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TRANSFORMANDO
LOS OCÉANOS:
INNOVACIÓN e ingeniería naval para
un mundo CONECTADO y SOSTENIBLE

Design of Salvage Tugs: Challenges and Solutions with Heroína de Sálvora

Passion for the Ocean

Seaplace, since 1980

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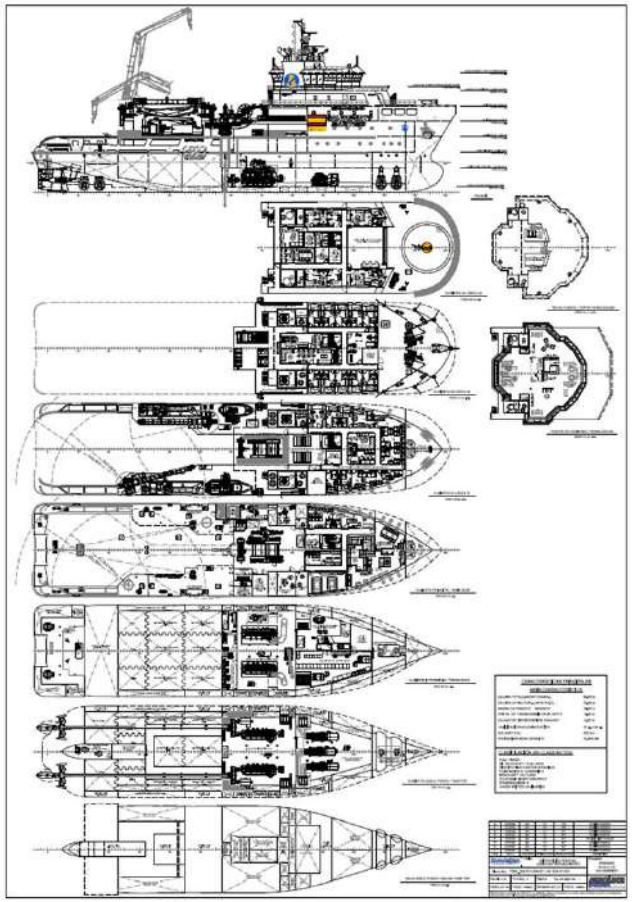
HEROÍNA DE SALVORA

- New versatile Salvage Tug
- Built at Zamakona Shipyards in Santurce
- Designed by Seaplace
- Operational and environmental improvement for SASEMAR

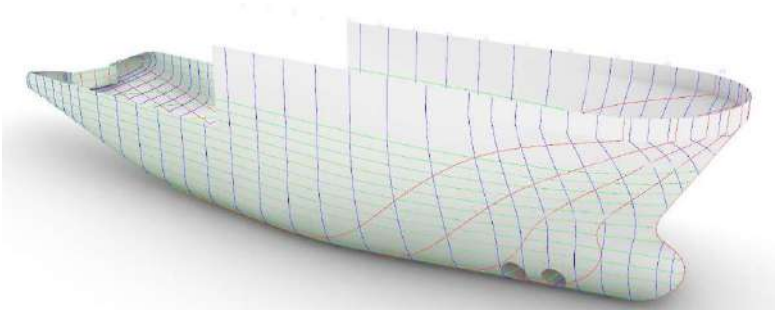
DESCRIPTION OF THE VESSEL

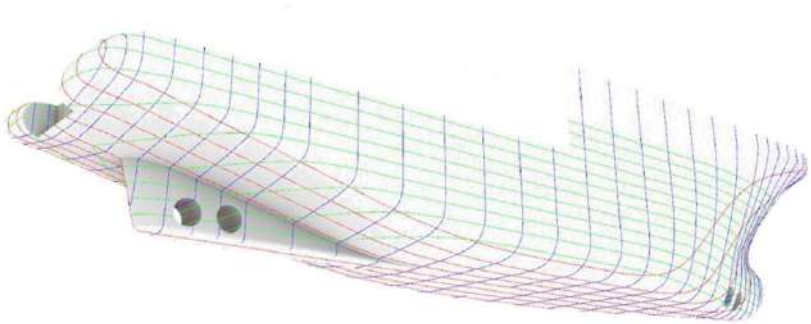
LOA	82.30 m
LPP	76.70 m
B	18.00 m
D	8.00 m
T max	6.30 m
POB	40 p
Speed. max	17,5 knots
Max Shaft Power	14600 kW
Bollard Pull	213 tons
DPII	
ORO Capacity	1800m3



BV I + HULL + MACH / AUT-UMS / SPECIAL PURPOSE SHIP TUG / UNRESTRICTED NAVIGATION / Fire-fighting 2 water spraying / CLEAN SHIP / DYNAPOS AM/AT R / COMF-NOISE 3/ COMF-VIB 3 / Oil recovery / IN WATER SURVEY / MON-SHAFT.

