SH-POWERING
Hydrodynamic Manager

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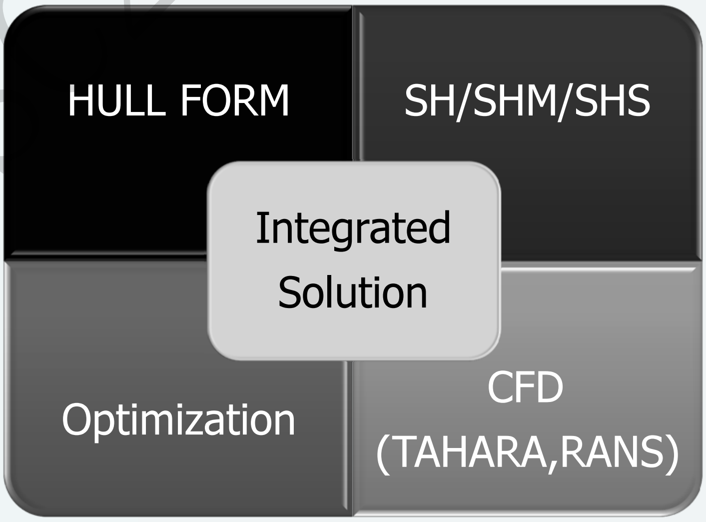
Contents

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

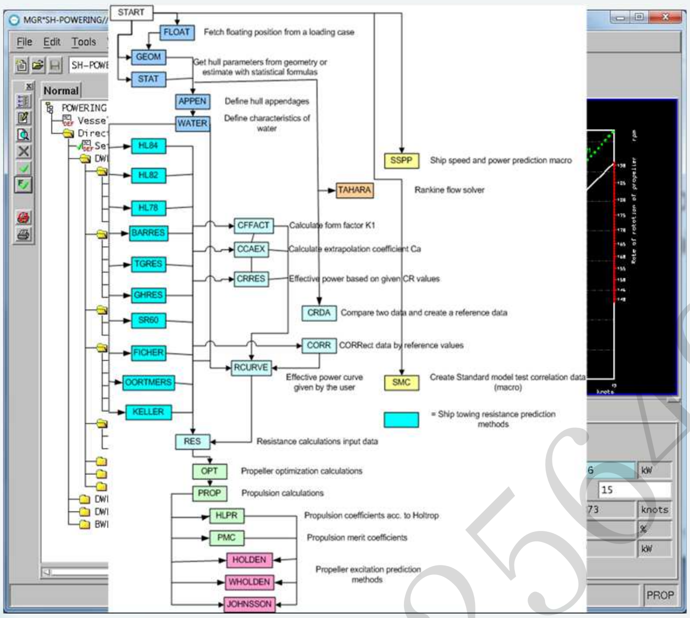
How many powering programs do you have for ... ?

- 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 environmetal forces at some B.F. Scale
- Propeller exitation force
- Propeller cavitation number and margin

