KAPUNI GREEN HYDROGEN PROJECT

RISK MANAGEMENT PROCESS SUMMARY REPORT

MAY 2021

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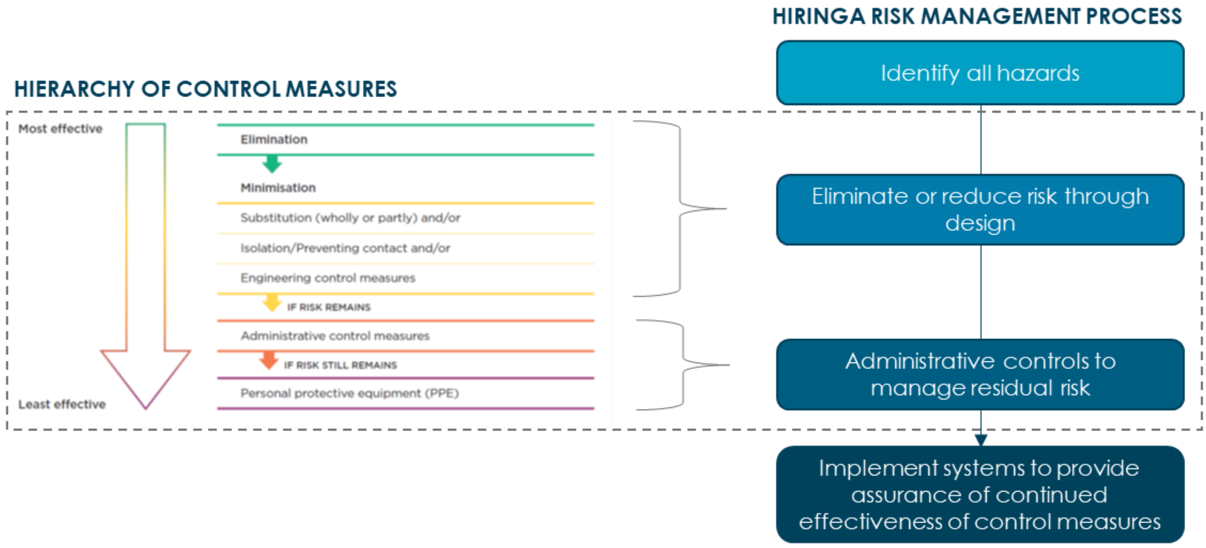
2 EXECUTIVE SUMMARY

This report has been prepared to fulfil the information requirements under Section 20.5.10 in the South Taranaki District Plan for Hiringa's Resource Consent application for the Kapuni Green Hydrogen Project. The report considers the risks relevant to hazardous substances with a focus on the proposed hydrogen facilities at the Ballance Agri-Nutrients Plant at Kapuni.

The Hiringa Risk Management Process provides a structured process for completing safety studies and activities to demonstrably identify, minimise and manage the risks so far as is reasonably practicable by applying the hierarchy of control measures, as required by the Health and Safety at Work Regulations.



Independent experts have completed contemporary risk management studies and risk assessments including a Quantitative Risk Assessment (QRA). The outcomes demonstrate risks can be classified As Low As Reasonably Practicable (ALARP) and acceptable. Critically, the results of the QRA, which have been conservatively modelled, show that the risk contour is contained to within the site boundaries.

In the event of a loss of containment of hydrogen resulting in a fire or explosion, the impact on the environment is localised to the area around the equipment which includes paddock grass and nearby shrubbery and no sensitive features or areas. Any impact damage would be short-term, with the environment expected to recover quickly.

There are no significant areas of indigenous vegetation or habitats of indigenous fauna around or near where the project equipment is sited. The nearest waterbody would be unaffected by a fire or explosion event. There are no sites of significance to Tāngata Whenua or sites of historical or archaeological significance near enough to the project location to be impacted by an incident.

3 INTRODUCTION

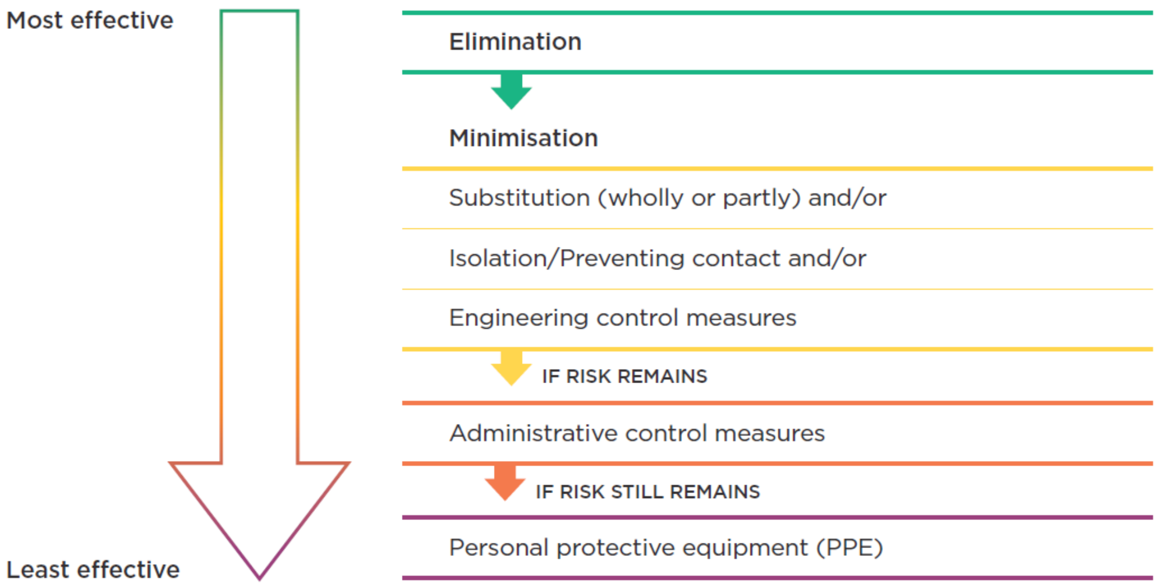
3.1 PURPOSE

The purpose of this document is to:

- provide an overview of the risk management processes for the successful and safe project delivery of the Kapuni Green Hydrogen Project in South Taranaki; and to
- Summarise the outcome of the key risk assessment studies and activities.

The objective of undertaking a risk assessment is to identify and eliminate risks to the health and safety of people and the environment so far as is reasonably practicable, and where elimination is not possible, minimise risk so far as is reasonably practicable. Figure 1 below presents the hierarchy of controls commonly used in risk management, this approach is used by WorkSafe and has been adopted by Hiringa.

FIGURE 1: HIERARCHY OF CONTROLS



Source: www.worksafe.govt.nz

The focus of this risk management report is on production and storage of hydrogen gas, the wind turbine vendor will provide a risk assessment for the turbines which will be reviewed internally by the Project team and then in a workshop setting with the wind turbine vendor. With regard to hazardous substances, the wind turbines have low quantities of coolant, gearbox oil and greases/lubricants onboard with low risk to the environment. Wind turbines are therefore not considered further in this report.

This risk assessment has been prepared in support of the resource consent application to be submitted to the Environmental Protection Authority for the project. The project will be located on Ballance Agri-Nutrients (Ballance) site in South Taranaki which is classified as a Significant Hazardous Facility under the South Taranaki District Plan. The risk assessment has been prepared consistent with the information requirements under Section 20.5.10 in the South Taranaki District Plan, as follows:

> *(e) Whether the risk assessment submitted with the proposal adequately address:*
>
> > *(i) An assessment of the sensitivity of the receiving environment to any potential risks*
> > *(ii) A hazard identification and risk management response*
> > *(iii) A quantitative risk assessment for all significant hazardous facilities*
> > *(iv) Whether there is a practicable alternative method of risk management that would present less risk*
> > *(v) Whether the proposal will avoid or adequately mitigate cumulative adverse effects with respect to other hazardous facilities in the area*
> > *(vi) Whether adequate setback is proposed to address the potential risks in the following situations:*
> >
> > > *• Proximity to sensitive activities, including residential zones activities, educational facilities, and community facilities and recreational areas;*
> > > *• Significant areas of indigenous vegetation and habitats of indigenous fauna;*
> > > *• Adjacent waterbodies;*
> > > *• Adjacent Sites of Significance to Tāngata Whenua, or sites of historical or archaeological significance.*

3.2 PROJECT DESCRIPTION

The Project will be undertaken by Hiringa Energy and its joint development partners, Ballance as developers of this infrastructure. It involves building new wind energy generation and hydrogen production facilities near the Ballance industrial plant at Kapuni in South Taranaki. The renewable electricity will power the industrial plant and produce green hydrogen gas from water electrolysis. Hydrogen will be used for production of ammonia and as a fuel supply for fuel cell powered heavy transport. Excess electricity will be exported to the grid.

