Permitting Decisions - Bespoke Permit

We have decided to grant the permit for High Marnham Hydrogen operated by Geopura Ltd.

The permit number is EPR/DP3329SM/A001.

The permit was granted on 29/08/2024.

The application is for production of hydrogen by electrolysis of water at High Marnham.

We consider in reaching that decision we have taken into account all relevant considerations and legal requirements and that the permit will ensure that the appropriate level of environmental protection is provided.

Purpose of this document

This decision document provides a record of the decision-making process. It summarises the decision-making process to show how the main relevant factors have been taken into account.

This decision document provides a record of the decision-making process. It:

- summarises the decision making process in the decision considerations section to show how the main relevant factors have been taken into account
- highlights key issues in the determination
- shows how we have considered the consultation responses

Unless the decision document specifies otherwise we have accepted the applicant's proposals.

Read the permitting decisions in conjunction with the environmental permit.

Key issues of the decision

Geopura Ltd submitted an application to develop a chemical site at High Marham Hydrogen, High Marnham Power Station, High Marnham, NG23 6SH. The permit application is for production of hydrogen gas by alkaline electrolysis of water which falls under the EPR 2016 Section 4.2 Part A(1)a(i): Producing inorganic chemicals such as hydrogen. The by-product oxygen gas is allowed to disperse into the atmosphere while the product hydrogen is purified, compressed and pumped into industry standard arrays of hydrogen cylinders fitted to trailers. Once the arrays are full the trailer is driven off-site and replaced with an empty array.

The total electrical input of the site is 14.45MWe (consisting of 13.8 MWe electric power supply to the electrolysers, corresponding to a hydrogen gas production rate of 260 kg/h, and 0.65 MWe for compression).

The applicant prepares the hydrogen ready for export as a product. The hydrogen is purified, compressed and pumped into arrays of cylinders on a trailer which is driven off-site once the trailer is full. The applicant has informed that depending on customer specification, a full trailer holds 300-600kg of hydrogen. They have also confirmed that site inventory management will maintain the total inventory in trailers below 4.5tonnes in total.

Review of operating techniques and BAT assessment

We have reviewed the operating techniques proposed by the applicant against the requirements of the Guidance: Hydrogen production by electrolysis of water: emerging techniques, also referred to as 'Guidance on Emerging Techniques', or GET.

The GET on production of hydrogen by electrolysis of water was developed by the UK environmental regulators, including the Environment Agency, and is informed by an evidence review carried out for the UK environmental regulators working with industry and other stakeholders.

The GET was developed for

- operators when designing and operating their plants and preparing their application for an environmental permit
- regulatory staff when determining environmental permit applications
- any other organisation or members of the public who want to understand how the environmental regulations and standards are being applied

The application was prepared, submitted and duly made before the publication of the GET on production of hydrogen by electrolysis of water 28/03/2024, hence it did not refer to this guidance. The application included a BAT assessment against:

- The indicative BAT requirements set out in the Environment Agency Sector Guidance, ‘The Inorganic Chemicals Sector (EPR 4.03)’, March 2009;

- An assessment against the BAT Conclusions for Common Waste water and Waste Gas Treatment/Management Systems in the chemical sector (CWW BAT conclusions)

We requested the applicant to supplement the information provided in the application with additional information against the key requirements of the GET in two Schedule 5 Notices served on 26/04/2024 and 22/05/2024.

The information on proposed operating techniques, either included in the application documents or received in response to the Schedule 5 Notices served to the applicant, is compared against the requirements of the GET on production of hydrogen by electrolysis of water in the following table.

	Requirements of GET on production of hydrogen by electrolysis of water [1]	Evidence
1. Hydrogen production by electrolysis of water: emerging techniques - GOV.UK (www.gov.uk)		
1	**Technique selection**	
	You should consider the overall environmental performance. You should justify your choice of technology at each stage using the principles of 'best available techniques' throughout your permit application, including energy demand and efficiency, water demand, efficiency and evaluation for re-use, emissions to the environment. The choice of technology will determine, for example, the energy required for compression. The selection will depend on the difference between the electrolyser system operating pressure and the pressure required by the user. Other associated activities may include: • Feed water treatment • Hydrogen purification & compression • Storage of hydrogen • Electrolyte treatment & recovery (where ALK technology employed) • Effluent treatment • Flaring and venting • Cooling and heat recovery • Steam systems (where SOEC technology employed)	The applicant stated they chose Alkaline Electrolysis as it is a mature technology with an established track record as opposed to other technologies. They explained that they also considered the alternate choice as proton electrolyte membrane (PEM), however, they concluded that this technology is yet to be proven at a large scale whereas alkaline electrolysis has a long and successful history. Besides, chlor-alkali industrial experience also gives added weight to alkali electrolysis, according to the applicant. Based on the evidence review gathered for the UK environmental regulators, we consider both alkaline electrolysis and PEM are suitable options to produce hydrogen by electrolysis of water. The evidence review document states that alkaline electrolysis is a mature technology, whilst PEM is a mature technology at small scale, with scope for development at larger scale. We consider the justification provided by the applicant, based on the higher maturity of the alkaline technology, is acceptable and we agree that proposed technology meets the requirements of our guidance in relation to providing a justification for the technology selection.