Goal - Integrated solution

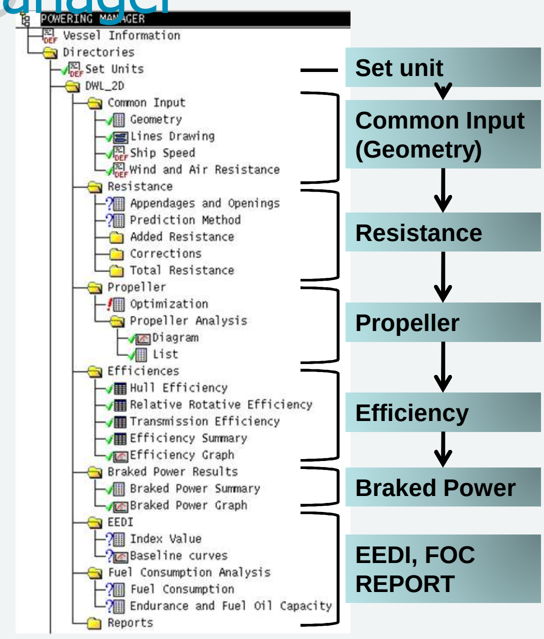


Goal – Improve usability

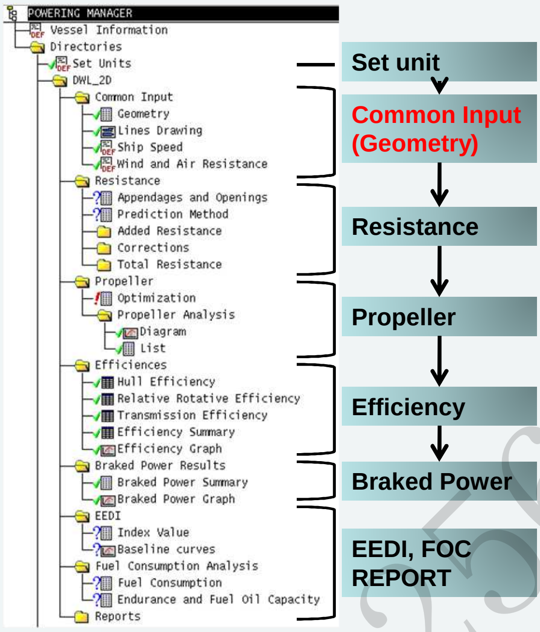


SH-Powering Manager

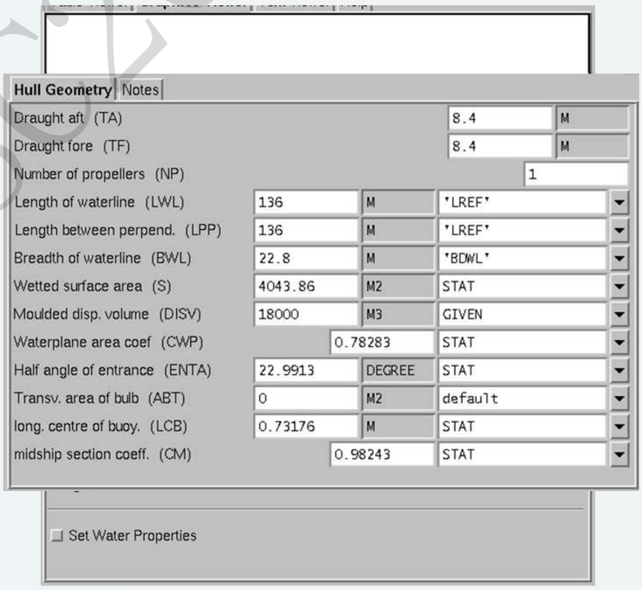
- The manager will guide a user the calculation process without missing required data
- Also it will show most of possible options available.



