



# SH-POWERING Hydrodynamic Manager

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## Contents

- Background
- Goal
- Introduction to Powering Manager
- Live demo
- Development plan



## How many powering programs do you have for ... ?

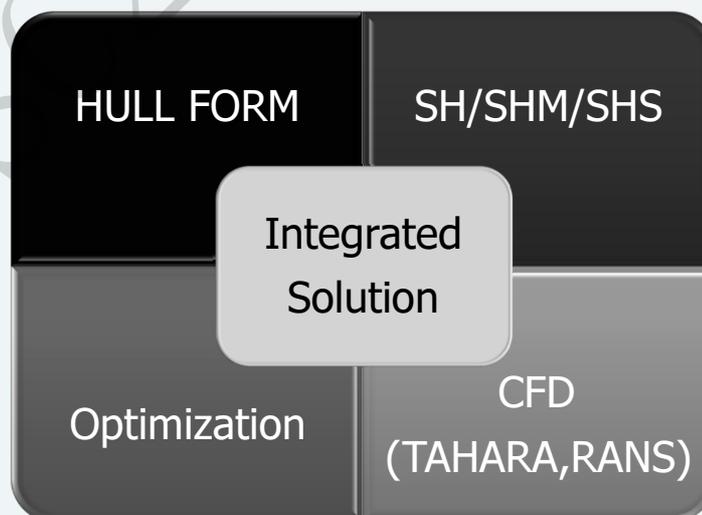
- Normal speed-power prediction
- Speed difference at different drafts
- Speed drop or gain as the change of propeller diameter and number of blade
- Speed analysis using resistance and propeller data from model test
- Speed effect on environmental forces at some B.F. Scale
- Propeller exitation force
- Propeller cavitation number and margin

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## Goal - Integrated solution

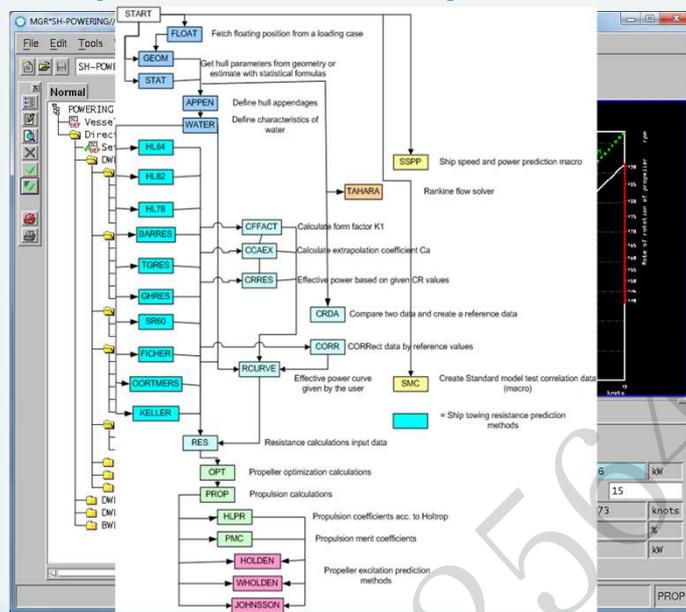


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## Goal – Improve usability



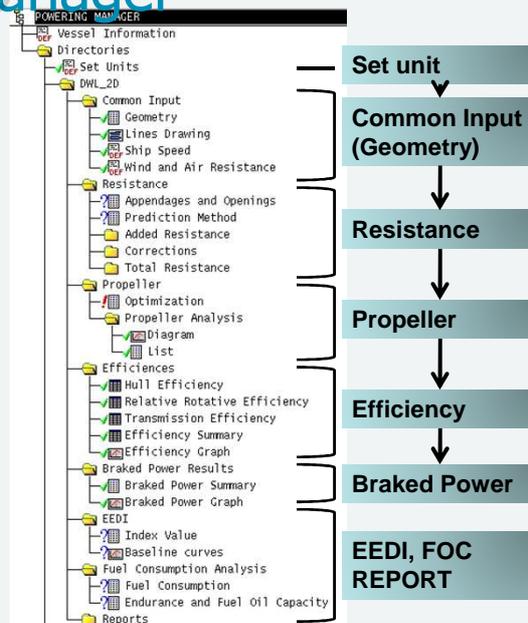
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## SH-Powering Manager

- The manager will guide a user the calculation process without missing required data
- Also it will show most of possible options available.

