NAVAL GROUP

POWER AT SEA

CAESES USER MEETING : HOLISTIC DESIGN EXPLORATION OF A MULTI-PURPOSE OCEAN VESSEL

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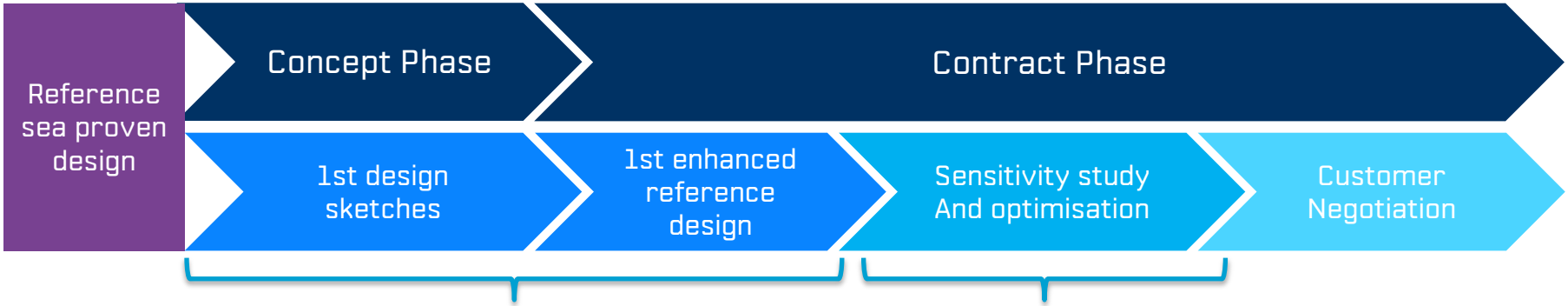
ITERATIVE DESIGN LOOP AND SYNCHRONOUS DESIGN EXPLORATION

ITERATIVE DESIGN LOOP AND SYNCHRONOUS DESIGN EXPLORATION – MPOV APPLICATION CASE



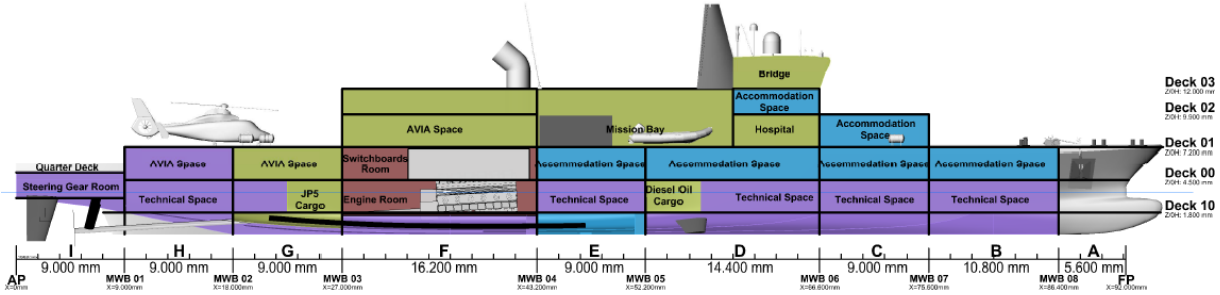
PARTNERS INVOLVED IN WP12 : MPOV DESIGN

Partners involved in this HOLISHIP application case :

- **Epsilon**
- **FRIENDSHIP SYSTEMS**
- **IRT System X**
- **Lloyd's**
- **Naval Group**
- **SINTEF**
- **Sirehna**
- **TNO**
- **University of Strathclyde**

