PEMBROKE GREEN HYDROGEN PROJECT: A PEMBROKE NET ZERO PROJECT: PERMIT VARIATION

Environmental Risk Assessment

Pembroke Power Station (EPR/DP3333TA)

794-ENV-EPC-JFR2794
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02 July 2025

Document status

Version	Revision	Authored by	Reviewed by	Approved by	Review date
1	0	Joanna Bruce	N/A	N/A	10 May 2024
1	1	Joanna Bruce	Jennifer Stringer	N/A	12 May 2024
2	0	Joanna Bruce	RWE Generation UK plc	N/A	29 July 2024
3	0	Joanna Bruce	RWE Generation UK plc	N/a	06 September 2024
4	0	Joanna Bruce	Jennifer Stringer	RWE Generation UK plc	02 October 2024
4	1	Roger Newman	RWE Generation UK plc		16 June 2025
4	2	Roger Newman	Jennifer Stringer	Jennifer Stringer	02 July 2025

Approval for issue

Jennifer Stringer	Technical Director		2 July 2025

File Name

250702 R 794-ENV-EPC-JFR2794 JB Pembroke ERA V4 R2 .docx

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1 INTRODUCTION

1.1.1 This Environmental Risk Assessment (ERA) has been carried out in support of an application to vary environmental permit (EPR/DP3333TA) at Pembroke Power station to include a proposed Green Hydrogen Production Facility (GHPF) adjacent to the site of Pembroke Power Station, West Pennar, Pembroke, SA71 5SS.

1.1.2 The scope of the ERA considers risks associated with the operation of the GHPF and demonstrate that the risk of pollution or harm will be acceptable by taking the appropriate measures to manage these risks.

1.1.3 There will be no new continuous aqueous waste produced on site by the GHPF; aqueous waste water associated with the demineralised water supply to the GHPF will be produced in the existing Power Station demineralised water plant and will be discharged within the parameters included within the current Power Station permit. There will be no continuous process water discharges from the GHPF. Process waters will generally be reused. For AEL and PEM technology the ion exchange will be replaced and sent for regeneration off site to avoid generating wastewaters.

1.1.4 The Air Quality Standards Regulations 2010 [[i]], amended by The Environment (Miscellaneous Amendments) (EU Exit) Regulations 2020 [[ii]], sets limit values for ambient air concentrations for the main air pollutants: particulate matter (PM_{10} and $PM_{2.5}$), nitrogen dioxide (NO_2), sulphur dioxide (SO_2), ozone (O_3), carbon monoxide (CO), lead (Pb) and benzene, certain toxic heavy metals (arsenic, cadmium and nickel) and polycyclic aromatic hydrocarbons (PAHs).

Table 1-1: Summary of Relevant Air Quality Limit Values, objectives and EALs

Pollutant	Averaging Period	Objectives/ Limit Values	Not to be Exceeded More Than
Nitrogen Dioxide (NO_2)	1 hour	200 µg.m^{-3}	18 times per calendar year
	Annual	40 µg.m^{-3}	-

1.1.5 For short-term NO_2, the air quality objective is for the hourly-mean concentration not to exceed 200 µg.m^{-3} more than 18 times per calendar year.

1.1.6 Initial information on the emissions to air from the GHPF indicate that the flare will operate during start-up and shutdown. It is estimated that there may be up to 15 start-up and shut-down events per year. The duration of flaring for each shutdown is expected to be circa 5 minutes and for each startup (assuming cold start-up) the flare will operate for 10 minutes. On this basis emissions from flaring for each event will be short-term. As the plant will not operate for more than 18 times a year, the objective is considered to be met.

1.1.7 On this basis an assessment of emissions from the flare is not considered significant and a screening assessment of emissions to air is not required. Once firm data for the selected GHPF is available this position will be reviewed to ensure it remains appropriate.

1.1.8 Oxygen will also be released to air, however as oxygen is not an air pollutant there is no requirement to assess the impact from these emissions.