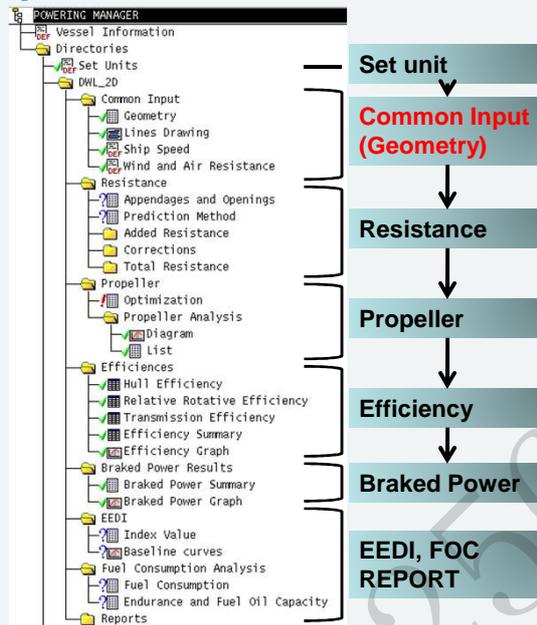


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# Geometry Definition



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# Geometry definition

Hull Geometry		Notes
Draught aft (TA)	8.4	M
Draught fore (TF)	8.4	M
Number of propellers (NP)	1	
Length of waterline (LWL)	136	M *LREF*
Length between perpend. (LPP)	136	M *LREF*
Breadth of waterline (BWL)	22.8	M *BCWL*
Wetted surface area (S)	4043.86	M2 STAT
Moulded disp. volume (DISV)	18000	M3 GIVEN
Waterplane area coef. (CWP)	0.78283	STAT
Half angle of entrance (ENTA)	22.9913	DEGREE STAT
Transv. area of bulb (ABT)	0	M2 default
long. centre of buoy. (LCB)	0.73176	M STAT
midship section coeff. (CM)	0.98243	STAT

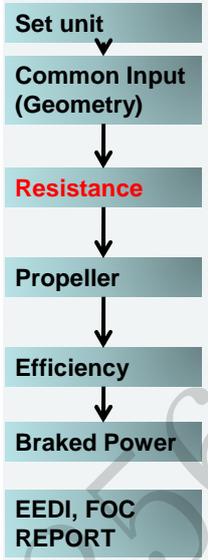
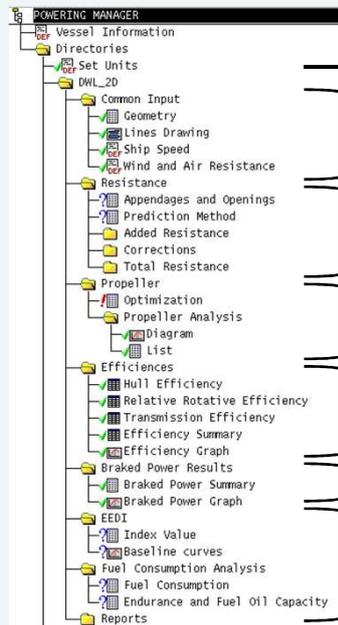
Set Water Properties

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# Resistance



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## Resistance – Empirical method

- Standard empirical method
- Prediction Methods

The screenshot shows the 'Resistance Prediction Method' dialog box. On the left, a list of methods is shown with 'HL84' selected. On the right, a table provides parameters for various ship types. Red arrows point to the 'Ship type', 'Froude no.', 'Cp', 'L/B', and 'B/T' columns.