2	**Plant design and operation**	
a.	<u>Operation</u> You must consider whether your hydrogen production plant may need to operate in steady state or on a flexible basis. You should identify all operating scenarios. Include those due to providing flexible operations where environmental performance could be affected, or where additional emissions are expected. You should describe measures you would take to minimise the environmental impact of these scenarios.	The plant will be operating in steady state with 8300 operating hours with a capacity to generate 260kg/hour hydrogen. The site will have emergency and abnormal occurrence procedure incorporated in the EMS.
b.	<u>Reliability and availability</u> You will need to identify the equipment and systems, and their associated operating and maintenance techniques, that are critical in avoiding emissions or minimising environmental impact. You will need to design, operate and maintain these to make sure they are reliable and available. This should include providing installed back-up equipment, where necessary. You should implement a risk-based other than normal operating conditions (OTNOC) management plan. This should identify potential scenarios, mitigation measures, monitoring and periodic assessment of the OTNOC management plan. This should be part of your environmental management system.	The applicant has justified that the key reliability provision is the use of mature technology and placing two compressors per quad of electrolysers. In case of a breakdown of a single or two units, the system will not require a full shutdown. It is capable of running at high availability percentage whilst any repairs are completed. Hydrogen leak potential is minimized by providing welded pipe construction and high-quality mechanical seals. Further, all equipment is fitted with alarmed hydrogen detection. In addition, the RO system is used to purify feed water and the membranes will be cleaned at regular intervals. There will be a spare cartridge on site for uninterrupted process of the ion exchanger. The site will have emergency and abnormal occurrence procedure incorporated in the EMS. Based on the information provided we consider that the proposed operating techniques will meet the requirements of our guidance on reliability and availability.

c.	<u>Energy Efficiency, process efficiency, cooling</u> You should design, operate and maintain your hydrogen production plant to maximise: • energy efficiency (minimise the energy needed to produce each tonne of hydrogen) • process efficiency (minimise the raw materials needed to produce each tonne of hydrogen) You should consider the use or recovery of oxygen by-product when this is commercially and technically viable. To decide on best available techniques for your plant, you will have to balance how you achieve these efficiencies to optimise the environmental and economic requirements. You must explain how you have done this and what your considerations were. Main energy users will include: • electrolysers • hydrogen compressors • hydrogen purification • pumping or fan systems You should consider: • electrical power needs and whether you will import or generate on site • high pressure steam need and availability (SOEC) • maximising any residual waste heat recovery • cooling needs • cooling type and medium • energy recovery devices on high pressure fluids, for example, reverse osmosis effluent, where applicable	The electrical consumption is 55.6kWh/kg H_2. This is within the benchmark range of 45-66kWh/kg H_2 for alkaline electrolysis stated in the <u>evidence review</u> document. The applicant has justified that recovery of oxygen would not be commercially viable and oxygen will be allowed to disperse harmlessly into the atmosphere. Compressor uses 2.5kWh/kg H_2. Hydrogen is purified by using deoxidiser at the collection point. Purified hydrogen passes to the compressor and the compressed hydrogen is pumped straight to the on-site trailers with no interim storage. The applicant has stated that the low-grade heat generated from the compressor has no immediate use at the facility and therefore there is no merit in installing heat recovery equipment. We accept the applicant's justification. The applicant has justified that the use of reverse osmosis for purifying the potable feed water followed by ion exchange to remove any residual hard cations is process efficient. Further the electrolyser is a packaged unit with integrated control panel and condition monitoring to assure optimal performance. Contents of the electrolyser solution are checked regularly to ensure that the optimum conductivity is maintained with potassium hydroxide being added as and when necessary. The energy and mass balance flow chart provided by the applicant shows that the water consumption for alkaline electrolysis is 9.0kg/kg H_2.

