

Environment Agency

Review of an Environmental Permit under the Environmental Permitting (England & Wales) Regulations 2010 (as amended)

Decision document recording our decision-making process following review of a permit

The Permit number is: EPR/VP3538XX
The Operator is: RWE Generation UK Plc
The Installation is: Staythorpe C Power Station
This Variation Notice number is: EPR/VP3538XX/V004

What this document is about

All Environmental permits which permit the operation of large combustion plant (LCP), as defined by articles 28 and 29 of the Industrial Emissions Directive (IED), need to be varied to implement the special provisions for LCP given in the IED, by the 1 January 2016 (Article 82(3)). The IED makes special provisions for LCP under Chapter III, introducing new Emission Limit Values (ELVs) applicable to LCP, referred to in Article 30(2) and set out in Annex V.

The IED provides a period of transition towards the new ELVs via Article 32, the Transitional National Plan (TNP). It also makes provision for plant that wish to be exempted from compliance with the new ELVs in Article 33, the Limited Life Derogation (LLD). Other derogations include limited operating hour regimes for sites using 500 hr or 1500 hr derogations. There are also options for exemption from emission limits based on operating hours.

The operator has submitted responses to our notices requiring information, issued under regulation 60(1) of the Environmental Permitting Regulations (EPR), which has provided us with information on which compliance route they wish to follow for each LCP. The responses also include specific details relating to each LCP, necessary for accurate implementation the IED requirements. A copy of the regulation 60 notice and the operator's response is available on the public register.

We have reviewed the permit for this installation, including all variations since the last permit consolidation, and referred to the operator's responses to the regulation 60 notices requiring information. This is our decision document,

which explains the reasoning for the consolidated variation notice that we have issued.

It explains how we have reviewed and considered the compliance routes and, where relevant, the emissions limits proposed by the Operator for each LCP on the installation. This review has been undertaken with reference to the:

- Chapter III and annex V of the IED
- “IED BAT ESI Review Paper, 28 October 2014” produced by the Environment Agency (referred to as the “2014 ESI BAT review paper” in this document)
- “Electricity Supply Industry – IED compliance protocol for Utility Boilers and Gas Turbines”, published by the Joint Environmental Programme.

It is our record of our decision-making process and shows how we have taken into account all relevant factors in reaching our position. It also provides a justification for the inclusion of any specific conditions in the permit that are in addition to those included in our generic permit template.

As well as implementing the chapter III IED compliance of the installation, the consolidated variation notice takes into account and brings together in a single document all previous variations that relate to the original permit issue. It also modernises the entire permit to reflect the conditions contained in our current generic permit template.

The introduction of new template conditions makes the Permit consistent with our current general approach and philosophy and with other permits issued to installations in this sector. Although the wording of some conditions has changed, while others have been deleted because of the new regulatory approach, it does not reduce the level of environmental protection achieved by the Permit in any way. In this document we therefore address only our determination of substantive issues relating to chapter III review

How this document is structured

Glossary

1. Our decision
2. How we reached our decision
3. The legal framework
4. Key Issues

GLOSSARY

Baseload	means: (i) as a mode of operation, operating for >4000hrs per annum; and (ii) as a load, the maximum load under ISO conditions that can be sustained continuously, i.e. maximum continuous rating
BAT	best available techniques
BREF	best available techniques reference document
CCGT	combined cycle gas turbine
Derogation	as set out in Article 15(4) of the IED
Emergency use	<500 operating hours per annum
ELV	emission limit value set out in either IED or LCPD
GT	gas turbine
IED	Industrial Emissions Directive 2010/75/EC
LCP	large combustion plant – combustion plant subject to Chapter III of IED
LCPD	Large Combustion Plant Directive 2001/80/EC
LLD	Limited Life Derogation
MCR	Maximum Continuous Rating
MSUL/MSDL	Minimum start up load/minimum shut-down load
OCGT	Open Cycle Gas Turbine
Peaking	500-1500 operating hours per annum
Part load operation	operation during a 24 hr period that includes loads between MSUL/MSDL and maximum continuous rating (MCR)
TNP	Transitional National Plan

1 Our decision

We have decided to issue the Variation Notice to the Operator. This will allow it to continue to operate the Installation, subject to the conditions in the Consolidated Variation Notice.

