Fortescue

Report

Public Knowledge Sharing Report (KSR) 2

Green Energy

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Government of **Western Australia**
Department of **Jobs, Tourism, Science and Innovation**

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1 INTRODUCTION

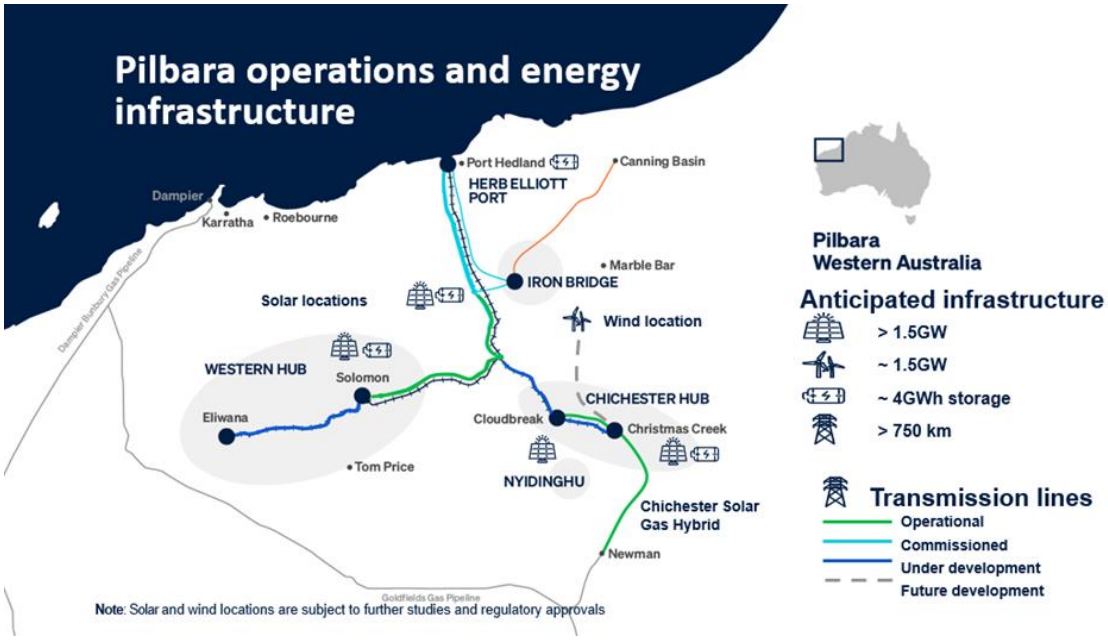
1.1 About Fortescue

Fortescue is a global green technology, energy and metals company that is committed to eliminating emissions and developing the green solutions required for the world to step beyond fossil fuels.

Fortescue operates with two divisions – Energy and Metals. Our metals business comprises our iron ore operations in the Pilbara, as well as our pipeline of exploration projects globally including in Gabon, Latin America and Australia. Through our energy business, we are pioneering the replacement of fossil fuels and driving breakthrough innovations to decarbonise our operations and scale decarbonisation technology. This includes developing the technology across battery and electric systems, green hydrogen and green ammonia.

By 2030, our aim is to have our Australian iron ore operations running on green energy and achieve real zero terrestrial emissions (Scope 1 and 2). Separately, we have a net zero Scope 3 emissions target by 2040, addressing emissions across our entire value chain.

We always strive to empower the communities we operate in and deliver positive social and economic change through training, employment and business development opportunities.



2 PROJECT SUMMARY & OVERVIEW

2.1 Summary

The project will develop and deploy onsite hydrogen generation (via electrolysis) and refuelling infrastructure to support a fleet of fuel cell coaches at Fortescue's Christmas Creek mine, 1300 km north of Perth and 400 km south of Port Hedland.

Energy for this project is currently sourced from a local grid owned and operated by APA (formerly Alinta) powered by a 60MW solar farm and gas generation.

