



# H<sub>2</sub>Ocean

Hydrogen tanker for the Baltic Sea


Ville Hirvenoja, Leevi Jääskeläinen, Julius Kuula, Johannes Vänskä, Antton Äijälä

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## Hydrogen Finland – global markets on the horizon

Blog post Antti Arasto, Jari Kiviäho Tue, 04.05.2021 - 10:45



Finland could potentially become a significant exporter of technology, green hydrogen and hydrogen products, but this can only be achieved through having the relevant solutions piloted in a relevant environment first. That would require long-term pilot projects and industrial demonstrations.

**What is different in the current hydrogen business compared to previous ones?**

According to the IEA Report (2019), there have been several 'hydrogen booms' which have slowly faded away. In all the previous cases, the hydrogen boom was caused by an increase in the oil and gas prices. Most of the development work and implementation has mainly taken place on the terms of and/or from the perspective of...

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# Business for a clean planet

## Hydrogen cluster Finland

Hydrogen Cluster Finland welcomes dialogue and collaboration with companies, clusters, and platforms active in hydrogen economy to create sustainable innovation and business opportunities in Finland, Europe and around the globe.

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# Hydrogen Bay of the North

## Wind power and competence help build the Baltic Sea hydrogen economy

The BotH<sub>2</sub>nia network aims to build a robust hydrogen industry around the Gulf of Bothnia and combine our resources to pursue this common goal. Here in the Nordics, we are better known for action than words, which means our greener future is already well underway.

Our network unites almost 100 organisations in Finland, Sweden and Estonia, and new members are always welcome. If you want to be a part of the solution, join us - together, we will make a historical shift towards a smarter utilisation of natural resources.

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development in the Kokkola area accelerates – Gasgrid Finland and Flexens invite stakeholders in the network development in Kokkola and invite stakeholders in the region to participate

development in the Kokkola area accelerates – Gasgrid Finland and Flexens launch a study on network development in Kokkola and invite stakeholders in the region to participate

development company, Flexens, is planning to build Finland's largest hydrogen network in terms of capacity. Gasgrid Finland and Flexens will be leading the development work and invite the regional stakeholders to participate in the hydrogen network development in the region as a concrete part of the national hydrogen network as well as the Nordic Hydrogen Network, which is a joint hydrogen transmission infrastructure of Gasgrid Finland and Swedish Nordion Energi.

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## Import of hydrogen

Rotterdam aims to be the leading port for sustainable energy. An important part of Rotterdam as Europe's Hydrogen Hub is the import of hydrogen.

For this purpose, exploratory studies are underway with more than ten countries, including Iceland, Portugal, Morocco, Oman, South Africa, Uruguay, Chile, Brazil, Australia and Canada.


Becoming the leading port for import of hydrogen is how we aim to do it.

### CONCRETE PROJECTS

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## Åland firm announces plans for Kokkola hydrogen plant

The city is in the centre of Finland's so-called 'wind energy belt'.



The 300 MW plant will be built in the Kokkola Industrial Park. Image: Raila Paavola / Yle

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# Demand for hydrogen

- VTT
- H<sub>2</sub> Cluster Finland
- BotH<sub>2</sub>nia
- Gasgrid Finland
- Port of Rotterdam
- Flexens



# The current situation of hydrogen transport

- Suiso Frontier, the first and, currently, **only operating hydrogen tanker**
- Operating between Kobe, Japan and Victoria, Australia
- Capacity: 1 250 m<sup>3</sup>

