Project Mermaid Electrification & Hybrid 2 stroke propulsion of cargo ships

Nikolaos Michas
Tanker Segment Manager

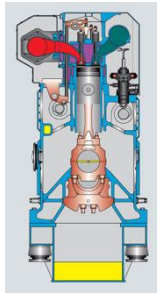
Our experience. Your growth.

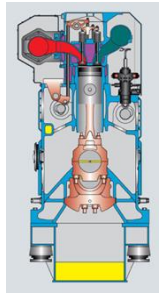
Sources of fuel consumption

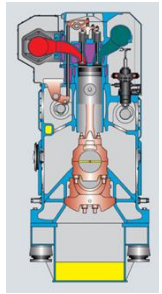
2 stroke, Main engine

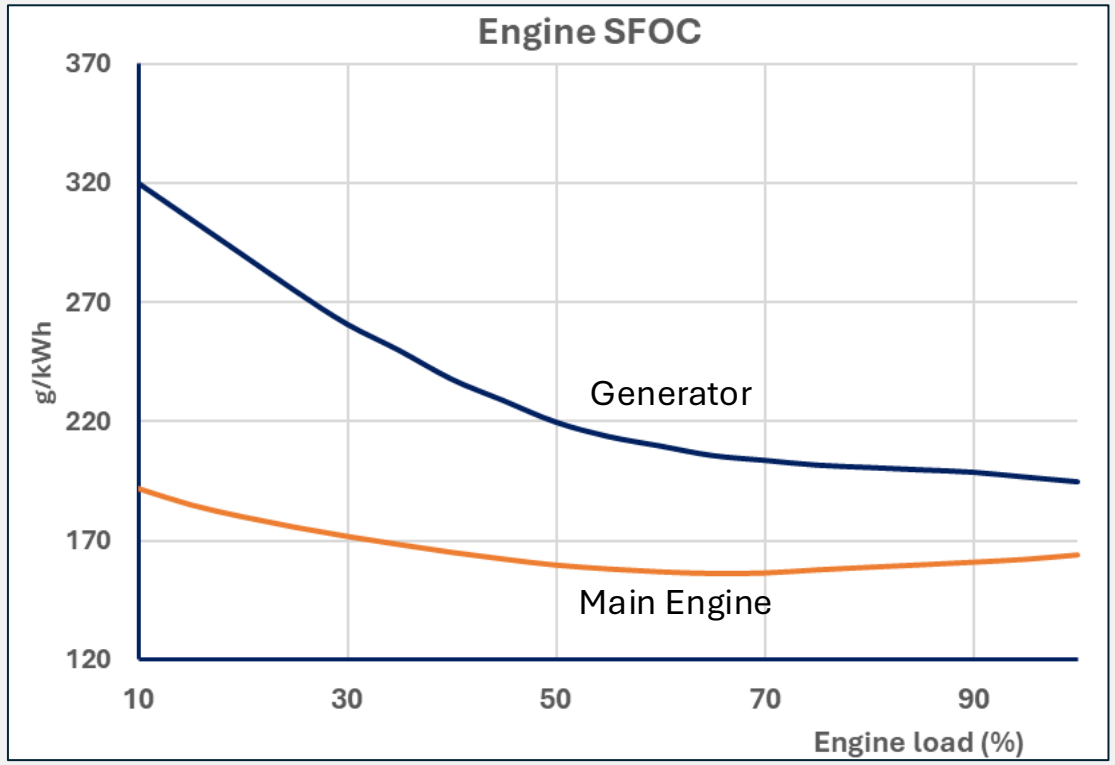


4 stroke, Generators



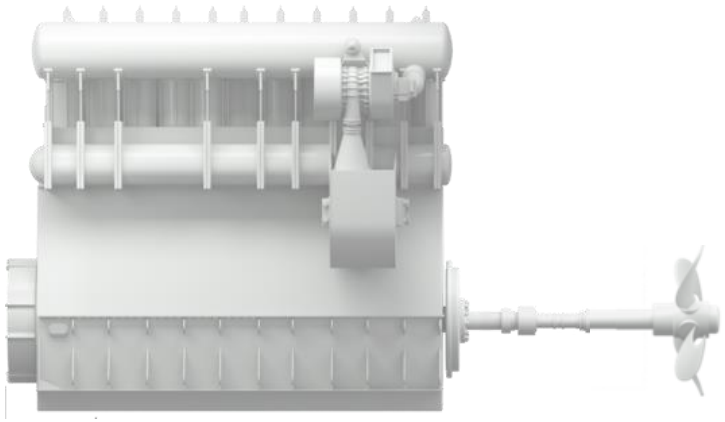






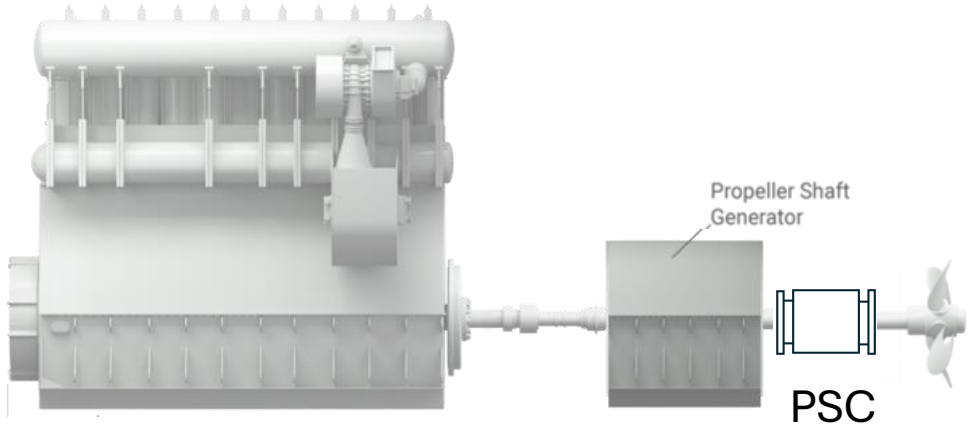
Ideally,
(propulsion + electric) Power from the Main Engine

How main engine becomes genset at port



- In standard designs, main engine drives the propeller at sea, and is stopped at port

