RV Svea

SUBSearch GROUP 2

FINAL PRESENTATION

VILLE-ALEKSI AALTO

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School of Engineering

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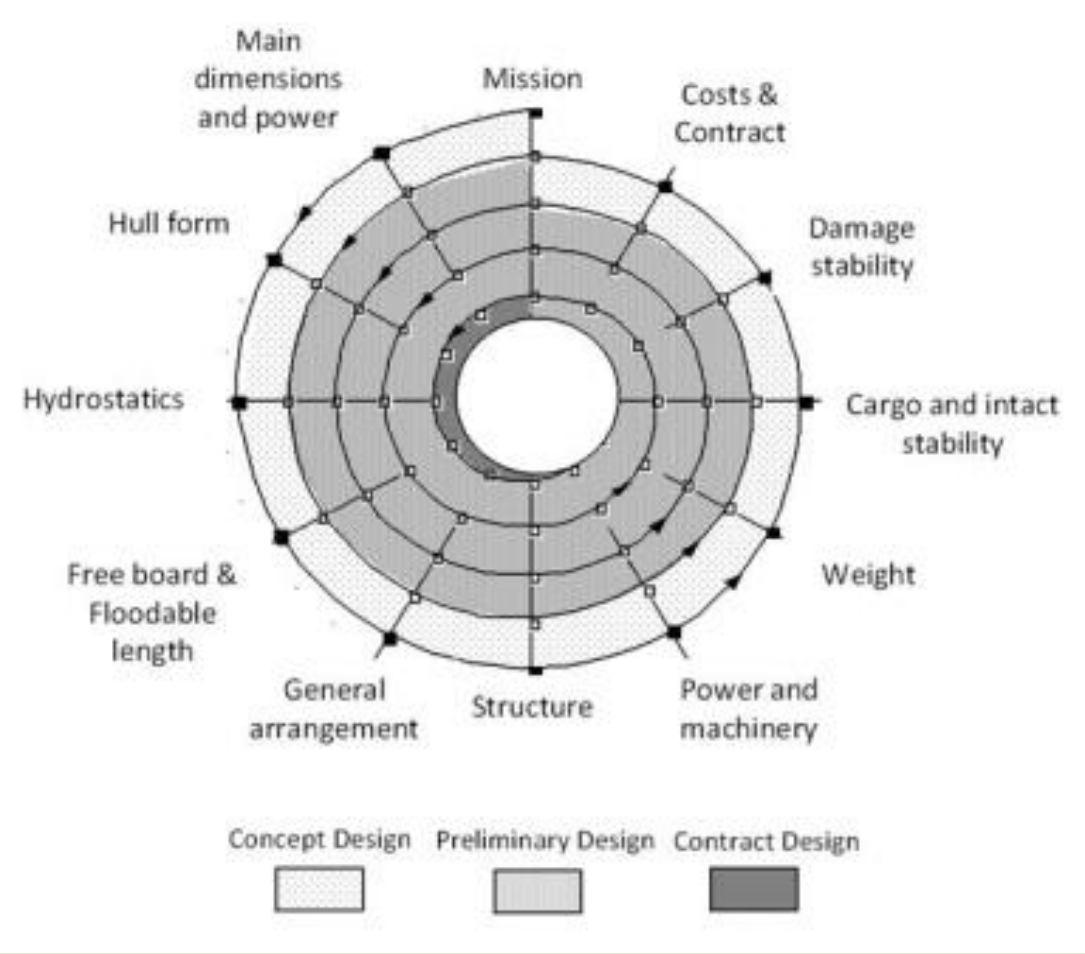

Ship design spiral (from course notes)

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The Group

INGA

ALLU

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KASPER

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The team consists of future professionals with various interests and backgrounds

Schedule of the project

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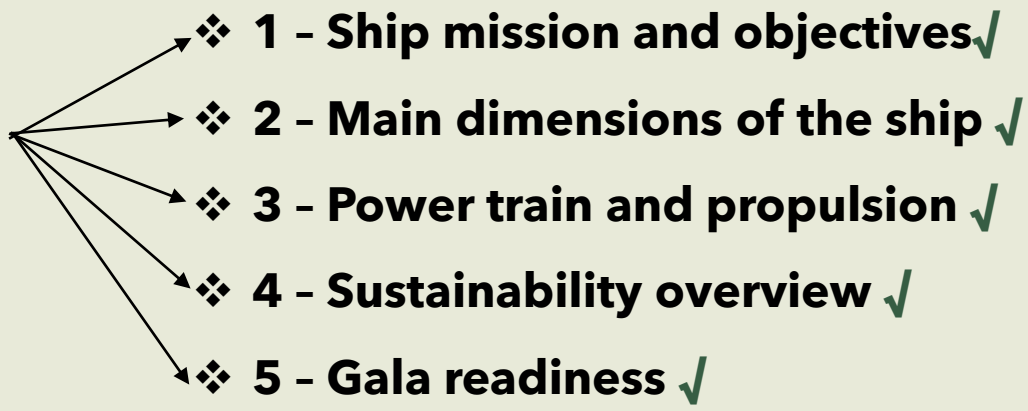
Scheduled Tasks	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10
Design context and ship mission.										
Innovation and role assignments.										
Collecting data from reference ships.										
The main dimensions and power requirements.										
Hull form study and discussion.										
Hydrostatics study an discussion.										
Free board and floodable length.										
Creation of the General Arrangement – GA.										
Ship structure study and discussion.										
Power, machinery, and equipment.										
Weight and stability study.										
Economic assessment of the ship.										



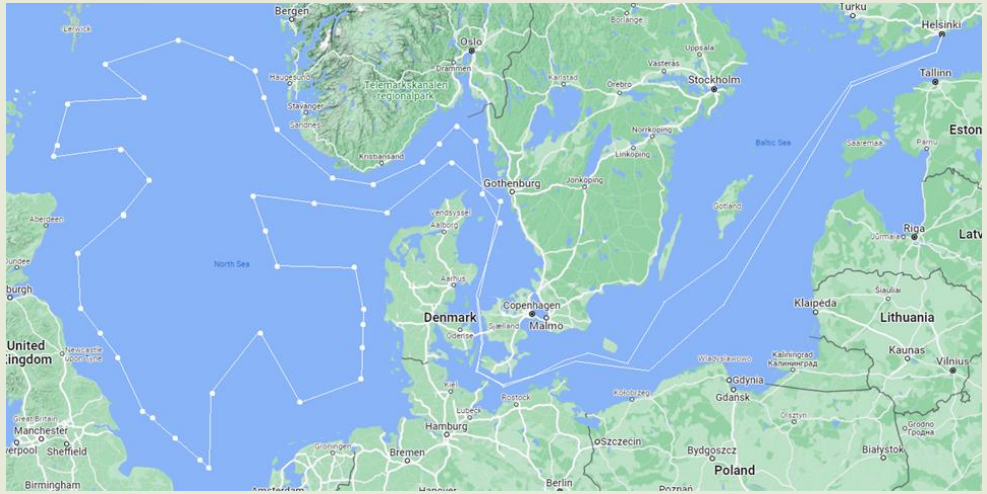
- **5 milestones to keep track of the progression**

