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**GCU-OE Environment & Chemistry**

Your ref.	PAN-010169
Your letter	-
Our ref.	PMB/EBGP/20-2
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28<sup>th</sup> July 2020

**Proposed Emergency Back-up Generating Plant at Pembroke Power Station  
Further Information Requested by NRW.**

Dear Kirsty,

In response to your letter dated the 14<sup>th</sup> July 2020 requesting further information in order for you to proceed with our application for a permit variation, we would like to provide the following information.

In order to make our response as clear as possible we have addressed each point individually, including your request in bold italics, followed by our response. Where more information was required it is attached within the appendices and signposted below.

***You have indicated that engines are tested once every 2 years but please confirm the number of testing hours for each engine.***

National Grid Electricity System Operator (NGESO) will have the right to request physical testing of the proposed self-start capability of the power station no more frequently than once every 2 years. The technical scope of their witness test is governed by the Grid Code, therefore the duration of each is reasonably consistent and predictable. The detailed testing programme, including the date for any test, is agreed between NGESO and RWE just prior to each test.

RWE believe that it is reasonable to assume that each auxiliary engine will operate for up to 5 hours during each two year period to satisfy this testing requirement, i.e. a total of up to 15 hours for all engines, every 2 years.

***Confirm how you test the backup engines as well as how long for (do you have a testing and maintenance plan you could send me a copy of which details some examples below):***

***-When you test backup engines you should:***

***-stagger the tests if you have multiple backup engines***

***-keep testing times and frequency to the minimum – just enough to demonstrate reliability at the appropriate load***

***-only test when you expect low ambient nitrogen oxides (NOx) background, such as not during peak traffic periods***

...

**-use the electricity generated from the test on your site**

**-install backup generators away from sensitive receptors (not below windows or venting onto car parks) and terminate the exhaust flues vertically, making sure there are no obstructions.**

Clarke Energy have proposed a maintenance/caretaker programme for the plant in their scope of supply including gas engines and battery system (BESS). This provides for monthly maintenance/caretaker visits, to include the tasks summarised in Appendix A. Whoever carries out this work for RWE in the future, the routine maintenance programme will be similar.

The engine manufacturer recommends running the engines monthly on full load, allowing the engine to warm up properly and achieve a stable temperature before being shut down. RWE proposes to run each engine for one hour each month, to ensure it is kept in working order.

***The Noise Impact Assessment provided states that “In the event of an emergency involving loss of Grid supplies, the EBGp would operate for up to 7 days continuously (the capability to do this is a standard NGENSO requirement). During this period the gas engines would run continuously.” I’m not clear if this scenario is demonstrated in the Air Quality (AQ) assessment (as this is based on back up engines running simultaneously at full load for 500 hours/year and the 3 engines running for 7 days would equate to 504 hours). Please clarify.***

The AQ assessment does cover the seven day NGENSO requirement and goes well beyond that. It assesses a worst case of all the EBGp engines running simultaneously (in order to assess the maximum possible impact in each and every operational hour) for up to 500hrs in a given year. So the AQ assessment is based on the EBGp running at full capacity for 500 hours (i.e. a total of 1500 engine hours), rather than a total of 500 engine hours.

Unless a loss of supply emergency occurred in any given year, the total gas engine operating hours during that year would be a maximum of 50 to 60 hours total across all gas engines (12hr per engine for routine monthly testing plus ~ 5hr per engine if NGENSO required a witnessed self-start test during the year).

Operation could be at any time during the year, i.e. random hours or groups of hours, up to ~20 (500/24) sequential days, etc. Section 5.1 and Appendix B of the AQ assessment report explain this a little more; in particular the statistical assumption used to assess short term impacts for 500hrs operation when modelling a whole year of continuous operation to capture all meteorological conditions. For completeness and transparency, Appendix C of the AQ assessment report presents short and long term NOx modelled impacts for the EBGp running continuously at full capacity throughout the whole year.