The Hydrogen Refuelling Station (HRS) will be scaled to allow production and refuelling requirements of the entire fleet to be achieved during daylight hours to align with when solar generation is expected on APA's grid.

2.2 Project Scope

Develop, deploy and operate a gaseous hydrogen plant at Christmas Creek mine site, which includes:

1. Hydrogen stationary refuelling system that is fully operational to support 10 fuel cell electric coaches (FCECs)
2. A station design, capable of generating, storing, and dispensing hydrogen while also having the capability to efficiently utilise renewable energy sources
3. Full system instrumentation and data acquisition capability supporting remote monitoring and detailed analysis Christmas Creek HRS performance characteristics
4. Detailed system documentation and a simplified modular design; allowing trained Fortescue staff or third-party vendors to perform system operations, maintenance, and repair functions.
5. Deploy 10x fuel cell electric coaches (FCEC) for ongoing operations at Christmas Creek

2.3 Key Components

Item	Details
1.	10x Fuel cell electric coaches (FCEC)
2.	2x 700 kW electrolyser and associated balance of plant
3.	2x compressors and associated balance of plant
4.	2x 350 bar dispensers
5.	13 high pressure storage vessel
6.	Transformer

3 PROJECT ECONOMICS

This R&D project supports strategic, rather than financial, outcomes. As such, no discounted cashflows or internal rate of returns models were generated.

The strategic drivers which support the R&D project include decarbonisation, energy security, and training and development of the first generation of Fortescue hydrogen specialists. Fortescue's broader decarbonisation plan aims to futureproof the business by lowering operating costs through the elimination of diesel, natural gas and carbon offset purchases.

CAPEX was slightly higher than FEED stage estimate of $32M due to additional infrastructure cost associated with relocation of the HRS closer to mining operations.

3.1 CAPEX

Item	AUD
Major HRS equipment, fuelcell coaches, electrical equipment	$26.2M
Construction and commissioning of HRS and supporting electrical infrastructure	$7.6M

4 OPERATIONAL SAFETY PLAN SUBMISSION

Fortescue submitted the following documentation to DEMIR's to satisfy Operational Safety Requirements;

- DG inspectorate - DG License amendment application, which included;
  - Safety Management Systems Interface Plan
  - HAZID Study
  - Quantitative Risk Analysis HRS at Christmas Creek Mine
  - HAZID Study HRS at Christmas Creek Mine
  - MHCS as well (which included Hydrogen Standards) and further evidence such as Bowties

- Mon 2 Notice of information about non-exploration mining operations- to the Mining Inspectors (via SRS platform)

- Building and Energy - Registration of Plant
  - Nationally Accredited Hydrogen Gasfitters Skills Package and Training Plan for Gasfitting work scope

5 KEY STANDARDS

5.1 Information of Interest to Australian Hydrogen Industry, Government Agencies/Researchers

5.1.1 Compliance

Compliance is an essential part of Fortescue's strategy for this project, and key industry and government stakeholders have been engaged, and will continue to be engaged through the life of the project.

5.1.2 Safety and Regulatory

FFI Energy is committed to ensuring that the deployment of the HRS & FCEC project meets all legislative and regulatory obligations, ensuring provision and maintenance of a safe work environment and safe system of work for all personnel involved in the project. FFI Green Fleet is currently taking the following steps to ensure:

(a) Prepared project management plan and safety management plan, which is supported by a team- based risk assessment

(b) Undertake risk assessments to identify areas of key risk in the ongoing development of project

(c) Preparation of internal governance documentation and associated risk assessment and documents for deployment

(d) Undertake final change management on site, once all approvals are in place

(e) Ongoing review of risk assessments and other risk mitigation plans, in recognition that this is a development program and changes being dynamic

5.2 Australian Standards

The Australian Standards listed below pertain to hydrogen infrastructure such as the HRS and form part of the requirements applicable to the Contractor for the installation of the HRS.

