

## **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/QP3632TF

The Operator is: Rolls-Royce Power Development Limited

The Installation is: Heartlands OCGT Power Station

This Variation Notice number is: EPR/QP3632TF/V002

#### **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 notice 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 responses are 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 notice 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.

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**

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
FGD	flue gas desulphurisation
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
Mid merit	1500-4000 operating hours per annum
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)

# 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(s).
- Minimum start up and shut down loads.
- The proposed emission limits and how they accord with the 2014 BAT review paper.
- 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 23/03/15.

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 19/07/15.

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.

<b>IED Article Reference</b>	<b>IED requirement</b>	<b>Permit condition</b>
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.	n/a
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.	n/a
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;	n/a
37	Provisions for malfunction and breakdown of abatement equipment including notifying the EA.	n/a
38	Monitoring of air emissions in accordance with Ann V Pt 3	3.5, 3.6
40	Multi-fuel firing	n/a
41(a)	Determination of start-up and shut-down periods	2.3.5 Schedule 1 Table 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 O2 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	3.1.2 Schedule 3, Table S3.1
Ann V Pt 1	For plants operating less than 500 hours per year, record the used operating hours	n/a
Ann V Pt 1(6(1))	Definition of natural gas	Schedule 6, Interpretation
Ann V Pt 2	Emission limit values	3.1.2 Schedule 3, Table S3.1
AnnV Pt 3(1)	Continuous monitoring for >100MWth for specified substances	3.5, 3.6 Schedule 3, Table S3.1
AnnV Pt 3(2, 3, 5)	Monitoring derogations	3.5.1 Schedule 3, Table S3.1
AnnV Pt3(4)	Measurement of total mercury	n/a



<b>IED Article Reference</b>	<b>IED requirement</b>	<b>Permit condition</b>
AnnV Pt3(6)	EA informed of significant changes in fuel type or in mode of operation so can check Pt3 (1-4) still apply	2.3.1 Schedule 1, Table S1.2
AnnV Pt3(7)	Monitoring requirements	3.5.1 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	n/a

## 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 an updated LCP number in accordance with the most recent DEFRA LCP reference numbers. The LCP reference has changed as follows:

- **LCP 195** is changed to **LCP 173**

### **LCP173**

This LCP consists of 2 x 128 MWth OCGT's which vent at emission point A1/A2. The unit burns natural gas only.

### **Compliance Route:**

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

### **Net Rated Thermal Input:**

The Applicant has stated that tests carried out on 14/06/15 to calculate both the thermal input and thermal efficiency at LCP 173 indicated that the net thermal input of Heartlands Unit 1 was 128.2 MWth which operates with a thermal efficiency of 39% and for Heartlands Unit 2 was 128.8 MWth which operates with a thermal efficiency of 38.8% combining to give an aggregated thermal input of 257 MWth. We, the Environment Agency, have reviewed and accepted the justified Net Rated Thermal Inputs.

The Operator has justified these figures by providing calculation for the thermal efficiency of each Industrial Trent Electrical Generation Package at the site using recent measured site data at an ambient temperature of 15<sup>0</sup>C using the following calculation:

Electrical Power (Gross at the Generator) / Total Energy Input (using gas fuel LHV)

### **Heartlands Unit 1 Thermal Efficiency.**

Measurements taken 14 June 2015 @ 20:30

Total gas fuel mass flow rate is 4055pph + 8193pph + 5780pph (3 Stage Combustion)  
= 2.27 ± 0.05 Kg/sec.

Total energy input = 105.2 ± 2.6MW (LHV).

Generator Power (Gross) is  $41.09 \pm 0.5$  MWe

Thermal Efficiency =  **$39.0 \pm 1.1\%$**

At 50MWe the Thermal Input to the site can be expressed as  $100/\eta \times 50$   
=  **$128.2 \pm 2.6$  MW.**

The overall uncertainty of the total energy input is pessimistically based on  $\pm 3\%$  of point individual fuel mass flow accuracy (3 stage combustion), and  $\pm 0.5$  MW gas fuel LHV variation.

