APPLICATION FOR AN ENVIRONMENTAL PERMIT VARIATION UNDER THE ENVIRONMENTAL PERMITTING (ENGLAND AND WALES) REGULATIONS 2016 (AS AMENDED)

NON TECHNICAL SUMMARY

PLOT 1C,
WILTON INDUSTRIAL ESTATE,
REDCAR,
TS10 4RF

MorGen Ref: 006-HS-REP-00002
MorGen Rev: D02
ECL Ref: H2EE.02.01/NTS
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TABLE OF CONTENTS

TABLE OF CONTENTS (cont.)

LIST OF FIGURES

ACRONYMS/TERMS USED IN THE TEXT

BAT	**Best Available Techniques**
BRef	**Best Available Techniques Reference Document**
DAA	**Directly Associated Activities**
Demin	**Demineralised water**
EA	**The Environment Agency**
ECL	**Environmental Compliance Limited**
EMS	**Environmental Management System**
EP Regulations	**Environmental Permitting (England and Wales) Regulations 2016 as amended**
EP	**Environmental Permit**
H_2	**Hydrogen**
Ha	**Hectare**
IED	**Industrial Emissions Directive**
MCERTs	**Environment Agency's Monitoring Certification Scheme**
MorGen	**MorGen Energy UK Limited**
NGR	**National Grid Reference**
O_2	**Oxygen**
LDAR	**Leak Detection And Repair**
PEM	**Proton Exchange Membrane**
PMP	**Planned Maintenance Plan**
The Installation	**MorGen Energy H_2 Plant**
UKAS	**United Kingdom Accreditation Service**

1. INTRODUCTION

1.1. Overview

1.1.1. Environmental Compliance Limited ("ECL") have been commissioned by MorGen Energy UK Limited ("MorGen") to prepare an Environmental Permit ("EP") application in relation to proposed Hydrogen ("H_2") Plant, hereafter referred to as "the Installation", located at Plot 1 C, the Wilton Industrial Estate, Redcar, TS10 4RF.

1.1.2. This permit application is for a 60 MW electrolytic hydrogen (H_2) plant of 1,080 kg H_2/h of nominal capacity. The H_2 plant would therefore comprise a listed activity under Section 4.2 Part A(1), sub paragraph (a)(i) *"Producing inorganic chemicals such as gases (for example….hydrogen)"*.

1.2. Installation Location

1.2.1. The Installation is located approximately 3km southwest of Redcar at Wilton Industrial Estate and is centred on national grid reference ("NGR") 457430 520790 covering an area of 3 hectares ("Ha") (see Figure 1). The approximate site area is shown in red on Figure 1

1.2.2. The H_2 plant will be constructed on an area of cleared grassland, bordered by a mix of overgrown scrub hedges and bushes.

1.2.3. Detailed drawings may be found in Section 3 of the EP application submission.

Figure 1: Indicative H_2 Plant Location

1.3. The Applicant

1.3.1. MorGen are developers of large-scale green hydrogen ecosystems. Founded in 2021 in Switzerland, MorGen delivers projects from conception to construction, and from production to delivery.

1.3.2. MorGen builds and operates the infrastructure needed to establish green hydrogen as a future core energy source, evolving the energy system to become more sustainable and resilient.

1.3.3. MorGen Energy was incorporated in 2025 under company number 16542901.

1.4. Pre-Application Advice

1.4.1. Basic pre-application advice has been sought from the Environment Agency (“EA”) , a copy of the Nature and Heritage Screening Assessment may be found within this application.

1.5. Approach to Application

1.5.1. Given the evolving nature of green hydrogen production, this application has been prepared in accordance with the following:

- the guidance followed is the EA’s Guidance on Hydrogen production by electrolysis of water;
- there is no requirement for continuous emissions monitoring systems on the emissions to air;
- as hydrogen and oxygen are not listed within the H1 guidance tool, emissions of both screen out and no further assessment is required.

2. LISTED ACTIVITIES

2.1. Installation

2.1.1. The proposed Schedule 1 Activity under the EP Regulations is S4.2 A(1)(a)(i) – the production of hydrogen gas, hereinafter referred to as "the H_2 Plant".

2.1.2. A 60MW H_2 generation plant will be installed within an area of approximately 3 hectares. The H_2 Plant will be able to generate a maximum of 1,080 kg of H_2 per hour (25.9 tonnes per day).

