Environment Agency

Review of an Environmental Permit for an Installation subject to Chapter II of the Industrial Emissions Directive under the Environmental Permitting (England & Wales) Regulations 2016

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

The Permit number is: EPR/BJ8022IZ
The Operator is: VPI Immingham LLP
The Installation is: Immingham CHP Power Plant
This Variation Notice number is: EPR/BJ8022IZ/V012

What this document is about

Article 21(3) of the Industrial Emissions Directive (IED) requires the Environment Agency to review conditions in permits that it has issued and to ensure that the permit delivers compliance with relevant standards, within four years of the publication of updated decisions on best available techniques (BAT) conclusions.

We have reviewed the permit for this installation against the revised BAT Conclusions for large combustion plant published on 17th August 2017. This is our decision document, which explains the reasoning for the consolidated variation notice that we are issuing.

It explains how we have reviewed and considered the techniques used by the Operator in the operation and control of the plant and activities of the installation. This review has been undertaken with reference to the decision made by the European Commission establishing best available techniques (BAT) conclusions ('BAT Conclusions') for large combustion plant as detailed in document reference IEDC-7-1. 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 considering the review of the operating techniques used by the Operator for the operation of the plant and activities 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

issued. 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 removed 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 the new BAT Conclusions.

This is our record of our decision-making process and shows how we have taken into account all relevant factors in reaching our position.

Throughout this document we will use a number of expressions. These are as referred to in the glossary and have the same meaning as described in “Schedule 6 Interpretation” of the Permit.

We try to explain our decision as accurately, comprehensively and plainly as possible. We would welcome any feedback as to how we might improve our decision documents in future. A lot of technical terms and acronyms are inevitable in a document of this nature: we provide a glossary of acronyms near the front of the document, for ease of reference.

How this document is structured

Glossary of acronyms used in this document

(Please note that this glossary is standard for our decision documents and therefore not all these acronyms are necessarily used in this document.)

APC	Air Pollution Control
BAT	Best Available Technique(s)
BAT-AEEL	BAT Associated Energy Efficiency Level
BAT-AEL	BAT Associated Emission Level
BATc	BAT conclusion
BREF	Best available techniques reference document
CCGT	Combined Cycle Gas Turbine
CEM	Continuous emissions monitor
CHP	Combined heat and power
CV	Calorific value
DAA	Directly associated activity – Additional activities necessary to be carried out to allow the principal activity to be carried out
DLN	Dry Low NOx burners
DLN-E	Dry Low NOx effective
EIONET	European environment information and observation network is a partnership network of the European Environment Agency
ELV	Emission limit value derived under BAT or an emission limit value set out in IED
EMS	Environmental Management System
EPR	Environmental Permitting (England and Wales) Regulations 2016 (SI 2016 No. 1154)
EWC	European waste catalogue
FSA	Food Standards Agency
GT	Gas Turbine (generator)
HRSG	Heat Recovery Steam Generator
IC	Improvement Condition
IED	Industrial Emissions Directive (2010/75/EU)
IPPCD	Integrated Pollution Prevention and Control Directive (2008/1/EC) – now superseded by IED
LCP	Large Combustion Plant subject to Chapter III of IED
MSUL/MSDL	Minimum start up load/minimum shut-down load
NOx	Oxides of nitrogen (NO plus NO_2 expressed as NO_2)
NPV	Net Present Value
OCGT	Open Cycle Gas Turbine
PHE	Public Health England
REF	Refining of Mineral Oil (BATc and BREF)
RFG	Refinery Fuel Gas (interchangeably used with ROG)

ROG	Refinery Off-Gas (interchangeably used with RFG)
SAC	Special Area of Conservation
SGN	Sector guidance note
TGN	Technical guidance note
TNP	Transitional National Plan
TOC	Total Organic Carbon
WFD	Water Framework Directive (2000/60/EC)

1 Our decision

We have decided to issue the consolidated variation notice to the Operator. This will allow them 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 to demonstrate compliance with BAT Conclusions for Large Combustion Plant

We issued a Notice under Regulation 61(1) of the Environmental Permitting (England and Wales) Regulations 2016 (a Regulation 61 Notice) on 1st May 2018 requiring the Operator to provide information to demonstrate how the operation of their installation currently meets, or will subsequently meet, the revised standards described in the large combustion plant BAT Conclusions document. The Notice also required that where the revised standards are not currently met, the Operator should provide information that:

- Describes the techniques that will be implemented before 17th August 2021, which will then ensure that operations meet the revised standard, or
- Justifies why standards will not be met by 17th August 2021, and confirmation of the date when the operation of those processes will cease within the installation or an explanation of why the revised BAT standard is not applicable to those processes, or
- Justifies why an alternative technique will achieve the same level of environmental protection equivalent to the revised standard described in the BAT Conclusions.

Where the Operator proposed that they were not intending to meet a BAT standard that also included a BAT Associated Emission Level (BAT AEL) described in the BAT Conclusions Document, the Regulation 61 Notice requested that the Operator make a formal request for derogation from compliance with that AEL (as provisioned by Article 15(4) of IED). In this circumstance, the Notice identified that any such request for derogation must be supported and justified by sufficient technical and commercial information that would enable us to determine acceptability of the derogation request.

The Regulation 61 Notice response from the Operator was received on 30 /08/2018.

We considered that the response did not contain sufficient information for us to commence the permit review. We therefore issued a further information request to the Operator on 19/11/2019. Suitable further information was provided by the Operator on 20/12/2019.