We consider that, in reaching that decision, we have taken into account all relevant considerations and legal requirements and that the varied permit will ensure that a high level of protection is provided for the environment and human health.

The Consolidated Variation Notice contains many conditions taken from our standard Environmental Permit template including the relevant annexes. We developed these conditions in consultation with industry, having regard to the legal requirements of the Environmental Permitting Regulations and other relevant legislation. This document does not therefore include an explanation for these standard conditions. Where they are included in the Notice, we have considered the techniques identified by the operator for the operation of their installation, and have accepted that the details are sufficient and satisfactory to make those standard conditions appropriate. This document does, however, provide an explanation of our use of “tailor-made” or installation-specific conditions, or where our Permit template provides two or more options.

2 How we reached our decision

2.1 Requesting information relating to the requirements of Chapter III of and Annex V to the IED

We issued a Notice under Regulation 60(1) of the Environmental Permitting (England and Wales) Regulations 2010 (a Regulation 60 Notice) on 31/10/14 requiring the Operator to provide information for each LCP they operate, including:

- The type of plant, size and configuration.
- The proposed compliance route.
- Minimum start up and shut down loads.
- The proposed emission limits and how they accord with the 2014 BAT review paper.
- For higher efficiency gas turbines where they wish to apply for the NO_x emission derogation, the energy efficiency details of the LCP.
- For gas turbines, proposed emission limits for each unit between the MSUL/MSDL and 70% load, with a justification.

The Regulation 60 Notice response from the Operator was received on 31/03/2015.

We considered that the response did not contain sufficient information for us to commence determination of the permit review. We therefore issued a further information request to the Operator. Suitable further information was provided by the Operator on 14/07/2015 and 09/10/2015.

We considered it was in the correct form and contained sufficient information for us to begin our determination of the permit review

The Operator made no claim for commercial confidentiality. We have not received any information in relation to the Regulation 60 Notice response that appears to be confidential in relation to any party.

3 The legal framework

The Consolidated Variation Notice will be issued under Regulations 18 and 20 of the EPR. The Environmental Permitting regime is a legal vehicle which delivers most of the relevant legal requirements for activities falling within its scope. In particular, the regulated facility is:

- an *installation* as described by the IED;
- subject to aspects of other relevant legislation which also have to be addressed.

We consider that, in issuing the Consolidated Variation Notice, it will ensure that the operation of the Installation complies with all relevant legal requirements and that a high level of protection will be delivered for the environment and human health.

We explain how we have addressed specific statutory requirements more fully in the rest of this document.

Meeting the requirements of the IED

The table below shows how each requirement of the IED has been addressed by the permit conditions.

IED Article Reference	IED requirement	Permit condition
30(6)	If there is an interruption in the supply of gas, an alternative fuel may be used and the permit emission limits deferred for a period of up to 10 days, except where there is an overriding need to maintain energy supplies. The EA shall be notified immediately.	Not applicable-see condition 2.3.5
32(4)	For installations that have applied to derogate from the IED Annex V emission limits by means of the transitional national plan, the monitoring and reporting requirements set by UK Government shall be complied with.	Not applicable
33(1)b	For installations that have applied to derogate from the IED Annex V emission limits by means of the Limited Life Derogation, the operator shall submit annually a record of the number of operating hours since 1 January 2016;	Not applicable
37	Provisions for malfunction and breakdown of abatement equipment including notifying the EA.	Not applicable
38	Monitoring of air emissions in accordance with Ann V Pt 3	3.5, 3.6
40	Multi-fuel firing	Not applicable
41(a)	Determination of start-up and shut-down periods	2.3.6 Schedule 1 Table S1.2 and S1.4
Ann V Pt 1(1)	All emission limit values shall be calculated at a temperature of 273,15 K, a pressure of 101,3 kPa and after correction for the water vapour content of the waste gases and at a standardised O ₂ content of 6 % for solid fuels, 3 % for combustion plants, other than gas turbines and gas engines using liquid and gaseous fuels and 15 % for gas turbines and gas engines.	Schedule 6, Interpretation
Ann V Pt 1	Emission limit values	3.1.1 and 3.1.2 Schedule 3, Table S3.1
Ann V Pt 1	For plants operating less than 500 hours per year, record the used operating hours	Not applicable
Ann V Pt 1(6(1))	Definition of natural gas	Schedule 6, Interpretation
Ann V Pt 2	Emission limit values	Not applicable
AnnV Pt 3(1)	Continuous monitoring for >100MWth for specified substances	3.1.1 and 3.1.2 Schedule 3, Table S3.1
AnnV Pt 3(2, 3, 5)	Monitoring derogations	Not applicable