Energy and mass balance as provided by the operator:

Inputs		**Step**		**Emissions**
Water 4423 kg/hr	→	**RO/Soften**	→	RO Reject 2083 kg/hr
		2340 kg/hr clean water		
		↓		
Electricity 13.8 MW	→	**Electrolysis**	→	Oxygen 2080 kg/hr
		260 kg/hr hydrogen		
		↓		
Electricity 0.65 MW	→	**Compression/Store**		
		260 kg/hr hydrogen		
		↓		
		Tanker Module		

	<u>Water supply and use:</u> Water supply and its efficient use is fundamental aspect of hydrogen production by electrolysis of water. Water is consumed in the process to make hydrogen in a minimum ratio of 9kg per 1kg of hydrogen gas produced. Remaining 8kg is oxygen as a gas. You should: • minimise the quantity of water you use • segregate, treat and re-use water where possible • identify how much contaminant needs to be removed to maintain the water quality necessary for effective operation • determine the quantity of water to be purged, the characteristics of that purged water, and design the treatment process accordingly • eliminate, minimise or treat any emissions to air or wastes that may result from the water treatment process • choose a cooling method that takes account of the impact of temperature on process performance, energy efficiency and environmental impact on the receiving medium	The process uses potable water mains as raw material in hydrogen production by electrolysis. The reverse osmosis treats 4423kg/hr and generates an effluent of 2083kg/hr. The effluent generated is 49.99m^3/day which is directly discharged to River Trent without reuse or treatment. The selected cooling system consists of a closed loop Monopropylene glycol is the coolant used for cooling the compressors. The glycol itself is cooled in a radiator unit by atmospheric air. This technique prevents the consumption of water for cooling purposes. We are satisfied that the proposed configuration meets an acceptable compromise between water efficiency and energy efficiency, when considering the scale of the proposed operations.
	<u>Electricity supply:</u> The power supply issues can affect the environmental performance of the hydrogen production process, such as through availability and variability. You should take this into account when you design and operate the hydrogen plant to eliminate or mitigate any environmental impact.	The site will use grid power initially but have plans to move to renewable energy from sister company located adjacent to the site. The applicant has justified that the grid electricity is relatively stable as there is a 400kV super substation near the site. The grid supply is stepped down and rectified for use in electrolysis and this ensures smooth supply to the electrolysers. We are satisfied that the operator has considered the availability and variability of power supply.

	<u>Hydrogen purification:</u> Your hydrogen purification requirements will depend on: • the hydrogen product quality specification • the production technique chosen • residual impurities in the hydrogen The impurities may include: • oxygen • water • other trace gases You should consider which other purification processes are appropriate, depending on the specification of hydrogen required. These may include: • deoxidiser system • dehydration system • other purification processes You should describe and justify your choice of techniques and the relevant aspects which will affect environmental criteria. For example: • consequential wastes and emissions • any recovery or treatment required	Hydrogen is collected from the cathode of the electrolyser and undergoes purification at this collection point by a catalytic deoxo unit which catalytically removes trace oxygen. The purified hydrogen passes over a physical desiccant chamber to remove residual traces of moisture.

3.	Emissions to air	
	You should identify, eliminate, minimise or reduce any emissions to air that could cause pollution and carry out a risk assessment to assess the impact of these emissions. You should design and operate your plant to achieve the following in priority order, where technically and economically viable, and ensuring safety is not compromised. 1. Prevent or avoid emissions of hydrogen. 2. Recover or recycle hydrogen. 3. Avoid or minimise continuous or intermittent flaring of hydrogen. 4. Avoid or minimise continuous or intermittent venting of hydrogen, whether for operational or safety reasons. You should quantify and assess other venting and purging requirements, identifying any pollutants that are expected to be present. Requirements for other continuous venting during normal operations may include, for example: • waste oxygen (which may contain hydrogen) • water vapour • deaeration of steam condensate • gases from processing wastewater streams • purge of tanks, vent or flare headers You should identify, quantify and assess other pollutants. These may include, for example, nitrogen oxides (NOx) and hydrogen from flaring of hydrogen.	The operator has provided the following values for emissions to air for the gases hydrogen, oxygen and nitrogen. The values provided are based on the energy balance diagram as well as estimates based on discussions with equipment suppliers. Oxygen – from electrolysis of water - 19,339t/yr Nitrogen – for purging system prior to maintenance work - <10kg/yr. Hydrogen – loss from seals – 10-100kg/yr. Hydrogen – electrolyser maintenance - 5-70kg/yr. Hydrogen – compressor maintenance – 2-30kg/yr. The applicant has justified that the quantity of hydrogen emitted via fugitive routes of this nature is extremely small therefore venting hydrogen safely is the preferred technique. There will be no flare stack on site. We have set requirements in the permit to monitor and report fugitive and venting emissions of hydrogen. We have also set improvement conditions requiring the operator to develop and propose the methodologies to estimate these emissions, for approval by us.

