Project Brief

MEG-HP1 Hydrogen Production Facility
Northam, Western Australia

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1 Introduction

1.1 Background

The Proposed MEG Hydrogen Plant (MEG-HP1) by Infinite Green Energy (IGE) is a development for producing green hydrogen by electrolysis. The facility is proposed to be located south of the existing 11MW Northam Solar Farm on leased land Lot 7.

The project will utilize 10MW of electrolysers. Hydrogen will be compressed in gaseous form and transferred to trailer-mounted Multi Element Gas Containers (MEGCs) for transportation by road to Hydrogen Refuelling Stations (HRSs). The hydrogen will be dispensed to multiple end users in the light and heavy vehicle transportation sector.

2 General

2.1 Design Life

The design life of the facility shall be 20 years.

2.2 Construction Design

Methodology for construction based on a modular offsite construction plan to reduce onsite construction costs.

Local company support in construction has been a priority with the project construction generating approximately 100 jobs in the construction phase and 5 to 10 operational staff for the long term operation of the plant.

Project Efficiencies

- an optimised cost of project delivery,
- an optimised site construction schedule,
- a reduction in health, safety and environmental exposure of site construction activities,
- minimisation of negative impacts on the local community.
- Site layout optimisation including review of mechanical equipment, buildings, electrical and switch room locations with an objective to minimise the interconnecting piping and cable lengths and associated structural and civil works
- Containerisation of electrolyser packages
- Use of prefabricated buildings including substation and switchgear buildings
- Modularisation or skidding of process and utility equipment wherever they can reasonably be collocated on a skid with local interconnecting piping, hydrotesting, painting and insulation completed offsite.
- Use of standard precast concrete sections for foundations, duct banks, culverts, pits, etc in lieu of cast in situ concrete.
- Prefabrication of reinforcement cages and formwork, where in situ concrete foundations are required
- Prefabricated tanks or pre-made with assembly on site
- Use of local labour to reduce mobilization costs.
- Design of low profile buildings to reduce visual impact.
- Landscaping plans to improve the sites overall visual impact.

3 Process

3.1 Plant Capacity

The electrolyser plant capacity and production basis are as follows:

- Daily production of Hydrogen up to 4 tonnes per day.

3.1.1 Product Hydrogen

Product hydrogen from the Electrolyser package shall be compressed and loaded directly to waiting trailer mounted tanks. This design methodology eliminates onsite storage tanks. Each Trailer tank capacity 1000kg.

Hydrogen manufacturing process produces Oxygen which is vented.

3.1.2 Feed Water

Hydrogen feedwater for production totals approximately 40000 litres per day with plant considerations. Water will be drawn from scheme supply up to 70 kl per day capacity. Water requires pre-treatment prior to Electrolyser use with filtration system included in the Electrolyser vendor package battery limit.

Notes: Feed water storage tanks to provide 24 hours of storage capacity for the 10 MW Electrolyser package.

3.2 Electrolyser package

The electrolyser package shall be installed to produce gaseous Hydrogen. Hydrogen shall be purified, dried and sent to a small Hydrogen buffer vessel prior to being compressed and loaded into awaiting tanker trailers.

Plant trailer loading bay capable of parking 8 20ft trailers with output capacity up to 4 tonnes per day. Each trailer gaseous volume capacity 1000kg.

Notes:

A key objective of the design philosophy shall be geared toward minimisation of the site construction and commissioning hours, so the electrolyser package will be containerised

3.2.1 Potable water

Potable water will be drawn from scheme water supply.

3.3 Electrolyser Cooling Water

Demineralised water to be used as the cooling water medium. Separate closed loop circulation cooling water systems shall be part of Electrolyser and compressor package vendor supply. Package vendor to confirm the process scheme for the cooling water circuit.

3.4 Instrument Air

Instrument air package consists of Air compressor, Air dryer and Instrument Air receiver.

3.5 Nitrogen Bottle cascade

High pressure Nitrogen bottle cascade shall be provided for the tank blanketing system, to purge the Electrolyser system for shutdowns.

3.6 Vents

Safe operation, start-up and shutdown of the electrolyser plant will be supported by vents to atmosphere at safe locations for all hydrogen, oxygen, and nitrogen vents.

Vent sizing will be done to adequately reduce noise at full flow conditions according to the relevant specifications and standards.

Pure oxygen vent shall be away from hydrogen vent and any discharge of ventilation vents.

3.7 Liquid Effluent

Reject water from the Electrolyser package will be diverted to holding tanks and dispersed to trees and planned reed pond areas. An evaluation on whether the reject water can be recycled will be carried out when the typical Reject water quality is received from the Electrolyser vendor.

Detailed reject water study completed as part of the EPA emissions surveys.

