The 'Ferry'

A vehicle and passenger ferry

operating in Restricted waters.

'Short'

Propulsion Options for the Modern Short Voyage Ferry

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Propulsion Options for the Modern Short Voyage Ferry

Operational Requirements:

Operator Defined

Passengers; Route; Terminals; Timetable; Crew

Other Factors

Sea State and Wind Speeds

Loading Times

Shore Services

Ambient Environmental Conditions

Class and Flag

Operator's preferences

Ambient Environmental Conditions

High Sea and Air temperatures –

- Machinery De-rate
- High HVAC and Electrical Loads

Environmental –

- Complex exhaust systems and Catalysts

Hull Design

Single ended

Better performance in high sea states with less slamming

Double ended

Requires less manoeuvring time

SWATH

Catamaran

High speed

Propulsion Options for the Modern Short Voyage Ferry

Speed

3 Ranges

10 – 12 Knots - **Typical 20 minute voyage 100 pax**

18 – 20 Knots - **1.5 hours transit, larger passenger numbers**

30+ knots - **High Speed**

Electrical Load

Air Conditioning gives electrical loadings of:

500 kWe for 500 passengers

1000kWe for 1500 passengers

For summer temperatures of 35 deg C

Wind Loads

40 to 70 knot wind speeds during Manoeuvring or berthing are not un-usual

For a two deck ferry

62.5 knot beam wind	-	135kN
12 knots max speed	-	90kN

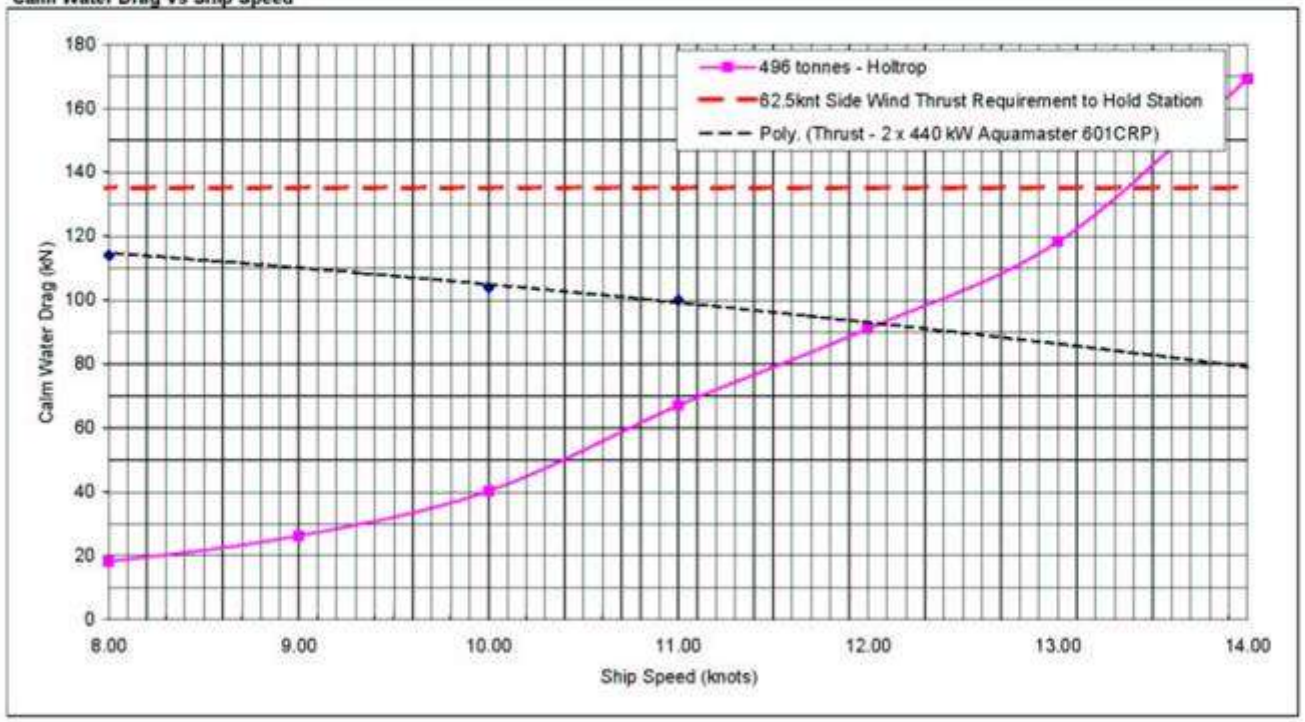
Propulsion Options for the Modern Short Voyage Ferry

