

Kruunuvuori Electric Ferry

150 Fully Electric Passenger Ferry

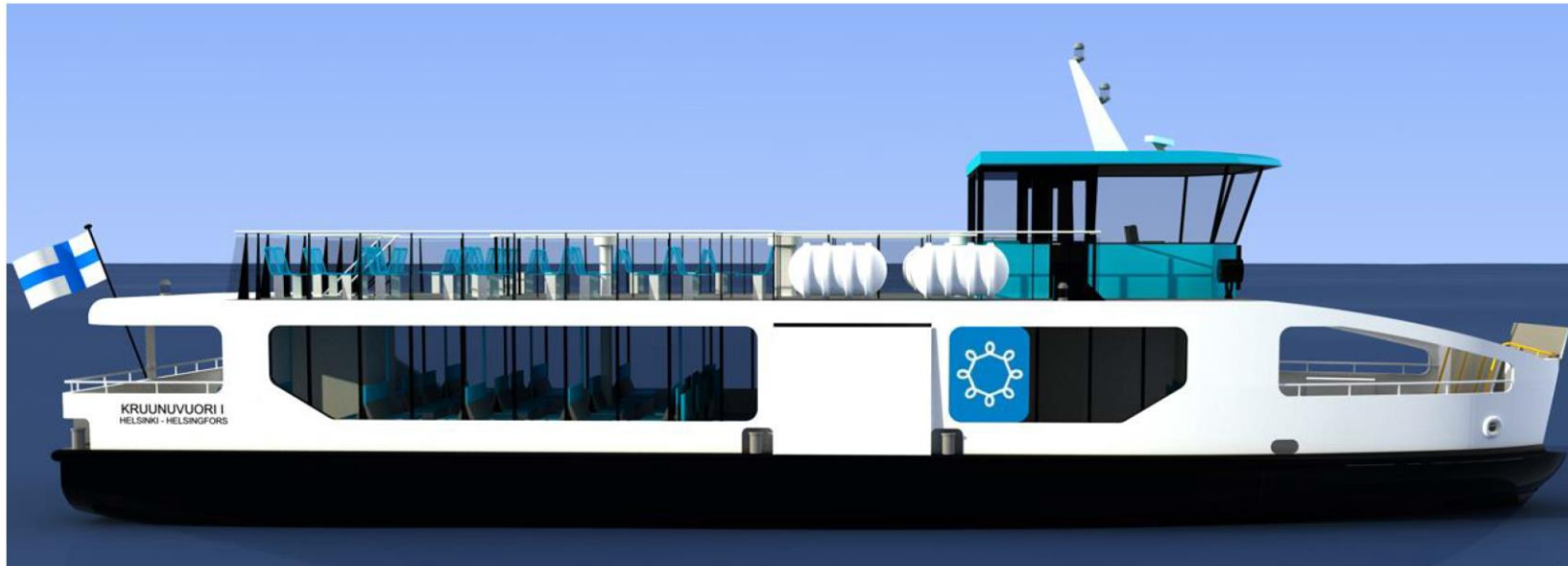
FS3664, February 22nd, 2022

FORESHIP
AT THE SHARP END





150 PASSENGER FULLY ELECTRIC FERRY



MAIN DIMENSIONS

Loa	24.90 m
Lpp	23.10 m
Beam mld.	7.20 m
Draught, Design	1.65 m
Draught, Subdivision	1.75 m
Air Draught, about	6.70 m
Gross Tonnage, about	170
Deadweight, Design	20 t
Max. persons (LSA)	155

PASSENGER CAPACITY

Indoor Seats (fixed + jump seats)	68 + 31
Outdoor Seats	50
Bicycles Indoors	17
Total Bicycles	27
Wheelchairs, up to	8
Baby strollers, up to	10

SAFETY FEATURES

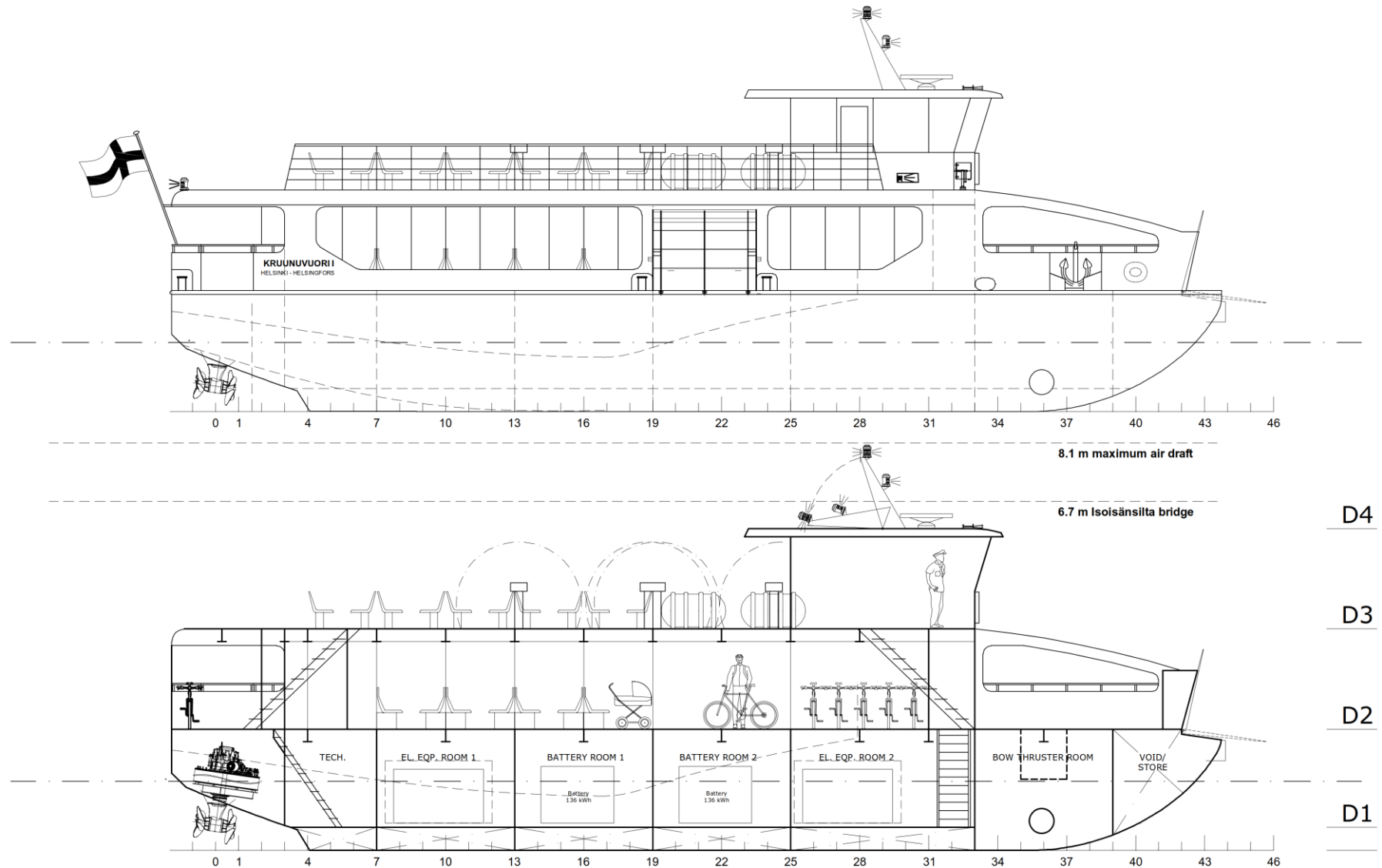
1-compartment damage stability
 Redundant machinery against loss of 1 compartment

TECHNICAL

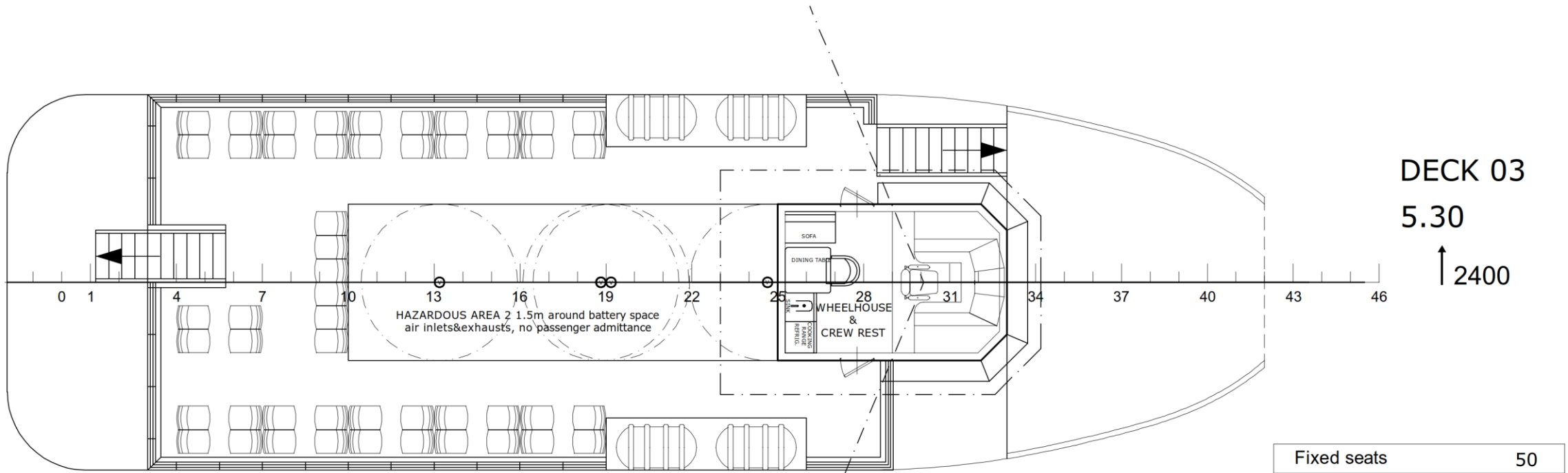
Propulsion Motors	2 x 200 kW
Bow Thrusters	1 x 50 kW
Trial Speed	10.0 knots
Service Speed	8.0 knots
Level Ice Performance	5.0 kn @ 0.2 m ice
Brash Ice Performance	8.0 kn @ 0.4 m brash ice
Battery capacity	544 kWh
Rafts	162 p. + spares
Ice Class	1B (Hull only)