We considered it was in the correct form and contained sufficient information for us to begin our determination of the permit review but not that it necessarily contained all the information we would need to complete that review: we requested additional information and clarification on the responses provided by the Operator on 20/12/2019. We received this additional information on 05/02/2020 and 18/02/2020.

2.2 Review of our own information in respect to the capability of the installation to meet revised standards included in the BAT Conclusions document

Based on our records and previous regulatory activities with the facility we have no reason to consider that the Operator will not be able to comply with the conditions that we include in the permit.

In relation to BAT conclusion 3, we agree with the Operator in respect to their current stated capability as recorded in their Regulation 61 Notice responses that improvements are required.

3 The legal framework

The consolidated variation notice will be issued under Regulation 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 the consolidated variation notice 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.

4 The key issues

The key issues arising during this permit review are:

- Emissions to air and the emission limits applied to the plant;
- The applicable requirements of the BAT Conclusions on the refining of mineral oil and gas (EU Commission implementing decision 2014/738/EU) (REF BAT conclusions), relevant to the combustion of refinery fuel gas at the installation;
- The energy efficiency levels associated with the Best Available Techniques (BAT-AEELs);
- BAT conclusion 3 on monitoring of flue gas parameters;
- The requirements for multi-fuel combustion plants set out by Article 40 of the IED.

We therefore describe how we determined these issues in most detail in the relevant sections of this document.

4.1 Emissions to air and the emission limits applied to the plant

A number of general principles were applied during the permit review. These included:

- The upper value of the BAT AELs ranges specified were used unless use of the tighter limit was justified.
- The principle of no backsliding where if existing limits in the permit were already tighter than those specified in the BREF, the existing permit limits were retained.
- Where a limit was specified in both IED Annex V and the BAT Conclusions for a particular reference period, the tighter limit was applied and in the majority of cases this was from the BAT Conclusions.
- Where AELs are indicative in the BAT Conclusions, these were applied unless adequate justification was provided by the Operator to demonstrate that an alternative limit was more appropriate.
- For gas turbines where the IED specified that limits applied over 70% load and the BAT Conclusions specified that AELs applied when dry low NOx is effective (DLN-E), we have used DLN-E as a default across all monitoring requirements for NOx and CO.

The installation consist of two LCPs, whose characteristics are summarised in the following table:

LCP	Emission Point	Equipment type	Thermal Input	Fuels	Operating scenario
LCP 188	A1	CCGT (GT 1 + HRSG 1)	GT = 730 MWth HRSG = 111 MWth	Natural gas	>1500 hrs
	A2	CCGT (GT 2 + HRSG 2)	GT = 743 MWth HRSG = 111 MWth	Natural gas	>1500 hrs
	A3	Auxiliary Boiler 1	290 MWth	• Natural gas • Refinery fuel gas • Fuel oil (stand-by only if natural gas is not available)	>1500 hrs
	A4	Auxiliary Boiler 3	290 MWth	• Natural gas • Refinery fuel gas	>1500 hrs

				• Fuel oil (stand-by only if natural gas is not available)	
LCP 415	A5	CCGT (GT 3 + HRSG 3)	GT = 751 MWth HRSG = 193 MWth	GT • Natural gas only HRSG • Natural gas • Refinery fuel gas	>1500 hrs

The plant was put into operation before IED came into force and therefore the existing limits in the permit are from Part 1 of IED Annex V applicable to existing plant.

The ELVs and AELs are based on the following operating regime:

- Unlimited hours operation (for gas turbines, heat recovery steam generators and auxiliary boilers fired on natural gas and/or refinery fuel gas, see table above)

The installation makes use of refinery fuel gas (RFG), also referred as Refinery Off-Gas (ROG) throughout the permit, imported from the nearby Philips 66 Humber Oil Refinery. In the LCP BAT conclusion document there are no specific provisions or BAT-AEL specified for the combustion of this fuel. Article 14(6) of the Industrial Emissions Directive requires that, where an activity or a type of production process carried out within an installation is not covered by any of the BAT conclusions or where those conclusions do not address all the potential environmental effects of the activity or process, the Competent Authority needs to set the permit conditions on the basis of the best available techniques that it has determined for the activities or processes concerned, by giving special consideration to the criteria listed in Annex III of the IED, which include, among others:

- comparable processes, facilities or methods of operation which have been tried with success on an industrial scale;
- the nature, effects and volume of the emissions concerned;

- information published by public international organisations.

Taking into account these criteria set in the IED, we have therefore determined BAT for the combustion of RFG in the combustion equipment at the installation, by referring to the requirements of the BAT Conclusions on the refining of mineral oil and gas (EU Commission implementing decision 2014/738/EU) (REF BAT conclusions), which include specific provisions and BAT-AELs for the combustion of this fuel. We have therefore considered the relevant parts of the REF BAT conclusions applicable to this installation, as a comparable process according to the provisions of Article 14(6) and Annex III of the IED.

The following tables outline the limits that have been incorporated into the permit for LCP188 and LCP415, where these were derived from and the reference periods at which they apply. The emission limits refer to concentrations, expressed as mass of emitted substance per volume of flue-gas under the following standard conditions: dry gas at a temperature of 273,15 K, pressure of 101,3 kPa and 15% (for gas turbines and their associated HRSG), 3% (for auxiliary boilers) volume reference oxygen concentration if flue gases. The emission limits and monitoring requirements have been incorporated into Schedule 3 of the permit.

