" PLANNING TODAY FOR TOMORROW'S PROSPERITY"

Hydrogen: Production, Storage, Transportation, Utilization and Safety

Principal Course Leader
Dr. Stephen Ramsay, P.Eng.

- More than 40 years 'experience in the field of pipeline, oil & gas, energy, transportation and related Industries.
- Author of three internationally published books covering pipeline and process risk assessment
- Internationally recognized expert in matters related to pipeline risk assessment, integrity management and leak detection

3rd -7th June 2024

Dubai, Millennium Hotel, Business Bay

AED 9200 / 2500+ VAT per person

Early Bird Registration: 5th May 2024

International Organizer

Traning & Consulting Group
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Hydrogen: Production, Storage, Transportation, Utilization and Safety

"Hydrogen: Production, Storage, Transportation, Utilization and Safety Course" has been designed to improve the scientific and professional level of engineers. This course will be held over 5 days starting on Monday 3rd June 2024 from 8:30 AM to 5:00 PM in Dubai, UAE.

Course Objectives

In this course, participants will work from a series of real-life scenarios to understand the current state of the hydrogen industry, explore challenges related to its transformation, and consider ways that current business practices might change to facilitate and expedite a requisite move towards global net-zero.

What You Will Learn

After course completion, participants will:

- Understand the broad tenets of the hydrogen economy;
- Understand the current status of hydrogen and the outlook for development and implementation in the context of global CO_2 emission reduction;
- Understand the technical challenges throughout the hydrogen value chain;
- Understand the basic technical economic principles that influence hydrogen development;
- Understand the cost structure of a hydrogen project throughout the value chain and project life cycle;
- Understand the role of policy and carbon pricing in project feasibility;
- Be familiar with relevant business models for transformation/implementation;
- Be familiar with a range of case studies including notable examples of successes and failure.

COURSE OUTLINE

1. Introduction:
While hydrogen has long been touted as the fuel for the future, it is more usefully and realistically considered as playing an integral part in the decarbonization process, including its important role in sector linkages. This course explores all aspects of the hydrogen value chain in the context of overall decarbonization.

2. Properties of Hydrogen:
Review of physical and chemical properties to understand hydrogen production, storage, transportation, utilization and safety.

3. Overview of Methods of Hydrogen Production:
Hydrogen can be produced from diverse domestic resources, including fossil fuels, biomass, and water electrolysis with electricity. The environmental impact and energy efficiency of hydrogen depends on how it is produced.
There are several ways to produce hydrogen:

- Natural Gas Reforming/Gasification: Synthesis gas—a mixture of hydrogen, carbon monoxide, and a small amount of carbon dioxide—is created by reacting natural gas with high-temperature steam. The carbon monoxide is reacted with water to produce additional hydrogen. This method is the cheapest, most efficient, and most common.
- Electrolysis: An electric current splits water into hydrogen and oxygen. If the electricity is produced by renewable sources, such as solar or wind, the resulting hydrogen will be considered renewable as well, and hasnumerous emissions benefits. Power-to-hydrogen projects are taking off, using excess renewable electricity when available, to make hydrogen through electrolysis.
- Renewable Liquid Reforming: Renewable liquid fuels, such as ethanol, are reacted with high-temperature steam to produce hydrogen near the point of end use.
- Fermentation: Biomass is converted into sugar-rich feedstocks that can be fermented to produce hydrogen.

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COURSE OUTLINE (Count)

Several hydrogen production methods are in development:

- High-temperature Water Splitting: High temperatures generated by solar concentrators or nuclear reactors drive chemical reactions that split water to produce hydrogen.
- Photobiological Water Splitting: Microbes, such as green algae, consume water in the presence of sunlight and produce hydrogen as a byproduct.
- Photo electrochemical Water Splitting: Photo electrochemical systems produce hydrogen from water using special semiconductors and energy from sunlight.

The primary challenge for hydrogen production is reducing the cost of production technologies to make the resulting hydrogen cost competitive with conventional transportation fuels.