# Our Team



Leevi Jääskeläinen



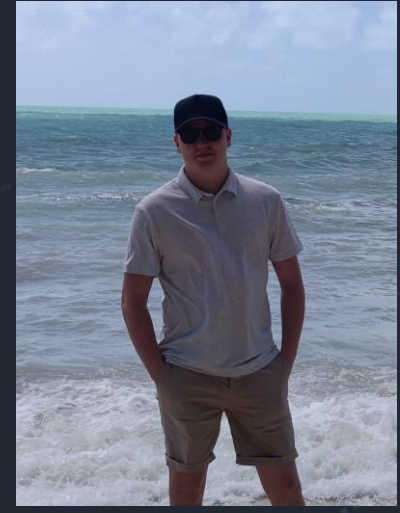
Antton Äijälä



Ville Hirvenoja



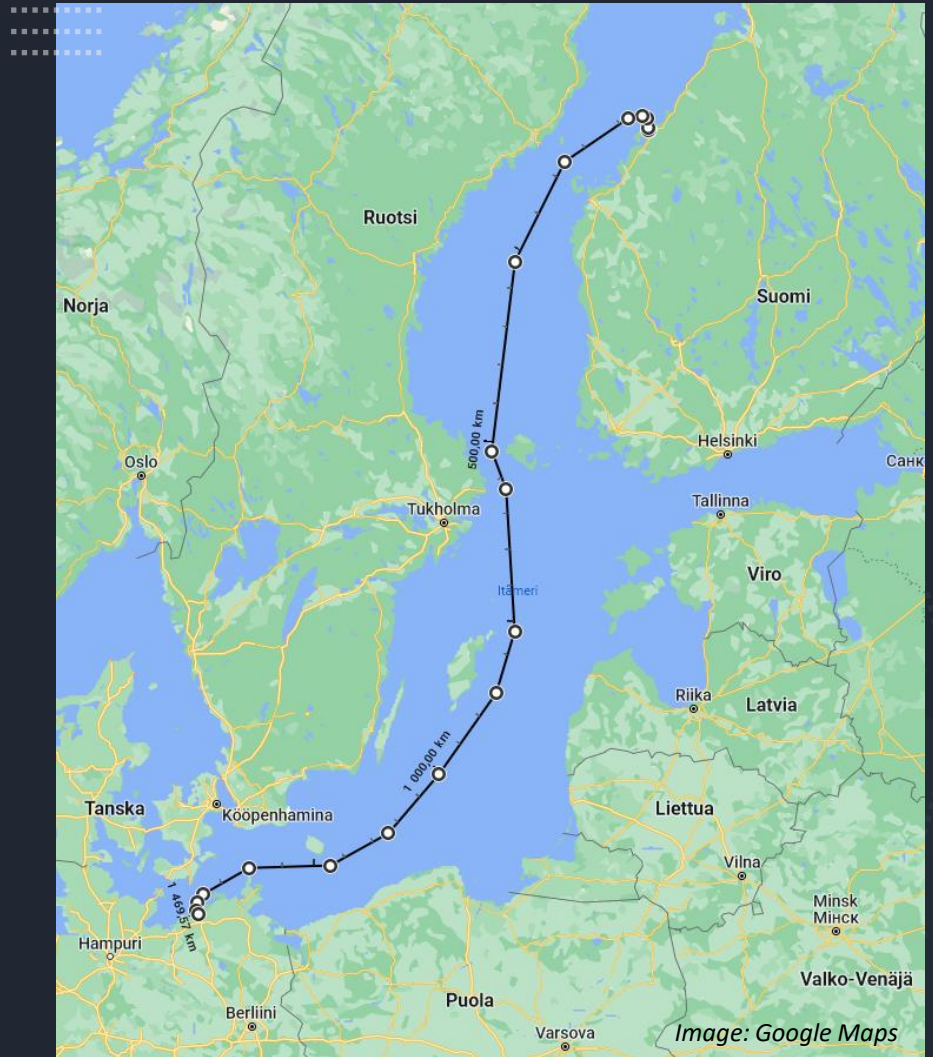
Julius Kuula

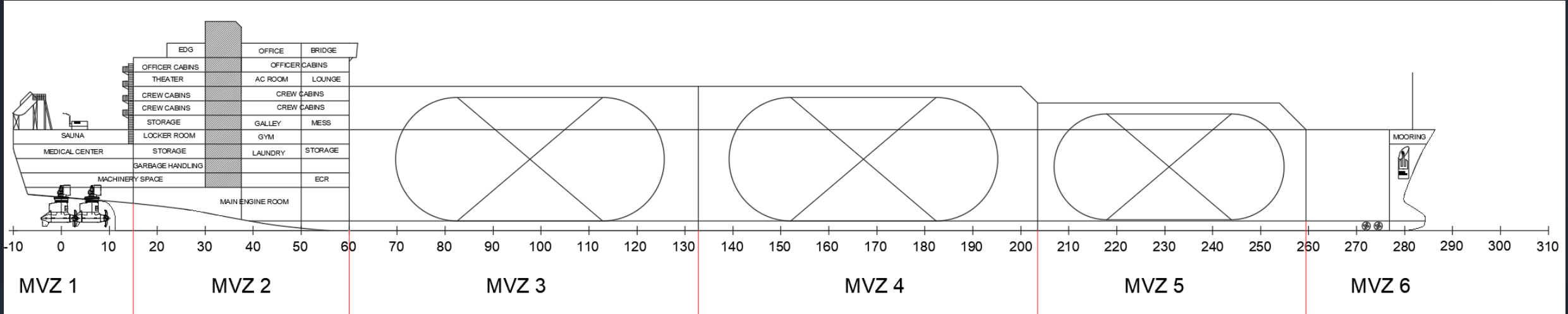


Johannes Vänskä

# Our Concept: Hydrogen tanker, H2Ocean

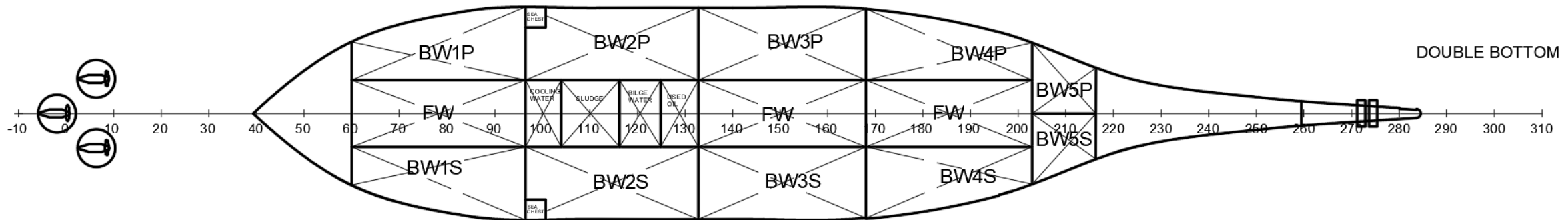
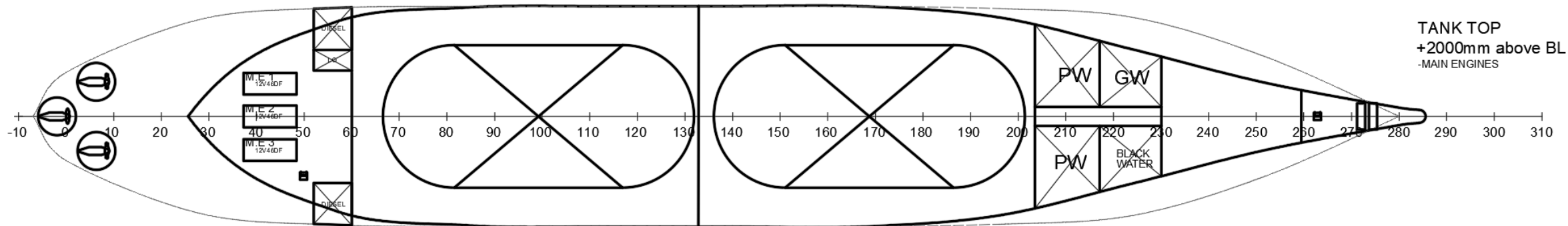
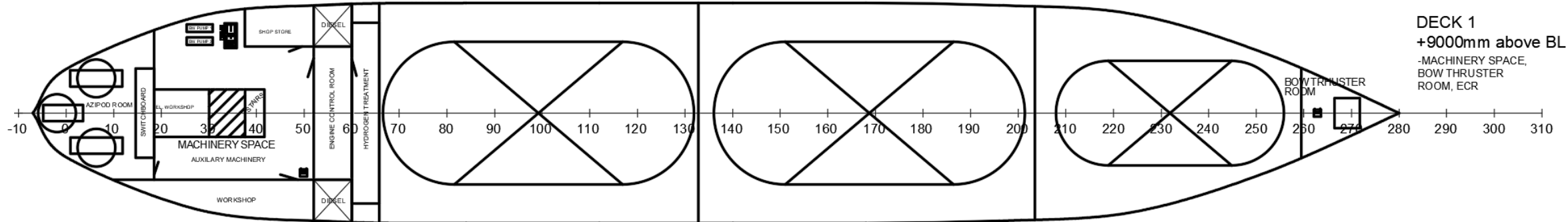