NG

ENCL. 5-3
REPORT
DATE ########

5.0 - Calm Water Resistance Estimates

Calm Water Drag Vs Ship Speed



Machinery Options

Single ended - Conventional propulsion with thrusters for side load

Double ended - Twin propulsors, one forward, on aft

Power split varies between 10% and 30% at forward. Thrusters for side load

1200 tonne Ferry, 50 knot side wind, 12 knots service speed

NG — Twin 6L20 + 1 Spare + 2 x 495 kW Bow Thrusters

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Table 2 - Performance With Twin Wartsila 6L20

12 knots - Open Water Passage		Station Holding - Beam Winds, TT1300 FP@495 kW	
Installed Power Demand[1]	1020 kW	Required Side Thrust =	194 kN
Ships Load	100 kW	Required Aft Thruster Thrust =	83 kN
Total Power Demand	1120 kW	Required Fwd Thruster Thrust =	111 kN
Available Power 2 Sets=	2050 kW	Power Demand Aft Thruster =	748 kW (at gen)
		Power Demand Fwd Thruster =	1122 kW (at gen)
		Ships Load =	100 kW
		Total Demand =	1971 kW
% MCR Used 2 Gen Sets =	54.62%	% MCR Used 2 Gen Sets =	96.13%
		Beam Wind Speed = 50 knots	

