Bachelor's degree in mechanical engineering**

**Experience in machinery and deck outfitting basic design**

## Ville Talonen

**Bachelor's degree in mechanical engineering**

**Interested in ship structures and calculations**

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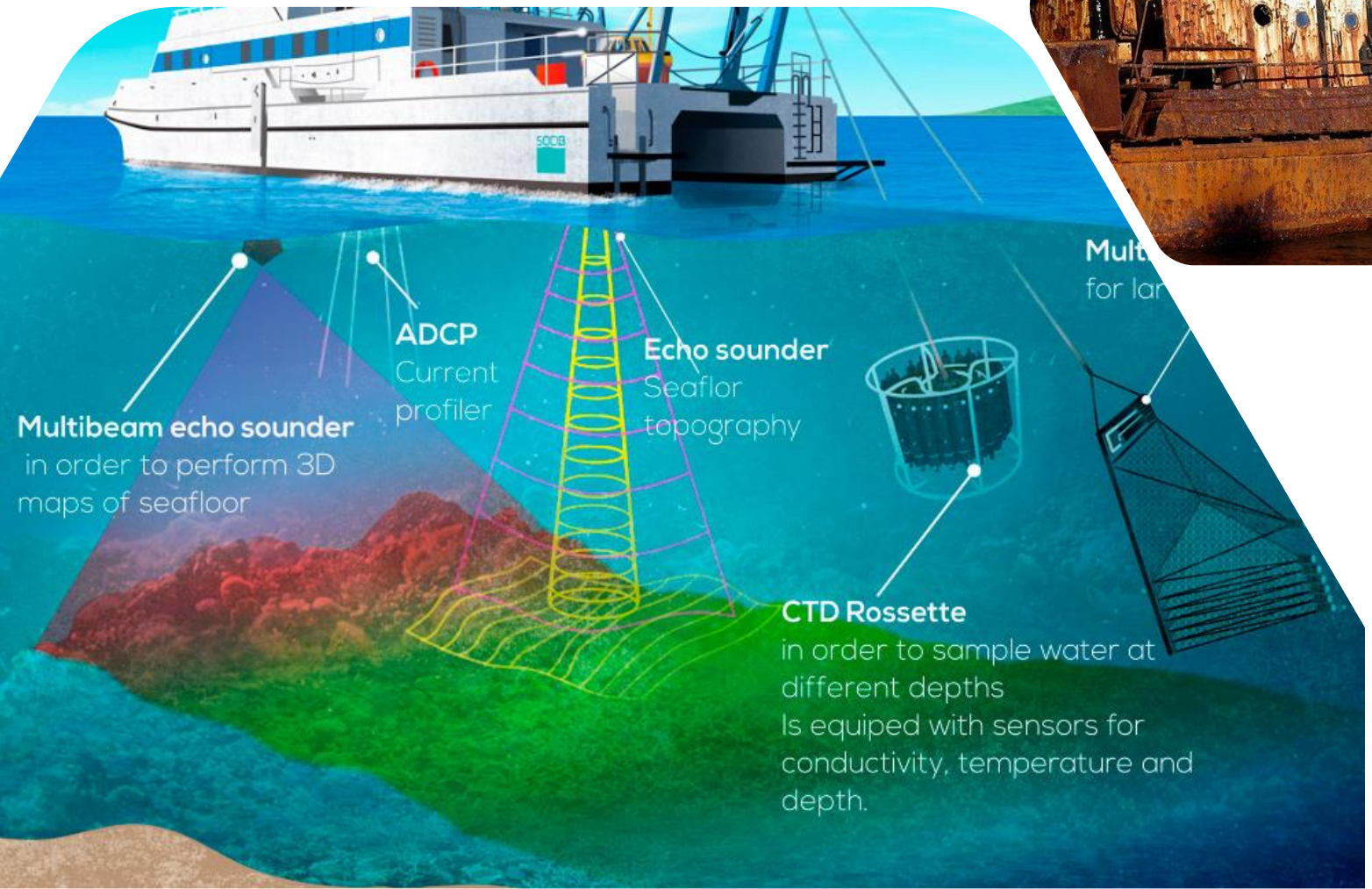
# Research vessels today



- **Research, monitoring and environmental protection of the Baltic Sea is seen as an important mission**

- **Old Technology & New Operational Requirements**
- **Aging fleet of research vessels**
- **Refits done on old vessels**
- **Replacing old vessels with green systems is a more a sustainable and profitable solution in the long run**

# Design objectives

Data collection

- **Oceano-graphic**
- **Hydrographic**
- **Aerial research**

Year-round operation (Ice Class)

- **Ice class 1ASuper**
- **Finnish-Swedish ice class rules**

As sustainable as possible

- **Methanol driven**
- **Low emission**

Crew safety

- **Safe handling of new fuels**
- **Safe mooring equipment**

Environmentally friendly in all aspects

- **Methanol as main fuel**
- **Low emission**
- **Low noise emissions**

Oil and chemical spill response

- **No own spill**
- **Spill response equipment**

# Ship mission

- ❑ **Main mission: conduct year-round research in the Baltic sea**
  - ✓ **Sustainable underwater and aerial Baltic Sea research (oceanographic, hydrographic, aerial)**
  - ✓ **Goal: 10-12 missions per year**
- ❑ **Ocean category**
- ❑ **1A Super ice class**