RINA proposal



- ✓ **Introduce the shaft generator**
- ✓ **Propeller Shaft Coupling** (PSC) provides an on/off connection between main engine and propeller

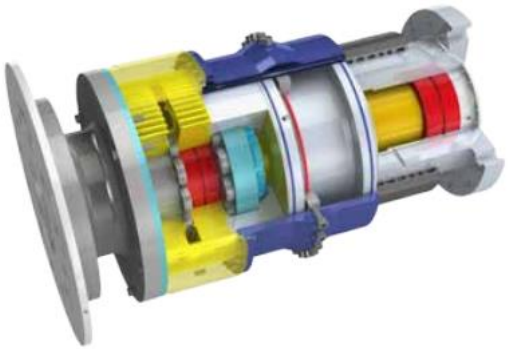
Shaft coupling



PSC Propeller Shaft Clutch

It operates by means of hydraulic pressure

Maker: **RENK**
Extensive Reference list (>150 ships)



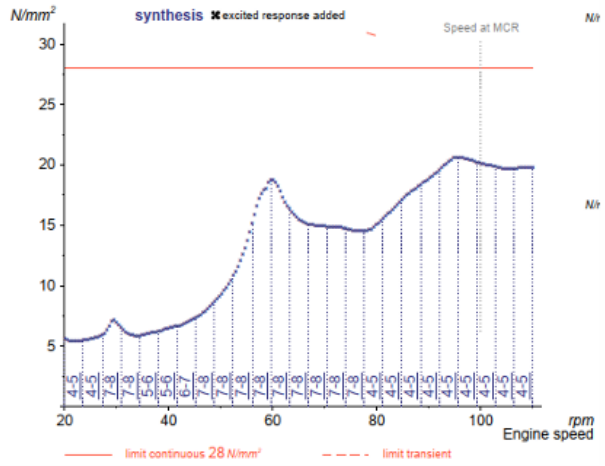
Engaged



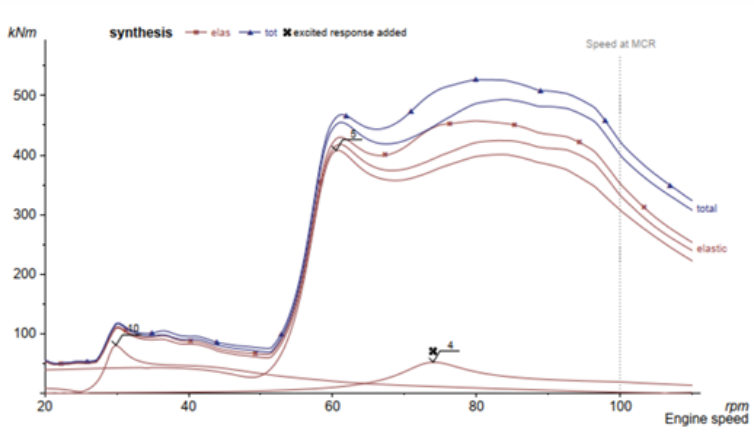
Disengaged

Study of Torsional vibrations

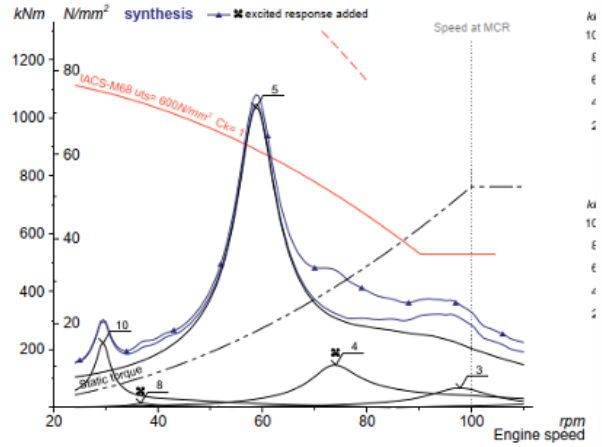
Full system



Maximum stress crankshaft

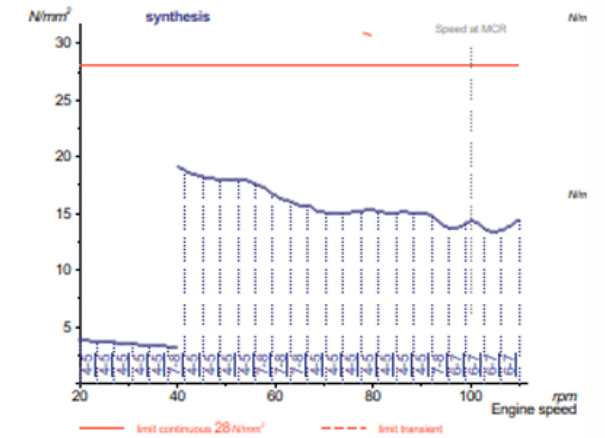


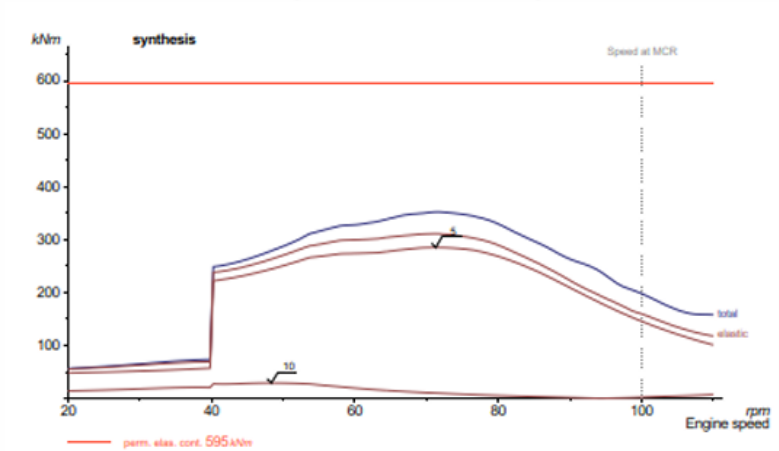
TV damper elastic torque

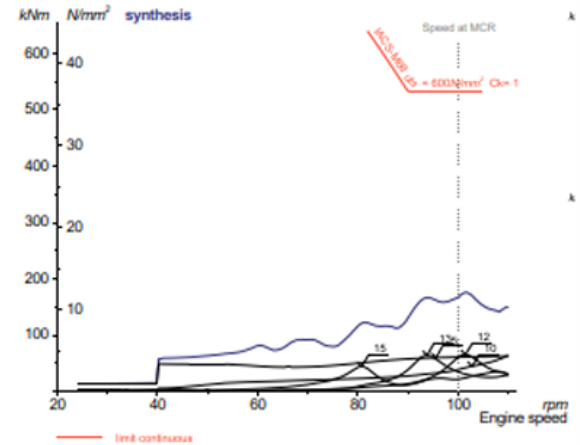


Vibratory torque generator shaft

Reduced system

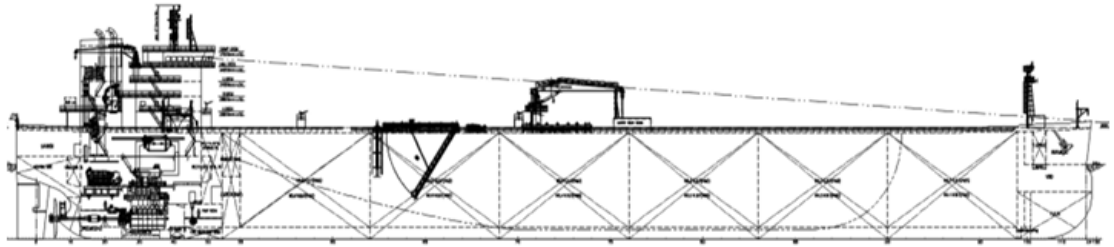






GEISLINGER

LR2 tanker developed by SDARI



MAIN PARTICULARS

Length overall	~249.90 m
Length between perp.	244.20 m
Breadth moulded	44.00 m
Depth moulded	21.50 m
Draught	
Design draught	13.50 m
Scantling draught	15.00 m
Deadweight	
@Design draught	99,000 t
@Scantling draught	114,400 t
Endurance	23,000 nm
Complement	28 P+6 SUEZ

TANK CAPACITIES

Cargo tanks (incl. slop& residual)	134,500 m^3
Slop tanks	3,000 m^3
Residual tank	200 m^3
LS. H.F.O.	2,200 m^3
Marine gas oil	700 m^3
Fresh water	540 m^3
Water ballast	40,000 m^3

CARGO CAPACITY AND EQUIPMENT

Max. Loading Rate	10,800 m^3/h
Max. Discharging Rate	9,000 m^3/h
Cargo Pumps	