- **1 – Ship mission and objectives √**
- **2 – Main dimensions of the ship √**
- **3 – Power train and propulsion √**
- **4 – Sustainability overview √**
- **5 – Gala readiness √**

Mission

- "***Sustainable Baltic Sea Research Vessel***"
- *An all-year-round operating research vessel*

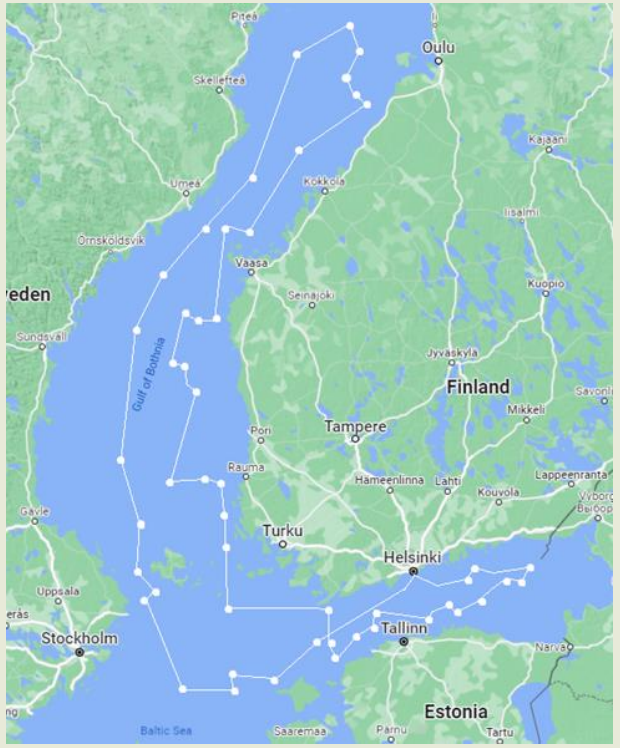
- *Main research*
  - *State of the Sea and monitoring*
  - *Marine ecology and modelling*
  - *Sustainable use of marine areas*
  - *Marine pollution*



Example route in North Sea

*In **the Baltic Sea**:*
- *Duration 10 days*
- *1404 nmi*
- *50 research points*

*In **the North Sea**:*
- *Duration 19 days*
- *3393 nmi*
- *45 research points*



Example route in Baltic Sea

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About the main dimensions

- *Length **69.0m**, beam **16.9m**, draft **5.4m** and depth **8.6m***
- *Displacement **4187** tons, DWT **831** tons and lightship weight **3356** tons*

- *Notable differences to reference vessel **RV Svea***
  - *Less energy dense fuel ammonia requires **DWT addition***
  - *Solar panels on decks and bridge for **additional power generation***
  - *Batteries **rechargable** from wind farms*

- *DWT addition **justifies** the increased length, beam and displacement.*

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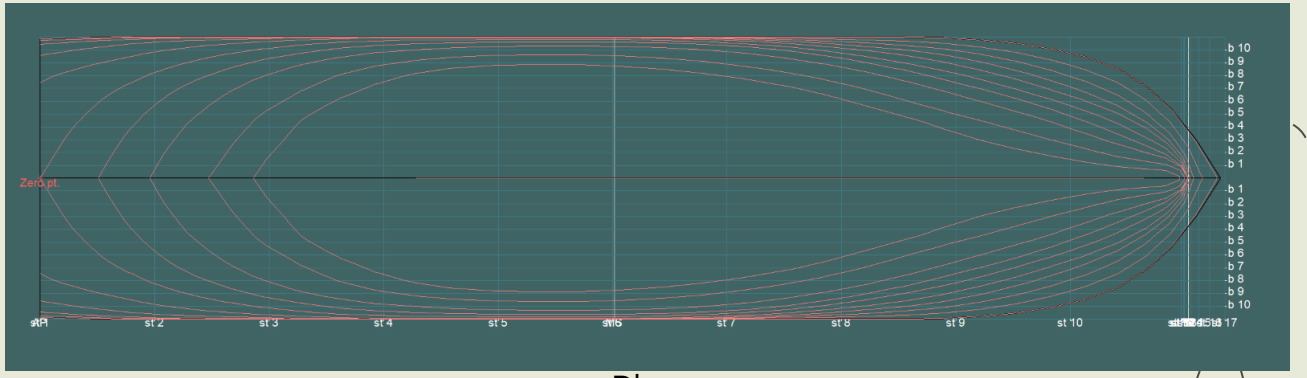
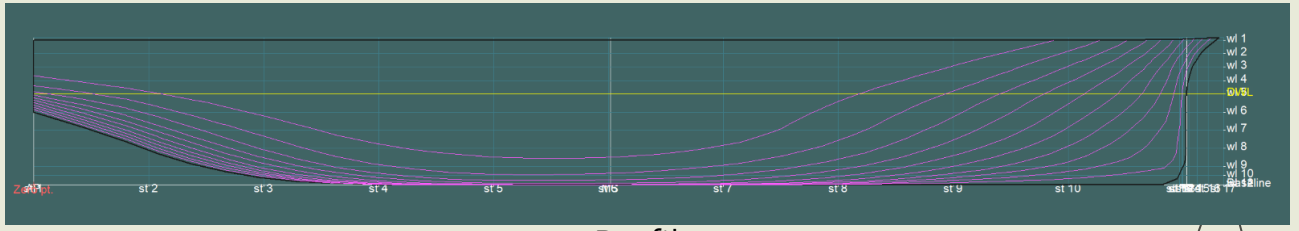
About hull design