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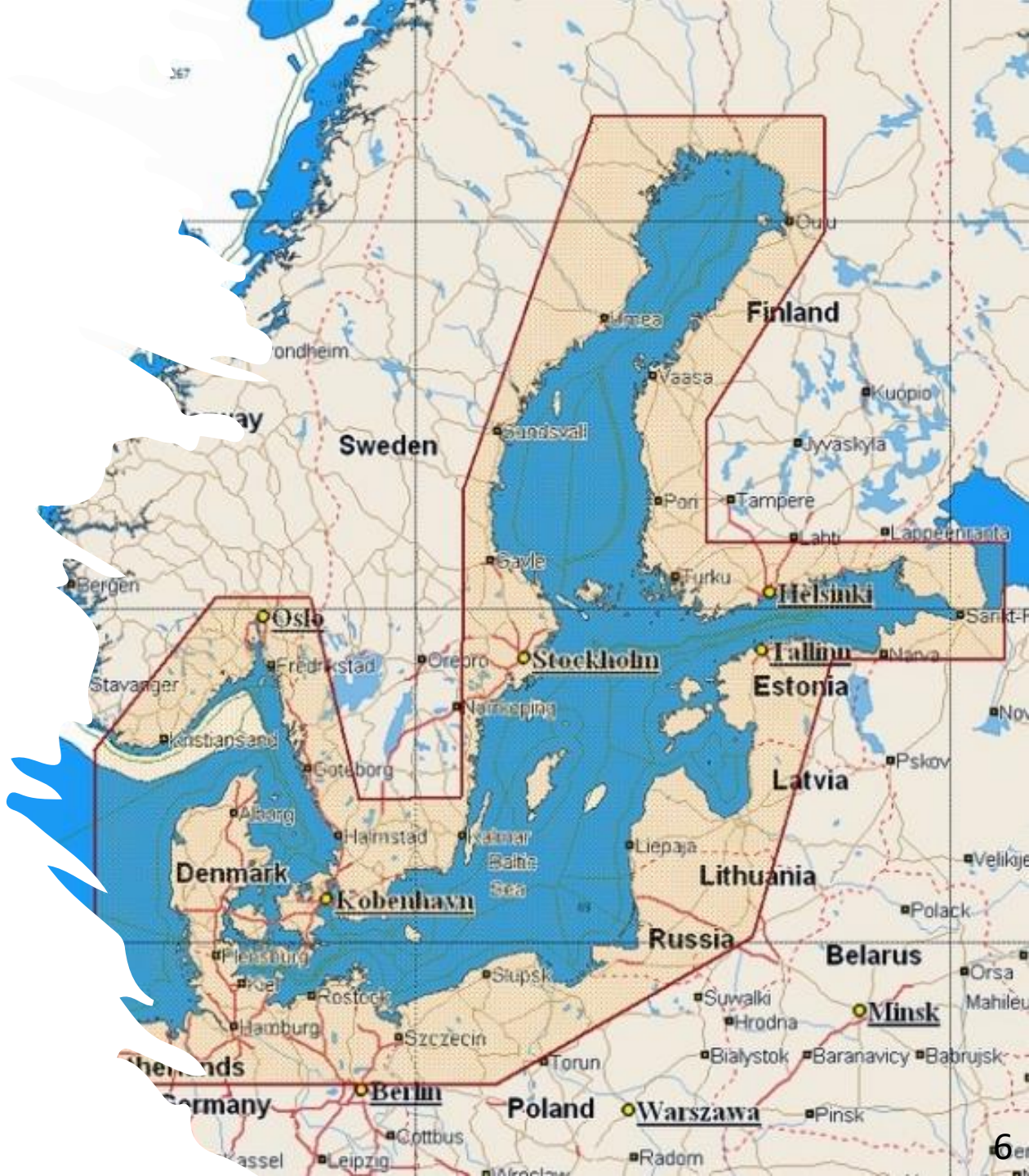
# Operational profile

- RV Nahkiainen is designed for sample collecting and analyzing in the Baltic Sea area
- The typical research voyage includes sailing to the research location, performing the research work there and sailing from one data point to another and finally returning to the shore
- Other than sailing, the energy will be consumed by the crew and ship's systems maintenance
- The typical voyage duration is up to three weeks and most of the time will go to research work as the Baltic Sea distances are short
- The speed is limited to 10.5 knots



# Main dimensions and weight

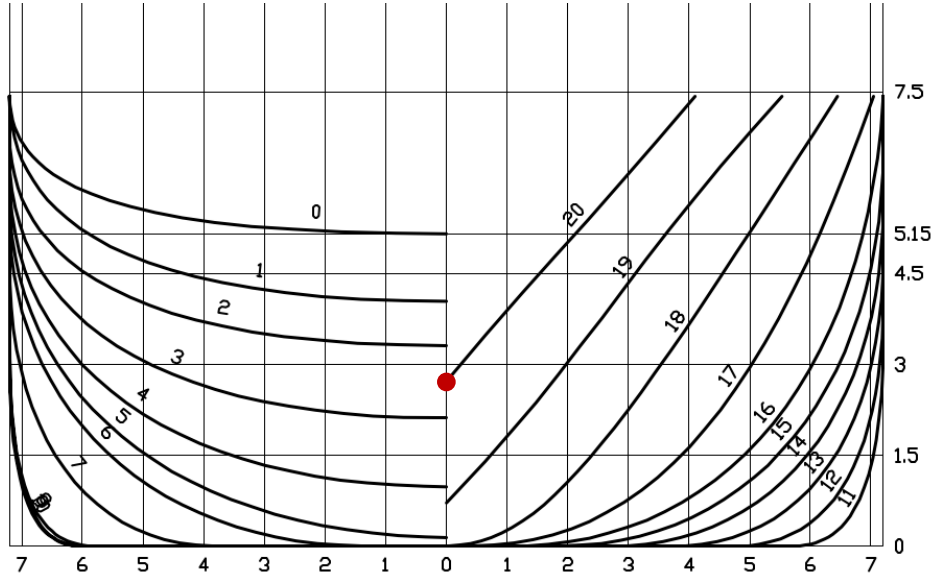
- The outfitting and cargo are light, and the center of gravity is near the bottom at four meters height
- This is due heavy machinery which is located on the one deck above the bottom deck
- The dimensions are in the same size class with the main reference ships RV Aranda and RV Svea

| Dimension | The measure |
|---|---|
| Length (Loa) | 69.54 m |
| Breadth (WL) | 14.40 m |
| Depth (D) | 7,42 m |
| Draft (T) | 5,15 m |
| Freeboard (Fb) | 2,27 m |
| Lightweight | 2100 t |
| Deadweight | 1100 t |
| Speed (design) | 10,5 kn |

# Hull form

- **U-shape hull**
- **Hydrodynamically efficient**
- **Bow shape:**
  - ✓*Must support ice breaking*
  - ✓*Traditional look, high forecastle*
- **Midship shape:**
  - ✓*Full bodied*
  - ✓*Maximal volume, large flat bottom*
- **Aft shape:**
  - ✓*Suitable for 2x Pod propulsion*
  - ✓*Transom stern, skeg*

| Dimension | The measure |
|---|---|
| **Length (Lpp)** | 65.10 m |
| **Breadth (WL)** | 14.40 m |
| **Displacement** | 3200 t |
| **Block coeff.** | 0.675 |
| **Waterplane coeff.** | 0.915 |
| **LCB** | 1.91 % |
| **VCB** | 2.90 m |