- Port of origin: Kokkola, Finland
- Destination: Rostock, Germany
- Round trip: 1587 nautical miles
- Year round operations -> Ice Class 1 A Super
- Speed: 20 knots
- Voyage time: 3.5 days for round trip + 2-3 days for cargo operations
- Capacity: 100 000 m<sup>3</sup> of liquid hydrogen

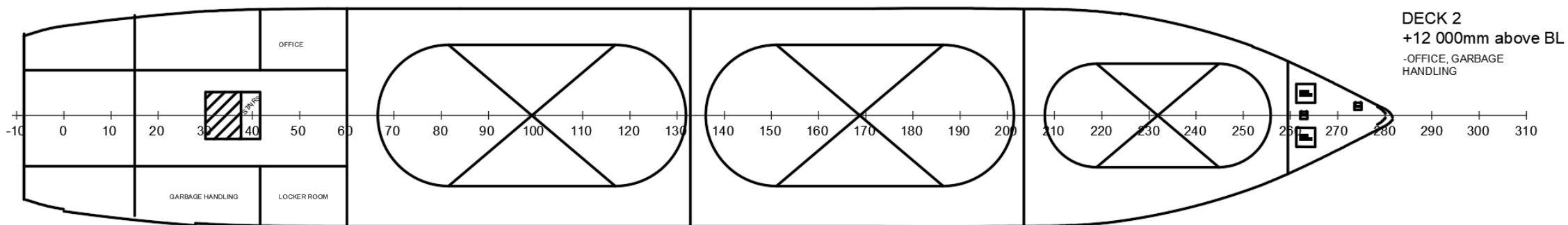
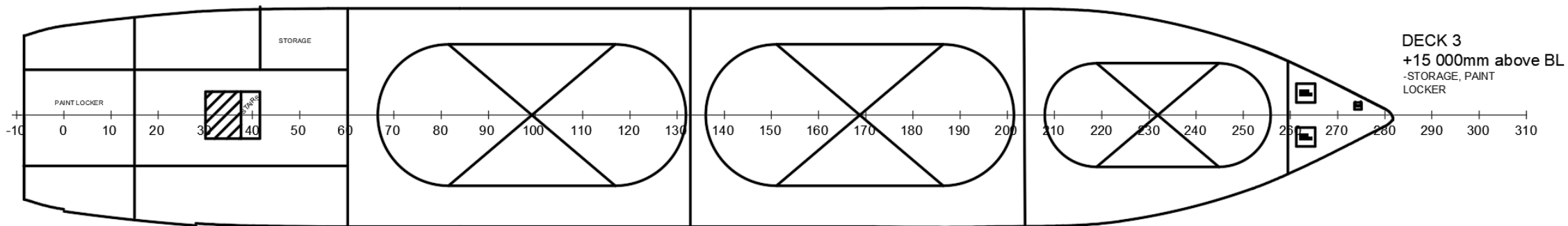
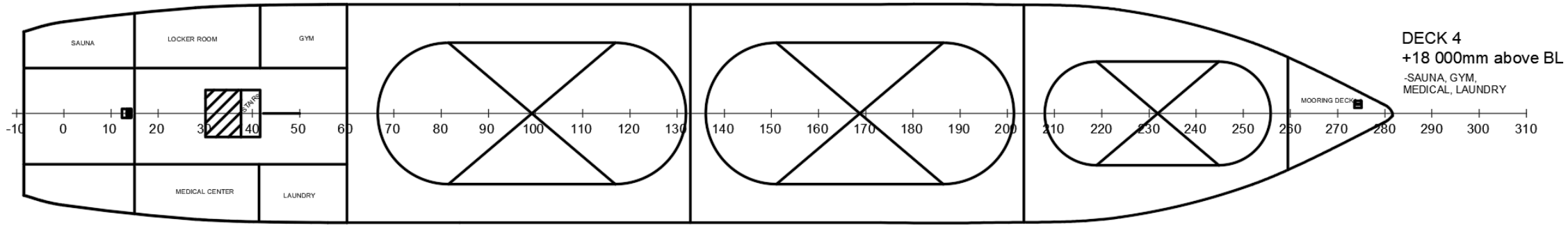