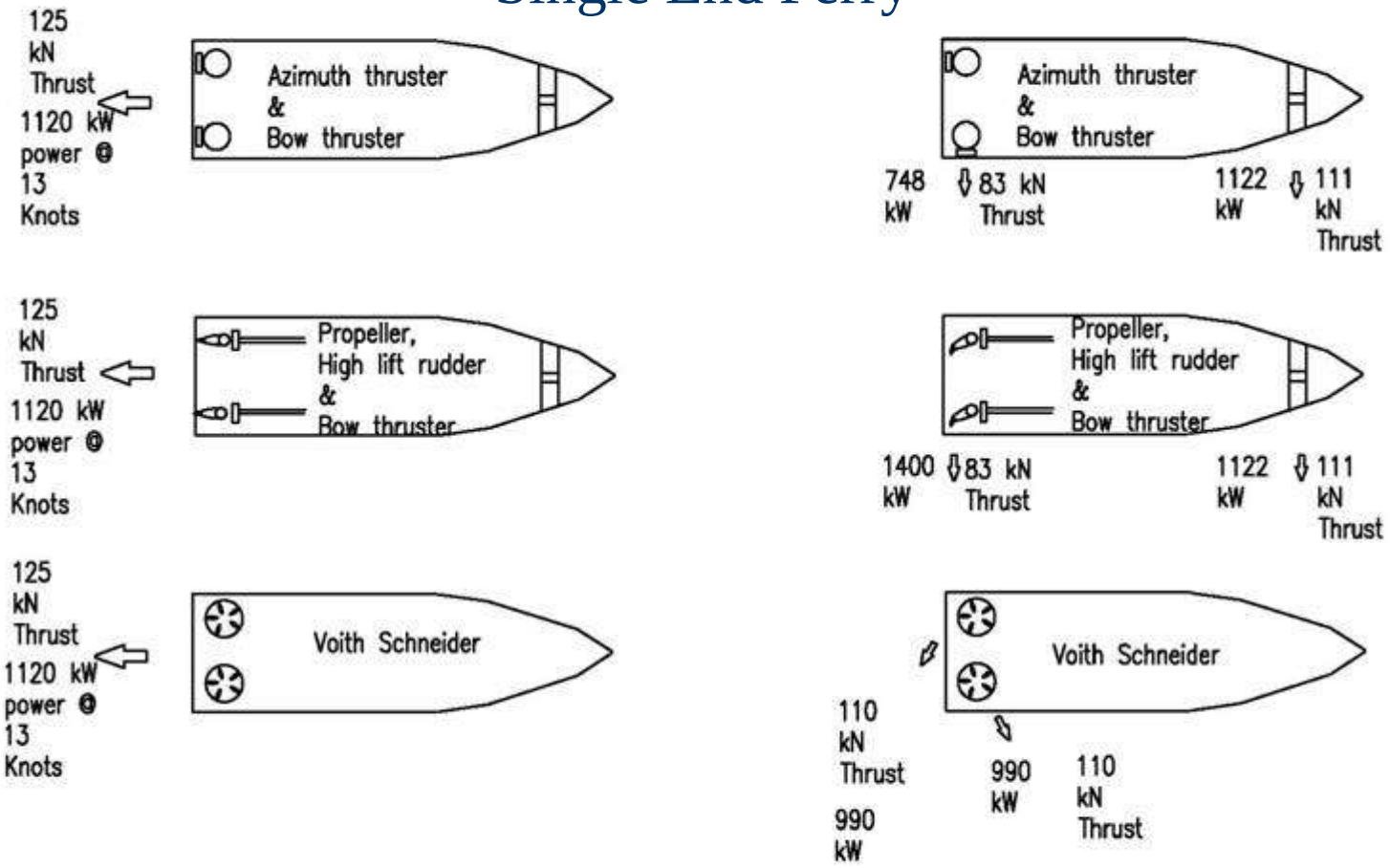
1. With 15% Sea Margin

Power requirement

Side movement 748+1122 kW= 1870 kW

12 knots calm water =1366 kW

Single End Ferry

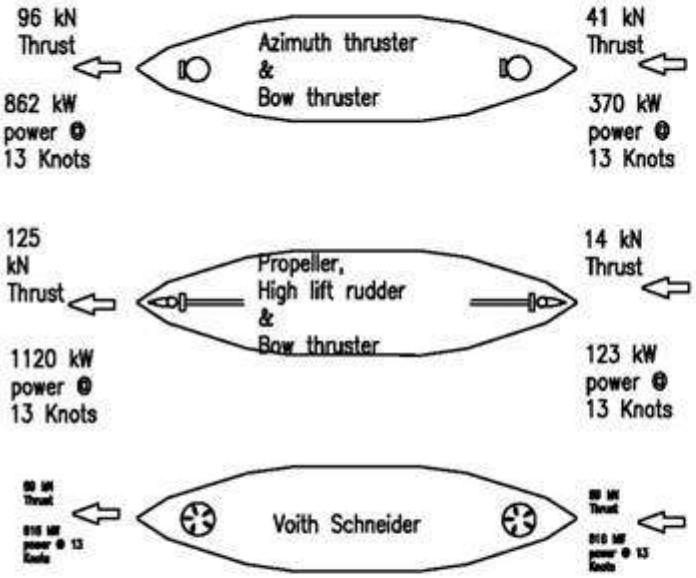


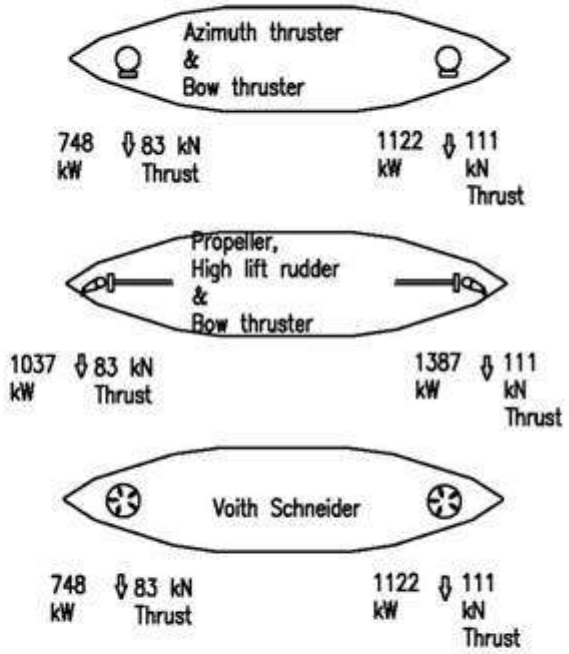
Single End Ferry

Propulsion powers are:

Azimuthing thruster aft with bow thruster fwd -	1870kW
Voith Schneider -	1980 kW
High lift rudder and bow thruster -	2522 kW

Double end Ferry





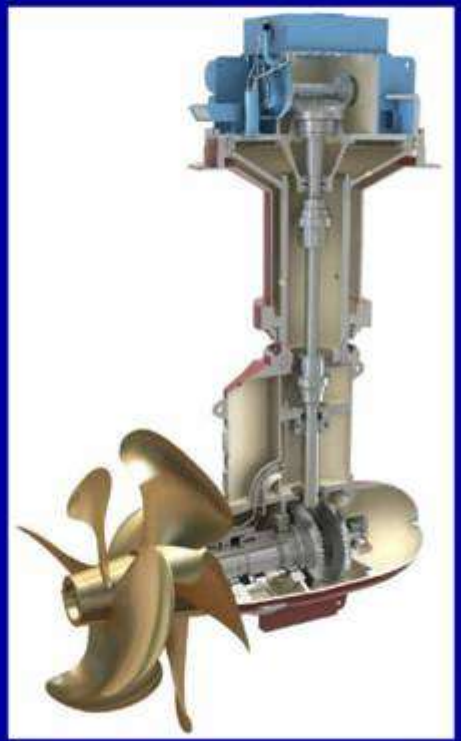
Double End Ferry

Propulsion powers are:

Azimuthing thruster aft and fwd	1984kW
Voith Schneider -	1870 kW
High lift rudder and bow thruster -	2507 kW

