

PILGRHYM

PRE-NORMATIVE RESEARCH ON INTEGRITY ASSESSMENT PROTOCOLS OF GAS PIPES REPURPOSED TO HYDROGEN AND MITIGATION GUIDELINES



Project ID	101137592
PRR 2025	Pillar 2 – H ₂ storage and distribution
Call topic	HORIZON-JTI-CLEANH ₂ -2023-02-02
Project total cost	EUR 3 999 073.75
Clean H ₂ JU max. contribution	EUR 3 999 073.75
Project period	01-01-2024 - 31-12-2027
Coordinator Beneficiary	GRTGAZ, FR
Beneficiaries	SNAM S.P.A., SINTEF AS, ENAGAS TRANSPORTE SA, GERG LE GROUPE EUROPEEN DE RECHERCHES GAZIERES, FLUXYS BELGIUM SA, FUNDACION PARA EL DESARROLLO DE LAS NUEVAS TECNOLOGIAS DEL HIDROGENO EN ARAGON, UNIVERSIDAD DE BURGOS, ONDERZOEKSCENTRUM VOOR AANWENDING VAN STAAL NV, FUNDACION TECNALIA RESEARCH and INNOVATION, FRAUNHOFER GESELLSCHAFT ZUR FORDERUNG DER ANGEWANDTEN FORSCHUNG EV, COMMISSARIAT A L ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES

<https://pilgrhy.com/>

PROJECT AND GENERAL OBJECTIVES

PilgrHYM is an interdisciplinary project which aims to contribute to the decarbonisation of the energy sector by providing a European roadmap with comprehensive guidelines to assess the feasibility of safely and efficiently integrating pure H₂ into existing natural gas infrastructure.

NON-QUANTITATIVE OBJECTIVES

- Develop a database of material characterisation testing on representative steel grades of the EU gas grids, including tensile, fracture toughness and fatigue crack growth (FCG) properties.
- Establish harmonised testing protocols to support the repurposing of natural gas lines to accommodate hydrogen.
- Develop a numerical modelling approach for simulating and predicting hydrogen assisted fracture and fatigue.
- Optimise a more realistic fatigue crack growth rate master curve for the purpose of assessing fitness-for-service, in particular for low delta K values corresponding to the actual operating domain of the EU gas grids.
- Identify existing and/or innovative technologies for mitigation compatible with operational constraints.
- Engage with stakeholders to ensure cooperation and awareness.
- Facilitate the uptake and exploitation of PilgrHYM results by the academic community, technology developers and end-users.

PROGRESS, MAIN ACHIEVEMENTS AND RESULTS

PilgrHYM delivered three main public reports in 2024:

- A literature and standard review focused on material mechanical testing in pressurised hydrogen gas. This review describes the testing procedures from more than 27 standards, highlighting their

incongruencies and gaps when it comes to pressurised hydrogen testing environments.

- A literature review of innovative modelling approaches, including more than 30 papers and four model frameworks, covering state-of-the-art modelling for fracture and fatigue applications.
- A transmission system operator (TSO) inventory which collects data on the transmission steel networks present in Europe. The questionnaire was sent out to all EU TSOs and various associations (GERG, ENTSOG, EPRG and CEN TC234) representing EU TSOs. A total of 23 onshore TSOs replied, accounting for a global length of more than 78% of the total European grid.

PilgrHYM has selected twelve materials to be tested (two for round robin tests and ten for the main testing campaign). The materials will be dispatched to the project's testing laboratories in 2025. The testing protocols have been established. The round robin test ended in June 2025. The results will be shared in a later update.


FUTURE STEPS AND PLANS

Following the round robin test, the main testing campaign on the other ten materials will be performed. In parallel numerical models will be developed. The expected outcomes of the project are:

- Definition of optimised testing procedures for hydrogen compatibility assessment of pipeline steels.
- Assessment of novel time and cost effective experimental procedures for material qualification in a hydrogen environment.
- Development of a database summarising the characterised relevant properties of pipeline materials in hydrogen gas.
- New and innovative models for hydrogen-induced fracture and fatigue cracking simulation.
- Development of improved and more cost-effective FCG-master curves, with a reduced number of experimental tests.



PROJECT TARGETS

Target source	Parameter	Unit	Target	Target achieved?
Project's own objectives	Number of km of the European grid covered - Information collected on the EU and connected countries H ₂ grid.	km	156 054	✓ (182 469)
	Different steel microstructures to be assessed (including 8 base materials, 2 welds and 2 heat affected zones).	Number	12	
	Dedicated testing protocols for H ₂ environments (tensile test, fracture toughness test and test on hollow specimen).	Number	3	
	Reports on suitable innovative technologies with proposed testing protocols.	Number	1	
	Guidelines (reports) on experimental characterisation of mechanical properties, mitigation techniques and master curves.	Number	2	
	Mitigation techniques identified.	Number	10	
	Numerical approach based on the performed experimental results.	Number	1	
	Optimisation of design codes and standards with reduced over-conservatism vs ASME B31.12 (reduction of over-conservatism on the master curve).	%	60	
	Fracture models	Number	1	
	Fatigue models	Number	1	
	Reduction of total testing time for fracture toughness (time reduction).	%	20	
	Dissemination of stakeholder analysis for the use cases and organised workshops and events.	Number	5	
	Dissemination of PilgrHYM's results towards the scientific, academic and standardisation community.	Number	2	