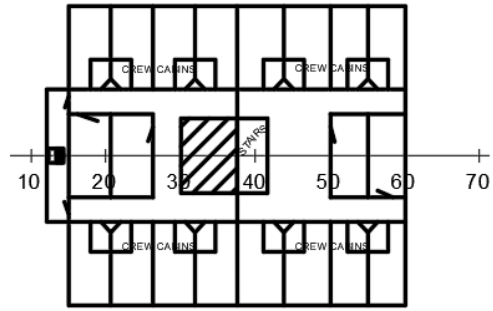
# Main dimensions

- Length overall 299.6 m
- LPP 280 m
- Breadth 44 m
- Draught 8 m
- Cargo capacity 100 000 m<sup>3</sup>
- Finnish Swedish ice class 1A Super
- Crew 35

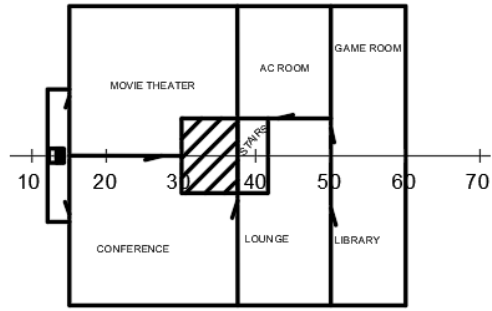




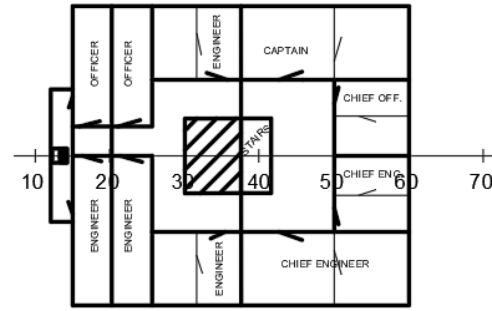




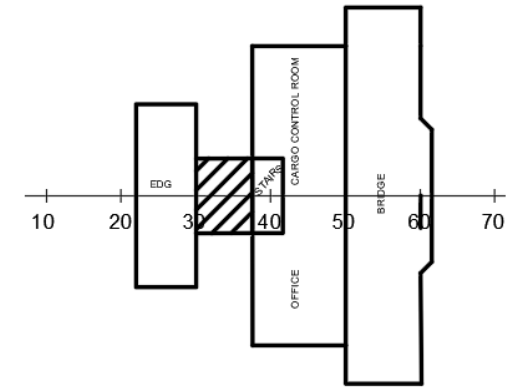
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+27 000mm BL  
-CREW CABINS