Ship type	Max Froude no.	Cp		L/B		B/T	
		Min	Max	Min	Max	Min	Max
Tankers, bulk carries	0.24	0.73	0.85	5.1	7.1	2.4	3.2
Trawlers, coasters, tugs	0.38	0.55	0.65	3.9	6.3	2.1	3.0
Containerships, destroyer types	0.45	0.55	0.67	6.0	9.5	3.0	4.0
Cargo liners	0.30	0.56	0.75	5.3	8.0	2.4	4.0
RORO ships, car ferries	0.35	0.55	0.67	5.3	8.0	3.2	4.0

The limits for Holtrop method are:

- Resistance components

$$RT = CT \times 0.5 \times \rho \times S \times V^2$$

$$\text{Where, } CT = CF + CR + CAEX + CRAPP + CRWIND$$

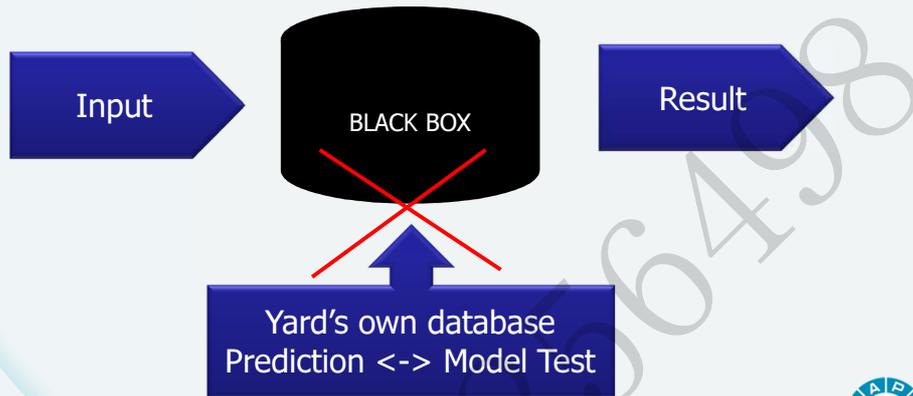
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## Resistance – Correction

- Does your program allow you to correct the resistance with your own correlation?



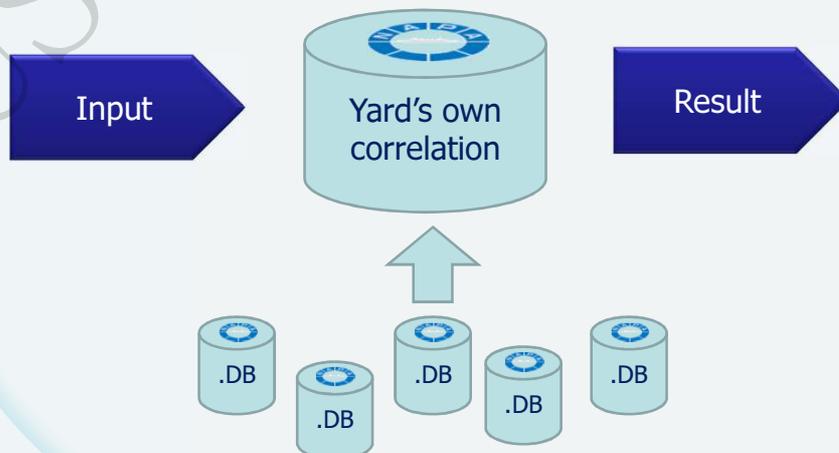
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## Resistance – Correction

- Your latest correlation from model test can be applied in NAPA



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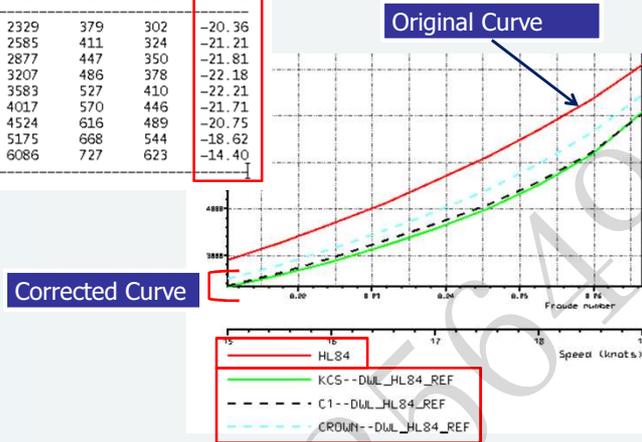


## Resistance - Correction

Corrected resistance and propulsion factors

Source: KCS--DWL\_HL84\_REF

Fn	Pe Org kW	Pe kW	Rt Org kN	Rt kN	Corr. %
0.211	2925	2329	379	302	-20.36
0.218	3281	2585	411	324	-21.21
0.225	3679	2877	447	350	-21.81
0.232	4121	3207	486	378	-22.18
0.239	4605	3583	527	410	-22.21
0.246	5131	4017	570	446	-21.71
0.253	5709	4524	616	489	-20.75
0.260	6359	5175	668	544	-18.62
0.267	7109	6086	727	623	-14.40