Propulsion Options for the Modern Short Voyage Ferry

Rolls-Royce
Azimuth units
Single, Contra-Rotating, Azipull



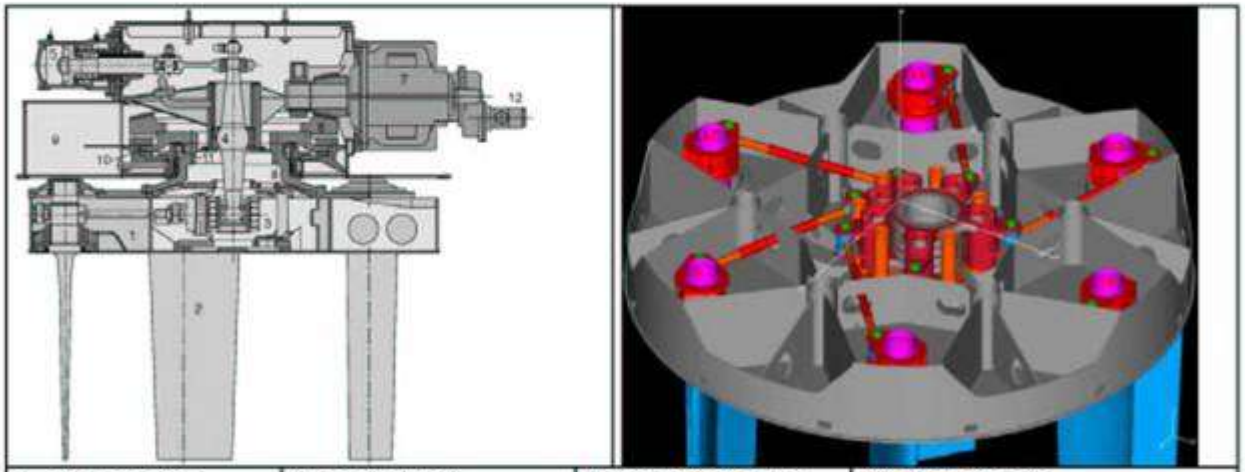
Rolls-Royce

Propulsion Options for the Modern Short Voyage Ferry

VOITH

SVA SCHIFFBAU-VERSUCHSANSTALT POTSDAM GmbH

The functional principle of the VSP is briefly explained to help to understand the technology of the VSP and its employment in DEF.



1. rotor casing	4. control rod	7. reduction gear	10. thrust plate
2. blade	5. servomotor	8. driving sleeve	11. roller bearing
3. kinematics	6. bevel gear	9. propeller housing	12. oil pump

Fig. 3: Voith-Schneider-Propeller, Typ GII, sectional drawing and 3D-CAD of the propeller housing and kinematics

Medium Speed Ferry

23 knots

145 m LOA

850 kN for 23 knots

750 kN side force for 40 knot beam wind

The options for propulsors are:

- **Propeller with high lift rudder.**

-There are no power or speed limits on the propeller although at high speeds there may be limits on the high lift rudder.

- The type of high lift rudder is limited on a double ended ferry.

- **Azimuthing thrusters**

- power is limited to 5000 kW for each unit and speeds are limited to 20 knots. Available as fixed pitch, contra-rotating propellers and controllable pitch propellers.

- **Voith Schneider**

- power is limited to 3485 kW for each unit and speeds are limited to16 knots

- **Electric drive pods**

  - powers starting at 5000 kW and rising to 22000kW.

- **Mini pods with external drive** (Azipull – Rolls-Royce) **and internal drives** (Compact Azipod - ABB)

  - with powers up to 5000 kW and speeds up to 25 knots.

Propulsion Options for the Modern Short Voyage Ferry

Type	Number	Total power	Usable power	Speed Limitation
Contra-rotating propeller thrusters	4	12,600 kW	9000 kW	20 knots
Propeller	2	32,400 kW	18,000 kW	23.5 knots
Voith Schneider	2	4000 kW	4000 kW	16 knots
Mini-pod	4	20,000 kW	14,285 kW	22 knots
Electric POD	2	25,200 kW	18,000 kW	23.5 knots

High Speed Ferry

Once the speed approaches 30 knots

The water jet or the propeller

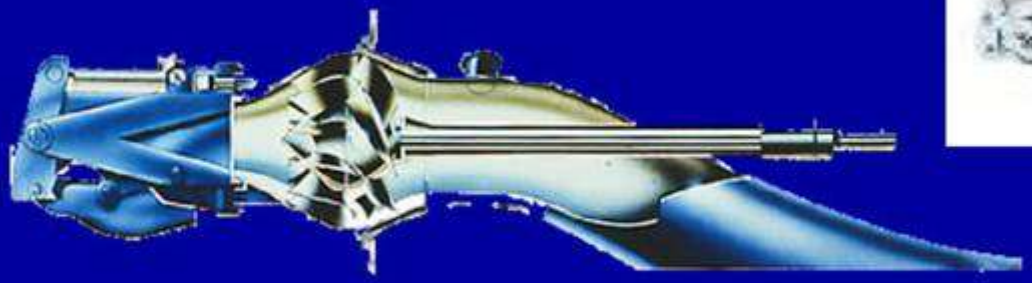
are the only options available

Water jet advantages are:

- Capability for thrust vectoring to increase manoeuvrability
- Capability to achieve operational speed with one jet down
- Improved efficiency above 30 knots over the propeller

Propulsion Options for the Modern Short Voyage Ferry

Kamewa Water Jets



Rolls-Royce

Typical High Speed Ferry

LOA 72 m

700 tonnes Displacement

250 passengers

35 Cars

14,400 kW propulsion power

4 Water Jets

Prime Movers

- **Direct Drive Geared Diesel**
- **Electric Drive using Diesel Generators**
- **Gas Turbine (diesel electric or direct)**
- **Fuel Cells**

- **Direct Drive Geared Diesel**

  SFC between 179 g/kWhr for Medium Speed and 210 g/kWhr for High Speed

  Medium Speed choice for small ferries limited

- **Electric Drive using Diesel Generators**

- **Gas Turbine (diesel electric or direct)**

  SFC 260 g/kWhr with power starting at 2400 kW

- **Fuel Cells**

  Power available currently limited

- **Electric Drive using Diesel Generators**

System losses		
Alternator	**-**	**4-5%**
Converter/ Transformer	**-**	**6-8%**
Motor	**-**	**4-5%**
Total loss (max)		**17%**

- **Electric Drive using Diesel Generators**

Weight increase (based on 1000 kW)

High speed Diesel	**-**	**6.5 t**
Alternator	**-**	**4 t**
Converter and transformer	**-**	**7 t**
Propulsion Switchboard	**-**	**0.5 t**
Weight Increase	**16.5 t**	

- **Electric Drive using Diesel Generators**

(based on 1000 kW)

Increased weight	**16.5 t**
Reduced efficiency	**17%**

Comparative Cost	
Direct drive	**£250,000**
Diesel electric	**£1,000,000**

Medium or High Speed Diesel ?

Medium Speed	High Speed
•Higher specific weight	Low weight
•No limit on power	Power limited to 9000 kW
•Better SFC	Lower initial cost
•Heavy Fuel	Higher Maintenance cost ??

Medium or High Speed Diesel ?

Comparison of 1000 kW diesels

6000 hrs /year including prime cost

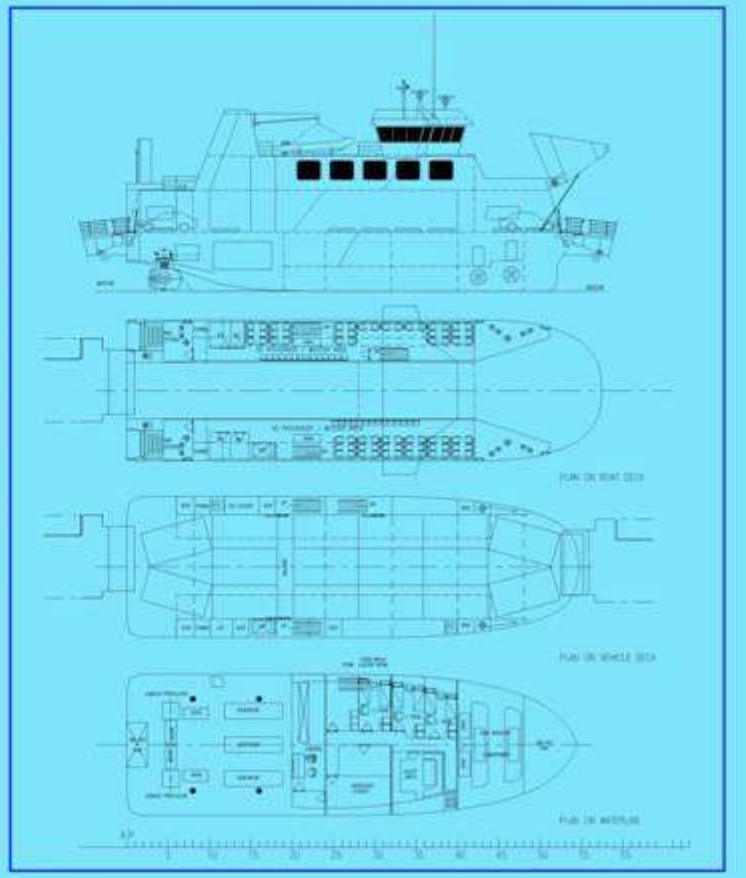
Medium Speed		High Speed	
20 years -	£500,000	20 years-	£422,000
30 years-	£660,000	30 years-	£671,000

Design Examples

Propulsion Options for the Modern Short Voyage Ferry

35m COMPACT DIESEL-ELECTRIC RO-RO FERRY

BMT NIGEL GEE AND ASSOCIATES LTD



Principal Particulars

LOA	35.00 m
LWL	31.74 m
BOA	10.20 m
BWL	9.34 m
T	2.60 m
No. Pax	100
No. Car	16
Dwt	156.4 tonnes
Vs Max.	12.0 knots