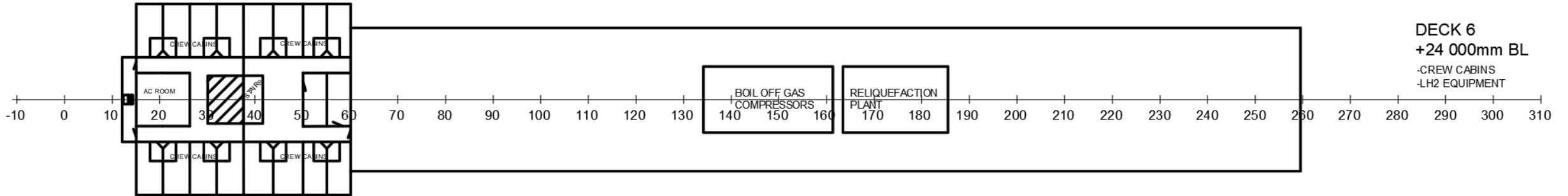
DECK 8  
+30 000mm BL  
-CREW WELLBEING



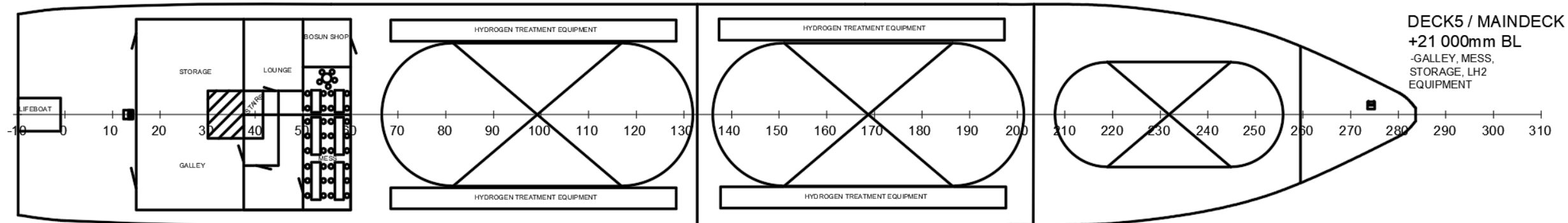
DECK 9  
+33 000mm BL  
-OFFICER CABINS



DECK 10  
+36 000mm BL  
-WHEELHOUSE,  
OFFICES, EDG



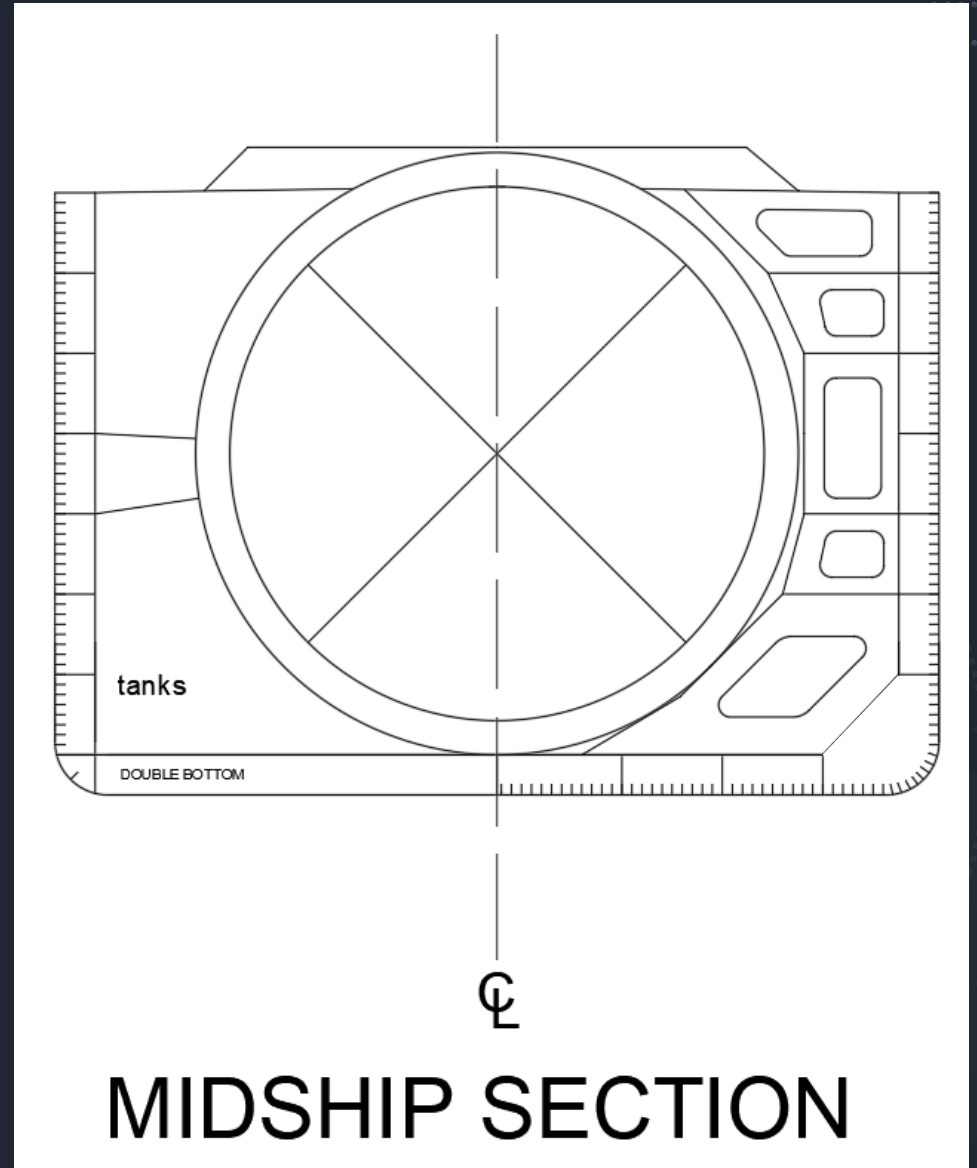
DECK 6  
+24 000mm BL  
-CREW CABINS  
-LH2 EQUIPMENT