IED Article Reference	IED requirement	Permit condition
AnnV Pt3(4)	Measurement of total mercury	Not applicable
AnnV Pt3(6)	EA informed of significant changes in fuel type or in mode of operation so can check Pt3 (1-4) still apply	2.3.5
AnnV Pt3(7)	Monitoring requirements	3.1.1 and 3.1.2 Schedule 3, Table S3.1
AnnV Part 3(8,9,10)	Monitoring methods	3.5, 3.6
AnnV Pt 4	Monthly, daily, 95%ile hourly emission limit value compliance	3.5.1 Schedule 3, Table S3.1
AnnV Pt7	Refinery multi-fuel firing SO2 derogation	Not applicable

4. Key Issues

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

Where relevant and appropriate, we have incorporated the techniques described by the Operator in their Regulation 60 Notice response as specific operating techniques required by the permit, through their inclusion in Table S1.2 of the Consolidated Variation Notice.

The variation notice uses updated LCP numbers in accordance with the most recent DEFRA LCP reference numbers. The LCP references have changed as follows:

- **LCP 409** is changed to **LCP 333**
- **LCP 410** is changed to **LCP 334**
- **LCP 411** is changed to **LCP 335**
- **LCP 412** is changed to **LCP 336**

LCP333, LCP334, LCP335 and LCP336

Each of the four LCP's units consists of 1 x 756 MWth CCGT which vents via its own dedicated windshield at emission points A1 to A4. The units burn natural gas and gas oil as a standby fuel.

Compliance Route:

The operator has proposed to operate this LCP under the ELV compliance route.

Net Rated Thermal Input:

The Applicant has stated that the Net Thermal Input is 756MWth for each of the 4 units.. They have justified this figure by providing the following data:

The guarantee performance test dates for each of the units are set out below and were carried out following the completion of the MXL 2 upgrade.

Unit	Test Date
409 (A1)	08/04/2015
410 (A2)	17/03/2014
411 (A3)	28/07/2014
412 (A4)	10/12/2013

The tests were undertaken by the OEM, Alstom Power under the supervision of RWE. The test were carried out to the following protocol; STMS-Service Test Procedure Staythorpe, Alstom document reference HTCZ591203. This document references the following international standards that were used in the performance tests;

Performance Test Code on Overall Plant Performance ASME PTC 46

- Gas turbines - Acceptance tests ISO 2314
- Rules for steam turbine thermal acceptance tests IEC953-2
- Measurement of fluid flow by means of pressure differential devices inserted in circular cross-section conduits running full ISO 5167
- Measurement of gas flow in closed conduits – Turbine meters ISO 9951
- Natural gas - Calculation of calorific value, density and relative

density and Wobbe index from composition ISO 6976

- Natural Gas – Calculation of Compression Factor Using Molar Composition Analysis (AGA8-DC92) ISO 12213-2
- Natural gas - Determination of hydrogen, inert gases and

hydrocarbons up to C8 – Gas chromatographic method ISO 6974-3

- Gaseous Fuels ASME PTC 3.3

We are satisfied that sufficient information has been provided regarding the net rated thermal input

Minimum start up load and Minimum shut-down load:

The Operator has defined the “minimum start up load” and “minimum shut-down load” for the LCP in their response to question 6 of the Reg 60, in terms of:

the output load (i.e. electricity generated) (MW); and this output load as a percentage of the rated output of the combustion plant (%)

and

three discrete processes or thresholds for operational parameters that suit the technical characteristics of the plant, which can be met at the end of start-up or start of shut-down.

We agree with all of these definitions and have set these thresholds in table S1.5 of the permit accordingly. Standard permit condition 2.3.6 has been set to define the period of start up and shut down, referring to the thresholds in this table.

Emission limits:

ELV's for >70% load:

The IED Annex V ELVs for oxides of nitrogen and carbon monoxide apply to OCGTs, CCGTs and mechanical drive gas turbines when the load is >70%. This has been interpreted as 70% of the rated output load. The rated output load used here is the same as that used for calculating the percentage load when specifying the end of start-up and beginning of shut-down.