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## Resistance – Direct input

- Direct input resistance curve
  - Residual or wave resistance from model test can be used to calculate the total resistance
  - External resistances(Radd), i.e. added resistance and any resistance components which are not included in model test, can be considered

- Resistance components

$$RT = CT \times 0.5 \times \rho \times S \times Vs^2 + \mathbf{Radd}$$

$$\text{Where, } CT = CR + CF + CAEX + Cair$$

$$CT = CW + (1+K)CF + CAEX + Cair$$

**for 2D**

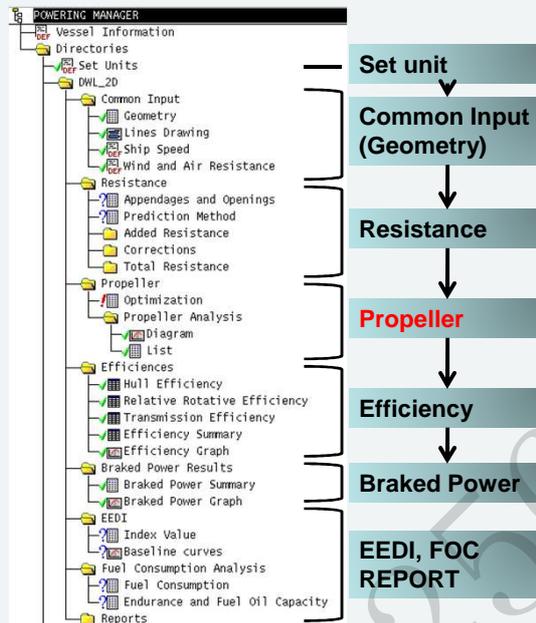
**for 3D**

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# Propeller



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# Propeller – Optimization

- Find an optimum propeller from standard propeller series
  - Wageningen Troost-B, MAU, KA series(Ducted)
- Three options are available for optimization
  - DP and PR (with given N)
  - N and PR (with given DP)
  - DP and N (with given PR)
- Two sub options are available in each option
  - Optimize for given calculation speed(VSO)
  - Optimize for given propulsion power(PD)

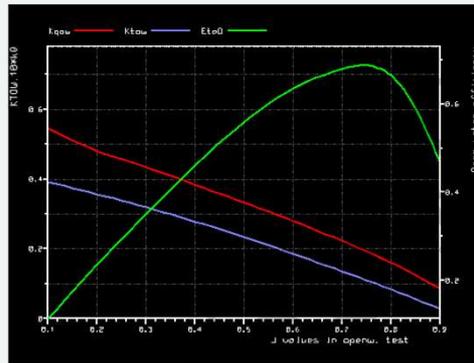
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# Propeller – Direct Input

- Direct input propeller performance
  - The data from POW(Propeller Open Water) test can be used

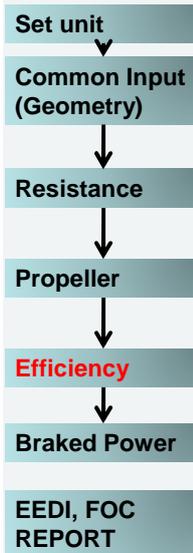
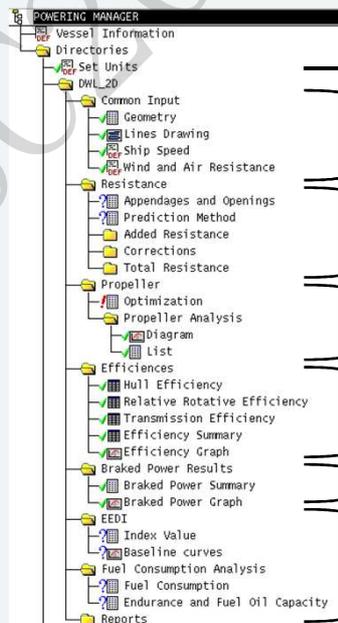


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# Efficiencies



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## Efficiencies – Propulsion factors