- *Hull designed using the **MAXSURF**–software*

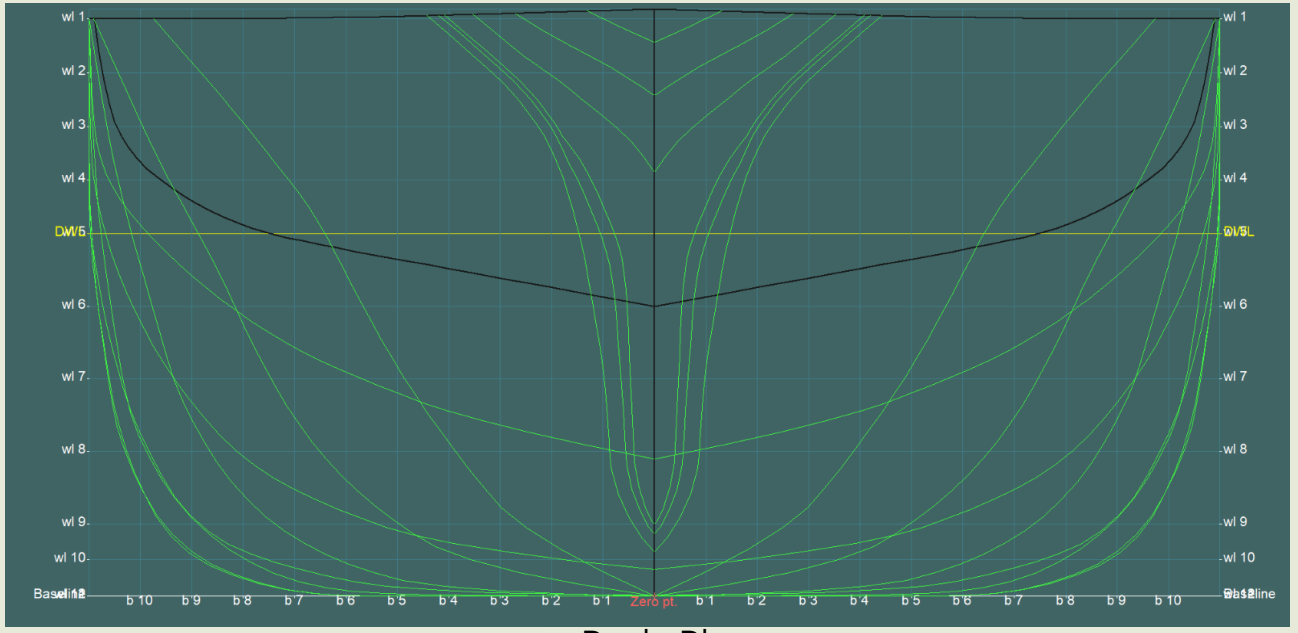
- ***Main considerations:***
  - *U-shaped hull for more **space under WL***
  - *Full cylindrical bow for **ice loads***
  - *Inclined sides (Ice class IB)*
  - *Transom stern, overall fairness*
  - *Skeg added **in next iteration***
    - *For aft shaft propeller*



Plan



Profile



Body Plan

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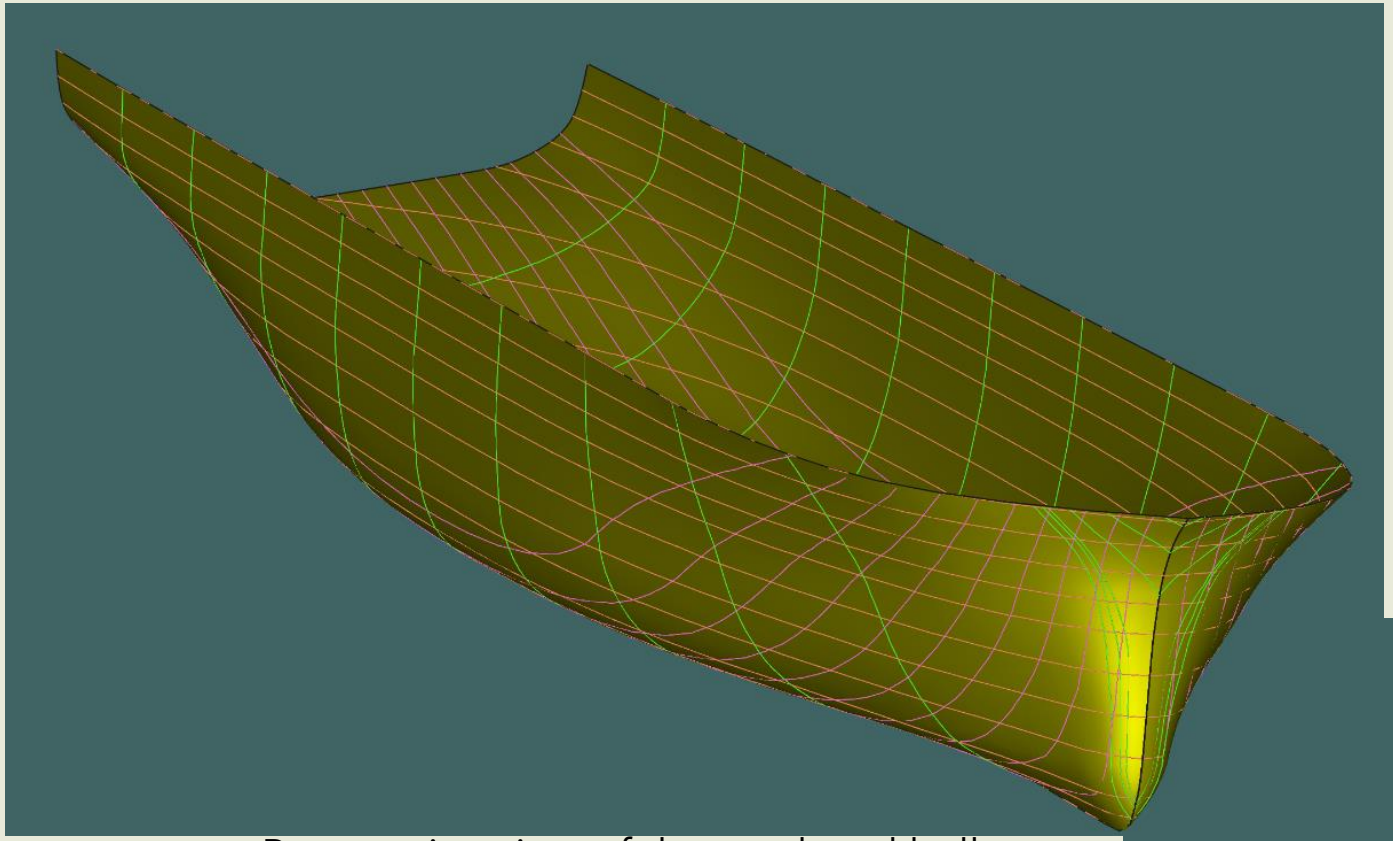
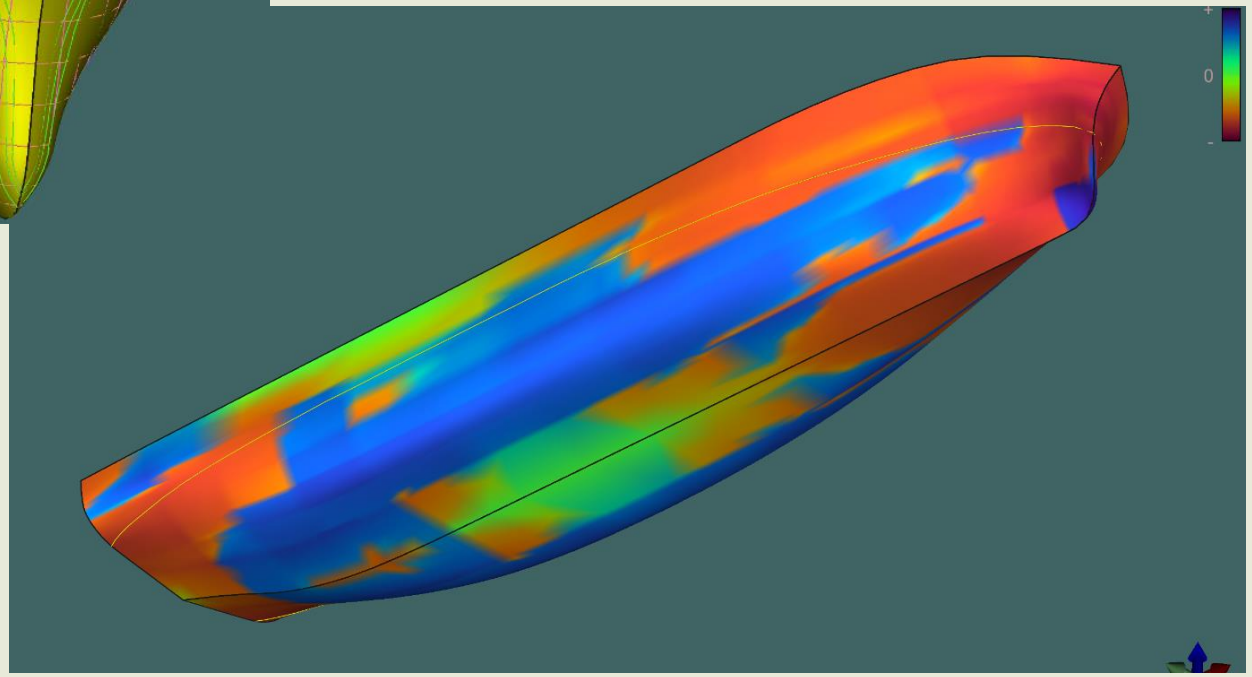
Hull design brought to life