Type	Electric motor driven, centrifugal
Capacity	3 x 3,000 m^3/h
Cargo tanks cleaning:	COW & sea water
Heating for cargo/slop tanks	heating coils
Inert gas system	11,250 Nm^3/h
Ballast pumps	
Type	Electric motor driven, centrifugal
Capacity	2 x 1,500 m^3/h
BWTS	total capacity: 3,000 m^3/h

MACHINERY MAIN COMPONENTS

Main engine	Everllence 5G60ME-C10.5 -HPSCR
Diesel generators	3 x ~1,600 kW
Shaft generators/PTI	2 x ~2,500 kW /~1000 kW
Emergency generator	1 x ~250 kW
Containerized battery(option):	~1,960kWh
Propeller	1 x FPP
Shaft clutch	installed between the propeller&PTO
Aux boiler：	1 set, 30t/h
Exhaust gas economizer:	1 set, 350kg/h

KEY FEATURES

- Electrical motor driven cargo pumps(low OPEX).
- Low CAPEX with rich function.
- Excellent performance in extreme sea conditions.
- Crude oil and product oil can be loaded in Pure epoxy coated 12 cargo tanks and 2 slop tanks
- Smart ship system installed
- Flexible design (Containerized battery, ICE notation of different level, Scrubber system, LNG/Methanol DF ready design, wind propulsion system)

ENERGY EFFICENCY PARTICULARS

Service speed at design draught	13.5 kn
(CSR output with 600kW PTOm load and 15% sea margin)	
Max. speed at design draught	~14.3 kn
Energy saving devices:	Duct & cap fin
ME fuel oil consumption at CSR output	
Tier II& Tier III	29.78 t/d
SPC NOx tier II	29.87 t/d

The above FOC includes 600kW PTOm load(~2.3t/day).

(Based on LCV 42,700 kJ/kg, ISO conditions, excl. engine tolerance)