Table 1: Australian Standards

Standard No.	Title
	Work Health and Safety Act 2020
	Emergency Management Act 2005 (WA)
SA TR 15916:2020:2021	Basic Considerations for safety of Hydrogen Systems
AS 3000	Electrical installations
AS 3008	Electrical installations - Selection of cables - Cables for alternating voltages up to and including 0.6/1 kV - Typical Australian installation conditions
AS 4041	Pressure Piping
AS/NZS ISO 9001	Quality management systems – Requirements
ASNT SNT-TC-1A	Personnel Qualification and Certification in Non-destructive Testing
AS/ISO 19880	Gaseous hydrogen fueling stations
ASME B31-3_2020	Process Piping
AS 62061	Safety of machinery—Functional safety of safety-related electrical, electronic and programmable electronic control systems
AS 61508	Functional safety of electrical/electronic/programmable electronic safety-related systems
AS 60079	Explosive Atmospheres
AS 2700	Colour standards for general purposes
ISO 31000	Risk Management
AS 4801	OHS Management System
ISO 55001	Asset Management
AS 14687:2020	Hydrogen fuel quality – Product Specification
AS 1210:2010	REC:2021 Pressure vessels and ASME BPVC codes
AS 16110.1:2020	Hydrogen generators using fuel processing technologies, Part 1: Safety (ISO 16110-1:2007, MOD

AS ISO 16110.2:2020	Hydrogen generators using fuel processing technologies, Part 2: Test methods for performance
AS ISO 14687:2020,	Hydrogen fuel quality – Product specification
AS 22734:2020	Hydrogen generators using water electrolysis – Industrial, commercial, and residential applications (ISO 22734:2019, MOD)
SA TS 19883:2020	Safety of pressure swing adsorption systems for hydrogen separation and purification (ISO/TS 19883:2017, MOD)
AS ISO 16111:2020	Transportable gas storage devices – Hydrogen absorbed in reversible metal hydride
AS ISO 19881:2020	Gaseous hydrogen – Land vehicle fuel containers
AS 19880.3:2020	Gaseous hydrogen – Fuelling stations, Part 3: Valves (ISO 19880-3:2018, MOD

Other key components for Standards and Regulations are:

Table 2: Other Relevant Information/Standards & Regulations

Key Components	Description/Summary
Project Approval Process	On 12 March 2020, Chichester Metals Pty Ltd (Chichester), formerly FMG Chichester Pty Ltd submitted a Detailed Proposal pursuant to clause 10(1) of the Iron Ore (FMG Chichester Pty Ltd) Agreement Act 2006 (Chichester Agreement) for the construction of a Hydrogen Refuelling Station (HRS) at the Christmas Creek mine site. The Minister for State Development approved the Proposal in accordance with clause 9(1) of the Chichester Agreement on 28 April 2020. Subsequently, Chichester submitted a Variation to the Approved Proposal pursuant to clause 9(8) of the Chichester Agreement to change the location of the HRS at the Christmas Creek mine site. The Minister for State Development approved the variation to the Approved Proposal in accordance with clause 9(8) of the Chichester Agreement on 26 October 2021.

