Introduction

This information sheet is provided to assist all persons who are proposing to store, handle or produce hydrogen gas in Western Australia (WA), from a dangerous goods safety perspective.

Hydrogen is a highly flammable gas. It is vital that hydrogen installations are correctly engineered, built, operated and maintained so that risk is minimised to people, property and environment.

Background

A number of significant hydrogen projects are proposed in Western Australia.

Some of these include large-scale ‘green’ hydrogen production through solar, wind and battery energy storage systems (BESS) to power hydrogen electrolysers. The hydrogen can then be stored in gas or liquid form. An extension of these projects is the production of ammonia from ‘green’ hydrogen.

Other projects include the effective conversion of natural gas and similar feedstock into hydrogen and high quality graphite, and microgrid power stations using hydrogen fuel cells. There are also proposals on the use of metal hydride systems to run hydrogen fuel cells for power generation.

In the not too distant future, hydrogen refuelling stations are planned in metropolitan and regional WA. Refuelling of vehicles will include cars, small to large commercial vehicles and trucks. These refuelling stations will provide compressed hydrogen in the short term and, in the longer term, liquid hydrogen.

It is vital that hydrogen installations are correctly engineered, built, operated and maintained so that risk is minimised to people, property and environment.

Hydrogen classification and properties

Hydrogen is a Division 2.1 (flammable gas) dangerous good.

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<thead>
<tr>
<th>UN No.</th>
<th>Proper shipping name</th>
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<tbody>
<tr>
<td>1049</td>
<td>HYDROGEN, COMPRESSED</td>
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<tr>
<td>1966</td>
<td>HYDROGEN, REFRIGERATED LIQUID</td>
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<tr>
<td>3468</td>
<td>HYDROGEN IN A METAL HYDRIDE STORAGE SYSTEM or HYDROGEN IN A METAL HYDRIDE STORAGE SYSTEM CONTAINED IN EQUIPMENT or HYDROGEN IN A METAL HYDRIDE STORAGE SYSTEM PACKED WITH EQUIPMENT</td>
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As a gas, hydrogen is lighter than air and will dissipate easily if it is unconfined.

Hydrogen has a boiling point of -253°C. The liquid to gas expansion ratio is about 1:850.

When mixed with air, hydrogen has a wide flammability range of 4 to 75% (v/v) compared to liquefied petroleum (LP) gas 2.1 to 9.5%(v/v) or petrol 1.2 to 7.4%(v/v).

Hydrogen has a low ignition energy, approximately 13 times lower than LP gas, meaning that it is much easier to inadvertently ignite.

Hydrogen burns with an almost invisible flame, so can be hard to detect. Hydrogen will much more readily detonate with minimal confinement when compared to other flammable gases.

Under certain conditions, hydrogen can detonate if not stored or handled correctly.

**Dangerous goods regulatory framework in Western Australia**

Under section 8 of the *Dangerous Goods Safety Act 2004*, (the Act) there is a duty placed on persons involved in dangerous goods to minimise risk to as low as reasonably practicable to people, property and the environment.

The following regulations apply in Western Australia for hydrogen storage and handling:

1. Dangerous Goods Safety (Storage and Handling of Non-explosives) Regulations 2007 (the Storage Regulations)
   a. Licensing of hydrogen facilities is required for a storage and handling installation exceeding 5,000 litres.
   b. A documented dangerous goods risk assessment is required. For information on what is required for risk assessment, send a blank email to ra@dmirs.wa.gov.au to receive guidance information.

2. Dangerous Goods Safety (Major Hazard Facilities) Regulations 2007 (the Major Hazard Facilities Regulations)
   a. Any facility with a capacity exceeding the critical quantity (5 tonnes of hydrogen) needs to notify the Department by completing the form — **Operator notification that critical quantity of Schedule 1 substances will be exceeded**.
   b. The Department will assess these facilities and determine if they will be classed as a Major Hazard Facility (MHF).
   c. An MHF must have a safety report, detailing the potential major incidents, safety critical controls and safety management system, approved by the Chief Dangerous Goods Officer prior to operation, as outlined in **Preparing a safety report for a major hazard facility**.

**Hydrogen Safety Standards**

The Standards Australia committee ME-093 Hydrogen Technologies is currently preparing Standards for use in Australia covering all aspects of the emerging hydrogen industry.

To date, the following Australian Standards have been published:

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<th>No.</th>
<th>Australian Standard and title</th>
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<tr>
<td>3</td>
<td>AS ISO 14687:2020 Hydrogen fuel quality – Product specification</td>
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</table>
Reference: Standards Australia – Hydrogen Standards Release Summary November 2021

Currently, there is no published Australian Standard on hydrogen storage and handling nor specifications for hydrogen refuelling stations. These are being developed.

In the absence of an Australian Standard for hydrogen refuelling facilities, the Department will accept the use of the ISO Standard ISO 19880-1:2020 Gaseous hydrogen — Fuelling stations — Part 1: General requirements as a reference document for the design and installation of hydrogen refuelling stations.

Standards Australia is expected to release a Technical Specification — Hydrogen — Storage and Handling in early 2022.

**Hydrogen passenger vehicles**

As of November 2021, there are two passenger hydrogen fuel cell electric vehicles (FCEVs) on the Australian market.

Fuel tanks for these cars are likely to have 3 to 6 kg of compressed hydrogen gas at a pressure of 70 MPa (at least 10,000 psi). For comparison, a car tyre has a pressure of about 35 psi (240 kPa – 0.24 MPa).

As hydrogen is handled at such high pressures, it is critical that hydrogen installations are correctly designed, installed and maintained to minimise risk of fires and explosions.

**Hydrogen storage and handling risk assessments**

The following summarises what DMIRS expects for hydrogen risk assessments:

1. Where the hydrogen storage and handling proposal is covered by an Australian Standard:
   a. Conduct a clause by clause compliance check against the Australian Standard
   b. Check to ensure risk controls are adequate to minimise risk as required by the Storage Regulations
   c. If the site has been declared an MHF, the operator/licensee needs to get the site safety report approved by the Chief Dangerous Goods Officer.
2. Where the hydrogen storage and handling is not covered by an Australian Standard:
   a. Review if it is covered by an International Standard, such as ISO standard.
      i. If an ISO standard is chosen, ensure the scope of the Standard covers the hydrogen storage and handling proposal
         ii. Document reasons for adopting the Standard, then conduct a clause by clause compliance check
      iii. Conduct a regulation check against the Storage Regulations.
   b. If no international Standard is available:
      i. Conduct a first principles quantitative risk assessment, to demonstrate that risk from a proposed hydrogen installation can be minimised as required by section 8 of the Act.
      ii. The risk assessment needs to address the fire and explosion hazards of hydrogen. Risk control measures need to adequately minimise those hazards.
      iii. Acceptable risk acceptance criteria is available from the NSW Department of Planning Hazardous Industry Planning Advisory Paper No 4 — Risk Criteria for Land Use Safety Planning (HIPAP4).
      iv. If the site has been declared an MHF, the proponent needs to get the site safety report approved by Chief Dangerous Goods Officer.

Additional information