Class: Lloyds Register of Shipping

Shipyard: Northern Shipyard, Gdansk, Poland

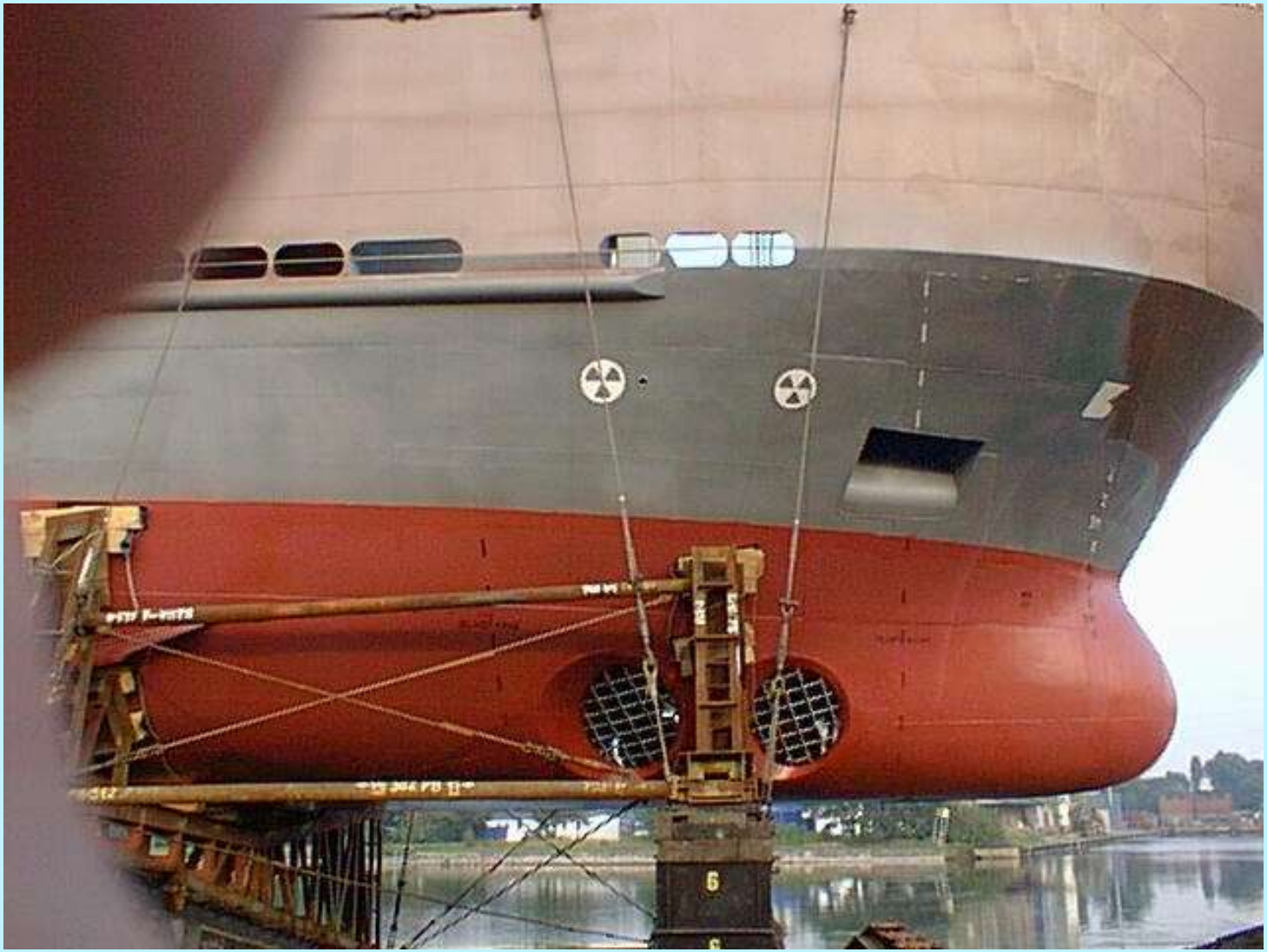
Safety: Maritime Coast Guard Agency (UK)

Propulsion

Main Engines	3 x 630(845 HP) kW Diesel
Generators	
Propulsors	2 x Aquamaster US 601 CP