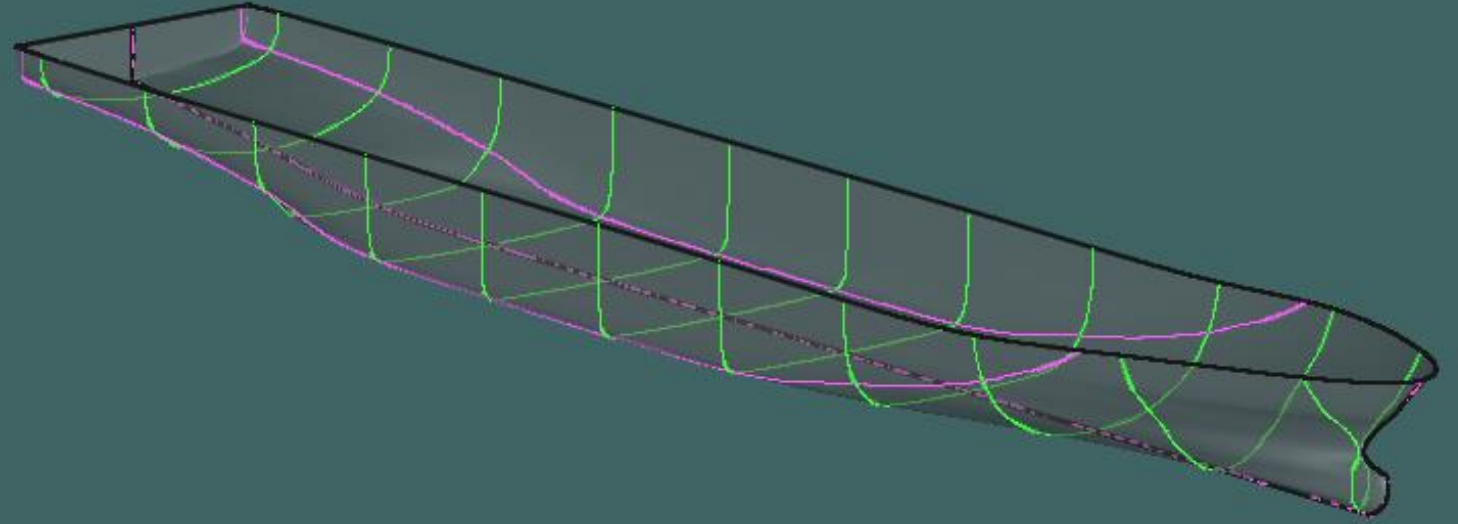
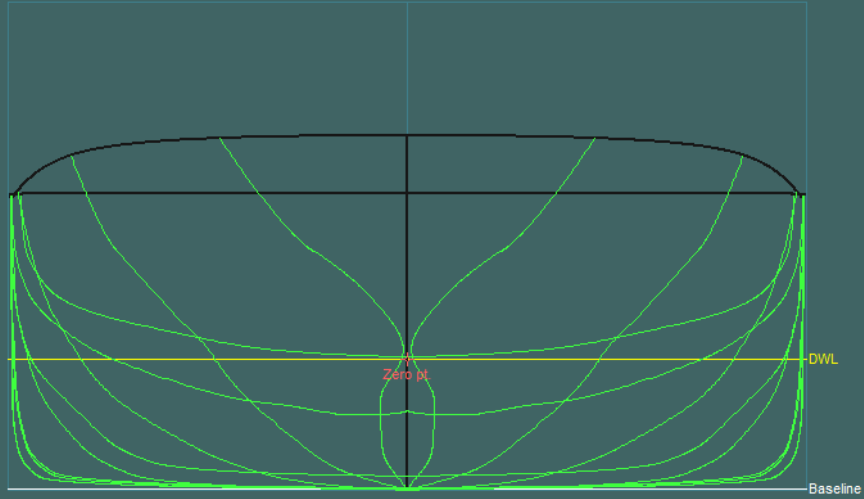
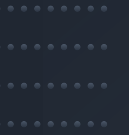


DECK5 / MAINDECK  
+21 000mm BL  
-GALLEY, MESS,  
STORAGE, LH2  
EQUIPMENT

# Structural aspects

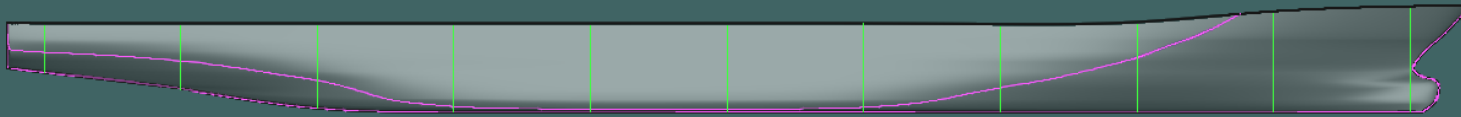
- Longitudinal stiffeners
  - 500mm spacing
- 2000mm double bottom height
- Hull material 16-20 mm S355 steel for additional strength
- Section modulus 18 577 m<sup>3</sup> (bottom) 9 824 m<sup>3</sup> (deck)





# Hull

- Block coefficient 0.647
- Displacement 72 826 tons
- Draught 8 m
- Freeboard height 10 m



