



Hydrogen Safety Engineering Course: Leak, Fire and Explosion Hazards and Facility Design



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Introduction:

Hydrogen safety engineering course on leak, fire and explosion hazards and facility design, held over 5 days for process, mechanical, technical safety and HSE engineers, ending with a Hydrogen Facility Safety Design Basis for a case organisation. Hydrogen plants, storage yards and refuelling sites are often laid out with hydrocarbon rules of thumb that miss buoyant releases, invisible flames, very low ignition energy and metal embrittlement. Nominees already prepare or review process and layout designs, and they work through case files of plot plans, release scenarios and zone drawings. CoreConcept Training Center delivers this hydrogen safety engineering course.

Course Objectives:

- Interpret hydrogen flammability, ignition energy, buoyancy and flame visibility using ISO/TR 15916 to rank facility hazards
- Apply NFPA 2 and NFPA 55 provisions and hydrogen material selection rules to piping, vessels and storage
- Classify hydrogen hazardous areas and specify gas group IIC, temperature class T1 equipment around release sources
- Estimate leak rates and flammable cloud extent, then set enclosure ventilation rates and gas and flame detector siting
- Analyse jet fire, deflagration and liquid hydrogen scenarios to set separation distances and explosion venting
- Produce a Hydrogen Facility Safety Design Basis for storage, process or refuelling areas of a case facility

Target Audience:

- Engineers responsible for process design and hazard identification on hydrogen and ammonia units
 - Engineers responsible for piping, vessel and material selection in hydrogen service
 - Engineers responsible for hazardous-area zoning and fire and gas detection layouts
 - Staff responsible for HSE review of hydrogen storage, compression and refuelling sites
 - Engineers responsible for plot plans and equipment spacing on new energy projects
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Course Outline:

Day 1: Hydrogen Hazard Properties and Facility Current-State Review

- ISO/TR 15916 Basic Safety Considerations for Hydrogen Systems
- Flammability Range and Detonable Range Comparison With Methane
- Minimum Ignition Energy and Static Discharge Ignition Sources
- Buoyancy, Diffusivity and Accumulation Under Roofs and Canopies
- Hydrogen Hazard Register Baseline for an Existing Facility

Day 2: Codes, Materials and Hazardous-Area Classification for Hydrogen

- NFPA 2 Hydrogen Technologies Code Structure and Chapters Used
- NFPA 55 Compressed Gas Storage Provisions for Hydrogen Systems
- Hydrogen Embrittlement and High-Temperature Hydrogen Attack in Materials Selection
- Gas Group IIC and Temperature Class T1 Equipment Selection
- NFPA 497 Classified Area Extent for Hydrogen Release Sources

Day 3: Release, Dispersion, Ventilation and Detection Design

- Leak Hole Size Selection and Release Rate Estimation Methods
- Dispersion Modelling of Buoyant Jets and Flammable Cloud Extent
- Enclosure Ventilation Design for Roof Peaks and Asphyxiation
- ISO 26142 Hydrogen Detector Types, Siting and Alarm Setpoints
- UV/IR and Multi-IR Flame Detection for Invisible Hydrogen Flames

Day 4: Jet Fires, Explosions, Liquid Hydrogen and Refuelling Problem Cases

- Jet Fire Flame Length and Radiation Consequence Estimation
- Deflagration Overpressure and Deflagration-to-Detonation Transition Triggers
- Explosion Venting, Congestion Reduction and Separation Distance Setting
- Liquid Hydrogen Boil-Off, Air Ingress and BLEVE Scenarios
- ISO 19880 Refuelling Station Layout and Dispenser Safeguards

Day 5: Case Study Hydrogen Facility Safety Design Basis

- Case Facility Plot Plan and Hydrogen Inventory Review
 - Case Release Scenario Set and Zone Drawing Markup
 - Case Detector Layout and Ventilation Rate Check
 - Case Separation Distance Table and Fire Wall Options
 - Hydrogen Facility Safety Design Basis Completion and Peer Challenge
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Skills You Will Gain:

- Hydrogen Hazard Ranking
- Hydrogen Material Compatibility Review
- Classified Area Drawing for Hydrogen
- Release Rate and Dispersion Estimation
- Hydrogen Detector Siting
- Jet Fire Radiation Assessment
- Explosion Venting Specification
- Separation Distance Setting

Why Attend This Course:

- Deliver a Hydrogen Facility Safety Design Basis for a case organisation to the project technical safety lead and the HSE manager for approval
- Decide zone extents, detector positions and ventilation rates for hydrogen equipment without borrowing hydrocarbon assumptions
- Avoid late layout changes, replacement of embrittled piping and undetected leaks that delay start-up of a hydrogen facility
- Coach design and operations colleagues with the release scenario set, zone markup method and separation distance table

Conclusion:

Back at work, the participant presents the Hydrogen Facility Safety Design Basis to the project technical safety lead, the process design lead and the site HSE manager. They use it to fix zone extents, detector and ventilation provisions, separation distances and explosion venting before plot plans are frozen and equipment is purchased. After its first use in a design review or hazard study, the unit should review which release scenarios were challenged, which distances changed and whether material selections for hydrogen service held up.

Frequently Asked Questions FAQ:

What should participants know before the hydrogen safety engineering course?

Participants should already work on process, mechanical, layout or HSE design for gas or energy facilities and read plot plans and P&IDs. No dispersion software is required; spreadsheets and hand methods are used for the release, ventilation and separation distance exercises.

How does hydrogen safety engineering differ from general technical safety engineering?

It concentrates on behaviour specific to hydrogen: buoyant releases, very low ignition energy, invisible flames, embrittlement and detonation risk. General technical safety courses cover hazardous areas, fire and gas and shutdown across all hydrocarbons, while hydrogen value-chain courses cover production, carriers and project economics.

Why is detection a central topic in hydrogen safety engineering?

Hydrogen is odourless, its flame is nearly invisible in daylight and small leaks can keep burning. Detection therefore relies on dedicated gas sensors placed where buoyant gas collects and on UV/IR or multi-IR flame detectors, rather than on smell or sight.

What do participants take back from the hydrogen safety engineering course?

Participants take back a Hydrogen Facility Safety Design Basis for a case organisation, with a release scenario set, zone drawing markup, detector layout, ventilation check and separation distance table they can adapt to their own hydrogen or ammonia project.