Government Engagement	Fortescue commenced a process with Department of Primary Industry and Regional Development (DPIRD) around identifying regulatory requirements for the HRS and vehicles and establishing a path to compliance. This transferred to Department of Jobs, Tourism, Science and Innovation when responsibility for the State's Hydrogen Industry Strategy moved agencies. As the first project of its type, government engagement for this project has informed subsequent HRS projects in the industrial and commercial sectors.
Regulations	Lack of governing regulation and Australian Standards relating to the design and construction of the HRS had the potential to delay the design and construction approval of the HRS. Fortescue engaged government and regulatory stakeholders early during the design and construction process with the goal of ensuring alignment with future legislation and standards.
Environmental Key Regulations	In a general sense, environmental regulation is concerned with effect not cause. That is, an action is regulated based on the degree or size of the effect it has on the environment, rather than simply whether it has an effect on the environment. Relevant standards are: ***Environmental Protection Act 1986 (WA)*** ***Environmental Protection Regulations 1987 (WA)*** ***Environment Protection and Biodiversity Conservation Act 1999 (Cth)***
Zoning & Planning Key Regulations	Local planning schemes are enforced by local governments in accordance with the scheme text and also the Planning and Development Act 2005 (WA). Relevant standards are: ***Planning and Development Act 2005 (WA)*** ***Port Hedland: Town Planning Scheme No. 5*** ***Shire of East Pilbara Town Planning Scheme No. 4*** ***Port Authorities Act 1999 (WA) (if the facility is to be located within port land)*** ***Building Act 2011 (WA)*** ***Building Regulations 2012 (WA)***
Mining Key Regulations	A mining lease confers broad rights. It entitles the holder, on its tenement area, to do all things necessary to effectively conduct mining operations. Relevant standards are: ***Mining Act 1978 (WA)*** ***Mining Regulations 1981 (WA)*** ***Work Health and Safety Act 2020*** ***Work Health and Safety (Mines) Regulations 2022*** ***The relevant mining tenements*** The Mines Safety and Inspection Regulations also contain regulations dealing with emergency plans, fuel transport and storage and fire suppression. These regulations

Occupational Safety & Health Key Regulations	Safety and health in non-mining Western Australian workplaces is regulated by the Work Health and Safety Act 2020 (WA) and Work Health and Safety (General) Regulations 2022 (WA), supported by many codes of practice and guidance notes. Relevant standards are: ***Work Health and Safety Act 2020 (WA)*** ***Work Health and Safety (General) Regulations 2022 (WA)*** ***Work Health and Safety (Mines) Regulations 2022 (WA)*** ***Mines Safety and Inspection Act 1994 (WA)*** ***Mines Safety and Inspection Regulations 1995 (WA)*** ***Petroleum and Geothermal Energy Safety Levies Act 2011 (WA)*** ***Work Health and Safety (Petroleum and Geothermal Energy Operations)) Regulations 2022 (WA)*** ***National Code of Practice, Control of Workplace Hazardous Substances [NOHSC:2007(1994)]*** ***Relevant mining tenements*** Hydrogen (as a gas) is classified as a hazardous substance due to its physical hazards (i.e. it is flammable and it stored under pressure).  GHS02 (Flame)  GHS04 (Gas Cylinder) Several codes of practice also potentially apply, for example, the requirement to comply with ***AS/NZS 3788:2006 and AS/NZS 3873:2001*** in relation to pressure vessels.
Dangerous Goods & Materials Handling Key Regulations	Dangerous substances such as hydrogen are covered by more than one legislative regime. As a hazardous substance, it will be regulated by (at present) one of two different OSH regulations and administered by DEMIRS: a. at non-mining workplaces – by the WHS Act 2020 and Work Health and Safety (General) Regulations, administered by the WorkSafe Division of DEMIRS. b. at mining operations – by the WHS Act 2020 and Work Health and Safety (Mines) Regulations, administered by DEMIRS. Relevant standards are: ***Dangerous Goods Safety Act 2004 (WA)*** ***Dangerous Goods Safety (Storage and Handling of Non-explosives) Regulations 2007 (WA)*** ***Dangerous Goods Safety (Road and Rail Transport of Non-explosives) Regulations 2007*** ***Dangerous Goods (Major Hazard Facilities) Regulations 2007***