3.3 KAPUNI PROJECT DESIGN AND LAYOUT

Figure 2 shows the main components of the Project, the highlighted components are the wind farm and the electrolysis equipment, however there will also be loadout facilities installed on-site to allow filling of Multi Element Gas Containers (MEGCs).

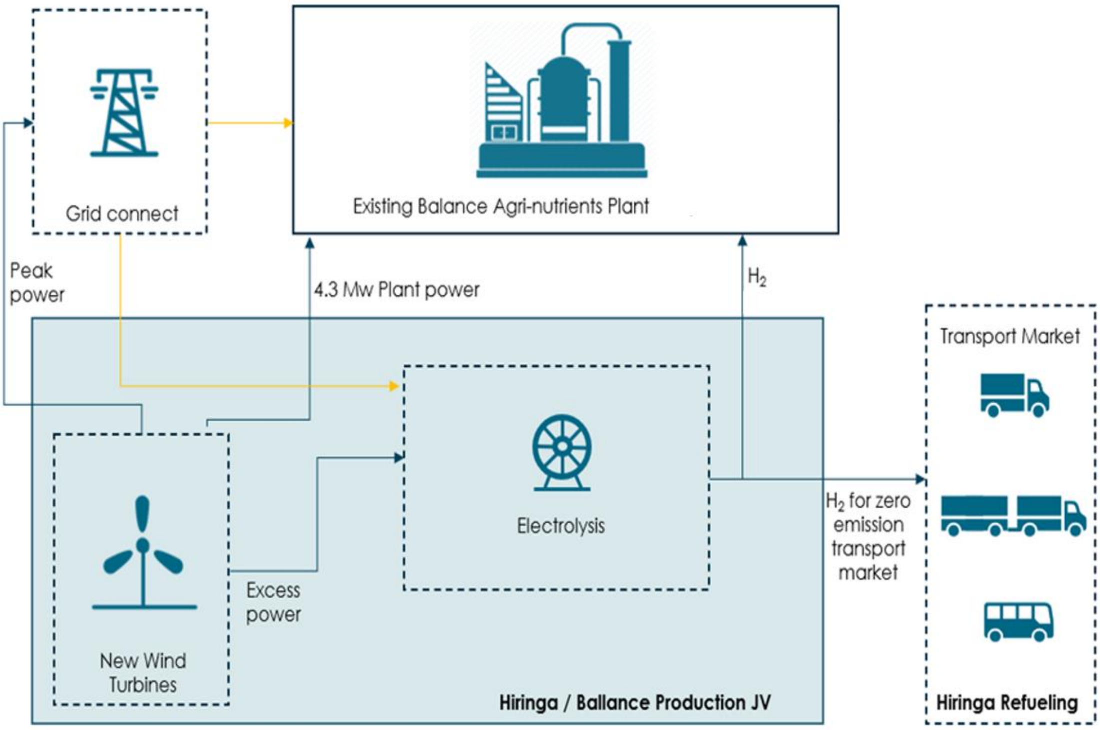


FIGURE 2: KAPUNI PROJECT COMPONENTS

The Project will install four wind turbines which will be sited on the PKW farm at Kokiri Road, Kapuni. The hydrogen production and loadout equipment will be located within the Ballance boundary, as illustrated in Figure 3 below. Electricity generated from wind turbines will power Ballance's plant, will be used to make hydrogen and will be exported to the grid.

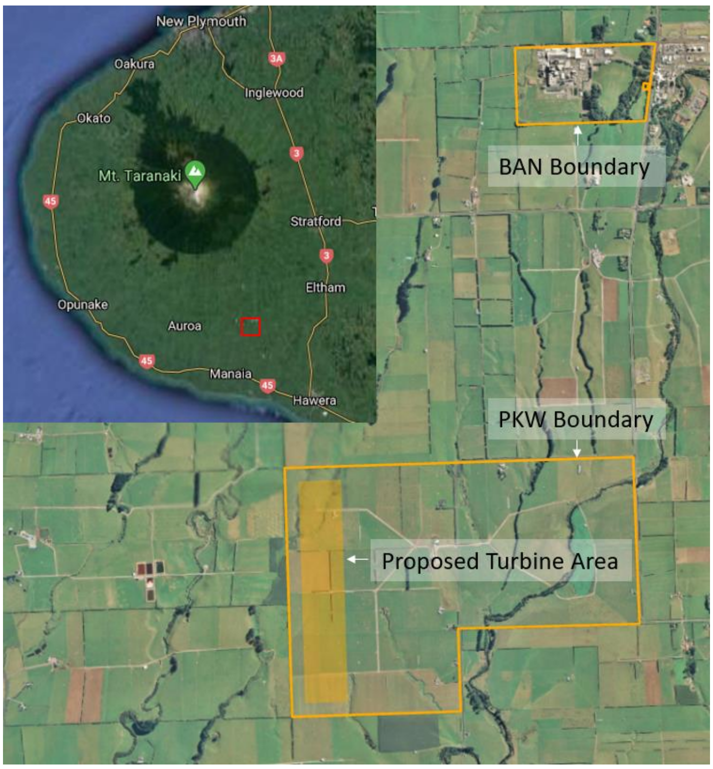


FIGURE 3: PROJECT LOCATIONS

Electrolysis equipment will be connected to the wind farm transmission lines via a new indoor substation. Other utility connections such as water, waste-water and interface controls systems be sourced from within the Ballance plant.

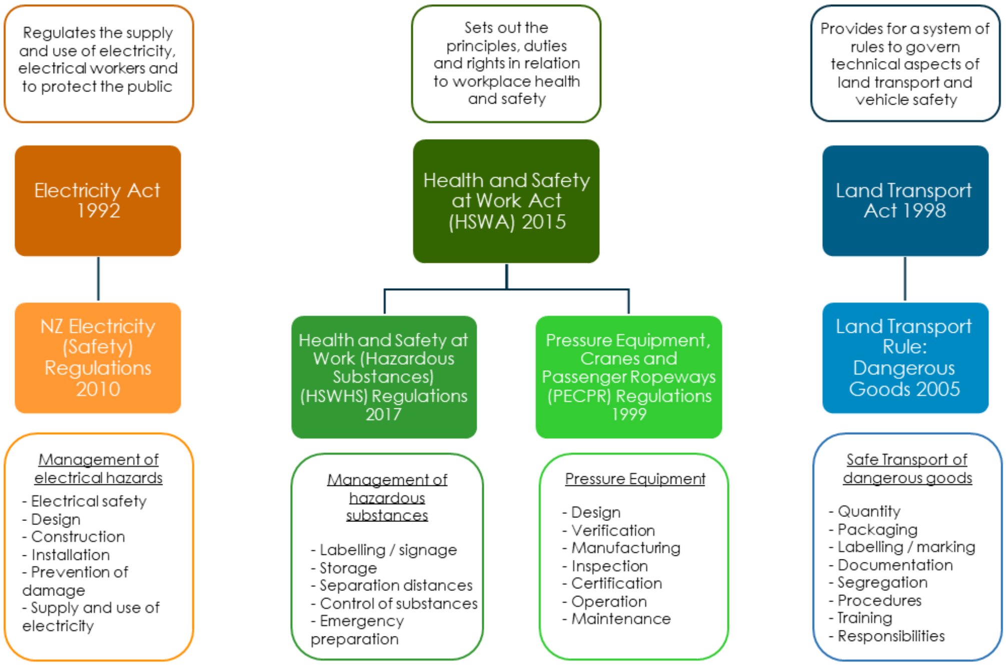
The electrolyser is fed with either treated river water or potable water which is split into hydrogen gas and oxygen by passing an electric current through a purified water stream. The oxygen is released to atmosphere as a by-product and the hydrogen gas is dried and purified. The hydrogen is either fed directly to the Ballance process downstream of the Methaneator at 40 barg or fed to a compressor at the loadout facility for compression up to 350 barg and used to cascade fill MEGCs (see Figure 4).