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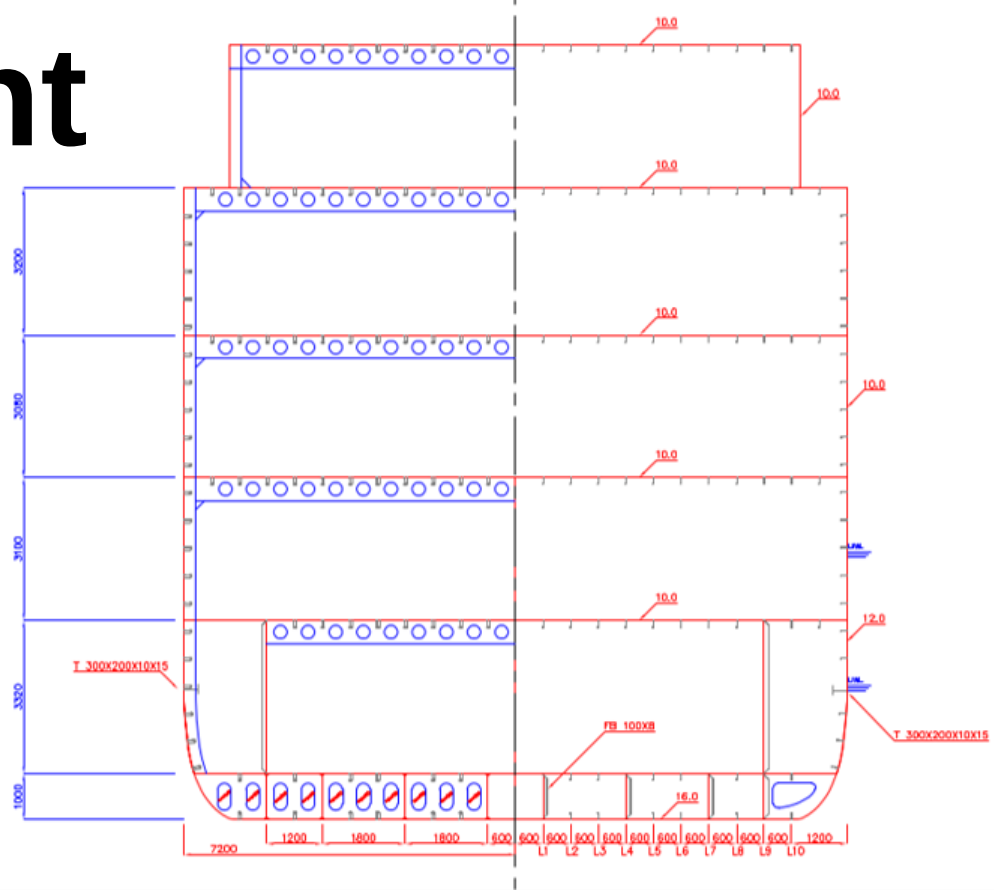
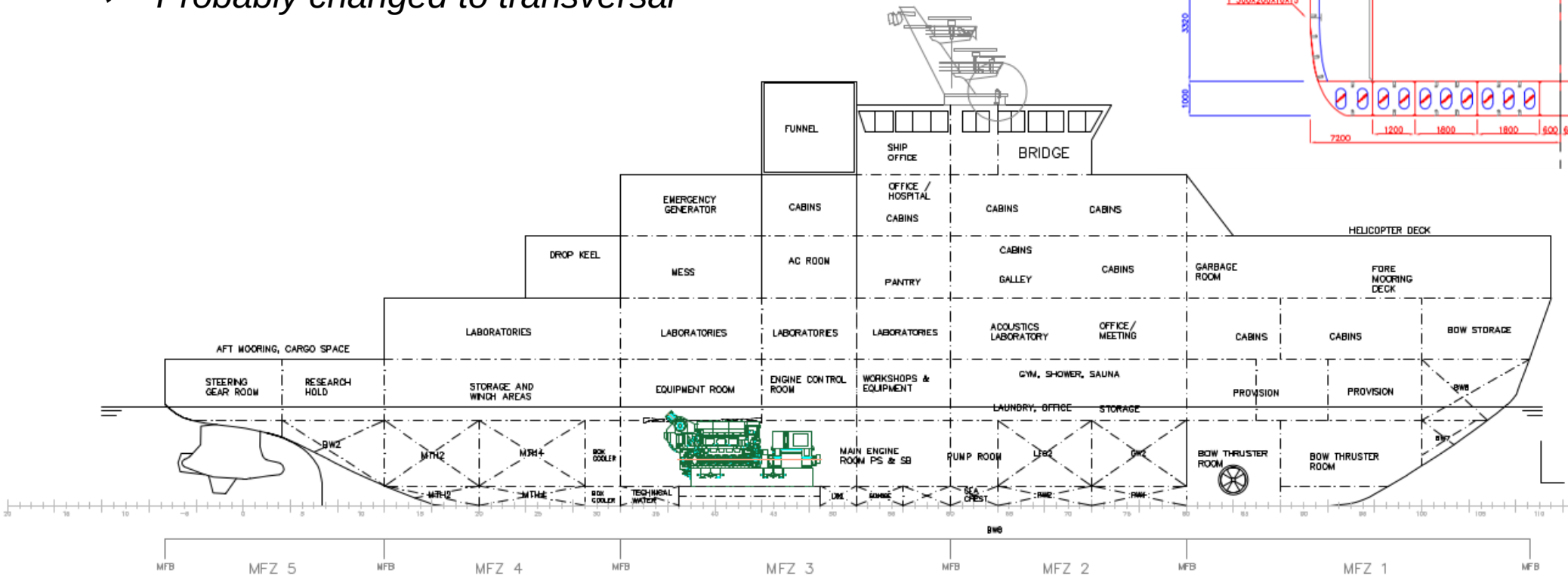
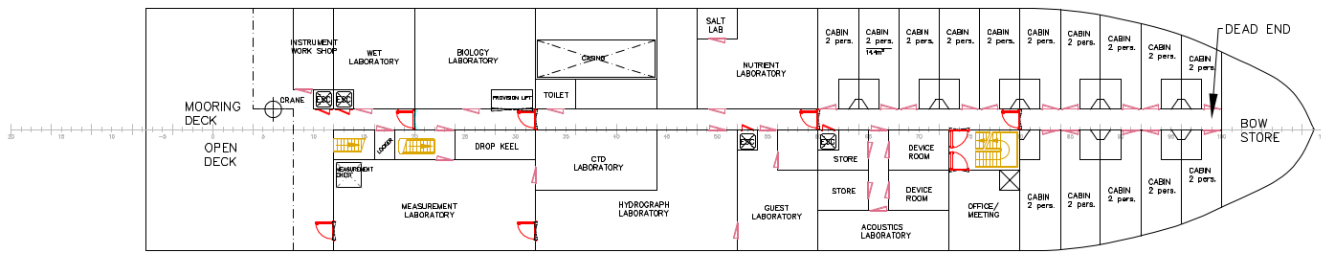
# Structural Arrangement

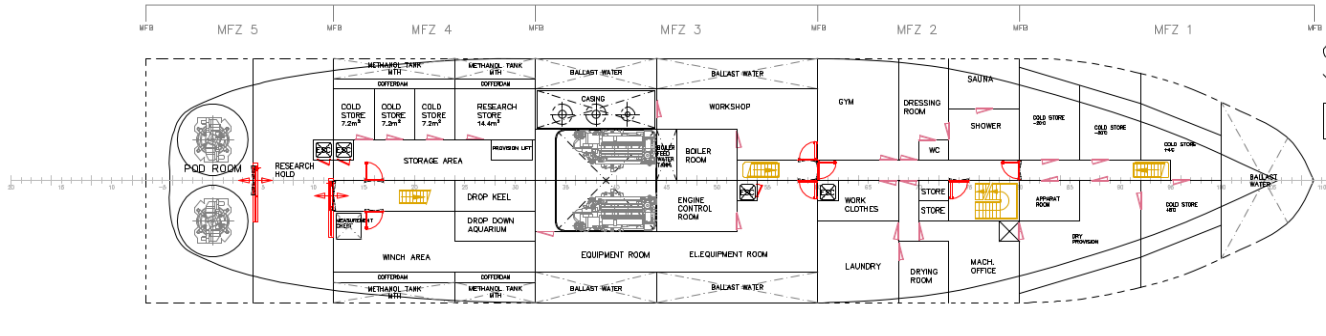
- ❑ **Structural continuity**
- ❑ **Ice classified, 1ASuper**
  - ✓ *Ice belt, ice stringers, S355 Steel*
- ❑ **Hull material basic structural steel S235**
- ❑ **Longitudinal framing**
  - ✓ *Probably changed to transversal*