4.	Emissions to water	
	You must identify and eliminate, minimise, recycle or treat any emissions to water that could cause pollution. You should carry out a risk assessment, including detailed modelling where appropriate, to assess the impact of these emissions. For emissions to surface water, you should refer to the guidance relevant to the location of your plant in UK through the information on surface water pollution: risk assessment for your environmental permit.	The applicant has informed that the only effluent discharged from the process is the RO elutriate which is allowed to discharge via existing channel into the River Trent. There is no wastewater treatment at the site. The RO effluent is introduced to the overall area run-off system downstream of the rainwater hydrobrake. The applicant has also confirmed that an attenuation pond and hydrobrake will maintain acceptable flowrates. The applicant has provided an H1 assessment for emissions to water, informed by data on the composition of a similar effluent generated at a nearby site and proposed to set improvement condition to validate the assessment with date gathered during the initial operation of the installation. Note: The applicant submitted additional information at operator review stage which showed that the flow rate would be $50m^3$/day than originally assessed. We have assessed this and agree that the increase in flow rate does not change the conclusions and all the substances screen out as insignificant. Therefore we conclude that there is no need to re-consult as the conclusions and outcomes is not changing our decision. This document has been updated to reflect the updated water flow rate data. The applicant has provided an updated form PartB6 for completeness purposes only.

	You should identify continuous and periodic effluent streams from the process and determine whether effluent treatment is required. These streams may include waste streams from water pre-treatment processes, cooling and steam systems, including: • effluent from reverse osmosis containing ions from the feed water • effluent from continuous deionisation • effluent from desalination • purges from cooling water systems • purges from condensed water from steam systems These will contain contaminants, which may need treatment or removal before discharge, for example: • high salinity effluents • metal ions You should decide how much water to treat and how to treat it before it is: • re-used • discharged to surface water or sewage undertaker • disposed of You should identify how much contaminant can be removed to comply with discharge requirements and design the treatment process accordingly. You should identify any unavoidable emissions to air or wastes that may result from the water treatment process. Ensure they are minimised or treated appropriately. You should treat water for re-use, where practicable.	We have assessed the applicant's H1 assessment report for confirming the flow rate used for River Trent, ensuring there are no nutrient neutrality areas that need to be considered as well as for the parameters of lead, total cadmium and chloride. These pollutants screen out as insignificant. Further, cadmium also passes the significant load test. The applicant has also confirmed that no additional chemicals are used in the RO process. We are satisfied with the applicant's risk assessment for emissions to water, but we consider the conclusions will need to be validated with effluent monitoring data gathered over the first year of operations, hence we have set an improvement condition specifying this requirement. It is to be noted that the laboratory analysis report (supporting document) provided by the applicant has cadmium values as 'Not Detected'. Therefore, the applicant has used the cadmium detection limit of 0.01µg/l in the H1 assessment. Further, the laboratory (Beverly labs) is not accredited by UKAS for water analysis. The applicant has committed to sending a confirmatory sample to a lab that is UKAS accredited for water analysis. This will be considered further by addition of an improvement condition in the permit requiring a reassessment of discharges to water, based on effluent data gathered during the first year of operations.

	<u>Best Available Technique</u> You should refer to the appropriate BREF, BATC and guidance: • [BREF and BATC for common wastewater and waste gas treatment/management systems in the chemical sector] • [UK cross-cutting interpretation guidance and permitting advice on the best available techniques (BAT) conclusions published under the Industrial Emissions Directive (IED)] • UK interpretation guidance and permitting advice on the best available techniques (BAT) conclusions for common waste water/waste gas treatment/management in the chemical sector (CWW) – available on request from your regulator	The applicant has provided a BAT assessment against the CWW BATC (BAT Conclusions for Common Waste water and Waste Gas Treatment/Management Systems in the chemical sector). The applicant has commented that the site will operate to an EMS in line with the principles of ISO 14001. The applicant has provided a review against BAT1 to BAT23 and have considered the following elements in the design and operation of the plant: • Reducing emissions to water • Implementation of suitable compliant monitoring via the EMS • Emissions to air • Reducing water use • Preventing contamination of surface water streams • Waste control and inventories control via EMS • Noise impacts We agree with the applicant's techniques are consistent with relevant BAT. The applicant has stated that the emissions to water are not anticipated to achieve the threshold set out in the CWW BAT conclusions Tables 1, 2 and 3 for the applicability of the relevant BAT-AELs. Whilst we consider the effluent flow rate is low enough to make it unlikely achieving the relevant thresholds, we have specified an improvement condition requiring the applicant to demonstrate the emission levels in the RO effluent remain below these threshold for the parameters that we consider relevant, i.e. total organic carbon or chemical oxygen demand, total suspended solids, total nitrogen,

		total phosphorus, chromium, copper, nickel and zinc. We have specified emission limits for these parameters in the permit, according to the CWW BAT-AELs. These emission limits, and the associated monitoring requirements, will only apply if the relevant BAT-AELs applicability thresholds are exceeded and might need to be amended based on the results of the updated H1 risk assessment required under IC1.