2.2. Directly Associated Activities

2.2.1. There are no directly associated activities ("DAAs").

3. MANAGEMENT TECHNIQUES

3.1. Management Structure

3.1.1. A specific Environment Management System ("EMS") will be developed and integrated with the broader Health, Safety and Environmental management system. This will include an organization chart and specific roles and responsibilities for each of the local operations stakeholder.

3.1.2. The Installation's Operations Manager will have overall responsibility for operational and technical aspects of the Installation, including Environmental matters.

3.2. Management System Overview

3.2.1. MorGen will operate a management system which is appropriate to the Installation and its operations and complies with the EA's Online Guidance "Develop a management system: environmental permits[1]. The management system will follow a plan, do check, act approach.

3.2.2. Senior management are committed to high standards of protection for people and the environment which is further defined in company policies and procedures.

[1] https://www.gov.uk/guidance/develop-a-management-system-environmental-permits

4. OPERATING TECHNIQUES

4.1. Technical Standards

4.1.1. The production of H_2 by electrolysis of water is an emerging technique. Consequently, this activity is outside the scope of existing established guidance. The EA's online guidance for *"Hydrogen production by electrolysis of water: emerging techniques"* has been used to inform this application. The techniques described in the EA online guidance and an assessment of compliance with the relevant techniques is provided in Section 5 of this report.

4.1.2. There are no existing best available techniques ("BAT") reference documents ("BREFs") or guidance that specifically covers the production of H_2 from water by electrolysis. Consequently, Article 14(6) of the Industrial Emissions Directive ("IED") has been considered.

4.2. Process Description

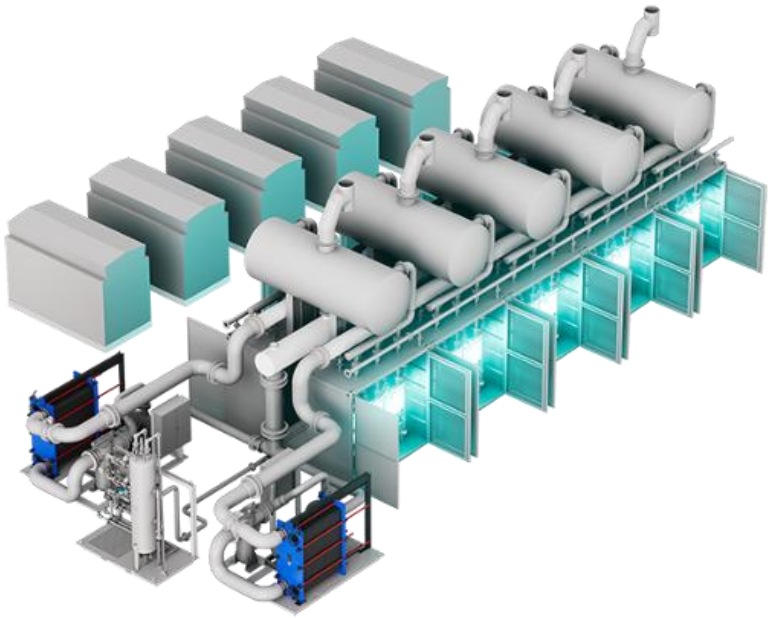
4.2.1. It is proposed to add a listed activity, namely Section 4.2 A(1) (a) (i), the production of H_2 via the electrolysis of water, to the Installation's activities ("the H_2 Plant").

4.2.2. The H_2 Plant will be controlled and operated from the local control room.

4.2.3. Electrolysis – Proton Exchange Membrane ("PEM") - will be used to generate the H_2 gas. The main inputs to the process are water and electricity, to split water into its constituent parts.

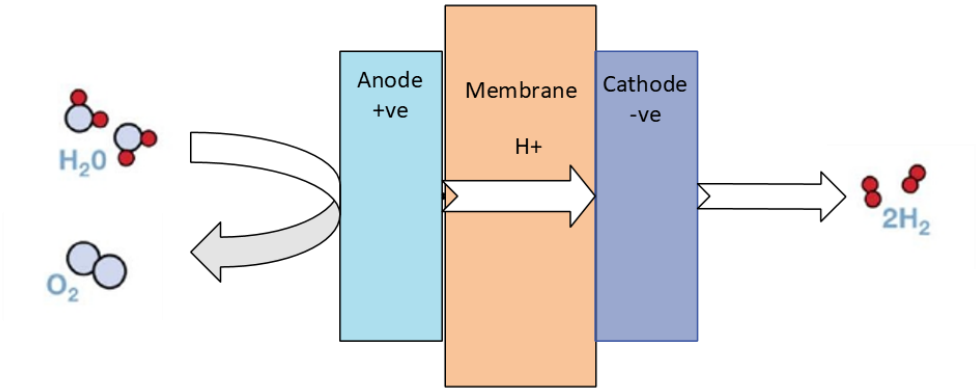
4.2.4. The individual electrolysis units have an input power of 20MW, therefore, there will be 3 units. Figure 2 shows an example of the electrolysis unit to be used. There are 30 stacks per unit, with an output of 0.667MW each – 20MW in total.