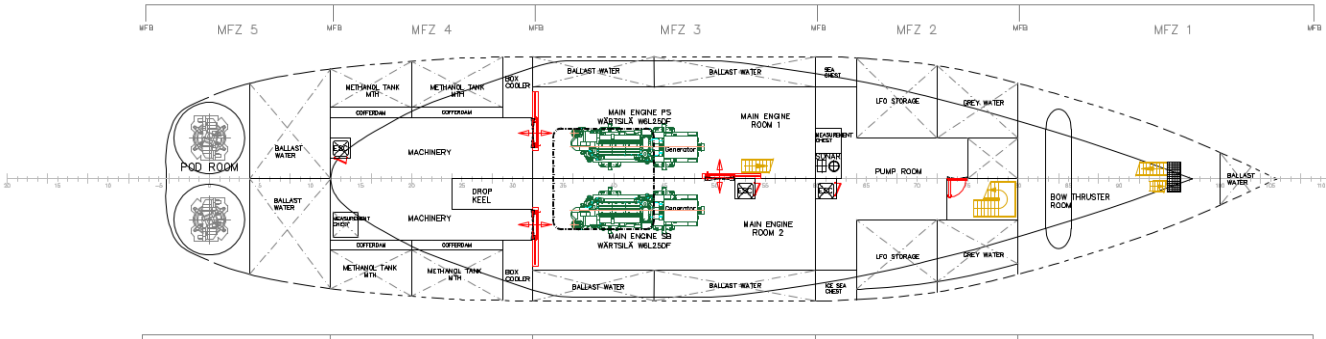


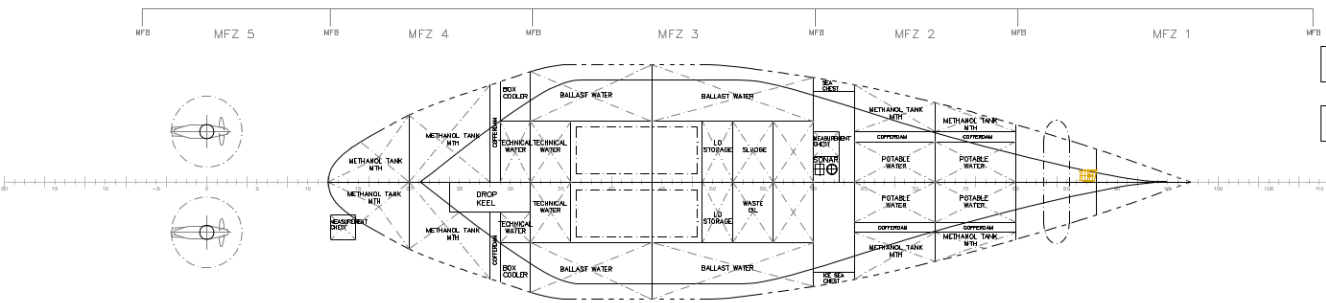



# General Arrangement




## ❑ Deck 3

✓ *Cabins, laboratories, aft mooring, workshops, offices, stores*

## ❑ Deck 2

✓ *Provision, storage, equipment, ECR, laundry, gym spaces, pod room*

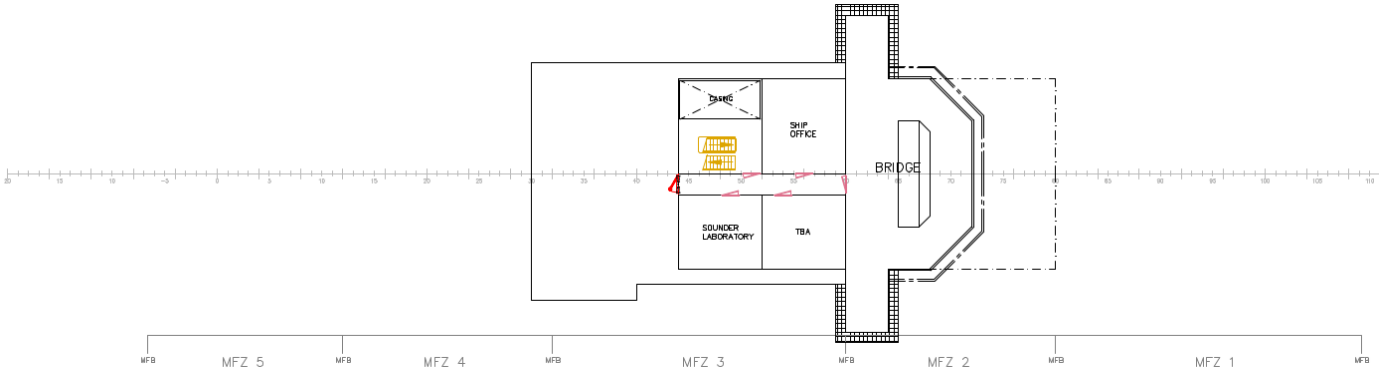
## ❑ Deck 1

✓ *Main engine room, machinery, methanol tanks, ballast, pump room, LFO, grey water, bow thruster*

## ❑ Deck 0

✓ *Methanol tanks, ballast, misc. tanks, potable water, measurement chests*

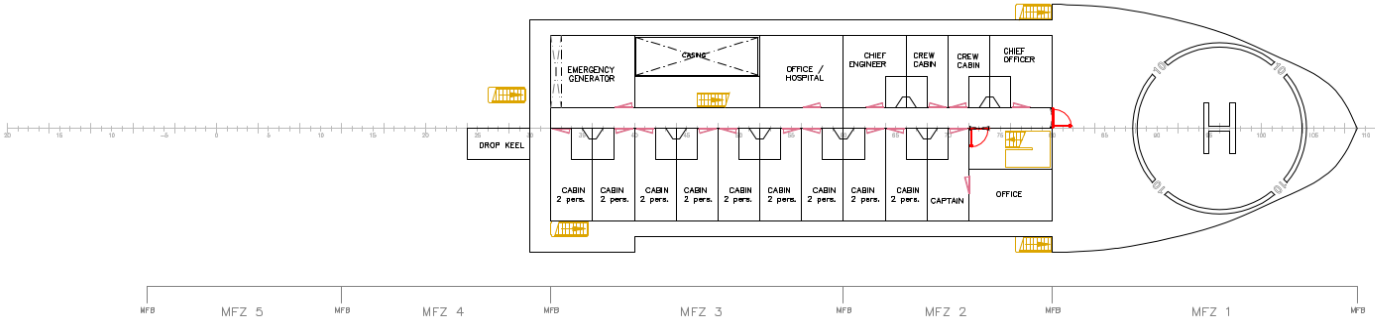
# General Arrangement




Bridge deck
Deck 6

16800 mm above B.L.