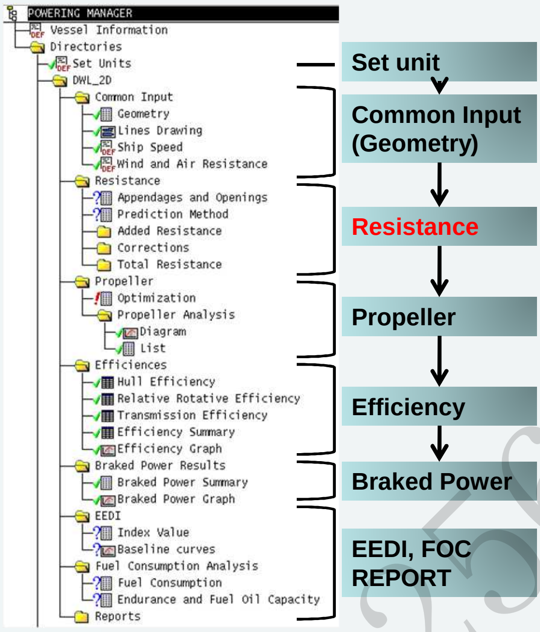
Geometry Definition



Geometry definition

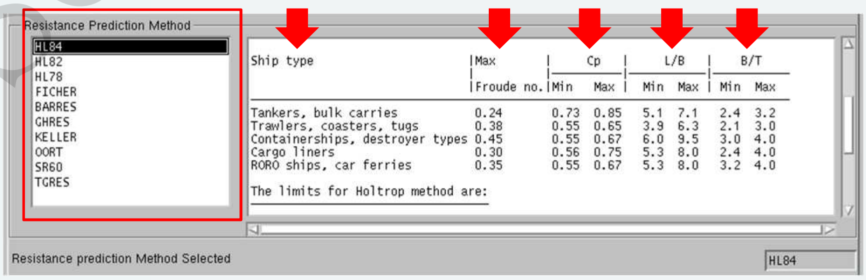


Resistance



Resistance – Empirical method

- Standard empirical method
  - Prediction Methods



Ship type	Max Froude no.	Cp Min	Cp Max	L/B Min	L/B Max	B/T Min	B/T 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