The installation also uses distillate fuel oil as back-up fuel in the auxiliary boilers of LCP188, for emergency scenarios when the supply of natural gas is interrupted. This operation is restricted in the permit to ‘no more than 500 hours per calendar year with a maximum period of 240 hours’ (i.e. less than 10 days), in line with the requirements of Article 30(6) of IED and its interpretation made by the UK Regulators at the time of the IED Chapter III implementation. Where a natural gas fired plant uses gas oil as a standby fuel for less than 10 days, we have not assessed the site against the BAT Conclusions applicable to that fuel as the use is not considered significant. As part of the on-going compliance assurance, the Operator will be required to demonstrate that the site is operated in a manner such that use of the standby fuel is minimised.

The emission limits for combustion of fuel oil specified in the permit, prior to this variation, have been retained, based on the non-backsliding principle.

LCP188 – GT 1 / HRSG 1, GT 2 / HRSG 2 (emission points A1, A2)

Fuel: natural gas
Operating hours: unlimited
Plant configuration: CCGT (steam cycle is common between LCP188 and LCP415), gas turbine operating at low load
Age: permitted before publication of the LCP BREF
Thermal input: >600 MWth
Net total fuel utilisation: <75%
Electric Efficiency: <55%

NOx limits (mg/Nm^3)								
Averaging	**IED (Annex V Part 1) - Existing**	**LCP BREF**	**Expected permit limits**	**Basis**	**Limits apply**	**Monitoring**	**Current Permit Limit**	**Revised Permit Limit**
Annual	**None**	**40** (≥600 MW_{th}, η <75%)[1,2]	**40**	BREF	E-DLN	Continuous	**None**	**40**
Monthly	**50** *(75 if EE>55% or η >75%)*	**None**	**50**	IED	E-DLN		**50**	**50**
Daily	**55** *(82.5 if EE>55% or η >75%)*	**50** (≥600 MW_{th}, η <75%)[1,2]	**50**	BREF - IED compliance.	E-DLN		**55**	**50**
95th %ile of hr means	**100** *(150 if EE>55% or η >75%)*	**None**	**100**	IED	E-DLN		**100**	**100**

1 - If electrical generating efficiency (EE) > 55% then limit is [limit] x EE/55
2 - Overall plant efficiency, η, based on 'net total fuel utilisation'

CO limits (mg/Nm^3) – indicative in *italics*								
Averaging	**IED (Annex V Part 1) - Existing**	**LCP BREF**	**Expected permit limits**	**Basis**	**Limits apply**	**Monitoring**	**Current Permit Limit**	**Revised Permit Limit**
Annual	**None**	***30*** *(50 for plant operating at low load)*	***50***	BREF	E-DLN	Continuous	**None**	**50**
Monthly	**100**	**None**	**100**	IED	E-DLN		**100**	**100**
Daily	**110**	**None**	**110**	IED	E-DLN		**110**	**110**
95th %ile of hr means	**200**	**None**	**200**	IED	E-DLN		**200**	**200**

In response to the additional Regulation 61(1) Notice served on 19/11/2019 (updated response received 05/02/2020), the Operator proposed an annual emission limit at 50 mg/m^3 for emissions of carbon monoxide from GT1/HRSG1 and GT2/HRSG2. This is above the indicative emission limit of 30 mg/m^3 set in the LCP BAT conclusions, for existing gas turbines in this tier of thermal input. However, the Operator justified the requested emission limit explaining that higher emissions of CO are associated with low load operation of the gas turbines. We have accepted this technical justification, which is in line with the provision of the BAT conclusions for a higher indicative CO emission limit when operating at low load. We have set this limit in table S3.1a of the variation notice.

The permit, prior to this variation, included emission limits for SO_2 and a requirement for continuous monitoring of this pollutant in GT/HRSG 1 and 2. However, in response to the additional Regulation 61(1) Notice served on 19/11/2019 and responded on 20/12/2019, the Operator has clarified that they considered this requirement a legacy from when these gas turbines and HRSGs were permitted to operate with refinery off-gas as a fuel. Therefore, the Operator has requested that the requirement for continuous monitoring of SO_2 in these two emission points is removed from the varied and consolidated permit.

We agree that emissions of SO_2 from the combustion of natural gas are not a concern, due to the low sulphur content of this fuel. We have therefore accepted the request made by the Operator and specified in the varied and consolidated permit that emissions

of SO_2 from these two emission points will need to be reported by calculation, based on the sulphur content in the natural gas. We have also removed the emission limit value for SO_2 from these two emission points, since there is no requirement to specify these limits for gas turbines operating on natural gas, in either IED Chapter III, Annex V or the LCP BAT conclusions. We consider that the use of natural gas, which is specified to contain low sulphur concentrations, ensures that emissions of this pollutant are maintained to levels of environmental non-significance and therefore we consider that this decision is not against the non-backsliding principle set for the permit review.

