

# Preparing for a Safe Hydrogen Economy

With a view to meeting global decarbonisation objectives, the UK Government has invested in the development of a hydrogen network. Whilst this shift to an emerging market represents many economic and climate change benefits, there are important Process Safety Management (PSM) considerations that must not be overlooked.

In commercialising hydrogen technologies and applications, all aspects of safety will be critical. Regulatory compliance will apply across many aspects of the hydrogen production, storage and distribution systems. It goes without saying that existing and potential future operations will require effective PSM.

## Design Considerations

Hydrogen has a wide flammable range and an extremely low ignition temperature, along with an invisible flame. The possibility of ignition will always be present, hence most incident prevention measures are likely to centre around leak detection and preventing loss of containment events. Therefore, hazardous area classification for the safe location of electrical equipment is critical. Operators will need to identify hazardous risks through Hazardous Operability Analysis (HAZOP) studies, which may require Consequence Modelling or the use of Computational Fluid Dynamics (CFD) to understand potential operational and catastrophic risks.

With the potential for hydrogen to cause significant vapour cloud explosions (VCE) and fires, operators must strive to reduce these hazards to occupants housed within their onsite buildings, commonly undertaken as part of a Facility Siting Study. Building vulnerability due to these hazards need to be appropriately evaluated through Occupied Building Risk Assessment (OBRA) to accurately determine the response of the structure so that cost-effective mitigation strategies can be implemented.

To meet the economic benefits of using hydrogen as a fuel source, alternative methods of production are being sourced from what is currently known as 'grey hydrogen' and turn it into 'green hydrogen'. Grey hydrogen currently relies on natural gasses and fossil fuels for its production. To turn this into green hydrogen, we need to lower the carbon footprint and move towards Carbon Capture, Utilization and Storage (CCUS). The development of these plants in turn presents a series of design issues which need to be addressed. It is important to acknowledge that general process engineering and pipeline standards may not provide satisfactory regulatory approval

for CCUS, and while there are currently no specific CCUS standards, it is essential that plants have a thorough design review and mitigation strategy to prevent issues such as brittle fracture propagation, loss of containment and corrosion.

## Construction and Commissioning

When a new hydrogen or CCUS facility or unit moves from the design stage to construction and commissioning, both inspection and witnessing of pressurised equipment to PED/ASME standards are recommended. These mandatory standards ensure the equipment complies with EU regulations; however, the use of the equipment is covered by national regulations specific to each country.

Once operational, the integrity of mechanical assets within the facility will also be an important feature in the ongoing maintenance. Asset Integrity Management (AIM) could help to expand the lifecycle of any plant by several years, increasing the profitability. Implemented management systems and audits help asset owners confirm the functionality of their equipment. Inspection Testing Preventative Maintenance (ITPM) strategies focus resources on the most important equipment failure modes, using techniques such as Risk-Based Inspection (RBI), Reliability Centred Maintenance (RCM) and Criticality-Based Maintenance (CBM).

Incident investigation techniques encompassing Root Cause Analysis (RCA) and Cultural Cause Analysis (CCA) help to maintain the plant's lifecycle. Addressing cultural safety and understanding the reasons why incidents occur will help staff adhere to process safety guidelines and decrease the likelihood of future incidents. Similarly, a proactive safety, risk and compliance management strategy considering all aspects of lowering operational and catastrophic risks can help operators address quality and reliability issues earlier to mitigate equipment failures.

***ABS Group provides services that help our clients face safety compliance shortfalls, understand operational and catastrophic risk, prioritize actions and improve overall safety and reliability. For more information, contact: [enquiriesuk@abs-group.com](mailto:enquiriesuk@abs-group.com).***