OPERATIONS OF THE VESSEL





- Rescue and salvage missions of vessels or human lives.
- Pollution response operations
- Firefighting operations, with FiFi-2 and water spraying capability.

POWER GENERATION

"Heroínas de Sálvora" is equipped with a hybrid power generation plant, allowing it to adapt efficiently to different operational profiles.

Electric power generation is facilitated by two electric motors, which can function as alternators or motors using frequency converters. Additionally, three Auxiliary Generators and a Shore Generator are available to meet specific operational requirements.

This energy flexibility ensures optimal performance in all operating conditions, contributing to the efficiency and reliability of the vessel's operations.

Diesel Propulsion Engines
2 x 4800 Kw
Bergen B33:45L8P

PTI/PTO
2 x 3125 kVA (2500 kW)
INGETEAM ACP-500-M/4

Auxiliary Genset
3 x 2385 kVA (1908 kW)
AvK DSG 86 L1/4 W
MAN 12V175D 1980 kW

Shore Generator
1 x 565 kVA (452 kW)
STAMFORD S5L1M-F4
Volvo Penta D16 MG HE/KC (532 kW)

Gearboxes
2 modes of operation:
- 1 input (DPE) → 2 outputs (PTO + Shaft line), or
- 2 inputs (DPE + PTI) → 1 output (Shaft line)

PROPULSION SYSTEM: Full Flexibility

Maximum Shaft Power

14600 kW

"Heroínas de Sálvora“ employs a hybrid propulsion system comprising:

Two shaft lines, each driving a controllable-pitch propeller in a nozzle (Kongsberg KAMEWA). Each propeller is 4-bladed and 4 meters in diameter.

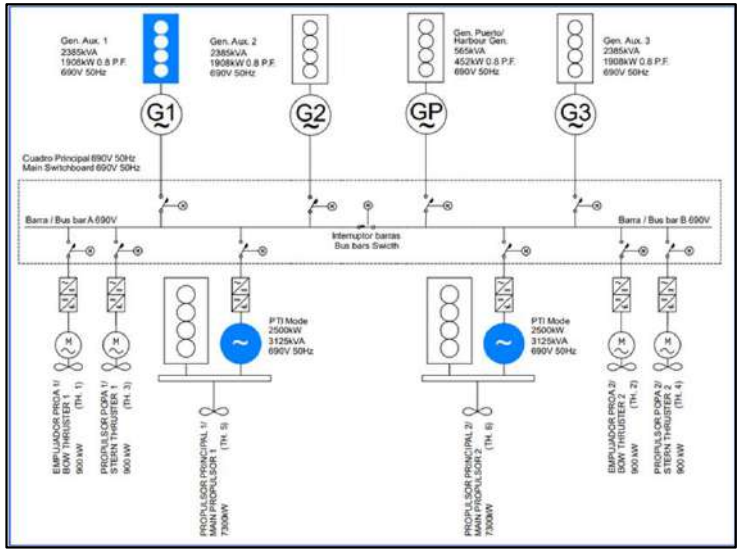
Four identical fixed pitch transverse thrusters (Kongsberg TT1850 - 900 kW each), two at the bow and two at the stern, powered by electric motors (MarelliMotori B5J).

The Main Propellers are powered through the gearbox, which can be supplied from:

- ❑ Main Engines,
- ❑ Electric Propulsion (PTI)
- ❑ or both simultaneously for Maximum Power required, (towing large vessels)