The current and proposed ELV's for >70% load are set out below (all units in mg/m³):

Unit	Parameter	Current ELV	Reference Period
409 (A1), 410 (A2) 411 (A3), 412 (A4)	NOx	100	Hourly
409 (A1), 410 (A2) 411 (A3), 412 (A4)	NOx	50	Daily
409 (A1), 410 (A2) 411 (A3), 412 (A4)	NOx	50	95%centile of hourly averages
409 (A1), 410 (A2) 411 (A3), 412 (A4)	CO	300	Hourly
409 (A1), 410 (A2) 411 (A3), 412 (A4)	CO	150	Daily
409 (A1), 410 (A2) 411 (A3), 412 (A4)	CO	100	95%centile of hourly averages

Unit	Parameter	Proposed ELV	Reference Period
409 (A1), 410 (A2) 411 (A3), 412 (A4)	NOx	50	Monthly
409 (A1), 410 (A2) 411 (A3), 412 (A4)	NOx	50	Daily
409 (A1), 410 (A2) 411 (A3), 412 (A4)	NOx	50	95%centile of hourly averages
409 (A1), 410 (A2) 411 (A3), 412 (A4)	CO	100	Monthly
409 (A1), 410 (A2) 411 (A3), 412 (A4)	CO	100	Daily
409 (A1), 410 (A2) 411 (A3), 412 (A4)	CO	100	95%centile of hourly averages

The NOx ELV's proposed are consistent with the approach given in the IED BAT ESI review paper which states that ELV's will not be tighter than the Annex V values unless an existing ELV is already tighter.

The no backsliding principle detailed in the IED ESI BAT review paper means that the current daily and 95%centile limits cannot be relaxed. As a result the operator proposed that the current daily and 95%centile ELV's of 50mg/m³ were retained and the monthly ELV set at 50mg/m³. This approach is consistent with the approach given in the IED BAT ESI Review paper 28/10/14 and reproduced below;

I. If the tighter current ELV is specified for an Annex V averaging period (hourly, 24 hourly or monthly), then it will remain as it is.

II. If the tighter current ELV is specified for an averaging period that is not in Annex V, then it will be derived for the closest averaging period that is in Annex V, based on site performance and using the ratios between averaging periods in Annex V as a guide.

III. Where a shorter term elv is tighter than Annex V, the longer term limit will usually be set at the same level, taking into account the fact that the shorter-term elv may be defined as a 95%ile, and the longer term elv as a more stringent 100%ile for compliance.

Comparison of the currently permitted CO ELV's with the Annex V ELV of 100mg/m³ indicates that with the exception of the 95%centile of hourly averages the other ELV's are in excess of the Annex V limits.

The ESI IED BAT review paper states that in the case of CO; "where CO limits are already set and are tighter than Annex V, they will remain as they are, otherwise the annex V limit will be set.

Based on this approach and taking into account the no backsliding principle it was proposed to retain 100mg/ m³ as the 95%centile average of hourly averages and using the principle of point III above it was also proposed to set daily and monthly ELV's at 100mg/ m³.

The operator has proposed limits in line with annex V of the IED and the 2014 BAT review paper. Consequently we have accepted the proposed limits and incorporated them into table 3.1 of the permit.

ELV's for <70% load:

"Low Load" Gas Turbine Emission Limits set when the load varies between MSUL/MSDL and base load during the daily reference period:

IED Annex V ELVs for GTs apply when the load is >70%. The operator has proposed the following <70% limits (all units are in mg/m³):

Unit	Parameter	Proposed ELV	Reference Period
409 (A1), 410 (A2)	NOx	No additional limit proposed	Monthly
411 (A3), 412 (A4)			
409 (A1), 410 (A2)	NOx	60	Daily
411 (A3), 412 (A4)			
409 (A1), 410 (A2)	NOx	No additional limit proposed	95%centile of hourly averages
411 (A3), 412 (A4)			
409 (A1), 410 (A2)	CO	No additional limit proposed	Monthly
411 (A3), 412 (A4)			
409 (A1), 410 (A2)	CO	200	Daily
411 (A3), 412 (A4)			
409 (A1), 410 (A2)	CO	No additional limit proposed	95%centile of hourly averages
411 (A3), 412 (A4)			

RWE proposed a NOx limit of 75 mg/m³ and presented a diagram that shows the deterioration in NOx emissions over a 6 month period of the "C" inspection cycle of unit A1. During this time there were approximately 27 instances when the maximum hourly emissions exceeded 50 mg/m³ and only one occurrence when the emissions were greater than 75 mg/m³. The emissions deterioration such as this can be alleviated by tuning the gas turbine to reduce the firing temperature. However, it should be noted that this has an impact on GT output of approximately 0.05MW per 5° K reduction in firing temperature and so there is a requirement to optimise operations to get the right levels of NOx as well as thermal output.