***I assume this would overlap with the operation of the main CCGT engine too when it is up and running. Can you also provide further clarity on if there will be overlap with the start up of the main CCGT engines with the EBGp and how long for. We would expect the impacts for noise and air quality for the site to be considered as a whole.***

The CCGT plant at Pembroke has been in full commercial operation for 8 years and therefore the power station's contribution to local and regional ambient NO<sub>x</sub> concentrations is now inherently taken into account as part of background NO<sub>x</sub> levels. To include explicitly for the existing power station contribution in the assessment would be to double-count the power station's contribution to existing NO<sub>x</sub> levels.

The original AQ assessment for the existing power station has already been provided to you.

As explained in Sections 1 and 4 of the AQ report, the methodology employed in the assessment inherently covers the situation where engines and CCGT units run simultaneously under normal operating conditions, even though in practice this will only occur on the very rare occasions when engines are tested and CCGTs are also operational. For the specific case of CCGT start up, NO<sub>x</sub> emissions will actually be lower than under normal operating conditions. Total impacts can be calculated by combining representative background impacts (which include contributions from the Pembroke station CCGTs, given it has been operational for 8 years) with modelled engine impacts, using standard approaches adopted by regulators to assess Process Contributions (PCs) and Predicted Environmental Concentrations (PECs). In most cases calculation of the PEC is unnecessary because the PC is below screening thresholds.

To calculate a PEC by modelling CCGT impacts and adding to engine and background impacts would be double-counting CCGT contributions, which are already represented in background data. It is also worth noting that maximum short term NO<sub>x</sub> impacts for engines and CCGTs will tend to occur at different times and locations due to the large difference in stack heights, so maximum impacts are not additive. There is in any case limited overlap between the plumes from the CCGTs and the EBGp for the same reason.

***Confirm if battery storage is relative to engines is optimised. Could you have a larger battery storage and less engines? This may be detailed in the Project Description document submitted which I have not had chance to review in significant detail yet, if so please direct me to the appropriate section.***

The factors behind the choice of a hybrid gas engine /battery EBGp as opposed to an all-gas engine scheme are explained in Section 2.4 of the Project Description document.

The gas engines and the battery system serve different purposes. As shown in Figure 1 of the Supporting Document, the auxiliary power demand during the start-up of a main CCGT unit is characterised by short term peaks when the gas turbine is run up and major auxiliary plant items are started. The purpose of the battery system is to meet these short term peaks of demand for auxiliary power.

The purpose of the gas engines is to meet the sustained component of auxiliary power demand, including after the main CCGT unit has started, and to maintain charge on the battery system, during a loss of supply emergency.

It would not be practical or cost-effective to increase battery capacity to cover

all or part of the sustained component of auxiliary power demand. To illustrate this point, to supply 1MW of continuous demand for 7 days (the endurance period required by NGESO) would require 168 MWh battery capacity for this purpose alone, compared to the proposed battery energy storage capacity of approximately 6 MWh.

**Confirm how many gas-fired boilers for the pressure reduction facility containing. Is it 1 or 2? Be specific.**

There will be 2 boilers, but only one will be in operation when gas engines are required to operate, the other will be on standby.

**The application form C3 table 1a does not match the tables 1.1 and 1.2 of the supporting document (Application for Variation of Permit ref. EPR/DP3333TA to cover operation of Emergency Back-up Generating Plant Supporting Document) in terms of activities to be listed in the permit. Please update the C3 form to correctly list all activities and DAA's to be added.**

See Appendix B

**Form C3 table 2 - there will be emissions to air from the gas-fired boilers for heating. These should be listed in table 2 also on the C3 form.**

See Appendix B

**Please can you include Carbon Monoxide (CO) in the H1 screening tool so it's clear it screens out and doesn't need to be considered further.**

The revised H1 screening tool will be provided when available (by early next week at the latest) via Pembroke Power Station's file sharing facility (see under WYG reports below).