Propulsion Options for the Modern Short Voyage Ferry

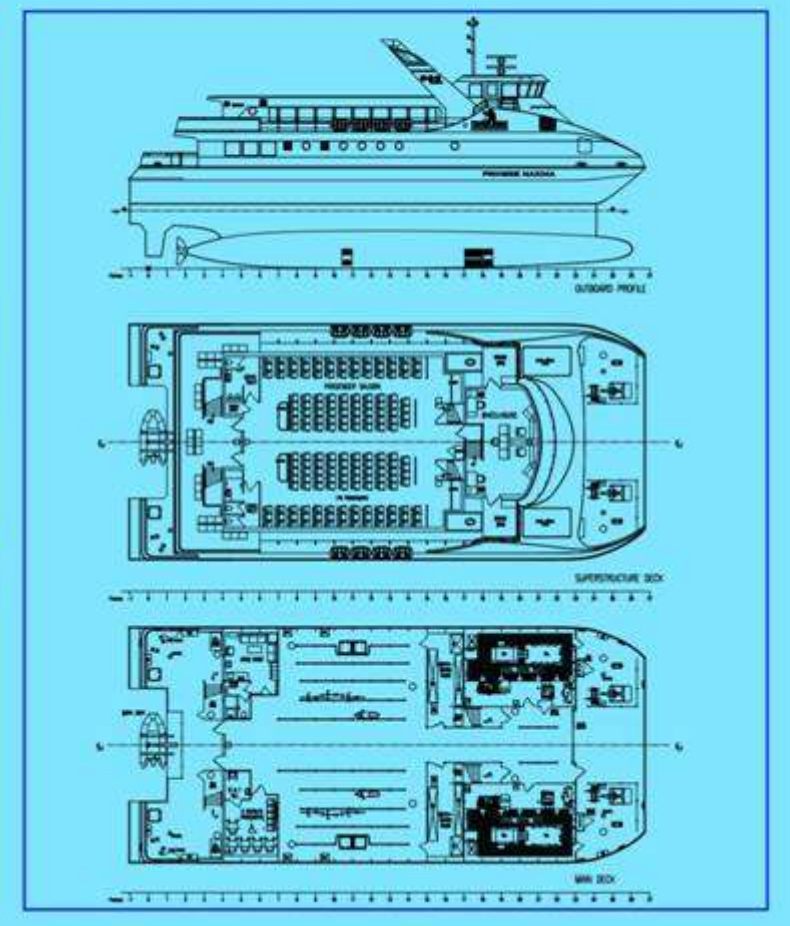
Propulsion Options for the Modern Short Voyage Ferry