# Power demand

- Power needed to overcome ships hydrodynamic resistance: 34 000 kW
- Power needed to overcome wind resistance: 965 kW
- Power needed to cover the hotel load: 50 kW
- Total power demand =  $P_{Hydro} + P_{Wind} + P_{Hotel}$  : 36 000 kW
- Maximum power output for the engine cannot be lower than 35 000 kW for 1 A super ice class according to Finnish-Swedish ice class rules



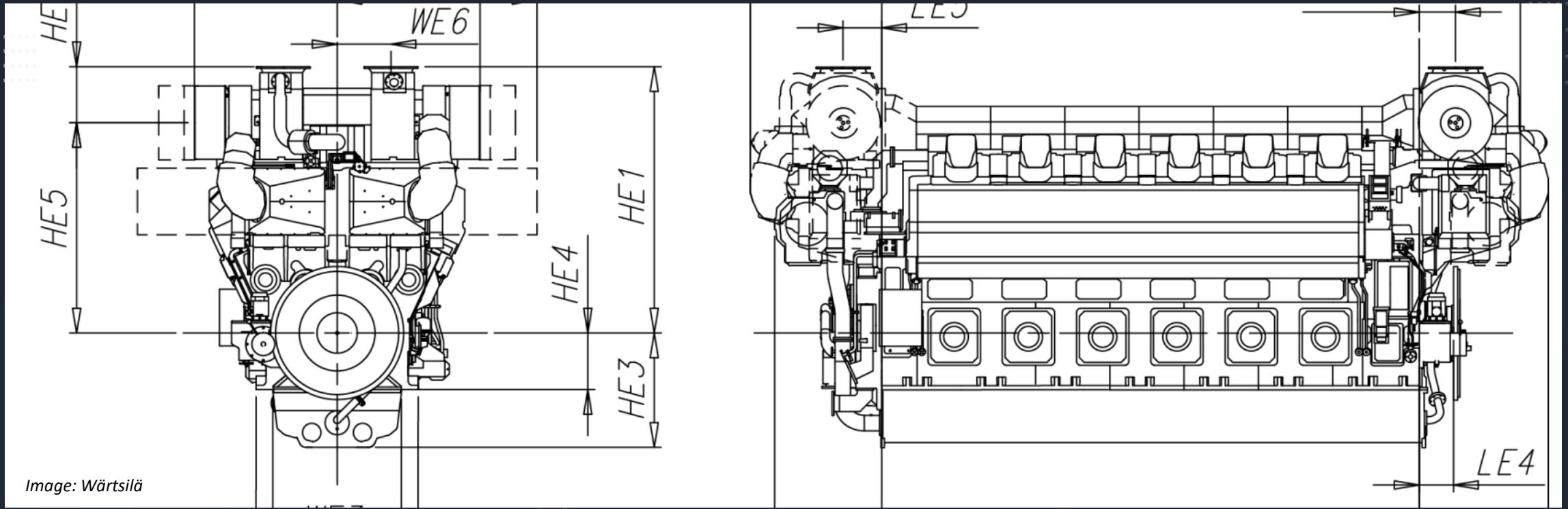
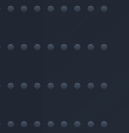


Image: Wärtsilä

# Machinery

- Main engines: 3 x Wärtsilä 12V46DF
  - Dual fuel – Diesel and LNG
  - Possibility to use hydrogen BOG and other green fuels
  - Combined power 41 220 kW
- Propulsion
  - 3 x ABB Azipod VI
  - Able to operate in ice
  - Great maneuverability

# Economic assessment



- Reliant on increased demand for hydrogen
  - Hydrogen is poised to be one of the future solutions for green power storage
  - Requires ample production capacity
- NPV: 176,4 million €
- RFR  $\approx$  0.17 €/kg