Perspective view of the rendered hull



Gaussian curvature render of the hull – Improvements need to be made

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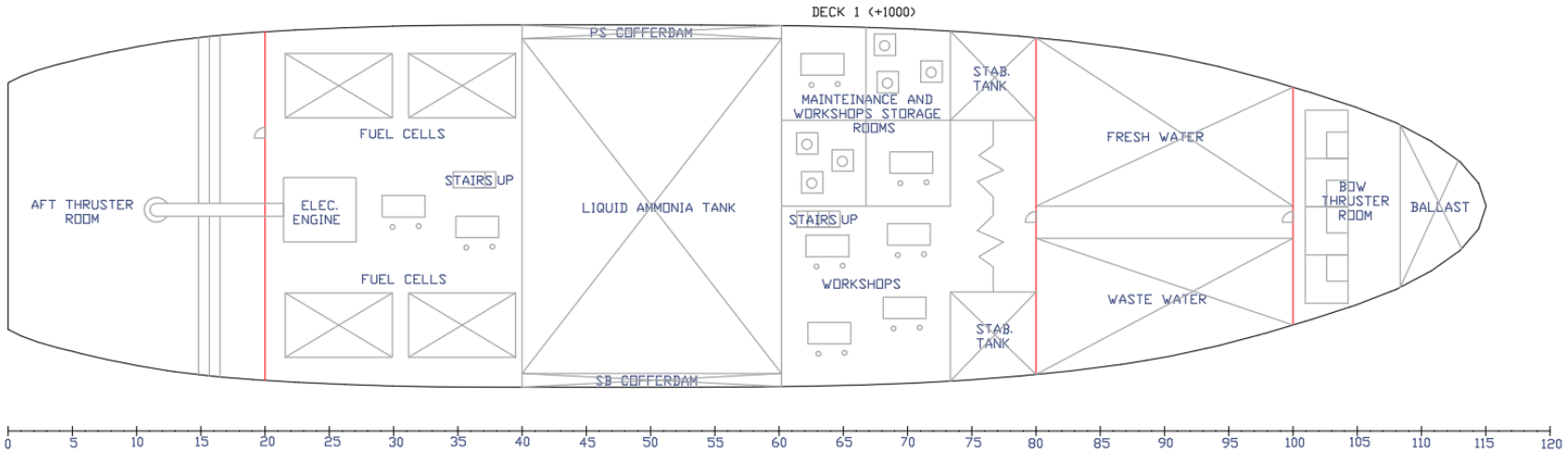
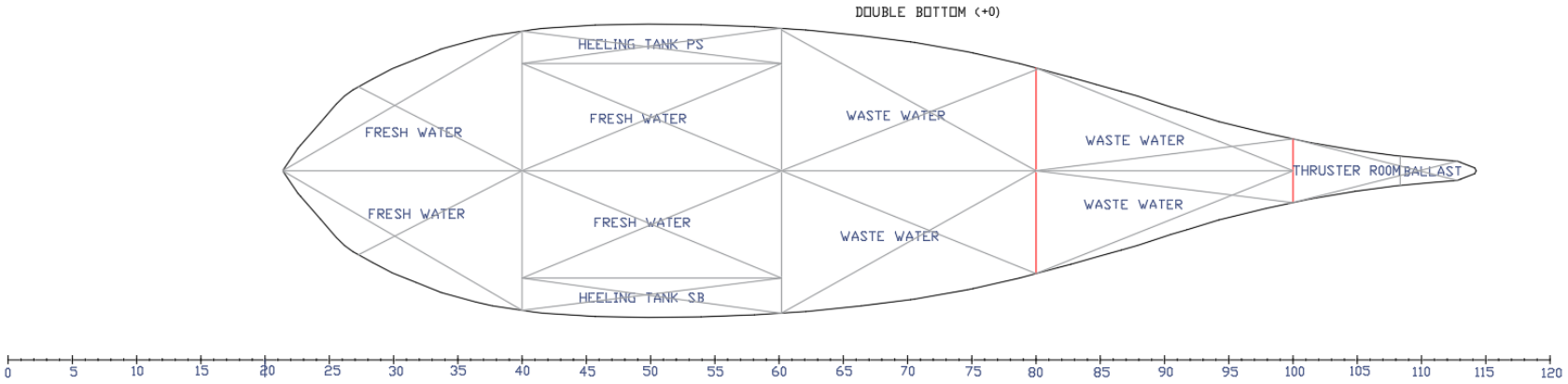
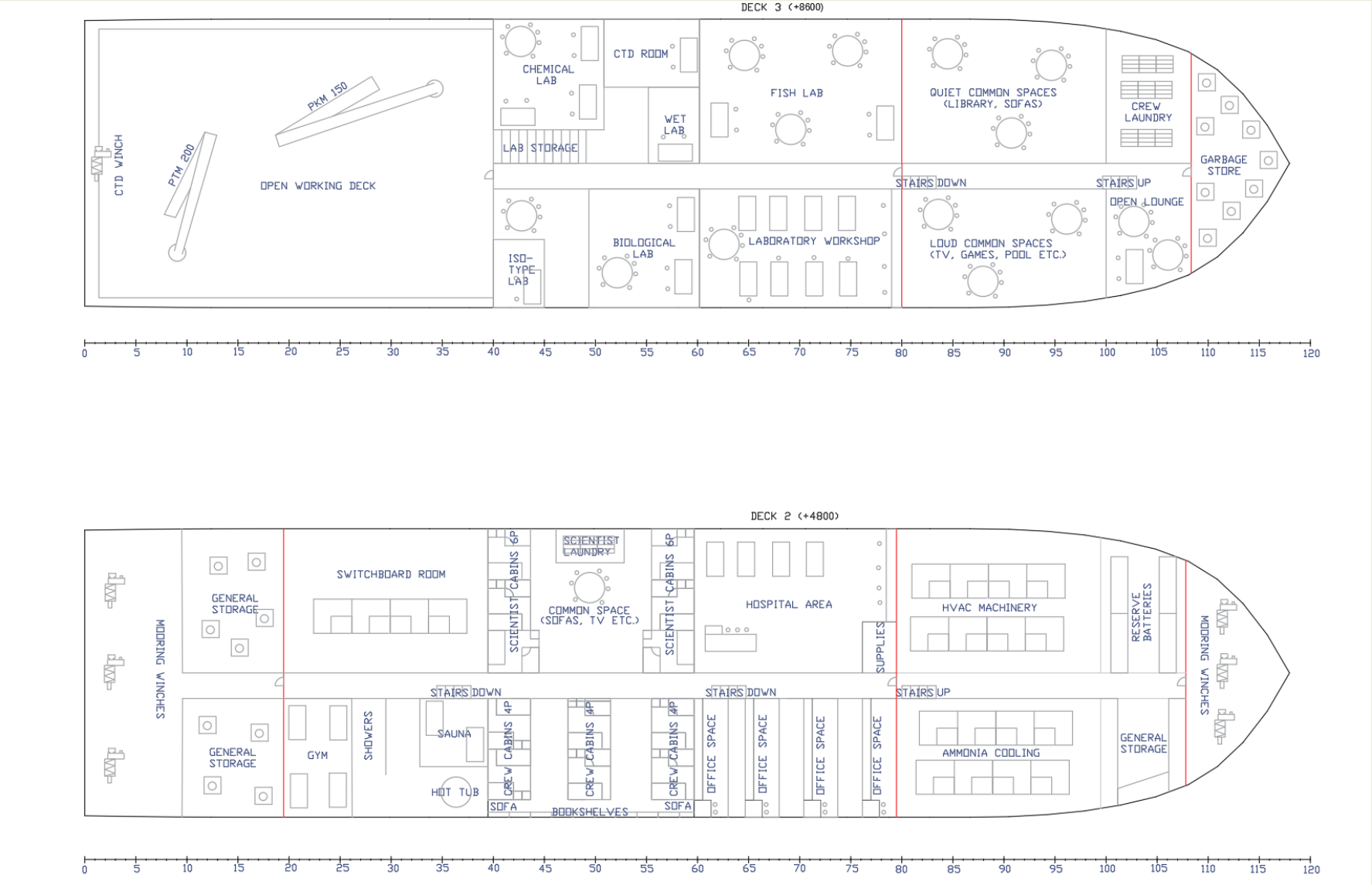
The General Arrangement





