

# Risks involving hydrogen and safety considerations: The Italian experience

*Hydrogen Fuel Risks Part 1*

*EU TWG for Seveso Inspections and OECD Working Party on Chemical Accidents*

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## Program and themes

1. The Central Committee for the technical safety of the energy transition and for the management of risks related to climate change
2. Systems and plants powered by hydrogen: Electrolysis and storage systems
3. Systems and plants powered by hydrogen: Transport of hydrogen and methane mixtures
4. Conclusions and Further Developments

# *1. The Central Committee for the technical safety of the energy transition and for the management of risks related to climate change*

## Purpose and skills

Technical, consultative, and proactive **body on technical safety issues** concerning systems and **plants powered by hydrogen**, including fuel cells, liquefied natural gas and electrochemical energy storage, innovative electricity production systems, and **solutions adopted to combat the risk related to climate change** and energy saving

- Identifies **criteria and guidelines** for the evaluation of **technical safety standards**, also considering the **evolution of risks** of systems and plants
- Proposes and coordinates **studies, research, projects, and experiments** in cooperation with other administrations, institutes, bodies, and companies

## Composition of the committee

The Committee is established at the **Ministry of the Interior**

- National Fire Brigade*
- Civil Protection Department*
- Department of Public Security*
- Ministry of Environment*
- Ministry of Infrastructure and Transport*
- Ministry of Industry*
- Ministry of Welfare*
- Ministry of University and Research*
- Agency for new technologies, energy, and sustainable development (ENEA)*
- National Institute for Environmental Protection and Research (ISPRA)*
- National Research Council (CNR)*

## *2. Systems and plants powered by hydrogen: Electrolysis and storage systems*

# The fire-fighting technical rule on hydrogen plants

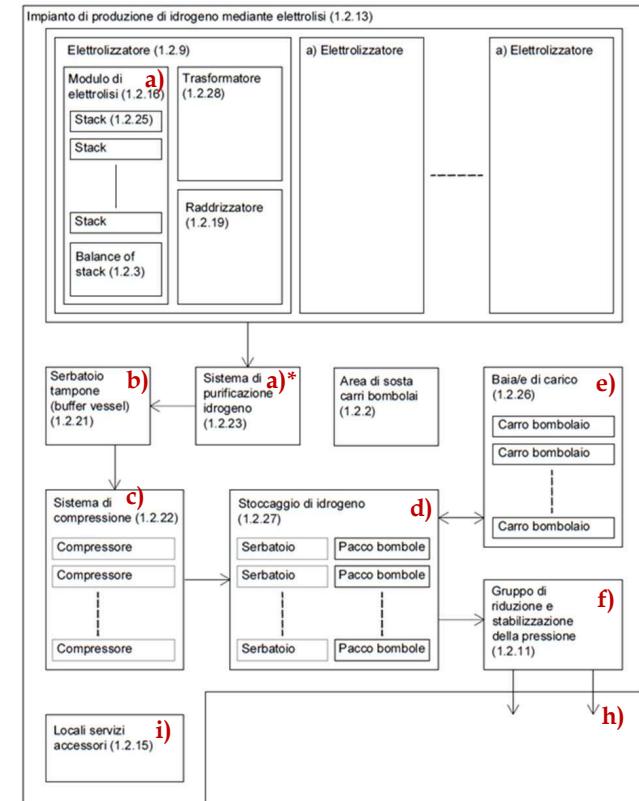
Ministerial Decree 7/7/23 “*Fire prevention technical rule for the identification of **methodologies for risk analysis and fire safety measures** to be adopted for the design, construction, and operation of **hydrogen production plants through **electrolysis and related storage systems*****”

- ✓ **Achievement** of the National Recovery and Resilience Plan (PNRR) objectives while guaranteeing the main **safety requirements**
- ✓ Operational **experience**, experimental **tests**, and comparison with **professionals and companies**
- ✓ **Measures** to be adopted to guarantee an **adequate level of safety** in the event of **fire**

# Main elements of an electrolysis system

Dangerous elements

- a) Electrolysis module**
- b) Buffer tank**
- c) Compression system**
- d) Hydrogen storage**
- e) Loading station (bays)**
- f) Pressure reduction and stabilization group**
- g) Connecting pipes for the hydrogen transferring (connections between a, b, c, d, e, f)**
- h) Rest area for cylinder trucks**
- i) Services and accessories**





# Safety in the event of fire: the risk analysis

## Measures to be adopted

- Typical **system** elements
- **Dangerous** elements
- Main active and passive **protection measures**
- Plant **operating** rules
- Safety **distances** per system element

Dangerous elements	Pression (bar)	External safety distances (m)
Hydrogen storage / Loading station / compressors / High pression sections	>700 ≤1000	30
	>500 ≤700	25
	≤500	20
Loading station / Compressors/ High pression sections	>100 ≤300	17
	≤100	12
Electrolysis module/ Low pression sections	>30 ≤50	8
	>10 ≤30	7
	≤10	5

### ***3. Systems and plants powered by hydrogen: Transport of hydrogen and methane mixtures***

# The technical rule on components in the natural gas network

Ministerial Decree 18/5/18 “*Technical rule on the chemical-physical characteristics and the presence of **other components in natural gas injected into and withdrawn from transportation and distribution networks***”

- ✓ Updated with a **precautionary limit value** for the introduction of **hydrogen into the networks** that do not compromise the treatment, storage, and/or use of natural gas

<i>Hydrogen</i>	$\leq 2$	<i>% vol.</i>
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# Allowable hydrogen concentrations in natural gas

- **Technical standard** UNI EN 16276:2018 “*Gas infrastructure - Gas quality - Group H*”
  - ✓ Suitability **up to 10% vol.** hydrogen
  - ✓ The **safety parameters** (flammability limits, ignition energy, flame speed) are marginally influenced
- **Experimental campaigns** for the evaluation of the **effect of H2-NG mixtures on the transport infrastructure**
  - Use of **H2 at 5% vol.**, in some sections of a **pressure reduction plant** on the national NG network
  - Use of **H2 at 5% vol.**, in some sections of the **national NG network** (supply for the pressure reduction cabin and two utilities)

## Critical issues and further investigations

- Identification of **models for risk assessment** and analysis relating to **pipeline transportation of H<sub>2</sub>-NG mixtures** (**probability of release and triggering in case of loss of containment**)
  - Uncertainties on the chemical-physical and **combustion properties**
  - Disagreement on **emerging risk scenarios** after a loss of containment
- Identification and design of **experimental tests** related to hydrogen transport
  - A maximum **hydrogen content of no more than 10% vol.** should not alter the risk scenarios defined for the transport of natural gas

## *4. Conclusions and Further Developments*

## Hydrogen as an energy carrier: the committee's activities

- ❑ Extend safety **evaluations**, for the hydrogen production plants, to **NATECH risk**, considering the increase in **extreme natural events** due to ongoing **climate change** (**Seveso directive methodology**)
- ❑ Investigate any **rescue procedures** in the event of accidents and **emergencies** related to the **storage, use, and distribution** of hydrogen
- ❑ Involvement of **natural gas distribution companies** for a working group for the **study of the safety aspects** of hydrogen as an energy vector

Acknowledgment: Michele Mazzaro, CNVVF

*If you think safety is expensive, try an accident*



**Thanks for the attention!**

*Questions...???*

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