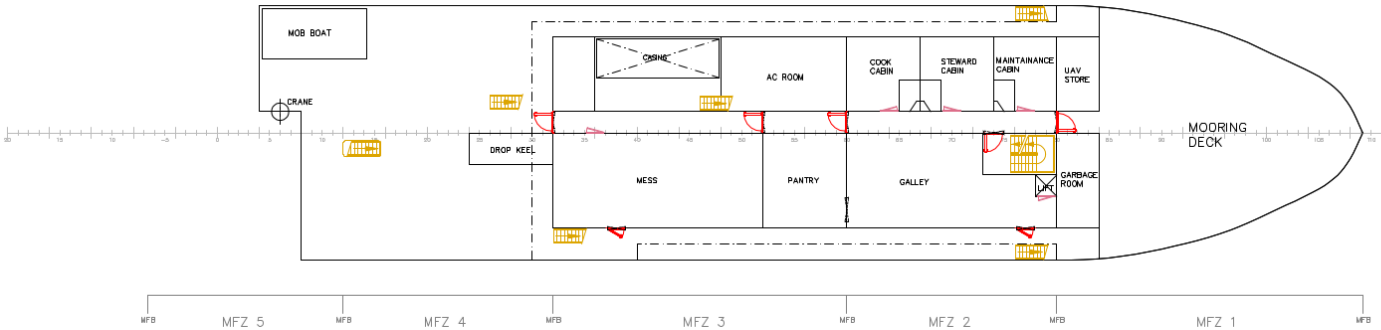
- **Deck 6**
  - ✓ *Bridge, ship office, auditorium, laboratory*




Helicopter deck
Deck 5

13700 mm above B.L.

- **Deck 5**
  - ✓ *Cabins, hospital, emergency generator room, helideck*




Boat deck
Deck 4

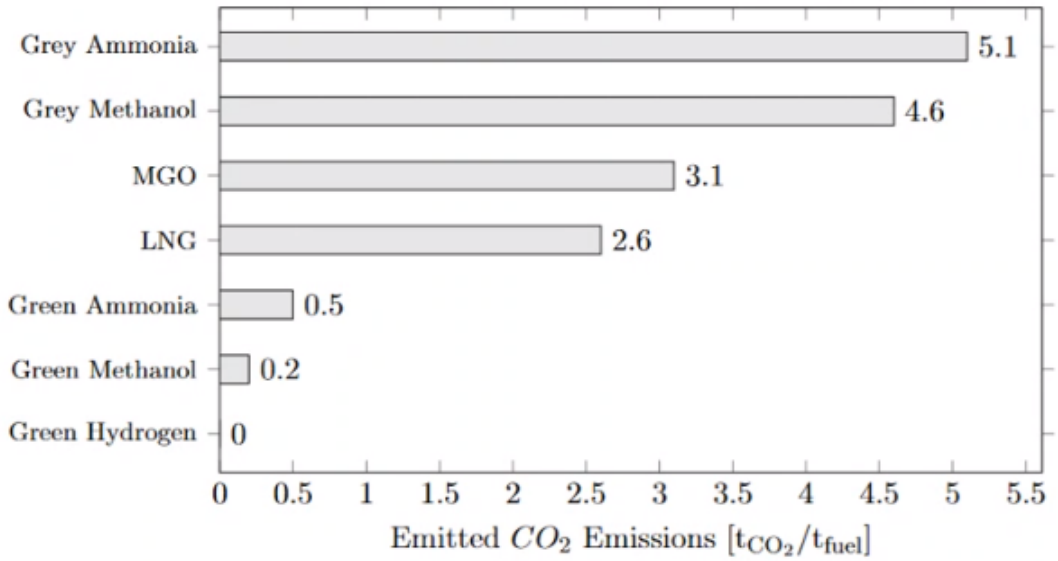
10500 mm above B.L.

- **Deck 4**
  - ✓ *MOB boat, mess, pantry, galley, cabins, AC, fore mooring*

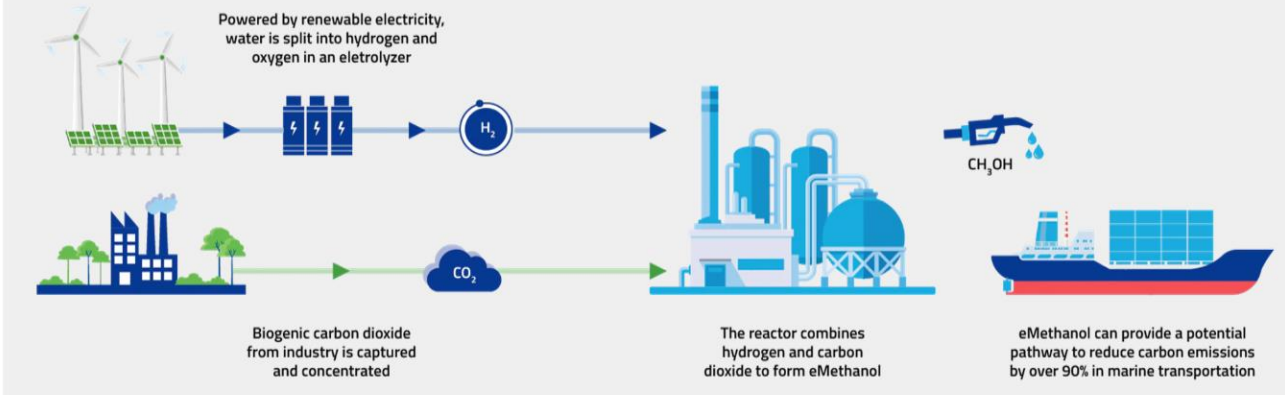
# Future fuels

- ❑ Methanol & ammonia options explored
- ❑ Methanol selected
- ❑ Design requirements, legislation & regulations under work