General Arrangement

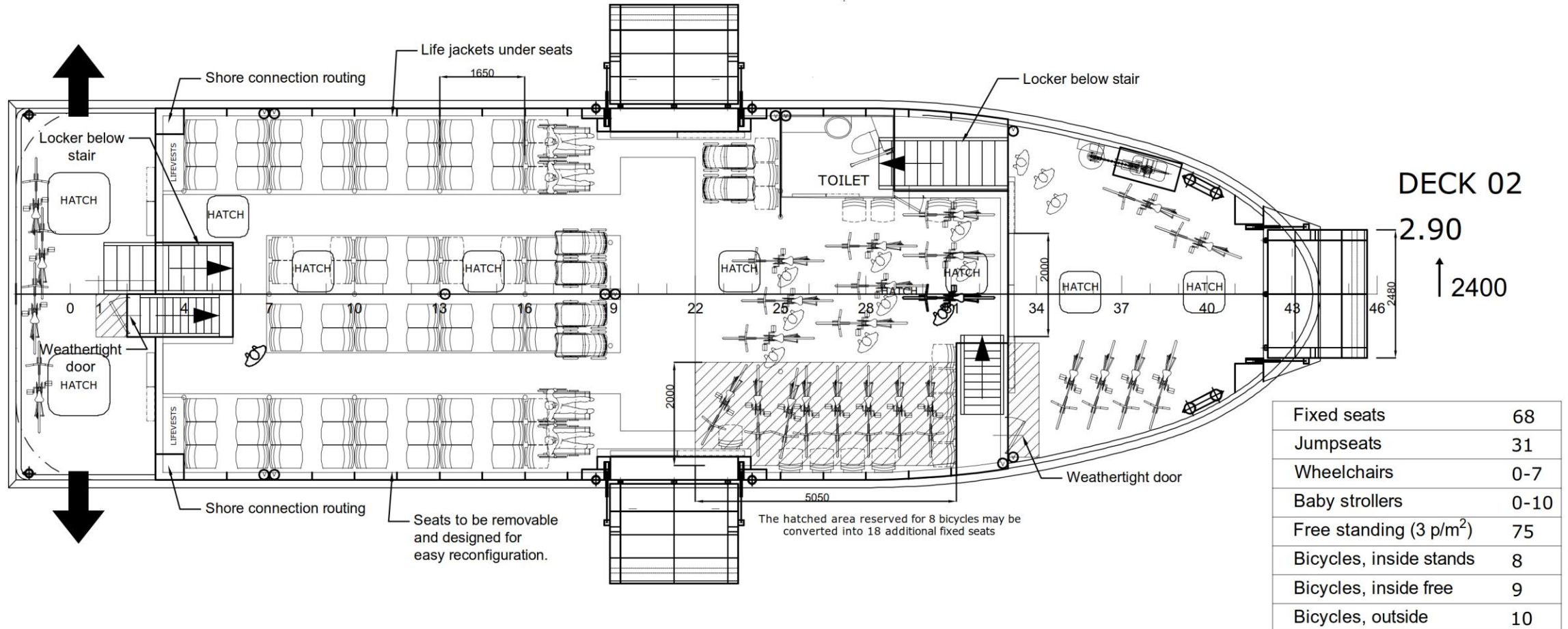
GA: Profile



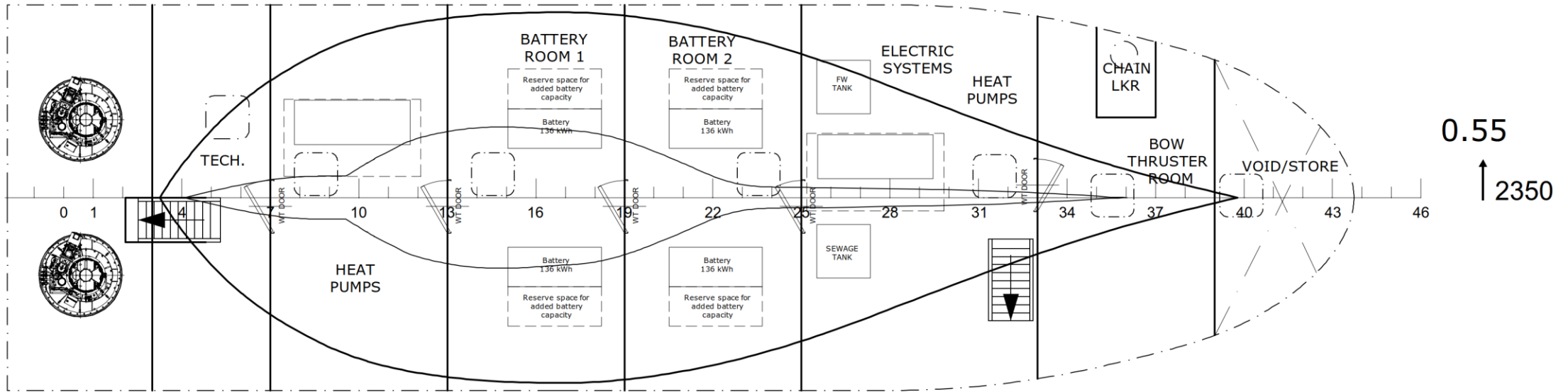
GA: Upper Deck



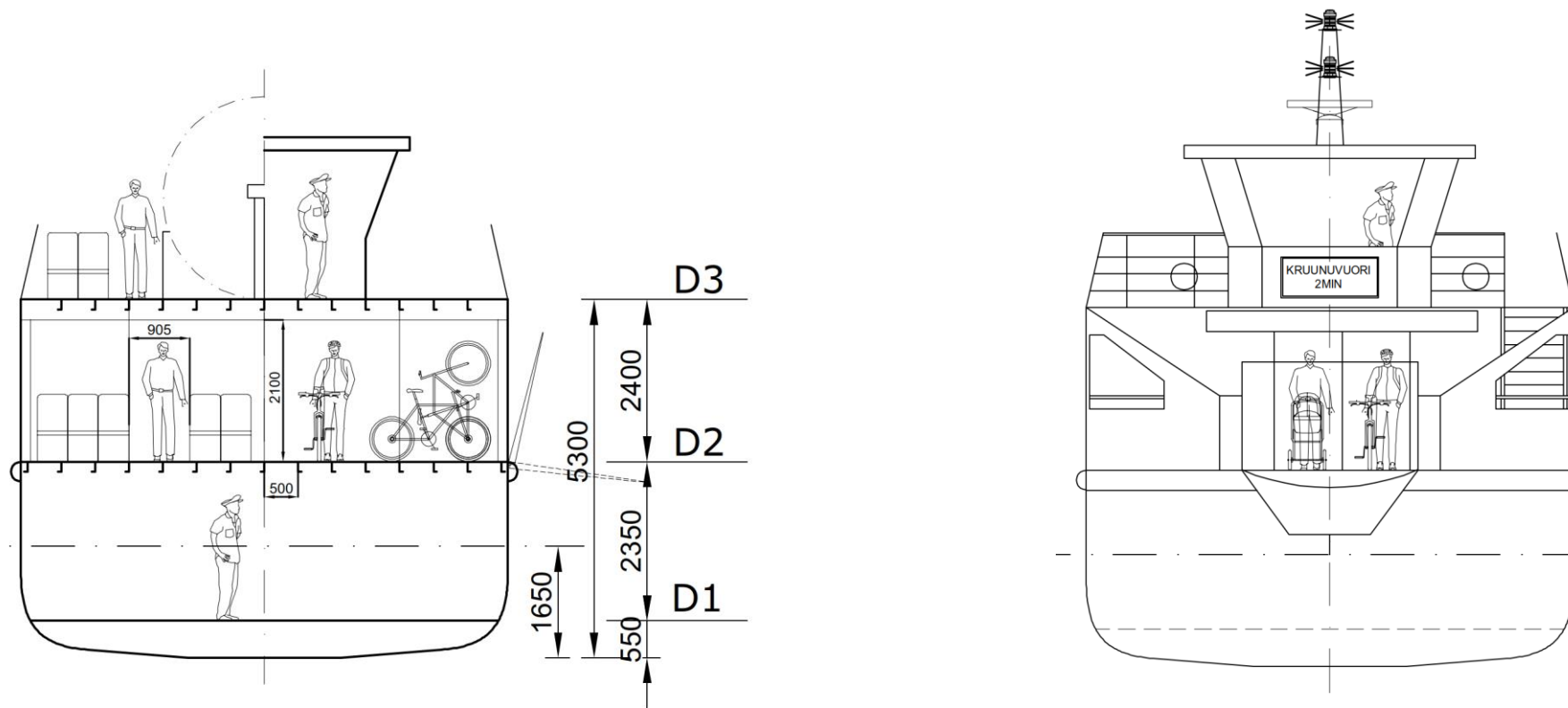
GA: Main Deck



GA: Machinery Area



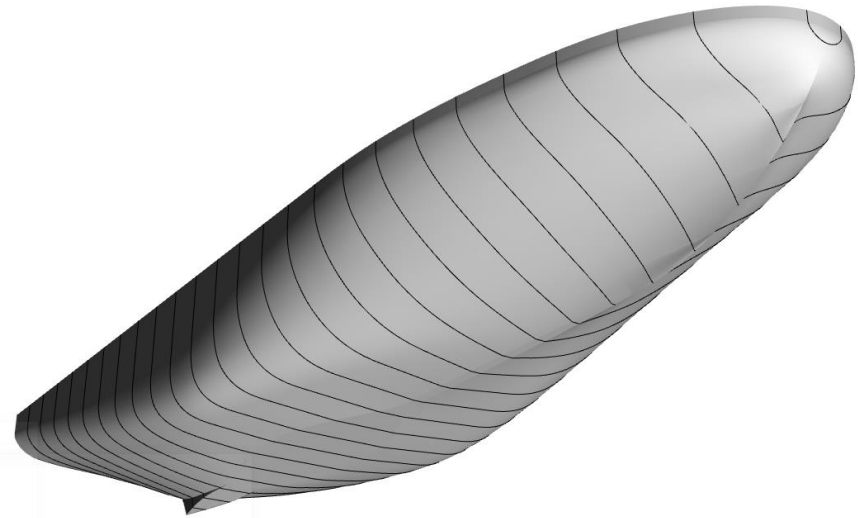
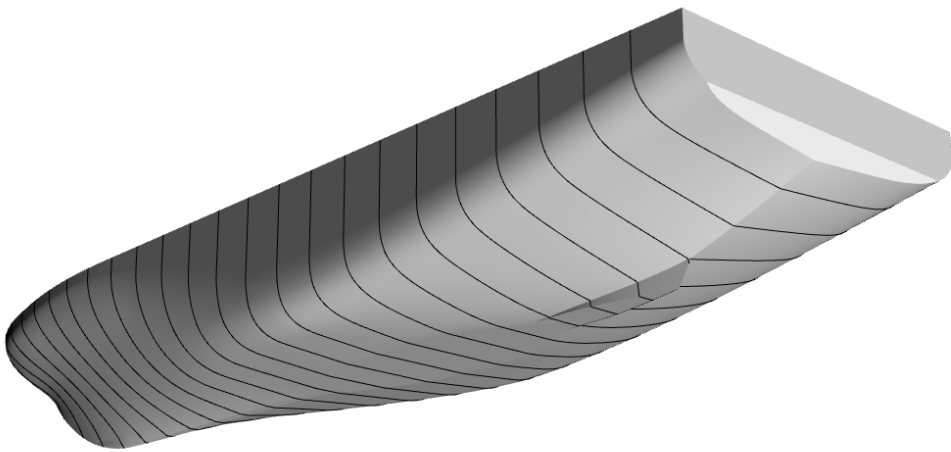
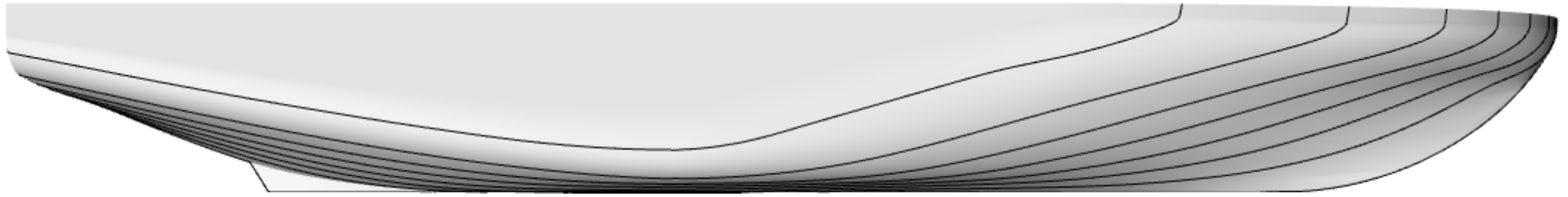
GA: Cross Section