#### Heartlands Unit 2 Thermal Efficiency.

Measurements taken 14 June 2015 @ 20:30

Total gas fuel mass flow rate is 4381pph + 8599pph + 5661pph (3 Stage Combustion)  
=  $2.35 \pm 0.05$  Kg/sec.

Total energy input =  $108.9 \pm 2.6$  MW (LHV).

Generator Power (Gross) is  $42.26 \pm 0.5$  MWe

Thermal Efficiency =  **$38.8 \pm 1.1\%$**

At 50MWe the Thermal Input to the site can be expressed as  $100/\eta \times 50$   
=  **$128.8 \pm 2.6$  MW.**

The overall uncertainty of the total energy input is pessimistically based on  $\pm 3\%$  of point individual fuel mass flow accuracy (3 stage combustion), and  $\pm 0.5$  MW gas fuel LHV variation.

#### Gas Fuel Flow Measurement

The total gas fuel flow is delivered to the engine combustion system through three parallel Gas Fuel Metering Valves (Primary, Secondary and Tertiary) at Heartlands Unit 1 and Unit 2 OCGT Power Station.

The Primary, Secondary and Tertiary gas fuel mass flow rate is calculated independently through each Gas Fuel Metering Valve using:

1. Flow rig characterised valve Effective Area.
2. Measured valve gas inlet pressure.
3. Measured valve gas exit pressure.
4. Measured gas temperature.
5. Monthly average gas fuel constituents.

Each Gas Fuel Metering Valve is flow characterised on a test rig by the supplier (Woodward Governor Company) in order to characterise the Effective Area vs. Resolver Position feedback and valve pressure ratio.

The Primary, Secondary and Tertiary gas fuel mass flow rates are added in order to provide the total gas fuel mass flow rate to the engine.

#### Gas Fuel Flow Accuracy

The overall gas fuel mass flow metering accuracy through each Fuel Metering Valve (including Effective Area, pressure and temperature measurement) is demonstrated by the supplier to be within  $\pm 1\%$  of point across the whole metered flow range.

For the purpose of this calculation, the individual gas flow accuracy is pessimistically assumed to be within the specification flow accuracy of  $\pm 3\%$  of point across the whole metered flow range.

In order to calculate the total gas flow metering accuracy, Root Sum Squared of the individual Primary, Secondary and Tertiary accuracy is calculated.

The Total gas fuel mass flow accuracy at the engine power levels described in this report is calculated to be  $\pm 0.05$  Kg/sec.

#### Gas Fuel Calorific Value

The average Lower Heating Value (LHV) (based on May 2015 average gas fuel constituents) is 46.34 MJ/Kg (using the method specified within BS EN ISO 6976 Natural Gas – Calculation of Calorific Values, Density, Relative Density and Wobbe Index from Composition).

#### Gas Fuel Calorific Value Accuracy

The uncertainty of the gas fuel calorific value calculation (based on observed variation of gas fuel constituents) is pessimistically calculated to be  $\pm 0.5$  MW

#### Generator Power Measurement Accuracy

The Power Sensor accuracy is specified to be  $\pm 0.5\%$ .

Taking into account the overall Generator Power measurement system, including the Voltage and Current transformers, Power Sensor, and Analog output / input, the overall Power measurement accuracy is pessimistically assumed to be  $\pm 1.0\%$  or  $\pm 0.5$  MW.

#### Overall Thermal Efficiency Accuracy

Taking into account:

- Gas Fuel mass flow measurement accuracy
- Gas Fuel calorific value variation
- Generator Power measurement accuracy

The overall Thermal Efficiency calculation accuracy at the engine power conditions described in this report is  $\pm 1.1\%$ .

We, the Environment Agency, accept the evidence and justification provided by the Operator.

**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 and RFI notice, in terms of three criteria 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 this definition and have set these thresholds in the Permit in table S1.4 accordingly.