On consultation with colleagues in Natural Resources Wales it was decided that although an ELV of over 50 mg/m³ was needed, 75 mg/m³ was too high and was not justified from the information submitted and so a limit of 60 mg/m³ was agreed for both Pembroke and Staythorpe..

A daily limit of 200 mg/m³ was proposed for carbon monoxide emissions at loads below 70%. This approach is based on operating experience from the sister station at Pembroke which has experienced elevated CO concentrations at part load. There was also a diagram for Staythorpe CO emissions for 2014 which highlights that CO concentrations are elevated to a level below 200 mg/m³ at low loads. We have accepted this proposed limit.

RWE have provided air dispersion modelling data demonstrating that these emissions will not cause significant pollution. We have reviewed the operator's assessment of the environmental risk and consider it to be satisfactory for the substances specified. IED Annex V ELVs still apply for operation at >70% load.

Sulphur Dioxide and Dust Emissions:

Sulphur dioxide emissions from natural gas firing will be reported on the basis of the fuel sulphur content without continuous or periodic monitoring since only trace quantities of sulphur are present in UK natural gas. Likewise, dust emissions for natural gas firing will be reported on the basis of emission factors without continuous or periodic monitoring. Natural gas is an ash-free fuel and high efficiency combustion does not generate additional particulate matter. The fuel gas is always filtered and, in the case of gas turbines, the inlet air is also filtered resulting in a lower dust concentration in the flue than in the surrounding air.

Standby fuels:

The operator normally uses gas fuel and uses gas oil as a standby fuel. Since it is BAT to use the cleaner gas fuel, gas oil use is limited to 720 hours per year as per the original permit.

ELV's for use of Stand-by Gas Oil

To date the gas-oil fired system has not been commissioned and existing ELV's have not been tested and so the ELV's will be set in accordance with the values for gas turbines using light and middle distillate fuel given in Annex V part 1 (5) as follows (all units are in mg/m³)

Unit	Parameter	Proposed ELV	Reference Period
409 (A1), 410 (A2) 411 (A3), 412 (A4)	NOx	90	Monthly
409 (A1), 410 (A2) 411 (A3), 412 (A4)	NOx	99	Daily
409 (A1), 410 (A2) 411 (A3), 412 (A4)	NOx	180	95%centile of hourly averages
409 (A1), 410 (A2) 411 (A3), 412 (A4)	CO	100	Monthly
409 (A1), 410 (A2) 411 (A3), 412 (A4)	CO	110	Daily
409 (A1), 410 (A2) 411 (A3), 412 (A4)	CO	200	95%centile of hourly averages

These ELV's will apply at all loads.

As burning gas oil can only run for 30 days per year maximum the 95%ile of hourly averages over the year annual value in the table will not be used.

Sulphur dioxide emissions from oil firing of gas turbines will be reported at six monthly concentrations on the basis of the known fuel sulphur content without continuous or periodic monitoring.

Monitoring & standards:

Standards for assessment of the monitoring location and for measurement of oxygen, water vapour, temperature and pressure have been added to the permit template for clarity.

A row has been included in table S3.1 which requires the operator to confirm compliance with BS EN 15259 in respect of monitoring location and stack gas velocity profile in the event there is a significant operational change (such as a change of fuel type) to the LCP.

Resource efficiency metrics:

A more comprehensive suite of reporting metrics has been added to the permit template for ESI plant. Table S4.2 "Resource Efficiency Metrics" has been added requiring the reporting of various resource parameters, as this is an Electrical Supply Industry (ESI) power plant. This table is being used for all ESI plant.

Additional IED Chapter II requirements:

Condition 3.1.3 relating to protection of soil, groundwater and groundwater monitoring, has been added in compliance with IED requirements.

Conditions 4.3.1 and 4.3.2 relating to notifications have been amended in compliance with IED requirements.