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GCU-OE Environment & Chemistry

Your ref.	PAN-010169
Your letter	-
Our ref.	PMB/EBGP/20-3
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19th August 2020

Pembroke Variation Application ref. PAN-100169 Supply Restoration Mode, Carbon Monoxide and Formaldehyde

Dear Kirsty,

In response to your e-mail dated 14th August 2020, I would like to clarify a number of points, as follows.

Modifications to main CCGT units and operation in supply restoration (SR) mode

As we explained in section 4.4 of our project description document ENV/647/2019, the main CCGT unit being operated in a supply restoration situation following a black start has to be capable of picking up sudden increases of load ("block loads") almost instantaneously as successive groups of consumers are reconnected. To do this the unit concerned will have to be operated differently from normal. Modifications will be made to the control systems of Units 11 & 31 (the units to be made black start-capable) to facilitate operation under these conditions. These changes will not affect the normal operation of these units.

In supply restoration (SR) mode, the operation of the gas turbine will be exactly the same as in normal operation at the same gas turbine power output. It is the steam plant which will be operated differently, to provide a reserve of energy enabling the steam turbine and hence the generator to increase output immediately in response to a block load, for a very short time until the gas turbine output can increase in response to the step increase in load. Therefore the operation of a main CCGT unit in SR mode does not increase the likelihood of the formation of products of incomplete combustion (e.g. formaldehyde) as compared to normal main unit operation.

(N.B. This reliance on the steam turbine to pick up block loads is specific to the CCGT units at Pembroke and the similar plant at Staythorpe.)

Whether the main CCGT unit concerned is operating in SR mode will not affect carbon monoxide emissions from the gas turbine at any given gas turbine load. However, emissions of carbon monoxide and potentially other products of incomplete combustion are of course affected by the load at which the unit is operating. During an emergency situation following a failure of Grid supplies,

the main CCGT units would be operating under the instructions of NGESO, and the loading of those units would be outside RWE's control.

Loading of main CCGT units during and following a black start event

A CCGT unit operating under the instructions of NGESO in an emergency situation following a failure of Grid supplies may be required to operate at abnormally low load for a sustained period. This applies whether the unit concerned is black start-capable or not, and, whether or not it has been the subject of a black start instruction during the emergency event in question.

This low-load operation of a main CCGT unit at Pembroke following a black start event, and the associated emissions including carbon monoxide, and potentially formaldehyde and other products of incomplete combustion, could still occur even if the EBGp scheme (to which the current variation application refers) does not go ahead. This issue is addressed for Pembroke Power Station by Condition IC8 of the recently issued "BREF" variation EPR/DP3333TA/V004.

Gas engine operation during and following black start

The hybrid EBGp scheme which RWE proposes for Pembroke has the major advantage that during a black start the gas engines will be loaded quickly and operate at close to full output thereafter until conditions on the Grid have been stabilised. This is possible because the battery system will cover the short term peaks of auxiliary plant and Station services load, while any excess of power can be used to recharge the batteries. Frequent starts, stops and sustained low-load operation of gas engines will therefore be avoided, minimising the potential for the emission of products of incomplete combustion including formaldehyde.

Formaldehyde

Small quantities of formaldehyde and other organic products of incomplete combustion can form during combustion of natural gas in situations where there is inadequate mixing, temperature and/or residence times. This will be most significant for engines and turbines during periods of start-up and low load operation.

Formaldehyde is a human carcinogen, but associated risks are only significant where there is long term human exposure. It also may have the potential to cause nose and throat irritation from low level exposure over the short term (WHO (2000)).

In recognition of the above risks, EA and NRW have adopted short and long term Environmental Assessment Levels (EALs) for formaldehyde of $100\mu\text{g}/\text{m}^3$ (hourly mean) and $5\mu\text{g}/\text{m}^3$ (annual mean), respectively, derived from WHO

(2000). These are guideline values and not legally binding standards or objectives.

Formaldehyde emissions from gas engines

As noted above, in the hybrid scheme as proposed by RWE, in a black start event the gas engines will run up quickly to close to full load and then run steadily at high load. This will, in itself, minimise the production of formaldehyde and related organics.

Any formaldehyde which is produced will undergo the same dispersion processes as described for other substances, with maximum plume impacts concentrated within the site boundary close to the engines. Given the low operating hours and load profile of the EBGp it is extremely unlikely that significant formaldehyde emissions will coincide with meteorological conditions which would cause maximum short term (hourly mean) impacts at locations of relevant exposure.

Long term impacts will be insignificant due to the low operating hours and the way in which the individual engines are operated (rapid loading and operation close to their maximum output), giving little opportunity for products on incomplete combustion such as formaldehyde to be formed.

The impact of formaldehyde and other organic products of incomplete combustion relating to the operation of these engines is not considered to present any risk.

I trust that the above answers your queries but if you have any further questions please contact me in the first instance.

Yours sincerely

Neil B K Richardson

Neil Richardson
Principal Consents and Permitting Advisor
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Reference:

WHO (2000). Air quality guidelines for Europe. Second edition. Page 87.