Humboldt Shipmanagement

Ahorro de Energía en el Transporte Marítimo

Colegio de Ingenieros de Chile

Ultranav Group

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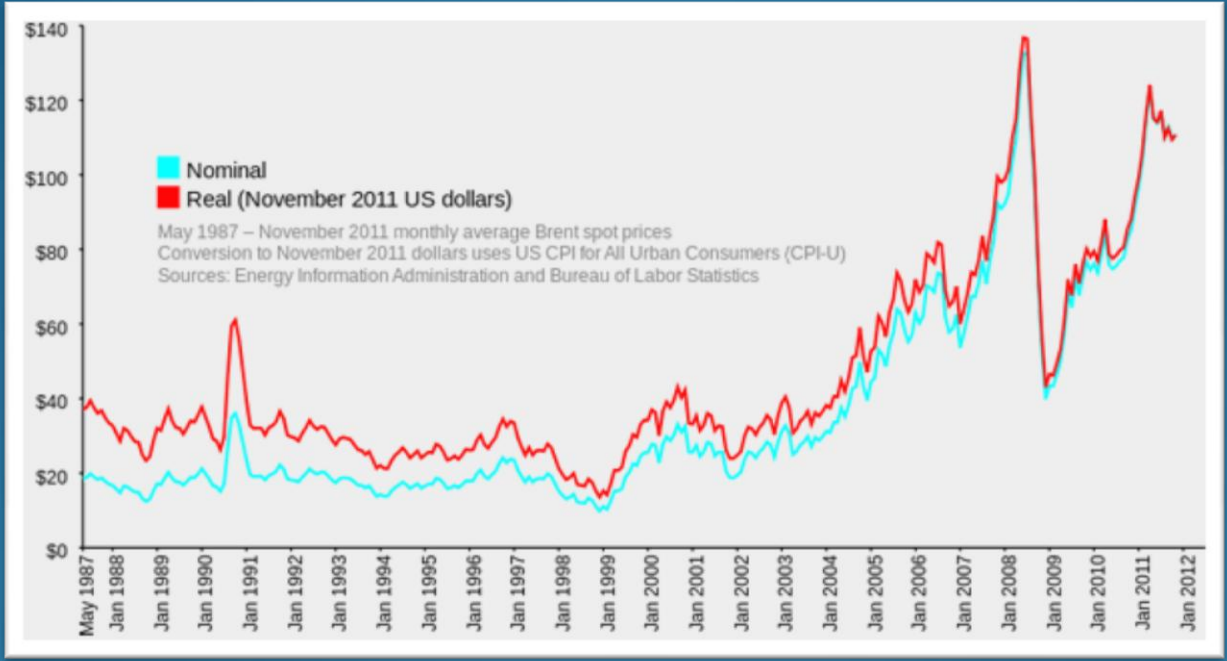
Fuel Prices



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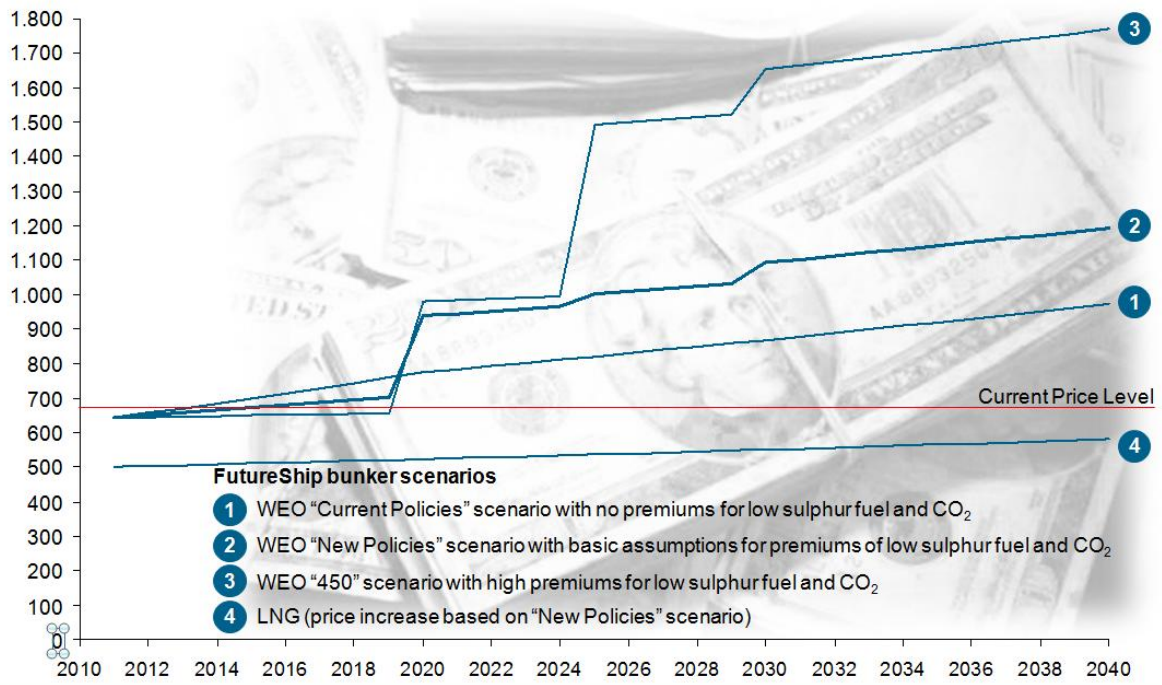
Looking ahead bunker prices are likely to nearly double over the lifetime of a vessel