LCP188 - Auxiliary Boilers AB1, AB2 (emission points A3, A4)

Fuel: **natural gas**
Operating hours: unlimited
Age: permitted before publication of the LCP BREF

NOx limits (mg/Nm^3)								
Averaging	**IED (Annex V Part 1) - Existing**	**LCP BREF (Table 25 BAT-c)**	**Expected permit limits**	**Basis**	**Limits apply**	**Monitoring**	**Current Permit Limit**	**Revised Permit Limit**
Annual	**None**	**100**	**100**	BREF	MSUL/MSDL to baseload	Continuous	**None**	**100**
Monthly	**100**	**None**	**100**	IED	MSUL/MSDL to baseload		**100**	**100**
Daily	**110**	**110**	**110**	BREF	MSUL/MSDL to baseload		**110**	**110**
95th %ile of hr means	**200**	**None**	**200**	IED	MSUL/MSDL to baseload		**200**	**200**

CO limits (mg/Nm^3) – indicative in *italics*								
Averaging	**IED (Annex V Part 1) - Existing**	**LCP BREF**	**Expected permit limits**	**Basis**	**Limits apply**	**Monitoring**	**Current Permit Limit**	**Revised Permit Limit**
Annual	**None**	***40***	***40***	BREF	MSUL/MSDL to baseload	Continuous	**None**	**40**
Monthly	**100**	**None**	**100**	IED	MSUL/MSDL to baseload		**100**	**100**
Daily	**110**	**None**	**110**	IED	MSUL/MSDL to baseload		**110**	**110**
95th %ile of hr means	**200**	**None**	**200**	IED	MSUL/MSDL to baseload		**200**	**200**
Dust limits (mg/Nm^3)								
Averaging	**IED (Annex V Part 1) - Existing**	**LCP BREF**	**Expected permit limits**	**Basis**	**Limits apply**	**Monitoring**	**Current Permit Limit**	**Revised Permit Limit**
Annual	**None**	**None**	**None**	NA	NA	Periodic or by calculation	**5** Note 1	**None**
Monthly	**5**	**None**	**5**	IED	MSUL/MSDL to baseload			**5** Note 2
Daily	**5.5**	**None**	**5.5**	IED	MSUL/MSDL to baseload			**5.5** Note 2
95th %ile of hr means	**10**	**None**	**10**	IED	MSUL/MSDL to baseload			**10** Note 2

Notes:

1. Emission limit applicable to periodic measurement, no averaging is applied since there is no requirement for continuous measurement in the current permit.
2. Monthly, daily and hourly emission limits have been specified in the revised permit since the Operator has opted for continuous monitoring of dust from these emission points and installed continuous emissions monitoring systems accordingly.

SO_2 limits (mg/Nm^3)								
Averaging	**IED (Annex V Part 1) - Existing**	**LCP BREF**	**Expected permit limits**	**Basis**	**Limits apply**	**Monitoring**	**Current Permit Limit**	**Revised Permit Limit**
Annual	**None**	**None**	**None**	NA	NA	Periodic or by calculation	**None**	**None**
Monthly	**35**	**None**	**35**	IED	MSUL/MSDL to baseload		**35**	**35**
Daily	**38.5**	**None**	**38.5**	IED	MSUL/MSDL to baseload		**39**	**38.5** Note 1
95th %ile of hr means	**70**	**None**	**70**	IED	MSUL/MSDL to baseload		**70**	**70**

Notes:

1. Emission limit was approximated to the nearest unit when the permit was issued prior to this variation. We have now approximated this to one decimal digit according to our most recent guidance.

Fuel: **refinery fuel gas**
Operating hours: unlimited
Age: permitted before publication of the REF BREF

NOx limits (mg/Nm^3)								
Averaging	**IED (Annex V Part 1) - Existing**	**REF BREF (Table 10 BAT-c)**	**Expected permit limits**	**Basis**	**Limits apply**	**Monitoring**	**Current Permit Limit**	**Revised Permit Limit**
Annual	**None**	**None**	**None**	-	--	Continuous	**None**	**None**
Monthly	**200**	**150**	**150**	REF BREF	MSUL/MSDL to baseload		**200**	**150**
Daily	**220**	**None**	**220**	IED	MSUL/MSDL to baseload		**220**	**220**

95th %ile of hr means	**400**	**None**	**400**	IED	MSUL/MSDL to baseload		**400**	**400**
CO limits (mg/Nm^3)								
Averaging	**IED (Annex V Part 1) - Existing**	**REF BREF (Table 15 BAT-c)**	**Expected permit limits**	**Basis**	**Limits apply**	**Monitoring**	**Current Permit Limit**	**Revised Permit Limit**
Annual	**None**	**None**	**None**	-	--	Continuous	**None**	**None**
Monthly	**None**	**100**	**100**	REF BREF	MSUL/MSDL to baseload		**None**	**100**
Daily	**None**	**None**	**None**	-	--		**None**	**None**
95th %ile of hr means	**None**	**None**	**None**	-	--		**None**	**None**
Dust limits (mg/Nm^3)								
Averaging	**IED (Annex V Part 1) - Existing**	**REF BREF (Table 12 BAT-c)**	**Expected permit limits**	**Basis**	**Limits apply**	**Monitoring**	**Current Permit Limit**	**Revised Permit Limit**
Annual	**None**	**None**	**None**	-	NA	Continuous	**5** Note 2	**None**
Monthly	**5**	**5-50** Note 1	**5**	IED	MSUL/MSDL to baseload			**5** Note 3
Daily	**5.5**	**None**	**None**	-	MSUL/MSDL to baseload			**5.5** Note 3
95th %ile of hr means	**10**	**None**	**None**	-	MSUL/MSDL to baseload			**10** Note 3

Notes:

1. BAT-AEL range is for multi-fuel combustion, including liquid fuels.
2. Emission limit applicable to periodic measurement, no averaging is applied since there is no requirement for continuous measurement in the current permit.
3. Monthly, daily and hourly emission limits have been specified in the revised permit since the Operator has installed continuous emissions monitoring for dust.

