

MODULE 1

PODCAST: HOW TO ADDRESS EMERGENCY SITUATIONS IN HYDROGEN LOGISTICS?

Welcome to our podcast focused on safety in hydrogen logistics. Today, we will explore a vital topic: "How to respond to emergencies?" Hydrogen, as the fuel of the future, introduces new challenges, particularly regarding its transportation, storage, and utilization. An appropriate response to incidents not only mitigates damage but, most importantly, preserves lives.

Why is Hydrogen a Challenge?

Let us begin with the fundamentals. Hydrogen is a gas characterized by its distinctive properties. As the lightest element, it ascends and disperses swiftly in the atmosphere upon release. This characteristic presents an advantage by diminishing the likelihood of forming a flammable cloud at ground level; however, it complicates detection and control in confined spaces. Additionally, hydrogen is odorless, colorless, and tasteless, rendering it ineffective for human detection. It possesses an extensive explosive range in air (ranging from 4% to 75% by volume) and requires minimal energy to ignite (0.02 millijoules—less than a spark from an electrostatic discharge).

The hydrogen flame is nearly imperceptible in daylight, thereby heightening the associated risks.

This underscores the importance of implementing proper procedures and ensuring a prompt response.

The response to emergency situations can be categorized into several essential phases:

1. Detection and Notification:

- The initial step involves the swift and accurate identification of the threat. For hydrogen, we predominantly depend on gas detection systems, which are strategically positioned at potential leak sites: tanks, pipelines, valves, and within confined spaces.
- Modern detectors are capable of identifying hydrogen concentrations significantly below the lower explosive limit, such as at levels as low as 1%. Upon detection, the system should automatically activate visual and audible alarms and alert the relevant emergency services and personnel.
- An illustration of this is the systems employed at hydrogen refueling stations, which automatically shut valves and halt refueling in the event of a leak detection.

2. Situation Evaluation and Source Disconnection:

- Upon receiving an alarm, it is essential to promptly evaluate the magnitude and nature of the threat. Operators must be adept at interpreting data from monitoring systems.
- The source of the leak should be isolated as swiftly as possible. This may involve remotely closing emergency valves, activating safety systems, or shutting down pumps.
- Numerous contemporary hydrogen facilities, including production plants and transshipment terminals, are equipped with automated safety systems (Emergency Shutdown Systems – ESD) that autonomously isolate the impacted area upon detection of a significant incident.
- According to the 2021 Hydrogen Council report, the deployment of ESD systems can reduce response time by several dozen seconds, which is critically important in the context of hydrogen.

3. Isolation and Evacuation:

- When severing the source, it is essential to isolate the affected area and evacuate personnel and bystanders.
- Hydrogen disperses rapidly; however, in confined or inadequately ventilated areas, it can accumulate to hazardous levels. Hazard zones must be distinctly marked, and evacuation procedures should be routinely rehearsed.
- In 2019, an incident at a hydrogen refueling station in Norway resulted in substantial infrastructure damage; however, a prompt evacuation prevented any fatalities.

4. Firefighting and Cooling Measures (if necessary):

- In the event of ignition, the primary focus is typically not on directly extinguishing the flame (unless there is a threat to individuals or essential infrastructure). The hydrogen flame, although intense, rapidly consumes the gas that ascends.
- Cooling the surrounding elements, such as tanks and pipelines, with water is crucial to prevent structural weakening and to inhibit the spread of fire.
- However, if the flame poses a risk to adjacent tanks or structures, it is essential to employ specialized extinguishing agents, such as water mist or carbon dioxide, which can effectively extinguish the fire without dispersing hydrogen.

5. Post-Incident Review and Evaluation:

- Once the emergency situation has been contained, the post-incident phase commences. This phase encompasses securing the scene, repairing damages, reconstructing infrastructure, and—most importantly—conducting a comprehensive analysis of the incident's causes.
- Every failure, regardless of its magnitude, offers invaluable lessons. Incident reports, such as those released by the Hydrogen Safety Panel, deliver comprehensive analyses and recommendations that contribute to the development of safer systems.
- Following a hydrogen leak incident at an industrial facility, analysis determined that the cause was material fatigue in an aging pipe. Consequently, rigorous new replacement schedules were instituted.

The Significance of Training and Protocols

None of these phases will succeed without adequate staff preparation. Regular hydrogen safety training, familiarity with emergency procedures, drills, and incident simulations are imperative. Employees must be able to identify hazards, utilize firefighting equipment, locate assembly points, and collaborate effectively with emergency services. Individuals working with hydrogen should complete certified training and understand the unique characteristics of this fuel. Organizations that invest in comprehensive training programs substantially mitigate the risk of serious incidents. Data from industry organizations such as Hydrogen Europe suggests that over 70% of incidents could be averted with improved procedures and operator training.

Finally, it is essential to underscore the significance of collaboration with local emergency services, including fire departments, ambulance services, and police. These entities should be well-acquainted with the specific hazards related to hydrogen, possess access to facility plans, and understand the appropriate procedures in the event of a hydrogen release or ignition. Joint exercises and the sharing of information are invaluable.

Summary

Responding to emergencies in hydrogen logistics entails a multifaceted process that necessitates meticulous planning, sophisticated detection and isolation technologies, and, most importantly, highly trained and knowledgeable personnel. Investing in safety is not merely an expense; it is an investment in the future of hydrogen energy. Let us remember that safety is our collective objective.

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