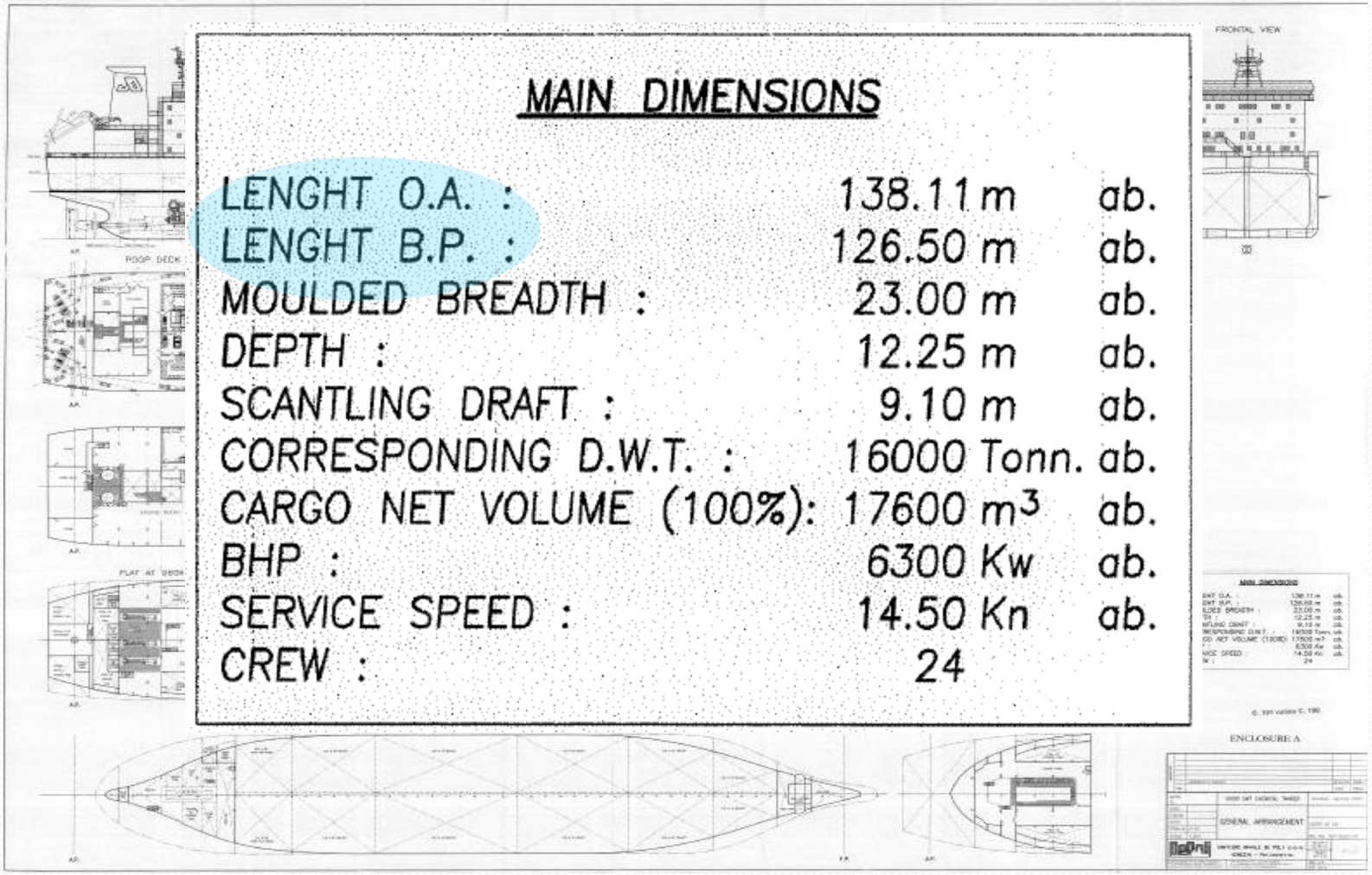
USD/t real 2010, outlook



Source: FutureShip bunker cost model

BASIC SHIP KNOWLEDGE:

General Arrangement:

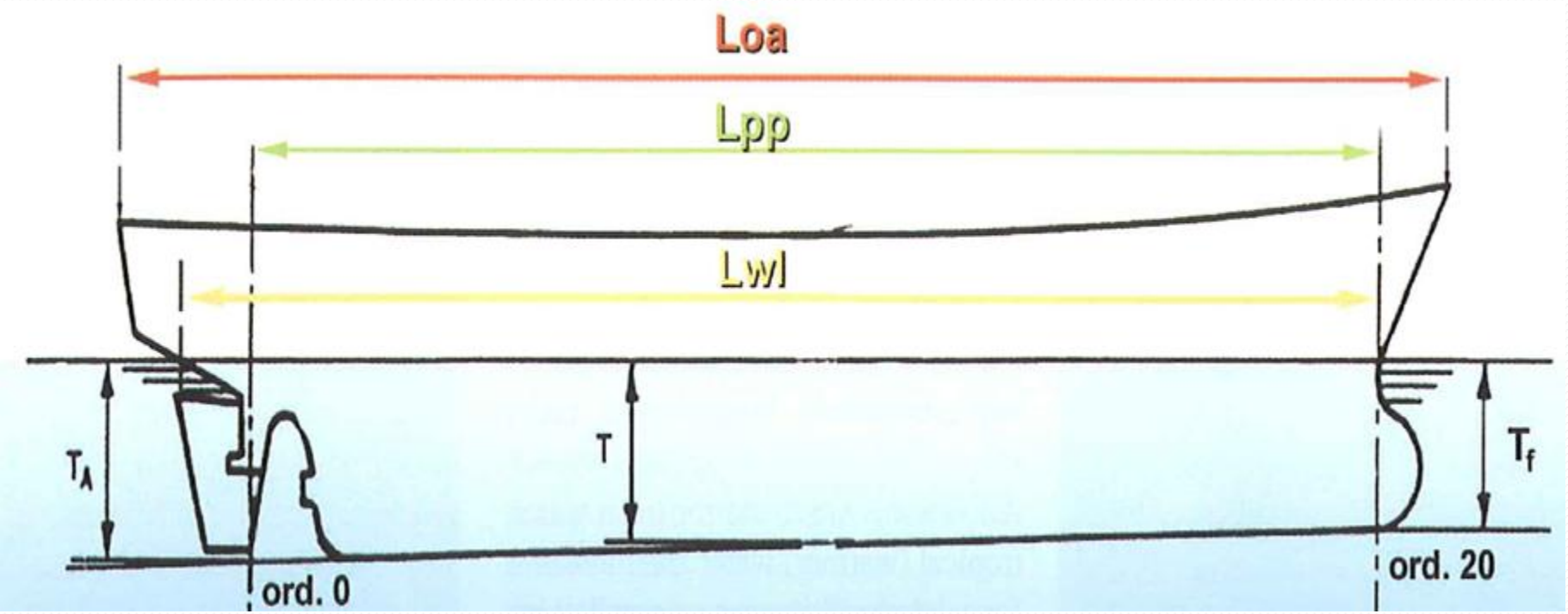


MAIN DIMENSIONS

LENGHT O.A. :	138.11 m	ab.
LENGHT B.P. :	126.50 m	ab.
MOULDED BREADTH :	23.00 m	ab.
DEPTH :	12.25 m	ab.
SCANTLING DRAFT :	9.10 m	ab.
CORRESPONDING D.W.T. :	16000 Tonn.	ab.
CARGO NET VOLUME (100%):	17600 m^3	ab.
BHP :	6300 Kw	ab.
SERVICE SPEED :	14.50 Kn	ab.
CREW :	24	