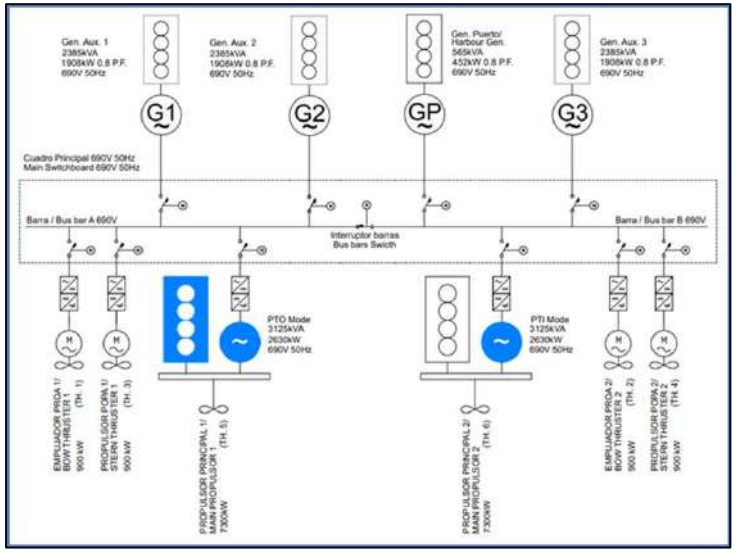
OPERATIONS MODES

Low Speed Navegation



Main Diesel Engines	0
Electric Propulsion	2 x PTI
Auxiliary Gensets	1

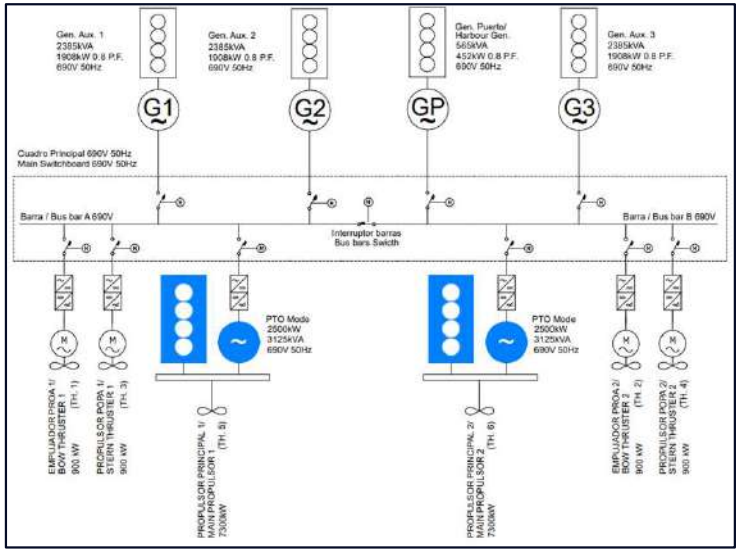
Medium Speed Navegation



Main Diesel Engines	1
Electric Propulsion	1 x PTI / 1 x PTO
Auxiliary Gensets	0

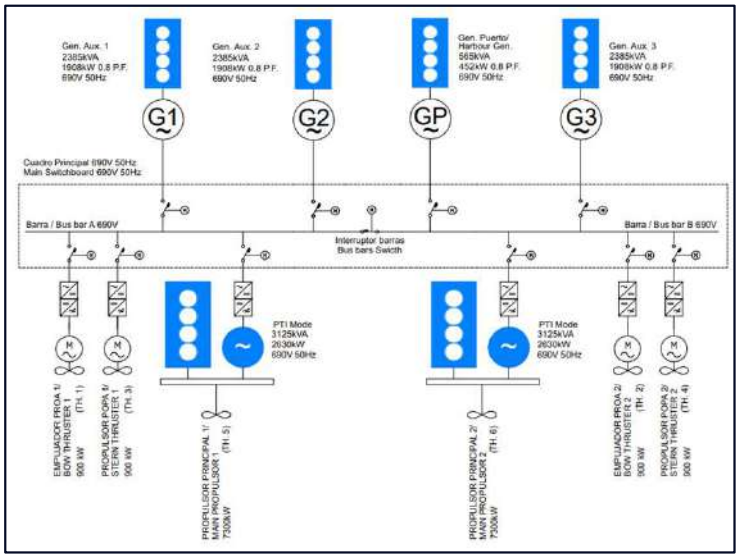
OPERATIONS MODES

High Speed Navegation



Main Diesel Engines	2
Electric Propulsion	2 x PTO
Auxiliary Gensets	1

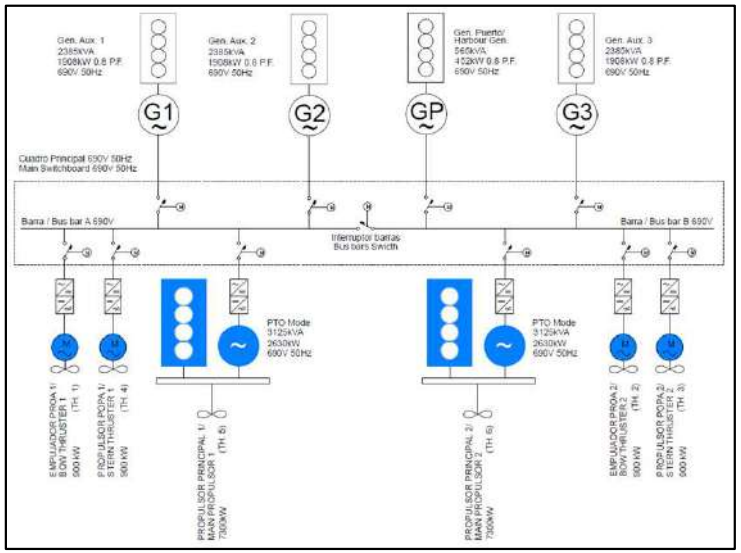
Maximum Speed Navegation



Main Diesel Engines	2
Electric Propulsion	2 x PTI
Auxiliary Gensets	3

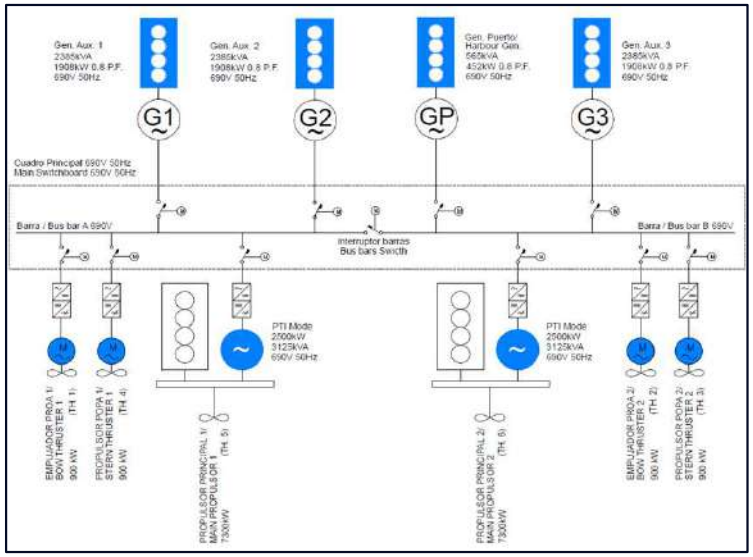
OPERATIONS MODES

Diesel DP



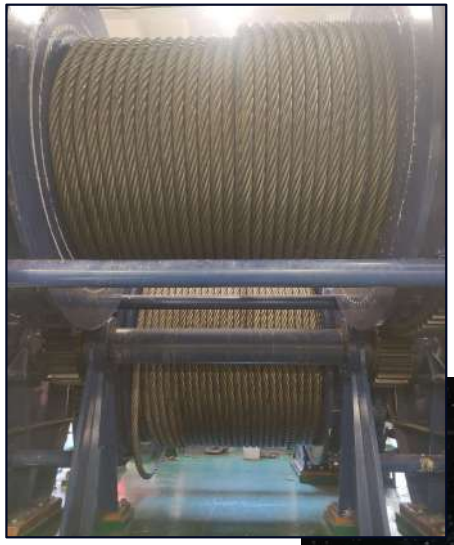
Main Diesel Engines	2
Electric Propulsion	2 x PTO
Auxiliary Gensets	0

Electric DP



Main Diesel Engines	0
Electric Propulsion	2 x PTI
Auxiliary Gensets	3

MAIN DECK EQUIPMENT



Towing Equipment

- One cascade electric towing winch from the IBERCISA brand. This winch has a pulling capacity of 200 tons, supported by a braking power of 500 tons. Located midship and elevated, the towing winch ensures proper balance of the vessel during towing operations.
- Quick release towing hook (working load of 200 tons)
- Gob-eye to restrict the maximum angle of the tow line to 45° to the centerline.
- A stern roller 6 meters long, 2.2 meters in diameter and a working load capacity of 250 tons.
- Hydraulically watertight pop-up pins on the working deck, forward of the roller
- Two ocean pins, one on each side

MAIN DECK EQUIPMENT

Lifting Equipment

- Two MELCAL cranes located on the main deck on each side.
- Maximum lifting capacity of 20 tons at a distance of 15 meters during port operations.

Salvage Equipment

- A Fast Rescue Daughter Craft, with a length of 9.2 meters and aluminum hull. It has a capacity for 12 people. The inboard engines will be suitable for reaching speeds exceeding 30 knots.
- A fast rigid rescue boat with a length of 6.75 meters
- Specific rescue areas, equipped with doors on the side and a sufficient recess on the main deck to facilitate access from sea level.