Ship Theory & Calculations

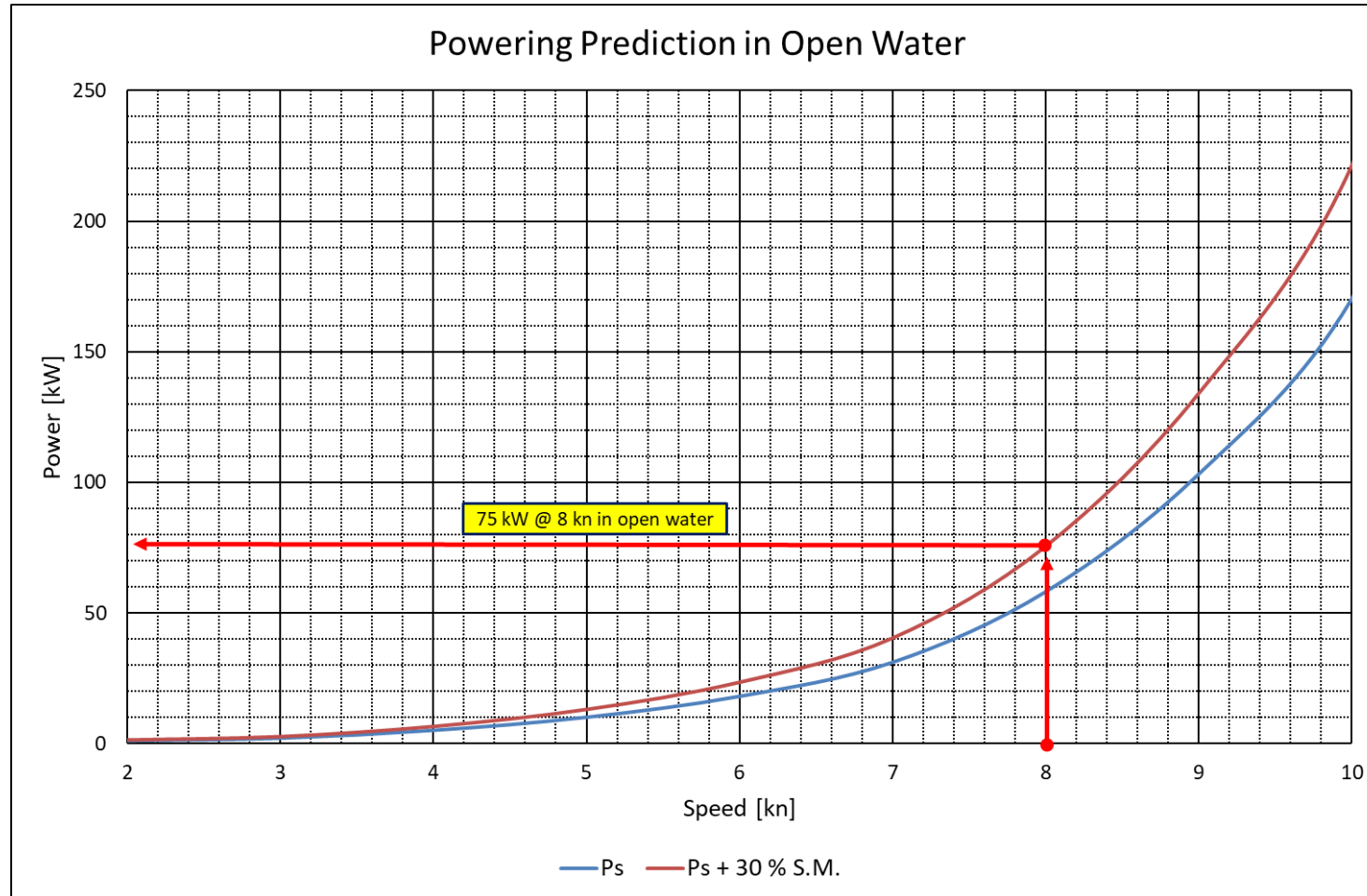
Hull Form

- Hull lines optimized for manoeuvring in ice, both forward and astern, as well as turning in ice.



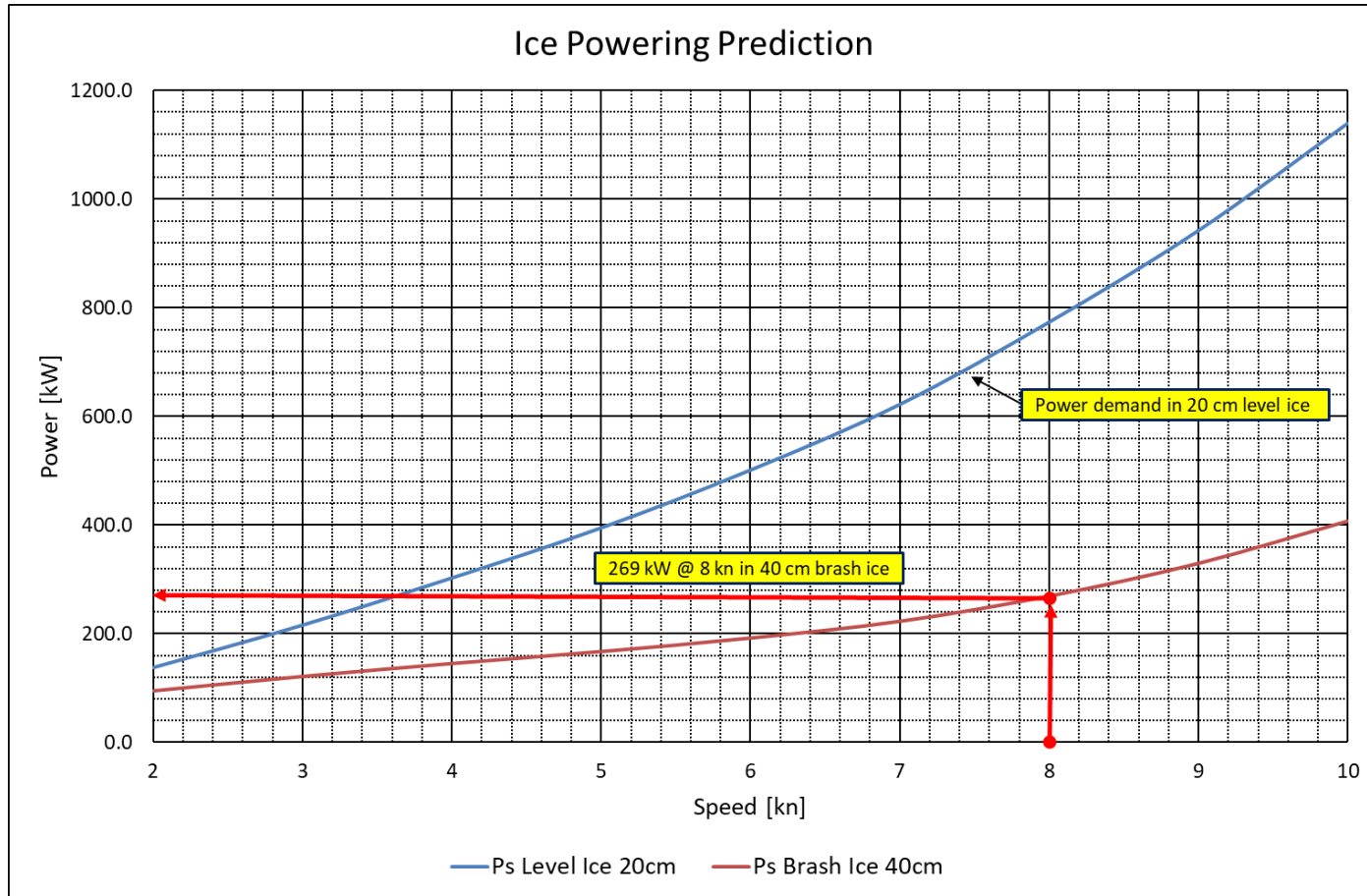
Speed-Power Prediction – Open Water

- Propulsion power prediction at 8 kn service speed in open water is 75 kW, incl. 30 % sea margin.
- Prediction is based on QPROP – a MARIN Software.



Speed-Power Prediction – Ice Conditions

- Propulsion power at 8 kn in 40 cm brash ice condition is 269 kW.
- Propulsion power at 5 kn in 20 cm level ice condition is 400 kW.
- Predictions are based on Traficom formulas.