BASIC SHIP KNOWLEDGE:

Main dimensions - lengths:



BASIC SHIP KNOWLEDGE:

Main dimensions – breadth/depth:

MAIN DIMENSIONS

LENGHT O.A. :	138.11 m	ab.
LENGHT B.P. :	126.50 m	ab.
MOULDED BREADTH :	23.00 m	ab.
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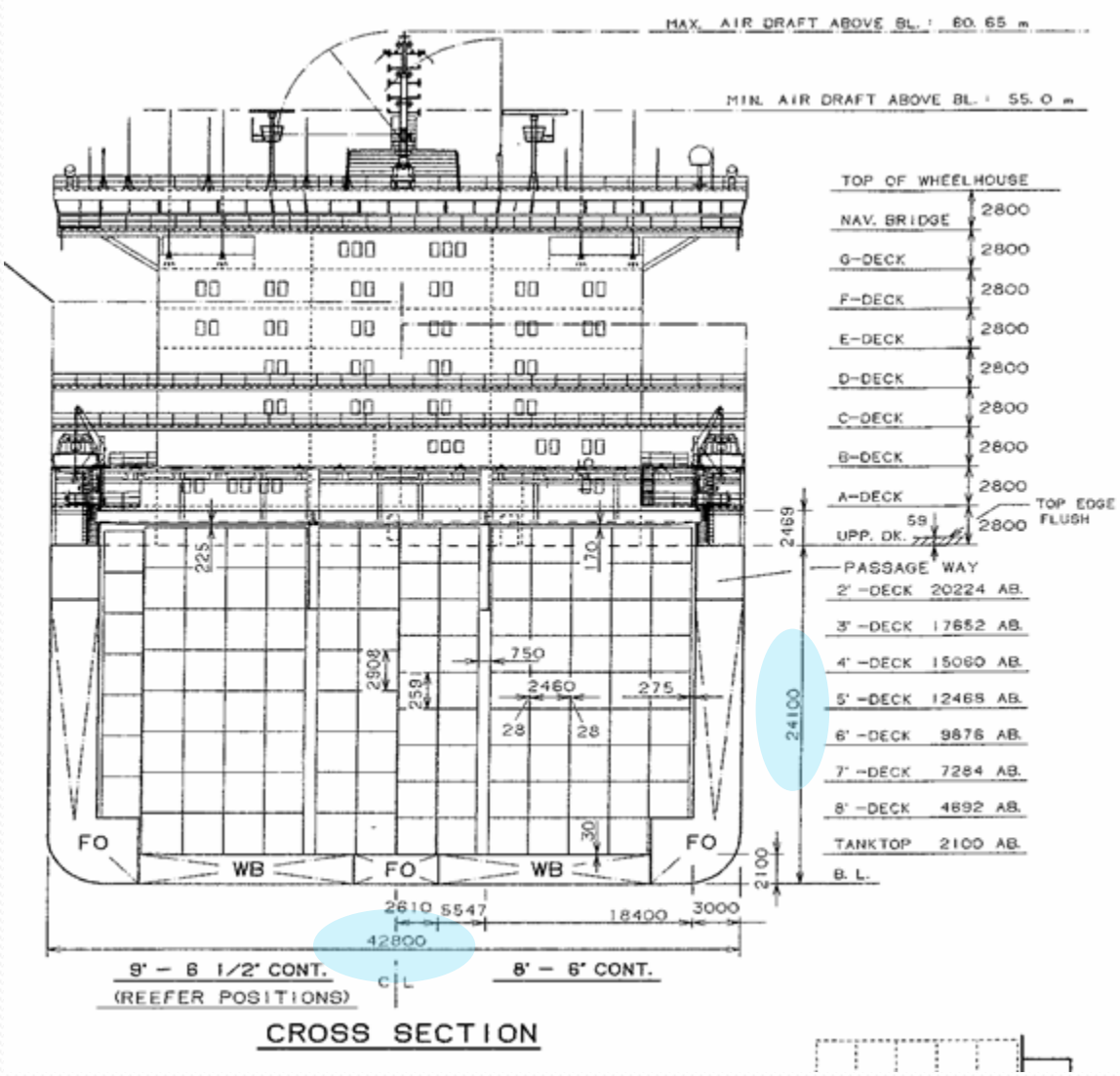
BASIC SHIP KNOWLEDGE:

Main dimensions – beam/depth:



BASIC SHIP KNOWLEDGE:

Main dimensions – draft:

MAIN DIMENSIONS

LENGHT O.A. :	138.11 m	ab.
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DEPTH :	12.25 m	ab.
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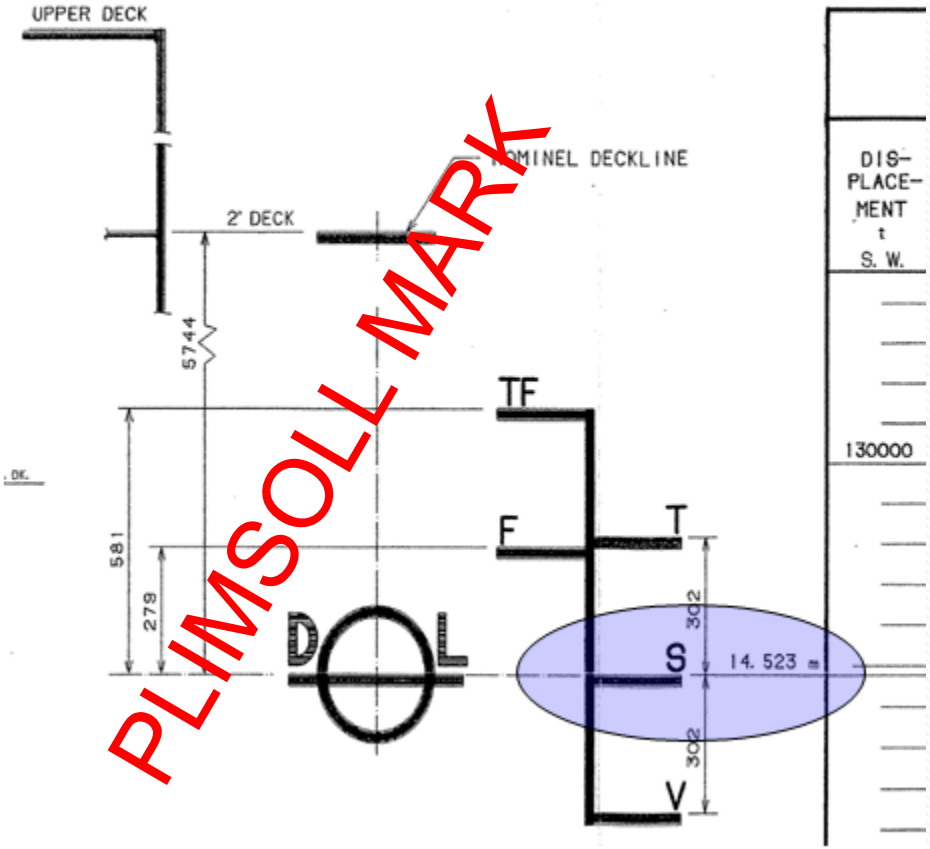
BASIC SHIP KNOWLEDGE:

Draughts – Design/Scantling/Summer

- The vessel's hull is designed to a certain draft called **design draft**.
- Design draft should present the optimum of the performance of the hull lines at a specified loading.
- The structure is constructed to a certain draft specified by the Class Society called **scantling draft.**
- Scantling draft is often the same as **summer draft** – and greater than design draft.



BASIC SHIP KNOWLEDGE:

Main dimensions – weights:

MAIN DIMENSIONS

LENGHT O.A. :	138.11 m	ab.
LENGHT B.P. :	126.50 m	ab.
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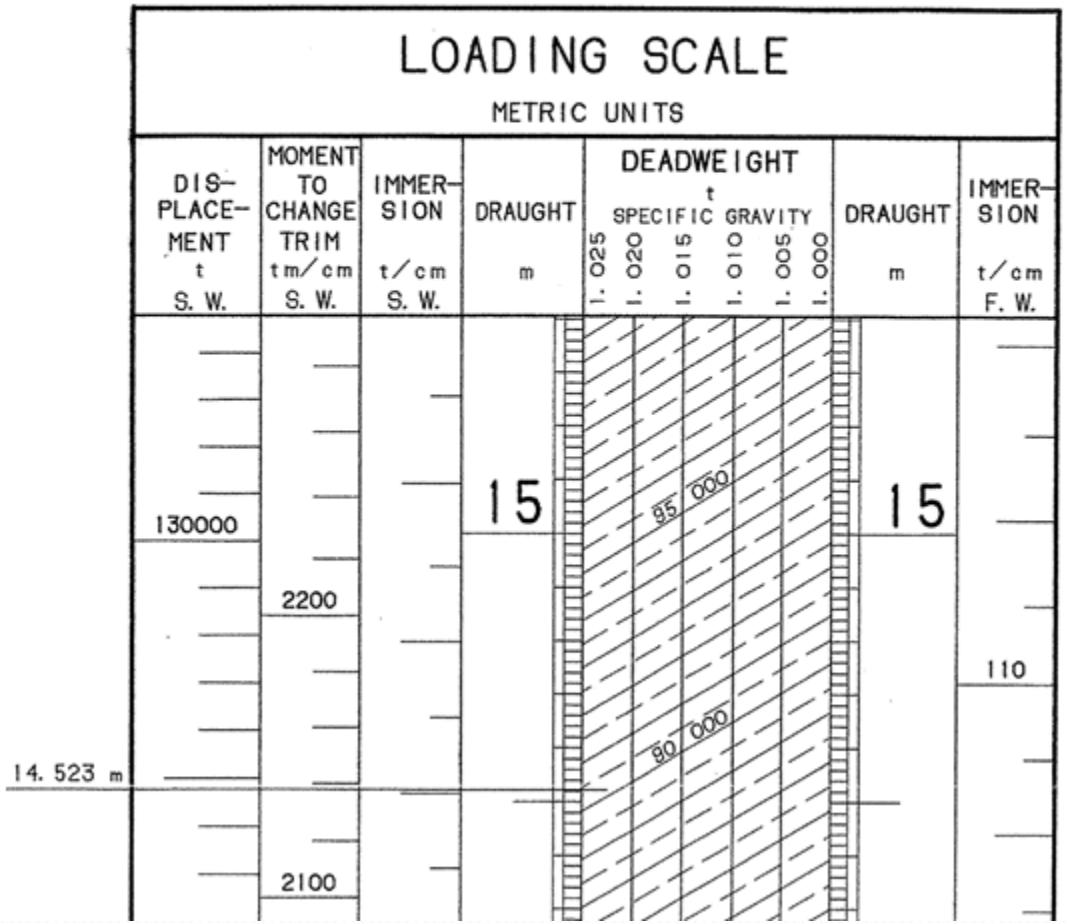
CREW :	24	

BASIC SHIP KNOWLEDGE:

Displacement, Deadweight & Lightweight,

- **Displacement** – volume of water displaced by the ship. Displa = Deadw + Lightw
- **Deadweight** – is the weight of cargo + ballast + fuel.
- **Lightweight** – Weight of ship +anchors + life saving appliances + paint + lub oil.
- **Deadweight:**
  Displacement – Lightweight



BASIC SHIP KNOWLEDGE:

Main dimensions – BHP/Service Speed:

MAIN DIMENSIONS

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LENGHT B.P. :	126.50 m	ab.
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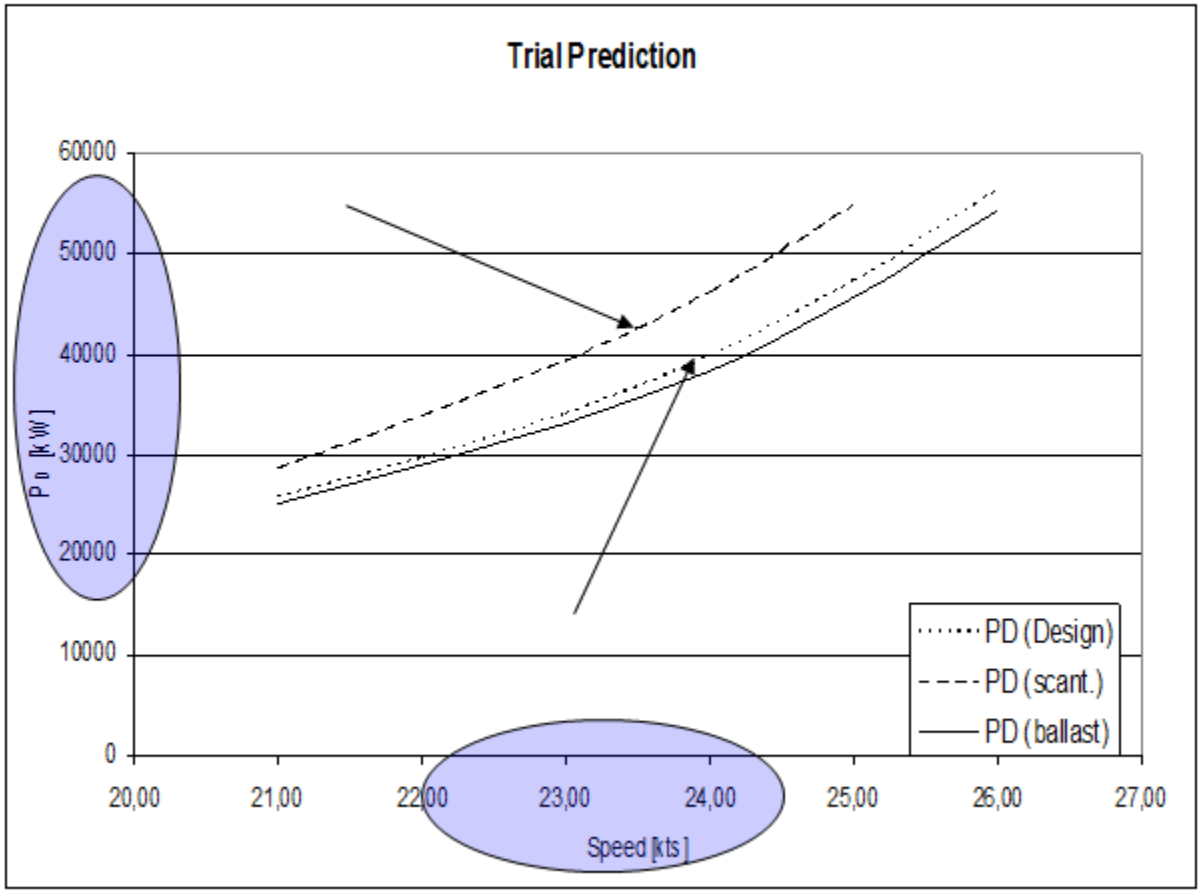
BASIC SHIP KNOWLEDGE:

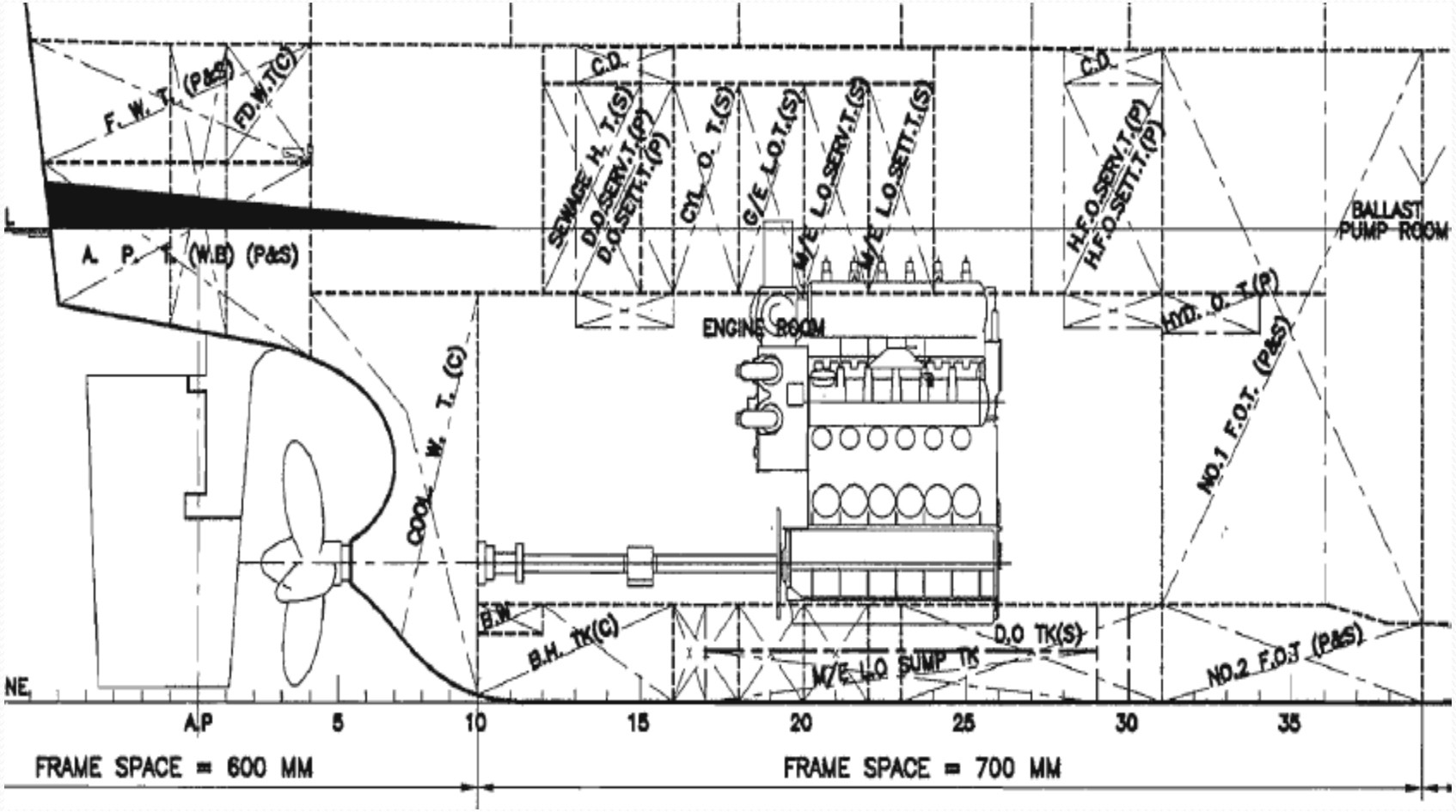
Speeds – trial/service/power

- **Trial speed** at design draft is normally the contract speed. Sea margin may be included.
- Trial speed is the speed at no wind, waves, current and fouling.
- **Sea margin** of 15 % of the power at 85 or 90 % maximum continuous rating of the main engine is supposed to cover the added resistance from waves, wind, current and fouling at a period between docking.



BASIC SHIP KNOWLEDGE:

Appendages – propeller: Two types – Controllable Pitch Propeller (CPP) & **Fixed Pitch Propeller (FP):** FP



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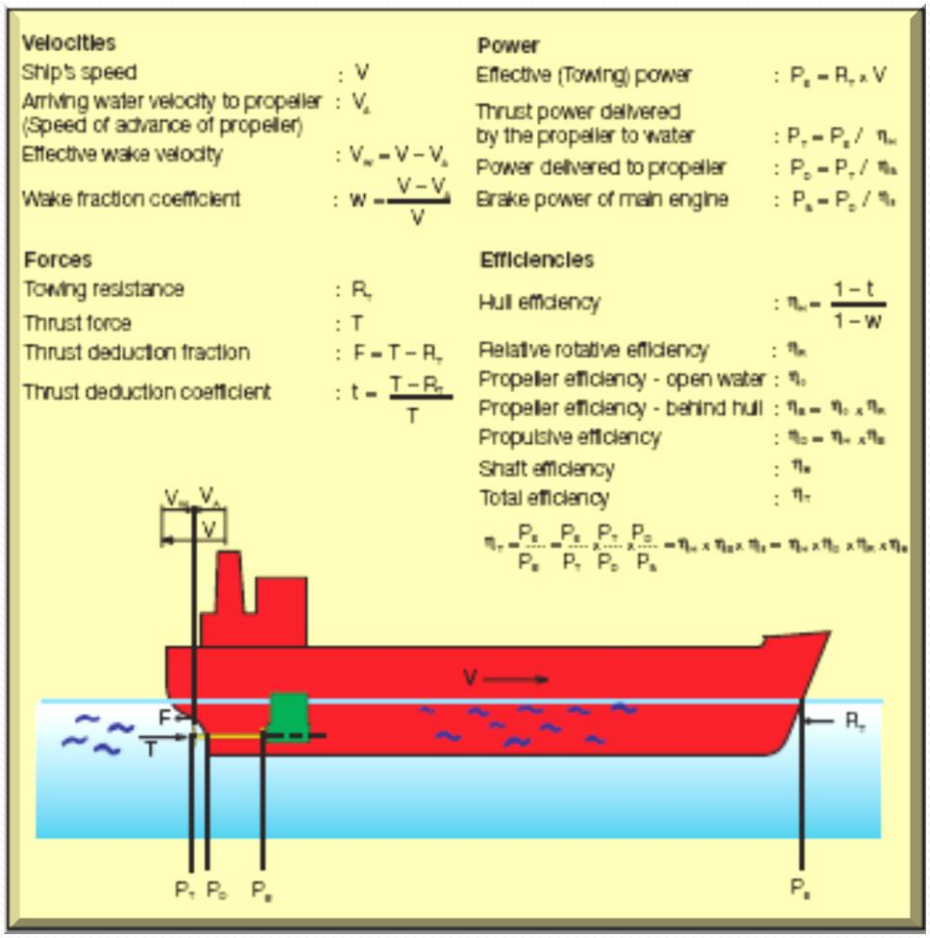
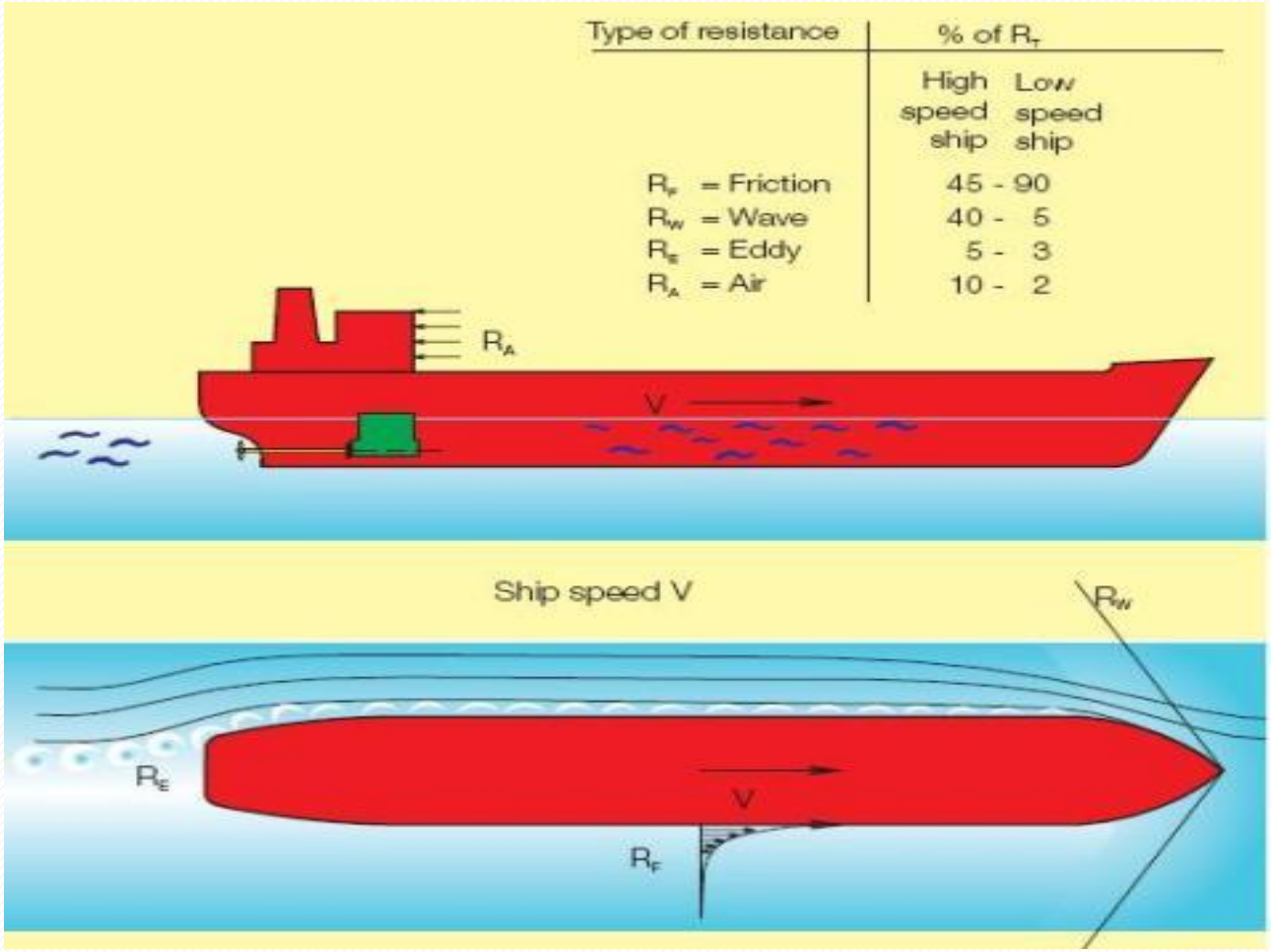