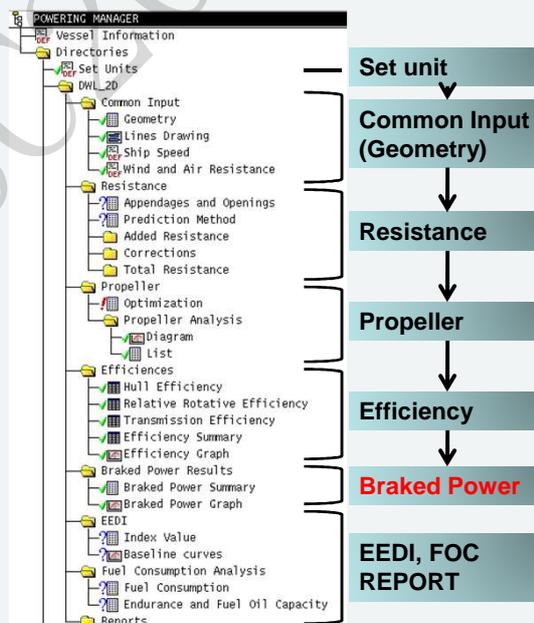
- Self propulsion factors WT, THD and ETAR can be handled by two ways
  - Calculate according to Holtrop formula
  - Direct input
- If known data such as model test result are not available, it is recommended to calculate the factors by the program.
- Then it is possible to take into account all effects of propeller geometry, hull main dimensions, scale and speed on the propulsion coefficients

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## Braked Power Results

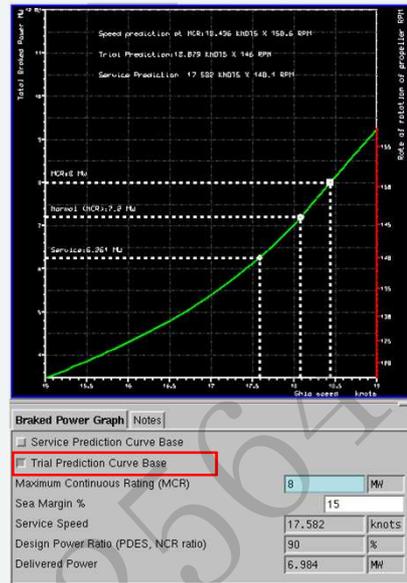


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# Braked Power Results

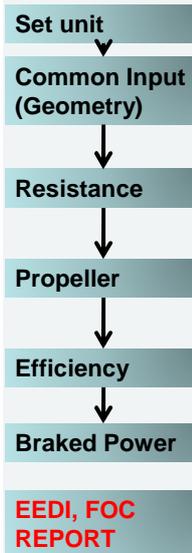
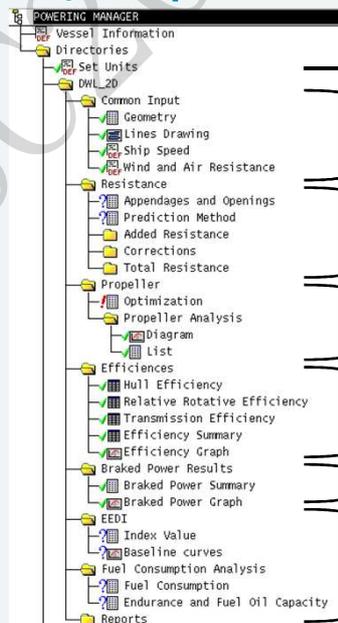


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# EEDI, FOC, Report



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## EEDI (Environmental Efficiency Design Index)

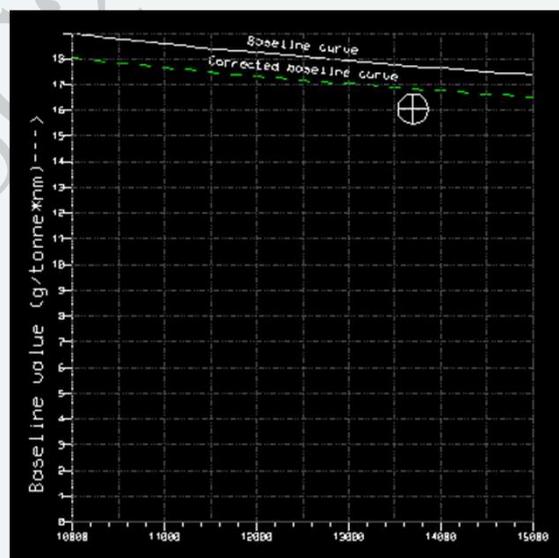
- The attained new ship Energy Efficiency Design Index (EEDI) is a measure of ships CO<sub>2</sub> efficiency and calculated by the following formula (MEPC.1/Circ. 681)