FIGURE 4: KEY EQUIPMENT LOCATIONS

3.4 LEGISLATION REVIEW AND REGULATOR ENGAGEMENT

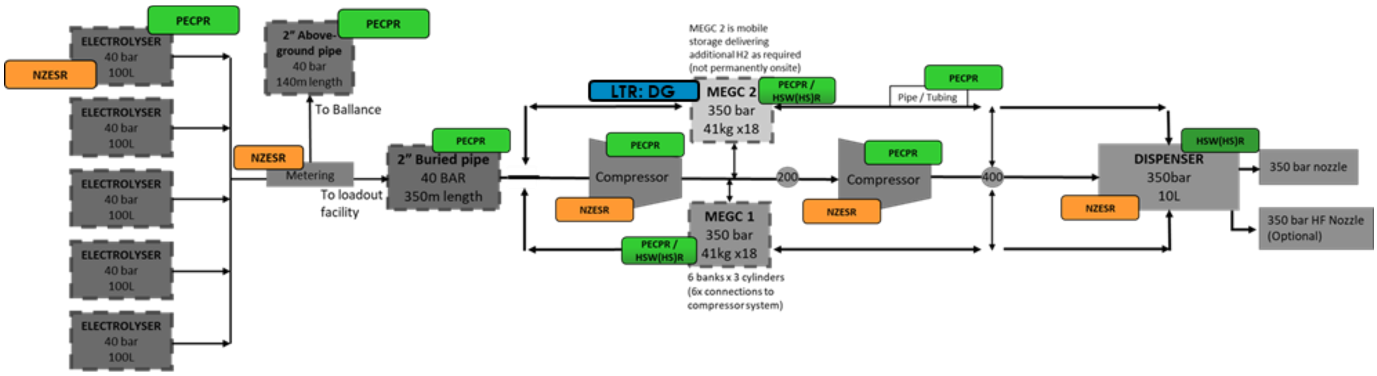
In preparation for designing the project equipment and site layout, Hiringa undertook a review of relevant New Zealand Acts and Regulations to identify requirements applicable to this project. As hydrogen as a transport fuel is a new application in New Zealand, Hiringa have held workshops and discussions with WorkSafe to determine the appropriate legislation and regulations that apply and how to apply them to ensure compliance.

FIGURE 5: NZ SAFETY LEGISLATION RELEVANT TO THE KAPUNI GREEN HYDROGEN PROJECT



From the WorkSafe engagement and regulatory reviews, the compliance requirements for the project equipment have been determined and applied when designing for safe management of electrical power, hydrogen gas production and storage and calculation of separation distances (Figure 5). As a result, compliance and certification will be achieved with each of the regulations presented in Figure 6.

FIGURE 6: KAPUNI GREEN HYDROGEN PROJECT COMPLIANCE MAP



Hiringa have also reviewed international hydrogen-specific standards for management of hydrogen systems that have been applied globally to similar projects. Although these hydrogen-specific standards have not yet been adopted in NZ, Australia have recently adopted eight widely-accepted ISO hydrogen standards with the intention of adopting more of the ISO hydrogen standards suite. Adherence with these standards ensures alignment with international best practice as well as compliance if these standards are adopted in New Zealand.

3.5 MAJOR HAZARD FACILITY (MHF) REQUIREMENTS

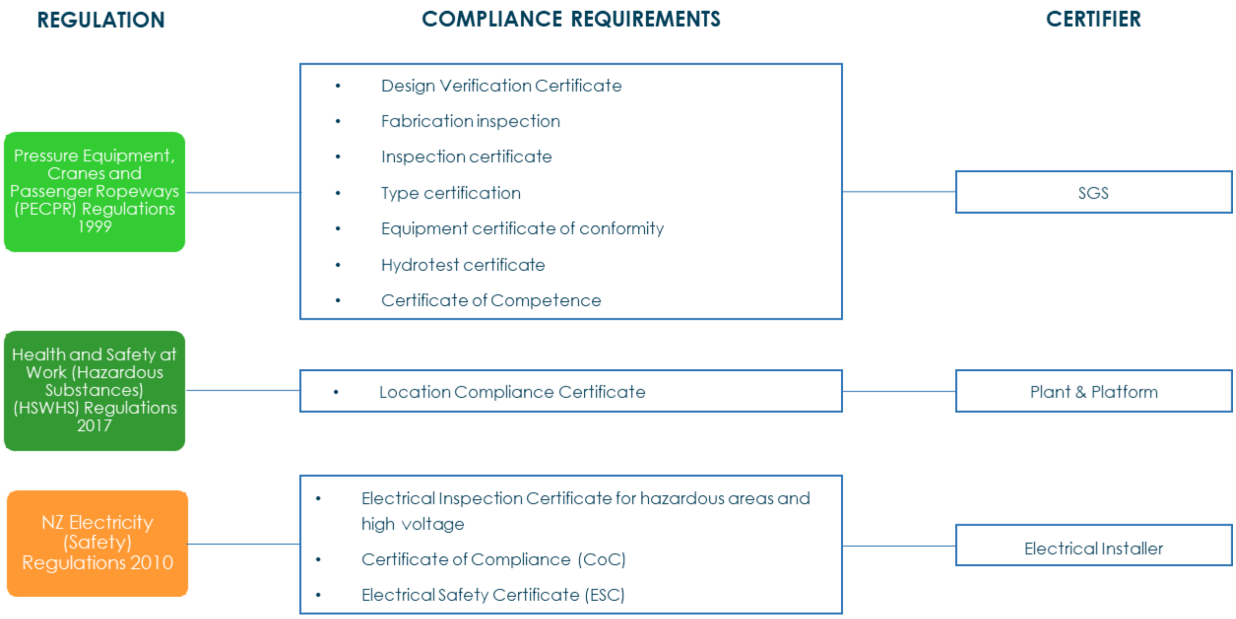
The Ballance Plant is classified as a MHF and they have prepared a safety case to meet the Health and Safety at Work (Major Hazard Facilities) Regulations 2016. Project elements involving hydrogen production will be sited within or immediately adjacent to the existing Ballance Plant, as such the project will comply with the MHF regulatory requirements as required.

This risk management process document forms part of the safety assessment for the new hydrogen equipment to demonstrate that all Major Incident Hazards (MIH) have been identified and controlled. Outcomes from the safety studies undertaken as part of the Hiringa risk management process will be integrated with the Ballance safety case, either as an appendix or a separate report.

3.6 CERTIFIER ENGAGEMENT

Hiringa have consulted with the Project's equipment manufacturers and New Zealand certifiers (SGS and Plant & Platform) to ensure all equipment imported to, or constructed in, New Zealand will be compliant with requirements of New Zealand regulations and achieve certification. Figure 7 below presents the certification requirements for each of the regulations. Certifications will be achieved prior to the project becoming operational.

FIGURE 7: CERTIFICATION REQUIREMENTS



4 HEALTH AND SAFETY RISK MANAGEMENT ACTIVITIES

4.1 RISK ASSESSMENT INTRODUCTION

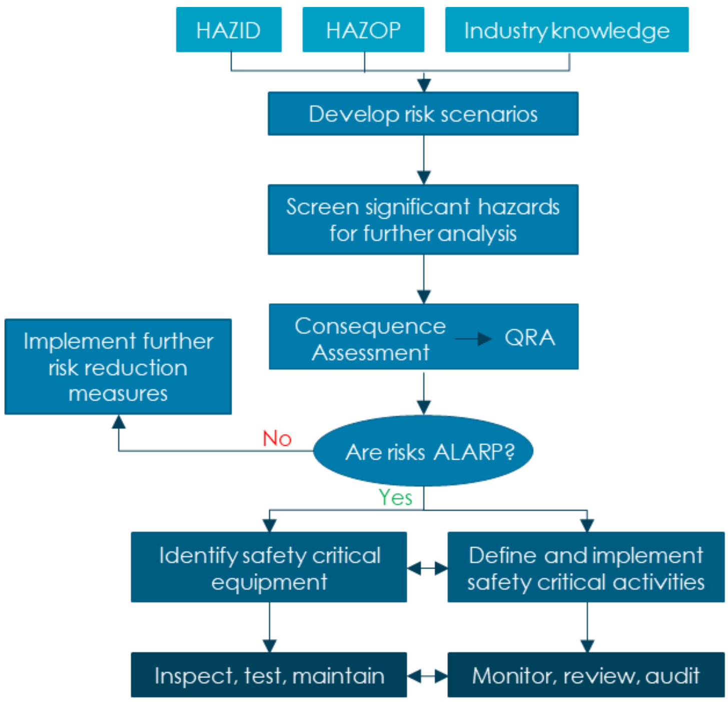
The Hiringa Safety Management System provides a structured process for completing safety studies and activities to demonstrably identify, minimise and manage the risks so far as is reasonably practicable, as required by the Health and Safety at Work Regulations.