5.	Emissions to ground and groundwater	
	You must design your process to avoid emissions to ground and groundwater.	There is no emissions to ground and groundwater. The applicant has identified oils, lubricants, potassium hydroxide (reaction promoter) and monopropylene glycol (coolant) as having the potential to cause pollution to ground and groundwater. This risk has been assessed (Document ref: R02 – Risks and Impact Assessment). The applicant has identified ways to mitigate the risks by ordering lubricants and hydraulic oils on as-required basis and these will be delivered in 25-205 litre containers, thereby avoiding bulk storage on site. There will be indoor storage facility and dedicated meshed tray bunds to store drums and contain any leaks. The EMS will contain infrastructure inspection plan to ensure the storage areas are inspected regularly. There are sixteen identical electrolysers on site, each containing 0.88m^3 potassium hydroxide (KOH) solution. The applicant has confirmed that there will be no additional storage of KOH on site. The alkaline solution is changed approximately biennially and sent for recovery. The new KOH solution is loaded into the unit via fill points by direct pumping from road tanker or manual pumping from IBCs. This is a controlled operation done under a permit to work and the controls and mitigation include the use of emergency shower and eyebath from a safety point of view and additional spill kits located in the area in case of a spill. The cooling tubes contain 0.65m^3 of monopropylene glycol in a closed system. This will not need to be removed. The applicant has carried out a source, pathway, receptor risk rating to identify the secondary containment class. Based on this, the risk rating was identified to be L (according to CIRIA C736). Further the failure of pipes and valves has been rates are L/M (as derived from HSE data). Overall the risk has been identified as ML or LL, therefore a class 1 (base level) containment would be required. The applicant has further justified that each electrolyser sits within a modified shipping container structure constructed of epoxy painted steel. The internal drip trays are also epoxy painted steel and provide 1.8m^3 (3 x 0.6m^3) containment for each electrolyser. This is well-above the 110% secondary containment which is 1.1m^3. We are satisfied with the applicant's mitigation measures and secondary containment.

<table>
<tr><td>6.</td><td colspan="2">Wastes</td></tr>
<tr><td></td><td>Before considering waste disposal, as far as practicable you must follow the waste hierarchy and:

• prevent
• minimise
• re-use
• recycle
• recover
• treat
<u>Liquid waste</u>

Liquid wastes such as:

• waste alkaline solutions, for example, potassium hydroxide
• any residual liquid wastes from the water treatment processes</td><td>• Residual liquid wastes from the water treatment process – The RO elutriate is directly discharged to the adjacent River Trent.
• Waste alkaline solutions – Here, the applicant has informed that potassium hydroxide is biennially drained from the cell and sent for recovery.</td></tr>
<tr><td></td><td><u>Solid waste</u>

Solid wastes such as:

• spent adsorbent materials from gas treatment, dehydration, hydrogen purification
• spent or damaged membranes
• catalyst materials
• other solid consumables, for example, electrolyser components such as seals</td><td>The applicant has identified the following solid wastes and have informed as below:

• Spent adsorbent materials – These granules will be used to absorb any spilled material. These will be disposed off as hazardous waste.
• Semi -permeable membranes – The membranes used in the RO will be cleaned using a backwash cycle to remove the accumulated material.
• Spent Ion-exchanger – Ion exchange cartridges will be picked up by suppliers and sent for regeneration and recovery.
• Spent catalyst – Spent catalyst will be sent for regeneration/recovery approximately every 2 years.</td></tr>
</table>

7.	Monitoring and reporting	
	Monitoring standards: MCERTS sets the monitoring standards you should meet. Process monitoring: The main purpose of monitoring is to: • appropriately control the process to ensure compliance with the permit • show that emissions to air, water or land from the process are not causing harm to the environment You must also carry out process monitoring to show that resources are being used efficiently. This may include: • energy efficiency • water efficiency • resource efficiency, for example, electrolyser consumables • verifying (when applicable) compliance with low carbon hydrogen standards, including any requirements relating to emissions of hydrogen	The applicant has included the following key performance indicators to ensure process efficiency: • Purified water: input water ratio • Hydrogen production: input water ratio • Hydrogen production: electricity consumption ratio According to our guidance and in line with the information provided by the applicant, we have specified the following process monitoring requirements in the permit: - Energy efficiency (kWh/kgH_2) - Water efficiency - (Kg water /kg H_2) - Emissions of hydrogen from venting (kg H_2) - Fugitive emissions of hydrogen (kg H_2)