$$\frac{\left( \prod_{j=1}^M f_j \right) \sum_{i=1}^{nME} P_{ME(i)} \cdot C_{ME(i)} \cdot SFC_{ME(i)} + (P_{AE} \cdot C_{FAE} \cdot SFC_{AE}^*) + \left( \prod_{j=1}^M f_j \cdot \sum_{i=1}^{nPTI} P_{PTI(i)} - \sum_{i=1}^{noff} f_{off(i)} \cdot P_{AEoff(i)} \right) C_{FAE} \cdot SFC_{AE}}{f_j \cdot Capacity \cdot V_{ref} \cdot f_w} - \left( \sum_{i=1}^{noff} f_{off(i)} \cdot P_{off(i)} \cdot C_{FME} \cdot SFC_{FME} \right)$$

- Rule has not been finalized yet.



## EEDI (Environmental Efficiency Design Index)



# Fuel Consumption Analysis

- Daily Fuel Oil Consumption
- Endurance / Cruising Range
- Required Fuel Oil Capacity

Maximum Continuous Rating MCR	= 8000	KW
Normal Continuous Rating NCR	= 7200	KW (90 % of MCR )
SFOC of MDO at Normal condition	= 169.5	g/kw.h
Fuel Lower Heat Value FLHV	= 40400	kJ/kg
SFOC of HFO at Normal condition	= 179.15	g/kw.h
Main Engine Margin	= 0	%
Main Engine FO Consumption	= 30.9571	t/day
<b>Total Fuel oil consumption</b>	<b>= 30.9571</b>	<b>t/day</b>

Endurance	-----
Ship Speed Vs	= 17.2 KNOTS
Fuel Oil Capacity	= 1000 m <sup>3</sup>
Fuel Oil Density	= 0.97 t/m <sup>3</sup>
Fuel Oil Max Filling Ratio	= 98 %
Margin - Endurance days	= 3 days
<b>Endurance in days</b>	<b>= 27.707 days</b>
<b>Endurance in Nautical miles</b>	<b>= 11437.4 NM</b>



# Report

UNDO-RCMR  
Haga Oy  
USER HYVE

2010-05-17  
16:41:05  
1

### 1. Geometry Information

For values calculated according to given loading position and actual quantity of fuel see HSL.

Current Directory SWPWR\_20

1	Draught main	8
2	Draught aft	8
3	Draught fore	8
4	Length between perpendiculars	126
5	Length of waterline	126
6	Length of deck	126
7	Length of hull	126
8	Length of keel	126
9	Length of rudder	126
10	Length of propeller	126
11	Length of shaft	126
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96	Length of propeller	126
97	Length of propeller	126
98	Length of propeller	126
99	Length of propeller	126
100	Length of propeller	126

### 7. Fuel Consumption Analysis

#### 7.1. Fuel Consumption

Maximum Continuous Rating MCR	= 8000	KW
Normal Continuous Rating NCR	= 7200	KW (90 % of MCR )
SFOC of MDO at Normal condition	= 169.5	g/kw.h
Fuel Lower Heat Value FLHV	= 40400	kJ/kg
SFOC of HFO at Normal condition	= 179.15	g/kw.h
Main Engine Margin	= 0	%
Main Engine FO Consumption	= 30.9571	t/day
Total Fuel oil consumption	= 30.9571	t/day

#### 7.2. Endurance and Fuel Oil Capacity

Ship Speed Vs	= 17.2	KNOTS
Fuel Oil Capacity	= 1000	m <sup>3</sup>
Fuel Oil Density	= 0.97	t/m <sup>3</sup>
Fuel Oil Max Filling Ratio	= 98	%
Margin - Endurance days	= 3	days
<b>Endurance in days</b>	<b>= 27.707</b>	<b>days</b>
<b>Endurance in Nautical miles</b>	<b>= 11437.4</b>	<b>NM</b>

#### 2.3. Coefficient Curve Graph

#### 5.2. Brake Power Graph



## Example Case

- Cargo Ship
- MCR : 8000 kW x 148 RPM
- NCR (90% MCR) 7200 kW x 142.9 RPM
- Sea Margin : 15 %
- No.of Propeller blade : 4
- RPM margin : 3% -> 147.2 RPM at NCR



## Example 1

- Prediction method corrected with reference data
  - Normal Speed Power Prediction in early design stage
  - Speed effect on changing propeller diameter and the number of propeller blade



## Example 2

- Estimate the speed decrease at scantling draft compared to design draft
  - Propeller which is optimized at the design draft must be used
  - Resistance and self propulsion factors are to be calculated according to the hull parameters at scantling draft.