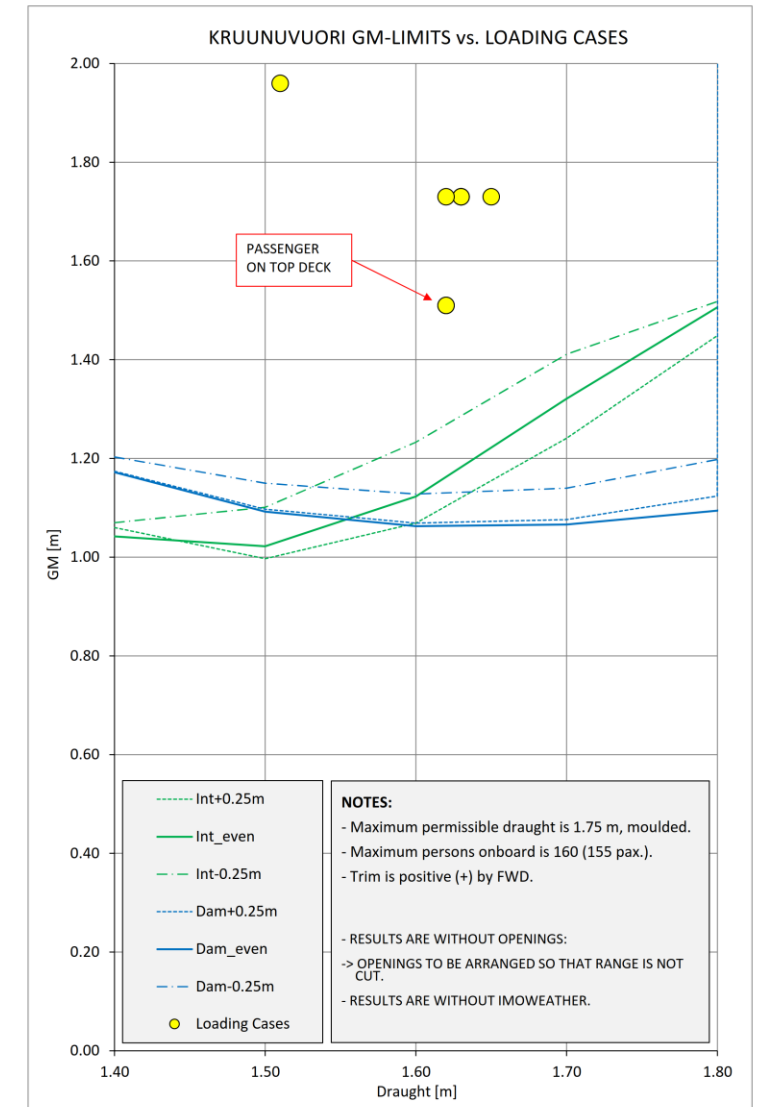


Weight and Stability

- Estimated lightweight is 145.1 t (all steel construction).
- Deadweight is 20 t.
- Damage stability is calculated for 1-compartment damages, acc. to EU non-SOLAS directive cat. D vessel.
- GM in loading conditions is 1.5-1.8 m while loaded, 2.0m when empty.

Lightweight	W [t]	XCG [m]	ZCG [m]
Structures (steel)	83.4	10.64	2.10
Deck outfitting	2.0	10.00	3.60
Accommodation	4.8	8.90	3.90
Wheelhouse outfitting	1.0	16.60	6.30
HVAC, waste, firepr.	1.0	9.60	3.00
Machinery + Batteries	17.0	7.50	1.50
Aux. Systems	3.0	15.00	1.50
liquids in pipes & systems	0.1	10.00	1.50
Electrical	4.0	10.10	2.40
Miscellaneous	13.0	9.00	3.50
Margin (12 %)	15.9	9.68	3.50
TOTAL	145.1	10.07	2.42

Deadweight	W [t]
Lubrication Oil	0.2
Potable Water	1.7
Treated Waste Water / Waste Water	1.5
Ballast Water	0.0
Provision stores	0.1
Deck stores	0.4
Miscellaneous Tanks and Stores	0.7
Passengers w/luggage	15.0
Bicycles	0.2
Crew	0.2
TOTAL	20.0



Harbor Manoeuvring

- Station keeping under wind conditions are calculated for steady wind.
- 50 kW bow thruster is adequate for 12 m/s steady wind from any direction.

Basic Information

Ship Name: Comment: Loa: m Lpp: m use [kN] use [t]

Main Propellers

Propeller Diameter: m

Maneuvering Power: kW

Shaftline from CL: m

Side thrust Percentage: %

Propeller Type: CPP FPP Pod

Wind Areas

Af (frontal area): m²

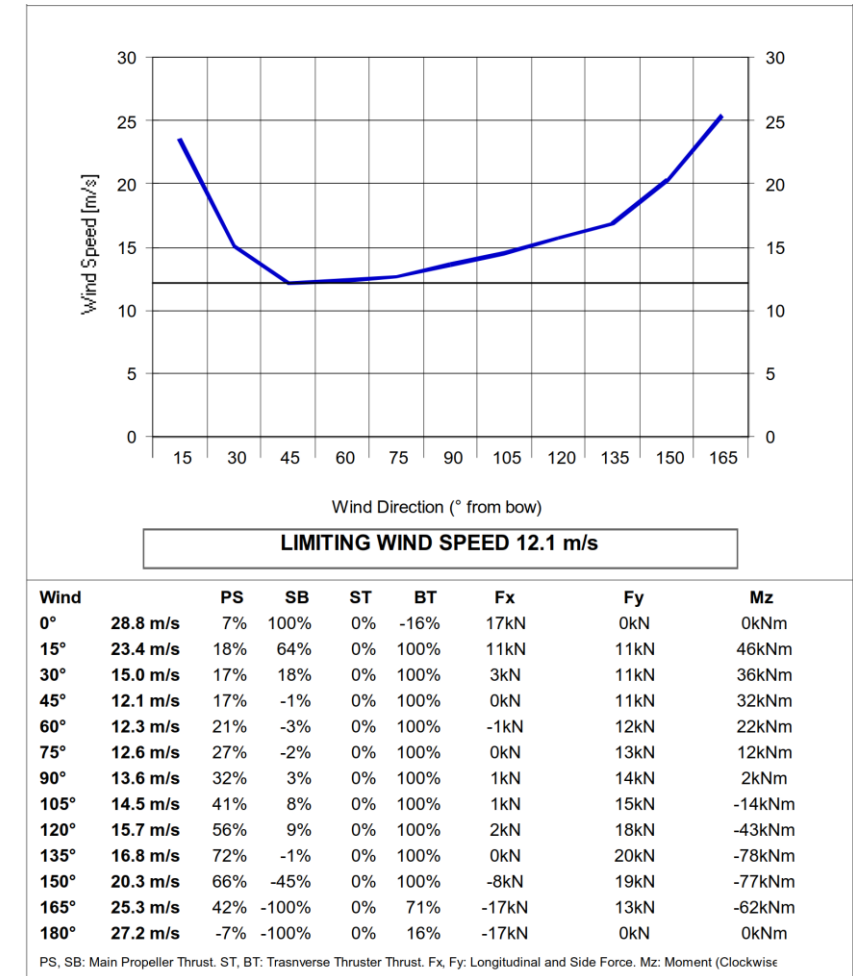
As (lateral area): m²

Number and Location of Transverse Thrusters (stern thr. on left, bow thr. on right)

<input type="checkbox"/>	<input type="text" value="13"/>	m from #0	<input checked="" type="checkbox"/>	<input type="text" value="19.7"/>	m from #0
<input type="checkbox"/>	<input type="text" value="15.6"/>	m from #0	<input type="checkbox"/>	<input type="text" value="174"/>	m from #0
<input type="checkbox"/>	<input type="text" value="20.9"/>	m from #0	<input type="checkbox"/>	<input type="text" value="170"/>	m from #0
<input type="checkbox"/>	<input type="text" value=""/>	m from #0	<input type="checkbox"/>	<input type="text" value="310.4"/>	m from #0

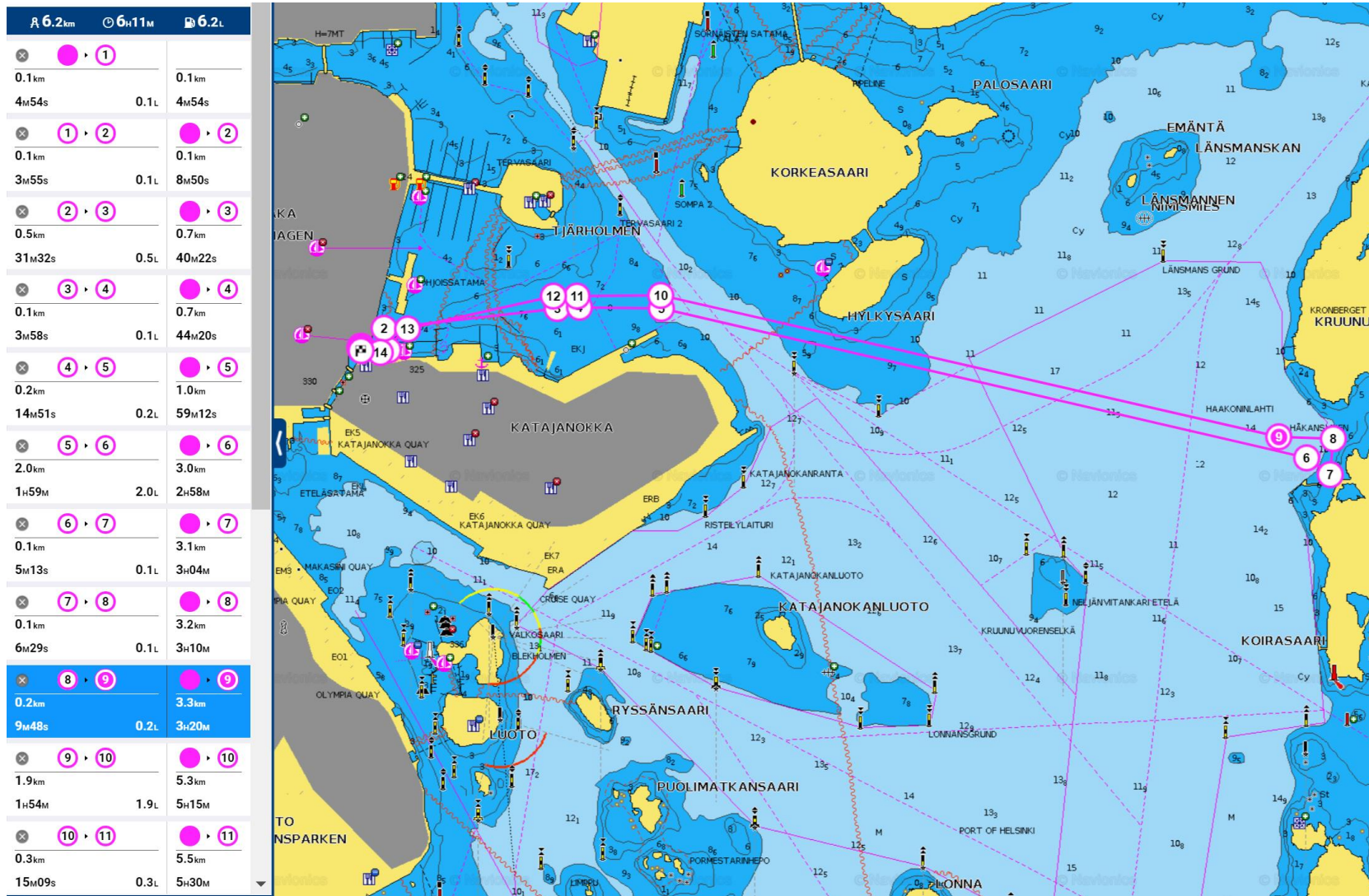
Thrust of Transverse Thrusters (stern thr. on left, bow thr. on right)