MULTI-PURPOSE OCEAN VESSEL 1ST REFERENCE DESIGN

MULTI-PURPOSE OCEAN VESSEL

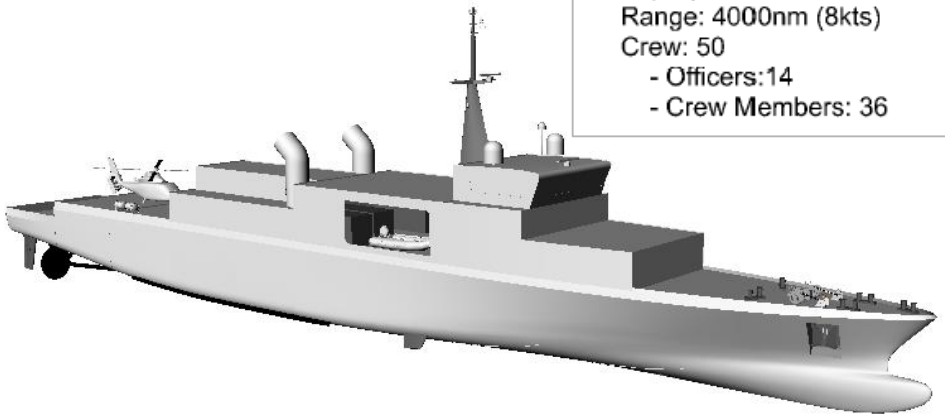


MPOV
Main Characteristics

Length Overall: 95m
Length of Waterline: 92m
Beam: 12,5m
Draught FLD: 3,58m
Depth: 7,2m
Full Load Disp.: 2493t
Engines: 2x10MW
Top Speed: 26kts
Range: 4000nm (8kts)
Crew: 50
- Officers:14
- Crew Members: 36

Operational scenarios :

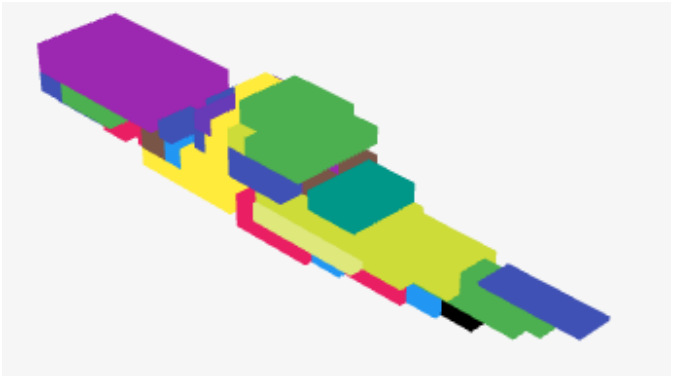
- Search and rescue an overloaded craft of migrants
- Surveillance of surrounding ship at EEZ
- Interception of a fast craft suspected of illicit activities
- Disperse pollution and investigate on leak
- Supply first necessity goods and rescue means to near shore disaster

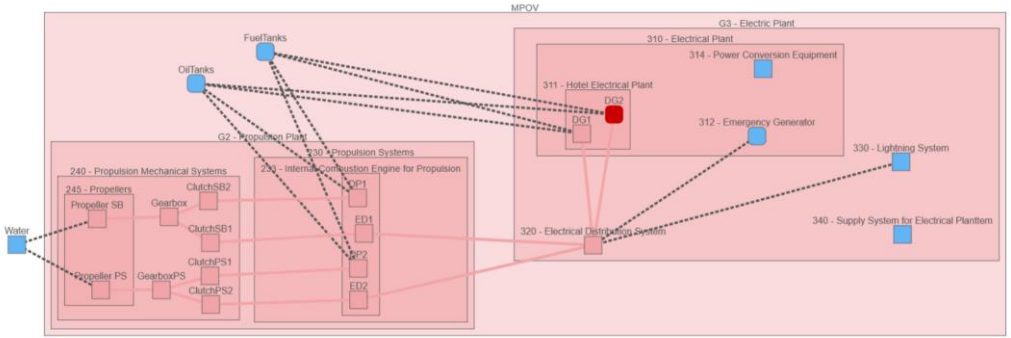


CONCEPT DESIGN PHASE : MULTI-PURPOSE OCEAN VESSEL 1ST REFERENCE DESIGN

Concept phase activities (sketches) :

- Operational scenarios and requirement definition
- System architecture (several options)
- Preliminary arrangement involving volumes and mass
- Main particular first assumption



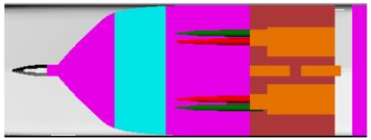


NON SENSITIVE

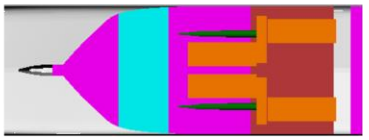
CONTRACT DESIGN PHASE : MULTI-PURPOSE OCEAN VESSEL 1ST REFERENCE DESIGN

Contract phase 1st reference enhanced design :