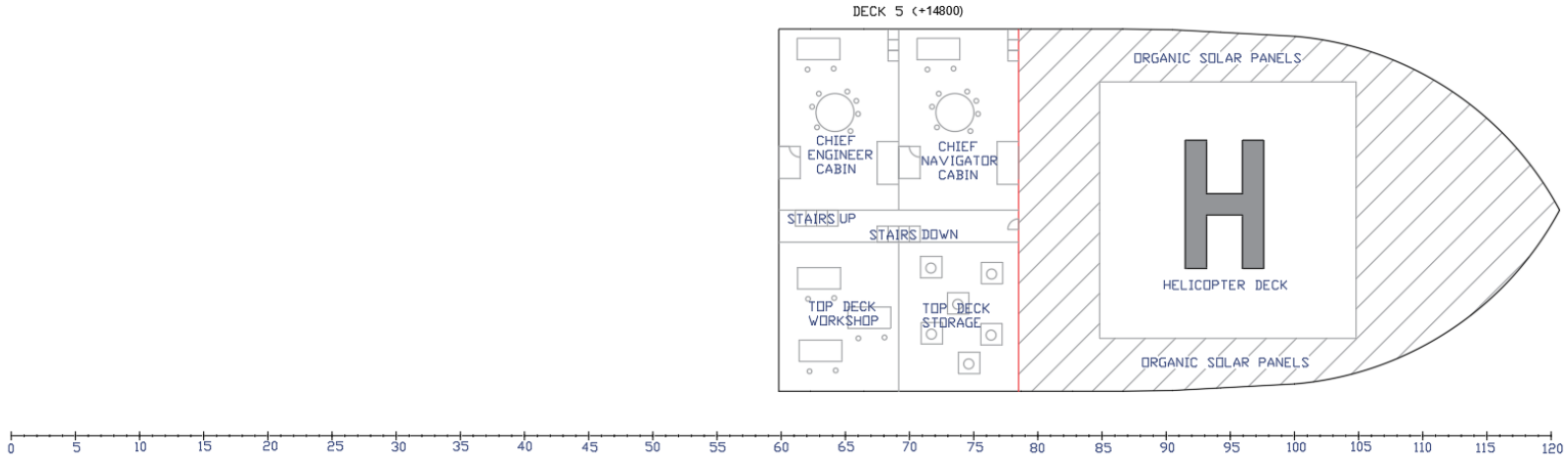
- *Deck 1 main parts include aft thruster room, ammonia tank and engine/fuel cell room*
- *Double bottom mostly fresh, waste, ballast and heeling water tanks*