4 Technical Safety and Risk Management

4.1 Hazard Management Process

4.1.1 Statutory Regulations

The design of the new facility shall be in accordance with the statutory regulations in Australia and the state of Western Australia. In Western Australia the relevant regulatory bodies are Energy Safety and the Department of Mines, Industry Regulations and Safety (DMIRS).

Dangerous Goods Safety Act 2004 and the Dangerous Goods Safety (Major Hazard Facility) Regulations 2007 regulate the manufacture, storage, handling, transport and use of dangerous goods. Energy Safety Act 2006 and Regulations 1996, Occupational Safety and Health Act 1984 and Regulations 1996 should be reviewed to ensure the safety of the hydrogen projects.

Based on the legislation and upon DMIRS assessment on Company / Operator's submission of its notification, a processing plant is classified as a Major Hazard Facility (MHF) if it stores and handles Schedule 1 Substances above the threshold (5 Te of hydrogen). The MHF shall have a Safety Report.

Under the Dangerous Goods Safety MHF regulation, all identified risk should be demonstrated and documented that controls, procedures and processes are in place and the risk has been reduced to the level that is tolerable and so far as reasonable practicable (SFARP).

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

4.2 Design Strategies

4.2.1 Plant Layout Philosophy

The layout is one of the key design considerations in the overall facility risk management approach in order to promote inherently safe design. The key safety principles for plant layout are to ensure:

- Plant layout minimises risk to people and potential for escalation between equipment / section. Higher risk areas such as the electrolyser pressurised systems, are located in separated containers / enclosures.
- The enclosure internal layouts should allow for adequate spacing between equipment to promote the natural ventilation of the areas that will limit the potential build-up of flammable gas mixture and escalation to adjacent sensitive facilities.
- Ventilation within the electrolyser containers shall be to the Vendor standard.

- Hydrogen equipment is located inside the enclosures to prevent vehicle damaging the equipment. Hydrogen equipment located outside will have physical collision barriers or be segregated from any vehicle access.
- Separation between hazardous and non-hazardous areas, for the purpose of hazardous area classification and control of potential ignition sources.
- Appropriate and safe access for construction, operation and maintenance. For emergency vehicles and for firefighting, adequate access including secondary access and turning radius to protect general traffic from a hydrogen accident (e.g. jet fire) and to reduce the risk of collision with the hydrogen equipment.
- Location of roads that carry general traffic are in non-hazardous areas, so that vehicles are unlikely to ignite a potential hydrogen leak.

Plant layout shall consider minimising risk to people and potential for escalation between equipment/section. Higher risk areas such as the electrolyser pressurised systems, are to be located furthest from area where personnel will likely be e.g. Control Room. API RP 752 **Error! Reference source not found.** and NFPA 2/55 **Error! Reference source not found.Error! Reference source not found.** will be used as a reference for the development of the separation distances on the plot plan.

4.2.2 Health and Safety Strategy for the Key Packages

Electrolyser Processing Facilities, LP Buffer Storage, Gas Compression and filling station.

Hydrogen is a flammable material and poses fire and explosion risks to the facility. The strategy for minimising the fire and explosion is through hazard prevention. This is achieved through reducing the frequency of release, the subsequent ignition, and their consequences. Several design and risk controls can be implemented:

- Layout arrangement includes appropriate spacing to maximise natural ventilation whilst reducing the risk of escalation between equipment.
- Reduced number of flanged joints, particularly the high-pressure sections.
- Application of the principles of hazardous area classification.
- Provision of good ventilation (e.g. mechanical ventilation) to prevent flammable gas build up on accidental release.
- Implementation of early detection before the released material becomes a flammable and explosive mixture.

Electrical and Control Rooms

All building fire rating (i.e. Fire Resistance Levels) should be of fire-resistant constructions as determined by ruling building codes buildings (process and non-process) shall be provided with appropriate fire detection in accordance with Building Code of Australia.

Truck Loading Terminal

The safe design of the truck loading terminal shall include Safety Instrumented Functions (SIF) such as overfill protection, emergency shutdown, overpressure, etc. Functional safety design and configuration with the new plant Safety Integrity System shall be in accordance with AS IEC

4.3 HSE Technical Specifications

4.3.1 Fire Zones

The MEG-HP1 plant facilities shall be segregated into discrete fire zones.

The fire zones are defined to correspond with obvious boundaries such as enclosures, partitions, module and fire types (e.g. hydrogen fires, electrical fires, or transformer oil fires). The fire zones will be used to separate one area from the other area by distance or physical barrier (including fire/blast rated wall if necessary) which will prevent the passage of fires, smoke and gas.