Fuel Quality Key Regulations	The Fuel Quality Standards Act 2000 (Cth) and associated regulations provide a legislative framework for setting and enforcing national fuel quality and fuel quality information standards for Australia. Relevant standards are: ***Fuel Quality Standards Act 2000 (Cth)*** ***Fuel Quality Standards Regulations 2001 (Cth), NOTE: replaced by Fuel Quality Standards Regulations 2019 (Cth) on 1/10/19*** ***Gas Standards Act 1972 (WA***
Water Access Laws Key Regulations	In August 2018, the WA Government approved drafting of the Water Resources Management Bill, to centralise the operation of WA's disparate water legislation, consolidating six pieces of legislation into one. Relevant standards are: ***Rights in Water and Irrigation Act 1914 (WA)*** ***Water Services Act 2012 (WA)***
Gas Sector Key Regulations	Gas sector legislation responds variably and rather arbitrarily to hydrogen. Relevant standards are: ***Energy Coordination Act 1994*** ***Gas Standards Act 1972*** ***Gas Standards (Gas Supply and System Safety) Regulations 2000*** ***Gas Standards (Gasfitting*** and Consumer Gas Installations) Regulations 1999
Vehicle & Licensing Key Regulations	The motor vehicle industry appears to be further developed in preparedness for FCEVs than other aspects of hydrogen regulation and there are a number of reforms already underway. Relevant standards are: ***Motor Vehicle Standards Act 1989 (Cth)*** ***Motor Vehicles Standards Regulations 1989 (Cth)*** ***Australian Design Rules, third edition*** ***Road Traffic (Vehicles) Act 2012 (WA)*** ***Road Traffic (Vehicles) Regulations 2014 (WA)*** ***Road Vehicles Standards Act 2018*** ***Road Vehicles Standards Rules 2019*** ***Australian Design Rule 110/00 – Hydrogen-Fuelled Vehicles Safety Related Performance) 2023***

6 CONSTRUCTION AND COMMISSIONING PLAN

6.1 Overview

The HRS refuelling equipment was strategically broken into sub-sections which allow for construction and commissioning of sections in isolation from other equipment. This approach enabled construction and commissioning activities to took place in parallel and allowed different parts of the system to be in different stages of commissioning.

Project duration from construction to commissioning completion was 18 months with a peak average construction workforce of 24 and a peak of 9 for operations workforce.

Construction workforce consisted of the following personnel on a rotational FIFO inclusive:

a) Project Manager
b) Superintendent
c) Supervisors (Mechanical and Electrical)
d) Various disciplined work crew (Civil, Mechanical and Electrical)
e) HV technicians

Operations workforce consisted of the following personnel on a rotational FIFO inclusive:

a) Superintendent
b) Supervisors (Mechanical and Electrical)
c) Process Safety Engineer
d) Industrial Advanced refrigeration Technicians
e) Instrumentation and EEHAS qualified Electricians
f) Technical document writer

The operational workforce will be supported by Fortescue's extensive Technology, Engineering and Asset management team as well as OEM technical remote Engineering support.

6.2 Construction Handover

The commissioning team accepted handover of a sub-system from construction following the completion of a sub-system mechanical completion certificate.

At this point the commissioning team accepted the sub-system and raised a Notice of Energisation.

6.3 Notice of Energisation

A Pre-Energisation checklist and a Notice of Energisation (NoE) along with supporting documentation was required prior to initial energisation of any sub-systems.

The NoE procedure was closely associated with the Initial Energisation Procedure and allowed the commissioning team to move forward to the pre-commissioning stage.

6.4 Pre-Commissioning

Pre commissioning activities commenced once NoE was issued for the sub-system. The pre-commissioning activities cover energisation of a sub-system, leak testing/pressure testing with nitrogen, function testing of emergency circuits and limited operational function tests. The introduction of hydrogen into any system was not part of pre-commissioning activities.

6.5 Commissioning

Commissioning activities commenced once the pre-commissioning has been completed and the Ready for Commissioning certificate was issued. The commissioning activities involve the introduction of hydrogen into the system, complete function testing to verify the safe operation of the system and performance testing to develop a baseline for ongoing performance evaluation.

6.6 Commissioning Support

Original Equipment Manufacturers (OEMs) provided commissioning support through the commissioning process. Due to the complexity of the electrolyser equipment and to preserve warranty conditions, OEM technicians were onsite to support commissioning of the electrolysers. The technicians formed a core part of the commissioning team and were supported by commissioning electrical and mechanical resources throughout the commissioning process. OEMs also had remote support available to assist with any technical related issues that arose during commissioning.