SO2 limits (mg/Nm^3)								
Averaging	**IED (Annex V Part 1) - Existing**	**REF BREF (Table 13BAT-c**	**Expected permit limits**	**Basis**	**Limits apply**	**Monitoring**	**Current Permit Limit**	**Revised Permit Limit**
Annual	**None**	**None**	**None**	NA	NA	Continuous	**None**	**None**
Monthly	**35**	**35**	**35**	IED	MSUL/MSDL to baseload		**35**	**35**
Daily	**38.5**	**None**	**38.5**	IED	MSUL/MSDL to baseload		**39**	**38.5** Note 1
95th %ile of hr means	**70**	**None**	**70**	IED	MSUL/MSDL to baseload		**70**	**70**

Notes:

1. Emission limit was approximated to the nearest unit when the permit was issued prior to this variation. We have now approximated this to one decimal digit according to our most recent guidance.

LCP415 - GT 3 / HRSG 3 (emission points A5)

Fuel: **natural gas**
Operating hours: unlimited
Plant configuration: CCGT (steam cycle is common between LCP188 and LCP415), gas turbine operating at low load
Age: permitted before publication of the LCP BREF
Thermal input: >600 MWth
Net total fuel utilisation: <75%
Electric Efficiency: <55%

NOx limits (mg/Nm^3)								
Averaging	**IED (Annex V Part 1) - Existing**	**LCP BREF**	**Expected permit limits**	**Basis**	**Limits apply**	**Monitoring**	**Current Permit Limit**	**Revised Permit Limit**
Annual	**None**	**40** ($\geq$600 MW_{th}, η <75%)[1,2]	**40**	BREF	E-DLN	Continuous	**None**	**40**
Monthly	**50** *(75 if EE>55% or η >75%)*	**None**	**50**	IED	E-DLN		**50**	**50**
Daily	**55** *(82.5 if EE>55% or η >75%)*	**50** ($\geq$600 MW_{th}, η <75%)[1,2]	**50**	BREF - IED compliance.	E-DLN		**55**	**50**
95th %ile of hr means	**100** *(150 if EE>55% or η >75%)*	**None**	**100**	IED	E-DLN		**100**	**100**
1 - If electrical generating efficiency (EE) > 55% then limit is [limit] x EE/55 2 - Overall plant efficiency, η, based on 'net total fuel utilisation'								

CO limits (mg/Nm^3) – indicative in *italics*								
Averaging	**IED (Annex V Part 1) - Existing**	**LCP BREF**	**Expected permit limits**	**Basis**	**Limits apply**	**Monitoring**	**Current Permit Limit**	**Revised Permit Limit**
Annual	**None**	***30*** *(50 for plant operating at low load)*	***50***	BREF	E-DLN	Continuous	**None**	**50**
Monthly	**100**	**None**	**100**	IED	E-DLN		**100**	**100**

Daily	**110**	**None**	**110**	IED	E-DLN		**110**	**110**
95th %ile of hr means	**200**	**None**	**200**	IED	E-DLN		**200**	**200**

In response to the additional Regulation 61(1) Notice served on 19/11/2019 (updated response received 05/02/2020), the Operator proposed an annual emission limit at 50 mg/m^3 for emissions of carbon monoxide from GT3/HRSG3. This is above the indicative emission limit of 30 mg/m^3 set in the LCP BAT conclusions, for existing gas turbines in this tier of thermal input. However, the Operator justified the requested emission limit explaining that higher emissions of CO are associated with low load operation of the gas turbine. We have accepted this technical justification, which is in line with the provision of the BAT conclusions for a higher indicative CO emission limit when operating at low load. We have set this limit in table S3.1a of the variation notice.

No BAT-AEL are specified for SO_2 in natural gas fired gas turbines in the LCP BAT conclusions and, for this type of fuel, the low sulphur content in the fuel specification would be sufficient per se to ensure that emissions of this pollutant are not of environmental significance. However, the current permit already included emission limits for SO_2 prior to this permit review and GT3/HRSG3 is a multi-fuel plant, fired on natural gas and refinery fuel gas. Since we consider appropriate the specification of an emission limit for SO_2 emissions when the plant is operating as multi-fuel (see section below for refinery fuel gas), we have also retained the existing emission limits for SO_2 for natural gas operation, based on the no-backsliding principle and to ensure that the multi-fuel operation is covered by an emission limit for this parameter.

Fuel: **refinery fuel gas**
Operating hours: unlimited
Plant configuration: CCGT (steam cycle is common between LCP188 and LCP415), gas turbine operating at low load
Age: permitted before publication of the REF BREF
Thermal input: >600 MWth
Net total fuel utilisation: <75%
Electric Efficiency: <55%

NOx limits (mg/Nm^3)								
Averaging	**IED (Annex V Part 1) - Existing**	**REF BREF**	**Expected permit limits**	**Basis**	**Limits apply**	**Monitoring**	**Current Permit Limit**	**Revised Permit Limit**
Annual	**None**	**None**	**None**	N/A	N/A	Continuous	**None**	**None**
Monthly	**120**	**120**	**120**	IED and REF BREF	E-DLN[1]		**120**	**120**
Daily	**132**	**None**	**132**	IED	E-DLN[1]		**132**	**132**
95th %ile of hr means	**240**	**None**	**240**	IED	E-DLN[1]		**240**	**240**