AIRCRAFT CAPABILITY

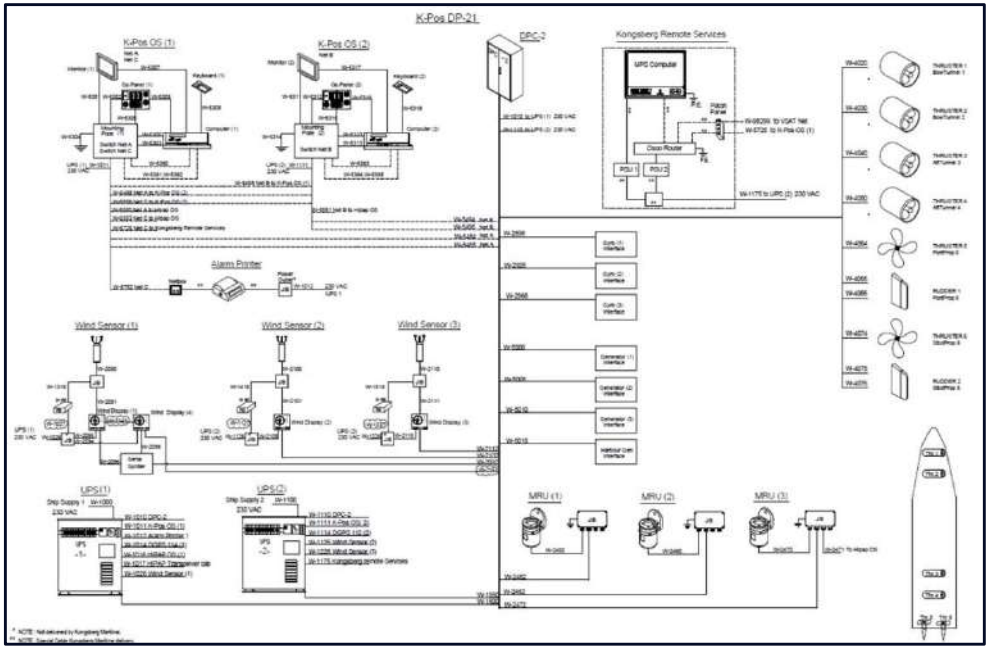
- Pioneer vessel in the use of drones for Maritime Rescue
- Innovation project "iSAR“

- ❑ Surveillance and Search
- ❑ Delivery of Salvage Equipment
- ❑ Damage Inspection
- ❑ Environmental Monitoring
- ❑ Logistic Support

AIRCRAFT CAPABILITY

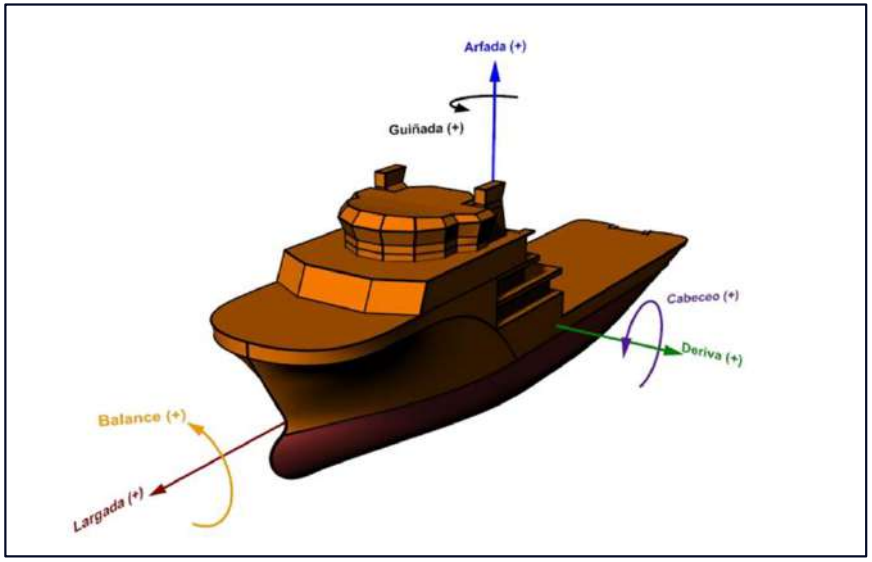
- Camcopter S-100ES drone, unmanned aerial vehicle (UAV)
- Wingspan of approximately 3.4 meters and can carry a payload of up to 50 kilograms.
- It is specifically designed for surveillance, reconnaissance, and security applications.