6.7 Operational Test Procedure

Some sub-sections, such as the electrolysers, have an operational performance test as the final stage of commissioning. This testing verifies the performance of the equipment against the design performance criteria and acts as a base line for future performance evaluation.

Once the full HRS has been safely commissioned, an overall system operational test will be conducted to evaluate the overall system to the design performance criteria. This will be the final commissioning/testing activity prior to plant handover from commissioning to Fortescue Operations.

6.8 Commissioning Handover

Following completion of the system operational test, a completed system handover dossier was issued to Fortescue for review and acceptance. Once Operations have accepted the handover dossier, a final punch list was prepared and agreed.

6.9 Facility Handover

The facility handover certificate was issued for the Facilities final acceptance by Operations and marked the transfer of ownership from Project to Operations and indicates the following:

a. All systems are operational, integrity and agreed performance criteria demonstrated and sustainable steady state operating conditions are met, and an y applicable proving period has expired.
b. Punchlist items have either been cleared or transfer has been agreed by Operations.
c. Any agreed remaining punch list items become the responsibility of the Operations.
d. All documentation and software have been handed over to Operations.

6.10 High Pressure Hydrogen Storage Vessels

To support Low Pressure Storage the facility supports four (4) Low Pressure hydrogen buffer vessels holding a total of 6.8 kg of hydrogen at 19.5 barg and 40 degrees C.

To support Medium Pressure storage the facility consists of thirteen (13) Medium Pressure hydrogen buffer vessels holding a total of 426.55kg of hydrogen at 450 barg and 40 degrees C.

a) All Medium Pressure vessels post installation were purged and leak tested with Nitrogen to 477 barg. Nitrogen was purged with Hydrogen and further leak testing and pressure testing was completed at 477 barg.

All vessels were both design registered to PED2014/68/EU and AS1210-2010 CL.1H. Plant registration as per WHS requirements was completed with submitted and approved through DEMIRs

7 DESIGN CONSIDERATIONS AND RATIONALE

The project presented several significant technical challenges with respect to the environment, location, reliability demands and availability of technology. While the project aims to make a step-change in hydrogen mobility, it is also installed in a continuous mining operation which is intolerant to interruptions in mobility of people and product.

To mitigate this risk of HRS unavailability, the HRS is designed with full redundancy with respect to the electrolyser, compressor and dispenser. In the event of a failure of one of these components, the stand-by unit will remain operational while the other unit is serviced or repaired, providing the degree of availability demanded by operations. The HRS is also designed to allow a coach usage profile which mirrors that of the existing diesel fleet, allowing the fleet to refuel at off-peak times to ensure maximum availability.

HRS is designed to maximise the use of green power. The components are designed and sized in such a way that they produce all required hydrogen in the 11 hours day-time window.

Due to the harsh climate of the Pilbara, all major components are housed in containers to minimise dust ingress and provides a consistent maintainable temperature range.

8 SYSTEM SPECIFICATIONS

There was no change to system and components sizing from FEED stage.

I. 10 x Fuel cell electric coaches (FCEC)
II. 50KL Potable Water Supply
III. 2x 700 kW electrolysers with balance of plant
IV. 2x compressors
V. 2x 350 bar dispensers
VI. 13 x high pressure storage vessel
VII. 4 x Low pressure storage vessel
VIII. Transformer

8.1 Electrolyser Efficiency, Energy Balance, Plant Availability & Forecast Annual Production

The HRS will be operated to suit demand requirements which includes refuelling hydrogen fuel cell coaches.

Nameplate Production is equivalent to 196.22 tonnes Gaseous Hydrogen.

The Hydrogen Refuelling Station (HRS) will be scaled to allow production and refuelling requirements of the entire fleet to be achieved during daylight hours to align with when solar generation is expected on APA's grid.

Electrolyser efficiency at incremental capacity factor was not considered as electrolyser sizing was selected based on the demand derived from the bus usage.

8.2 Forecast Annual Consumption of Water and Power

Based upon the Forecast annual production, water use is projected to be 1.5ML. Water supply comes from Fortescue's EPA approved bores within the minesite tenement.