Figure 2: Example Electrolysis Unit



4.2.5. PEM electrolysis splits water into H_2 and O_2. The H^+ ions and some water are passed through a membrane where H^+ ions combine to form H_2 on the cathode side, leaving O_2 and excess water on the anode side. The membrane conducts the H^+ ions and therefore separates H_2 and O_2. A simplified model of the process is provided in Figure 3.

Figure 3: Simplified Electrolysis



4.2.6. Demineralised ("Demin") water supplied by Sembcorp will be further treated to achieve the required ultra-pure water quality for the PEM electrolysis units..

4.2.7. One gas treatment unit with deoxygenation and dehydration is located east of the electrolyser units and is used to dry the produced hydrogen and to remove remaining oxygen from the hydrogen product stream.

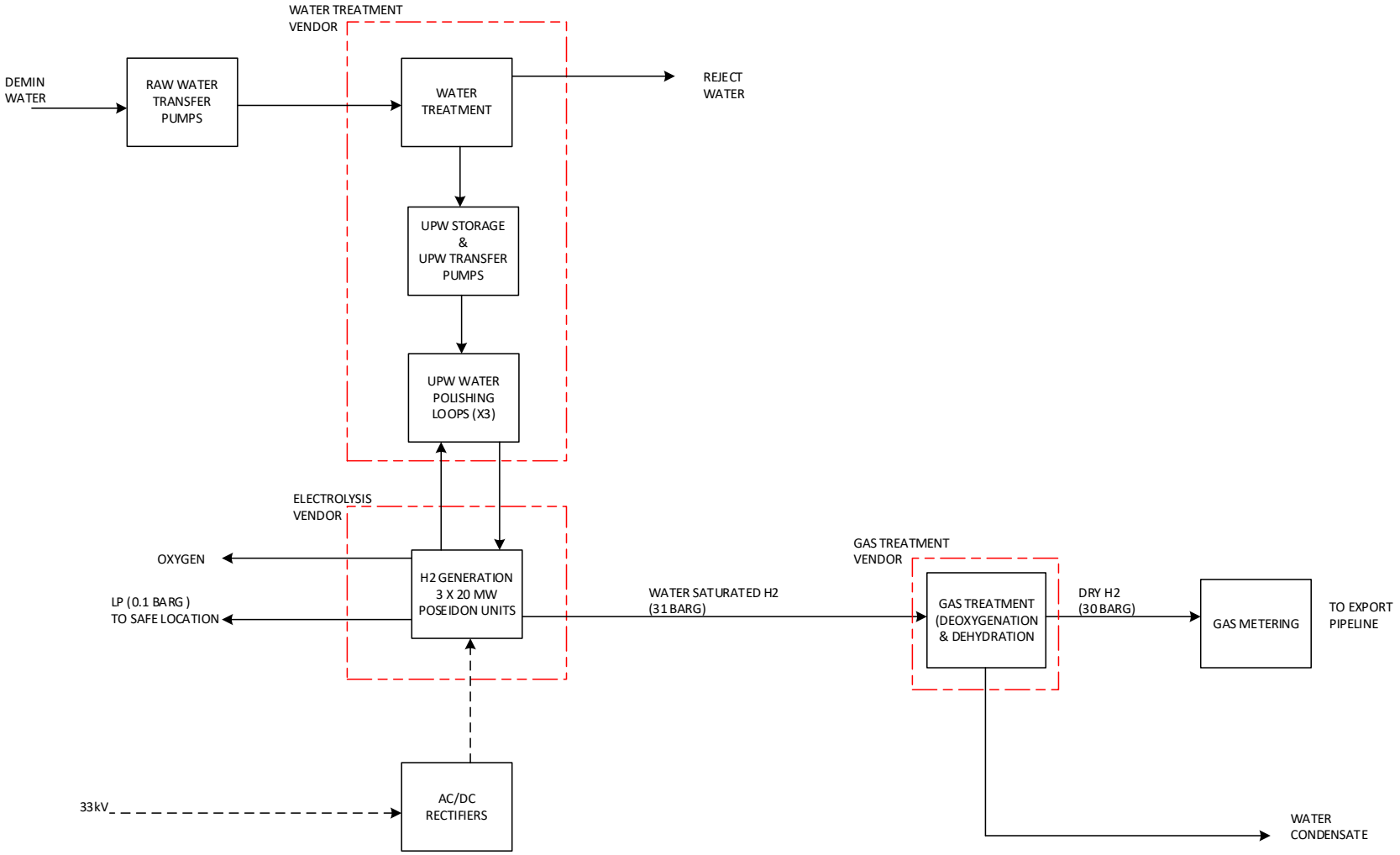
4.2.8. Air cooling units, located to the west of the electrolyser units, are used to disperse excess heat from the process.