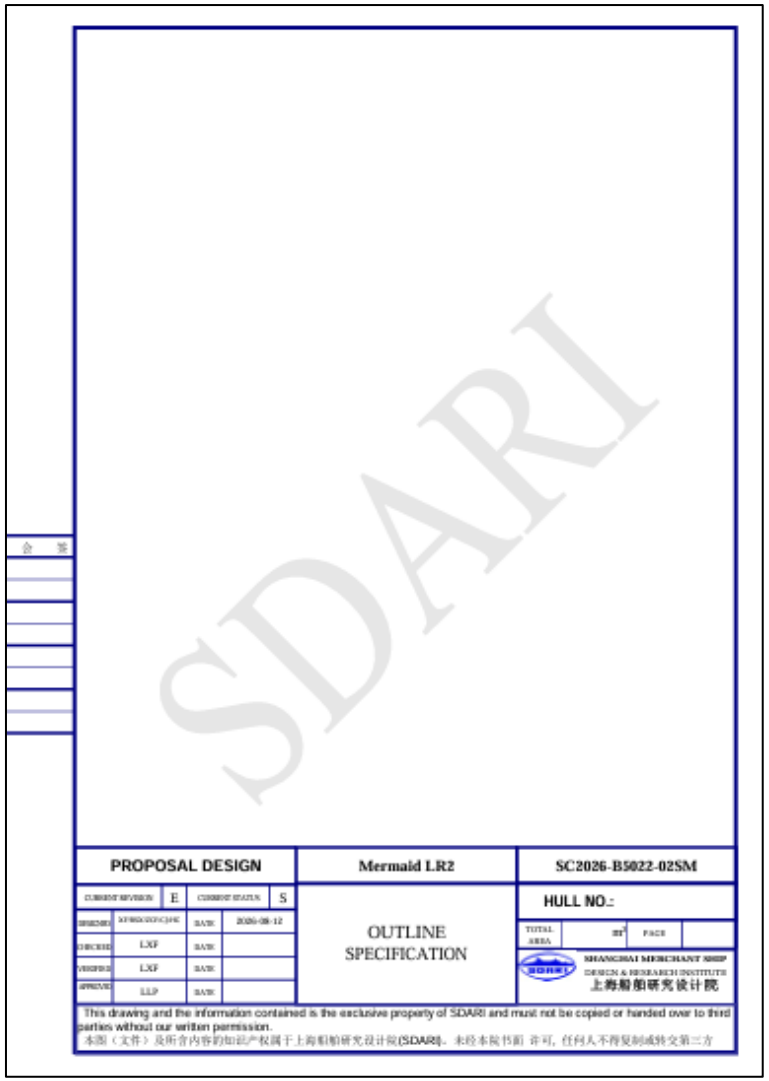
Attained EEDI Phase 3 compliant

CLASSIFICATION

RINA C ✠ Oil tanker-double hull, CSR, unrestricted, SPM, COAT-WBT, INWATERSURVEY, ESP

✠ AUT-UMS, MON-SHAFT, BWM-T, TAS, VCS, IHM,INERTGAS-A, EGCS- NOx, Smart Powered Ship, Cyber Resilience

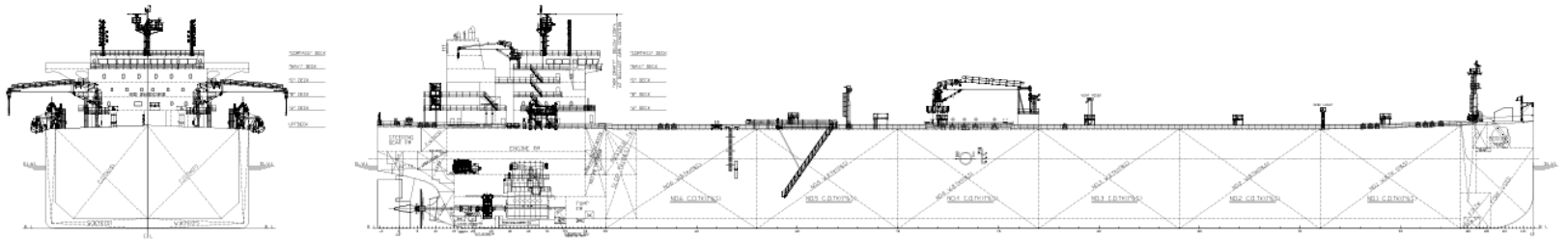
Flag: convenient flag



Web: www.sdari.com.cn Email: business@sdari.com.cn
Add: 2633 Zu Chong Zhi Rd., Shanghai, China Tel: +86 21 64044111

CSSC 上海船舶研究设计院 SHANGHAI MERCHANT SHIP DESIGN&RESEARCH INSTITUTE

LR2 tanker developed by New Times



MAIN PARTICULARS

L.O.A	abt. 249.90 m
L.B.P	245.40 m
Breadth (mld)	44.00 m
Depth (mld)	21.50 m
Designed draft	13.60 m
Scantling draft	15.20 m
DWT on Td	abt. 97,500 MT
DWT on Ts	abt. 114,000 MT
Cruising range(FO/MGO)	abt.22,000 n.mile
Speed at Td	13.5 knots

(adopted energy saving devices at NCR with 15% sea margin)

COMPLEMENT Crew of 28+6 Suez crew

CLASS RINA

RINA C ✠Oil tanker, CSR, ESP, INWATERSURVEY, LOADINT-HUG-ST3, COAT-WBT, CPS-COT, BWM-T, VCS, GREEN-STAR 3, SPM, INERTGAS-A, AUT-UMS, HVSC-NB, SYS-NEQ-1, MON-SHAFT, TAS, BATTERY POWERED SHIPS，CYBER RESILINCE, SMART POWERED SHIP

EEDI: Phase III

TANK CAPACITY

Cargo capacity (incl. slop tanks)	abt. 130,900 m^3
Water ballast	abt. 38,000 m^3
FO	abt. 2,050 m^3
Marine gas fuel	abt. 700 m^3
Fresh water	abt. 400 m^3

CARGO EQUIPMENT

Cargo Pump	3 sets
Type	Electric motor driven
Capacity	3,000 m^3/h x 125 mlc
Stripping pump	1 set
Type	Electric motor driven
Capacity	200 m^3/h x 130 mlc

WATER BALLAST SYSTEM

Ballast Pump	2 sets
Capacity	1,800 m^3/hr x 35 mlc
Ballast Water Treatment System	1 set
Capacity	about 3,600 m^3/hr

NAVIGATION EQUIPMENT

Radar plant	1 set of X-band 1 set of S-band
DGPS navigator	2 Sets
AIS	1 Set

ENERGY SAVING DEVICE:
PSV Duct + HVAF combined with a rudder bulb

MAIN ENGINE 1 Set

Type	6G50ME-C10.7-HPSCR
SMCR (kW/RPM)	8,150 / 79

PROPELLER Fix pitch propeller

FUEL CONSUMPTION OF MAIN ENGINE

F.O.C at NCR abt. 28.8 mt/d+5%
(L.C.V = 42,700 KJ/kg)
(Tier II mode, ISO standard reference conditions)

POWER SUPPLY

Diesel generators	2 x 2,550 kWe
PTO/PTI	abt. 3200kW/1200kWe
Emergency generator	1 x 250 kWe

AMP

STEAM GENERATING PLANT

Boiler	1 set
Capacity	35,000 kg/hr
Composite Boiler	1 set
Fire Section	1,600 kg/hr
Exhaust gas section	630 kg/hr

(NCR of M/E under ISO reference condition)