## Example 3

- Direct input of resistance data from model test
  - Resistance data of model test can be directly used
  - Speed loss at B.F scale from SeaKeeping calculation(SHS)
  - Propeller open water characteristics from model test can be input directly



# Live Demo



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# Development Plans

- SH-Powering Manager
  - Improvement of using model test library and reference data
  - Vibration excitation
  - Engine library
  - ECC

Main Engine Selection Notes

Speed Category: LOW\_SPEED

Make: MANB&W

Estd Req'd Power (MW): Type: Num Cyl:

Select Engine from table below:

	TYPE_ENGINE	NOCYL	R1	R2	R3	R4	RPM(R1&R2)	RPM(R3&R4)	WEIGHT	IMO
1	K98-ME7	6	37.3800	34.6800	30.0000	27.7800	97.000	90.000	1067.00	TIER 2 ONLY
2	K98-ME7	7	43.6100	40.4600	35.0000	32.4100	97.000	90.000	1220.00	TIER 2 ONLY
3	K98-ME7	8	49.8400	46.2400	40.0000	37.0400	97.000	90.000	1437.00	TIER 2 ONLY
4	K98-ME7	9	56.0700	52.0200	45.0000	41.6700	97.000	90.000	1581.00	TIER 2 ONLY
5	K98-ME7	10	62.3000	57.8000	50.0000	46.3000	97.000	90.000	1755.00	TIER 2 ONLY
6	K98-ME7	11	68.5300	63.5800	55.0000	50.9300	97.000	90.000	1895.00	TIER 2 ONLY
7	K98-ME7	12	74.7600	69.3600	60.0000	55.5600	97.000	90.000	2058.00	TIER 2 ONLY

Select Engine

Selected Main Engine: Select Rating: R1

Number of Cylinders:

Edit Engine Library

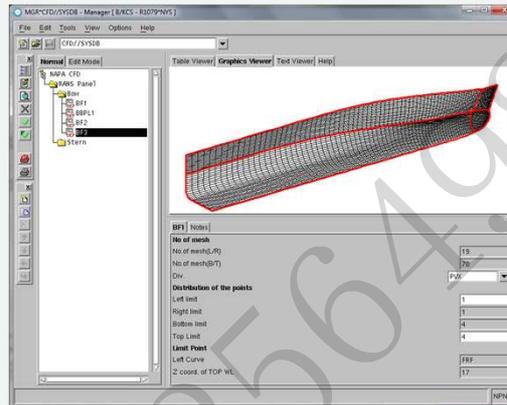
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## Development Plans

- CFD Manager :
  - Automatic surface and volume mesh
  - RANS and TAHA, viscous and potential flow solvers
  - Optimization



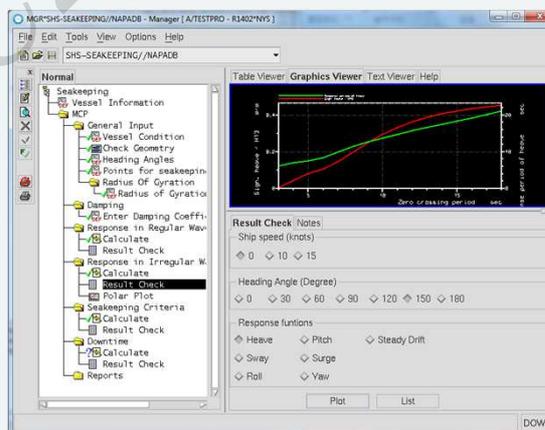
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## Development Plans

- SHS-Seakeeping Manager



- SHM-Manoeuvring Manager
  - Circle, Zig Zag, Stationkeeping, etc.

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Thank you

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