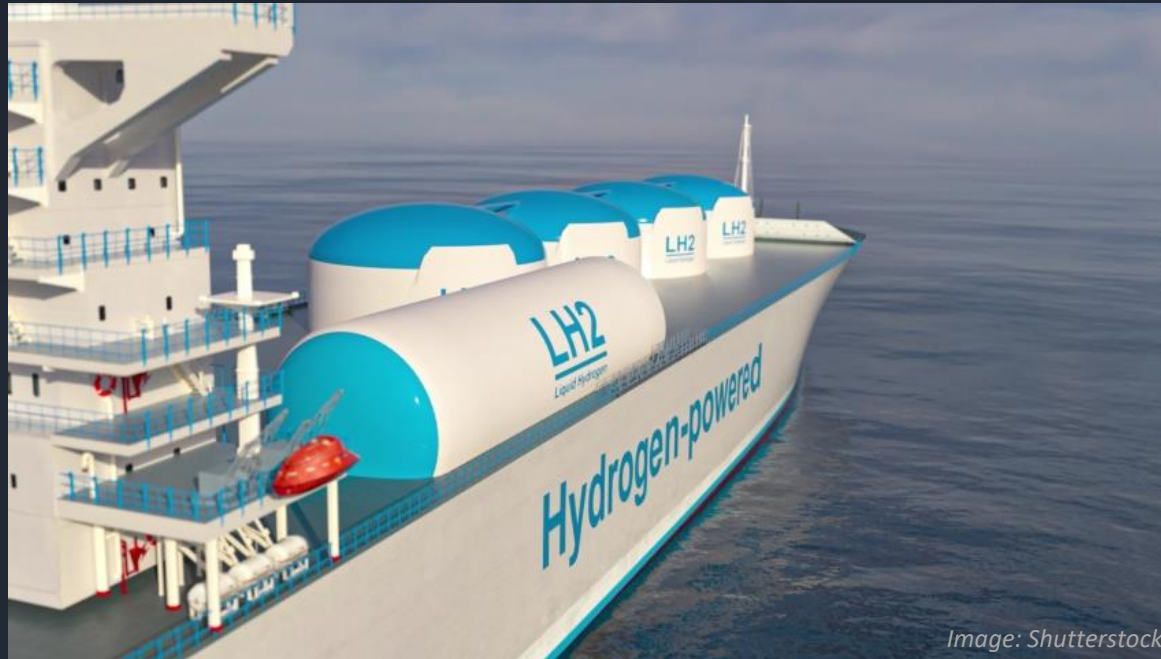


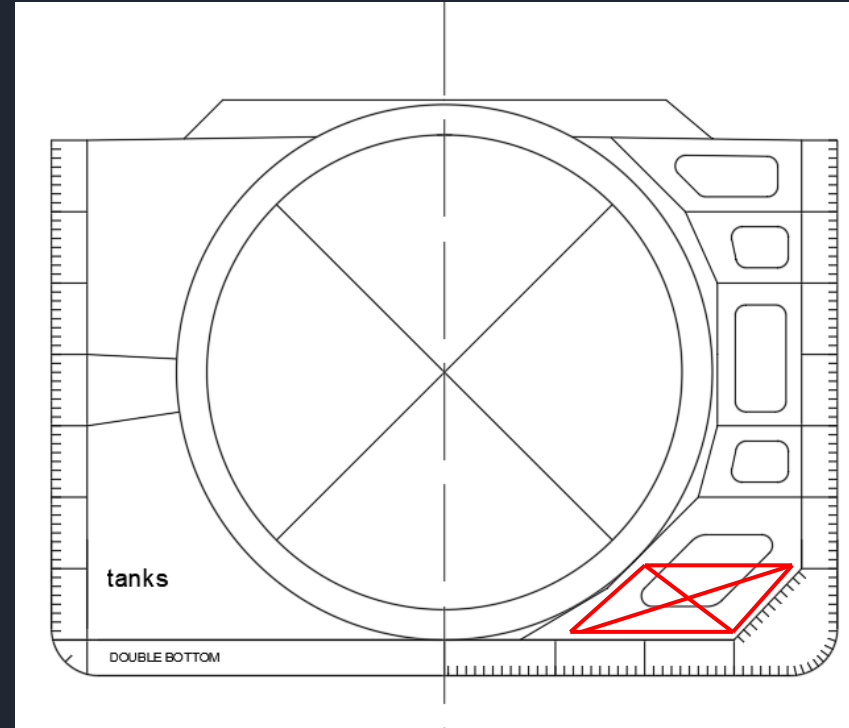
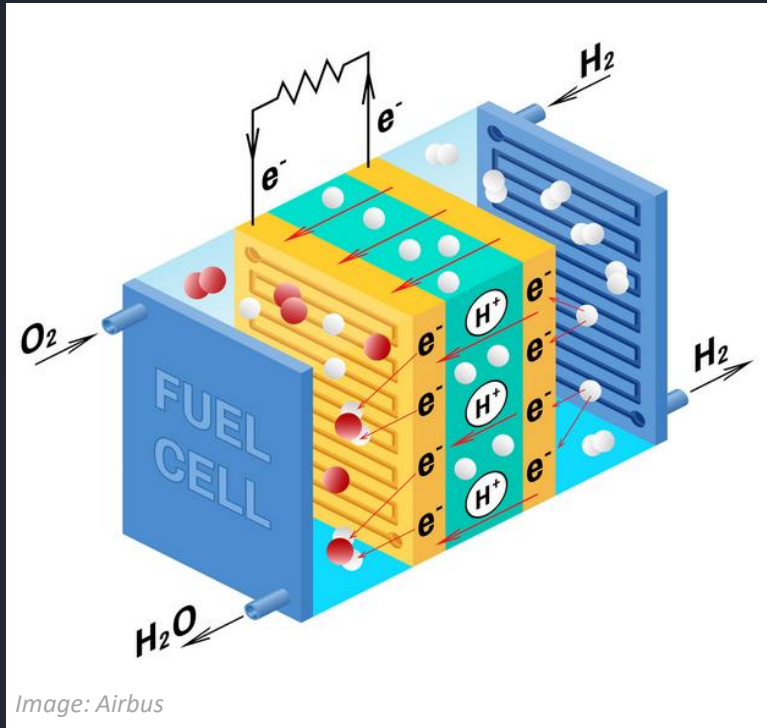
Image: Shutterstock

# Further Development

- Competition against pipelines, pipeline planned around the Bay of Bothnia 0.1-0.2 €/kg. Currently we are on par with that with the added benefit of route flexibility.
- Use of different fuels
- Cost and technology of the tanks



Image: Getty Images



# Alternative approach with fuel cells

- Currently many fuel cell systems have approvals in principle from different classification societies.



Thank you!



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