1. Although for gas turbines where the IED specified that limits apply over 70% load, we have considered them to apply when low NOx is effective (DLN-E) as a default across all monitoring requirements for NOx and CO to use a consistent approach with the LCP BREF

CO limits (mg/Nm^3) – indicative in *italics*								
Averaging	**IED (Annex V Part 1) - Existing**	**REF BREF**	**Expected permit limits**	**Basis**	**Limits apply**	**Monitoring**	**Current Permit Limit**	**Revised Permit Limit**
Annual	**None**	**None**	**None**	N/A	N/A	Continuous	**None**	**None**
Monthly	**None**	**100**	**100**	REF BREF	E-DLN[1]		**None**	**100**

Daily	**None**	**None**	**None**	N/A	N/A		**None**	**None**
95th %ile of hr means	**None**	**None**	**None**	N/A	N/A		**None**	**None**
1. Although for gas turbines where the IED specified that limits apply over 70% load, we have considered them to apply when low NOx is effective (DLN-E) as a default across all monitoring requirements for NOx and CO to use a consistent approach with the LCP BREF								
SO_2 limits (mg/Nm^3)								
Averaging	**IED (Annex V Part 1) - Existing**	**REF BREF**	**Expected permit limits**	**Basis**	**Limits apply**	**Monitoring**	**Current Permit Limit**	**Revised Permit Limit**
Annual	**None**	**None**	**None**	NA	NA	N/A	**None**	**None**
Monthly	**None**	**None**	**None**	IED	MSUL/MSDL to baseload		**35**	**35** [1, 2]
Daily	**None**	**None**	**None**	IED	MSUL/MSDL to baseload		**39**	**39** [1, 2]
95th %ile of hr means	**None**	**None**	**None**	IED	MSUL/MSDL to baseload		**70**	**70** [1, 2]
Notes: 1. Emission limits are retained from the existing permit based on the non-backsliding principle. Although the sulphur content of the RFG is specified in table S2.1 of the permit, since sulphur might be present in RFG due to the source, nature and variability of this fuel, we consider that the specification of an emission limit for SO2 emissions when firing this fuel is appropriate. 2. Requirement for continuous emissions monitoring of SO2 is retained from the current permit based on the non-backsliding principle.								

No emission limits for dust for combustion of RFG in gas turbines apply from either IED or the REF BREF / BAT conclusions. According to our guidance, we have therefore considered that no monitoring is required for this parameter.

4.2 The energy efficiency levels associated with the Best Available Techniques Conclusions

An energy efficiency level associated with the best available techniques (BAT-AEEL) refers to the ratio between the combustion unit's net energy output(s) and the combustion unit's fuel/feedstock energy input at actual unit design. The net energy output(s) is determined at the combustion unit boundaries, including auxiliary systems (e.g. flue-gas treatment systems), and for the unit operated at full load.

The table below sets out the BAT-AEELs specified in the LCP BAT Conclusions for the large combustion plant on the site and the energy efficiency levels confirmed through the Regulation 61 notice response.

BAT AEELs (%)			Plant efficiency (%)		
Net electrical efficiency	Net total fuel utilisation	Net mechanical efficiency	Net electrical efficiency	Net total fuel utilisation	Net mechanical efficiency
Combined LCP188 and LCP415: CHP CCGT, ≥ 600 MWth, existing plant					
50–60	N/A	N/A	52%	N/A	NA

Taking the above into account, we consider this plant is BAT in relation to the AEELs. See additional explanation below.

The evidence provided to demonstrate that the AEELs are met was in the form of a response to our request for additional information (additional information in Response to Regulation 61, received 05/02/2020), supplemented by operational data and calculations taking into account the energy content of the steam export from the CHP.

The Operator responded that the performance of each gas turbine at the installation was tested independently according to international standards ASME PTC 22 that we consider compliant with the requirements of BAT conclusion 2.

Due to the process configuration of the CHP, with common steam headers supplying steam to 3 steam turbines operating in parallel, fed by steam generated in the HRSG1 and 2 (part of LCP188), supplementary steam in the Auxiliary Boilers 1 and 2 (part of LCP188) when required, and steam generated in the HRSG3 (part of LCP415), the Operator has provided information on the overall energy efficiency of the CHP installation, as opposed to specific information for each LCP. We agree with this approach.

In addition to the above, note 1 to BAT conclusion 2 recognises that, in the case of CHP units, if for technical reasons the performance test cannot be carried out with the unit operated at full load for the heat supply, the test can

be supplemented or substituted by a calculation using full load parameters. The Operator has reported that the CHP unit at the installation cannot operate at full load, without exceeding the users' steam requirements.

For the reasons summarised above, the Operator has provided calculations referring to operational data for example hours to demonstrate the energy efficiency levels of the installation. These example hours were selected to represent operational conditions close to the nominal base loads of the gas turbines, as measured at their respective performance tests.

The LCP BAT conclusions, specify that, in the case of CHP units, only one of the two BAT-AEELs 'Net electrical efficiency' or 'Net total fuel utilisation' applies, depending on the CHP unit design, i.e. either more oriented towards electricity generation or heat generation. We have reviewed the information provided by the Operator and we consider that, since the VPI Immingham CHP Plant is more oriented toward electricity generation, the appropriate BAT-AEEL to be considered is the Net Electrical Efficiency.

