

# DELIVERING A SAFE, VIABLE HYDROGEN ECONOMY IN AUSTRALIA

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## ABSTRACT

At Woodside Energy Ltd (Woodside), safety is built into everything we do and progressing hydrogen opportunities is no exception. This paper will present information from the macro level of process safety for hydrogen at a plant level, through to the consumer experience. Examples of the benefits of an integrated process safety approach will be used from Woodside's experience pioneering the liquefied natural gas industry in Australia-

This paper will underscore the reasons why Australia needs to adopt robust safety standards for hydrogen as quickly as possible, in order to advance the hydrogen economy across all sectors. Focus areas requiring attention during development of standards and potential mechanisms to close will be proposed. Establishing a hydrogen economy in Australia could lower carbon emissions, stabilise power grids, increase renewable energy penetration and create jobs. Developing Australian standards that are fully aligned with international standards will facilitate Australia taking a leading role in the global hydrogen economy.

## 1.0 INTRODUCTION

In August 2018, Australia published three significant hydrogen strategy and analysis papers from CSIRO, National Hydrogen Roadmap [1], ARENA, Opportunities for Australia for Hydrogen Exports [2] and the National Hydrogen Strategy and Workplan [3] report from the Chief Scientist to the Council of Australian Governments Energy Council. These papers highlighted the significant opportunity hydrogen could play in the provision of clean, reliable energy in the domestic market, both power and mobility, and as an export opportunity for the nation.

Woodside is the pioneer of the LNG industry in Australia and the largest Australian natural gas producer. We have a global portfolio and are recognised for our world-class capabilities as an integrated upstream supplier of energy. We are pursuing opportunities to commercially produce and export hydrogen

Safety is the foundation for everything we do at Woodside. This is reflected clearly in our Woodside Compass (Figure 1) which underpins who we are through the value Working Sustainably. *We are here for the long term. We look after each other, our communities and the environment. We keep each other safe.* As an experienced operator, Woodside has strong systems and capability for health, safety and environmental management at the industrial scale. These existing systems and capability can be leveraged in the production of hydrogen and establishment of a domestic and export industry. Effective process safety management throughout the hydrogen value chain will be a key requirement for a successful hydrogen industry. It is essential to facilitate community support and acceptance and is part of the licence to operate for industry.



Figure 1: The Woodside Compass

It is critical for Australia that the regulatory framework and standards adopted enable a competitive industry. Use of appropriate codes and standards is a feature of all process safety management systems. Regulations, codes and standards facilitate safe operation and provide the necessary foundation for regulators, government, councils, business and the community to participate effectively.

Where practical, the existing regulatory frameworks for the sectors involved, for example: hydrogen production, chemical manufacturing; pipeline transmission; mobility, should be updated to accommodate hydrogen, as suitable foundations are in place in many cases. This will simplify the regulatory environment, in comparison to the development of new dedicated regulations. Adoption of existing and emerging international standards consistent with harmonisation objectives will also be essential, particularly to be cost competitive in the export arena. Australian specific requirements should only be added where there is a material gap relating to geographical factors or health, environment and safety reasons. The establishment of the Australian Standards ME-093 Hydrogen Technologies Mirror Committee in April this year is a key first step.

## 2.0 WOODSIDE PROCESS SAFETY MANAGEMENT

Woodside has always had a strong focus on process safety and asset integrity. Our existing facilities operate under Safety Case regimes through the *Offshore Petroleum and Greenhouse Gas Storage (Safety) Regulations 2009* [4] and the *Dangerous Goods Safety (Major Hazard Facilities) Regulations 2007* [5]

In 2015, Woodside embarked on a refresh of our approach to process safety to provide a fully integrated framework aligned to an international industry standard, in addition to the Woodside Management System (WMS). The implemented framework is aligned with the U.K. Energy Institute

High Level Framework for Process Safety Management (PSM) [6], which is consistent with our objectives and enabled us to develop a company-specific PSM procedure with synergies to existing systems and processes. The PSM framework is presented in Figure 2.



Figure 2: Woodside’s Process Safety Management Framework

For process safety, it is essential that “we all own, understand and act to control process safety risks” as no one person, team or function can deliver all requirements and effective collaboration is key to successfully managing process safety risks. The focus areas within this framework: leadership; risk identification and assessment; risk management; review and improvement all apply for the emerging hydrogen industry.