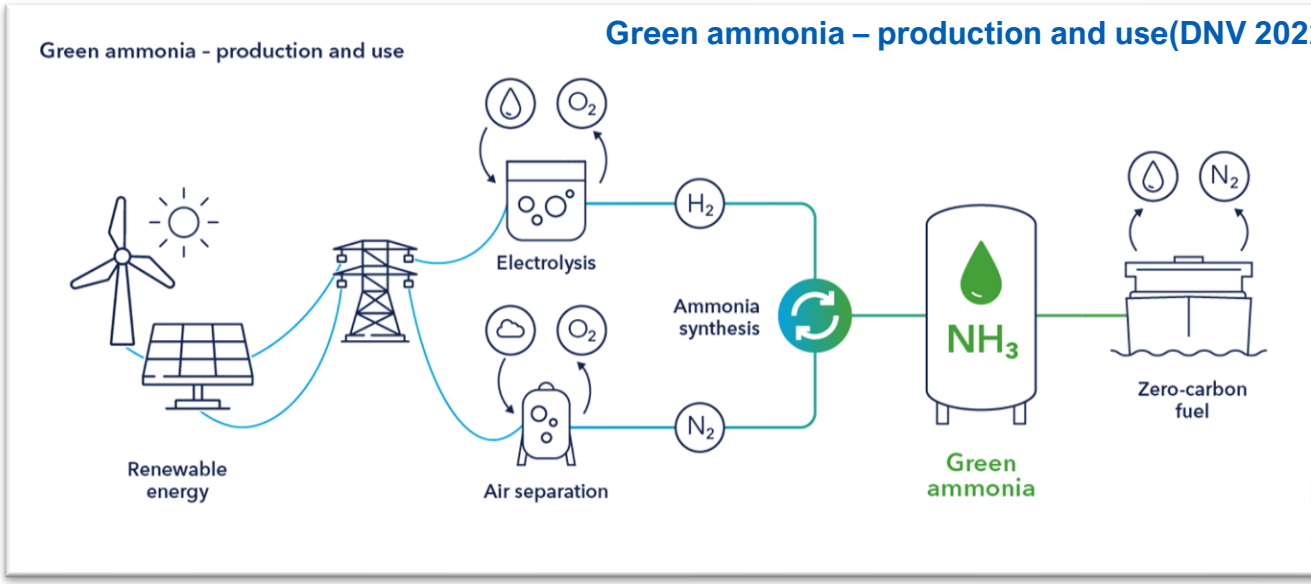
Well-to-Wake Emissions




Green methanol – production and use (Worley 2021)




Green ammonia – production and use(DNV 2022)




**DNV 2022:** "Ammonia is one of the most promising future fuels in the maritime world"

**Wärtsilä 2021:** "As shipping looks to cut emissions, methanol is emerging as a prime fuel candidate."

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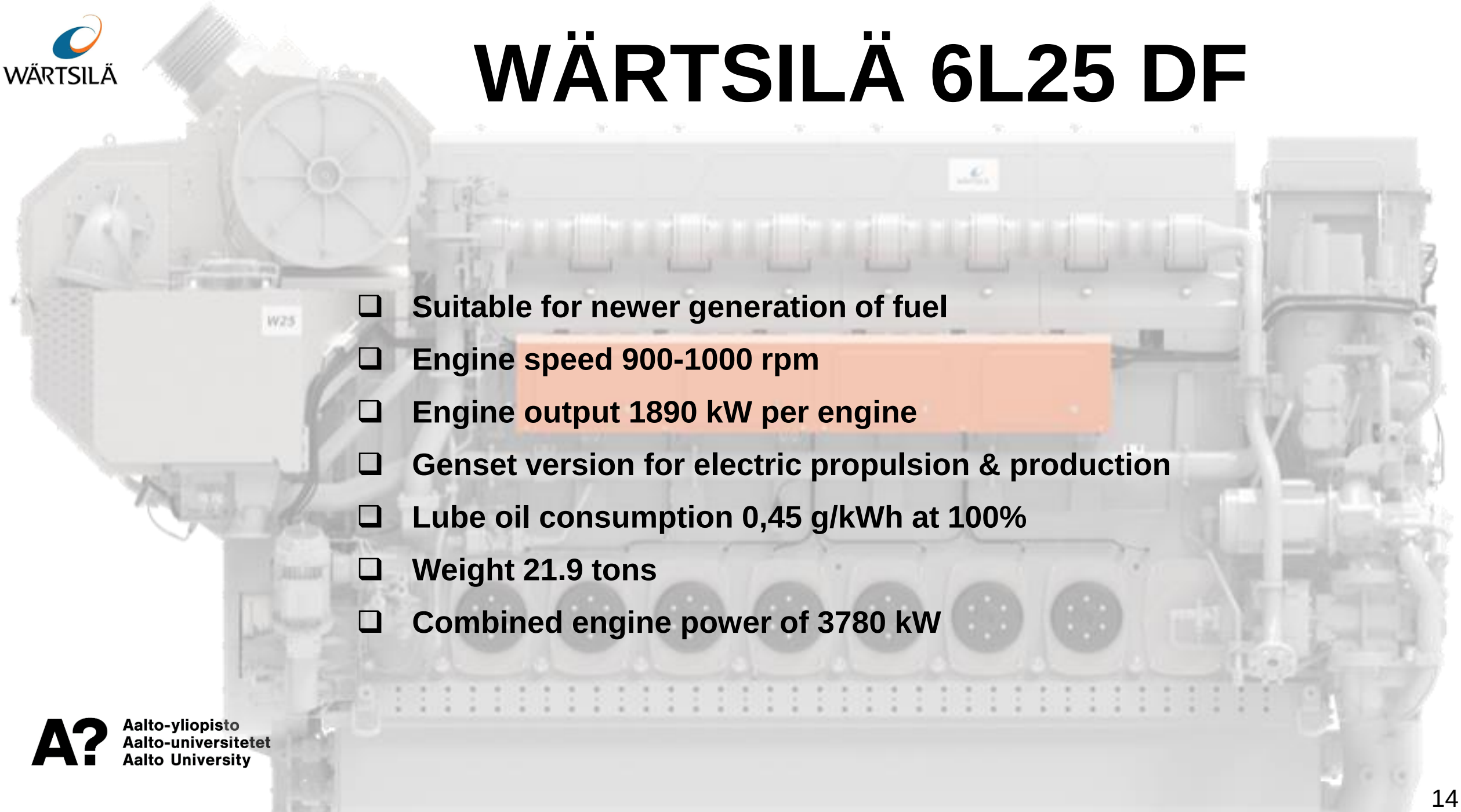
# Engine room main equipment

- Azipod steering modules and drive units
- Two Wärtsilä 6L25 DF and the Wärtsilä MethanolPac
- LFO tanks for engine pilot fuel
- LO separator for engines
- Steam boiler
- Exhaust gas boiler


WÄRTSILÄ

# WÄRTSILÄ 6L25 DF



- Suitable for newer generation of fuel
- Engine speed 900-1000 rpm
- Engine output 1890 kW per engine
- Genset version for electric propulsion & production
- Lube oil consumption 0,45 g/kWh at 100%
- Weight 21.9 tons
- Combined engine power of 3780 kW