4.2.9. A dedicated pipeline will be used to transport H_2 to local users in the wider Wilton area.

4.2.10. During the H_2 Plant's operation, it will vent approximately 52,000 tonnes per annum of oxygen as a by-product.

4.2.11. A block diagram is provided as Figure 4.

Figure 4: Block Diagram



5. Emerging Techniques: Hydrogen Production

5.1. Technique Selection

5.1.1. When designing the H_2 Plant, the overall environmental performance of the H_2 Plant was considered which includes:

- energy demand and efficiency;
- water demand, efficiency and evaluation for re-use; and
- emissions to the environment.

5.1.2. The H_2 Plant will use PEM technology. An assessment of the three main technologies – Alkaline Electrolysis, PEM and Solid Oxide Electrolyser Cell - has been undertaken. As there is currently no BREF for this sector, the EA's guidance note on the Review of Emerging Techniques for Hydrogen Production from the Electrolysis of Water[2] has been used to inform the assessment.

5.1.3. In summary, PEM technology offers several advantages, including low operational temperatures and rapid response times allowing it to be used on demand when needed. Solid oxide electrolyser cell technology is not considered to be a sufficiently mature technology to be used. Whilst alkaline electrolysis is well established, the chemicals used (potassium hydroxide) carry a significant environmental risk compared to water.

5.1.4. It should also be noted that PEM also has a high efficiency and compatibility with renewable energy sources (thus future proofing the system should renewable energy such as wind and/or solar be considered in the future).

5.2. Plant Design and Operation

Operation

5.2.1. Due to variability in the grid and the cost of electricity supply, the H_2 Plant is designed to operate in a flexible manner. It is designed to operate when electricity is at the most cost effective price, and therefore it can react to power fluctuations within less than 5min.

Reliability and Availability

5.2.2. The Installation operates a preventative maintenance programme to identify and maintain items of monitoring and measurement equipment required for environmental, quality and safety reasons. The relevant procedures will be updated to identify equipment, systems, and operating and maintenance techniques to avoid emissions and minimise environmental impact.

5.2.3. Monitoring of power and H_2 is undertaken, together with daily inspections of the H_2 Plant as a whole to ensure that it is operating correctly.

[2] https://assets.publishing.service.gov.uk/media/65fb0d06703c42001158f0c9/Review-of-emerging-techniques-for-production-of-hydrogen-by-electrolysis-of-water.pdf

Hydrogen Venting versus Flaring

5.2.4. It is proposed to utilise venting for the release of hydrogen in connection with depressurisation and purging and continuous venting of unrecoverable low-pressure hydrogen. A small amount of low pressure hydrogen will be released during normal operation. The venting of H_2 is a well proven, simple, and reliable method for H_2 gas removal.

5.2.5. A flare system will involve maintaining a pilot flame, ignition, flame monitoring system and purge systems. Consequently, flaring is not considered the optimum technology choice outside of large facilities which have the infrastructure to support flare operations.

5.2.6. With due consideration to the amounts of hydrogen released in different scenarios, and the relative complexity involved in a flare system design, it has been decided to utilise venting as opposed to flaring for the Teesside Green Hydrogen project.

Energy Efficiency, Process Efficiency and Cooling

5.2.7. Maximising the life of the equipment and components, particularly rare global resources is critical to maximising the production of H_2. The electrolyser has an expected design life of 20 to 30 years with the individual stacks being replaced every 7-10 years.

5.2.8. Various controls are in place to minimise the use of raw materials.

Water Supply and Use

5.2.9. The water used in the process is Demin water (i.e. not potable) and will be obtained from Sembcorp. The Demin water will be treated within the water treatment plant to be suitable for use in the electrolysis process.