Hydrogen as an industrial gas is not new and the risks and mitigation measures for hydrogen production through electrolysis or steam methane reforming are well understood. Within the industrial setting, many of the required codes and standards to support a safe hydrogen industry already exist internationally. However, new process safety challenges will emerge, particularly in the export vectors; existing infrastructure use and end-use applications. While vigilance needs to be maintained in the industrial sector and continuous improvement sought, the near-term focus needs to be on deploying the process safety principles that work in the industrial sector to other parts of the value chain in a fit-for-purpose way.

The PSM Procedure that supports delivery of the framework has 20 detailed requirements (see Figure 3) covering the breadth and depth of process safety across the full lifecycle of an operating production facility. The process safety requirements from the procedure are embedded in the WMS to facilitate integrated delivery as part of usual business activities. It is not an add-on or separate area. For example, PSM-related management of change (MOC) requirements are built in to the relevant MOC procedures and are identified as being PSM-related in the WMS assurance processes.

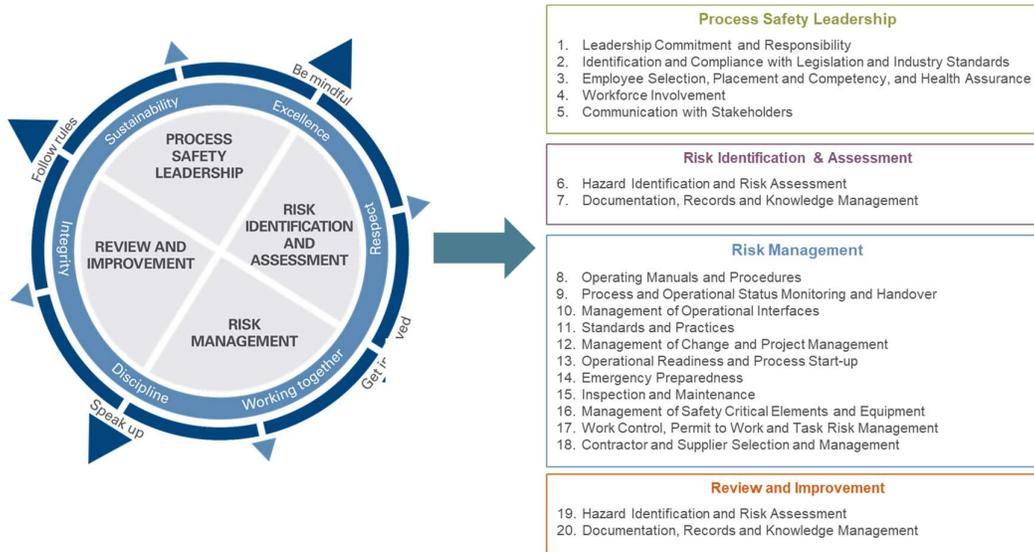


Figure 3: Process Safety Management Framework Requirements

Our experience would suggest that when establishing or refreshing systems and procedures for process safety, strong leadership is essential. Clear communication of expectations and consistent leadership behaviours facilitate the performance needed across the business to support process safety. A focus area in the early phases of deployment needs to be competency. It is critical as we move forward with the hydrogen industry that the training and competency requirements for all sectors are clearly established and deployed early with a clear competency assessment framework that includes minimum competency requirements for different roles within the industry. This applies across a wide spectrum of the workforce, from the hydrogen production operators to the maintenance technicians on hydrogen fuel cell buses in the mobility sector. The effort needed in this space will be significant and early engagement with sectors that develop and deliver competency standards and training materials will be necessary.

Existing risk identification and assessment tools available can be applied for the hydrogen industry. Tools such as HAZOP and Job Hazard Analysis are readily transferred. We need to be careful to take a fit-for-purpose approach in this area. Detailed assessment techniques, such as consequence modelling, should be leveraged to generate guidelines that can be universally applied to industry sectors. For example, refueling stations could operate within an existing rule set where possible, to avoid the need for costly bespoke assessments. Investment in risk management strategies should be weighted towards assessment and implementation of appropriate mitigation measures guided by a risk-based approach versus over-assessment of perceived risk.

### 3.0 REGULATORY FRAMEWORK AND STANDARDS OPPORTUNITIES

It is critical for Australia that the regulatory framework and standards developed for the hydrogen industry enables a competitive hydrogen industry. This will ensure all sectors can proceed with confidence within a viable framework. The timeliness of this work will be essential, and this is where government, regulators and industry organisations can provide support to the emerging industry through near-term delivery of the regulatory framework and standards.