4. Storage:

An overview of all considerations:

- Introduction to the concept of hydrogen storage
- Underground hydrogen storage
- Fundamentals of hydrogen compression and expansion
- Mechanical and non-mechanical hydrogen compressors
- Compressed hydrogen tank types
- Design considerations
- Hydrogen liquefaction
- Liquid state hydrogen storage tanks
- Fundamentals and thermodynamics of absorption-based hydrogen storage
- Metal hybrids
- Novel materials for solid state hydrogen storage
- Economics of storage

5. Transportation:

At present, most hydrogen is produced at or close to where it is used–typically at large industrial sites. The infrastructure needed for distributing hydrogen to the nationwide network of fueling stations required for widespread use of fuel cell electric vehicles still need to be developed. The initial rollout for vehicles and stations focuses on building out these distribution networks. Currently, hydrogen is distributed through three methods:

- Pipeline: This is the least expensive way to deliver large volumes of hydrogen, but the capacity is limited because only about 1600 miles of pipelines for hydrogen delivery are available now in the United States. These pipelines are located near large petroleum refine ries and chemical plants in Illinois, California, and the Gulf Coast.
- High-Pressure Tube Trailers: Transporting compressed hydrogen gas by truck, railcar, ship, or barge in high-pressure tube trailers is expensive, and used primarily for distances of less than 200 miles.
- Liquefied Hydrogen Tankers: Cryogenic liquefaction is a process that cools hydrogen to a temperature where it becomes a liquid. Although the liquefaction process is expensive, it enables hydrogen to be transported more efficiently (compared with high-pressure tube trailers) over longer distances by truck, railcar, ship or barge. If the liquefied hydrogen is not used at a sufficiently high rate at the point of consumption, it boils off (or evaporates) from its containment vessel. As a result, hydrogen delivery and consumption rates must be carefully matched.

Creating an infrastructure for hydrogen distribution and delivery to thousands of future individual fueling stations presents many challenges. Because hydrogen contains less energy per unit volume than all other fuels, transporting, storing, and delivering it to the point of end-use is more expensive on a per gasoline gallon equivalent basis. Building a new hydrogen pipeline network involves high initial capital costs, and hydrogen's properties present unique challenges to pipeline materials and compressor design. However, because hydrogen can be produced from a wide variety of resources, regional or even local hydrogen production can maximize use of local resources and minimize distribution challenges. There are tradeoffs between centralized and distributed production to consider. Producing hydrogen centrally in large plants cuts production costs but boosts distribution costs. Producing hydrogen at the point of end-use at fueling stations, for example-cuts distribution costs but increases production costs because of the cost to construct on-site production capabilities.

6. Utilization:

- Internal combustion engines
- Fuel cells
- Decarbonization of industry

7. Regulation and Safety:

- Properties of hydrogen associated with hazards
- Classification of hydrogen hazards
- Compressed and liquid hydrogen-related hazards
- Regulation:
  - ✓ Codes
  - ✓ Standards

8. Future Directions and Path(s) Forward:

A survey of the future development paths for hydrogen in a variety of contexts.

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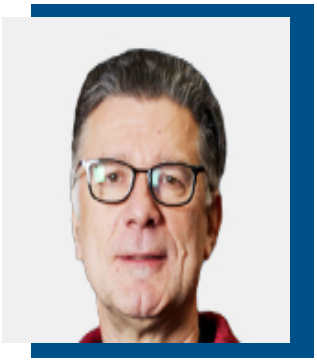
Who Should Attend

This training course is suitable to a wide range of professionals but will greatly benefit:
Hydrogen: production, storage, transportation and storage is intended for managers, engineers and planners involved in hydrogen-related decision-making processes. It assumes some familiarity with basic concepts of engineering, economics, and finance, but no specialized experience or knowledge.



Principal Course Leader
Dr.Stephen Ramsay,P.Eng.

Dr. Stephen Ramsay is a professional engineer with over 40 years of experience in consulting, teaching and research related to the pipeline, oil & gas, energy, transportation and related industries. Dr. Ramsay's expertise includes pipeline engineering, risk assessment, optimization, process engineering and simulation. Dr. Ramsay is an internationally recognized expert in matters related to pipeline risk assessment, integrity management and leak detection.

Dr.Ramsay was the author of the Canadian Association of Petroleum Producers (CAPP) Pipeline Leak Detection Best Practice and now he is Senior Consultant with Grey Owl Leak Detection (GOLD) in Calgary, Alberta, a leading organization in the development and application of pipeline leak detection technology.

Dr. Ramsay is an expert in risk assessment of hazardous industrial operations and transportation systems. Dr. Ramsay is the author of the textbook "Dense Gas Dispersion and Risk Assessment" and is an internationally recognized expert in dense gas dispersion. Dr. Ramsay has worked extensively in safety case regimes for risk management.

Dr. Ramsay obtained a BASc and MASc degrees in Civil Engineering and Mechanical Engineering from the University of British Columbia and a PhD in Engineering and Applied Mathematics & Theoretical Physics (Fluid Mechanics) from the University of Cambridge. Dr. Ramsay was Professor of Engineering Science at the University of Western Ontario. Dr. Ramsay has provided expert testimony in numerous hearings and trials in many jurisdictions in Canada and internationally.

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