A key to successful risk management is understanding how to manage any given hazard, in this case hydrogen. Hydrogen is a 2.1.1a class substance, meaning it is a high- hazard flammable gas so understanding how it behaves is key to putting appropriate controls in place. Hydrogen gas is:

- 14x lighter than air so disperses upwards rapidly if released
- Odourless
- Non-toxic
- Has a colourless flame when ignited
- Produces minimal radiative heat when it burns

During the design phase, risks associated with the project are eliminated or reduced to As Low As Reasonably Practicable (ALARP) through design and engineering using the concept in Figure 1 above and the Hiringa Risk Management Process presented in Figure 8.

FIGURE 8: HIRINGA RISK MANAGEMENT PROCESS



The status of the risk assessment techniques and studies are presented in Table 1 below.

TABLE 1: RISK ASSESSMENT STUDIES STATUS

Technique / study	Status	Findings of study
Hazard identification (HAZID)	Completed August & December 2020	Section 4.2 of this document & Reference 1
Hazard and operability (HAZOP) study	Completed November 2020 for the electrolyser package.	Section 4.3 of this document & Reference 2
	Completed February 2021 for compressor package.	Section 4.3 of this document & Reference 7
	Completed March 2021 for equipment tie-ins to Ballance facilities.	Section 4.3 of this document & Reference 8
Consequence assessment	Completed December 2020.	Section 4.4 of this document & Reference 3
Quantitative Risk Assessment (QRA)	Completed January 2021	Section 4.5 of this document & Reference 5
Hazardous area classification	Ongoing – Preliminary assessment completed	-
Emergency response planning	To be completed with Ballance before operations	-

The risk management process sets out requirements during the operations phase for inspection, testing and maintenance to ensure engineered safeguards remain effective. Associated residual risk will be managed by procedural controls, training and competency.

4.2 HAZARD IDENTIFICATION (HAZID) STUDY

Hazard identification is a key first step in the risk management process. Unless hazards are identified, they cannot be controlled through implementation of appropriate risk reduction measures. The HAZID therefore forms the foundation for all subsequent safety studies.

A design HAZID study was undertaken by Environmental Risk Solutions (ERS) in June 2020 for Hiringa's Refuelling Infrastructure Project. The Refuelling Infrastructure Project will establish a national hydrogen refuelling station network for refuelling fuel cell electric heavy vehicles with hydrogen, and comprises the same key hydrogen equipment as the Kapuni Green Hydrogen Project, with the same hydrogen hazards present. Therefore, Hiringa used the output of this HAZID as the basis for an internal preliminary Kapuni Green Hydrogen HAZID with Hiringa personnel in August 2020, followed by a virtual HAZID workshop involving Hiringa and Ballance personnel on 21st December 2020.

Ballance currently produce and process hydrogen in their facility as part of normal operations so understand how hydrogen behaves and have the knowledge and experience in working with it.

The purpose of a HAZID study for this Project was to:

1. Identify all reasonably foreseeable, significant hazards/threats associated with hydrogen production, storage and distribution.
2. Identify consequences of hazards/threats to people or the environment.
3. Risk rank the identified hazards using a Risk Assessment Matrix (RAM).
4. Identify any controls/mitigation to prevent/mitigate the hazard/threat.
5. Raise any actions necessary to either confirm/obtain further information, carry out additional assessment or incorporate risk reduction measures into the design.

Detailed risk assessments for construction, commissioning, operating and maintenance activities will be completed for these activities as the project advances.

The study findings have informed key design decisions as the project advances, and where possible, the project will reduce the risks which fall in the 'medium' area of the Hiringa Risk Assessment Matrix (RAM) (Appendix 1) to 'low' through further design and inclusion of engineered safeguards. Any residual risk carried into the operations phase will be managed by administrative and operational safeguards.

4.2.1 HAZID METHODOLOGY

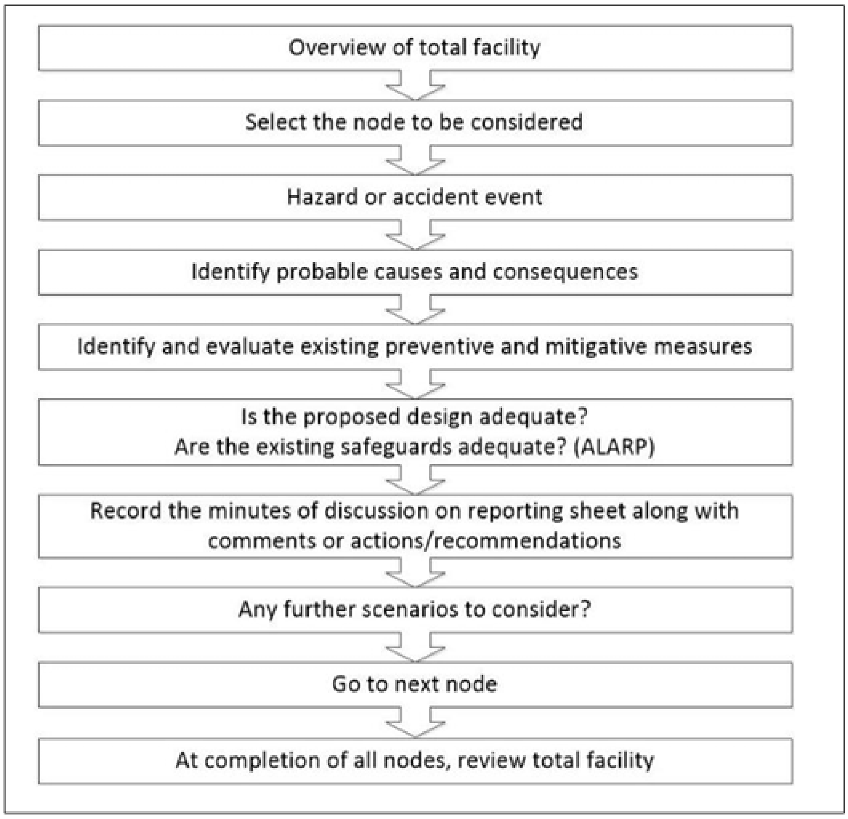
The HAZID studies took the form of structured workshop reviews of the potential hazards and threats associated with production, storage and refuelling of hydrogen, using guidewords taken from ISO 17776 'Petroleum and natural gas industries – Offshore production installations – Guidelines on tools and techniques for hazard identification and risk assessment'. Although originally produced for offshore oil & gas application, these guidewords are comprehensive and commonly used globally in the energy industry for HAZID workshops.

The HAZID studies considered hazards associated with;

- Production of hydrogen using water electrolysis
- Compression of hydrogen
- Storage of hydrogen in MEGCs
- Transferring hydrogen to/from MEGC
- Transfer of hydrogen via piping to Ballance tie-in or to MEGCs, storage vessels and refuelling dispenser
- Dispensing hydrogen
- External hazards;
    - Vehicle movements (including Truck delivery movements associated with Ballance operations
    - Natural hazards
    - Hazards which are external to site e.g. offsite fire
    - Ballance plant operations
    - Truck delivery movements associated with Ballance operations

The methodology for identifying and assessing the hazards associated with the above equipment and activities is shown Figure 9 below, taken from the ERS study report:

Figure 9: HAZID Methodology



By considering each relevant guideword in turn, the HAZID study participants brainstormed to identify potential safety hazards.

The following information was recorded in the HAZID worksheet:

1. A description of the identified hazard.
2. A summary of the resulting consequences of the identified hazard to people.
3. The likelihood, severity and unmitigated risk score of the identified hazard consequence (based on the Risk Assessment Matrix (RAM) taken from AS/NZS 4645 – "Gas Distribution Network Management" for the purposes of this study)
4. Any controls/mitigation which can be implemented to prevent/mitigate the hazard.
5. The likelihood, severity and mitigated / residual risk score of the identified hazard consequence.

4.2.2 HAZID FINDINGS & NEXT STEPS

The detailed findings of the Kapuni Green Hydrogen design HAZID study are presented in Reference 1. The study identified no hazards as having a 'high' residual risk after safeguards are considered. The study findings have been used to inform key design decisions as the project advanced reducing 'medium' level risks to 'low' through engineered safeguards.