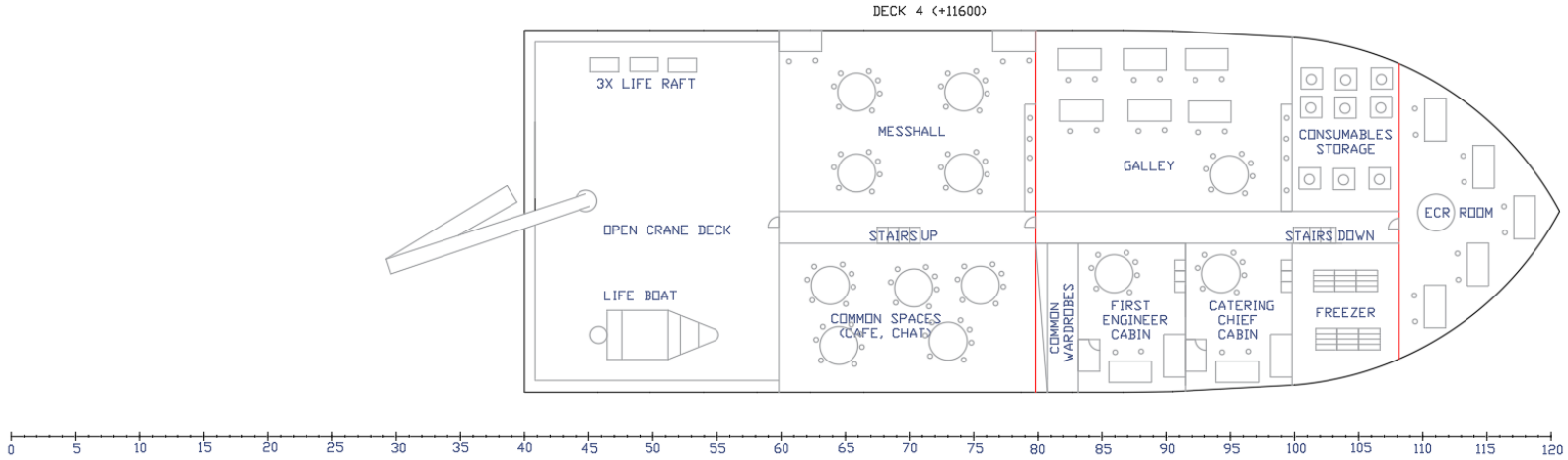
GA - Decks 2 and 3



- *Deck 3 has the open working deck, as well as the laboratory spaces and common spaces*
- *Deck 2 includes eg. HVAC and ammonia cooling, switchboard room and cabins*

GA – Decks 4 and 5

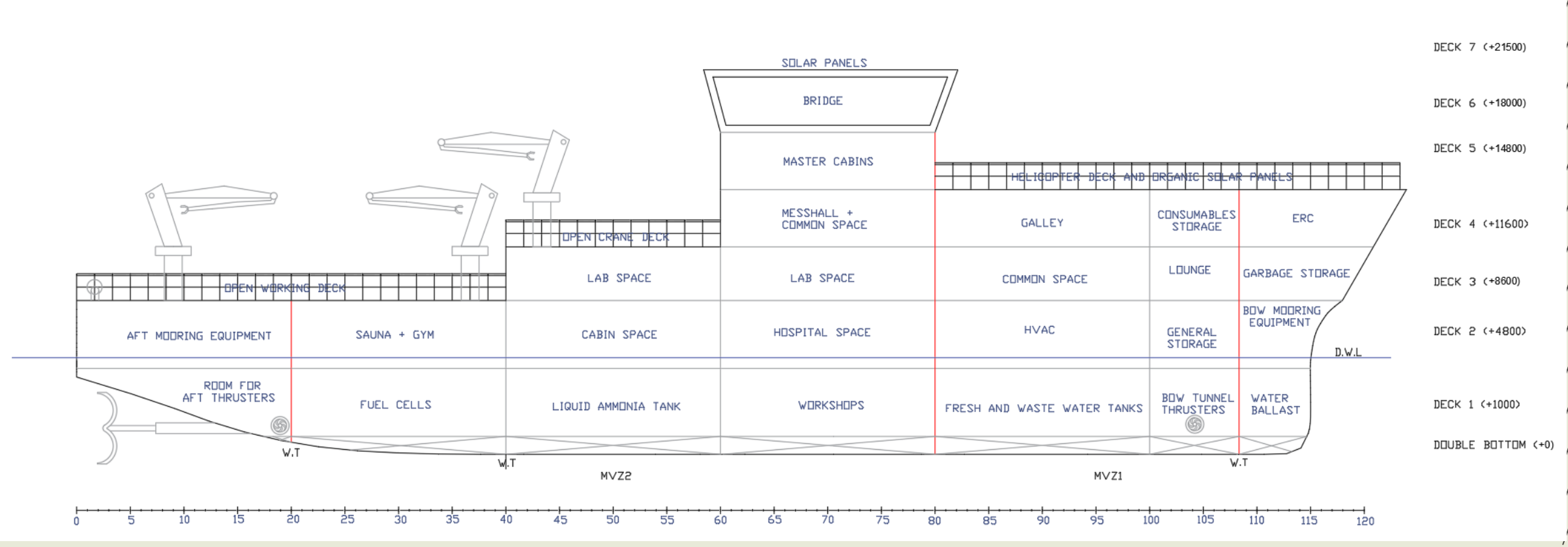




- *Deck 5 includes open helicopter deck with solar panels, as well as workshops and chief cabins*
- *Deck 4 has open crane deck, mess, galley and officer/chief cabins*