Through work undertaken by Siemens the operator has provided a report with the recommendation of Discrete and Operational parameters to determine:

- The end of the engine start up period.
- The beginning of the engine shut down period.

For the purpose of Engine Emission Monitoring, satisfying the Implementing Decision 2012 / 249 / EU Article 9.

Standard permit condition 2.3.5 has been set to define the period of start up and shut down, referring to the thresholds in this table.

**Emission limits:**

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 S3.1 of the permit.

The table below shows the previous limits set within the environmental permit EPR/QP3538LZ.

Parameter	Limit	Justification
NO <sub>x</sub>	60 mg/Nm <sup>3</sup>	IPC Authorisation
CO	50 mg/Nm <sup>3</sup>	No LCPD limit specified so in line with current IPC limit.

We previously set the above limits for NO<sub>x</sub> at 60mg/m<sup>3</sup> for both turbines, based on the ELVs in the IPC authorisation. This is below the benchmark levels contained in the Sector Guidance Note (SGN) of 75mg/m<sup>3</sup>. Emissions data indicated that the Operator can comply with these limits, and we considered it BAT to carry forward the IPC limits as the more stringent alternative, due to the existence of the declared AQMA for this substance in the City of Birmingham. We also decided to set the ELVs at the same level as the IPC ELV, 50mg/m<sup>3</sup>. This was a more stringent level than the benchmark value in the SGN of 100mg/m<sup>3</sup>. However, we regarded it as BAT to impose the more stringent control. Emissions monitoring data indicated that this ELV could be complied with.

The Operator has stated that they will **not** run at low load, but go straight from MSUL/MSDL to base load, therefore we are not required to set low load limits. This operating regime is incorporated into the operating techniques tables (S1.2). Additionally, we have set a reporting requirement within the variation notice to report any operational hours below 70% load.

Therefore, in accord with Annex V of the IED and the 2014 BAT review paper, as well as a comparison of the current limits set and those requested by the Operator through the Regulation 60 Notice Response we have set the following limits within the variation and consolidation notice:

Parameter	Existing mg/m <sup>3</sup>	Existing Reference Period	Annex V mg/m <sup>3</sup>	Reference Period	New Permit limit mg/m <sup>3</sup>	Reference Period
Oxides of Nitrogen	60	Validated hourly average	100	95%ile of hourly averages	60	95%ile of hourly averages
Oxides of Nitrogen	-	-	55	Daily mean of validated hourly averages	55	Daily mean of validated hourly averages
Oxides of Nitrogen	-	- average	50	Monthly mean of validated hourly averages	50	Monthly mean of validated hourly averages
Oxides of Sulphur	-	-	Not required	-	-	All
Carbon Monoxide	50	Validated hourly average	200	95%ile of hourly averages	50	All <sup>[note1]</sup>
Particulates/ Dust	-	-	Not required	-	-	All <sup>[note1]</sup>

[Note 1] includes 95% validated hourly average within a calendar year, daily mean of validated hourly averages and monthly mean of validate hourly averages

### Gas fired plant:

Sulphur dioxide emissions from natural gas firing of gas turbines and boilers will be reported as six monthly concentrations. This is 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. Dust emissions for natural gas fired boilers will, likewise, be reported on the basis of emission factors without continuous or periodic monitoring. For gas turbines we have not required any reporting as the dust emissions will always be reported as zero. This is because natural gas is an ash-free fuel and high efficiency combustion in the gas turbine 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.

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.

**Energy efficiency:**

The operator is currently permitted to operate the OCGT which is a standalone OCGT, and not a CCGT that can also run in OCGT in some circumstances. A review of what can be considered BAT for the sector regarding the STOR market and OCGTs is underway, when the results of this review are known the permit may need to be varied again to reflect the outcome of the review.

**Reporting efficiency:**

In order to ensure the efficiency of plant using fossil fuels or biomass is maximised and regularly recorded, condition 1.2.1(c), condition 4.2.2(b) and table S4.2 have been added to the permit.

**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.