Thirty actions came out of the HAZID study, these are presented in full in Reference 1. A risk assessment action log has been compiled to track actions to closure.

Engineered safeguards identified in the study will feed into the operational plan for asset management and maintenance of engineered systems to ensure continued performance and system integrity. The project team will ensure all engineered safeguards are shown in drawings/documents prepared by equipment suppliers. Non-engineered safeguards identified in the study (i.e. those requiring human action) will provide input into operational procedures and administrative safeguards.

Actions and recommendations from the HAZID study have been actioned during the detailed design phase of the project. A project action list is used to track and close actions generated by the risk assessment.

4.3 HAZARD & OPERABILITY (HAZOP) STUDY

A HAZOP study is a qualitative technique to identify and evaluate process hazards and potential operating issues using a series of guidewords to examine deviations from normal process conditions.

A HAZOP has been undertaken for the electrolyser package supplier and reviewed by both Hiringa and Plug Power. These workshops took place over the course of eleven 1-2hour sessions between 29th September and 23rd October 2020.

A HAZOP study for the compression skid, MEGC manifolds and refuelling dispenser was undertaken with the equipment vendor, Haskel, on 17th and 18th February 2021. The HAZOP was initially undertaken by Haskel, and was then reviewed in a virtual workshop setting by both Hiringa and Haskel.

A HAZOP study of the tie-ins to the Ballance Plant was undertaken in a workshop setting at the Ballance Plant on 23rd March 2021. The workshop included representatives from Hiringa, Ballance and from Process Group (the process engineers for the balance of plant (BoP)).

4.3.1 HAZOP METHODOLOGY

The design intent and expected plant operations for the system were outlined at the start of the workshop. The system was broken down into nodes, or subsystems. This is highlighted and marked-up on the Piping & Instrumentation Diagrams (P&IDs) and used as a reference during the study. For each node, the normal and abnormal operation conditions were described.

There were 9 nodes reviewed for the electrolyser system;

- Anode loop
- Oxygen system
- Hydrogen system
- Water system
- Polisher component
- H2 separator
- Nitrogen loop
- Cooling loop
- Deoxydrier component

There were 6 nodes reviewed for the compressor package:

- Air compressor
- Compression skid
- Storage bank valve system
- Fire safety valve system
- Vent stack and venting system

- External hydrogen dispenser

There were 2 nodes reviewed for the tie-in scope of works:

- Hydrogen supply from electrolyser to BAN
- Electrolyser reject water stream

Each node was assessed, applying a series of parameters and guidewords to represent deviations, e.g. the parameter 'pressure' and guideword 'high' create the deviation 'high pressure'. A node may have several parameters that are applicable to it, and each of these may have several guidewords, thus generating a number of applicable deviations. Each deviation was evaluated to determine what could cause that deviation e.g. blocked filter, and the potential consequences of the deviation e.g. overpressure leading to an uncontrolled release.

The safeguards in place to either prevent the deviation, or to mitigate the consequences if the deviation occurred were then identified.

Comments, actions and recommendations that arose during the study were documented and summarised at the end of the workshop for tracking and follow-up as the project progresses.

4.3.2 HAZOP FINDINGS & NEXT STEPS

The output from the HAZOP studies can be found in References 2, 7 and 8. A number of recommendations for modifications came out of the HAZOP studies, these are currently being addressed in the design by vendors. P&IDs have undergone several revisions and will be re-assessed in detailed design HAZOPs; the electrolyser package detailed design HAZOP is currently underway (May 2021), this is being conducted over a series of workshops, and the detailed design HAZOP for the tie-ins is scheduled for 24th May 2021. The compressor package will be undertaken in June 2021. Hiringa are having several sessions per week with the vendors to finalise the design and progress HAZOP action items.

The design has and will continue to be thoroughly assessed with risks eliminated or reduced early in the design process, leaving the project with an acceptable risk.

4.4 CONSEQUENCE ASSESSMENT

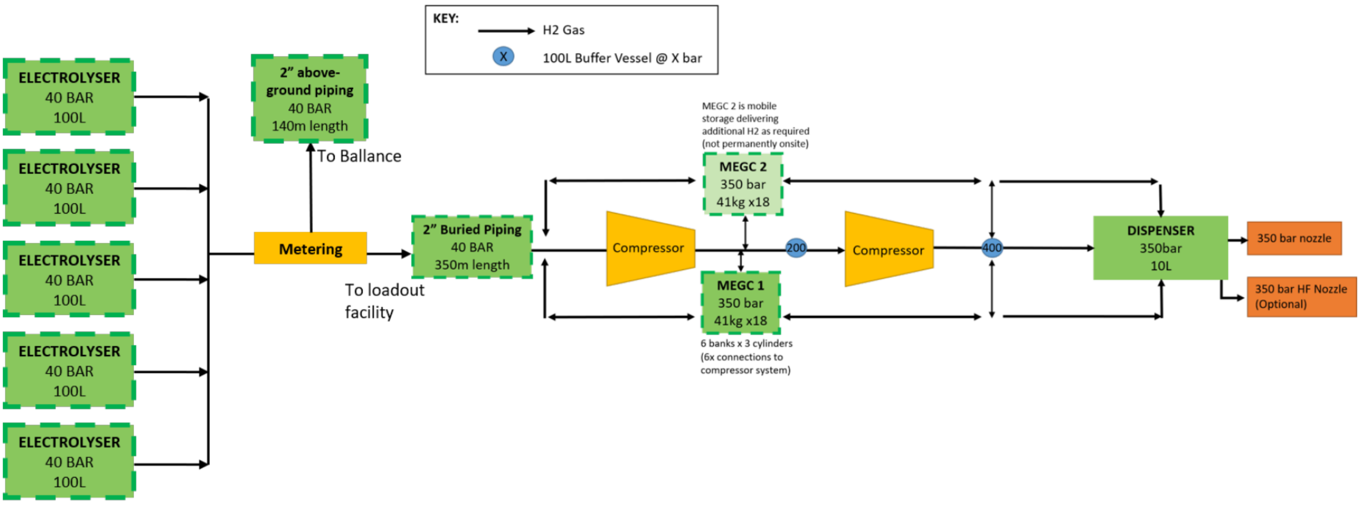
Worley New Zealand was commissioned to undertake a consequence assessment as part of the Quantitative Risk Analysis (QRA). The purpose of the study was to estimate the worst-case physical effects of unmitigated jet fire, flash fire and explosion scenarios arising from an incident from the hydrogen equipment.

This study assesses unmitigated consequences only, without consideration of safeguards or likelihood of scenario. The likelihood of those consequences is considered in the QRA (section4.5) using failure rate data of equipment components and integrating that data with the results of the consequence assessment to determine overall risk to personnel.

4.4.1 CONSEQUENCE ASSESSMENT METHODOLOGY

Hiringa provided information on each of the key equipment items to allow individual modelling for each piece of equipment. Figure 10 presents the process flow diagram (PFD) for the key project equipment;

FIGURE 10:HRS KEY EQUIPMENT ITEMS



Worley compiled an assumptions register (Appendix 1 of Ref. 3) which presented all modelling inputs and assumptions. These included representative hole sizes for leaks, release heights and directions, meteorological data for various wind conditions and ambient conditions. The assumptions register also included information on consequence end-point criteria for heat radiation and explosion overpressure effects, using Hazardous Industry Planning Advisory Paper No. 4 (HIPAP4) criteria (Ref. 4).

Each potential release scenario was identified and the potential consequences associated with those were then modelled in Phast 8.22 software using the assumptions and criteria in the assumptions register.

The software examines the progress of a potential incident from the initial release to far-field dispersion, as well as flammable and toxic effects.

Some conservative assumptions were made for the modelling, including;

- Jet fire results were evaluated based on the initial release rate and therefore produce conservative results. In reality, the flame lengths and thermal radiation distances would reduce over time as the inventory exhausts and pressure depletes, especially post-emergency isolation and shutdown.
- Personnel exposure duration of 20 seconds was used as a base case, although personnel are likely to find some form of shielding protection within this time frame.
- Overpressure impact distances predicted in Phast software are conservative as the presence of obstacles in the explosion area is not considered.

<u>Modelling exclusions</u>

- The electrolyser equipment is located within ISO shipping containers[1], and the compressors and buffer vessels are located within chambers in another container. The container walls would prevent the effects of a jet fire or flash fire reaching beyond the container walls, but this was not accounted for in the modelling.

