



# MODULE 1

## WORKSHEET 1: HYDROGEN LOGISTICS FAILURE CASE STUDY ANALYSIS

### The Objective

The objective of this worksheet is to assist students in recognizing the causes, consequences, and potential preventative strategies related to accidents involving hydrogen transport and storage. Participants will cultivate the capacity to critically evaluate incidents and derive conclusions aimed at enhancing safety.

### Substantive Introduction

Hydrogen logistics, essential for decarbonizing the energy sector, poses several challenges and potential risks. Hydrogen is a highly flammable and explosive gas, necessitating specialized safety protocols for its storage and transport under high pressure or low temperatures. Analyzing historical incidents and failures provides valuable insights that can help avert similar occurrences in the future. Comprehending the mechanisms of failure, their repercussions on individuals, the environment, and infrastructure, along with effective crisis management strategies, forms the cornerstone of secure hydrogen logistics.

### Task

Please examine the following hypothetical incident description. Your objective is to assess the incident and subsequently compile a report that encompasses:

1. **Detailed account of the incident:** Utilizing the information available, reconstruct the sequence of events surrounding the incident.
2. **Cause Identification:** Determine both direct and indirect causes of failure (e.g., human error, technical defect, procedural negligence, environmental factors).
3. **Consequence Assessment:** Evaluate the potential repercussions of the incident on individuals (injuries, fatalities), the environment (contamination, fire), property (material damage), and the organization's reputation.
4. **Recommendations for preventive measures:** Suggest specific actions that could avert a similar incident in the future. These may encompass procedural changes, investments in new technologies, training initiatives, infrastructure enhancements, and more.
5. **Emergency Response Plan Recommendations:** Contemplate your response to this incident to mitigate its impact.

## Description of a Theoretical Incident

- **Data:** 15 May 2024
- **Time of incident:** 14:30.
- **Location:** Liquid hydrogen (LH2) transshipment facility at Port X.
- **Type of facility:** LH2 storage tank with a capacity of 500 m<sup>3</sup>, equipped with a transfer line for refueling tank trucks.

### Course of Events:

- During the standard procedure of refueling a tanker truck with liquid hydrogen, the operator observed a sudden rise in pressure within the transfer line.
- He then heard a loud hissing sound and noticed a swift leak of hydrogen near the shut-off valve of the storage tank.
- Within seconds, hydrogen's interaction with air, coupled with a spark—likely originating from a nearby faulty electrical installation—ignited and resulted in a significant fire.
- The operator promptly activated the alarm, and terminal personnel endeavored to facilitate an evacuation.
- The situation was exacerbated by strong winds that propelled the flames toward adjacent tanks.
- Emergency services arrived at the location after a duration of 20 minutes.

## Preliminary Results

- During the scene inspection, it was determined that the leak resulted from a fractured gasket in the shut-off valve flange, which had not been replaced for seven years, despite the manufacturer's recommendation for replacement every five years.
- The hydrogen detection system functioned with a delay.
- One employee sustained severe burns while attempting to manually close the emergency valve.
- The fire impacted a section of the transmission facility and the adjacent transformer station.

## Tips

- Collaborate in groups to discuss and share ideas.
- Concentrate on discerning the primary and secondary causes of failure.
- Consider both technical, human, and organizational factors.
- Consider which procedures might have averted such an incident.
- Be precise in your proposals and recommendations for preventive actions.
- Prepare to present the findings of your analysis to the entire group.

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