Diameter	<input type="text" value="1.75"/>	m	<input checked="" type="radio"/> Calculate Thrust for CPP	Diameter	<input type="text" value="0.45"/>	m
Power	<input type="text" value="900"/>	kW	<input type="radio"/> Calculate Thrust for FPP	Power	<input type="text" value="50"/>	kW
Thrust	<input type="text" value="131"/>	kN	<input type="radio"/> Enter Thrust	Thrust	<input type="text" value="8"/>	kN

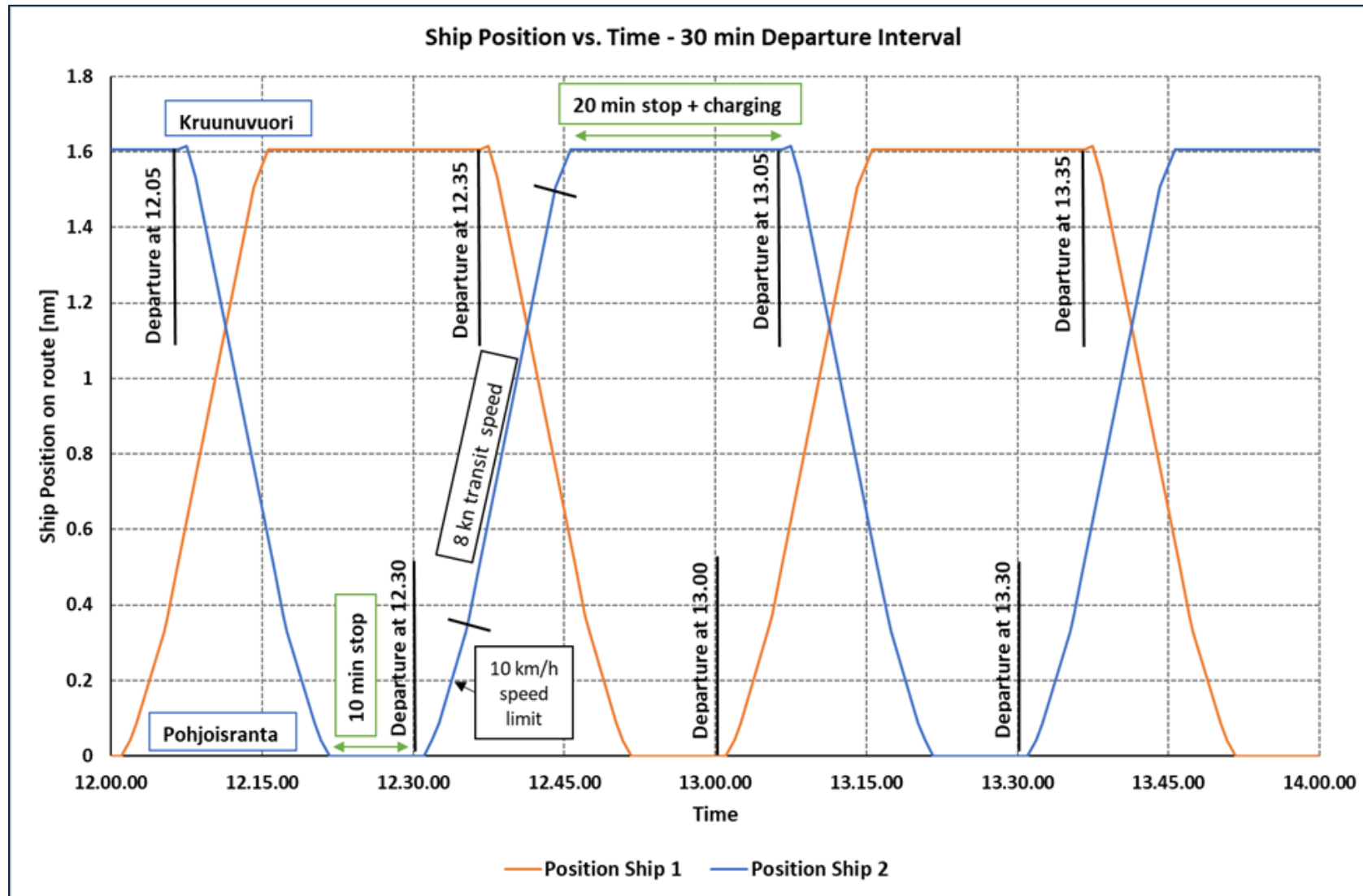


Route Planning & Battery Capacity

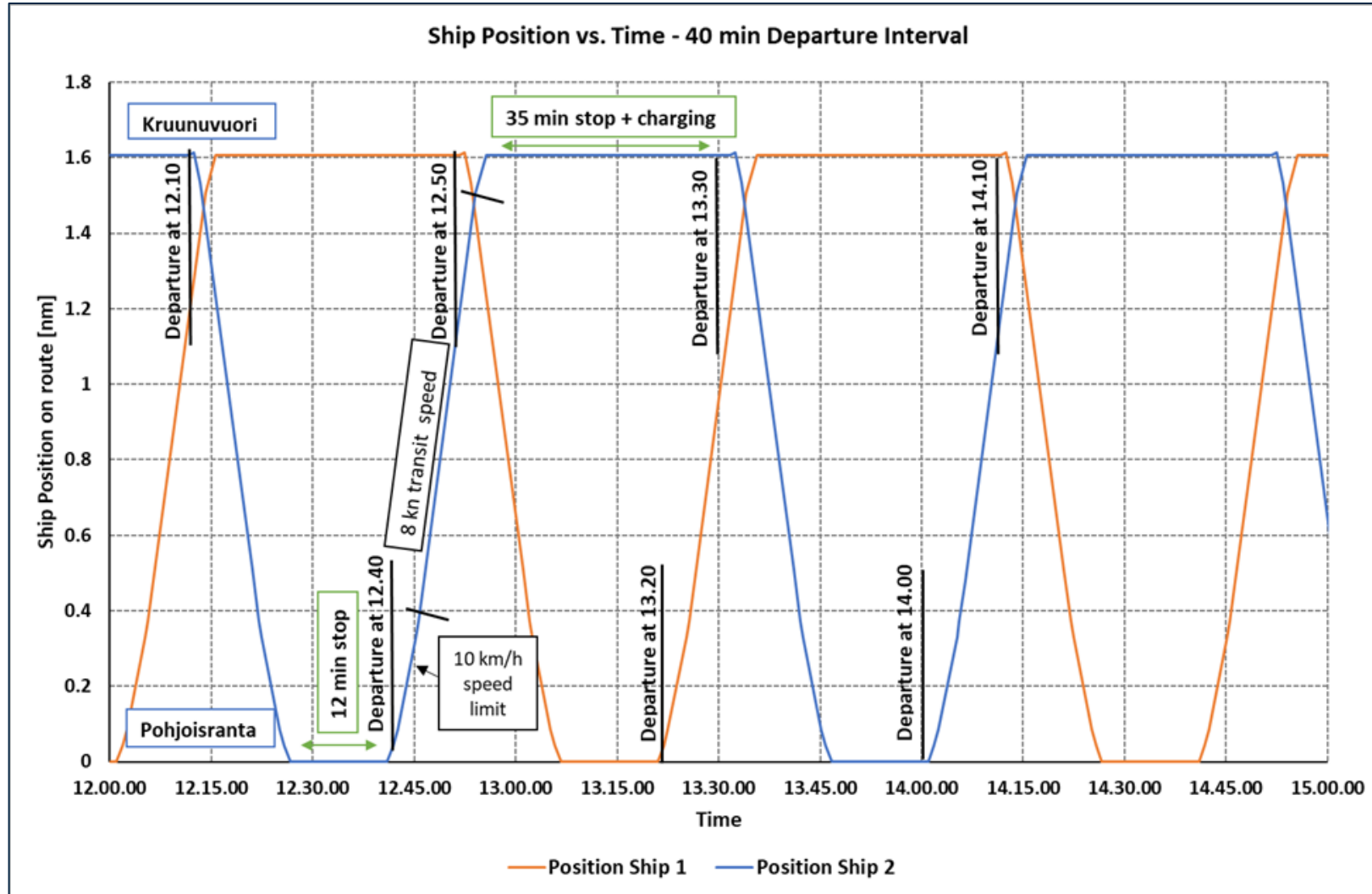
Route Calculation



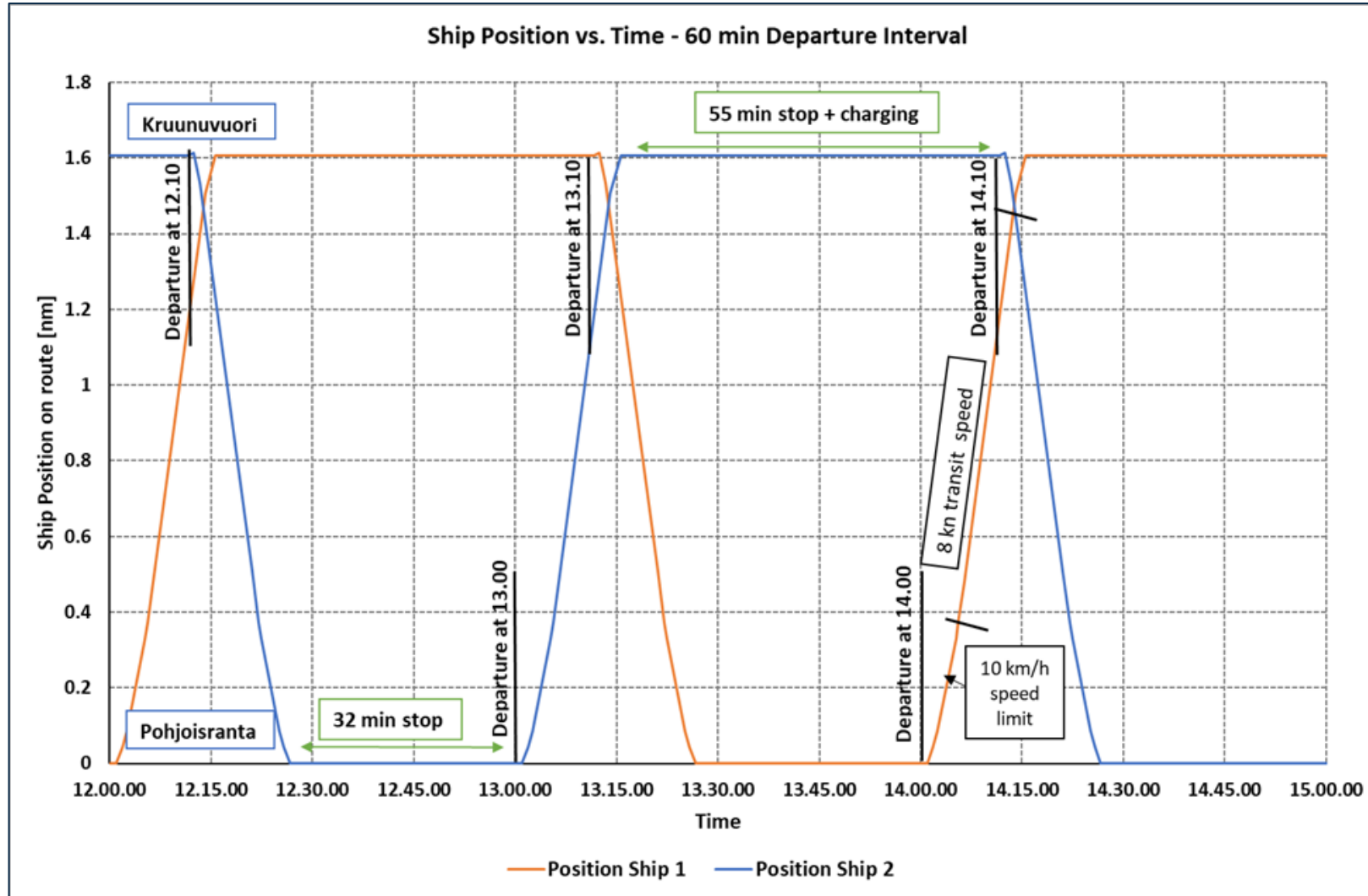
30 min Schedule



40 min Schedule (Ice Conditions)



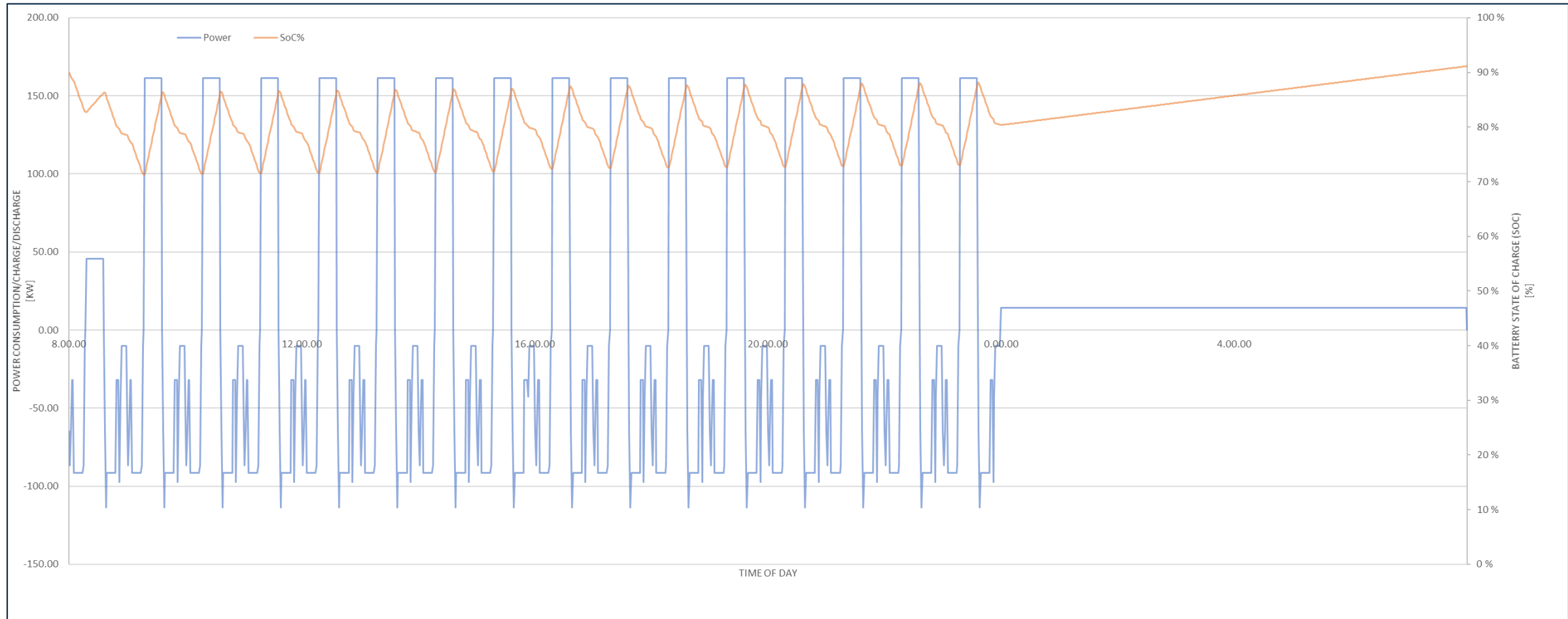
60 min Schedule (Ice Conditions)



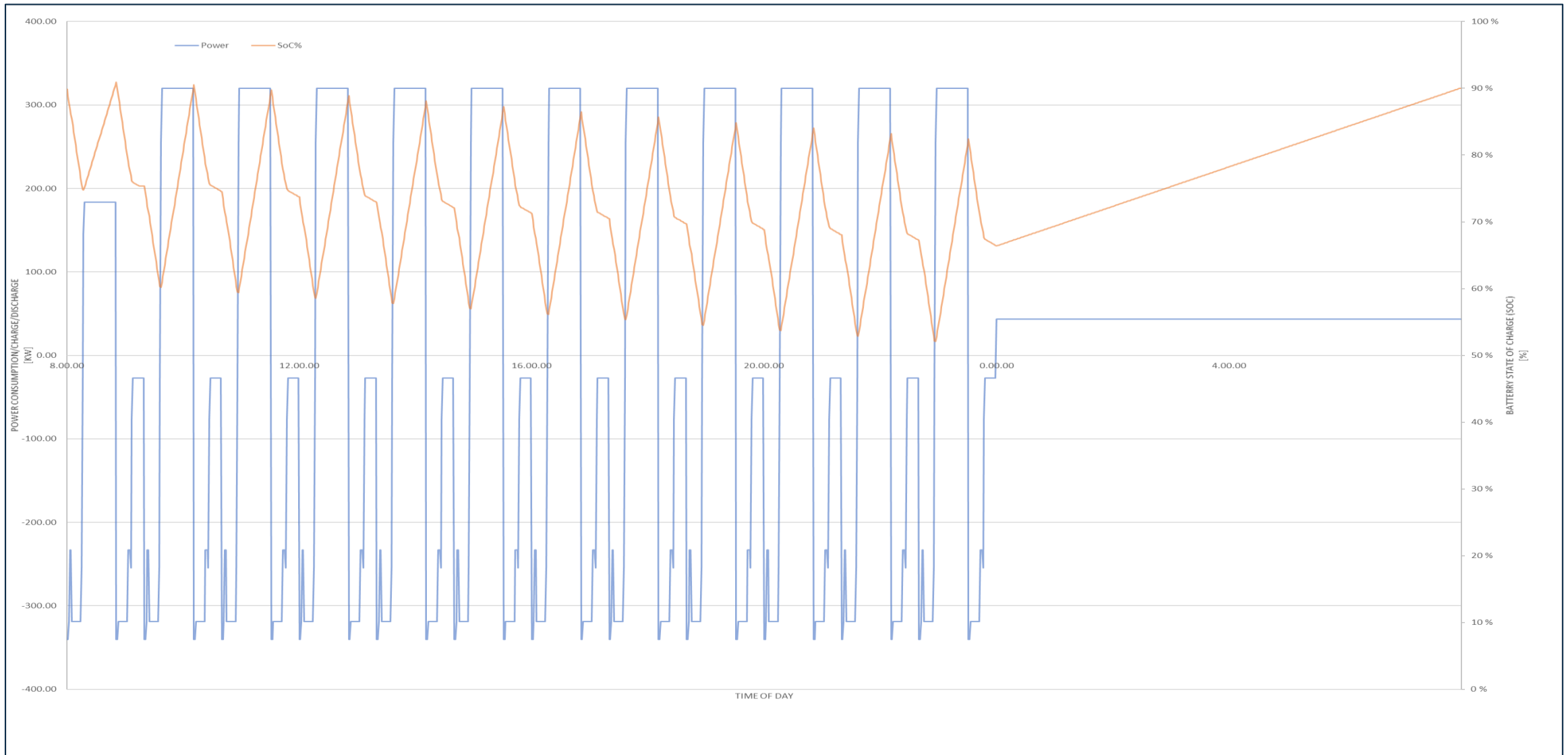
Battery & Charging System Dimensioning

- For the battery and charging system infrastructure sizing, the following assumptions and schedules has been used:
 - Open water: departure every 30 min with 20 min charging time in Kruunuvuori
 - Ice conditions: departure every 40 min with 35 min charging time in Kruunuvuori
 - Ice conditions: departure every 30 min with 20 min charging time in Kruunuvuori
- Recommended battery size is 544 kWh for a 10-year lifetime expectation, with:
 - 161kW/300kWh ratio, giving a c-rate of 0.5 for summer-time (300kWh needed for summer)
 - 320kW/544kWh ratio, giving a c-rate of 0.5 for ice conditions and 40 min departure interval
 - 520kW/544kWh ratio, giving a c-rate of 1 for ice conditions and 30 min departure interval
- Charging power from shore side (electrical losses included - 0.951):
 - Summertime: 170kW
 - Ice conditions: 337kW with 40 min departure interval and 547kW with 30 min departure interval
- Recommended shore charger is a shore-based switchboard system based on low voltage shore connection standard, IEC 80005-3, where the vessel is controlling the electrical connection and charging sequences through a Power and Energy Management System (PEMS). The IP rating of the manually connected plug, IP69.
 - At least a charging power of 550kW can be achieved with this solution.