[1] An ISO container is any type of shipping container which is designed, manufactured, tested and certified to the standards of the International Standards Organisation (ISO) in terms of size, strength and durability.

- The consequences do not consider the availability of any engineered safeguards (pressure relief valves (PRV), isolations, shutdowns) or fire and/or blast protection in the HRS design.
- The scenarios for the interconnecting piping between equipment were excluded from the consequence modelling because piping volume is less than the minimum volume that can be modelled in the software (the low error limit), due to the small piping size and length. Releases from the piping transporting hydrogen to the Ballance facility and to the loadout facility was modelled in the QRA however, due to the larger piping diameter and length.

4.4.2 CONSEQUENCE ASSESSMENT FINDINGS & NEXT STEPS

References 3 and 5 presents the detailed results of the consequence assessment. An overview of the worst-case estimated consequences are;

- Flash fires are predicted to last seconds for all scenarios.
- Jet fires from an electrolyser or buffer vessels is predicted to last seconds. Although the containers were not modelled, it is assumed the container walls would not be compromised in this timeframe. Therefore, the range of the jet fire and flash fires scenarios for the buffer vessels and electrolysers would be limited to the container itself, with no impact outside of the containers.
- A jet fire from an MEGC is predicted to last less than three minutes.

Due to its short-lived nature, a flash fire is not expected to cause an escalation impact on other equipment and structures. Jet fires are directional and leaks would need to be directed towards a sensitive receptor for escalation to occur. The site layout has been designed so that, as far as possible, a leak would be directed away from other equipment, assuming the leak was from a valve or connection point.

The vent stack will be approximately 6m in height with a release directed vertically. The vent opening will be at atmospheric pressure so there would be a drop in pressure before hydrogen reaches the vent outlet. The vent stack will be in open space and not located under any structures such as buildings, canopies or near any building air intakes. It is expected there will not be any significant incidents from normal or emergency venting and therefore would not have a bearing on overall risk assessment results and conclusions.

The credible failure scenario for an MEGC cylinder is a leak through the valve or connecting manifold pipework. Catastrophic failure of a cylinder is considered non-credible due to:

- Cylinders are made of glass fibre reinforced composites and are approved for "infinite lifetime" according to EN 12245:2009
- The design parameters of the cylinders (the pressure of hydrogen within the cylinders is less than half of what the cylinders are designed to contain).
- Stringent fire, fatigue, stress rupture, burst, impact and proof tests of cylinders as part of the certification process
- Non-corrosive properties of cylinder material
- Excellent fatigue properties (designed according to "leak before burst" principle through connections)
- Wide temperature tolerances (-40/+65 C) under normal conditions
- Low conductivity of external heat through the cylinder due to cylinder material (composite glass fibre) and wall thickness.

Despite the points above, catastrophic failure of a cylinder and large leak holes from a cylinder wall were modelled for completeness with results presented in Reference 5.

4.5 QUANTITATIVE RISK ASSESSMENT (QRA)

The purpose of the QRA is to further assess results from consequence assessment to quantify the risk to people.

4.5.1 QRA METHODOLOGY

The QRA report for Kapuni (Ref. 5) presents the methodology in detail, however this section presents a high-level summary of the methodology.

A frequency of failure analysis for the equipment was completed to give an estimated overall likelihood of an event. Frequency of failure for each isolatable section of the equipment was estimated by doing a parts count of components and applying failure frequency data for equipment and piping, using HyRAM criteria (Ref. 6). Assumptions about the operating condition of equipment was applied i.e. electrolysers operating for 80% of the time. The frequency analysis resulted in an estimated overall likelihood of event.

DNV Safeti v8.2.3 software used the output of the frequency analysis and consequence assessment to produce the QRA risk results in the form of risk contours indicating the overall risk to people.

As there is no standard risk criteria developed for the New Zealand context, the individual risk was assessed against suggested risk criteria in the HIPAP4 "Risk Criteria for Land Use Planning" (Ref. 4), as shown in Table 2 below.

TABLE 2: HIPAP 4 RISK CRITERIA

Land Use	Risk Criteria (per annum)	Risk Contour	Interpretation for QRA
Industrial	5E-05 (1 in 20,000)	Red	5E-05/year risk contour should, as a target, be contained within the boundaries of the industrial site where applicable.
Sporting complexes and active open space	1E-05 (1 in 100,000)	Orange	1E-05/year risk contour should not extend to these areas.
Commercial developments including offices, retail centres, and entertainment centres	5E-06 (1 in 200,000)	Yellow	5E-06/year risk contour should not extend to these areas.
Residential, hotels, motels and tourist resorts	1E-06 (1 in 1 million)	Green	1E-06/year risk contour should not extend to these areas.
Hospitals, schools, childcare facilities and old age housing	5E-07 (1 in 2 million)	Blue	5E-07/year risk contour should not extend to these areas.

4.5.2 QRA FINDINGS & NEXT STEPS

Reference 6 presents the detailed results and risk contours of the Kapuni QRA. This section summarises the findings in that report.

The QRA risk contours have been overlaid onto the site location and are presented in Figure 11 below.

FIGURE 11: KAPUNI QRA RESULTS

Table 3 below presents observations for each of the contours for the site.

TABLE 3: COMPARISON WITH HIPAP 4 CRITERIA

LSIR Criteria (per annum)	Risk Contour	Risk Criteria	QRA output comparison
5E-05/year	Red	5E-05/year risk contour should, as a target, be contained within the boundaries of the industrial site where applicable.	5E-05 per year contour extends to the bushes near Palmer Road but remains within the boundary of the Ballance site. Hence, this criterion is met.
1E-05/year	Orange	1E-05/year risk contour should not extend to sporting complexes and active open space areas.	This criterion is met as there are no sporting complexes and active open areas within the proximity.
5E-06/year	Yellow	5E-06/year risk contour should not extend to commercial developments including offices, retail centres, and entertainment centres.	This criterion is met as there are no commercial developments within the proximity.
1E-06/year	Green	1E-06/year risk contour should not extend to residential, hotels, motels and tourist resorts.	This criterion is met as there are no residentials within the proximity.
5E-07/year	Blue	5E-07/year risk contour should not extend to hospitals, schools, childcare facilities and old age housing.	This criterion is met as there are no hospitals, schools, childcare facilities and old age housing within the proximity.

Risk contours at the selected location for the loadout facility at Kapuni do not extend into land use areas detailed in

Table 2 and the red contour is contained within the site boundary. Therefore, the HIPAP4 criteria is met and level of risk to the people is considered acceptable at the Kapuni site.

4.6 TRANSPORTATION OF HYDROGEN

MEGC's will be filled with hydrogen at the loadout facility and transported to other refuelling stations in the network (as part of the Refuelling Infrastructure Project). The risks associated with the MEGCs onsite have been included in the safety studies detailed in Sections 4.2 to 4.5 of this document.

A traffic impact assessment is being undertaken to support the resource consent application which assesses the access and egress from the proposed hydrogen facilities at the Ballance Plant to ensure safety for vehicles using the site. This will include mapping of tracking curves and impact of expected additional vehicles on the public road.

While transporting hydrogen, the MEGCs will be compliant with the Transport of Dangerous Goods legislation, as well as any further legislative requirements.

The hydrogen fuel-cell vehicles which will be refuelled with hydrogen will be EC79 compliant and will be risk assessed separately, with involvement from the vehicle manufacturers.

4.7 CUMULATIVE EFFECTS

The potential cumulative effects from an incident from Ballance's plant on the new equipment proposed for this Project was assessed during the HAZID, and vice versa. Due to the separation distance, an incident at the electrolyser or the loadout facility is not expected to have a serious impact or cause an incident on Ballance plant. The emergency response procedures will be initiated and the Ballance plant will respond to this by implementing their shutdown procedures and making the site safe.

Ballance have undertaken a cumulative risk effects assessment as part of their safety case. The findings of the HAZID were that an incident at Ballance should not spread to, or cause an incident with, the equipment for this Project due to separation distances and emergency shutdown processes. These findings will be incorporated into the safety case if required.

The Operative South Taranaki District Plan has been reviewed to understand the cumulative effects for the Todd Energy facilities located across the road from the loadout facility. Special Map 03 in the district plan shows that the Petroleum Activity Risk Contour does not extend into the area of the new facilities proposed for this Project. Likewise, the red QRA contours presented in Section 4.5.2 above do not extend beyond the site boundary and therefore it is not expected that an incident associated with the proposed hydrogen facilities would have any effect on Todd Energy or vice versa.