1.1.9 Section 3 provides the environmental risk assessment of ‘Amenity and Accident’ hazards associated with the operation of the GHPF.

1.1.10 This document provides the relevant risk assessments covering the above aspects.

2 SITE DETAILS

2.1 Site Setting

2.1.1 The GHPF will be located on a parcel of land associated with Pembroke Power Station, West Pennar, Pembroke, SA71 5SS.

2.1.2 The GHPF will be located to the west of Pembroke Power Station and will occupy an area of circa 4ha. The two facilities form a single installation and distances quoted in this document refer to the distance from the installation boundary as shown in Figure 2 in the drawings accompanying the permit application. The land currently comprises of grass, with trees and other vegetation around the perimeter and in the southern section. There is a small third-party natural gas AGI in the north-west corner which will be excluded from the extension to the permit boundary.

2.1.3 The watercourses in the surrounding vicinity are Pembroke River immediately to the east and Milford Haven Waterway immediately to the north of the installation. Drainage ditches are present on and adjacent to the proposed extension to the permit boundary.

2.1.4 The nearest European designated site is Pembrokeshire Marine/Sir Benfro Forol SAC, which is immediately adjacent to the installation at its nearest point. The nearest SSSI is Milford Haven Waterway SSSI also immediately adjacent to the installation at its nearest point.

2.1.5 The nearest residential receptor is over 1.5 km east of the GHPF. The Valero Pembroke Oil Refinery is located 1.3 km to the west.

2.1.6 The area to be occupied by the GHPF site overlies a Secondary A Aquifer, relating to the Alluvium beneath the site and widespread Avon Group bedrock. The water pipeline area is underlain by a Principal Aquifer relating to the Black Rock bedrock.

2.1.7 The centre of the site grid reference is SM 92507 02511.

3 ENVIRONMENTAL RISK ASSESSMENT

3.1.1 The environmental risk assessment complies with regulatory guidance and uses the following approach for identifying and assessing the risks in six steps:

- Step 1: Identify and consider risks for your site, and the sources of the risks;
- Step 2: Identify the receptors (people, animals, property and anything else that could be affected by the hazard) at risk from your site;
- Step 3: Identify the possible pathways from the sources of the risks to the receptors;
- Step 4: Assess risks relevant to your specific activity and check they are acceptable and can be screened out;
- Step 5: State what you will do to control risks if they are too high;
- Step 6: Present your assessment as part of you permit application.

3.1.2 This section provides an assessment of risks to environmental amenity and from accidents that could arise from operation of the GHPF. The assessment has been completed in accordance with NRW's 'Risk Assessments for your environmental permit'.

3.1.3 The scope of the assessment has covered the following aspects:

- Odour;
- Noise and vibration;
- Fugitive emissions; and
- Accidents.

3.1.4 For each of the above, the approach to the assessment has followed the following six stage process:

- Identify and consider risks for the site, and the sources of the risks;
- Identify the receptors at risk;
- Identify the possible pathways from the sources of the risks to the receptors;
- Assess risks relevant to the activity;
- Choose appropriate further measures to control these risks (if required); and
- Submit the assessment of overall risk.

3.1.5 Results of the assessment are provided in the following tables:

- Table 3-2 Odour Risk Assessment and Management Plan
- Table 3-3 Noise and vibration risk assessment and management plan
- Table 3-4 Fugitive emissions risk assessment and management plan
- Table 3-5 Accidents Risk Assessment and Management Plan

3.1.6 The risk assessment methodology has used a scoring mechanism whereby scores are assigned to:

- The probability of the exposure; and
- The consequence of the hazard to the environment or human health.

3.1.7 The risk assessment has been completed by scoring the hazard areas outlined above using a risk matrix as shown in Table 3-1 below:

Table 3-1: Risk Matrix

Consequence of the hazard to the environment or human health	Probability of Exposure			
	High	Medium	Low	Very Low
High	High	Medium	Low	Low
Medium	Medium	Medium	Low	Very Low
Low	Low	Low	Low	Very Low
Very Low	Low	Very Low	Very Low	Very Low

3.1.8 In completing the assessment, the proposed prevention and control measures are assumed to be put in place prior to operation. Where relevant, details of these measures are identified within the assessment.