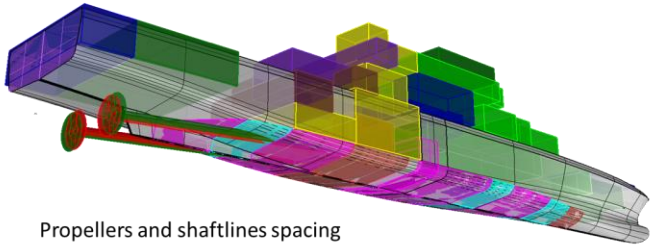
- General arrangement
- 1st reference 3D hull definition
- Weight and load case definition
- Intact stability check
- Resistance assessment
- Seakeeping check
- Structural cross section check

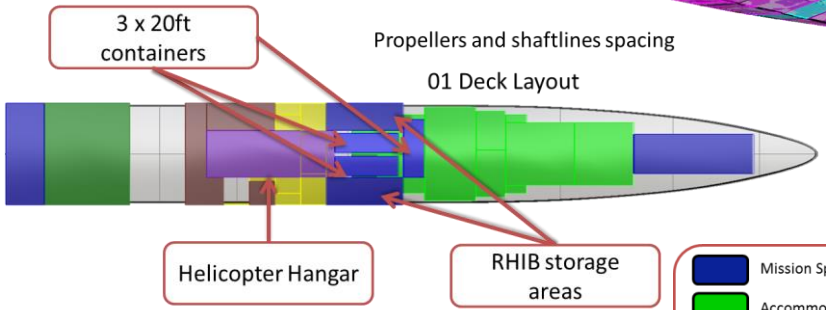


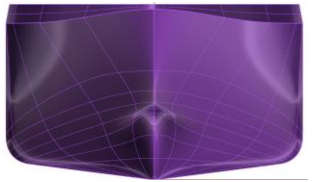
DAD propulsion system integration



CODAD propulsion system integration

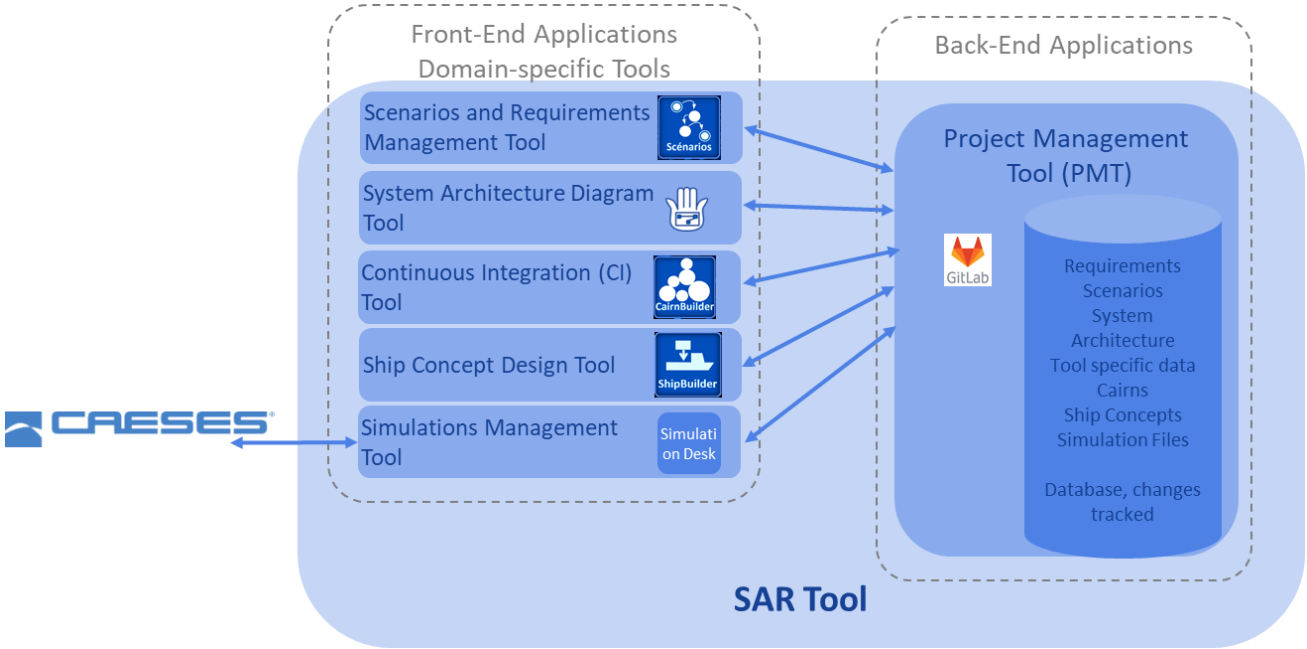






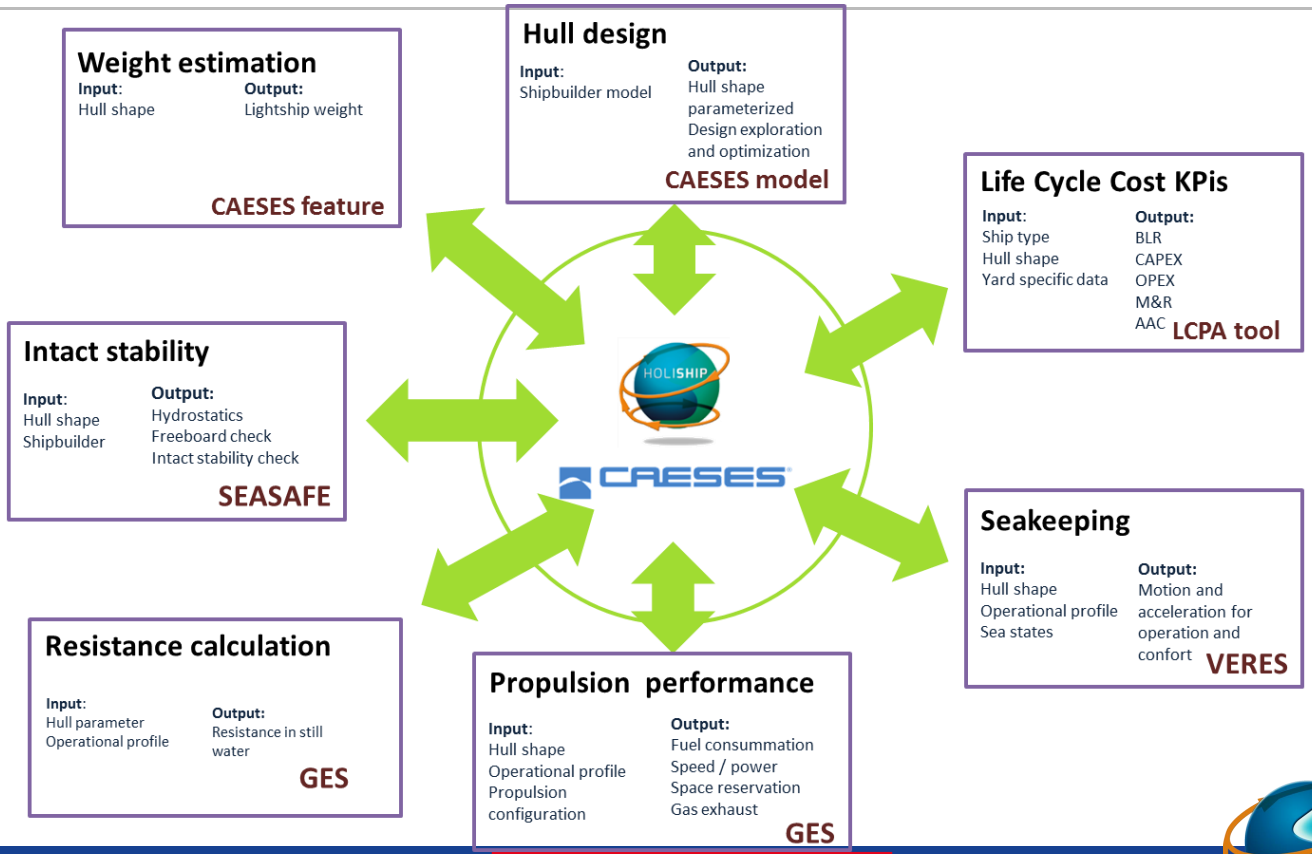
CONTRACT DESIGN PHASE : MULTI-PURPOSE OCEAN VESSEL 1ST REFERENCE DESIGN

System architecture and requirement management tool



CAESES MODEL IMPLEMENTATION

MPOV CAESES MODEL IMPLEMENTATION

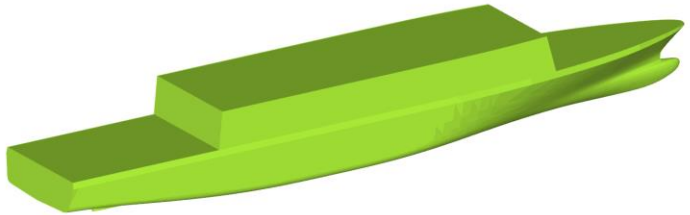


NON SENSITIVE

HULL SHAPE IMPLEMENTATION

- Import from .iges then global hull shape modification

- Simple deformation implementations in a first step :
  - Length : scale 1D
  - Breadth : scale1D
  - Depth : scale1D
  - Lackenby
  - Bulb box modification