Battery System

Containerized power battery	2 sets
Capacity	3,900kWh
Type	LFP Lithium-ion

114,000 DWT CRUDE/PRODUCT OIL TANKER

Hybrid Propulsion- PTO and Battery/Cargo pump-Electric motor

Fax: +86-523-84215129 Tel: +86-523-80686819
Email: business@ncship.com.cn
New Times Shipbuilding Co., Ltd.
Add.: Dan Hua Port, Jing Jiang City, Jiangsu Province, P. R. China 214518

OUTLINE SPECIFICATION

FOR

114,000DWT CRUDE / PRODUCT OIL TANKER

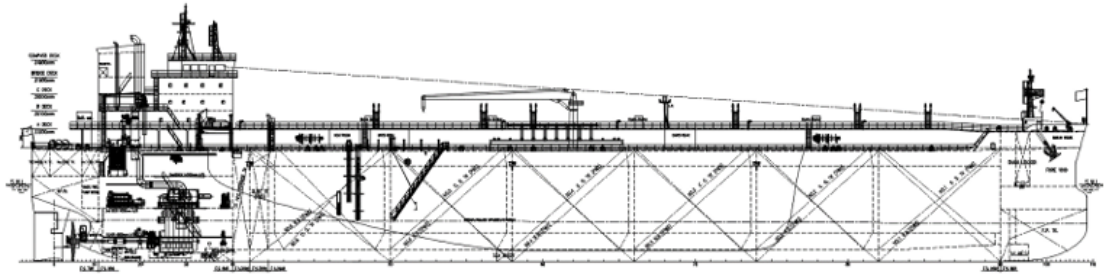
(Hybrid Propulsion with PTO and Batteries/Centrifugal cargo pump-Electric motor)

Ref.No : JDP-2601-OS

BUILDER: NEW TIMES SHIPBUILDING CO., LTD

30th July, 2026

MR tanker developed by SDARI



MAIN PARTICULARS

Length overall	max. 182.99 m
Length between perp.	178.80 m
Breadth moulded	32.20 m
Depth moulded	19.10 m
Draught	
Design draught	11.00 m
Scantling draught	max. 13.30 m
Deadweight	
@Design draught	~38,000 t
@Scantling draught	49,990 t
Endurance	21,000 nm
Complement	25 P

TANK CAPACITIES

Cargo tanks (incl. slop&residual)	55,000 m^3
Slop tanks	~1,400 m^3
Residual tank	100 m^3
L.S.H.F.O.	1,390 m^3
Marine gas oil	470 m^3
Fresh water	250 m^3
Rinse Fresh water	300 m^3
Water ballast	21,000 m^3

CARGO CAPACITY AND EQUIPMENT

Cargo Pumps	
Type: submerged, hyd. type or /deepwell /Ele.type	
Capacity	12 x ~600 m3/h; 2 x 300 m3/h
Max. Discharging Rate	~3,600 m^3/h
Max. Loading Rate	4,200 m^3/h
Material of cargo piping	AISI316L
Cargo tank heating	deck heater for cargo tanks
	Heating coins for slop tanks
Ballast pumps	
Type	Hyd. or Ele. motor driven centrifugal
Capacity	2 x 750 m^3/h
Inert gas generating plant	~4,500 m^3/h

MACHINERY MAIN COMPONENTS

Main engine	Everllence 5G50ME-C10.7-HPSCR
Diesel generators	3 x ~900 kW
Shaft generators	1 x ~2,700 kW
Emergency generator	1 x ~150 kW
Containerized battery(option):	~1,960kWh
Propeller	1 x FPP
Shaft clutch	installed between the propeller&PTO
Aux boiler :	1 set, 18t/h
Exhaust gas economizer:	1 set, 330kg/h

KEY FEATURES

- Hybrid driven.
- Low CAPEX with rich function.
- Chemicals(suitable for IBC ship type 2&3) and product oil can be loaded in Phenolic epoxy coated 12 cargo tanks and 2 slop tanks
- Smart ship system installed
- Flexible design (Containerized battery, Scrubber system, N2 generator, LNG/Methanol DF ready design, ICE notation, wind propulsion system)

ENERGY EFFICENCY PARTICULARS

Service speed at design draught 13.0 kn

(CSR output **with 500kW PTOm** load and 15% sea margin)

Energy saving devices: Duct & cap fin

ME fuel oil consumption at CSR output

Tier II	15.7 t/d
Tier III	15.8 t/d

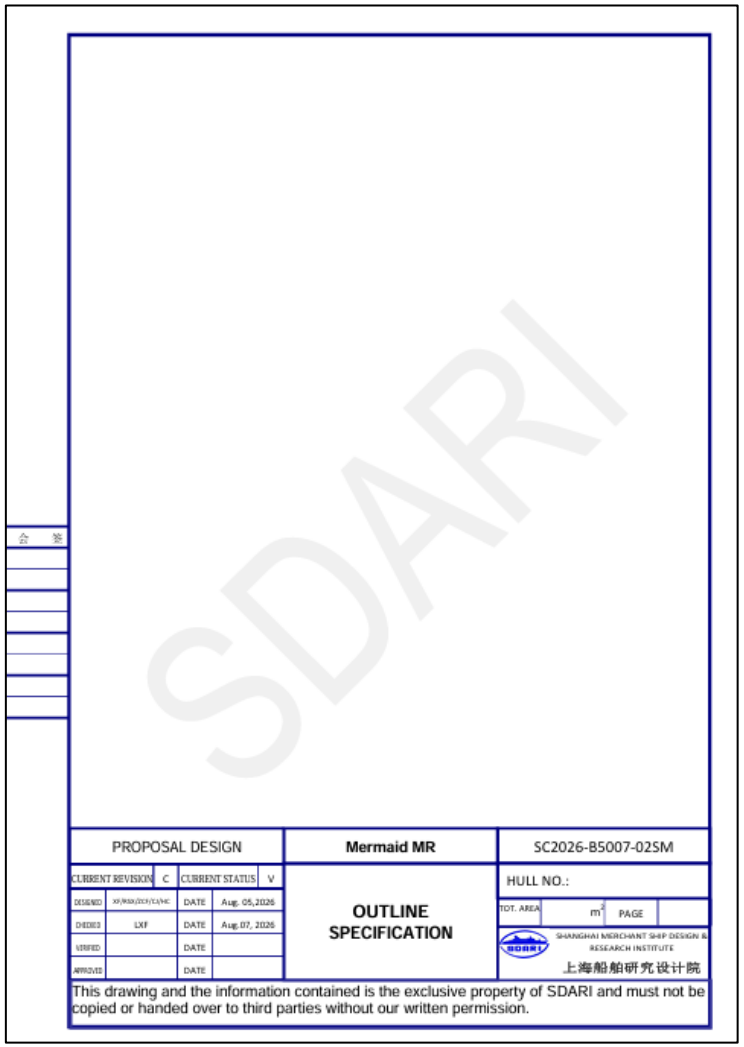
(Based on LCV 42,700 kJ/kg, ISO conditions, excl. engine tolerance)
The above FOC to be confirmed by the Makers.