	<u>Monitoring emissions to water:</u> You must monitor emissions to water based on expected impurities using appropriate methods and measuring techniques. You should use monitoring standards for discharges to water following [BATC for common waste water and waste gas treatment/management system in the chemical sector](#). <u>Monitoring emissions to air:</u> You should eliminate or minimise emissions of hydrogen due to their global warming potential. You should provide a monitoring plan for monitoring emissions to air, based on expected pollutants such as hydrogen. You should do this using appropriate methods and measuring techniques. Your monitoring should consider, for example, any other sources of hydrogen emissions, such as venting and fugitive emissions, including vented oxygen. <u>Monitoring emissions to ground and groundwater:</u> Though the life of the permit, your regulator may require a: • site condition and baseline report • soil and groundwater monitoring plan	The wastewater generated from the reverse osmosis system is directly discharged via existing drains to the adjacent River Trent. This effluent discharged from the RO unit is an accessible pipe flow. The flowrate will be monitored prior to the effluent joining with any other streams and will be measured using an MCERTS compliant flowmeter. We have added improvement condition in the permit to verify the applicant's risk assessment. The applicant does not have a monitoring plan for emissions to air. The values provided under emissions to air (above) is based on estimates informed by the supplier. We have specified improvement conditions requiring the operator to develop and propose the methodologies to estimate fugitive and venting emissions of hydrogen, for approval by us. The applicant has provided a site condition report. There are no direct emissions to ground and groundwater. The risks have been covered in the above sections.

<table>
<tr><td>8.</td><td colspan="2">Unplanned emissions and accidents</td></tr>
<tr><td></td><td>You should design your plant to:
inherently avoid leaks by good design practice
ensure the plant is operated and maintained to appropriate industry standards
You should propose a risk-based leak detection and repair (LDAR) programme that is appropriate for the fluids and their composition. This should use available industry best practice to minimise releases, including from:
joints
flanges
seals
glands
You should include how you will use the principles of LDAR to eliminate or reduce fugitive emissions of hydrogen due to its global warming potential. Your hazard assessment and mitigation for the plant must consider the risks of accidental releases to the environment.</td><td>As best practice, guidance for emerging technique advice a risk-based leak detection and repaid (LDAR) programme that is appropriate for the fluids and their composition. The applicant has informed that all welded construction will be employed for the hydrogen systems, all major equipment will have gas detection in unit housings and additional gas detection will be provided across the site. Further emergency procedure will be incorporated into EMS.
The applicant has also considered accidental releases to the environment by informing that water would be used for firefighting/cooling and applied externally to hydrogen containing units. As they do not anticipate any polluting contaminants to be picked up by the water, a fire-water containment strategy has not been considered.
We have specified an improvement condition requiring the operator to develop and propose a risk-based LDAR programme for approval by us.</td></tr>
<tr><td>9.</td><td colspan="2">Noise</td></tr>
<tr><td></td><td>You should consider sources that have potential for noise and vibration. Hydrogen compression, pumps and fans could be significant sources.</td><td>The applicant has identified the nearest residential receptors to be at a distance of 600m. The noise source from each compressor is 78dB which equates to 22dB at the receptor (as informed by the applicant) and therefore they have ruled out any noise impact. We have assessed this using our internal tool (QNST) and we are satisfied that a noise impact assessment would not be required.</td></tr>
</table>

Decision considerations

Confidential information

A claim for commercial or industrial confidentiality has not been made.

The decision was taken in accordance with our guidance on confidentiality.

Identifying confidential information

We have not identified information provided as part of the application that we consider to be confidential.

The decision was taken in accordance with our guidance on confidentiality.

Consultation

The consultation requirements were identified in accordance with the Environmental Permitting (England and Wales) Regulations (2016) and our public participation statement.

The comments and our responses are summarised in the consultation responses section.

The application was publicised on the GOV.UK website.

We consulted the following organisations:

- Local Authority – Environmental Protection Department
- Director of PH/UKHSA
- Health and Safety Executive
- Sewerage Authorities

The comments and our responses are summarised in the consultation responses section.

Operator

We are satisfied that the applicant (now the operator) is the person who will have control over the operation of the facility after the grant of the permit. The decision was taken in accordance with our guidance on legal operator for environmental permits.

The regulated facility

We considered the extent and nature of the facility at the site in accordance with RGN2 'Understanding the meaning of regulated facility' Appendix 2 of RGN2

‘Defining the scope of the installation’, Appendix 1 of RGN 2 ‘Interpretation of Schedule 1’ and the published guidance on ‘Hydrogen production by electrolysis of water: emerging techniques’.

The extent of the facility is defined in the site plan and in the permit. The activities are defined in table S1.1 of the permit.

The site

The operator has provided a plan which we consider to be satisfactory.

During the operator review, the applicant has updated the site plan effectively reducing the area of the installation as this was an error in the original site boundary. We have accepted this.

The plan is included in the permit.

Site condition report

The applicant’s original Site Condition Report (SCR) characterised the wider site that is not subject to this application. Therefore, an updated SCR was required to be submitted. The applicant provided a recent ground investigation survey report and an updated site condition report which we consider is satisfactory. The decision was taken in accordance with our guidance on site condition reports.