5.2.10. There are no point source emissions to air from the water treatment process. Waste heat is not used for any cooling methods.

Electricity Supply

5.2.11. Electricity will be supplied from Sembcorp's private network.

5.2.12. An emergency power system in the form of a diesel-powered generator will be installed to ensure power supply to critical components (security systems and lighting) during any grid outages.

Hydrogen Purification

5.2.13. H_2 purification will be to achieve high purity and recovery of hydrogen.

5.3. Raw Materials

5.3.1. For the H_2 Plant, the following raw materials will be required:

- demin water for electrolysis;
- potable water for safety shower and domestic use
- deoxo catalyst for oxygenation of hydrogen gas
- ethylene glycol for antifreeze
- ionic resin for further water treatment;
- activated alumina for H_2 gas refinement;
- diesel for the backup generator;
- transformer oil; and
- other maintenance fluids are used in very limited quantities such as lubricants,
- cleaners, paints and gasses.

5.3.2. All potentially polluting substances are bunded and stored on impermeable hardstanding.

5.4. Emission to Air

5.4.1. Emissions of H_2Plant have been minimised, the H_2 Plant uses state of the art electrolyser technology with a proven track record.

Other Emissions

5.4.2. Waste O_2 is vented to air from the process This is located at a suitable distance from the vent of H_2 to minimise fire and explosion risk.

5.4.3. The operation of the H_2 plant does not give rise to any odour emissions.

5.4.4. It should be noted that nitrogen is also occasionally used to purge the system. The operations of the H_2 plant do~~es~~ not give rise to any odour emissions.

5.5. Emissions to Water

5.5.1. Wastewater is minimised as parts of the less concentrated water is collected and recirculated to be reused. Any remaining water is discharged through Sembcorp's combined drainage system for the wider Wilton site. A H1 assessment of emissions to the combined drainage system and the ultimate discharge point has been undertaken and confirmed that emissions are not significant.

5.6. Emissions to Ground and Groundwater

5.6.1. There will be no emissions to ground nor groundwater. Fugitive releases will be prevented by conducting all operations in areas sealed with an impervious barrier to prevent a pathway for migration to ground or groundwater.

5.7. Waste

5.7.1. Small quantities of waste will be generated and will consist of empty chemical packaging, waste from maintenance tasks and general commercial. All waste will be stored on impermeable hardstanding in containers with lids.

5.8. Monitoring and Reporting

Monitoring of Point Source Emissions to Air

5.8.1. There are 18 point source emissions to air proposed as follows: A1-A3 for H_2 and A4-A18 for O_2. Since neither are considered by the EA to be pollutants, and there are no air quality standards for either, monitoring of the discharge is not proposed.

5.8.2. The quantity of H_2 released will be calculated from a mass balance and year 1 will be used to set a baseline, with the objective of lowering emissions of H_2 year on year as low as practically possible.

Monitoring of Emissions to Combined Drainage System

5.8.3. Monitoring of emissions to the Sembcorp combined drainage system will be undertaken as required. Sembcorp will issue an “internal” discharge consent to MorGen to ensure that limits at the final point of discharge can be met.

Monitoring Emissions to Ground and Groundwater

5.8.4. In accordance with the IED, soil monitoring will be undertaken every 10 years and groundwater every 5 years for any potentially polluting substances that will be used at the Installation.

Monitoring Standards

5.8.5. All monitoring will be undertaken by staff who are competent and work to recognised standards – e.g. UKAS/MCERTS accreditation. Any samples will be sent to UKAS/MCERTs laboratories.

Monitoring Process Performance

5.8.6. Monitoring of process performance will be contained within the Objectives and Targets Register of the Installation's EMS. For the H_2 Plant, in the first year of operations, the following will be monitored:

- energy consumption per kg of H_2 product; and
- water consumption per kg of H_2 product.

5.8.7. Year 1 will then be used as baseline to identify opportunities to reduce both energy and water consumption where technically and economically feasible.

5.9. Unplanned Emissions and Accidents

5.9.1. There will be a Planned Maintenance Plan ("PMP") for the Installation. The PMP will incorporate a risk based leak detection and repair ("LDAR") programme to cover all tanks, pipework, joints, seals and glands.

5.10. Noise and Vibration

5.10.1. A Noise Impact Assessment was undertaken as part of the planning application and concluded that the proposed plant would likely contribute to the existing low-level hum audible below road traffic at quiet periods, but is unlikely to pose a significant intensification. Within the context of the existing industry in the area the impact of this is unlikely to be significant.