DYNAMIC POSITIONING



- The vessel is equipped with a Class 2 dynamic positioning (DP) system in accordance with International Maritime Organization (IMO) regulations.
- Equipped with the K-Pos DP-21 system, dual redundant dynamic positioning control system.
- The DP system is equipped with a number of external reference systems and sensors
  - ❑ 2 x pcs DGPS reference systems (DPS 112 and DPS 114)
  - ❑ 1x pc acoustic reference system HiPAP 351
  - ❑ 3 x RAYTHEON Standard 30MF gyrocompasses
  - ❑ 3 x Gill ultrasonic wind sensors
  - ❑ 2 x motion reference units MRU-D
  - ❑ 1 x MRU-3 motion reference unit
  - ❑ 2 x Powerware 9130 UPS uninterruptible power supply monitoring units

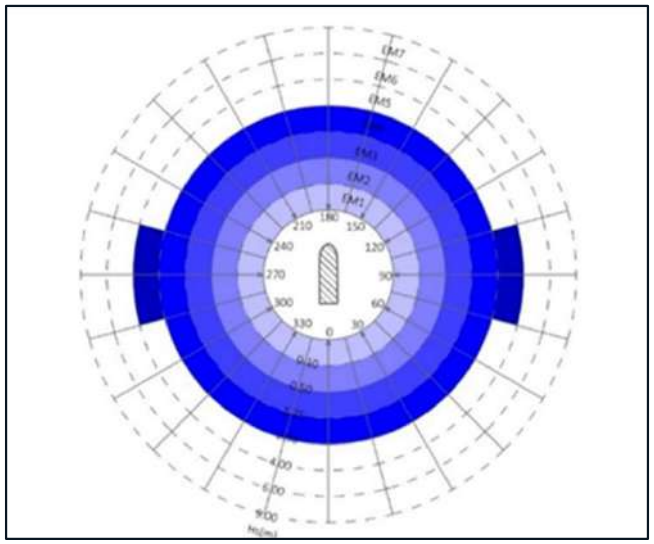
SEAKEEPING: Enhancing Crew Working Conditions



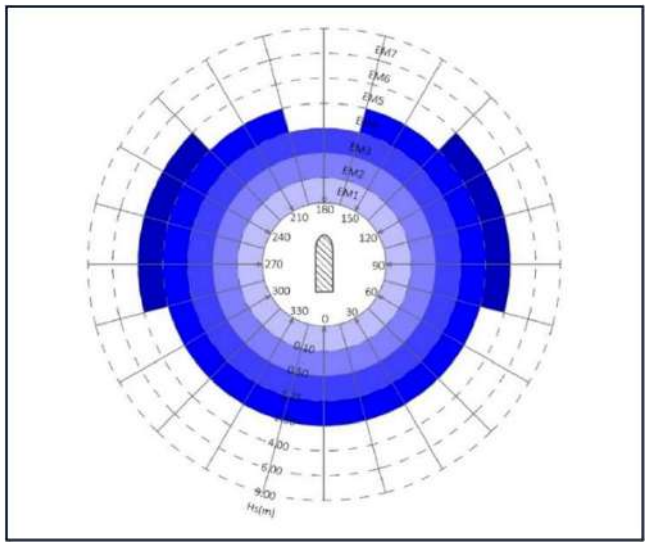
- In this type of vessel it is important to ensure good seakeeping, in order to increase the operational window, reduce risks during operations and improve the comfort of the SASEMAR crew
- A total of 84 cases have been evaluated (software ANSYS AQWA) combining wave courses, speeds and Sea States for three operational profiles:
  - ❑ Salvage (0 knots)
  - ❑ Towing (5 knots)
  - ❑ Navigation (9 knots).
- Sea performance evaluation criteria, based on STANAG 4194 and Bureau Veritas Bureau Veritas Rules for Naval Ships

SEAKEEPING: Enhancing Crew Working Conditions

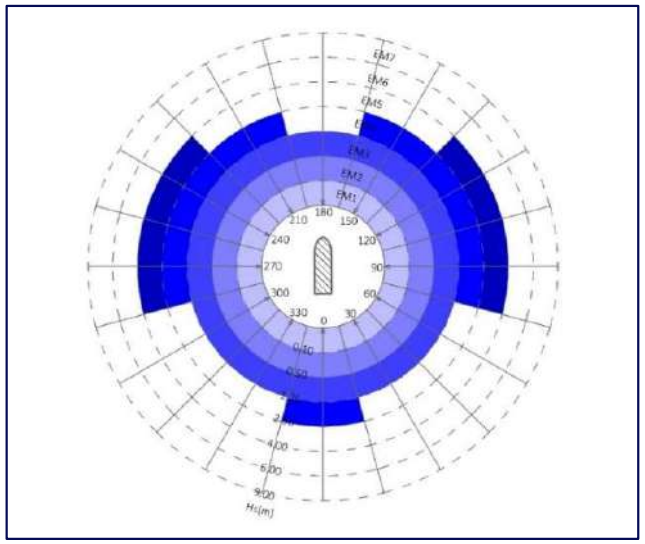
The results obtained, confirmed by model tests, indicate that the vessel has a remarkable operational capability.