Combustion of natural gas in the EBGp gas engines will result in some CO formation, as will be the case in any activity where fossil fuels are burnt, due to imperfect mixing of fuel and air. Such emissions are minimised and combustion efficiency maximised by monitoring the air:fuel ratio, controlled by the supply of 'excess air'.

Impacts from the EBGp CO emissions do not in fact screen out when applying the generic 'H1' assessment. Our experience is that this is always the case for permitted combustion activities, due to the conservative assumptions used in the 'H1' approach, which are generally not relevant to real world scenarios. However, where we have carried out site-specific modelling for our combustion processes, including all our gas engine sites and the CCGTs at Pembroke station, we have always found CO impacts are a small fraction of the relevant air quality standards at locations of relevant human exposure. Given there has never been a failure to comply with the EU limit value for CO in any EU country or the UK National Air Quality Objective (NAQO) in the UK since the limit value was introduced in 2005, this is perhaps not surprising.

Following discussions with NRW we have modelled CO impacts across the same grid used to assess human health impacts for NO<sub>2</sub>. All modelling assumptions were as used for NO<sub>2</sub>, with the CO emission rate taken as 2.47g/s

per engine, derived from a bona fide emission concentration of 1050 mg/Nm<sup>3</sup> (@5% dry O<sub>2</sub>), provided by the engine supplier.

Maximum modelled EBGp CO impacts (max 8-hr rolling mean) across the whole modelling grid assuming continuous running throughout each specified year were as follows:

Year	2001	2002	2003	2004	2005
<b>Maximum modelled EBGp CO impact (µg/m<sup>3</sup>)</b>	635	989	594	659	536

These maxima occur on-site in the immediate vicinity of the gas engines, due to downwash effects.

So the maximum impact at **any** location is 989µg/m<sup>3</sup>, i.e. 9.89% of the 10,000µg/m<sup>3</sup> limit value; below the 10% short-term impact screening threshold **even if all the engines ran continuously at full load for the whole year**. Including modelled impacts for the main station running at full load throughout the year has no effect on this maximum modelled impact, because respective plumes do not overlap, with the maximum contribution from the EBGp occurring on-site close to the engines. So the maximum impact across the modelling grid for the main station + EBGp is the same as the maximum for EBGp alone.

These modelling results clearly show that CO impacts at any location with relevant human exposure will be insignificant, with no adverse effect on human health, regardless of the operating regime of the EBGp and main Pembroke station.

**Confirm you are not applying for any commercial confidentiality.**

I can confirm that we are not applying for commercial confidentiality.

**Please provide a copy of the WYG reports ‘WYG RWE Pembroke Power Station Ground Conditions Desk Top Study October 2018 and WYG RWE Pembroke Power Station Ground Investigation Report May 2019’ to support the Site Condition Report provided.**

Since the Site Condition Report was prepared, both these WYG reports have been superseded. Some of the information in the 2018 report had been superseded by the 2019 report. Therefore the 2019 report has been revised and reissued and the remaining valid content of the 2018 desktop study report has been subsumed in the revised report, ‘WYG RWE Pembroke Power Station Ground Investigation Report, June 2020’.

The Site Condition Report (RWE ref. ENV/653/2020) has been reissued with the references to the WYG reports updated accordingly. The revised version is attached as Appendix C.

The June 2020 revised WYG report, with its appendices, is too big to send as an e-mail attachment. Arrangements are being made by my colleagues at Pembroke to give you access to it via their file sharing facility.

***There are Ancient Woodlands within screening distance that have not been considered in the Air Quality assessment. Please provide details on the impacts the proposed activity will have on these sites/ update the Air Quality assessment as necessary.***

See Appendix E

***The Gweunydd Somerton Meadows SSSI appears to be within 2km of the proposed activity but hasn't been assessed in the Air Quality assessment. Please provide details on the impacts the proposed activity will have on this site.***

See Appendix E

***There are several sites such as Pembrokeshire Bat Sites and Bosherton Lakes SAC that are not assessed within the Air Quality assessment. There is reference to them being screened out in the document 'Response to Queries about Potential Effects on Special Areas of Conservation' but could not see detailed information on why some sites have not been looked at further. Please provide further information.***

See Appendix E.