Table 3-2: Odour Risk Assessment and Management Plan

Hazard	Receptor	Pathway	Risk management	Probability of exposure	Consequence	What is the overall risk?
Odour emission from operation of the GHPF	The nearest residential receptor located over 1.5 km east of the GHPF. Oil Refinery workers 1.3 km west.	Air	The main materials associated with the GHPF are water, hydrogen and oxygen which are not odorous. Hydrochloric acid (HCl) solution is an odorous substance used within the GHPF (≥ 30% < 50% volume) which has a pungent odour. It will be stored in storage tank designed to industry standard and bunded to provide 110% containment. The quantity of HCl solution stored at any one time is limited to the tank volume of 600 litres. Diesel will be used to fuel the backup generator. It will be stored in a 1.3 tonne tank in compliance with the Control of Pollution (Oil Storage) (Wales) regulations[1]. The generator will be tested for up to an hour once a month to ensure it functions properly and therefore usage and the potential for odour nuisance from use and storage of this material is considered low. A complaints procedure will be put in in place and in the unlikely event of a complaint, the incident will be investigated and recorded in line with this procedure.	Very Low	Low	Very Low

Table 3-3: Noise and Vibration Risk Assessment and Management Plan

Hazard	Receptor	Pathway	Risk management	Probability of exposure	Consequence	What is the overall risk?
Noise and vibration from operation of the GHPF.	Pembrokeshire Marine Special Area of Conservation (SAC) and Milford Haven Waterway Site of Special Scientific Interest (SSSI) immediately adjacent to the installation at the nearest point. Local residents 1.5 km east. Oil Refinery workers 1.3 km west.	Air	The electrolysers and compressors will operate within a building which will reduce the potential for external noise nuisance. The compressors and electrolyser plant are provided with additional sound insulation to reflect the BAT for minimising sound emissions. A complaints procedure will be put in in place and in the unlikely event of a complaint, the incident will be investigated and recorded in line with this procedure. A noise impact assessment has been undertaken and is included in Appendix B of the main permit application. This concluded that noise impacts from the operation of the GHPF are considered not significant.	Low	Very Low	Very Low
Noise from flaring	Pembrokeshire Marine Special Area of Conservation (SAC) and Milford Haven Waterway Site of Special Scientific Interest (SSSI) immediately adjacent to the installation at the nearest point. Local residents 1.5 km east. Oil Refinery workers 1.3 km west.	Air	The flare will only operate during start up, shut down and any emergency shut down situations. Under normal operation of the GHPF only the pilot light would be in continuous operation, not the flare itself. Operation of the pilot light would involve low gas flows which would not be expected to result in significant sound emission. Any additional loads to the flare are only expected to occur during start up, shut down and any emergency shut down scenarios. The impact of sound emission from these normal and occasional operating scenarios would be expected to be low.	Low Activity will be intermittent	Low	Low

[1] The Water Resources (Control of Pollution) (Oil Storage) (Wales) Regulations 2016 (legislation.gov.uk)