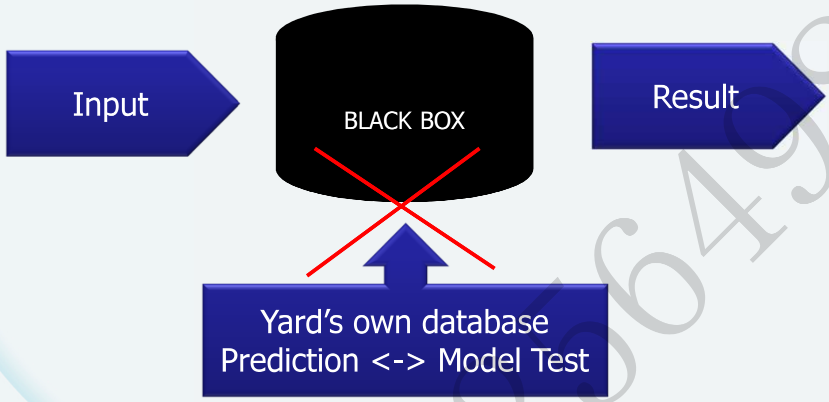
- Resistance components

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

  Where, $CT = CF + CR + CAEX + CRAPP + CRWIND$

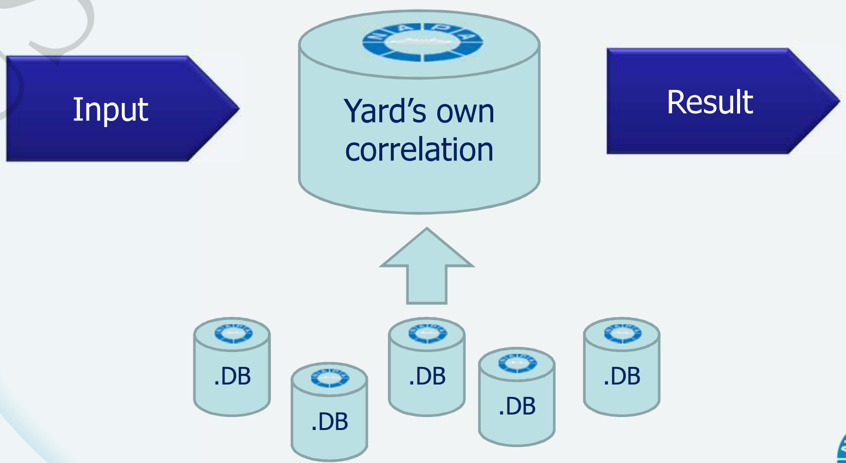
Resistance – Correction

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



Resistance – Correction

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

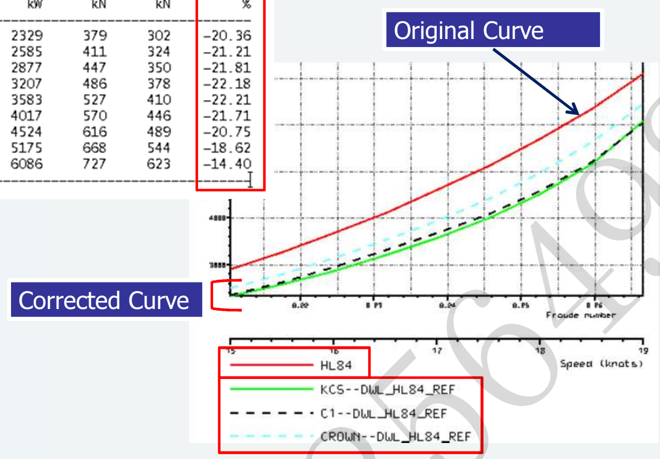


Resistance - Correction

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



Resistance – Direct input

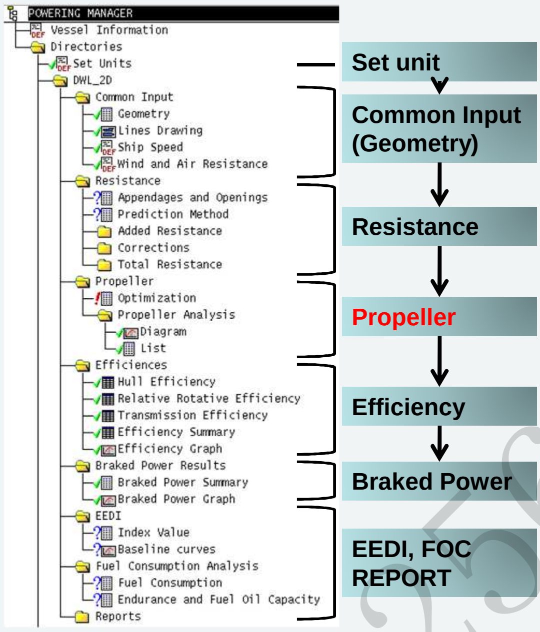
- Direct input resistance curve
  - Residual or wave resistance from model test can be used to calculate the total resistance
  - External resistances(Radd), i.e. added resistance and any resistance components which are not included in model test, can be considered
  - Resistance components

    RT = CT x 0.5 x ρ x S x Vs^2 + **Radd**

    Where, CT = CR + CF + CAEX + Cair **for 2D**

    CT = CW + (1+K)CF + CAEX + Cair **for 3D**

Propeller

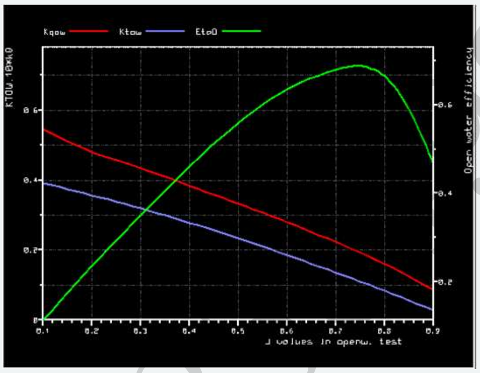


Propeller – Optimization

- 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)

Propeller – Direct Input

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



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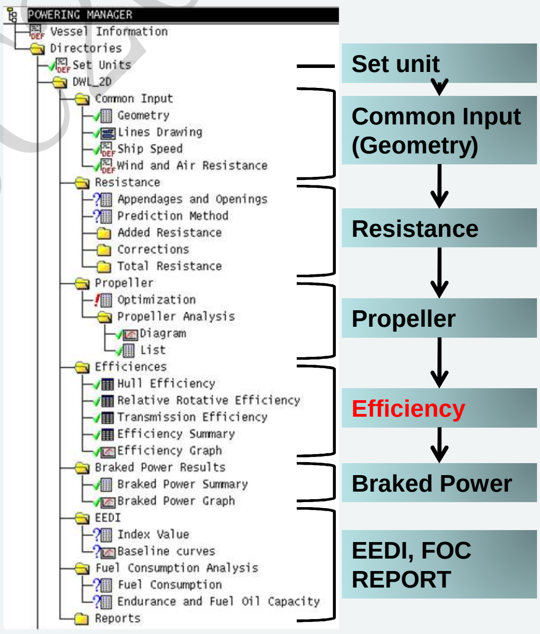
Efficiencies