6. EMISSIONS

6.1. Point Source Emissions to Air

6.1.1. There are 18 emission points to air proposed as follows: A1-A3 for H_2 and A4-A18 for O_2.

6.1.2. It should be noted that the H_2 vents are located at a suitable distance from the O_2 vents to minimise fire and explosion risk.

6.1.3. H_2 is continuously vented (via emission points (A1-A3), at a rate of 2.4kg/h from each electrolyser as part of the process and there are pressure relief valves which can be used to vent H_2 in case of overpressure.

6.1.4. Each of the three electrolysis modules will have five water-oxygen separators which will release O_2 at rate of 1,811Nm^3/h (5,433Nm^3/h total). O_2 from electrolysers is vented via 10" vent lines above the anode separators. It should be noted that is a trace amount of hydrogen (0.03%) in the oxygen vent, therefore at this concentration there is no explosion risk.

6.1.5. An emergency power system in the form of a diesel-powered generator will be installed. The generator will be tested occasionally and generally expected to be non-operational Therefore, it will be considered as an 'excluded generator' with no set specific generator emission limits.

6.2. Point Source Emissions to Combined Sewer

6.2.1. Emissions to the combined sewer will arise from water treatment and from the dehydration and regeneration process. The likely emissions to the combined sewer are reject water and rainwater. A H1 assessment of emissions has been undertaken and confirmed that emissions are insignificant.

6.2.2. The dry weather flow, pH; visible oil or grease; and suspended solids will be monitored if required:

6.3. Point Source Emissions to Land

6.3.1. There are no emissions to land.

6.4. Fugitive Emissions to Air

6.4.1. All plant and equipment will be operated in accordance with manufacturer manuals and instructions and subject to routine maintenance and inspection to ensure they are operating within set parameters and at optimal performance levels.

6.4.2. Fugitive emissions of H_2 would only arise should there be a leak in any pipework. Quantities of H_2 within the H_2 Plant are limited as the H_2 produced is transferred directly to drying and transferred off site via the pipeline.

6.4.3. It should be noted that elemental nitrogen is also occasionally used to purge the system in very low quantities.

6.5. Fugitive Emissions to Surface Water, Sewer and Groundwater

6.5.1. Fugitive releases to the groundwater will be prevented by conducting all operations in areas sealed with an impervious barrier to prevent a pathway for migration to ground and groundwater.

6.5.2. For the H_2 Plant, all water treatment is undertaken, on impermeable hardstanding. This eliminates the risk of fugitive emissions to surface water.

6.5.3. All potentially polluting liquids will be appropriately bunded. All plant and equipment will be subject to regular maintenance and servicing as per the PMP contained within the Installation's EMS.

7. GENERAL REQUIREMENTS

7.1. Emissions Management

7.1.1. The Environmental Risk Assessment undertaken has demonstrated that emissions of substances not controlled by emission limits (i.e. fugitive emissions) are not considered to be significant, consequently, an Emissions Management Plan is not required as part of this application.

7.2. Odour Management

7.2.1. The process does not give risk to any odours, consequently, an Odour Management Plan is not required as part of this application.

7.3. Noise Management

7.3.1. It is not considered that the changes proposed as part of this variation will result in noise nuisance being experienced by sensitive receptors in the surrounding area.

7.4. Fire Management

7.4.1. The Installation will have an Accident Management Plan which will include details how to effectively manage and report incidents and potential emergency situations including fire.

8. RESOURCE EFFICIENCY AND CLIMATE CHANGE

8.1. Monitoring

8.1.1. MorGen will monitor the annual consumption of water, energy and raw materials, as well as the annual generation of residues and wastewater, with a frequency of at least once a year.

8.2. Energy Efficiency Measures

8.2.1. A number of energy efficiency measures will be implemented at the Installation to improve energy efficiency: including the use of electricity during low demand periods, helping balancing supply and demand in the overall electricity market

8.3. Energy Consumption

8.3.1. In one hour of full load, 1,080 kg H_2 is produced from 62.7MWh.

8.4. Raw Materials Justification

8.4.1. It is not possible to substitute materials with waste as part of the proposals; however, the Installation will undertake an annual review of raw material usage and investigate the suitability of raw materials with an improved environmental profile.

8.5. Waste Minimisation

8.5.1. As part of the initial concept and design of the improvement proposals, waste minimisation was considered. Very little waste is generated from the H_2 Plant, with the electrolyser stack only needing to be replaced every 7-10 years.