Power use is forecasted to be consumed at 1800 MWh annually.

9 SAFETY & ENVIRONMENTAL IMPACTS, INCIDENTS AND CONSTRAINTS

As part of the approvals process, extensive modelling (quantitative risk assessment) was undertaken by third party specialists to look at the affects of a containment release of Hydrogen. The results show that for the onsite risk, the maximum total IRPA (individual risk per annum of a fatality) contribution from the HRS is estimated to be 1.2×10^{-6} which is far less than the Fortescue on site risk criteria of $1x10^{-3}$.

To date, throughout construction, commissioning and the early stages of production Fortescue is proud to say that there have been no loss of containment incidents and as such no safety impact to the facility.

The facility is well managed through extensive security protocols both physical and virtual (cybersecurity) to ensure that only trained and competent personnel have access to operate and maintain the equipment.

Emergency responders have undertaken extensive training to be well prepared and equipped to respond to any emergency and undertake regular drills to ensure preparedness. Lessons learnt and efficiency opportunities are evaluated and recorded after exercises to continually improve the response protocols.

Substantial Operational Readiness has been undertaken to ensure the facility is maintained in alignment to both OEM and regulatory standards.

To further ensure worker safety and grow hydrogen skills and knowledge relevant to renewable hydrogen technologies, Fortescue partnered with ATCO to successfully deliver Australia's first nationally recognised Hydrogen gasfitters course as part of the training for its HRS workforce. This skillset was demonstrated to the Office of Building and Energy and accepted as part of the Gas fitting Authorisation for the HRS Supervising Gasfitters and trainees.

10 PROCUREMENT AND SUBCONTRACTOR ARRANGEMENT

It was evident during FEED project phase that HRS design and construction will require specialised skillset. Existing Fortescue mining contractors didn't have right skillset to deliver. Because of this, the HRS scope was split into two major categories:

a. HRS design, construction and commissioning

b. Ancillary works (civil, power & water infrastructure) design, construction and commissioning

During FEED phase, key suppliers were identified and were invited to submit tenders to design and construct HRS. A site visit to Christmas Creek was arranged to help the potential contractor understand the ambient conditions in the Pilbara. BOC was awarded EPC contract for HRS. BOC was selected based on their proposed components size, original equipment manufacturer (OEM) market reputation of key components such as electrolysers and refuelling package and OEM's previous association in design and supply of HRS.

Existing Fortescue suppliers were invited to tender for ancillary works, which mainly included, civil, power and Domeshelter design and construction. Several contracts were

issued based on contractor's expertise and previous works they carried out at other Fortescue mine sites. BG&E was contracted to carry out design works related to civil, power and water infrastructure. Decmil was contracted to construct and commission ancillary works.

Hydrogen fuel cell coaches tenders were invited based on tenderer's experience with fuelcell powertrain development. Submitted tenders were assessed taking into consideration of fuel cell size, capacity of hydrogen storage tanks and previous experience in the field. Hyzon was awarded the contract to supply 10 fuelcell coaches based on their experience working with Horizon fuelcells and hydrogen powetrain.

11 LESSONS LEARNED

Design & Procurement:

- Due to limited development and supply of hydrogen related technologies in Australia most of the components were outsourced to overseas suppliers. This posed challenges in terms of meeting Australian Standards and codes. In some cases, it required modification of supplied packages to meet applicable Australian Standards.

- At the time of project execution governing legislation for hydrogen infrastructure such as HRS was underway. The project worked closely with relevant Government organisation to ensure relevant approvals are sought and obtained. It took longer than normal timeframe to obtain such approvals.

- The Gas Standards Act 1972 does not provide guidance for hydrogen gas technologies.