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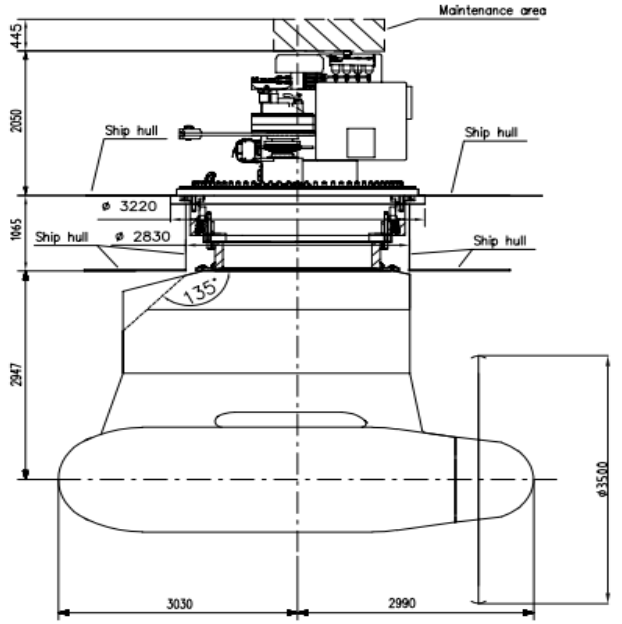
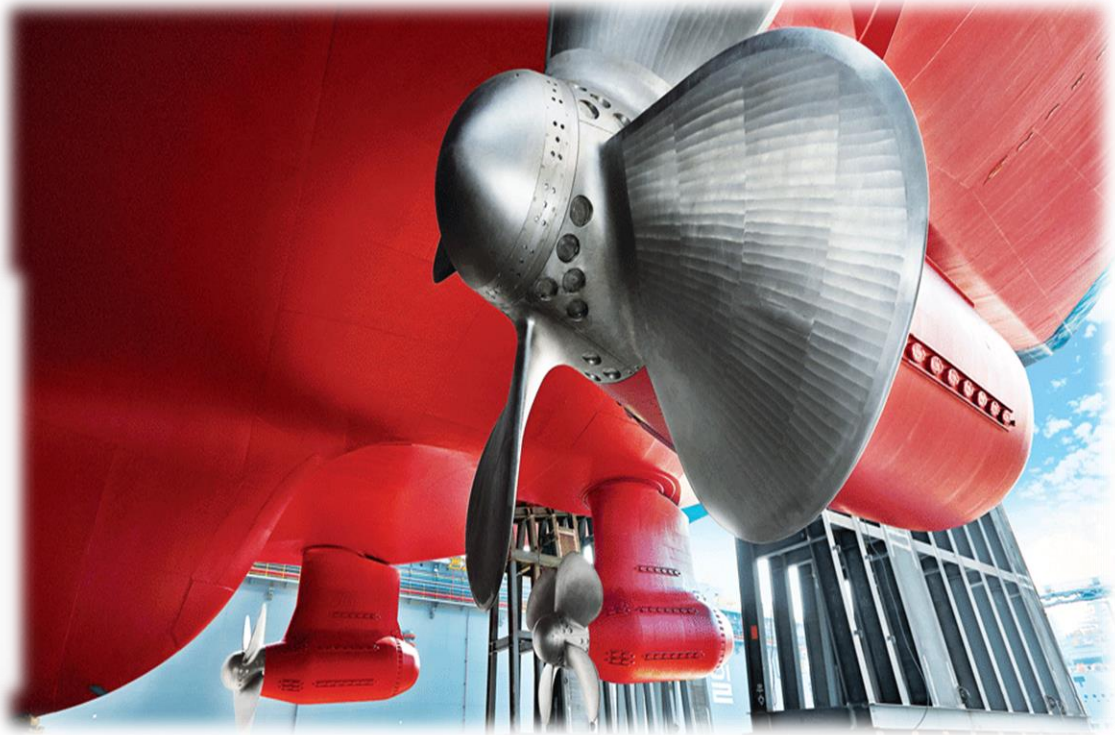
# Propulsion

- 2 x ABB's Azipod ICE 1400 units in the stern
- Bow thruster unit
- Good maneuvering and low noise emission
- Great choice for the ship's mission

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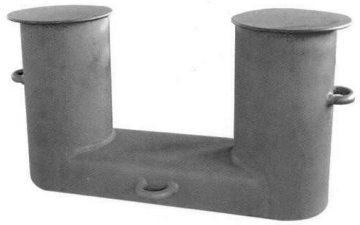
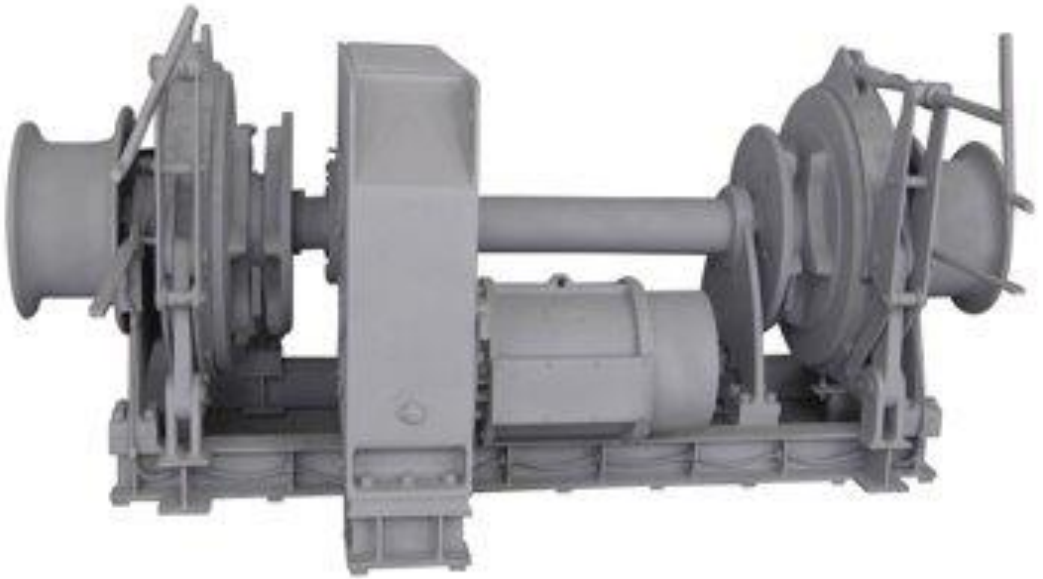
# Mooring equipment

- 2 x mooring winch + cable lifter windlass combination in the bow on deck 4
- Driven by pole change motor with frequency converter drive
- High Modulus Polyethylene ropes for mooring lines





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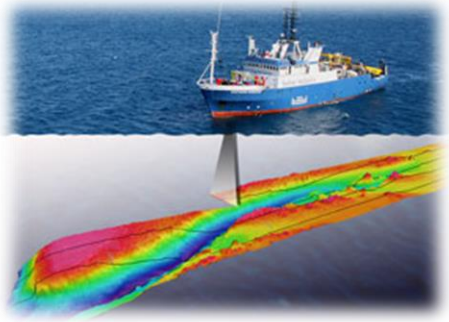
# Research equipment

## ❑ Deck 2

- ✓Multibeam sonar
- ✓Sedimentation trap
- ✓Plankton net
- ✓Metal and oil samplers
- ✓Air & aerosol sampling



## ❑ Deck 3

- ✓Moon pool & reeling winches
- ✓Side-scan sonar
- ✓CTD Probe and rosette sampler

## ❑ Deck 4

- ✓ AUV (autonomous underwater vehicle) storage
- ✓ AUV control container
- ✓ Fish finding sonar
- ✓ Crane for lifting between decks
- ✓ ROV (Remote operated vehicle)

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# Techno-economic assessment

