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Hazard Management Framework in the Energy Transition: An Operational Readiness and Regulatory Perspective

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ABSTRACT

The succesful and safe execution of energy transition projects such as Carbon Capture Utilisation and Storage (CCUS) as well as Hydrogen generation and transport, relies on management of diverse process safety and engineering hazards.

Currently various standards guide the technical controls and assurance for major hazards facilities. Nevertheless, there are several gaps when it comes to the implementation of these documents for risk management associated with the energy transition. For instance, the incubent guidelines are applicable to various fluids including crude oil, natural gas and liquid petroleum products. These have different properties and phase behaviour when compared to Carbon Dioxide, Hydrogen or even Ammonia.

In this work we have conducted a gap analysis on standards with the intent to understand applicability to energy transition, focusing on Carbon Dioxide (CO2) and Hydrogen (H2). Likewise, we have examined the existing legislation in place applicable to the energy transition with the intent of identifying best practices worth replicating. We focused on the various elements of the safety management system, namely: hazard identification (HAZOP), hazard and operability (HAZOP), quantitative risk assessment (QRA) as well as emergency response. Whilst these areas are common in major hazard faciliites, the specific and unique aspects of the energy transition operations underscores the necessity of having bespoke solutions. This in turn, means that the risks to the public, environment and asset are visible and managed to as low as reasonably possible (ALARP).

From a technical perspective, the biggest challenge we observe is the importance of having procedures and controls in place for fluid characterisation, materials selection and inspection. Recent data investigated showed that over one third of all failures and leaks in existing facilities were related to either materials or weld issues. A detailed understaing of the chemistry and operational envelopes (and their uncertanties) is therefore paramount. The properties of CO2 and H2 are highly sensitive to the presence of impurities and contaminants. These can have a significant detrimental effect on asset integrity.

We hope that this work may raise awareness amongst the wider engineering community and risk management practitioners. Project specific requirements will dictate the need for fit for purpose assurance activities. Overall, technical as well as non-technical aspects of the energy transition should also be identified as early as possible for operational excellence outcomes.

KEY WORDS

Energy transition, technical standards, legislation, hazard management

BIOGRAPHY

Andrew Shepherd is a chemical engineer with over 20 years' experience in design and operations of major hazards facilities including in the oil and gas, LNG, mining and energy transition sectors. He holds a PhD from Heriot-Watt University. He is a Felow of the Royal Society of Chemistry (UK) and a Fellow of the Institute of Engineers Australia.

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