Salvage (0 knots)



Towing (5 knots)



Navigation (9 knots)

OIL POLLUTION RESPONSE EQUIPMENT

- OIL RECOVERY SHIP

- The vessel has two LAMOR modular Stiff Sweep Oil Recovery System, which can be mounted on deck and deployed on both sides, to collect and pump the on board.
- A secondary hydrocarbon spill collection system is available. This system operates by deploying booms, stored on a reel for this purpose, and utilizing skimmers.
- The vessel is fitted with ORO storage tanks with a total capacity of 1800 m3.
- To maximize the amount of ORO collected, a serial decanting process is employed to separate the oil from the seawater.

OIL POLLUTION RESPONSE EQUIPMENT

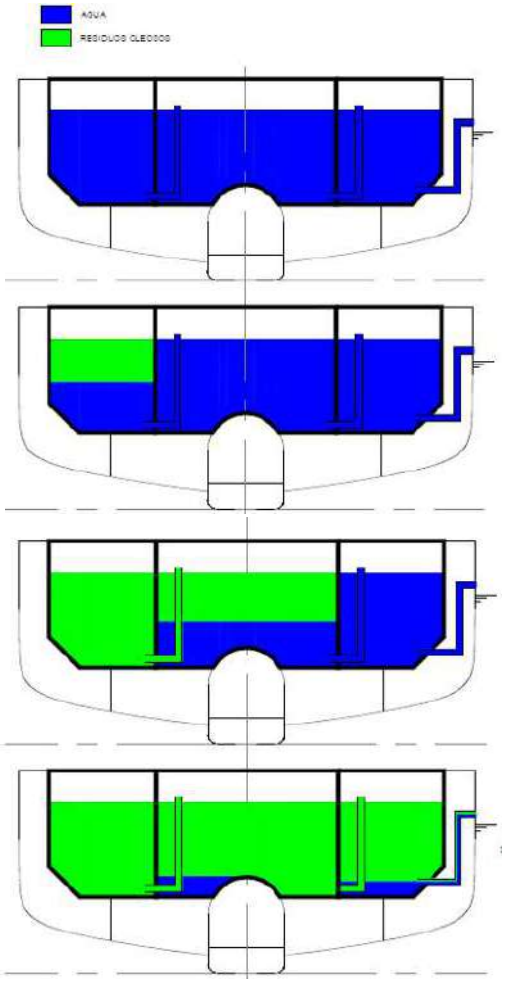
Decanting process

Initial Phase: Tanks partially filled with water.

1st Decanting: Start of decanting from the first tank.

2nd Decanting: Start of decanting from the second tank.

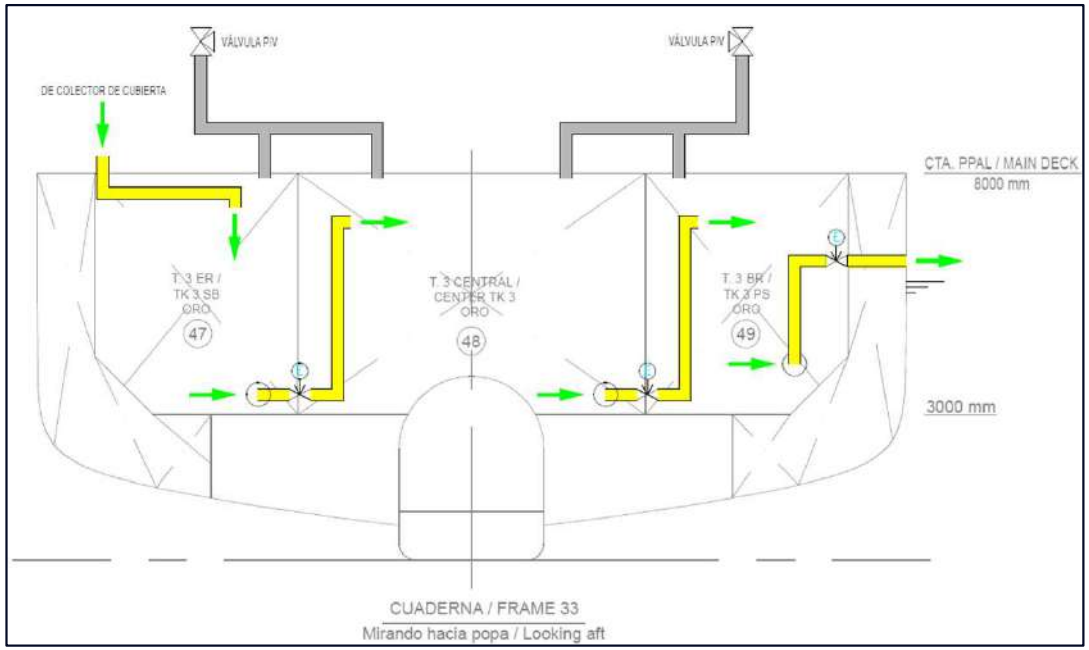
Final Phase: Discharge to the side, mixed with ORO and water.