In the additional information in Response to Regulation 61, received 05/02/2020, the Operator has reported a calculated Net Electrical Efficiency of 52%, for the combined CHP operation of LCP188 and LCP415, example hour 14:00 (GMT) 14th June 2019. This particular hour of operation was selected because:

- The net electricity exported was consistent with the installation baseload output under nominal conditions;
- The CHP was operating at a low steam export load; since the steam for export is spilled from the steam turbine, higher steam export loads result in lower net electric efficiency figures, because the steam exported does not contribute to the electricity generation in the steam turbine where it is spilled from. For this reason, the Operator has theoretically adjusted the net electrical efficiency to account for the potential electricity generation of the exported steam.

We have reviewed the information provided by the Operator and the supporting calculation and we agree with their conclusion that the installation meets the applicable BAT-AEEL.

4.2 Monitoring of flue gas parameters – LCP BAT conclusion 3

BAT conclusion 3 requires the Operator to monitor the following key parameters for the flue-gas:

Stream	Parameter(s)	Monitoring
Flue-gas	Flow	Periodic or continuous determination
	Oxygen content, temperature, and pressure	Periodic or continuous measurement
	Water vapour content (3)	

In response to the Regulation 61 Notice, the Operator has confirmed that LCP415 (Gas Turbine 3/HRSG3) is currently compliant with the requirements of this BAT conclusion as flue-gas flow rate, oxygen content, temperature and pressure are measured continuously, whilst the sampled flue gas is dried before analysis for emissions and therefore measurement of water vapour content is not necessary.

For LCP188, the Operator has confirmed the following:

Auxiliary Boilers 1 and 2 – currently compliant: flue-gas flow rate, oxygen content, temperature, pressure are measured continuously. The sampled flue gas is dried before analysis for emissions and therefore measurement of vapour content is not necessary.

Gas Turbine 1/HRSG1 and Gas Turbine2/HRSG2 – compliant in the future: flue-gas flow rate, oxygen content, temperature, are measured continuously. The sampled flue gas is dried before analysis for emissions and therefore measurement of water vapour content is not necessary. However, pressure measurement is currently not in place.

In response to the additional Regulation 61(1) Notice served on 19/11/2019 and responded on 20/12/2019, the Operator had confirmed that pressure sensors will be installed in GT 1/HRSG 1 and 2 by the compliance date of 17/08/2021. We have therefore set an improvement condition (IC19) to reflect this requirement.

4.3 Requirements for multi-fuel combustion plants

The EPR Compliance Assessment Report BJ8022IZ/0342536, dated 26/09/2019, recorded an inconsistent approach between the way the existing permit addressed the requirements for multi-fuel firing and our current interpretation of multi-fuel compliance requirements for LCP, according to Article 40 of the IED.

Article 40 (1) of IED applies to multi-fuel firing combustion plant involving the simultaneous use of two or more fuels.

Article 40 (2) of IED includes specific provisions for multi-fuel firing combustion plants permit before 7 January 2013, which use refinery fuels from the refining of crude-oil for own consumption.

LCP188 and LCP415, part of the Immingham CHP Power Plant, were developed in technical connection with the nearby refineries, in particular Phillips 66 Humber Oil Refinery and permitted before 7 January 2013. The installation receives refinery fuel gas from Phillips 66 Humber Oil Refinery and exports steam and power to this refinery and export steam to Total Lindsey Oil Refinery. For this reason, we consider that the specific provisions of Article 40 (2) of the Industrial Emission Directive are applicable to calculate multi-

fuels emission limits for equipment fired on refinery off-gas at the installation, instead of the general provisions of Article 40 (1).

For refinery combustion plants, the Environment Agency decided to exercise its discretion, by applying the provisions of article 40(2) and developed the document titled 'IED Chapter III Protocol for Multi-fuel Firing Refinery Combustion Plants granted a Permit prior to 7th January 2013'.
The approaches described in this document are referred to for setting multi-fuel weighted emission limits at the installation.

As part of this permit review, we have therefore addressed this historical inconsistency and varied the permit to make it compliant with our current regulatory interpretation of the multi-fuel requirements of the IED.

We have specified in Tables S3.1 and S3.1a of the varied and consolidated permit that equipment fired on multi-fuel shall comply with emission limits calculated according to the multi-fuel weighting formulae of the IED Article 40 (2).

In response to the Regulation 61 Notice served on 19/11/19, the Operator has submitted a draft multi-fuel firing plan (document titled 'BJ8022IZ – Multi Fuel Firing Plan (MFFP)', received 20/12/19). We have reviewed this document and we consider it still needs further development to be aligned to the requirements of the 'IED Chapter III Protocol for Multi-fuel Firing Refinery Combustion Plants granted a Permit prior to 7th January 2013'.

We have therefore set an improvement condition (IC18) requiring the Operator to fully develop within six months a plan to report and assess compliance of the emissions from the multi-fuel combustion equipment of LCP188 and LCP415 against the multi-fuel weighted emission limits calculated from the limits specified in Tables S3.1 and S3.1a, according to the formulae provided in IED Article 40(2), following the methodologies described in the document titled 'IED Chapter III Protocol for Multi-fuel Firing Refinery Combustion Plants granted a Permit prior to 7th January 2013'.
We have also included in the variation notice a table (table S3.3) specifying the requirement for setting annual mass emission limits for multi-fuel operating equipment. These emission limits for multi-fuel firing equipment are to be determined upon completion of improvement condition IC18, if fixed multi-fuel weighted emission limit values are proposed, according to the methodology described in the document titled 'IED Chapter III Protocol for Multi-fuel Firing Refinery Combustion Plants granted a Permit prior to 7th January 2013'.