Attained EEDI Phase 3 compliant

CLASSIFICATION

RINA C ✠ Oil tanker-double hull, CSR, IMO2,Chemical tanker-double hull, unrestricted, SPM, COAT-WBT, INWATERSURVEY, ESP
✠ AUT-UMS, MON-SHAFT, BWM-T, TAS, VCS, IHM,INERTGAS-A, EGCS- NOx, Smart Powered Ship, Cyber Resilience

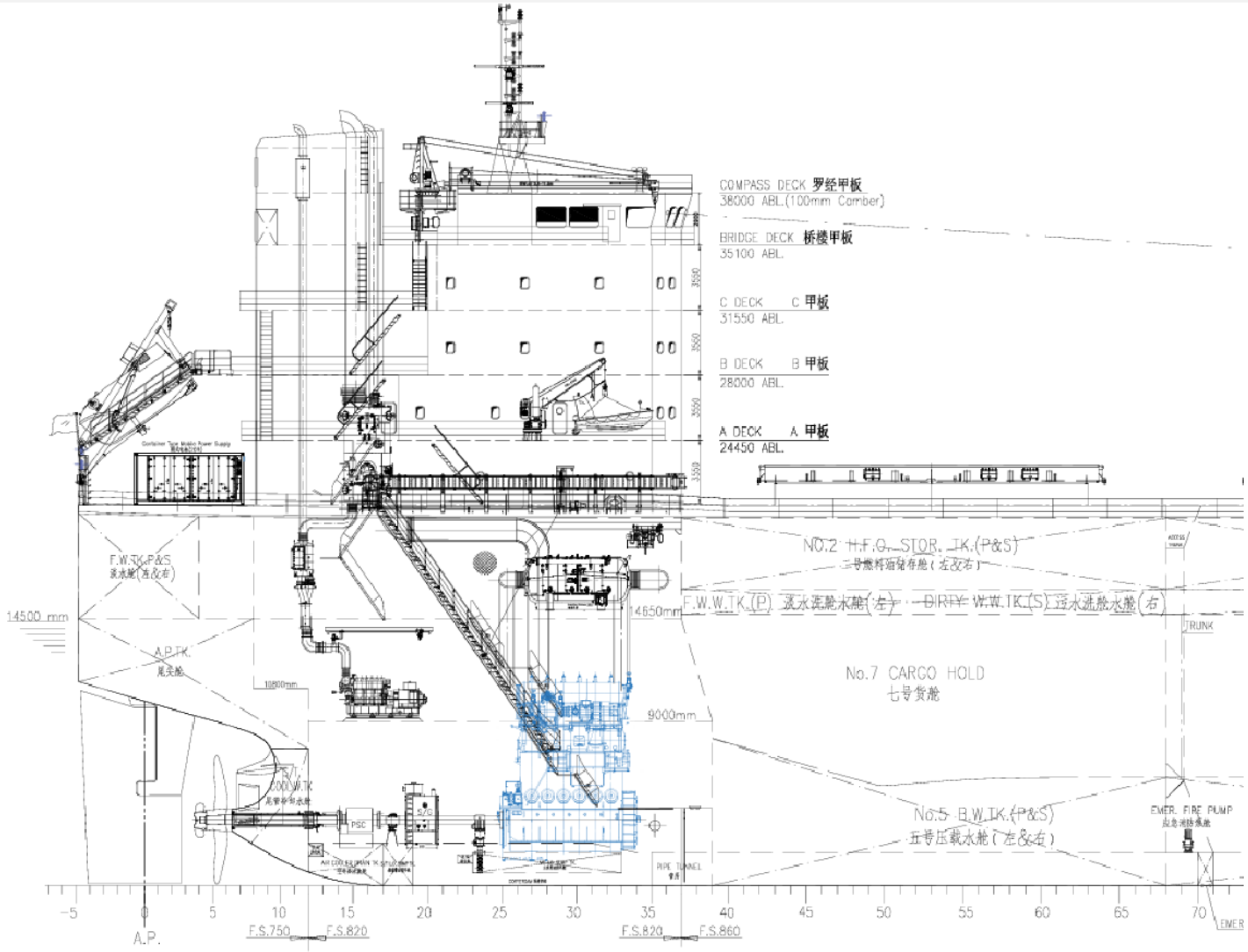
Flag: convenient flag except Liberia/Singapore



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82k DWT developed with Chengxi



RINA

CERTIFICATE OF APPROVAL IN PRINCIPLE
No. 202600253

This is to declare that the Approval in Principle of the following project:

82K DWT Bulk Carrier featuring Hybrid Propulsion with Batteries

Name of the Client: Chengxi Shipyard Co., Ltd
No.1 Hengshan road, jiangyin, Jiangsu, China

Description: The Approval in Principle refers to 82k dwt bulk carrier featuring hybrid propulsion with batteries.

has been carried out in compliance with the process described in the "RINA Guide for Approval in Principle of Novel Technologies", on the basis of the technical criteria of the:
- RINA Rules for the Classification of Ships (2026 Jan. 1st), including hybrid propulsion ship and battery powered ships.
- SOLAS Convention, as amended.
- MARPOL Convention, as amended.

with the specification below reported.