Additional GA considerations

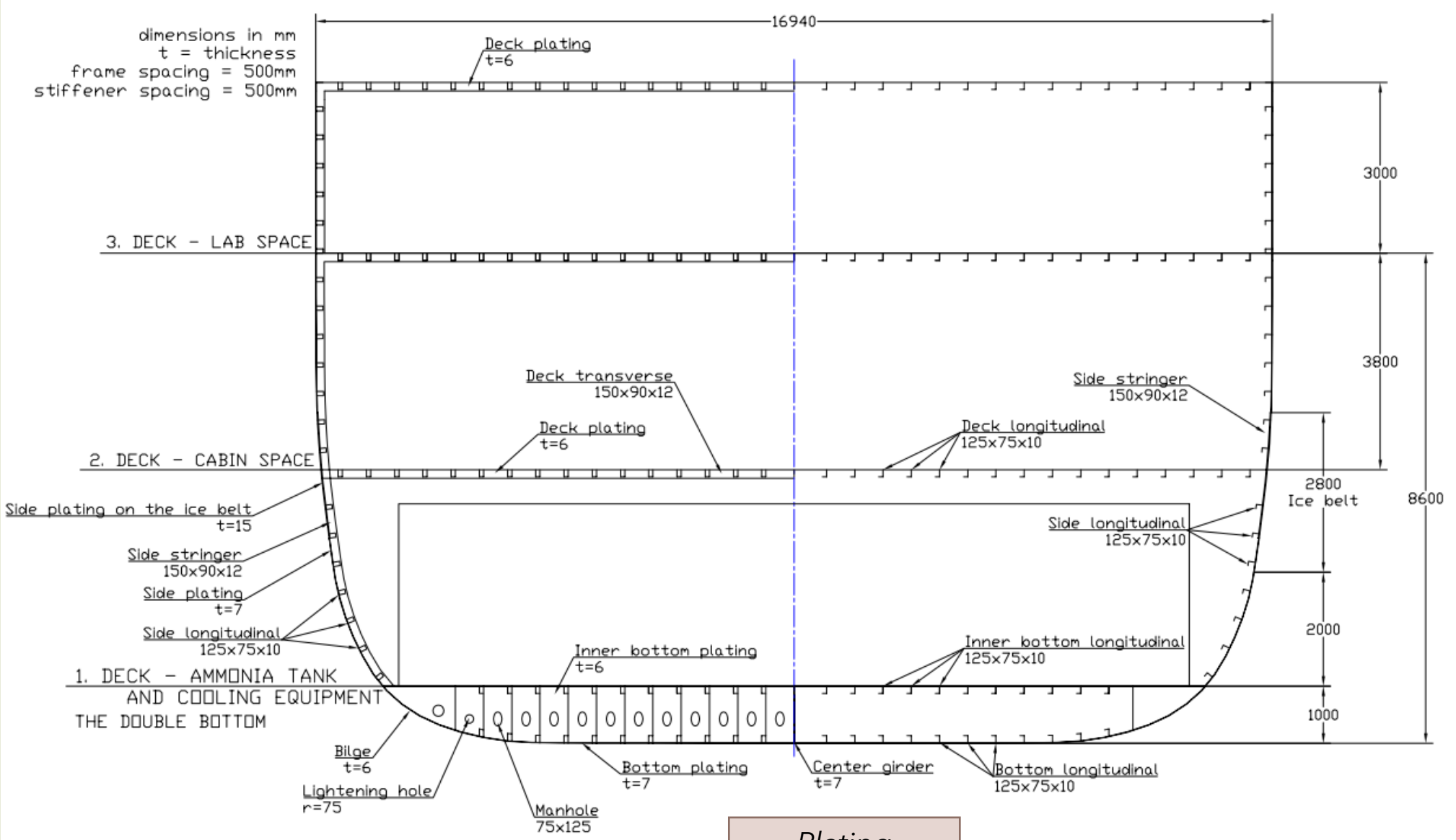
- *Main fire zones divided with red lines, DWL with blue line*
- *Collision bulkhead and aft bulkhead **W.T**, also bulkhead separating engine room*
- *Lab spaces **easily accessible from** working deck*
- ***Structural continuity, rationality of the arrangement!***



Cross section

Longitudinals
125x75x10

Deck transverse
150x90x12



Midship section

Plating

Bottom / Sides ***7 mm***

Decks / Inner bottom ***6 mm***

On the ice belt ***15 mm***

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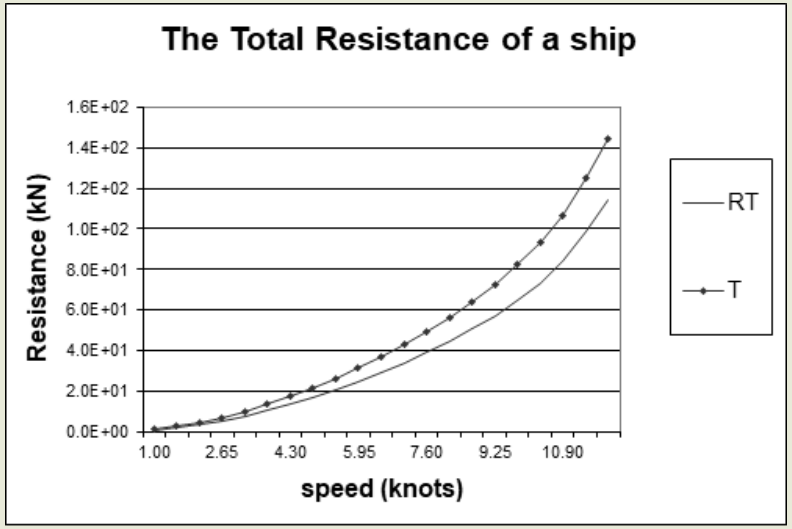
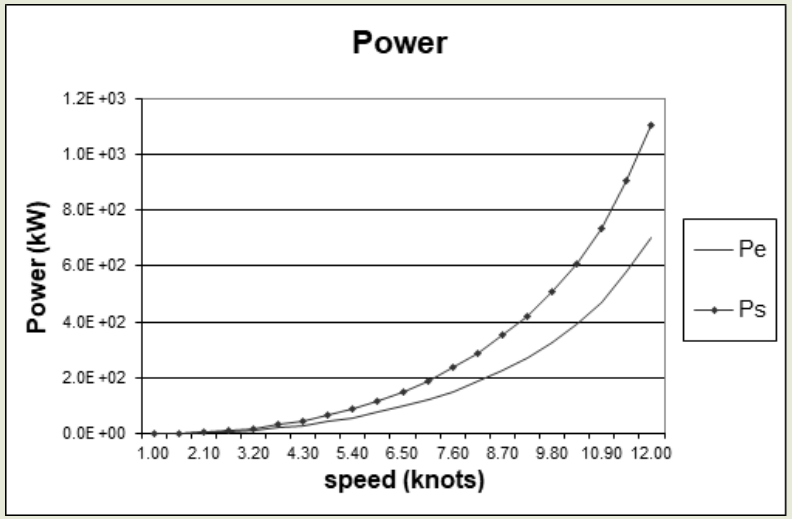
Power and Resistance

- *Cruising speed @* ***10.8 kn***
  - *Shaft power* ***705 kW***
  - *Resistance* ***81,5 kN***
- ***2050 kW*** *(Ice Class IB)*



Ship resistance as a function of speed



Required power as a function of speed

$$P_{min} = K_e \frac{(R_{CH}/1000)^{3/2}}{D_p} \text{ [kW]},$$

$$R_{CH} = C_1 + C_2 + C_3 C_\mu (H_F + H_M)^2 (B + C_\psi H_F) + C_4 L_{PAR} H_F^2 + C_5 \left(\frac{LT}{B^2}\right)^3 \frac{A_{wf}}{L},$$