Attention is also drawn to the Test of Likely Significant Effect (TLSE) document issued by Pembrokeshire County Council, in consultation with, and with the agreement of, NRW in April 2019 and included in the document 'Response to Queries about Potential Effects on Special Areas of Conservation' as Appendix A thereto. This TLSE document screened out certain European sites, including in particular Pembrokeshire Bat Sites and Bosherton Lakes SAC. Given the screening-out of this and other sites in the TLSE document the potential effects of the EBG project on the sites in question were not considered further in the submitted documentation.

***The final treatment or disposal method and location of treatment/disposal of waste arising from the EBG will be in line with the current arrangements at Pembroke Power Station. The management of operational waste from the EBG will be undertaken by staff at Pembroke Power Station. The details above are estimated based on similar plant at other RWE power stations." Clarify what these arrangements are.***

Pembroke Power Station is regulated under the Environmental Permitting Regulations and as such is subject to regular auditing by NRW, this includes auditing of our onsite waste arrangements as well as the relevant documentation and returns.

The site has various waste disposal/ recycling areas and a waste compound managed by onsite personnel. Disposal/ recovery of waste offsite is then undertaken by our waste contractor. This process is defined and controlled under our Environmental Management System, which is certified to ISO14001:2015 by a UKAS accredited certification body, through a central portfolio procedure and a local implementation record. These are attached in Appendix F.

Any waste arising from the EBGp will enter this process along with all other site waste, these quantities will be minor and incidental.

***The back-up engines are cogeneration engines. Please can you confirm that this a Combined Heat and Power engine type.***

Although the engines proposed are capable of Cogeneration that mode of operation is not suitable for this application. In order for successful combined heat and power operation the demand for heat and its supply must be synchronised, i.e. the heat is available when required. As these engines will be kept in reserve, ready to respond in the event of a loss of Grid power supplies, the availability of heat from them will be intermittent, unpredictable and rare. This renders them unsuitable for CHP operation in this instance.

These are emergency plant that will operate so infrequently that any loss of heat to atmosphere is inconsequential.

***Please provide a copy of the noise and vibration management plan.***

See Appendix G

***Please elaborate on the main unit supply restoration (SR) operating mode in terms of what will change: details of changes in steam system and GT operation, potential for increased noise due to safety valve lifts or higher steam by-pass flows, load profile details, associated emissions profiles for NOx and CO and any implications for part-load ELVs and updated air quality assessments if necessary.***

Supply restoration (SR) operation is unpredictable and the exact details will depend on the extent of the loss of Grid and the demand in specific areas at the time of restoration. This process will be led by National Grid, asking for increases in power to the Grid as and when required. It is not possible to supply a load profile as this will vary with each occurrence.

During SR the steam system and GT will operate fundamentally as they normally would, in that the energy within the steam cycle will increase as heat is transferred to it from the GT exhaust gas. The GT is likely to idle for longer than normal at lower loads as the Grid recovers, but to what extent and at what output levels is impossible to predict.

No additional safety valve lifts are anticipated, especially with the GT at lower output levels and not transferring large amounts of energy to the steam cycle, reducing the likelihood of overpressure. This is not normal operation, widespread power grid failures in the UK of the type requiring use of the proposed emergency back-up generating plant are extremely rare and the activation of safety systems such as safety valves cannot be ruled out, under any mode of operation. However, during the routine operation of the power station, its safety valves do operate and are tested: the plant is well designed and no complaints have been received related to safety valve operation over the 8 years of full operation at Pembroke.

