

Ship hybridization

EU Interreg 2 Seas project ISHY

&

one of its pilots: hybrid retrofit Vera Cruz

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EU Objectives for the Interreg 2 Seas region

EU objectives:

- Reduction of greenhouse gases emissions
- Adoption of low carbon technologies
- Cross border regional cooperation



ISHY Project

Key numbers: Project budget EUR 16 Million
 Project ERDF (subsidy amount) EUR 9,2 Million
 Start of project 1 February 2019, commercial operation of pilots 30 June, 2022.

The ISHY Project consists of 5 Pilots:

- The hybrid hydrogen diesel retrofit of the Inland Waterway Breakbulk Barge, the Vera Cruz from Vera Cruz Shipping
- The new to be build hydrogen propelled passenger ship, the Z9 from De Zilvermeeuw
- The new to be build hybrid hydrogen diesel crew transfer vessel (CTV) from GEO xyz
- The to be retrofitted hybrid battery electric-diesel inland waterway inspection vessel of the UK, performed by Hybrid Marine
- The multi-fuel and power bunkering facility in the harbour of Ostend, to be developed by Parkwind

The Project Partners are: The harbour of Ostend as the lead partner, Vera Cruz Shipping, Yerseke Engine Services (YES), Impuls Zeeland, ZEPP Solutions, GEO Aqua, Hybrid Marine

Knowledge Partners are: Solent University of Southampton, University of Technology Delft, Polytechnique Hauts-de-France Valenciennes, University of Applied Sciences Vives Kortrijk plus Loydd's Register and Waterstofnet.

Observer partners: 43 observers

Pilot Inland Waterway Breakbulk Barge Vera Cruz



Vera Cruz main ship dimensions and tonnage

Main ship	Push barge (ship's extension)	Total combination
Cargo tonnage: 2479	1589	4069
Length: 110 m	70 m	180 m
Width: 11,5 m	11,5 m	11,5 m
Draft: 3 m	3 m	3 m

Main propulsion: 2 diesel engines of 1379 hp (1014 kW) each

Ship's operational load profile

- Heavy (full) loaded sailing up-stream on river with strong current (river Rhine) for 42 hours
- Heavy (full) loaded sailing up-stream on calm river, passing several locks (river Mosel) for 36 hours
- Low loaded sailing downstream of above and in calm waters (low current waterways region Rotterdam Antwerp)

Typical round trip of around **150 hours** (6 days and 6 hours).

Total propeller power fluctuates between **416 - 1006 kW** normally.

Pilot Vera Cruz hybrid design conclusion 3Q2019

- **One (1) diesel drive train** will be retrofitted to hybrid hydrogen diesel.
- CO₂-emission reduction target **0,8 kton CO₂-emission reduction/year**.
- Ambition remains, having both drive trains retrofitted to hybrid hydrogen diesel propulsion and realizing **1,6 kton CO₂-emission reduction/year**

Energy storage capacities on-board

Hydrogen fuel tank capacity

Operational ship profile requires, in addition to diesel, an on-board storage capacity of at least **1400 kgH₂**, for operating with one hybrid drive train. Gross 1500 kgH₂.

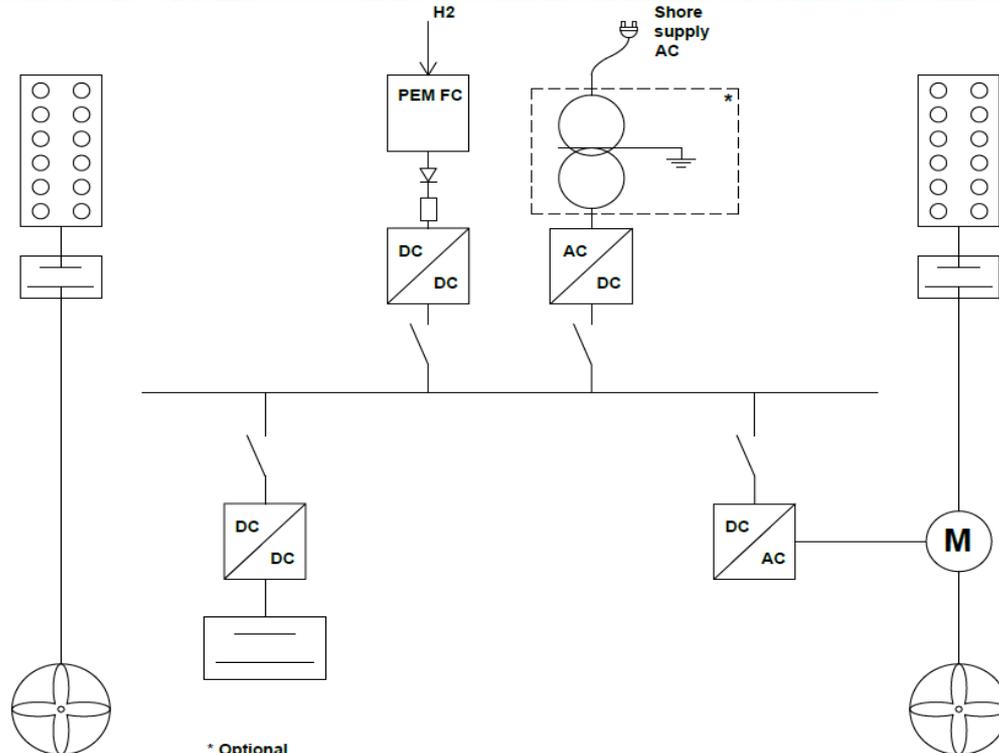
Selected **Liquid Hydrogen**, therefore cryogen tank and related LH₂ supply system.

Optional: battery pack and shore charger

Schedule of main activities for project completion

- 4Q19: Defining hybrid retrofit control and safety systems of the technically integrated system, tuning with classification bureau, vendor selections and qualifications.
- 2Q20: Detail system design and engineering, procurement of long lead time equipment and start of key component manufacturing.
- 3Q21: Equipment deliveries and retrofitting the ship at yard (YES subsidiary ADR Antwerp).
- 4Q21 Test sailing and ship classification
- 2Q22 Commercial hybrid operation not later then 30 June 2022.

Hybrid hydrogen diesel retrofit single line diagram



Hybrid retrofit configuration currently defined as

On board H2 cryogen fuel tank of 1500 kg / 20.000 litre capacity.

Under research:

Swap LH2 tank containers and bunkering by exchange of tank containers.

Fixed LH2 fuel tank on board and bunkering from truck cryogen tank trailer or from cryogen harbour/quay bunkering facility.

Under development:

Bunkering facilities/locations along the sailing route.

Fuel cell module one (1) minimal 300 kW.

Electric motor one (1) of 250kW. (Optional two electric motors of 125 kW, one for each propeller shaft.)

Integrated control system.

Extended and integrated safety system.

Challenges

- Maritime sufficiently proven technologies for the required ship's operational load profile.
- Maritime qualified and commercial available drive train components.
- Classification/certification of hybrid retrofit design.
- Inland Waterway regulations / approval to sail hybrid hydrogen internationally.
- Economically acceptable operation with hybrid sailing.

Thank you!

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