TRAFICOM, Ice regulation text

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Energy Calculations

Sauna & Galley

Labs, PCs, Cooling Systems

Warm water

Space heating

Main propulsion

Ventilation System for Ammonia

Reserve

$$E_{total} = 5{,}72\ MWh + 18{,}72\ MWh + 1392\ kWh + 64{,}38\ MWh + 480\ MWh + 192\ MWh + 15MWh = \mathbf{777{,}2\ MWh}$$

$$E_{storage} = 777{,}2\ MWh \cdot \frac{1}{0{,}6} = \mathbf{1295\ MWh}$$

Efficiency of a SOFC system

$$V_{Ammonia} = 1295\ MWh \div 3{,}195\ \frac{MWh}{m^3} = \mathbf{405\ m^3}$$

$$m_{Ammonia} = 1295\ MWh \div 5{,}167\ \frac{MWh}{t} = \mathbf{250\ t}$$

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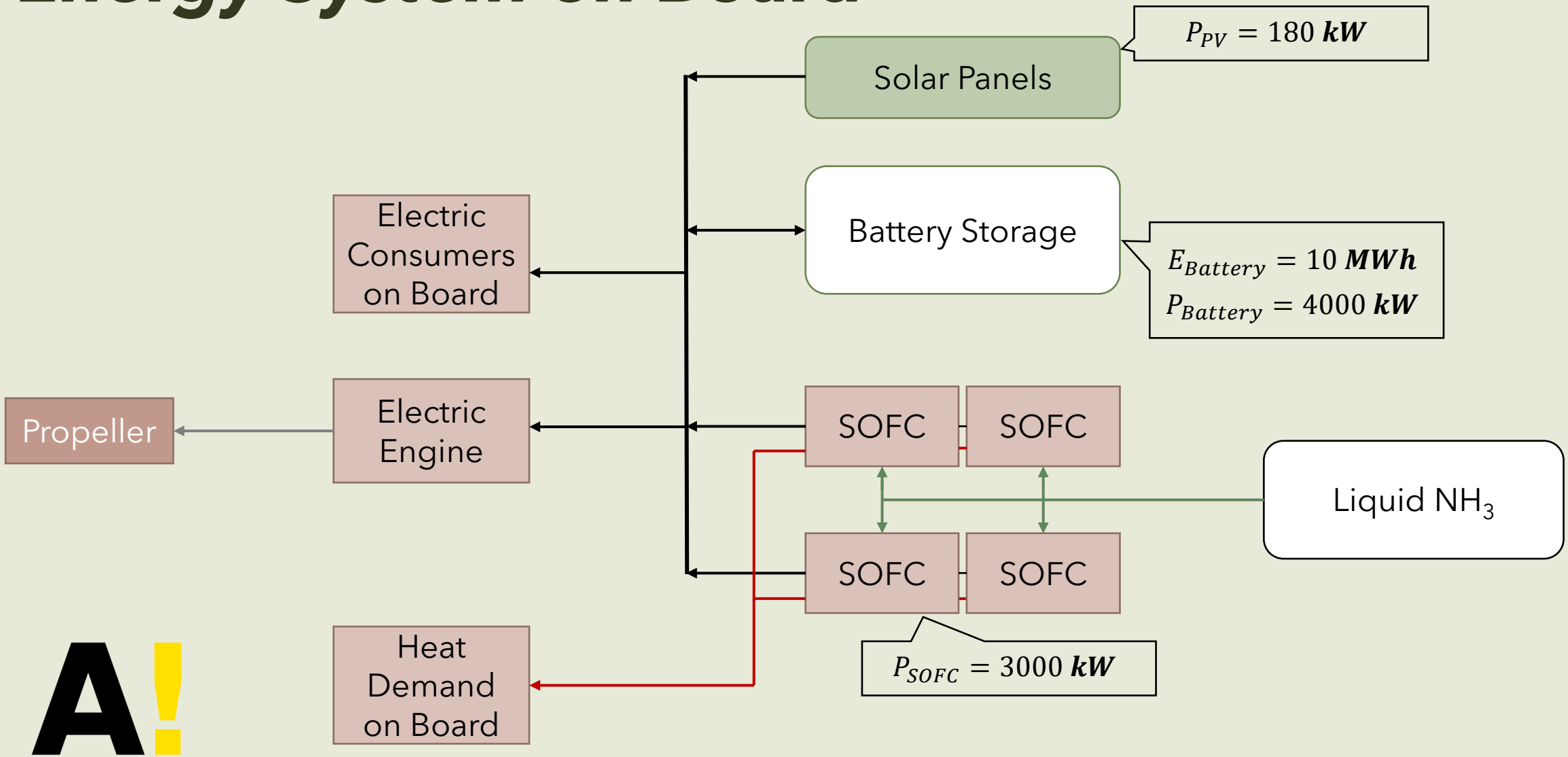
Source Efficiency: Bosch SOFC. (https://www.bosch-sofc.com/technology/how-it-works/)

Energy System on Board



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Economic assesment

- *Estimation of the coefficients C1 and C2*
  - *Based on Svea*
- *B is 0.8*

- *Operational costs around 31 000 €/day*
  - *Including all costs*

- *Other annual costs 470 000 €/year*

$$P = C_1(DWT)^B, P = C_2(W_E)^{0.87}$$

$$C_1 = \frac{38.7\ m€}{775t^{0.8}} = 0.189\ , C_2 = \frac{38.7m€}{3256.6t^{0.87}} = 0.034$$

$$P_1 = 0.189 * 831.55t^{0.8} = 40.96\ m€,$$

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About the next iterations

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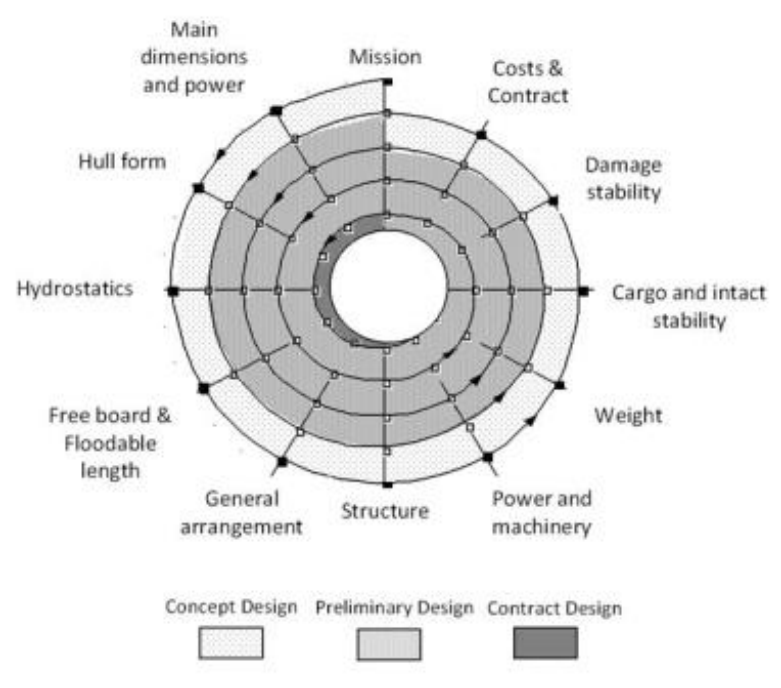

- *The vessels hull is too bulky, making reserve weight amounts too high*
- *Propeller, power generation and transmission should be discussed*
- *Possible extra plating thickness from ice classes needed*




THANK YOU!
Any questions?

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