Steam by-pass operation is likely for extended periods during SR. However, steam by-pass occurs every time a unit is brought into operation (daily) and for

extended periods when units are brought back from outage or extended periods of no operation (several times per year per unit). As with safety valve operation no complaints related to steam by-pass operation have been received at Pembroke to date.

Levels of NO<sub>x</sub> are lower under these low load conditions, while CO levels are higher. However these elevated levels of CO production are for very short periods and will occur predominantly when the other units are not operating, therefore the mass release of CO is unlikely to increase significantly. Once the unit restarting has achieved stable export limit (approx. 190MW) it will be subject to, and compliant with, its normal permit limits.

It must be remembered that activation of the EBGp would be in response to a national or local emergency resulting from loss of Grid power supplies. In order to restore supplies and minimise the danger and disruption that would cause, periods of operation in this mode will be minimised with normal operation restored as soon as possible. Therefore although SR operation is unpredictable it is unlikely; any abnormal emissions to air or nuisance caused, although unlikely, will be the consequence of responding to this emergency, short-lived and kept to a minimum.

The probability of a loss of supply emergency requiring use of the EBGp is very low based on past experience. There has not been an incident of this type which has required generating stations to self-start without external power supplies for over 10 years. There have been lesser incidents within the UK-wide network where there have been localised losses of supply or some electricity consumers have been disconnected to prevent the situation escalating to a complete shutdown of the transmission system in accordance with National Grid's standing emergency procedures.

***Confirm if you have applied for a Greenhouse Gas Permit for the activity. You can contact [GHGHelp@cyfoethnaturiolcymru.gov.uk](mailto:GHGHelp@cyfoethnaturiolcymru.gov.uk) for more help.***

We can confirm that we have been in touch with GHGHelp with brief details of what we are likely to be applying for. However in order to make an application we will need some very specific information, such as serial numbers of flow meters etc., this information will not be available until we have more details regarding the plant. When this is available we will make an application to vary Pembroke Power Station's existing Greenhouse Gas Emission permit. GHGHelp have thanked us for the information and look forward to receiving our application.

***Are emissions such as Mercury etc actually coming from these engines (even if insignificant)? Can you detail how they are insignificant please?***

Emissions of all trace elements from CCGT, CHP and conventional units firing natural gas are assumed to be zero except for mercury. Mercury is found in natural gas at a very low concentration and is assumed to be released entirely in the vapour phase. The JEP 2019 Pollution Inventory (PI) methodology used to calculate annual loads for PI and E-PRTR reporting assumes 100ng

mercury emitted/m<sup>3</sup> natural gas consumed, where the gas is supplied via the National Transmission System (as in the case of Pembroke).

I trust that all the information you require in order to progress with our application is now enclosed. If you have any queries on the above, please contact the undersigned in the first instance.

Yours sincerely

*Neil B K Richardson*

Neil Richardson  
Principal Consents and Permitting Advisor  
RWE Generation UK plc

Enclosures and References: Please see attached list.

## **List of Enclosures and References**

- Appendix A Monthly routing maintenance/caretaker activities for gas engines.
- Appendix B Revised application form Part C3 (including additions to Table 1a) & separate sheet including replacement Part C3 Table 2.
- Appendix C Revised version (v1.2) of site condition report (RWE ref. ENV/653/2020) with updated references to WYG reports.
- Appendix D Not used.
- Appendix E Annex to RWE Report ref. ENV/649/2019: RWE Generation UK plc: Proposed Emergency Back-up Generating Plant, Pembroke. Air quality impact assessment.
- Appendix F RWE Generation UK EMS: Management of Waste. (RWE ref. GMD-ENV-007 v1) & associated Pembroke-specific implementation record.
- Appendix G Operational noise and Vibration Management Plan, February 2012.

### Documents provided or to be provided via file-sharing facilities:

Revised version of White Young & Green ground investigation report: 'RWE Pembroke Power Station Ground Investigation Report, June 2020'.

Revised version of completed H1 screening tool including carbon monoxide emission data for gas engines.