Summary of EU + OECD Hydrogen Fuel Risks Webinar series –Background and developments

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Outline

- What is the EU+OECD Hydrogen Fuel Risks initiative?
- Findings from Hydrogen Fuel Risks Webinar 1
- Conclusions and next steps

EU + OECD Hydrogen Fuel Risks (HFR) Webinar Series

EU+OECD ad hoc Hydrogen Fuel Risks Technical Advisory Group

- Launched as an ad hoc initiative in May by the European Commission Joint Research Centre (JRC)
- Formed a technical advisory group (TAG) from JRC, OECD, EU-OECD countries and experts
- Met virtually in May 2023 and decided to host HFR Webinar 1

HFR Webinar 1

- Took place on 15 September 2023
- About 60 participants from 20 countries, both EU and OECD
- Purpose was to get a feeling about the situation across the various countries
- Because it was very exploratory, participation was restricted

Background on EU + OECD HFR Initiative

Triggers

- Recent high focus on hydrogen as a possible substitute for carbon-based fuels for many uses, within the media and in national and international policy documents
- (Known) properties of hydrogen and chemical accident potential not widely publicized
- Questions arising during the OECD meetings (2020 +) and especially 2022 Seminar on Energy Transition in the Working Party on Chemical Accidents (WPCA)
- Cases and questions shared in the EU Technical Working Group for Seveso Inspections (TWG 2)
- Bilateral exchanges between national authorities and JRC on how to consider new hydrogen uses being proposed

Recognition of an urgent need for sharing knowledge, experience and good practices between authorities and experts to meet risk management challenges that new uses of hydrogen may bring

Properties of hydrogen and chemical accident potential

Typical considerations for hydrogen risk management

- Hydrogen is the smallest, lightest and most abundant molecule in the universe
- It rises rapidly but diffusion makes it disperse in all directions
- Confined and semi-confined spaces can increase the risk of explosion
- Cryogenic hydrogen, when released, is usually a mixture cloud of hydrogen, air, and water that can ignite with very low energy input, e.g., static
- Hydrogen reacts spontaneously and violently at room temperature with chlorine or fluorine.
- Completely dust-free hydrogen, released from a pipe or tank, does not catch fire easily but ignition can follow when escaping gas comes into contact with dust particles or water droplets
- Hydrogen can be accidentally produced in various ways, e.g., from contact between water and molten metal
- Hydrogen has a very broad explosive range, so that bursting is a very dangerous concern.

Properties relevant for chemical accident risk

- Tendency to escape due to its low molecular weight
- Wide flammability range
- Low ignition energy demand
- Ability to detonate easily

Findings from Hydrogen Fuel Risks Webinar 1

Risk considerations in a future hydrogen-fueled economy

The potential use of hydrogen is creating a number of questions around hypothetical situations in which hydrogen risks may be present, including:

- Hydrogen storage (increased volume, increase in storage sites, location)
- Electrolysis of hydrogen (e.g., hydrogen-gas mixtures, many leak opportunities – one paper identified 99 high risk scenarios (without safety measures))
- Hydrogen distribution through pipelines (e.g., leaks, fire risk of hydrogen/ natural gas blends, concentration of H2 at point of release)
- Liquid hydrogen distribution via road, using pressurized or cryogenic storage (pressure burst, embrittlement)
- Transport of hydrogen in the form of ammonia (increased ammonia hazard)
- Compression and regasification of hydrogen associated with liquid hydrogen transport
- Consumer fueling stations (many locations, proximity to urban areas, etc.)

Additional risk considerations for a hydrogen fueled economy

- Hydrogen is currently handled by a small set of companies with long experience
  - Green deal incentives are bringing many new players into the market
  - Current experiences may not be representative of the risks of new uses (e.g., electrolysis, compression, transport, distribution) especially with inexperienced users and untested systems
- Most plans to produce, transport and distribute hydrogen are still "futuristic" because technical issues associated with performing these tasks at a large scale have not yet been resolved.
  - Lack of complete knowledge about the technological requirements = the safety risk cannot be estimated
  - Even so, these processes will all involve several interactions that create opportunities for loss of containment and failure.
  - This does not mean the problems cannot be overcome. There are various private and public efforts to underway for this purpose. It simply means that the time horizon is uncertain.

Thanks to JRC hydrogen expert, Pietro Moretto who provided guidance on risks of future hydrogen energy needs.

Consequence analysis of hydrogen scenarios

- Consequence analysis of hydrogen is currently based on the limited statistics that tend to create very large distances

- Examples of hydrogen modeling challenges
  - Uncertainties surrounding temperature of pressurized hydrogen gas
  - Unique dispersion and reactivity characteristics
  - Liquid hydrogen – Few modeling tools, lack of experimental data

- These are considered too conservative, but there is no reliable alternative

- A few countries, e.g., Germany, the U.S. NFPA, have established shorter, but still very large distances for hydrogen storage. The Netherlands and Norway also have some guidance

Conclusions and next steps

EU + OECD Hydrogen Fuel Risks Webinar #1 – 15 September 2023

Key issues highlighted
Link to website

Change in profile of high hazard sites

Growth in number of sites

Increase in high hazard sites with hydrogen fuels

Existing high hazard sites with increased hydrogen volumes

Location of hydrogen distribution and storage sites

New actors in charge of hydrogen fuel operations

Increase in ammonia sites

Risk and engineering issues

Potentially new and increased risks in some locations (urban areas, residences, ports)

Competency of new operators

Feasibility and cost of control measures

Limitations of hydrogen consequence modeling

Need for new reference accident scenarios

Authority issues

Criteria for permitting, land-use planning

Competency of “new” authorities

Gaps in standards and risk management norms

Gaps in regulatory framework

Emergency preparedness and response

Preliminary conclusions

A lot of work to do

- Understand the scope of the new hydrogen fuel uses (existing, in construction and proposed)
- Collecting good practices and tools
- Exchange on findings from research
- Identify gaps in practices and tools
- Known gaps already in terms of risk scenarios, consequence analysis
- Using scientific information to design regulatory controls and standards
- Turning scientific information into decision criteria for inspectors

Next steps

- **3rd and possibly 4th webinar in 2024/2025**
  - Webinar 3: Efforts of industries and standard organisations to address new hydrogen risk issues
  - Webinar 4 (possibly): Additional risk issues, e.g., ammonia storage and bunkering
- **Finalisation of webinar reports**
  - Summary report of Webinar 1 available soon
- **Publication of non-confidential presentations on the Minerva website under Events https://minerva.jrc.ec.europa.eu/en/minerva**

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