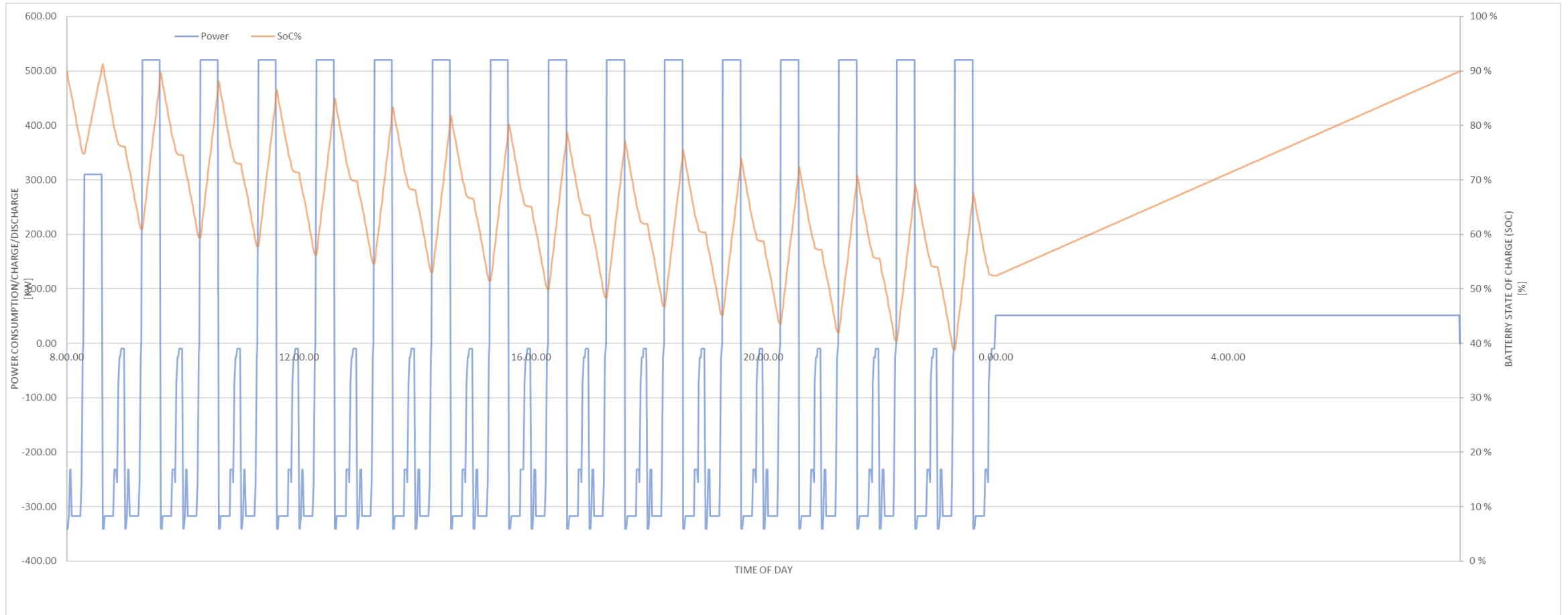
30 min Schedule Energy Analysis



Ice conditions Energy Analysis (40 min Schedule)

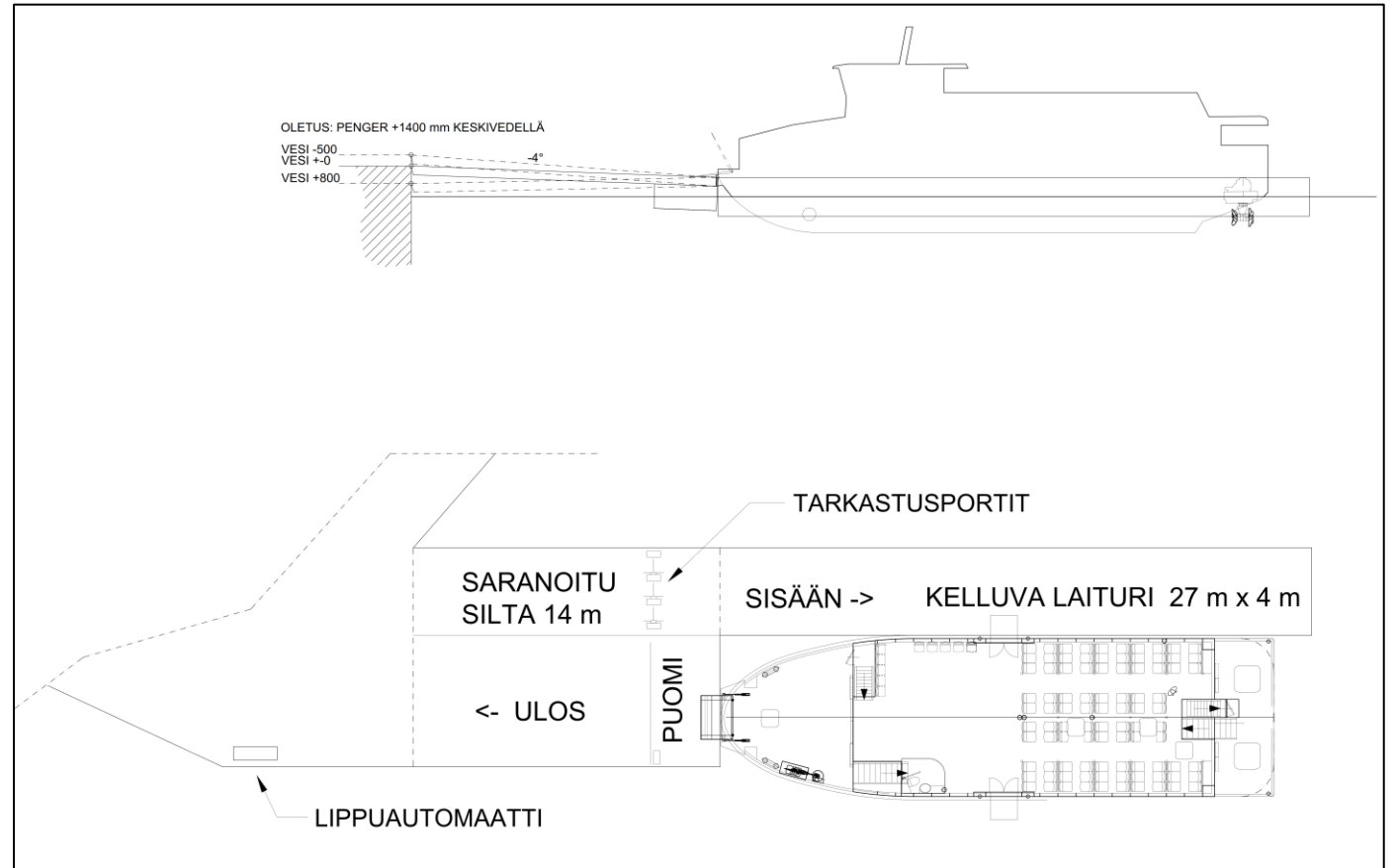
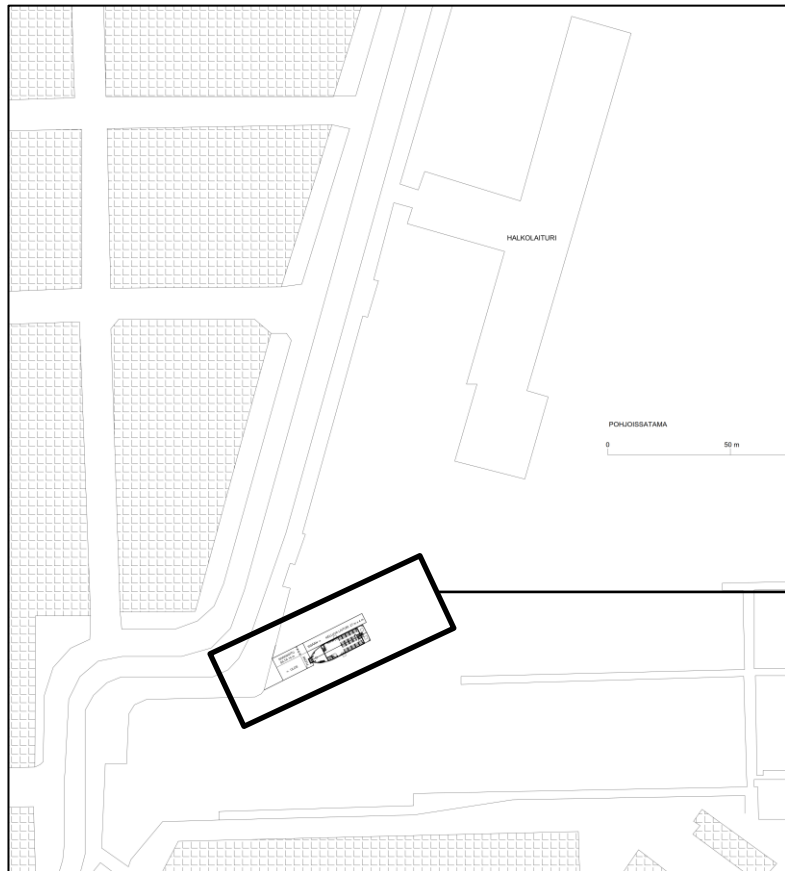


Ice Conditions Energy Analysis (30 min Schedule)