- Next step : Fully parameterized hull implementation (more deformation and parameters)

WEIGHT ESTIMATION

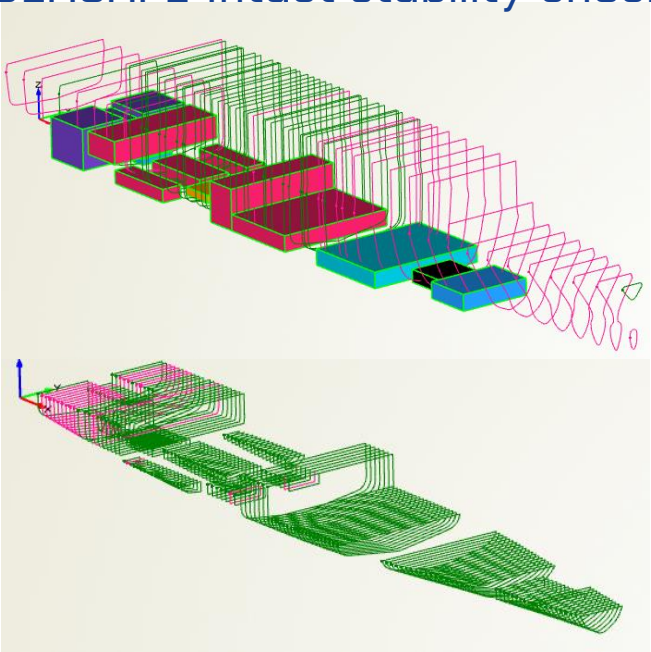
One specific feature scripted in CAESES taking into account specific ratios for each system items.

Base on one reference design.

Reference design weight		Current design weight	
01Deadweight	314.50 t	01Deadweight	326.83 t
02Structure	912.74 t	02Structure	984.33 t
03Systems	223.25 t	03Systems	240.76 t
04Propulsion	198.03 t	04Propulsion	247.54 t
05Electricity	42.52 t	05Electricity	45.85 t
06Miscellaneous	15.95 t	06Miscellaneous	17.20 t
10Tot_Full_load	1706.99 t	10Tot_Full_load	1862.51 t
11Tot_Lightweight	1392.49 t	11Tot_Lightweight	1535.68 t
20_Lpp_ref	91.80 m	20_Lpp	99.00 m
21_Boa_ref	12.50 m	21_Boa	12.50 m
22_D_ref	7.40 m	22_D	7.40 m
23_P_prop	20.00 MW	23_P_prop	25.00 MW

HYDROSTATICS AND INTACT STABILITY CRITERIA

Import tank definition from 3D arrangement tool to SEASAFE
Define windage and margine line
SEASAFE Intact stability check



Output implemented :

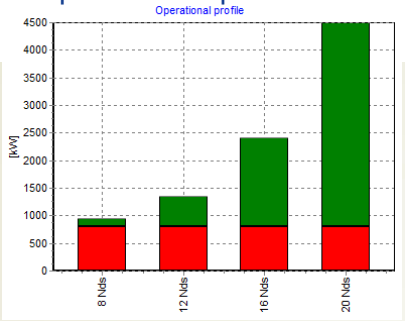
- Gmt
- Gmt corrected with free surface effects
- Intact stability criteria on GZ curve including weather criterion (in progress)

RESISTANCE AND PROPULSION PERFORMANCE ASSESSMENT

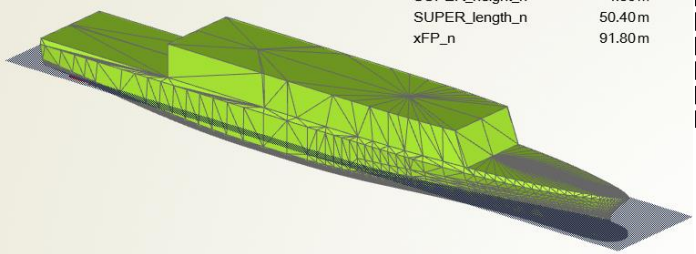
GES connection :

Inputs :

- Hull parameters required for HOLTROP
- 3 pre-set propulsion system model in GES (DAD / CODAD / CODLAD)
- Operational profile