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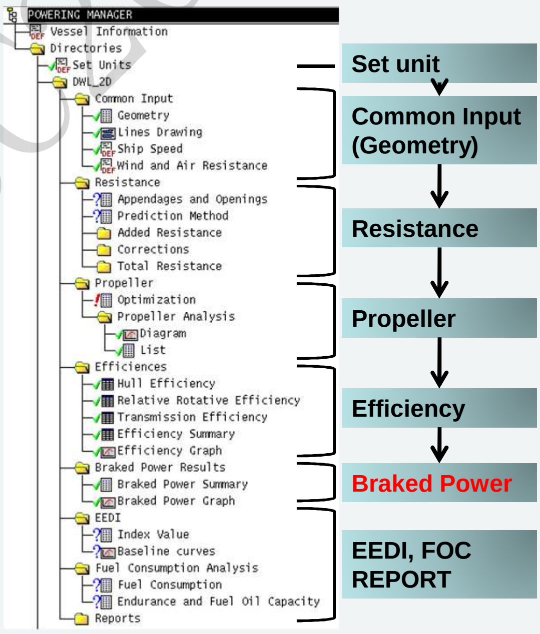
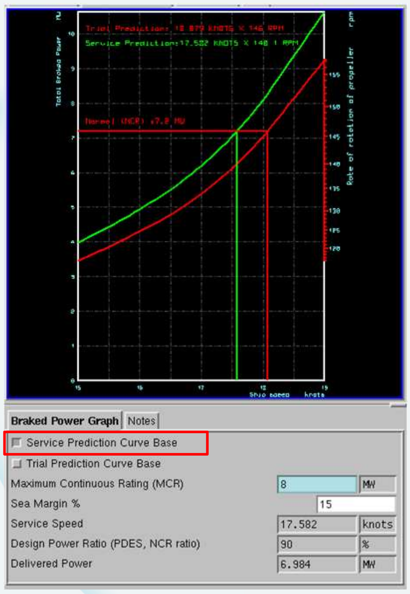
Efficiencies – Propulsion factors

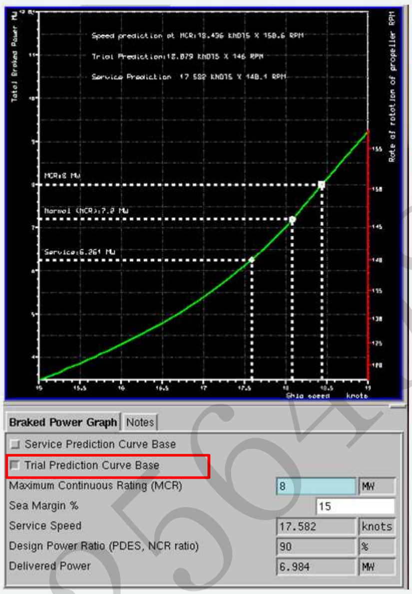
- Self propulsion factors WT, THD and ETAR can be handled by two ways
  - Calculate according to Holtrop formula
  - Direct input
- If known data such as model test result are not available, it is recommended to calculate the factors by the program.
- Then it is possible to take into account all effects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