Table 3-4: Fugitive Emissions Risk Assessment and Management Plan

Hazard	Receptor	Pathway	Risk management	Probability of exposure	Consequence	What is the overall risk? .
To Air						
Dust	Pembrokeshire Marine Special Area of Conservation (SAC) and Milford Haven Waterway Site of Special Scientific Interest (SSSI) immediately adjacent to the installation at nearest point. Oil Refinery 1.3 km west. Local residents 1.5 km east.	Air	There are no significant dust-generating activities or dusty materials used or stored within the GHGF. In the event of a complaint, the operator would follow the complaints procedure to record the complaint and take appropriate action or provide further monitoring as necessary. The site will maintain a high standard of housekeeping which will minimise potential dust emissions from the site.	Very Low	Very Low	Very Low
Leak of hydrogen	The nearest residential receptor located over 1.5 km east of the GHPF. Oil Refinery workers 1.3 km west.	Air	The hydrogen handling systems will be designed and maintained to be leak free, and will be inspected and maintained to minimise fugitive emissions throughout the life of the facility.	Very Low / Low	Low	Very Low
To Water and Groundwater						
Leak of glycol	Nearest Surface water receptor Milford Haven immediately adjacent to the installation boundary at its nearest point. Pembroke River immediately to the east. Principal and Secondary A aquifers underlying the site.	Surface water drainage system Ground	Glycol is used within the closed-circuit cooling system and is present as a dilute solution. Glycol is not stored within the GHPF, any top-up requirement is brought to site during routine maintenance. Leak and pressure tests will be regularly performed as part of the maintenance on site. Spill kits will be available to contain and clean up any spills. A spillage procedure will be included as part of the management system procedures and will ensure that staff are appropriately trained so to ensure that any risk from spillages is minimised, and they are cleaned up as soon as detected. The surface drainage system includes pen stock valves which can be closed in the event of a spillage and prevent the release off site.	Very Low	Medium This assumes even with management measures the substance reaches the SSSI	Very Low
Leak of oils (from compressor, transformer oil, and diesel fuel oil from emergency backup generator	Nearest Surface water receptor Milford Haven immediately adjacent to the installation at its nearest point. Pembroke River immediately to the east. Principal and Secondary A aquifers underlying the site.	Surface water drainage system Ground	A single 205-litre drum of compressor oil is stored on site. Waste oil will be removed directly off site after being replaced. Diesel will be stored in a 1.3 tonne tank in compliance with the Control of Pollution (Oil Storage) (Wales) regulations[2]. Transformer oil is not stored on site and is limited to the inventory of the system. A hard, impermeable surface will underlie the hydrogen compressor to prevent fugitive emissions to groundwater should spills / leaks occur. Drainage within the GHPF includes oil interceptors and pen stock valves which can be closed in the event of a spillage and prevent the release off site. Leak and pressure tests will be regularly performed as part of the maintenance on site. Spill kits will be available to contain and clean up any spills. A spillage procedure will be included as part of the management system procedures and will ensure that staff are appropriately trained so to ensure that any risk from spillages is minimised, and they are cleaned up as soon as detected.	Very Low	Medium/High This assumes even with management measures the substance reaches the SSSI or aquifer	Low

[2] The Water Resources (Control of Pollution) (Oil Storage) (Wales) Regulations 2016 (legislation.gov.uk)

