

# HYDROGEN PIPELINES: RISK MITIGATION, CONFORMITY ASSESSMENT AND SUSTAINABLE DEVELOPMENT

Roman Samsonov<sup>1</sup>, Darya Michurina<sup>2</sup>, Aleksej Samsonov<sup>1</sup>

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<sup>1</sup>Moscow State University of Civil Engineering, RUSSIA

<sup>2</sup>Russian Union of Industrialists and Entrepreneurs, Moscow, RUSSIA

[romanglobal@yandex.ru](mailto:romanglobal@yandex.ru)

## Abstract

*The article examines the issues of standardization and safety of pipelines for hydrogen transportation, emphasizing the importance of international recommendations and harmonization of standards. The established UNECE working group develops approaches to risk assessment, compliance and supervision, which contributes to the development of the market and increased safety. An important aspect is the introduction of conformity assessment systems and state control, including digital monitoring and independent inspections. The introduction of hydrogen into existing gas transportation systems is seen as a step towards energy decarbonization and sustainable infrastructure development.*

**Keywords:** standardization of pipelines for hydrogen transportation, safety of pipelines for hydrogen transportation, recommendations for the transportation of hydrogen

## I. Introduction

Pipelines for hydrogen: risk management, conformity assessment and sustainable development Standardization of pipelines for hydrogen transportation includes regulatory documents, requirements for design, installation and operation, as well as requirements for pipe materials and testing. This is associated with a high degree of risk when working with hydrogen gas, and standardization is aimed at ensuring safety.

The key issue is the safe operation and maintenance of trunk and distribution pipelines transporting hydrogen gas, while recognizing the increased risk caused by the flammability of hydrogen and the open location of such infrastructure. Hydrogen and its derivatives are the central components of a decarbonized energy system.

## II. Activities of the working group

In January 2024, at the initiative of Germany, Russia and the USA, a working group was established in the UNECE WG 6 to prepare recommendations for the transportation of hydrogen through main pipelines (hereinafter referred to as the Working Group). The Working Group became a continuation of the activities of the sectoral initiative on the safety of main pipelines that existed until 2024.

The mandate to prepare recommendations was designed for a year and a half, during which time a working group was formed, which included representatives of 6 countries – Russia, China,

USA, Canada, Germany, Belgium, as well as experts from industrial associations from the European Union (IRENA), Russia (Committee of the Russian Union of Industrialists and Entrepreneurs), USA (API). The purpose of the developed recommendations is to reduce technical barriers to trade and facilitate access to international markets.

### III. Recommendations for the transportation of hydrogen

The recommendations are aimed at:

- creation of models for the development of legislation in countries where there are currently no regulations on pipeline infrastructure for the transportation of hydrogen;
- promote the alignment of existing national standards with internationally harmonized best practices.

The recommendations relate to risk assessment, conformity assessment, and market surveillance. Risk assessment is used to determine the likelihood and consequences of potential threats to the integrity of the pipeline. These assessments help identify areas where additional integrity analysis or preventive measures are needed. As a rule, threats are divided into time-dependent (for example, external corrosion, internal corrosion, stress corrosion cracking), constantly present (for example, construction or manufacturing defects) and time-independent (for example, damage from third parties, improper operation, natural impact). The results of these assessment procedures serve as the rationale for prioritizing integrity measures and may affect the requirements specified for monitoring systems and intervals in product-related documentation.

On the one hand, many countries are currently creating a regulatory framework for renewable and low-carbon hydrogen, often accompanied by the establishment of specific requirements for hydrogen.

### IV. Standardization of hydrogen transportation

At the current stage, hydrogen producers need to demonstrate compliance with regulatory criteria in order to gain market access and benefit from benefits. Standardization plays a key role in this, creating non-tariff barriers to market access.

The lack of uniform standards is a problem for increasing hydrogen production [1], although work on international hydrogen standards is already underway.

Difficulties arise not only at the stage of hydrogen production, but also during its transportation [2].

The United Nations Economic Commission for Europe began to create recommendations in the field of standardization of hydrogen transportation. Since 2014, the Working Group on Regulatory Policy in the Field of Standardization (UN/ECE WP 6) has been developing an initiative to develop a unified policy in the field of ensuring the safety of main pipeline systems for oil and gas.

Since January 2024, a working group has been operating within the framework of the UNECE WP 6 to develop recommendations on the harmonization of approaches to the creation of standards and conformity assessment systems for transportation through main pipelines of various carriers – oil, gaseous fuels, including hydrogen.

The relevance of the topic is related to the implementation of several Sustainable Development Goals [3]:

- Ensuring access to affordable, reliable, sustainable and modern energy sources for all.
- Promoting sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.
- Building solid infrastructure, promoting inclusive and sustainable industrialization and

innovation.

- Taking urgent measures to combat climate change and its consequences.

This project reflects the need to harmonize procedures and approaches to conformity assessment, as there are currently many different standards in the field of hydrogen energy. The project aims to develop guidelines for the harmonization of standards and conformity assessment systems for the transportation of hydrogen through main pipelines using the template of Recommendation L General Regulatory Regulation.

## V. Conclusion

The addition of hydrogen to existing natural gas transportation systems (for example, methane) reflects a gradual movement towards decarbonization using existing infrastructure.

In order to ensure the safe and effective implementation of hydrogen pipeline systems, national and local regulations are expected to establish requirements for project quality control and conformity assessment procedures. They should cover the design, construction, operation and modification of pipelines and related components. These conformity assessment mechanisms aim to determine product requirements based on real-world operating conditions, promote the harmonization of such requirements between jurisdictions, and ensure compliance with international requirements in terms of safety and performance. ECE/CTCS/WP.6/2025/13 20 GE.25-10190 98. The conformity assessment should take into account not only the pipeline equipment, but also the organizations involved in its design, production, installation, operation, maintenance and repair, including the qualifications of the relevant personnel.

Moreover, the implementation of an effective compliance assessment system is possible without government oversight mechanisms. Effective market surveillance in the field of main pipelines may include:

- Verification of compliance with regulations and regulations: both planned and unplanned at all stages of the life cycle;
- Digital monitoring: the use of digital reporting systems in real time or on a periodic basis to increase transparency and accessibility of data;
- Third-party inspections: independent authorities may conduct inspections or inspections in addition to regulatory oversight;
- Documentation and accounting: Operators are required to keep comprehensive records of compliance information for verification and traceability.

### CONFLICT OF INTEREST.

Authors declare that they do not have any conflict of interest.

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