

E-SHYIPS

ECOSYSTEMIC KNOWLEDGE IN STANDARDS FOR HYDROGEN IMPLEMENTATION ON PASSENGER SHIP



Project ID	101007226
PRR 2025	Pillar 5 - Cross-cutting
Call Topic	FCH-04-2-2020
Project Total Costs	2 500 000.00
Clean H ₂ JU Max. Contribution	2 500 000.00
Project Period	01-01-2021 - 31-12-2024
Coordinator Beneficiary	POLITECNICO DI MILANO, IT
Beneficiaries	DAMEN RESEARCH DEVELOPMENT and INNOVATION BV, DAMEN GLOBAL SUPPORT BV, IDF - INGEGNERIA DEL FUOCO SRL, LEVANTE FERRIES NAFTIKI ETAIREIA, DIMOS ANDRAVIDAS-KYLLINIS, ATENA SCARL - DISTRETTO ALTA TECNOLOGIA ENERGIA AMBIENTE, TEKNOLOGIAN TUTKIMUSKESKUS VTT OY, GHENOVA INGENIERIA SL, UNI - ENTE ITALIANO DI NORMAZIONE, DNV HELLAS SINGLE MEMBER SA, OY WOIKOSKI AB, SCHEEPSWERF DAMEN GORINCHEM BV, DANAOS SHIPPING COMPANY LIMITED, Proton Motor Fuel Cell GmbH, CINECA CONSORZIO INTERUNIVERSITARIO, UNIVERSITA DEGLI STUDI DI NAPOLI PARTHENOPE, AGENZIA NAZIONALE PER LE NUOVE TECNOLOGIE, L'ENERGIA E LO SVILUPPO ECONOMICO SOSTENIBILE

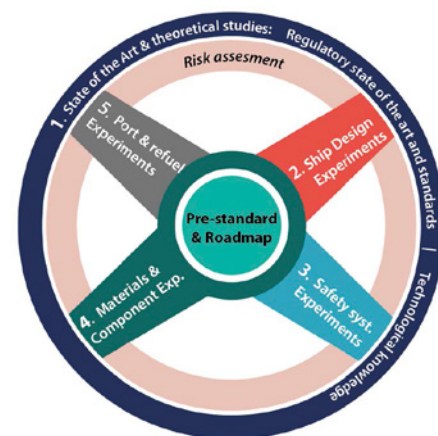
<https://e-shyips.com/>

PROJECT AND GENERAL OBJECTIVES

Hydrogen is considered an option for reaching emission reduction targets; however, a regulatory framework applicable to hydrogen-fuelled ships is not yet available. e-SHYIPS brings together hydrogen and maritime stakeholders to gather new knowledge based on a regulatory framework review and experimental data. The approach is vessel independent, and is focused on the risk and safety assessment methodologies. e-SHYIPS will define a pre-standardisation plan for an update of the International Code of Safety for Ships using Gases or other Low-flashpoint Fuels for hydrogen-based-fuels passenger ships and a roadmap to boost the hydrogen maritime economy.

NON-QUANTITATIVE OBJECTIVES

- e-SHYIPS aims to define project concept functional scenarios. In close cooperation with its industrial maritime partners, the technical and functional requirements of hydrogen-based-fuels passenger ships will be elicited in operational profile scenarios.
- Use cases for vessel design will be defined in line with the requirements of industrial maritime partners and the stakeholders.
- e-SHYIPS aims to determine vessel scenario and bunkering functional and technical requirements. The functional and technical requirements of hydrogen-based-fuels passenger ships, which are meant for a scenario report, were elicited from operational profile scenarios. The technical features will be described for the associated subsystem (e.g. pumps, hoses, etc.). The metrics and safety-related analyses to be conducted will be communicated and specified for the purposes of the risk assessment process. Operational features, such as bunkering procedures and hydrogen fuel conditions, will also be described, defining the limits for the scope of the analysis.
- e-SHYIPS aims to determine risk and safety best practices for the maritime sector. Therefore e-SHYIPS will report on technical knowledge gaps and models for risk assessment



and risk management of gaseous hydrogen and liquid hydrogen, and hydrogen-based alternative fuels on ships, in 2024.

PROGRESS, MAIN ACHIEVEMENTS AND RESULTS

- The analysis of emergency hydrogen discharge or major leaks from the vessel focusing on piping/venting mast arrangements for emergency hydrogen discharge, and the dispersion of hydrogen outside the ship.
- The guidelines for ship design and operation regarding emergency hydrogen discharge for different types and sizes of vessels and hydrogen storages.
- Fuel cell stack inclination testing (IR).
- Fuel cell salt spray testing.
- HAZID Analysis for Gas Compressed Hydrogen.
- Safety System Review.
- HAZID Analysis for Liquid Hydrogen.
- Explosion Risk Assessment.
- Testing of new forcing/damping methods in OpenFOAM.
- Optimisation of mesh focused on seakeeping.
- Validation of zero hull velocity wave-hull interaction simulation (LINCOSIM).
- Test of new LincoSim production web application to external expert users.

FUTURE STEPS AND PLANS

- e-SHyIPS will continue to develop the hydrodynamic analysis. Implementation on the LINCOSIM platform using the updated mesh and wave-hull interaction simulation.
- The safety assessment for each vessel design for each scenario is completed.
- The H₂-based fuel bunkering systems basic design technical report has been completed.

- On-board H₂ dispersion and explosion model test
 - Test results from material and component testing and postmortem analysis are expected
- Initial results for the fuel delivery and bunkering solutions for ships are expected

PROJECT TARGETS

Target source	Parameter	Achieved to date by the project	Target achieved?
Project's own objectives	Constant operation of stack possible	-	✓
	To find materials which do not induce additional degradation to fuel cell compared to baseline	Certain EPDM materials identified which may be suitable for cathode side	
	Performance degradation (potential loss at constant current) (mV)	-10 to -20 mV (during UI curve) -13 mV during continuous operation	
	Generate new and missing knowledge to define a standardised knowledge database	150 Gaps in existing knowledge identified (literature) 90 gaps in IGF Code identified (35 matched to existing hydrogen standards)	
	Propose a pre-standardisation plan for IGF	Pre-normative plan for H ₂ applications to passenger ships included in CWA WSESH001:2024 "e-Ships"	
	Hydrogen-based fuels adoption roadmap definition for passenger ships	-	