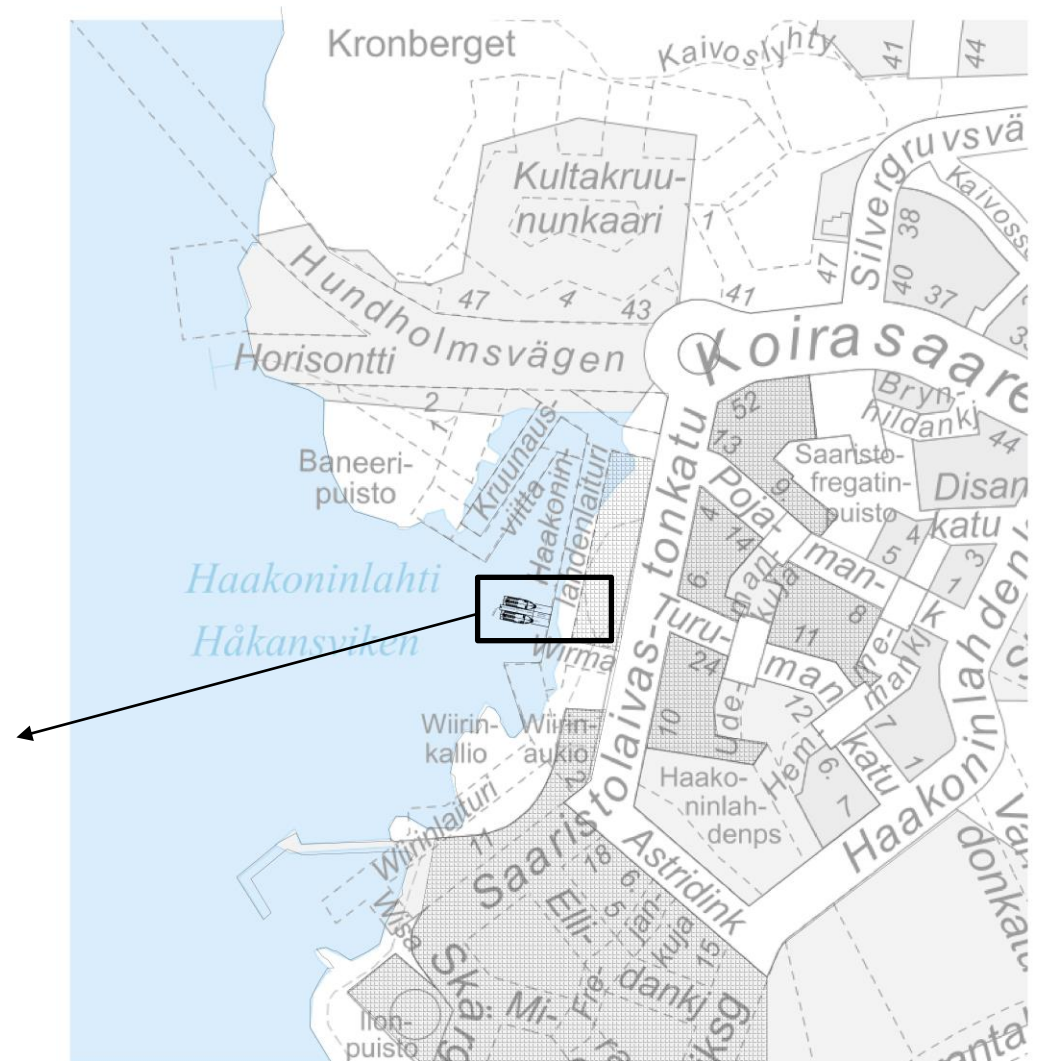
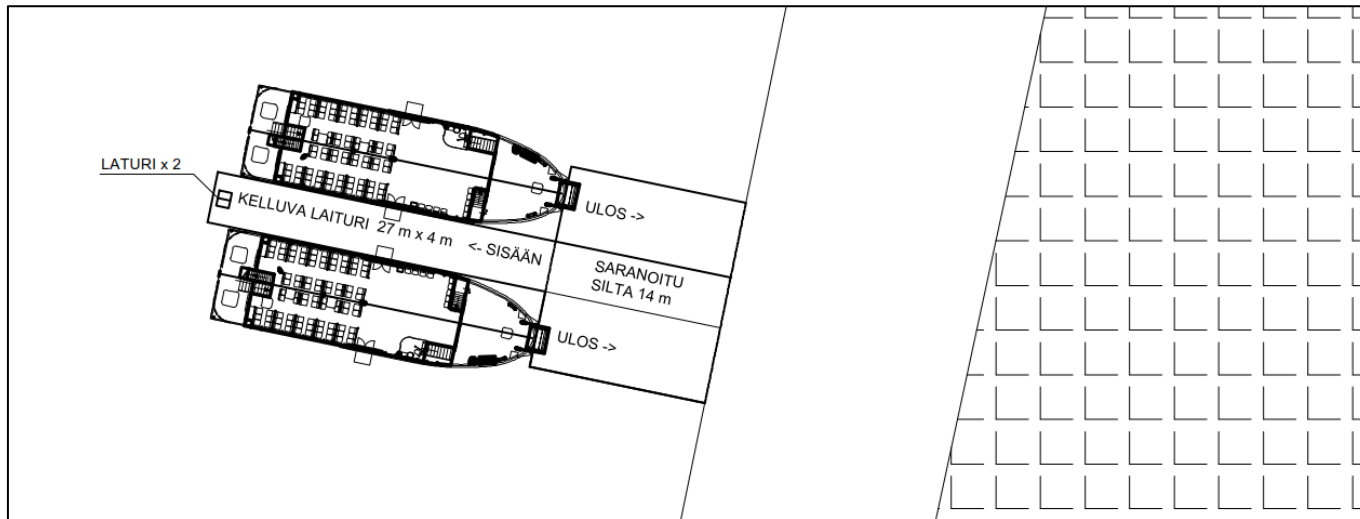
Shore Interface – Harbor in Pohjoisranta

- 3 optional positions in Pohjoisranta
- 27 x 4 m floating pier with 14 m hinged bridge.
- Gates at the bridge, ticket machine at quayside.

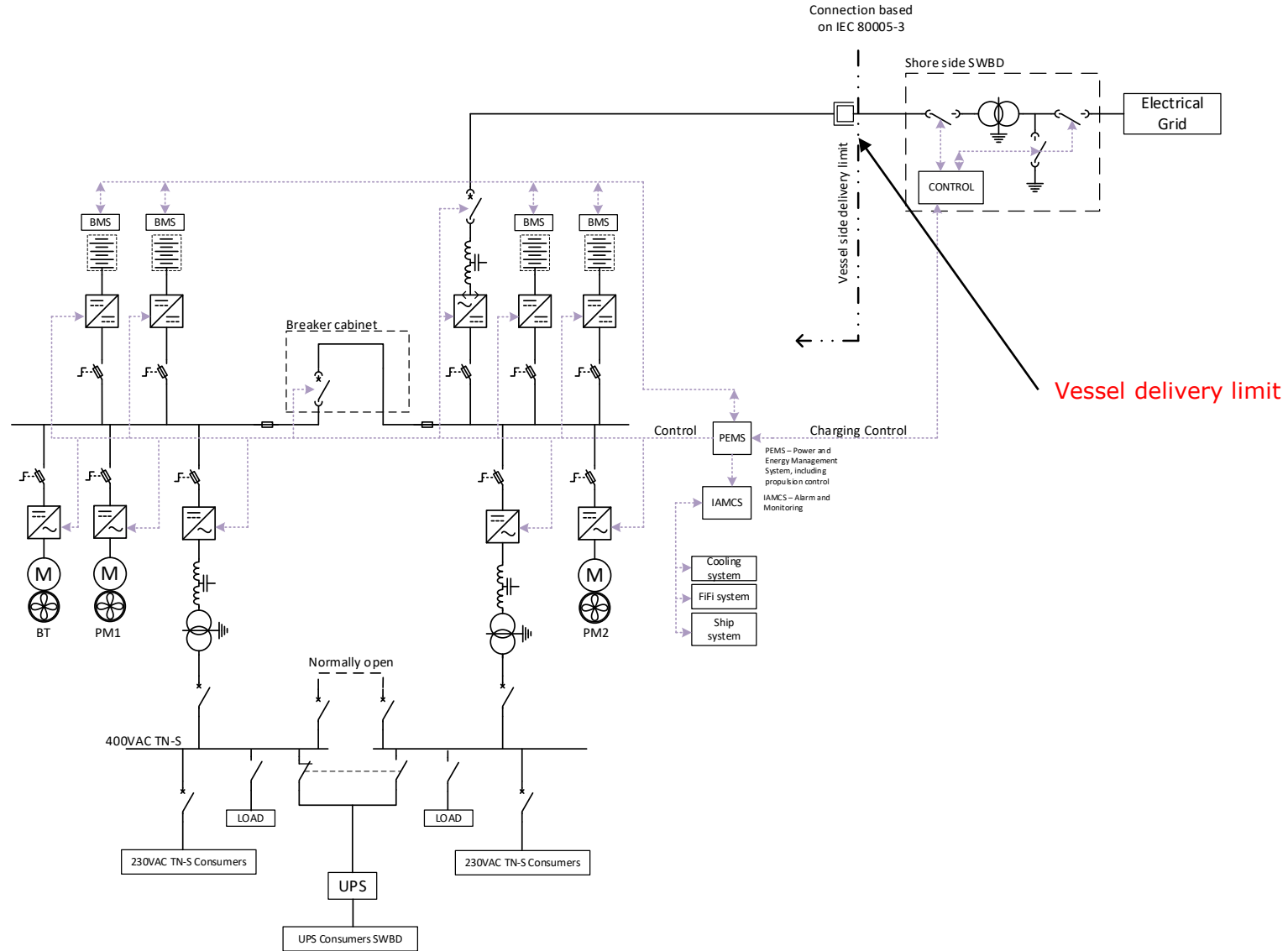


Shore Interface – Harbor in Kruunuvuori

- 27 x 4 m floating pier with 14 m hinged bridge.
- 2 berths on either side of the pier.
- Charging devices at the end of the pier.



Electrical 1-Line Diagram

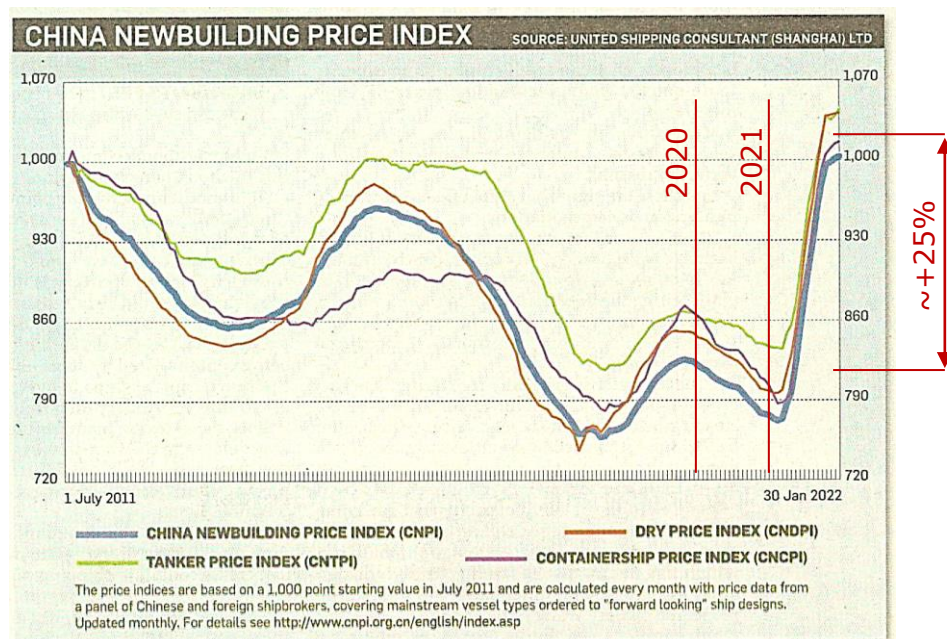


Newbuilding Price Development

- Ship newbuilding prices have increased rapidly during the past year, as indicated by press (see below), which may have significant impact on the price of the ship or service contract.

2021 Shipbuilding Review: Containers Lead Ordering Uptick, By Alex Springer, 28 January 2022:

"Driven by demand for new vessels and rising raw material costs (steel plate prices up from c.\$600/t in Q1 2021 to c.\$1,000/t in Q4), newbuild prices increased notably last year as shipyards began to fill out their orderbooks for 2023 and often beyond. Price benchmarks for many vessel types increased by c.30% across the year (VLCC: \$86m to \$112m, Capesize: \$46.5m to \$60.5m), with some boxship prices increasing by c.50% (15,500 TEU unit: \$106m to \$155m)."



FORESHIP



AT THE SHARP END