Braked Power Results

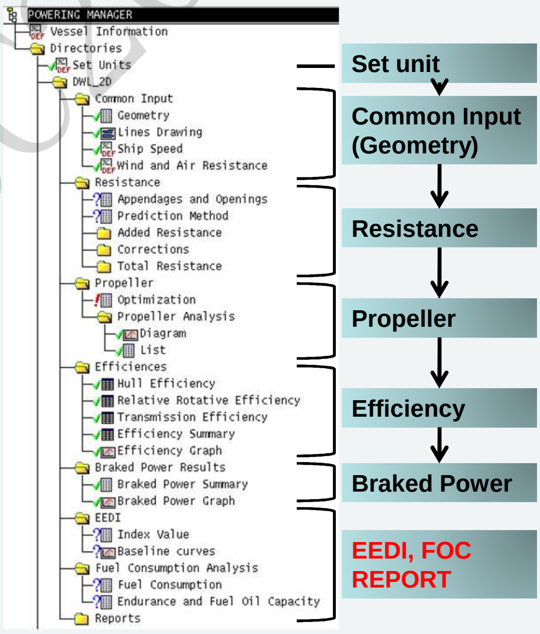


Braked Power Results





EEDI, FOC, Report



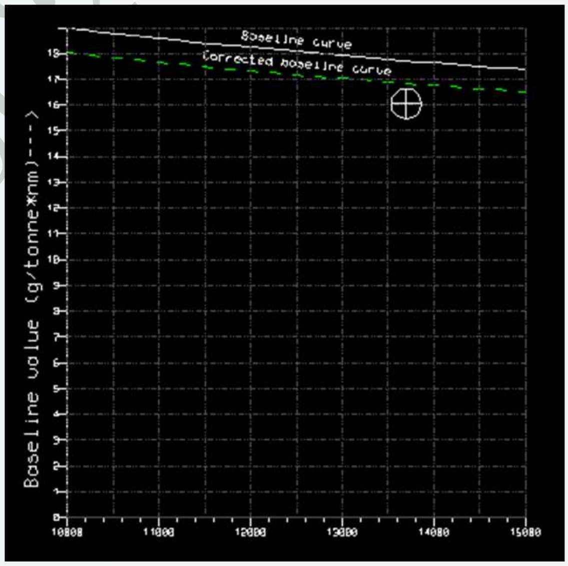
EEDI (Environmental Efficiency Design Index)

- The attained new ship Energy Efficiency Design Index (EEDI) is a measure of ships CO_2 efficiency and calculated by the following formula (MEPC.1/Circ. 681)

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

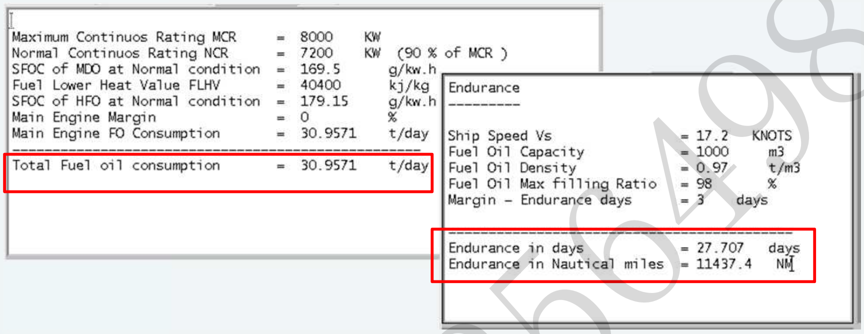
- Rule has not been finalized yet.