Construction & Commissioning:

- It was identified that the Owners Construction and Commissioning team faced challenges due to their limited experience in effectively engaging with vendor Subject Matter Experts (SMEs) for Hydrogen Refuelling. To address this, it became evident that specialists with a background in Oil & Gas were needed to provide the necessary construction and commissioning knowledge. Similarly, the Hydrogen vendor SMEs lacked familiarity with mine site regulations, highlighting the need for experts who understand the unique processes and regulations specific to mine sites, as they differ from standard installations.

- The project's expedited design and construction, coupled with evolving stakeholder expectations throughout its progression, necessitated upgrades and reworks. Given the pioneering nature of establishing a HRS within a mine site, some level of unforeseen adjustments was anticipated. However, the increased costs resulting from these modifications were challenging to forecast and explicitly understand. This highlights the importance of robust contingency planning and stakeholder communication to address evolving project needs and manage associated costs effectively.

Operation:

- The requirement for certain management plans, hazardous areas, functional safety, gas authorisation management where learning opportunities for the operations team, being mostly an iron ore business, these management plans had to be created to help us comply and manage these specialist fields.

- Guidance relating to the licencing requirements for work at the facility from DEMIRS has been vague which resulted in, industry confusion on how we are able to comply with the gas regulations. The gas licensing/regulations do not really consider H2 as a gas and are more written for NG, LNG, LPG.

- As part of training and upskilling the existing workforce, Fortescue engaged ATCO to help develop electrolyser and hydrogen specific training. These are now nationally recognised units of competency for electrolysis. Other training, gas safety, OEM electrolyser training (ITM), 'supervised & supervising' gas fitters at north metropolitan TAFE.

- Gaining Gas Authorisation for the facility, again as the GSR is written mainly for NG, LNG, LPG, there was not clear guidance on the requirements for the facility. We were issued a Gas Authorisation for Class P. It would help to have a clear pathway to a permit for H2 Gasfitting for Class P (Hydrogen Refuelling Stations) as well as the current Class I(a) for type B appliances.

- It would be useful to have a nationally aligned standard for Hydrogen Gasfitting, or a skilled OEM pathway to achieving the outlined Nationally Accredited Hydrogen Training as per ISC Skill Package outlined on Training.gov.au;

    - − UEGSS00013 - Basic Hydrogen Safety Skill Set
    - − UEGNSG902 – Commission, operate and maintain electrolysers
    - − UEGNSG903 – Fault find and repair hydrogen storage equipment
    - − UEGNSG906 – Undertake routine hydrogen storage operations

Fuel cell electric coaches:

- The discrepancy between DEMIRS rules and ADR (Australian Design Rules) standards necessitated clearer guidelines for tank design registrations within minesites. This created challenges in complying with hydrogen tank design registration. Fortescue took a proactive approach which involved extensive stakeholder engagement to bridge regulatory gaps and achieve compliance. Persistent advocacy from Fortescue ensured Hyzon's alignment with DEMIRS rules, highlighting the need for regulatory clarity and proactive engagement in specialized environments such as minesites. Recommendations include early regulatory alignment, proactive stakeholder engagement, thorough risk assessment, and continuous monitoring to mitigate compliance risks in future projects.

- The absence of a local gas testing laboratory compliant with AS ISO 14687, coupled with logistical complexities in sending samples overseas, posed significant challenges. While supplier guarantees from BOC regarding impurity levels in hydrogen alleviated some concerns, there was a clear need for enhanced contractual clarity surrounding ownership responsibilities. This highlighted the importance of precise contract language and proactive stakeholder coordination. Moving forward, strategic investments in domestic testing infrastructure and streamlined logistical processes are crucial to ensure regulatory compliance and operational efficiency within the hydrogen sector.

- Due to the aforementioned design registration challenges, there were delays in registering the design of the fuel cells, which are considered pressure vessels, with an authorised agency in Australia as required under all state WHS laws and regulations in Australia. This resulted in delays to the commissioning of the hydrogen refuelling facility which could have been avoided by ensuring vendors and the Fortescue projects team were aware of the regulatory requirements for all systems within their scope. One mitigation measure could be to break the project in to sub-systems when reviewing regulatory requirements to ensure all are being met.