The following submitted documentation, provided by the Client, allowed the Approval in Principle certificate issuance.
- CX418211-010-01SM_A_OUTLINE SPECIFICATION (CX KamsarMax) 2026.05.22
- CX418211-100-04_A_GENERAL ARRANGEMENT (CX KamsarMax) 2026.05.22

The innovative bulk carrier design featuring hybrid propulsion includes two stroke propulsion engine driving shaft generator with PTO/PTI functions with battery during sea going voyage, and shaft generator running at port together with battery to cover all elec. load at port (with propeller disconnected), which will enhance the safety feature of the ship and carbon emission reduction, especially at port. Available information and arrangements in submitted documents related to these innovations have been reviewed and evaluated. They are deemed to be Approved in Principle, in accordance with RINA Approval in Principle Processes, and relevant IMO regulations and RINA rules as mentioned above.

All requirements detailed in involved IMO regulations and RINA rules have to be fulfilled at the final detail design stage, with the possible additions of further measures introduced by involved Flag administration.

Issued in Shanghai on

28th May 2026

Mr. Bunan Xu
RINA Services S.p.A.

The rules, surveys and activities performed by RINA, reports, certificates and other documents issued by RINA are in no way intended to replace the duties and responsibilities of other parties such as Governments, designers, ship builders, manufacturers, repairers, suppliers, contractors or sub-contractors, owners, operators, charterers, underwriters, sellers or intended buyers of a ship or other product or system surveyed. These documents and activities do not relieve such parties from any fulfilment, warranty, responsibility, duty or obligation (also of a contractual nature) expressed or implied or in any case incumbent on them according to the law, nor do they confer on such parties any right, claim or cause of action against RINA. With particular regard to the duties of the ship Owner, the services undertaken by RINA do not relieve the Owner of his duty to ensure at all times proper maintenance of the ship and reconditioning. Likewise, the results, surveys performed, reports, certificates and other documents issued by RINA are intended neither to guarantee the buyers of the ship, its components or any other surveyed or certified item, nor to relieve the seller of the duties arising out of the law or the contract, regarding the quality, commercial value or characteristics of the item which is the subject of transaction. In providing the services, as well as other correlated information or advice, RINA, its surveyors, servants or agents operate with due diligence for the proper execution of the activity. However, considering the nature of the activities performed (see art. 1 c of the General Conditions), it is not possible to guarantee absolute accuracy, correctness and completeness of any information or advice supplied. Therefore, express and implied warranties are specifically disclaimed. In providing its services, and also in the case of activities carried out by delegation of Governments, neither RINA nor any of its surveyors will be liable for any loss, damage or expense of whatever nature sustained by any person, in tort or in contract, derived from carrying out the services. However, should any user of RINA's services prove that he has suffered a loss or damage due to any negligent act or omission of RINA, its surveyors, servants or agents, then RINA will pay compensation to such person for his proved loss, up to, but not exceeding, five times the amount of the fees charged for the specific services, information or opinions from which the loss or damage derives or, if a fee has been charged, a maximum of one hundred thousand Euro. Any liability for indirect or consequential loss, damage or expense is specifically excluded. In any case, irrespective of the amount of the fees charged, the maximum damages payable by RINA will not be more than 1 million Euro. No report, statement, notation on a plan, review, class certificate, document or information issued or given as part of the services provided by RINA shall have any legal effect or implication other than a representation that, on the basis of the checks made by RINA, the ship, structure, material, equipment, machinery or any other item covered by such document or information meet the rules issued by RINA. Therefore, RINA cannot be held liable for any act made or document issued by other parties on the basis of the statements or information given by RINA.

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Tel: +86 21 62482604, 62482605
Fax: +86 21 62482605

Project Mermaid : application on LNG carriers

- LNG carriers use an expensive fuel, and any saving is very important (fuel cost)
- Many of them trade in EU, and are subject to FuelEU and ETS taxation (emission cost)
- Cargo discharge is made with 4 stroke aux engines which have much lower efficiency and much higher methane slip than the main engine
- Cargo discharge typically involves a big % of one main engine power



Project Mermaid : application on tankers



MR tanker

- This type of ship traditionally uses deep well pumps
- They can be of either electric or hydraulic drive

The PSC & Battery usage promote the selection of **electric pumps**

Benefits

- About 15% less fuel consumption
- No hydraulic oil lines, no leakage, no oil condtionig / contamination issues, less maintenance
- Electric motor on deck, easy to access