- The purpose of the ship is to conduct research, not offer return of investment
- Main source of income is government funding
- Funding can be improved by investing in research equipment and training scientists
- Approx. initial investment 30-40 M€

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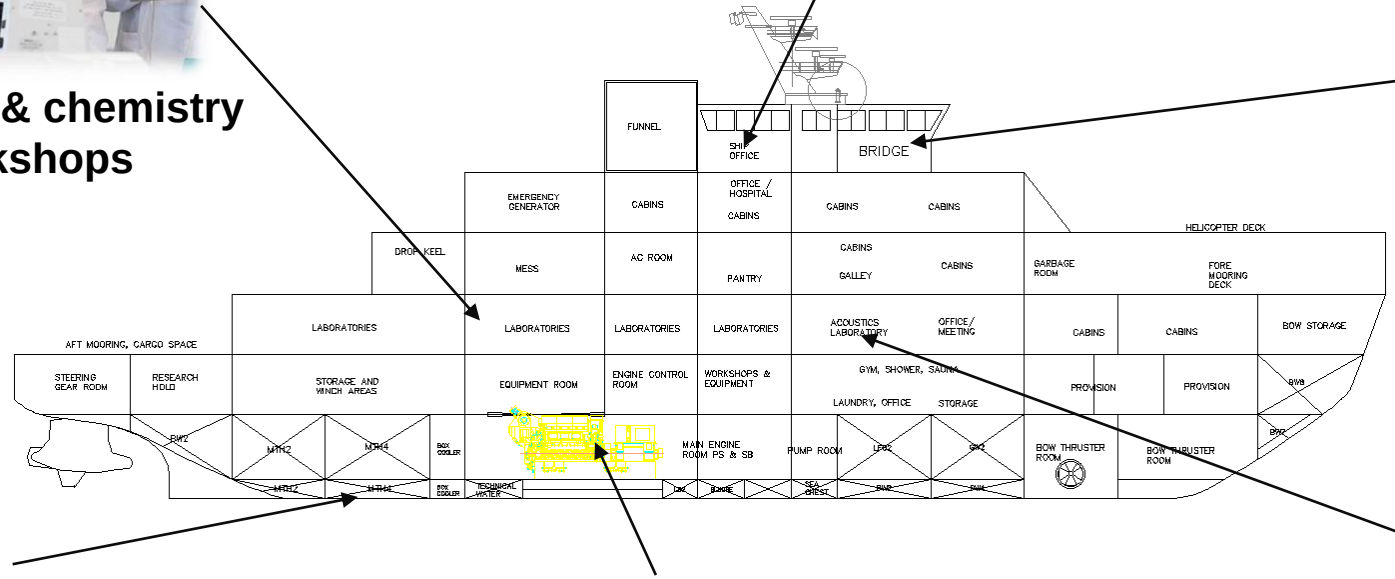
# Campus at sea

Lectures

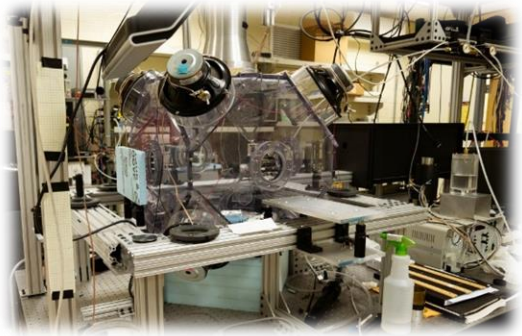
Marine biology & chemistry laboratory workshops

Ship operations learning center




Drop-down aquarium

Ship systems learning center



Atmospheric & acoustic laboratory workshops

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# Campus at sea

- Main purpose of the ”campus at sea” - program is to create a new generation of marine scientists an d specialists
- Onboard lectures/workshops + remote workshops
- 6 student voyages per year
- Ship costs funded by internal funding and campus ticket prices
- Ticket prices would be 500 €/day per person
  - ✓ *150 000 – 300 000 € annually in ticket sales*

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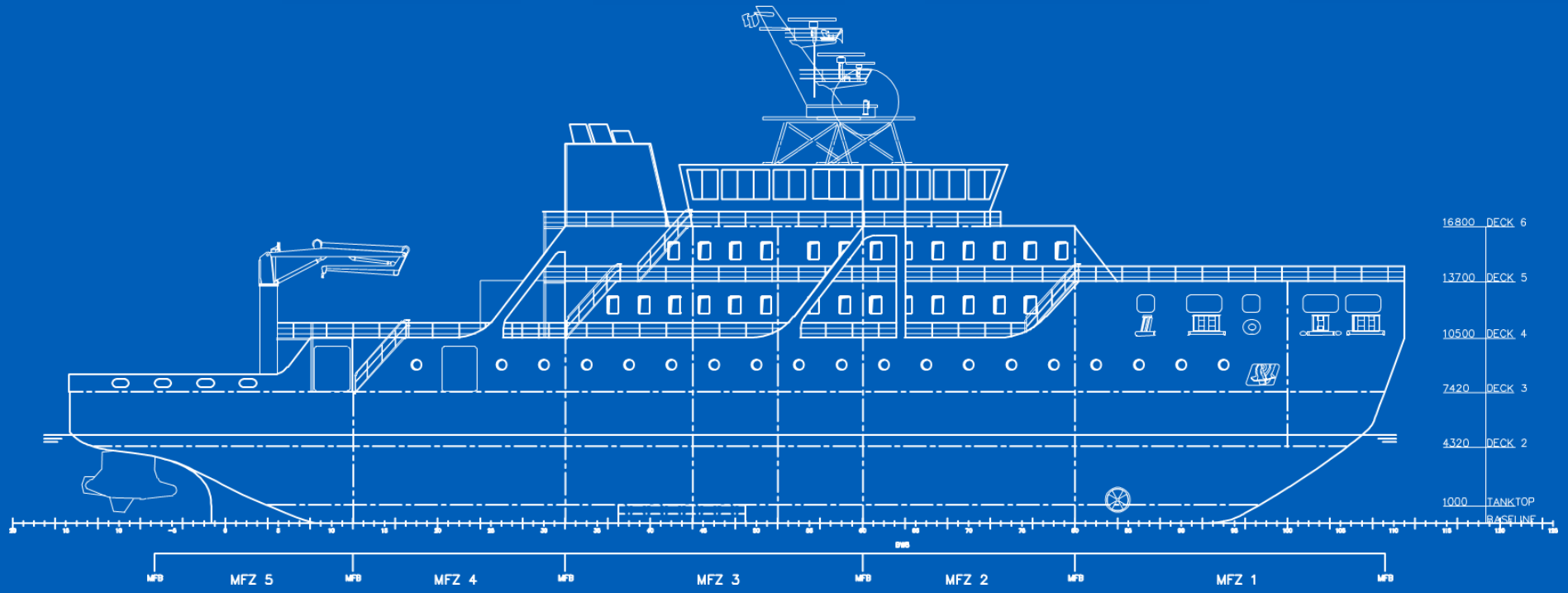
# Thank you

## Questions?




**30.11.2022**

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