BASIC SHIP KNOWLEDGE:

Ship Resistance – an overview



BASIC SHIP KNOWLEDGE:

Ship Resistance – Total resistance – R_{TOT}:

The total resistance for a slow speed vessel is:

$$R_{TOT} = R_{fric} + R_{wave} + R_{eddy} + R_{air}$$

$$R_{TOT} = 90\% + 5\% + 3\% + 2\%$$

….so let's have a look at the friction part:

$$R_{Fric} = C_{fric} * \tfrac{1}{2} * \rho * V^2 * A_{surface}$$

…meaning that it is only the **wetted surface area** and **speed** that have major influence on the resistance – and thereby the consumption.

BASIC SHIP KNOWLEDGE

- Established a common policy regarding blasting and coating for dry-docking periods based on coating maker's recommendation.

- Suggest the antifouling to be applied for future dry-docking (based on dry-docking schedule and coating equivalent table)

- Include Ultranav Paint Supervisor during dry-docking of charter's vessels.

AFTER 2 MONTHS OFF MEXICO

$$R_{Fric} = C_{fric} * \tfrac{1}{2} * \rho * V^2 * A_{surface}$$

RULE OF THUMB: 25/1000 mm = 2-3% HIGHER FUEL CONSUMPTION

Task Developed

- ✓Determination of the fleet's vessels consumption curves.
- ✓Determination of fuel economy measures to be implemented in the fleet.
- ✓SEEMP implementation and determination of each vessel's EEOI.
- ✓Incorporation of the fuel saving concept to the new constructions.

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Vessel	Main Engine Particulars	Eco RPM (50 % MCR)	Expected consumption Mt/day	Expected Speed Knots	RPM Real	Real Consumption Mt/day	Real Speed Knots	At 40% MCR
Cordillera	CAT 6M43 MCR 5400 KW at 500 rpm	Constant mode: 132 rpm y 53 % pitch	14,71		Constante mode 132 rpm at 81 % Pitch	19.11 MT/D	11,88	
Cóndor	Zollner MAN B&W 8S35MC MCR 5700 KW at 170 rpm	Constant Mode 170 rpm y 55 % Pitch	14.8		170 rpm 72.6 % Pitch	14.92 MT/D	13,77	
Copihue I	Zollner MAN B&W 8S35MC MCR 5000 KW at 170 rpm	Combine Mode: 138 rpm Constant Mode 170 rpm y 55 % Pitch	13.2		P	P	P	
Vicuña	H. Cegielski-Poznan SA Wartsila 6RTA48T-B MCR 8730 KW at 127 rpm	Combined Mode 95 rpm	21,26		Combined Pitch Mode 94.88 rpm	22.2 MT/D	11,5	
Guanaco	MAN B&W 6S50MC-C MCR 9.480 KW at 127 rpm	103 rpm	22,88		103 rpm	26.24 MT/D	13	
Alpaca I	Kobe Diesel 6UEC52LS MCR 7980 Kw a 120 rpm	102 rpm	20.50	13.0 / 13.5	102 rpm	22.4 MT/D	12,9	
Taruca	Akasaka Diesel Mitsubishi 7UEC 45LA MCR 6230 kw a 158 rpm	128 rpm	15,86		P	P	P	
Andesgas	MAN B&W 6L50 MCE MCR 5910 Kw at 141 rpm	112 rpm	15,17		113 rpm	20.92 MT/D	13	
Antarticgas	MAN B&W 6L50 MCE MCR 5910 Kw at 141 rpm	112 rpm	15,17		122.6 rpm	24.05 MT/D	13,8	
Patagoniagas	MAN B&W 6L50 MCE MCR 5910 Kw at 141 rpm	112 rpm	15,17		117 rpm	21.4 MT/D	13,76	
Polargas	MAN B&W 6L50 MCE MCR 5910 Kw at 141 rpm	112 rpm	15,17		119,6	19.8 MT/D	13,88	
Pacificgas	Kawasaki MAN B&W S60MC	84 rpm			P	P	P	
Tacora	MITSUBISHI SULZER 6RTA58 MCR 6089 kw	88 rpm	15,55		89.25 rpm	20.25 MT/D	11,85	

II. Measures for Saving Fuel

Revision carried out by DNV's Hydrodynamics Section

- Openings
- Mewis Duct
- Propeller design
- Pre Swirl Stator
- Trim Studies
- Propeller Rudder Transition Bulb
- Rudder Profile
- Main Engine De-rating
- Propeller Nozzle
- Wake Equalizing Duct (Pre duct)

Consulted to manufacturers and suppliers

- High quality paint
- Hull cleaning
- Wind Kite
- Boat in a Bubble (Air lubrication of hull)
- Led illumination
- Heat recovery system

Revision carried out by DNV´s Petroleum Service

- Homogenizers
- Fuel Additives

Openings

✓A suitable design of sea chests and thruster openings will have a favorable effect, not only on the hull resistance, but also on noises and vibrations.