CS Marine

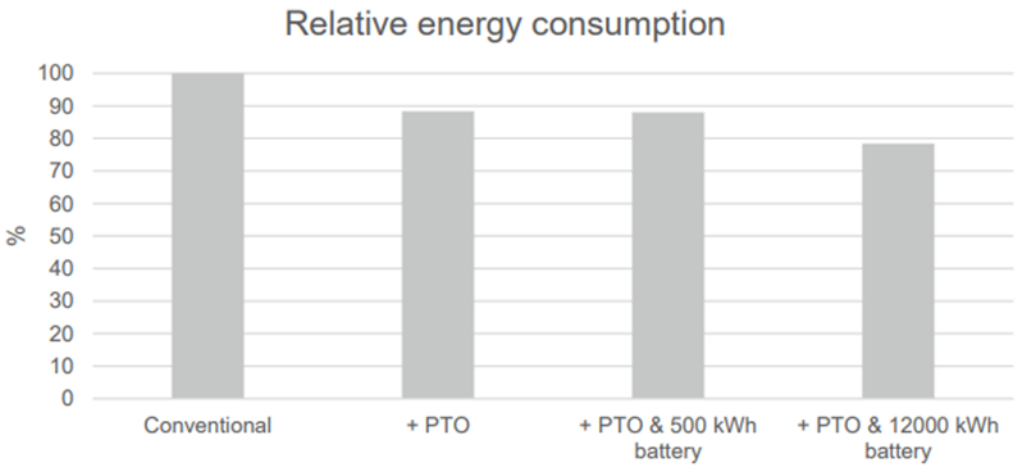
SDARI CSSC

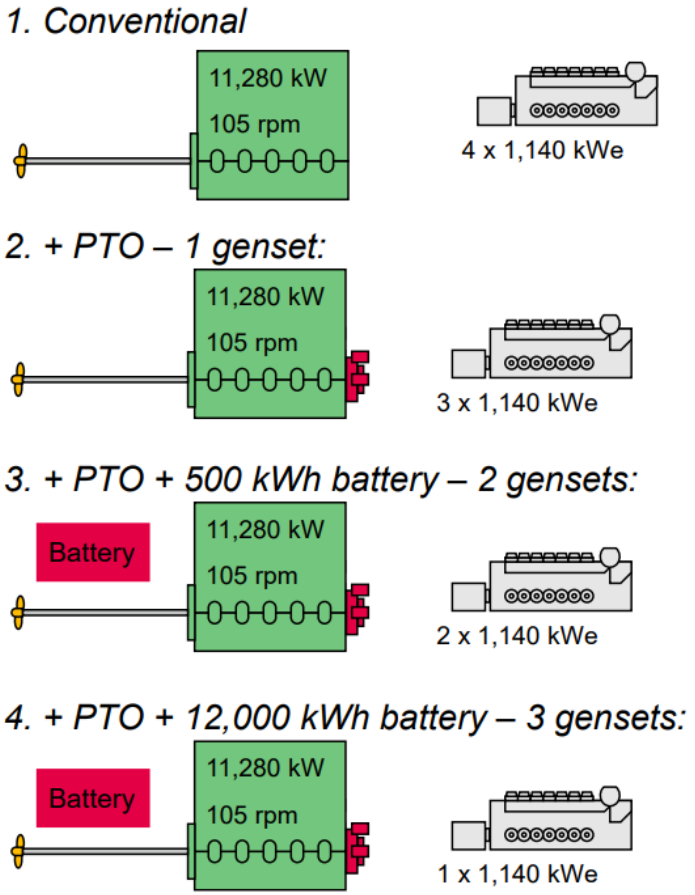
NTS

Applications of batteries

Containers

- ✓ Achieve net zero emission requirement at EU ports, without the need of green fuels (the supply chain of which is still not mature)
- ✓ The use of batteries will ensure faster load response and reduce methane slip by stabilizing electric loads during crane operations





Source : Everllence

Applications of batteries



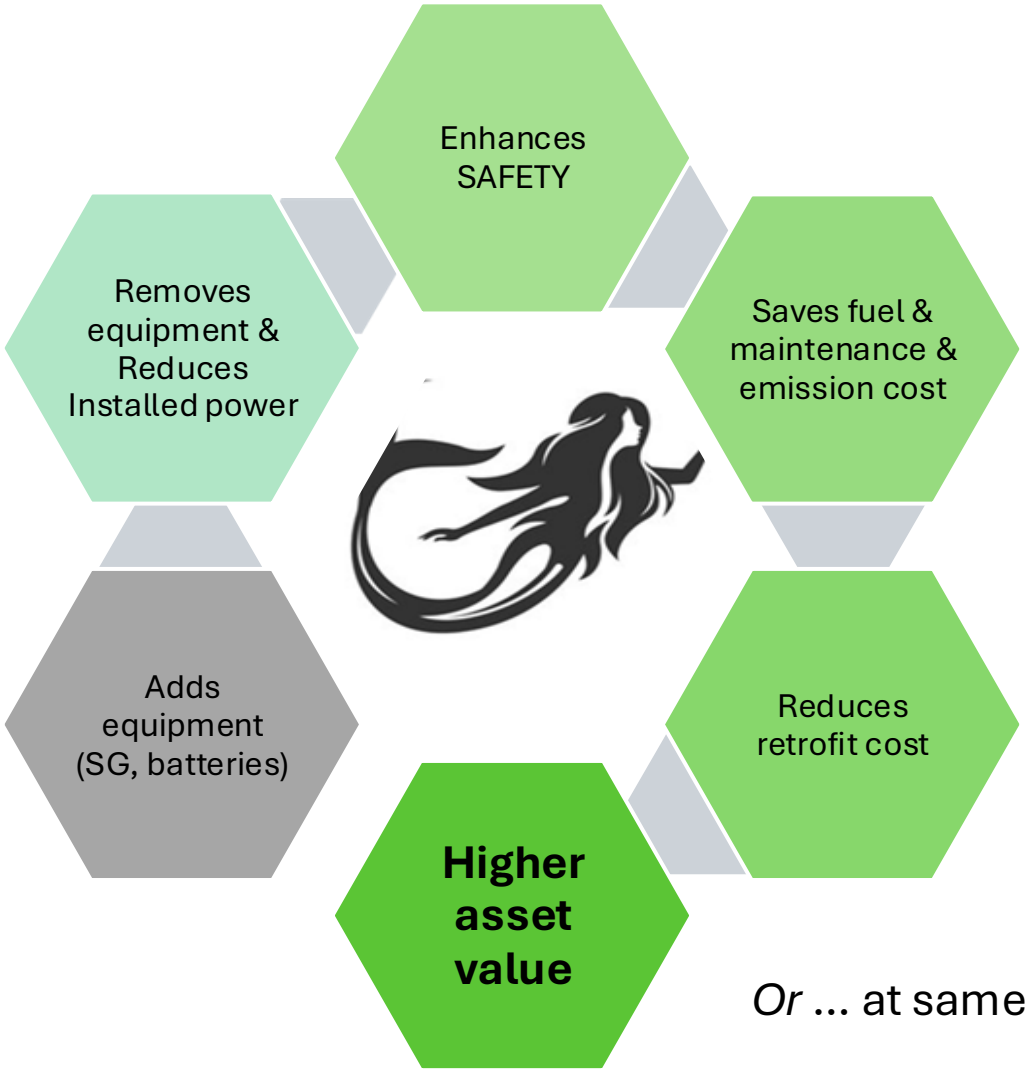
Geared Bulk carriers

- Cargo operations with all cranes typically require 3 gensets
- It is very rare that the power of all 3 gensets are required
- This results in engines running continuously at low loads :
- Accumulation of running hours for maintenance
  - Higher fuel consumption
  - Increased wear dur to poor combustion
  - Deterioration of engine oil
  - High methane slip

Batteries can serve to either

- Provide the whole power alone
- Together with less units of running gensets providing spinning reserve , dynamic load and peak shaving

Conclusion in a nutshell



Or … at same ship price, ***better performance***

For more info:



Thank you for your attention