Nature conservation, landscape, heritage and protected species and habitat designations

We have checked the location of the application to assess if it is within the screening distances we consider relevant for impacts on nature conservation, landscape, heritage and protected species and habitat designations. The application is not within our screening distances for these designations.

Environmental risk

We have reviewed the operator's assessment of the environmental risk from the facility.

The operator’s risk assessment is satisfactory, but we consider it will need to be validated with monitoring data as specified in improvement condition IC1. Refer to the key issues section for additional information on environmental risk assessment for emissions to surface water.

General operating techniques

We have reviewed the techniques used by the operator and compared these with the relevant guidance notes and we consider them to represent appropriate techniques for the facility.

The operating techniques that the applicant must use are specified in table S1.2 in the environmental permit.

Operating techniques for emissions that screen out as insignificant

Emissions of the following pollutants have been screened out as insignificant:

Lead
Chloride
Total Cadmium
Magnesium

We agree that the applicant's proposed techniques are Best Available Techniques (BAT) for the installation.

We consider that the emission limits included in the installation permit reflect the BAT for the sector.

National Air Pollution Control Programme

We have considered the National Air Pollution Control Programme as required by the National Emissions Ceilings Regulations 2018. By setting emission limit values in line with technical guidance we are minimising emissions to air. This will aid the delivery of national air quality targets. We do not consider that we need to include any additional conditions in this permit.

Pre-operational conditions

Based on the information in the application, we consider that we need to include pre-operational conditions.

We have included a pre-operational condition (POC1):

POC1 – POC1 has been included in the permit for the Operator to submit a summary report of the site Environment Management System (EMS) to the Environment Agency for assessment and written approval. POC1 specifies the guidance to be followed when developing the EMS; it also requires the operator to make all documents and procedures which form part of the EMS available for inspection, particularly the site's Accident Management Plan. The report is to be submitted prior to the commencement of commissioning.

Improvement programme

Based on the information on the application, we consider that we need to include an improvement programme.

We have included an improvement condition (IC):

IC 1 – IC 1 has been included in the permit for the Operator to submit a written report to the Environment Agency for technical assessment and approval for emissions to surface water. IC 1 specifies the requirement to validate the conclusions of the H1 risk assessment submitted on application with monitoring or engineering data or a combination of these gathered over the first year of operations of the installation; and to confirm whether the emission levels for parameters with relevant BAT-AELs from the CWW BAT conclusions are below the relevant applicability thresholds. The report is to be submitted in line with the timescales agreed in writing with the Environment Agency.

IC 2 – IC 2 has been included for the Operator to submit a LDAR (Leak detection and repair) plan for approval by the Environment Agency and to propose detection and quantification methodologies for fugitive emissions of hydrogen. The plan is to be submitted in line with the timescales agreed in writing with the Environment Agency.

IC 3 – IC 3 has been included for the Operator to submit a proposed methodology to quantify and report any venting emissions of hydrogen associated with the operations of the installation.

Further information on the need for setting these improvement conditions is discussed under the key issues section.

Emission Limits

Emissions to water:

We have included a limit on the volume of the discharge from the RO effluent. We have included pH limits protective of the receiving water body.

We have included emission limits for Chemical oxygen demand (COD), Total suspended solids (TSS), Total nitrogen (TN), Total phosphorus (TP), Chromium (expressed as Cr), Copper (expressed as Cu), Nickel (expressed as Ni) and Zinc (expressed as Zn), according to the CWW BAT-AELs. These emission limits will only apply if the relevant BAT-AELs applicability thresholds are exceeded. Refer to the key issues section for further details.

Monitoring

We have decided that monitoring should be carried out for the parameters listed in the permit, using the methods detailed and to the frequencies specified.

- Flow rate
- pH
- Chemical oxygen demand (COD),
- Total suspended solids (TSS),
- Total nitrogen (TN),
- Total phosphorus (TP),
- Chromium (expressed as Cr),
- Copper (expressed as Cu),
- Nickel (expressed as Ni)
- Zinc (expressed as Zn)
- Cadmium (expressed as Cd)
- Lead (expressed as Pb)

These monitoring requirements have been included in order to ensure that there is no adverse impact resulting from the emission of the RO effluent into the surface water body. We have included monitoring for Cadmium and Lead as they were included in the H1 risk assessment submitted by the applicant.

We made these decisions in accordance with Surface water pollution risk assessment for your environmental permit - GOV.UK (www.gov.uk) and the CWW BAT conclusions.

Based on the information in the application we are satisfied that the operator's techniques, personnel and equipment have either MCERTS certification or MCERTS accreditation as appropriate.

Reporting

We have specified reporting in the permit.

We made these decisions in accordance with Surface water pollution risk assessment for your environmental permit - GOV.UK (www.gov.uk) and Common Waste water and waste gas treatment/management systems in the chemical sector

Management System

We are not aware of any reason to consider that the operator will not have the management system to enable it to comply with the permit conditions.