✓The design shall also take into consideration the thrusters performance.

✓The aft openings shall also take into consideration their effect on the propeller's inlet flow.

✓Fuel saving from 1% to 5%

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Mewis Duct

✓It is a device whose function is to improve the propeller's inlet flow, thus enhancing the performance of the same.

✓It includes the advantages of two devices previously invented.

✓It may be fitted, in some cases, on vessels in operation.

✓Applicable to vessels below 21 speed knots and with a high block coefficient.

✓Fuel saving of about 5%.

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Propeller Boss Cap Fins

✓They provide a more efficient outlet flow and thereby increasing the propeller performance.

✓There are no limitations concerning the size and type of the vessel. It can even be fitted in CPP.

✓Fuel saving of about 3%

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Main Engine De-rating

✓It is generated by the increase of the thermal efficiency upon reducing the effective rating pressure to be developed by an engine in respect of the maximum acceptable pressure.

✓The electronic injection engines can easily adjust the “tuning” because their parameters adjustment is easier.

✓It is estimated a saving of about 4%.

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Wind Kite

✓It is based on taking advantage of the eolic energy through a sail of big dimensions which is secured to the bow sector of the vessel and governed by an automatic control system.

✓Under optimal wind conditions, it can provide up to 2.000 kW of power.

✓Depending on the vessel operational profile, it could reach a 10% of fuel saving.

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Boat in a Bubble

✓The dragging friction is one of the main problems in the dynamics of fluids, and said system is centered on the decrease of losses. It consists on injecting air over the flat bottom of the vessel in order to produce an “anti-friction” padding.

✓The Air Cavity System is the most popular one and requires modifications in the midforward section of the vessel, which may be made to a vessel in operation.

✓It is a complex system which is still under development stage.

✓It is estimated a potential saving of about 10%.

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What is the SEEMP?

It is the Ship's Energy Efficiency Management Plan.

The SEEMP consists of a number of measures to be adopted in order to control and improve the efficient management of the energy, involving:

- Crew
- Management Companies
- Operators

•Objectives

Monitoring and reduction in the fleet consumption → ✓Lower operational costs. Greater business fringe.

→ ✓More attractive for the customers.

Compliance with the last regulations which came into force in 2013

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Software for the consumption and degree of efficiency monitoring

The SEEMP have, among its measures, the introduction of the Energy Efficiency Operational Index, (EEOI).

This index shows the efficiency reached in each voyage performed by the ship in terms of consumption and CO2 emissions related to the quantity of cargo carried on board.

The software developed by the Japanese Class NK enables:

- To calculate and record this Index
- To monitor and establish the consumption limits
- To determine whether the implemented improvements have been effective

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The target is to obtain a new building whose design and features would represent the next generation of ships within the UNAV fleet as well as the international shipping industry.

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Improvements on Full Specifications

• Main Engine Selection - The most efficient main engine in its class was selected among existing alternatives so as to obtain the lowest consumption and emissions rates.

• STX MAN B&W 6S50ME-C 8.2 TII with Part Load Optimization (VTA) - The engine is fitted with an electronic control of the combustion process, i.e. fuel injection timing, actuation of exhaust valves, starting valves and cylinder lubrication. It also complies with IMO's Tier II emissions.

• The advantages of the ME-type engine are:

- Optimized fuel consumption over a wide power range
- Improved cylinder lube oil consumption
- Improved low-load running
- Adaptation to different fuel oil qualities
- Better part-and low-load efficiency provided by Variable Turbine Area (VTA) system
- Equipped with MAN B&W Alpha cylinder lubricators

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Improvements on Full Specifications

- Mewis Duct - A power-saving device that provides significant fuel saving. It consists of a strong fixed element mounted on the vessel and a duct positioned ahead of the propeller, together with an integrated fin system within.

- The duct both straightens and accelerates the hull wake into the propeller, as well as producing an increase in propeller thrust at a given propulsive power.

- The advantages of the Mewis Duct are:

✓Improved propulsion.
✓Proven fuel saving of 3%.
✓Reduced greenhouse gases (GHG).
✓No moving parts, no service necessary.
✓Reduced vibrations and pressure pulses.

Performance Monitor

Reliable Information

- New performance monitor concept available in the market is being analyzed (Sky Sails, GME, Kyma Ship Performance).
- System allows permanent monitoring of fuel consumption. Torque meter, mass flow meter, vessel's movement sensors and the application software are part of the system.
- High investment cost (around USD 70.000 per vessel), plus service rate.

Human Resources

- Operators + Vessel´s Performance Supervisor

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Frequency Convertor - An effective energy saving device to be installed in the cooling water pumps and engine room ventilators, which consists of the electric motors speed being controlled by frequency convertors, thus reducing the loss of energy due to unnecessary requirements

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Green Passport - The new buildings will comply with the requirements of IMO guidelines on Ship Recycling, IMO resolution A.962(23)

Low Sulphur Fuel Oil Tanks - In order to comply with last regulations which have established a limit on sulphur content for all grades of fuel oil used on ships. Steam generating plant and main engine will be able to safely burn low sulphur fuel oils

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Exhaust Gas Scrubber - Considerations for future external funnel installation

Heat recovery system

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Trim optimization studies

- Computer Fluid Dynamics Calculation allows to inform the Captain about the optimum trim on each circumstance.

- Different alternatives on the market are under study

- Up to 2 % saving in fuel consumption can be reached.