EEDI (Environmental Efficiency Design Index)

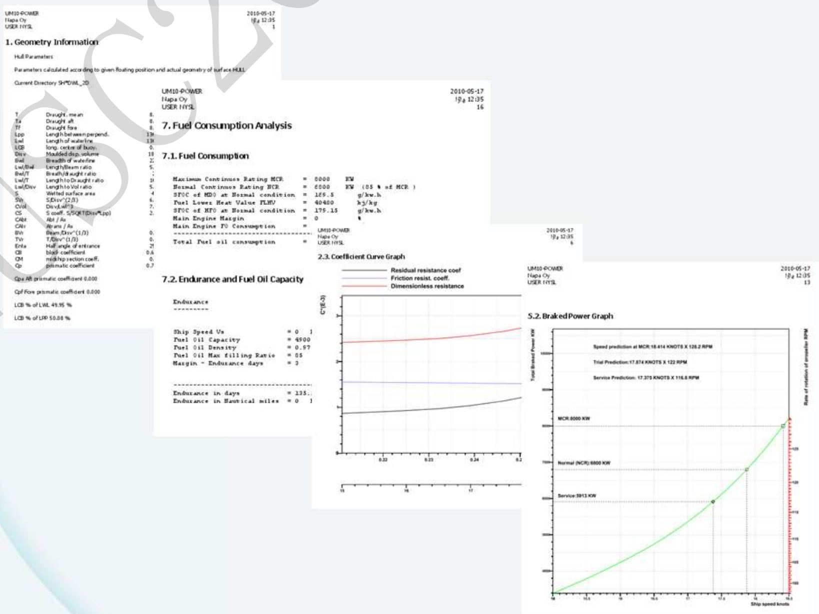


Fuel Consumption Analysis

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



Report



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.

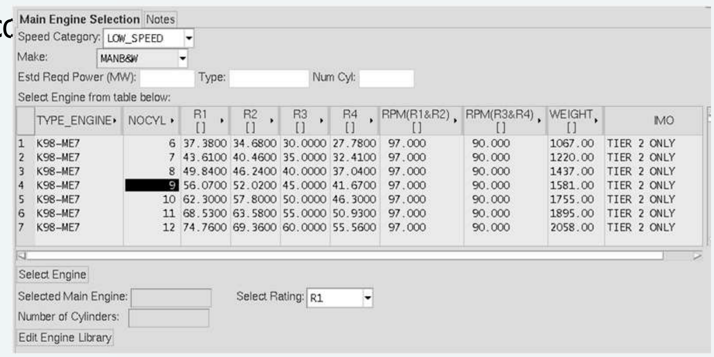
Example 3

- 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

Development Plans

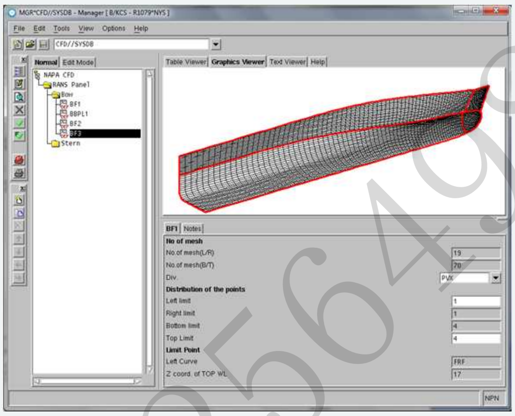
- SH-Powering Manager
  - Improvement of using model test library and reference data
  - Vibration excitation
  - Engine library
  - Ecc



	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

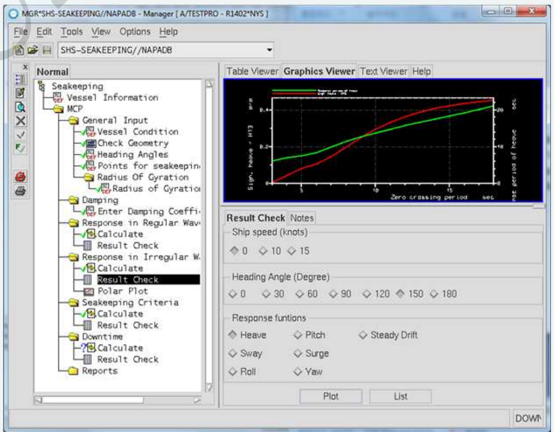
Development Plans

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



Development Plans

- SHS-Seakeeping Manager



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

Thank you