Hazard	Receptor	Pathway	Risk management	Probability of exposure	Consequence	What is the overall risk? .
Leak of chemicals (sodium hydroxide, hydrochloric acid, biocide, corrosion inhibitor and hardness stabiliser, and potassium hydroxide for AEL system)	Nearest Surface water receptor Milford Haven immediately adjacent to the installation boundary at its nearest point. Pembroke River immediately to the east. Principal and Secondary A aquifers underlying the site.	Surface water drainage system Ground	All chemical storage tanks/containers will be appropriately bunded in accordance with CIRIA 736 to industry standard and with 110% secondary containment. Sodium hydroxide and hydrochloric acid will be stored in separate secondary containment. A hard, impermeable surface will underlie all chemical and oil storage areas to prevent fugitive emissions to groundwater should spills / leaks occur. The surface drainage system includes pen stock valves which can be closed in the event of a spillage and prevent the release off site. Spill kits will be available to contain and clean up any spills. Regular inspections will be carried out to detect for any signs of deterioration and repairs made as necessary. Spillage procedure will be included as part of the management system procedures and will ensure that staff are appropriately trained so to ensure that any risk from spillages is minimised, and they are cleaned up as soon as detected.	Very Low A significant release would only occur in the event of an accident/incident and would require failure of both primary and secondary containment	Medium/High This assumes even with management measures the substance reaches the SSSI or aquifer.	Very Low
Litter						
Waste release from GHPF	Pembrokeshire Marine Special Area of Conservation (SAC) and Milford Haven Waterway Site of Special Scientific Interest (SSSI) immediately adjacent to the installation at nearest point Pembroke River immediately to the east. Oil Refinery 1.3 km west Local residents 1.5 km east	Air	Waste generation from maintenance is infrequent. The main wastes produced are associated with periodic replacement of plant items. Potassium hydroxide will not be stored on site and will be directly removed from site after being replaced approximately every 5 years (see above for consideration of a leak). Waste compressor oil is not stored on site and will be directly removed from site after being replaced as and when required (see above for consideration of a leak). Electrolyser stacks will be replaced every 8 to 10 years and removed off site. Stacks will be refurbished rather than directly replaced and disposed to reduce waste production. Deoxo catalyst and adsorbent will not be stored on site and directly removed from site after being replaced approximately once a year. Resin filters will be replaced every 9 months and removed on site prior to being replaced. All staff will be trained in waste management procedures by their supervisors. All wastes produced during maintenance tasks will be immediately removed from the installation following completion of the relevant maintenance task.	Very Low	Very Low	Very Low
Pests						
Flies and other pests or vermin	Oil Refinery 1.3 km west Local residents 1.5 km east	Land/Air	The GHPF is not expected to be highly attractive to pests. All hardstanding areas will be regularly swept and maintained in good working order. Site housekeeping procedures ensure that site areas are routinely checked and should litter be identified arrangements would be made to clean the affected area. Routine pest control is undertaken with additional measures to be used in accordance with advice from a pest control specialist should a problem arise.	Very Low	Low	Very Low

Table 3-5: Accidents Risk Assessment and Management Plan

Hazard	Receptor	Pathway	Risk Management	Probability of exposure	Consequence	What is the overall risk?
Flooding	Special Area of Conservation (SAC) and Milford Haven Waterway Site of Special	Water Ground	The GHPF is within Flood Zone A, considered to be at little or no risk of fluvial or coastal/tidal flooding, including the effects of climate change, and the risk of groundwater flooding is also considered low due to the underlying geological conditions.	Very Low	Medium/High	Low