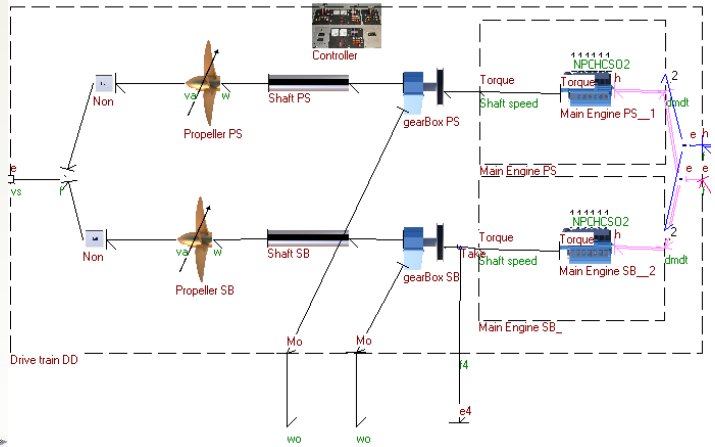


Current parameters	
Beam_n	12.50 m
Depth_n	7.40 m
Design_draft_n	3.50 m
Lpp_n	91.80 m
nSection_n	102.00 m
Offset_fore_superstructure	2.00 m
PLH_length_n	21.60 m
Ratio_Beam	1.00 m
Ratio_Depth	1.00 m
Ratio_Lpp	1.00 m
SUPER_height_n	4.80 m
SUPER_length_n	50.40 m
xFP_n	91.80 m



Computations outputs :

- Resistance calculation
- Propeller definition for design speed
- Maximum speed reached with the fixed installed power
- Gas emission during the whole operational profile



Direct Drive	: DAD
Number of aux gensets	: 2
CPP propeller	
Number of drive trains	: 2
Number of shaft engines	: 1
Propeller diameter [m]	: 3.1
Total drive power [kW]	: 20000
Auxilary power [kW]	: 1000
Max speed [kts]	: 27.0137
Efficiency configuration	: 0.175198
Total mass [kg]	: 251289
Total floor area [m2]	: 393.525
Total volume [m3]	: 329.091
Total IPC [kEuro]	: 3523.15
Total Fuel consumption [kg]	: 483451
Total NOx [kg]	: 39465.6
Total PM [kg]	: 507.168
Total CO [kg]	: 5203.42
Total HC [kg]	: 1885.69
Total CO2 [kg]	: 1.51879e+06
Total SO2 [kg]	: 4834.51
EEDI [g CO2/(tonne n.m)]	: 134.336

SEA KEEPING CRITERIA CHECK

VERES connection (in progress)

Criteria to be checked depending on hull parameters :

- Helicopter launch and recovery criteria at sea state 4 (acceleration + pitch/roll RMS)
- ROV launch and recovery criteria at sea state 3 (acceleration + pitch/roll RMS)
- RHIBs launch and recovery criteria at sea state 4 (acceleration + pitch/roll RMS)
- Comfort criteria according to rules

LIFE CYCLE COST ESTIMATE

Excel tool connection
Inputs :

- Deadweight - DWT [t]
- Lightweight - LWT [t]
- Operational Speed [kn]
- Lenght btween perpendiculars - Lbp [m]
- Breadth - B [m]
- Draft - T [m]
- Block Coefficients - Cb
- Gross Tonnage - GT [tons]
- Depth - D [m]
- Hull height H [m]
- Wet Surface [m2]
- Number of main shafts/propeller
- Total propulsion power [kW]
- Total electrical power [kW]
- Machinery density [% surface occupied]
- Lifetime (years)

Computations outputs :

For each design variant an Excel macro is launched from Caeses.
Following outputs are stored in Caeses from LCC tool :

- BLR : Building cost
- OPEX : Operational expenditure
- CAPEX: Capital expenditure
- M&R : Maintenance and repair cost (part of OPEX)
- AAC : Average annual cost

PERSPECTIVES

EXPECTED RESULTS :

1st exploration design on following values (to be performed) :

- B
- Lpp
- D
- Superstructure main dimensions

Constraints :

- Intact stability criteria
- Seakeeping criteria
- Max speed

Objectives :

- Gas emissions
- Fuel consumption
- Life cylce cost : OPEX & CAPEX

NEXT STEPS :

Next steps that could be performed for MPOV design exploration within CAESES :

- Fully parametrised hull model (in progress)
- Specific batch simulation for bow and stern shape optimization
  => Implies to connect a CFD tool
- Damage stability, only floodable length as a first step for WP12

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