Propulsion Options for the Modern Short Voyage Ferry

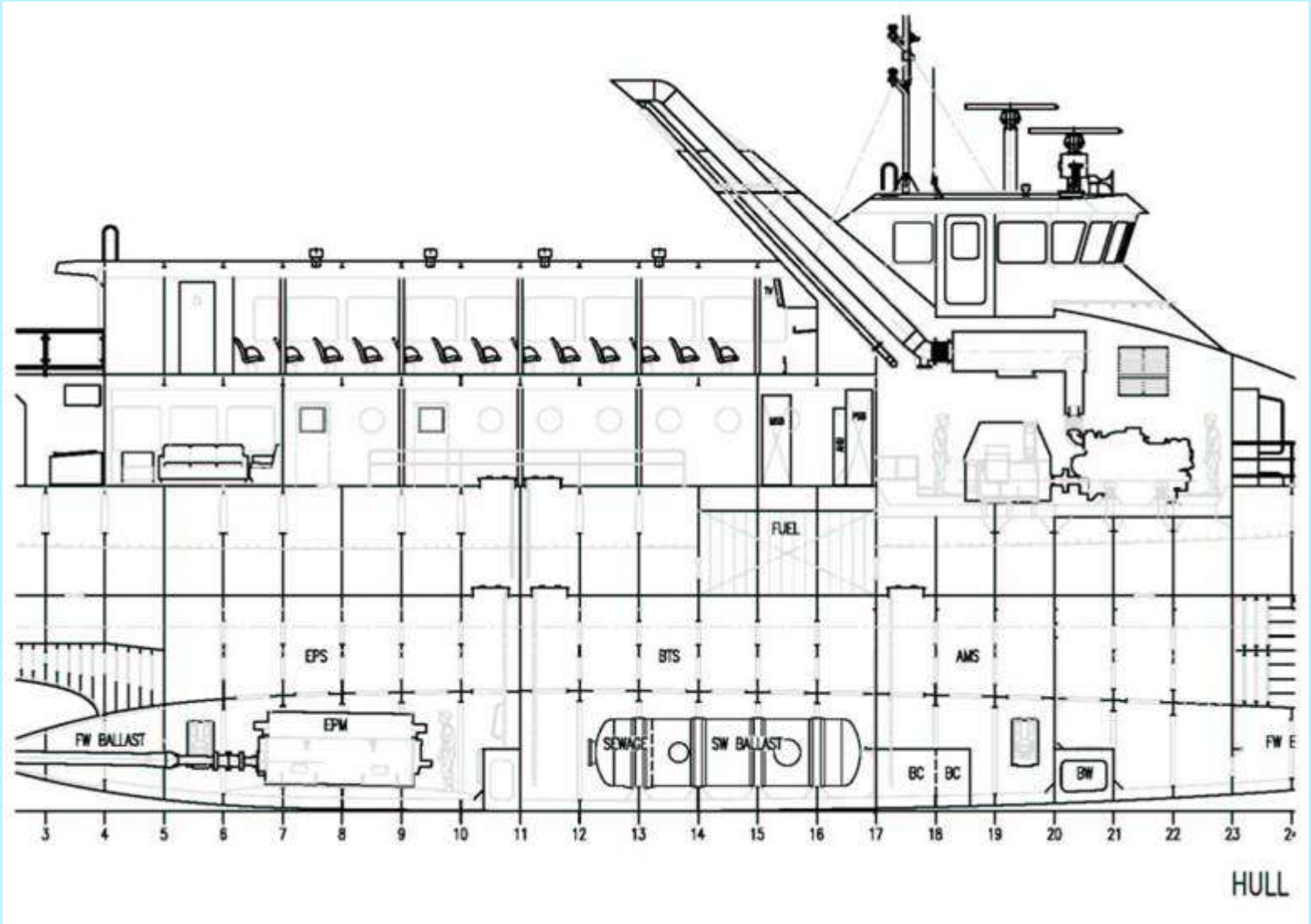
FAST PASSENGER/CARGO FERRY

NG NIGEL GEE AND ASSOCIATES LTD



Principal Particulars		Class
LOA	41.00 m	Shipyard: Damen
LWL	35.63 m	
BOA	10.50 m	Safety
BWL	2.48 m	
T	1.90 m	Propulsion
No. Pax		Main Engines
No. Car	-	Power
Dwt	tonnes	Propulsors
Vs Max.	knots	Ride Control

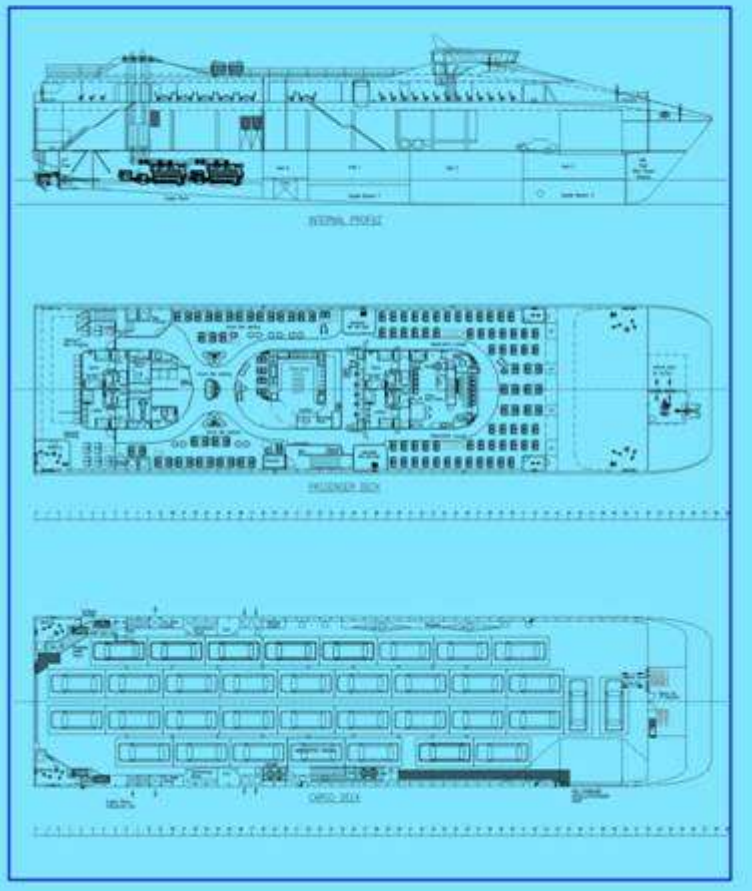
Propulsion Options for the Modern Short Voyage Ferry



Propulsion Options for the Modern Short Voyage Ferry

FAST VEHICLE PASSENGER FERRY

NG NIGEL GEE AND ASSOCIATES LTD



Principal Particulars	
LOA	73.40 m
LWL	64.10 m
BOA	18.00 m
BWL	3.75 m
T	2.71 m
No. Pax	250
No. Car	35
Dwt	192.0 tonnes
Vs Max.	38.6 knots

Class: Det Norske Veritas

Shipyard: Derecktor

Safety: International Maritime Organization

Propulsion

Main Engines: 4 x MTU 16V 595 Te70 Diesels
Power: 4 x 3600 kW / 4 x 4828 HP
Propulsors: 4 x KaMeWa 90 SII
Ride Control: Trim Tabs

Propulsion Options for the Modern Short Voyage Ferry