Hazard	Receptor	Pathway	Risk Management	Probability of exposure	Consequence	What is the overall risk?
	Scientific Interest (SSSI) immediately adjacent to the installation at its nearest point, and Pembroke River immediately to the east. Principal and Secondary A aquifers underlying the site.		A new drainage system will be installed to separately handle process wastewater and surface waters from the new GHPF. The new drainage system will connect into the existing power station drainage. Surface water will be discharged from site via an existing headwall into a swale drainage system with check dams at 10m intervals that will direct surface water to an attenuation basin and ultimately discharging into the existing surface water network via an existing manhole connection. In an emergency event the penstock valve can be shut to stop the discharge of any contamination to surface water. As part of the site's emergency procedures, the appropriate procedures for responding to, reporting and investigation in the event of a flood will be assessed.		This assumes even with management measures the substance reaches the SSSI and/or aquifer.	
Fire/Explosion causing emission to air	Special Area of Conservation (SAC) and Milford Haven Waterway Site of Special Scientific Interest (SSSI) immediately adjacent to the installation at its nearest point. at nearest point. Oil Refinery 1.3 km west. Local residents 1.5 km east.	Air	Hydrogen is a flammable gas and could pose a fire or explosion risk from storage and pipeline transport within the GHPF and in the export pipeline (albeit the pipeline sits outside of the installation boundary). Hydrogen will be stored in fully contained systems which will be regularly checked and maintained. Should any leaks occur, the system will be isolated, and repairs made. Subject to final design of the flare, propane gas may be used to fuel the flare pilot light. Like hydrogen, propane poses a risk of fire / explosion. As such, propane would be stored securely in a fully contained system and would also be subject to regular checks and maintenance. In the event of a leak being detected, the system would be isolated to allow repairs to be carried out immediately. Fire alarms, detection/suppression systems will be installed in the GHPF. Staff will be trained in emergency fire procedures and actions to take in the event of a fire at the site. The firefighting system at the GHPF will be a water based system, no foam will be used. The firewater will be contained and tested before disposal. The GHPF will have a hazardous substances consent (HSC) which will detail management of storage of hydrogen and propane (should propane be included in the final design).	Low	Low/ Medium Short term impacts	Low
Failure to contain firewater	Special Area of Conservation (SAC) and Milford Haven Waterway Site of Special Scientific Interest (SSSI) immediately adjacent to the installation at its nearest point. at nearest point, and Pembroke River immediately to the east. Principal and Secondary A aquifers underlying the site.	Surface Water Drainage System Ground	The GHPF has incorporated a 2,400 m^3 underground cellular firewater storage tank to enable run-off from firefighting to be contained in the event of a fire incident. The drainage system includes penstock valves upstream of the surface water attenuation basis which can be closed in the event of a fire or spillage to prevent contamination of clean surface water in the attenuation pond and ensure all contamination is held within the installation boundary. Oil interceptors (class 1) are included within the surface water drainage system, and these will be regularly emptied and maintained. Firefighting will be carried out in accordance with advice from the Fire and Rescue service. In the event that firewater is required the fire water would be contained. Fire response systems will ensure a rapid response thereby addressing the fire at the earliest point. Staff will be trained in emergency fire procedures and actions to take in the event of a fire at the site.	Low	Medium/High	Low
Vandalism	Air/water/land Depending on the nature of the incident: Oil Refinery 1.3 km west, local residents 1.5 km east and Special Area of Conservation (SAC) and Milford Haven Waterway Site of Special Scientific Interest (SSSI) immediately adjacent to the installation at its nearest point	Various	Security fencing, gates, full time security, CCTV will all be in place prior to commissioning of the GHPF. The security in place at the site will minimise the likelihood of any potential trespassers and potential vandalism.	Very low	Variable depending upon nature of incident	Low

Hazard	Receptor	Pathway	Risk Management	Probability of exposure	Consequence	What is the overall risk?
Loss of power	Air	Air	An uninterruptible power supply (UPS) will be provided by batteries to ensure that in a fault event the electrolyser plant can still be shut down safely. In addition to the UPS, a 500 kW emergency diesel generator will be provided and would only provide power to safely shutdown the plant in the event of a power failure. Routinely the generator will only be run for short periods (30 to 60 minutes) on a monthly basis for testing purposes.	Very Low	Very Low	Very Low
Operator error	Air/land/water – Milford Haven	Variable – dependent on nature of the error	The GHPF will be controlled by an automatic control system, reducing the likelihood of operator error. The automatic control system will include alarms to alert the Operator of potential operational problems and where relevant will be triggered with sufficient safety margin to permit operator intervention to prevent an incident. All operational staff will be fully trained against the site operating procedures which cover normal, abnormal and emergency operating conditions. Training will include raising awareness of key plant parameters and the potential implications of failure to control operations as designed and the associated potential impact on the environment.	Low	Variable depending upon nature of incident	Low

4 CONCLUSIONS

4.1.1 The environmental risk assessment (ERA) report has been undertaken to assess the likelihood of risk from amenity and accidents, air emissions and global warming potential associated with the proposed GHPF.

4.1.2 The results of the ERA have shown that the risk of odour, noise and vibration, fugitive emissions, and accidents range from ‘very low’ to ‘low’.

4.1.3 Emissions to air are limited to the release of oxygen which is not an air quality pollutant and flaring. Flaring will operate during start-up and shutdown. It is estimated that there may be up to 15 start-up and shut-down events per year. The duration of flaring for each shutdown is expected to be circa 5 minutes and for each startup (assuming cold start-up) the flare will operate for 10 minutes. On this basis emissions from flaring for each event will be short-term. As the plant will not operate for more than 18 times a year, the objective is considered to be met.

ENVIRONMENTAL RISK ASSESSMENT

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