4.3.2 Fire and Gas Detections and Alarms

Fire & gas detection system shall be provided for areas handling hydrogen. Fire and gas detectors considered for the plant are as follows:

- Flame detector – a sensor designed to detect and respond to the presence of a flame or fire, allowing flame detection
- Hydrogen Gas detector – a device that detects the presence of hydrogen gases in an area.
- Smoke detector – is a sensor that detects smoke as a primary indication of fire. It provides a signal to a fire alarm system in a building / enclosure or produces an audible and visual signal locally in a room.
- Manual activated call points (MAC) – used to initiate an alarm signal and operate using a simple button press or when glass is broken revealing a button. They can form part of a manual alarm system or an automatic alarm system.
- Very Early Smoke Detection System (VESDA) – aspirating smoke detection used for early warning application where response to a fire is critical in electrical rooms.
- ESD push button - A push button switch located close to the doors to stop the equipment or workflow when required.
- Thermographic cameras can be used to detect hydrogen fires.
- Closed Circuit Televisions (CCTV) to monitor the restricted areas (e.g. electrolyser enclosure), to minimise requirement for operators to perform routine walkaround and to assist site emergency response team, should a major incident occur.

Hydrogen gas detectors are recommended for the areas with potential hydrogen release. Their types and specifications will be determined in the detailed phase.

Fire and gas detection shall initiate automatic alarms and executive actions to:

- Alert personnel to evacuate area and find muster.
- Minimise the inventory of released flammable materials.
- Remove sources of ignition.
- Initiate fire protection responses.

Confirmed gas detection of low and high level shall initiate alarm at the Control Room. The alarm levels for gas detectors shall be set to the lowest level possible to achieve rapid response.

Acoustic gas leak detection threshold setting shall raise an alarm at the Control Room and shall not initiate executive action apart from an alarm at the Control Room, unless voted with a flammable gas detector within the same fire zone.

Fire and Gas Mapping shall be carried out in detailed design to determine the types and locations of fire and gas detectors for the plant.

4.3.3 Safety Instrumented Functions

The Safety Instrumented Functions (SIFs) for the project will be performed in compliance with industry standards. This will be covered in the Layer of Protection Analysis (LOPA) workshop in the execute phase.

4.3.4 Emergency Shutdown Philosophy

Emergency shutdown of the MEG-HP1 plant is to initiate safe shutdown of the facility to prevent or mitigate the effects of major incidents.

4.3.5 Venting

The plants safety systems are designed to safely vent Hydrogen in an emergency only.

Venting volumes are minimal.

4.3.6 Fire Protection

Active fire protection shall be provided using the appropriate Australian Standards and shall meet DFES requirements for emergency response.

The Hydrant system shall include:

1. Two fire water storage tanks with a total capacity to provide the required flow to the hydrants for 4 hrs
2. Two fire pumps (with alternative power sources (i.e. electric and diesel) with local controller and 6 hr fuel tank. The pumps shall be sized to provide the total design flow with a minimum pressure of 700 kPa at the remote hydrant.
3. Jockey pump with local controller and hydro-accumulator
4. Minimum flow rate for each hydrant shall be 10 l/sec and they shall be spaced every 60.0m
5. Fire Brigade Booster Assembly
6. The transport loading bay will be fitted with a zone operated drencher system.

4.3.7 Safety Shower and Eyewash Stations

Safety showers and eye wash fountain shall be provided in the vicinity equipment areas where personnel may be exposed to chemical or corrosive materials.

4.3.8 Noise Minimisation

The following local noise limit requirements shall be met:

- Work area limit: 75dB(A) during continuous 8 hrs operation
- Absolute (impulse) noise: 130 dB(C).

Noise and vibration limits shall be specified for each equipment / packages in the design.

4.3.9 Human Factors and Ergonomics

Appropriate Human Factors Engineering and Ergonomics considerations shall be included in design to ensure ease of operation; access and maintenance

4.3.10 Bunding and Drainage

Bunding requirements for hazardous material storage shall be as per required standards:

Appropriate segregation of hazardous and non-hazardous drains shall be implemented. A hazardous drain system should be avoided and local sumps are referred.

4.4 Solar Expansion

The development involves the addition of 8MW of additional solar panels located West of the Hydrogen plant for 6.8 MW and 2.2 MW added to the existing plant.

Electrical Equipment Rooms containing UPS batteries shall have adequate ventilation in accordance with AS 2067 **Error! Reference source not found.** requirements.

4.4.1 Electrical Cables.

A new overhead power cable including poles to be included in the proposal joining the existing solar farm to the new plant.

4.4.2 Lighting

4.4.2.1 General

External area lighting shall automatically switch off to prevent light pollution, impact to local fauna and wasted electrical power.

5 Structural

5.1 Fencing

Boundary fencing, as well as a security gate shall be provided to control access to the facility.