Since the site is new to operations, we have specified a pre-operational condition requiring the operator to submit to the Environment Agency a summary report of the site Environment Management System (EMS) for assessment and written approval and to make available for inspection all documents and procedures which form part of the EMS, including in particular the site's Accident Management Plan to cover environmental risks from potential accidental events associated with the operations of the installation.

The decision was taken in accordance with the guidance on operator competence and how to develop a management system for environmental permits.

Financial competence

There is no known reason to consider that the operator will not be financially able to comply with the permit conditions.

Growth duty

We have considered our duty to have regard to the desirability of promoting economic growth set out in section 108(1) of the Deregulation Act 2015 and the guidance issued under section 110 of that Act in deciding whether to grant this permit.

Paragraph 1.3 of the guidance says:

"The primary role of regulators, in delivering regulation, is to achieve the regulatory outcomes for which they are responsible. For a number of regulators, these regulatory outcomes include an explicit reference to development or growth. The growth duty establishes economic growth as a factor that all specified regulators should have regard to, alongside the delivery of the protections set out in the relevant legislation."

We have addressed the legislative requirements and environmental standards to be set for this operation in the body of the decision document above. The guidance is clear at paragraph 1.5 that the growth duty does not legitimise non-compliance and its purpose is not to achieve or pursue economic growth at the expense of necessary protections.

We consider the requirements and standards we have set in this permit are reasonable and necessary to avoid a risk of an unacceptable level of pollution. This also promotes growth amongst legitimate operators because the standards applied to the operator are consistent across businesses in this sector and have been set to achieve the required legislative standards.

Consultation Responses

The following summarises the responses to consultation with other organisations, our notice on GOV.UK for the public and the way in which we have considered these in the determination process.

Responses from organisations listed in the consultation section:

Response received from Bassetlaw District Council's Environmental Health.

Brief summary of issues raised: The local authority's Environmental Health team has commented that the proposed permitted process appears to be fairly low risk in terms of the Environmental impact on ecological receptors and local residents. The electrolysis of water is not expected to give rise to a significant level of noise, odour, land contamination or water pollution.

The consultee sought information on ammonia cracking and if the plant will be a demonstrator for industrial hydrogen use.

Summary of actions taken: The operator has applied for hydrogen production by electrolysis of water only. The ammonia cracking technique, initially included in the proposal, was removed in the final application, however this was not reflected in the site condition report (SCR) sent out for consultation. An updated SCR has been received from the operator which reflects the scope of the application covering electrolysis process only. Further the operator has informed that the hydrogen will be exported off-site.

Response received from UK Health Security Agency

Brief summary of issues raised: The UKHSA has highlighted the main emissions of potential concern are gases and consist of nitrogen, oxygen and hydrogen. Recommendation is to ensure that risks to public health are assessed in the event of explosion and/or fire.

Summary of actions taken: The operator has provided a document P207-R05-D1 EMS Summary dated April 2023. They have identified the need for an Environmental Accident Management Plan (EAMP) in section 1.3.1 of this document. It identifies the hazards, risks and measures in place to reduce environmental risks from accidents.

Environmental permitting does not assess risks to 'public health' in general. However, there is a general duty with regard to requiring the operators to avoid or minimise 'pollution' which includes any emission which may be 'harmful to human health or the quality of the environment'. This would include environmental effects from pollution as a result of any accident or incident. We consider hydrogen fires and explosions at electrolysis plants process safety hazards that, due to the nature of the process and inventory of substances, are unlikely to cause significant pollution in the case of an accident. We consider the safety risks to workers and members of the public, associated with hydrogen fires and explosions, fall beyond our regulatory remit under the Environmental Permitting Regulations. We have consulted the Health and Safety Executive on this application, but we have not received any comments.

We will require the operator to provide the EAMP as a pre-operational condition and the compliance team will be advised to assess this.

Response received from Director of Public Health, Nottinghamshire County Council

Brief summary of issues raised: The consultee supports the recommendations by UKHSA that the Environment Agency ensures that the risks to public health are assessed in the event of explosion and/or fire. Nottinghamshire County Council planning have commented that they are not aware of any noise or other amenity issue at this site and there is no enforcement action in place.

The consultee expects the permit holder to provide assurance that *they shall take all appropriate measures to prevent or control pollution in accordance with the relevant sector guidance and industry best practice. It is the expectation that these will be regularly reviewed and monitored to mitigate any risk to local residents.*

Summary of actions taken: The applicant has referred to the Guidance on Hydrogen production by electrolysis of water: emerging techniques to follow best practices. We will include improvement conditions in the permit to assess the impacts of emissions to water, to implement Leak detection and repair (LDAR) programme, to assess emissions to air and a pre-operational condition to provide Environmental Accident Management Plan (EAMP).