The containerised solution for the equipment provides passive protection from an external event at Ballance or a neighbouring facility.

4.8 SITE LAYOUT DESIGN

The findings of the safety studies informed the final site layout which has been optimised to reduce risk while maintaining operational efficiency.

The loadout facility will be unmanned and the hydrogen compression and storage equipment contained within a secure compound, with access only to authorised personnel for service and maintenance, or to refill/drop-off an MEGC. The dispenser will be accessible by the public, however access to hydrogen is restricted in a few ways:

- Only hydrogen fuel-cell vehicles are compatible with the refuelling nozzle. The nozzle will not connect to any other vehicle, accidentally or forcefully.
- Hydrogen will be sold using a fuel card system, available only to companies who have a contract for purchasing hydrogen fuel.
- Hydrogen will only be released once a positive connection is made with the vehicle refuelling receptacle, and the system activated using the fuel card system.
- The volume of hydrogen contained within the refuelling assembly is limited to the buffer vessel within the dispenser (10L), and not by the storage onsite. Therefore, a release from the dispenser due to an external event e.g. vehicle impact or vandalism is minimised.

As a result of the risk assessment process, the loadout facility will be setback off the road sufficiently such that the risk is contained to within the site boundary.

The piping leading from the electrolyser containers to the Ballance plant will be above-ground and will join existing hydrogen pipelines. This does not pose any additional site hazards for that area. The piping will be secured to existing pipe-runs and protected from impact from site activities.

The piping to the loadout facility will be buried underneath a paddock used for irrigation of Ballance waste water. This section of piping was not modelled for a release, however a release at either end of the piping where it rises above-ground was modelled. If there were a release from the buried piping it is predicted that any release would lose its momentum before it reaches the surface and readily disperse into the atmosphere. The electrolyser would be shutdown in the event of a release from the piping (buried or at above-ground sections at either end), limiting the inventory release further.

Hazardous area zones will be established around the equipment to ensure only appropriately rated electrical equipment is installed in these zones.

4.9 ENVIRONMENTAL EFFECTS

Hydrogen gas is non-toxic and has almost no impact on the atmosphere and is not considered to have short or long-term effects on the environment. A by-product of hydrogen production via water electrolysis is oxygen, this will be released to atmosphere with no negative effects on the environment.

In the event of a hydrogen fire or explosion, the impact on the environment would be localised to the area around equipment including paddock grass and nearby shrubbery. Any impact damage would be short-term, with the environment expected to recover quickly.

There are no significant areas of indigenous vegetation or habitats of indigenous fauna around or near where the project equipment is sited. The nearest waterbody would be unaffected by a fire or explosion event. There are no sites of significance to Tāngata Whenua or sites of historical or archaeological significance near enough to the project location to be impacted by an incident.

4.10 NATURAL HAZARDS

As part of the risk assessment, external hazards were assessed, including risks from natural disasters and severe weather events to determine the consequences and how response is managed.

- Earthquake - New Zealand is a high earthquake hazard region and earthquake considerations are integral to the design of any system or building. Seismic design requirements have been incorporated into the plant designs with all vendors. The equipment is constantly monitored for pressure and temperature, if either of these were affected by an earthquake, the equipment would automatically shut down to make the system safe. If appropriate, the system would be vented, although shutdown and containment would be the primary response.

- Volcanic eruption - A volcanic eruption of Mt. Taranaki has been assessed as a moderate-very high hazard for the Taranaki region. A literature review has been undertaken to understand the likelihood of an eruption and the anticipated consequences. The findings are:
    - 50/50 chance of eruption within the next 23 years
    - 3% chance annually
    - 81% of at least one eruption by 2065

  It is expected that Mt. Taranaki will demonstrate unrest in the days, weeks and possibly months before an eruption starts, allowing sufficient time to shutdown systems and vent (if appropriate) to make the system safe.
- Tornados – Taranaki is a high-risk area for tornadoes, accounting for 12% of the national total, of that, 70% of the regions' tornadoes occur in or near New Plymouth city. On average, one damaging tornado will occur somewhere in the region every year and a severe tornado occurs about once in every four years. The MetService issues a severe weather warning when widespread gales are expected over a 1000 km2 area, with a severe-weather watch generated if these conditions are expected to occur in a 24–72 hour period.

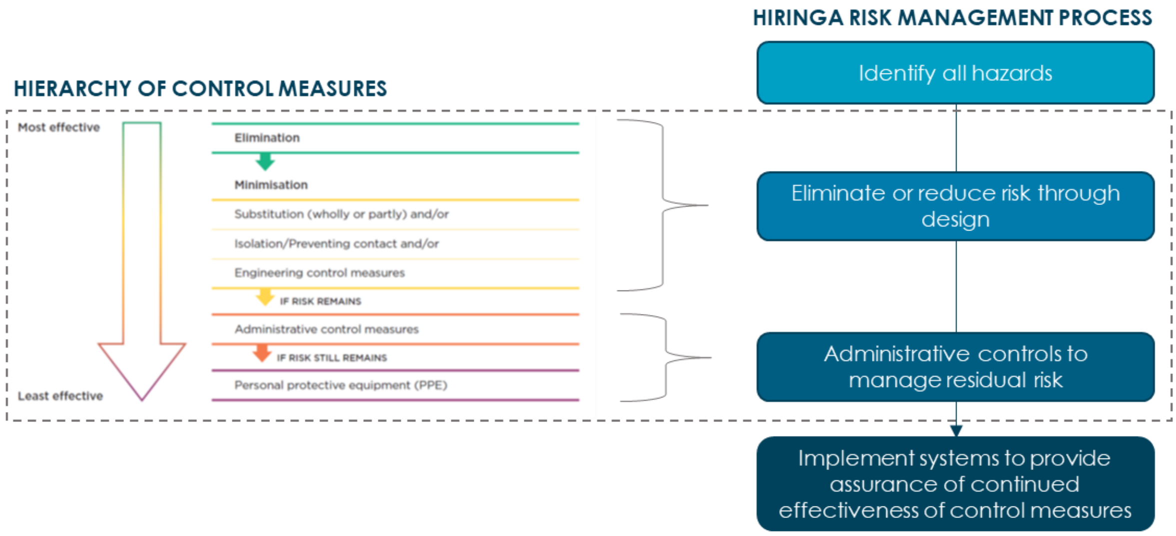
  These weather warnings would provide sufficient time to shutdown systems and vent if necessary. Loss of power (as a result of tornado damage) would result in automatic shutdown of equipment. Given the containerised housing of the key equipment, significant damage from debris caught in high winds or a tornado is expected to be limited.

In the case of a natural disaster, site personnel will be advised to seek shelter, or if safe to do, will be permitted to leave work early. A communication plan for emergency response will be developed as the project moves into the operational phase. This will include what sources site personnel will be advised to monitor to establish if external conditions are safe e.g. police, local authority, civil defence.

4.11 RISK ASSESSMENT FINDINGS SUMMARY

The above sections present the process undertaken to identify and reduce risks to ALARP during the design phase of the project, aligning with WorkSafe's approach of using the hierarchy of control measures (Figure 12).

FIGURE 12: RISK MANAGEMENT PROCESS



Using the Hiringa Risk Assessment Matrix presented in Appendix 1, risks from hazards were scored with and without safeguards in place to give an unmitigated and mitigated risk score. Taking account of all safeguards identified through the risk management process, the mitigated risk is considered ALARP, with residual risk managed through operational safeguards such as administrative controls which are described further in Section 5.

This risk assessment report and supporting reports listed in the references section (Section 6) demonstrate a thorough process has been undertaken to identify and manage the risks associated with this project and can satisfy the risk assessment information and assessment requirements under Section 20 in the South Taranaki District Plan.

5 OPERATIONAL RISK MANAGEMENT

The electrolyser and associated hydrogen production and metering equipment will be owned by the joint venture. Hiringa will be the system operator on behalf of the JV and will be responsible for day-to-day operations of the plant including production management and administering maintenance contracts on the works. Ballance will provide day-to-day on-site support in terms of periodic system checks and monitoring.

5.1 EMERGENCY RESPONSE

The preparation, issue, control, and regular review of emergency response documentation and associated training is an imperative part of any risk management system in order to maintain readiness for an emergency situation.