OIL POLLUTION RESPONSE EQUIPMENT

Pipelines inside ORO tanks

1. Filling pipe
2. Decanting pipe between tanks.
3. Discharge pipe to the side.
4. Pressure equalization and venting pipeline to the atmosphere.



ENVIRONMENTAL CONSIDERATIONS

"Heroínas de Sálvora" stands out for its focus on environmental protection and operational efficiency due to several key features

CLEANSHIP: This vessel is designed with a double hull ensuring that no fuel tank comes into direct contact with the hull, thus greatly reducing the risk of spills in the event of collisions or accidents.

BWT (Ballast Water Treatment): Although ballast water treatment is generally applied to ships making international voyages, this vessel has a treatment system aligned with SASEMAR standards, focused on environmental protection.

GREEN PASSPORT: The vessel undergoes an inventory of materials to ensure proper recycling at the end of its service life. Additionally, stringent control measures are implemented during construction to minimize the use of hazardous materials.

SCR Catalysts - NOx Reduction (urea injection) TIER III: To mitigate atmospheric emissions, the vessel is equipped with catalysts and mixers in the propulsion system, aimed at reducing nitrogen oxides (NOx) in exhaust gases through selective catalytic reduction (SCR) with urea injection

ENVIRONMENTAL CONSIDERATIONS

HYBRID MECHANICAL PROPULSION: The two-shaft-line propulsion configuration, combined with five combustion engines and two electrical generation systems (PTI-PTO), allows the vessel to adapt to different modes of operation as needed, thus reducing fuel consumption and emissions in various missions, operations and emergency situations throughout its service life.

COOLING: Air conditioning system utilizes a chilled water system to minimize the need for refrigerants, thus lowering the GWP as much as possible.

ENVIRONMENTAL CONSIDERATIONS

One of the achieved objectives of the project is that the vessel "Heroínas de Sálvora" can navigate at an economical speed with the same power and consumption as SASEMAR vessels of the "salvamares" type (21 meters in length).

"Heroínas de Sálvora" achieves a reduction of 3.3 tons of CO2 compared to the vessel Clara Campoamor. Assuming 1000 hours of operation per year, this translates to a net reduction of more than 3000 tons of CO2.

Vessel	Consumption (l/h)	Emission CO_2 (kg/h)
Clara Campoamor	1660	4465
Heroínas de Sálvora	400	1076
CO_2 Reduction		3389

ENVIRONMENTAL CONSIDERATIONS

	Trials (Kn)	Draft (m)	Sea State	Consumption (l)	Litre/mile
Maximum Speed	17,52	5,9	Beaufort 4	3350	191,21
Speed (1 PTI-1PTO)	12,50	5,9	Beaufort 4	1000	80,00
Slamming Index	8,10	5,9	Beaufort 4	360	44,44

Data from sea trials also indicate a significant reduction in consumption compared to other vessels in the SASEMAR fleet. “Clara Campoamor” and “Don Inda” have historically averaged a consumption of 251.5 liters/mile; MDO consumption is reduced by 25%.

Another example would be comparing it with the SASEMAR vessels of the María/SAR series (40-meter tugboats), which consume 65 liters per mile while sailing at 9 knots. The vessel "Heroínas de Sálvora" in its low-speed configuration reduces this consumption by 31%.

CONCLUSION

Salvamento Marítimo has enhanced its operational capacity with the arrival of the new vessel "Heroínas de Sálvora", reinforcing its fleet and expanding its capabilities for diverse maritime operations.

The collaboration between Seaplace and Zamakona Shipyard has yielded a high-quality vessel that fulfills SASEMAR requirements, showcasing the excellence of the Spanish maritime industry

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