Where practical, the existing regulatory frameworks for the sectors involved should be updated to accommodate hydrogen, as in many cases the foundations are in place. This simplifies the structure in comparison to new dedicated regulations. For example, Dangerous Goods Safety (Major Hazard

Facilities) Regulations 2007 [4] can be leveraged for large scale production and processing for export through liquefaction, conversion to ammonia or use of liquid organic carrier routes.

Woodside are advocating for the adoption of relevant international standards, such as ISO or IEC standards unless there is a specific geographical or health, safety and environment reason that requires modification or unique standards. The establishment of the ME-093 Hydrogen Technologies ISO TC 197 Mirror Committee by Australian Standards is a welcome first step and we look forward to participating. Progress of ME-093 consistent with the harmonisation guidelines established by Australian Standards will support the objective of direct adoption where practical.

As ME-093 progresses, an early focus on “quick wins” through a concentrated effort to review and adopt existing ISO standards would benefit the overall objectives. This should be followed by prioritising end-use standards for the residential, commercial and mobility sectors. This would enable local governments, emergency services, business users and the public to have confidence in hydrogen as an energy solution, and support wide-scale adoption

An opportunity exists for those establishing standards for Australia, such as the ME-03 committee, to liaise with groups such as the Future Fuels CRC to make use of the findings arising from work currently in progress. An example is the assessment of end-use domestic appliances to operate with a 10% hydrogen concentration in feed gas and what, if any, modifications may be required to ensure compatibility.

Where practical, we need to leverage the work being done by the various projects underway in Australia and internationally to validate proposed standards and identify gaps early for closure. Where gaps are identified, Australia should advocate for update of the relevant international standard as the base case.

#### **4.0 COMMUNITY ACCEPTANCE**

Collaboration and education will be key to broader community acceptance of hydrogen. Having appropriate and adequate standards and regulations will facilitate adoption of hydrogen technology. Engaging with relevant stakeholders during the regulatory and standards development process will assist with adoption. This could be facilitated through industry associations and establishment of reference groups for the relevant sectors.

The stakeholder groups will vary across each hydrogen industry sector. Early identification and development of an engagement strategy would be beneficial. We need to plan for proactive, clear communication with stakeholders in a way they can interpret, to support a safe and viable hydrogen industry.

#### **5.0 CONCLUSION**

As we build the hydrogen economy in Australia, we need to actively look back at what we know how to do well in each sector and leverage those learnings and build on them - not start from scratch. We should also be challenging ourselves to reflect on areas where we could improve and seize this new opportunity as a chance to improve what we do. Embracing the opportunity the hydrogen industry offers and going forward with safe, reliable and cost-efficient hydrogen generation, distribution and use.

For process safety, industry can play a role in supporting other sectors through sharing of systems and experiences. Strong HSE performance is an enabler for licence to operate and we will all benefit from

an industry which has no process safety incidents. Conversely, we may all be impacted if an incident occurs, even outside our specific sector.

It is critical for Australia that the regulatory framework and standards enables a competitive industry. Government, regulators and industry bodies can actively contribute to this process, in addition to companies involved in the sectors. Adoption of existing and emerging international standards consistent with harmonisation objectives will also be essential. The ME-093 Mirror Committee is a welcome first step.

Collaboration will be central to Australia's success in establishing a hydrogen economy.

## 6.0 ACKNOWLEDGEMENTS

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## 7.0 REFERENCES

1. CSIRO Australia (2018) *National Hydrogen Roadmap*. Retrieved from <https://www.csiro.au/en/Do-business/Futures/Reports/Hydrogen-Roadmap> on 20 January 2019
2. ACIL Allen Consulting for ARENA (2018), *Opportunities for Australia from hydrogen exports*. Retrieved from <https://arena.gov.au/assets/2018/08/opportunities-for-australia-from-hydrogen-exports.pdf> on 21 January 2019
3. COAG Energy Council (2018) *National Hydrogen Strategy and Workplan*. Retrieved from <http://www.coagenergycouncil.gov.au/publications/establishment-hydrogen-working-group-coag-energy-council-on-16-February-2019>
4. Australian Government (2010) *Offshore Petroleum and Greenhouse Gas Storage (Safety) Regulations 2009*
5. Western Australian Government (2018) *Dangerous Goods Safety (Major Hazard Facilities) Regulations 2007*
6. Energy Institute (2010) U.K. *Energy Institute High Level Framework for PSM*