Hiringa has identified potential incidents during the risk management process detailed in Section 4, emergency response and action required for these will be planned for in emergency response procedures. These will be integrated with the Ballance emergency response procedures to ensure personnel understand how to respond to an incident on both sites in the event of an incident.

5.1.1 EMERGENCY SHUTDOWN

In the event of a hydrogen release or site emergency, the electrolyser and refuelling station equipment will automatically shutdown after detection of gas or activation of emergency stops. The Supervisory Control And Data Acquisition (SCADA) system will notify the operations team to the site condition and the emergency response arrangements will be activated.

5.1.2 EMERGENCY RESPONSE PLAN

The Emergency Response Plan (ERP) for this project will be incorporated with the existing Ballance Plant ERP. The ERP will include details of hazardous substances on site, instructions on what to do in an emergency situation, communication for emergency response assistance and a list of contact numbers.

A key part of an ERP is action by the local emergency services to assist in responding to an incident. Ballance already have a relationship with the local fire service, they will be informed of the new equipment (including detials of volume and pressures) and its location onsite.

Ballance emergency response drills are held periodically, JV personnel will be involved in these to ensure they know how to respond to a Ballance incident, and likewise Ballance personnel can respond to a JV incident. Emergency response drills will involve Ballance, Hiringa and contractors/service providers as necessary, and where possible, local emergency services.

Balance has a four-level system for emergencies depending on severity and extent of response required, Level 1 is 'minor emergency' and Level 4 is 'crisis emergency'. For any event considered level 2 or above, a bulk messaging service is activated to notify neighbours and neighbouring businesses by text message. The message would provide details of the incident and what measures they must take to ensure their safety.

5.1.3 MUTUAL AID AGREEMENT

Ballance have a mutual aid arrangement in place with the neighbouring facilities owned and operated by Todd Energy. This arrangement allows the three sites to share resources, including people, during an incident. For emergency response, the JV project will be considered to be part of, and contribute to, Ballance response.

Each control room at the different sites have a dedicated landline phone to communicate between sites during an emergency. In addition to regular information sharing and coordination meetings between the sites, the mutual aid arrangement allows for collective testing of emergency response, including an annual inter-plant major incident exercise. If an emergency is in progress, the neighbouring sites can take the appropriate measures to protect their plant, and provide aid to the site experiencing the emergency, where possible.

5.2 TRAINING & COMPETENCY

Operations of the JV hydrogen equipment will require suitably qualified and competent personnel. Hiringa will ensure that appropriate training will be developed or resourced for personnel, with assistance from equipment vendors to ensure all training requirements are identified. The type of training will depend on a number of factors, including:

- Their role and responsibilities;
- Their occupation e.g. maintenance technician;
- The type of tools required for that occupation; and
- The hazards associated with that occupation

Hiringa's approach to training is outlined in the Hiringa Health, Safety, Environment and Quality (HSEQ) Manual which details how training is recorded and completed. The training records demonstrate that staff are competent to perform their work tasks in accordance with approved procedures and practices, with regular re-assessments carried out to ensure ongoing competence. The records can also be used to identify the need for additional or refresher training where required.

Where required, work will be contracted out to a specialist third party who will provide the necessary evidence to support their competence and qualifications.

5.3 OPERATIONS FRAMEWORK

Once the JV equipment is operational, residual risks will be managed via administrative controls such as procedures, permits and reporting. The final line of defence will be use of appropriate PPE.

5.3.1 PROCEDURES

An operations framework is in development to ensure the appropriate documentation, planning and procedures are in place to safely undertake commissioning and operations activities. The operations framework;

- Describes the activities that are to be carried out and the associated documentation required to demonstrate that commissioning of the station is complete.
- Defines the roles and responsibilities.
- Defines the handover process from the commissioning team to operations.

- Describes the activities that are to be carried out for operating the station.
- Presents the templates and checklists to be used for commissioning and operations.

An operations manual will be developed using the process outlined in the operations framework. The operations manual will detail the safe operating procedures for each activity.

Safe operating procedures are written instructions which ensure that tasks can be carried out correctly and safely. A comprehensive suite of safe operating procedures are being developed for the refuelling stations. Where procedures require to be developed by a third party, Hiringa will have overall responsibility for ensuring the procedures are in place and up to date. These procedures will be developed for tasks such as;

- Lock out/tag out
- Inspection, maintenance and testing
- Hydrogen transportation
- Refuelling protocol
- Working at height
- Manual handling
- Electrical work

Additional activities that are identified as the project progress will have procedures developed as required. All procedures will be developed through consultation with equipment suppliers, legislation and other industry recognised good practice.

The safe operating procedures will include:

- Steps for each operating phase, such as; start-up, normal operation, normal shutdown, emergency shutdown, returning to operations after service;
- Operating limits;
- Safety considerations, such as precautions to be taken to prevent exposure and measures to be taken if physical contact or airborne exposure occurs; and
- Safety systems and their functions.

5.3.2 ASSET MANAGEMENT

An asset management system is currently under development and will be functional prior to the commencement of operations (with assurance provided as part of the operational readiness assurance review). The asset management system will set out the activities required to manage the assets and asset systems, their associated performance, the risks and the expenditures over their lifecycle.

6 REFERENCES

1. Kapuni HAZID Report, Rev 0, January 2021
2. Plug Power design HAZOP Results, November 2020
3. Hydrogen Refuelling Station Generic Consequence Assessment, 503958-RPT-R0002, January 2021
4. New South Wales Hazardous Industry Planning Advisory Paper No. 4 (HIPAP4)
5. Kapuni Green Hydrogen Project QRA report, 503958-RPT-R0005, April 2021
6. Hydrogen Risk Assessment Model (HyRAM) 3.0, Sandia National Laboratories
7. H2-GENO-L560-01-Q1 Haskel HAZOP Study Report, Rev. 00, February 2021.
8. Kapuni Green Hydrogen Tie-in HAZOP Report, April 2021.

APPENDIX 1 – HIRINGA RISK ASSESSMENT MATRIX

								Likelihood				
								Highly unlikely to occur during lifetime. Never heard of in gas industry	Unlikely but possible to occur. Heard of in gas industry	Could occur at a Hiringa site. Happened more than once in gas industry	Will probably occur at a Hiringa site. Happened several times at a comparable installation	Expected to occur at a Hiringa site. Incident has occurred several times per year in a comparable installation
								Less than once every 1000 yrs	Occurs once every 100 yrs	Occurs once every 10 to 100 yrs	Occurs once every 1 to 10 yrs	Occurs one or more times per year
	People	Environment	Financial – OPEX / CAPEX	Financial – Project Schedule	Reputation			Rare	Unlikely	Possible	Likely	Frequent
								A	B	C	D	E
Consequence Severity	Minimal / no impact on H&S	No/negligible effect on environment	Minor financial impact – capable of recovery. <$100k loss CAPEX or <$10k/year OPEX	No/negligible impact on schedule <1 month	No media coverage - Issue not of concern to stakeholders	Slight	1					
	Minor injury requiring first aid treatment only	Minor local effect – short term (recovery <5 years)	Moderate financial impact– capable of recovery. $100k-$1m CAPEX or $10k-$100k/year OPEX	Moderate delays. 1-3 months	No media coverage but stakeholders alerted	Minor	2					
	Illness or injury requiring hospital treatment	Localised effects to habitat/wildlife - recovery <10 years	Significant financial impact – difficult to recover. $1m-$5m CAPEX or $100k-$0.5m/year OPEX	Significant delays. 3-6 months	Legislative enquiry/briefing. Issue of concern to stakeholders – local reputational damage	Moderate	3					
	Life-threatening injury /permanent disability	Major off-site impact or long-term severe effects	Major financial impact – unlikely to recover. >$5m CAPEX or $0.5m- 1m/year OPEX	Major delays. >6 months	**At fault/unresolved complexities; ministerial involvement. Issue of significant concern to stakeholders – national reputational damage**	Major	4					
	Fatalities	Effects widespread, Permanent major effects	Recovery not possible – loss of business	Non-achievement of project objective	International exposure, Loss of Hiringa's credibility, irreversible damage to reputation and hydrogen industry	Catastrophic	5					

Key	
Risk Rank	**Required Action**
High	Measures to reduce the consequence or likelihood must be identified and implemented immediately to reduce risk to medium or lower.
Medium	Reduce the risk where possible and where this is not possible, measures to manage residual risk should be identified and implemented to demonstrate hazard is being managed to ALARP.
Low	Risks monitored and reviewed if changes could affect risk classification