ELVHYS

ENHANCING SAFETY OF LIQUID AND VAPORISED HYDROGEN TRANSFER TECHNOLOGIES IN PUBLIC AREAS FOR MOBILE APPLICATIONS

Project ID	101101381
PRR 2024	Pillar 5 – Cross-cutting
Call topic	HORIZON-JTI-CLEANH2-2022-05-02: Safety of cryogenic hydrogen transfer technologies in public areas for mobile application
Project total costs	EUR 1 433 960.00
Clean H_2 JU max. contribution	EUR 1 433 960.00
Project period	1.1.2023–31.12.2025
Coordinator	Norges teknisk-naturvitenskapelige universitet, Norway
Beneficiaries	Alma Mater Studiorum – Università di Bologna, Deutsches Zentrum für Luft- und Raumfahrt EV, Health and Safety Executive, Karlsruher Institut für Technologie, L'Air Liquide SA, National Centre for Scientific Research 'Demokritos', University of Ulster

https://elvhys.eu/

PROJECT AND GENERAL OBJECTIVES

The Elvhys project addresses a critical gap in international standards related to liquid and cryogenic hydrogen transfer technologies for mobile applications, such as filling trucks, ships and stationary tanks. Currently, there is limited or no experience in this area, which poses significant challenges for safety and efficiency in hydrogen transfer operations.

The overarching objective of Elvhys is to develop inherently safer and more efficient liquid and cryogenic hydrogen technologies and protocols for mobile applications. This objective is pursued through innovative safety strategies and engineering solutions, including the selection of effective safety barriers and hazard-zoning strategies. The project utilises an interdisciplinary approach, combining experimental, theoretical and numerical studies to address various aspects of liquid and cryogenic hydrogen transfer.

NON-QUANTITATIVE OBJECTIVES

- The results of Elvhys will contribute to many objectives of the Clean Hydrogen Joint Undertaking strategic research and innovation agenda, such as increasing the level of safety and supporting the development of regulations, codes and standards (RCSs) for hydrogen technologies and applications.
- Increasing the level of safety of hydrogen technologies and applications is the cornerstone of the entire Elvhys project. It will be addressed by performing cutting-edge research, closing numerous knowledge gaps in the understanding of the underlying liquid hydrogen (LH_2) transfer physical phenomena of heat and mass transfer at cryogenic temperatures and under multiphase flow conditions, advancing the SOA through the generated knowledge, developing innovative prevention and mitigation strategies and proposing risk-informed recommendations and guidelines on cryogenic hydrogen transfer technologies.
- The objective of supporting the development of RCSs for hydrogen technologies and applications, with a focus on standards, will be addressed through the developed science-based recommendations for RCSs, beyond the SOA guidelines and fuelling/bunkering/transfer procedures.

PROGRESS AND MAIN ACHIEVEMENTS

The Elvhys project's progress regarding LH_2 transfer technologies is as follows.

- Operational data collection and best practices in LH_2 transfer. Extensive data collection efforts made to identify best practices in LH_2 transfer operations.
- LH_2 transfer ecosystem, infrastructures and applications. Comprehensive overview of the LH_2 transfer ecosystem provided.
- Piping and instrumentation diagrams of LH_2 transfer installations and list of existing safety devices. Detailed piping and instrumentation diagrams developed for LH_2 transfer installations.
- Refined research programme on the safety of LH_2 transfer systems. Refined research programme developed to focus on the safety aspects of LH_2 transfer systems.
- Review of methodologies, preliminary risk analysis and gap identification. Preliminary risk analysis of specific scenarios conducted to identify gaps and areas for further investigation.
- Compilation of relevant/existing RCSs and bodies. Comprehensive list of relevant RCSs and regulatory bodies compiled for LH_2 transfer operations.
- Support of LH_2 fire and explosion tests through modelling. Computational models selected to provide insights into potential hazards and mitigation strategies.
- Experiment set-up and test readiness review for fire tests and boiling liquid expanding vapour explosion tests on LH_2 hoses.
- Hazard identification for LH_2 transfer operations. Detailed identification of potential risks and proposed mitigation strategies completed.

FUTURE STEPS AND PLANS

The Elvhys project aims to provide a supportive regulatory and standardisation framework.

PROJECT TARGETS

Target source	Parameter	Unit	Target	Target achieved?	SOA result achieved to date (by others)	Year for reported SOA result
SRIA (2021–2027)	Impact on standards at scope	number/project	1	⚙	0.6	2020
	Safety, PNR/RCS workshops	number/year	2	✓	1	2020

Clean Hydrogen Partnership
Co-funded by the European Union