5 Decision checklist regarding relevant LCP BAT Conclusions

BAT Conclusions for large combustion plant, were published by the European Commission on 17th August 2017. There are 75 BAT Conclusions. Only the BAT Conclusions relevant to the particular fuel type used on site have been replicated below.

This annex provides a record of decisions made in relation to each relevant BAT Conclusion applicable to the installation. This annex should be read in conjunction with the Consolidated Variation Notice.

The conditions in the permit through which the relevant BAT Conclusions are implemented include but are not limited to the following:

BAT Conclusion requirement topic	Permit condition(s)	Permit table(s)
Environmental Management System	1.1.1	S1.2
BAT AELs	3.1.1 and 3.5.1	S3.1a
Monitoring	2.3, 3.5 and 3.6	S1.2, S1.4, S1.5, S3.1a
Energy efficiency	1.2 and 2.3	S3.4
Noise	3.4 and 2.3	S2.1
Other operating techniques	1.2	S1.2

The overall status of compliance with the BAT conclusion is indicated in the table as:

NA Not Applicable
CC Currently Compliant
FC Compliant in the future (within 4 years of publication of BAT conclusions)
NC Not Compliant
PC Partially Compliant

BAT C. No.	Summary of BAT Conclusion requirement	Status NA/ CC / FC / NC	Assessment of the installation capability and any alternative techniques proposed by the Operator to demonstrate compliance with the BAT Conclusion requirement
General			
1	**In order to improve the overall environmental performance, BAT is to implement and adhere to an environmental management system (EMS) that incorporates all of the following features:** i. commitment of the management, including senior management; ii. definition of an environmental policy that includes the continuous improvement of the installation by the management; iii. planning and establishing the necessary procedures, objectives and targets, in conjunction with financial planning and investment; iv. implementation of procedures (a) Structure and responsibility (b) Training (c) Communication (d) Employee involvement (e) Documentation (f) Efficient process control (g) Maintenance programmes (h) Emergency preparedness and response (i) Safeguarding compliance with environmental legislation v. checking performance and taking corrective action, paying particular attention to: (a) monitoring and measurement (see also the Reference Document on the General Principles of Monitoring) (b) corrective and preventive action (c) maintenance of records (d) independent (where practicable) internal and external auditing in order to determine whether or not the EMS conforms to planned arrangements and has been properly implemented and maintained; vi. review of the EMS and its continuing suitability, adequacy and effectiveness by senior management; vii. following the development of cleaner technologies; viii. consideration for the environmental impacts from the eventual decommissioning of the installation at the stage of designing a new plant, and throughout its operating life; viii. consideration for the environmental impacts from the eventual decommissioning of the installation at the stage of designing a new plant, and throughout its operating life; ix. application of sectoral benchmarking on a regular basis.	CC	The Operator has addressed compliance with this BAT conclusion, in response to the additional Regulation 61(1) Notice served on 19/11/2019 and responded on 20/12/2019. This confirmed that the Operator's environmental management system, certified to ISO14001:2015, incorporates all the applicable requirements set out in this BAT conclusion. We agree with the Operator's stated compliance.

<table>
<tr><th>BAT C. No.</th><th>Summary of BAT Conclusion requirement</th><th>Status NA/ CC / FC / NC</th><th>Assessment of the installation capability and any alternative techniques proposed by the Operator to demonstrate compliance with the BAT Conclusion requirement</th></tr>
<tr><td></td><td>Etc - see BAT Conclusions

Applicability. The scope (e.g. level of detail) and nature of the EMS (e.g. standardised or non-standardised) will generally be related to the nature, scale and complexity of the installation, and the range of environmental impacts it may have.</td><td></td><td></td></tr>
<tr><td>2</td><td>BAT is to determine the net electrical efficiency and/or the net total fuel utilisation and/or the net mechanical energy efficiency of the gasification, IGCC and/or combustion units by carrying out a performance test at full load (1), according to EN standards, after the commissioning of the unit and after each modification that could significantly affect the net electrical efficiency and/or the net total fuel utilisation and/or the net mechanical energy efficiency of the unit. If EN standards are not available, BAT is to use ISO, national or other international standards that ensure the provision of data of an equivalent scientific quality.</td><td>CC</td><td>The Operator has confirmed that the gas turbines were tested according to international standard ASME PTC 22 (in 2017 and 2018) and the auxiliary boilers were tested according to international standard ASME PTC 4 when they were originally commissioned.
We consider that these international standards ensure provision of data of an equivalent scientific quality to EN standards.
The Operator has claimed that the Auxiliary Boilers cannot be performance tested due to the variable steam demand of both refineries. This is consistent with note 1 to BAT conclusion 2: In the case of CHP units, if for technical reasons the performance test cannot be carried out with the unit operated at full load for the heat supply, the test can be supplemented or substituted by a calculation using full load parameters.
We consider the operating techniques stated by the Operator are compliant with this BAT conclusion. We have set a process monitoring requirement in the permit to test the Net Electric efficiency and/or Net Total Fuel Utilisation, according to EN standards or equivalent, after each modification which that could significantly affect these parameters.</td></tr>
<tr><td>3</td><td>BAT is to monitor key process parameters relevant for emissions to air and water including those given below.
<table>
<tr><th>Stream</th><th>Parameter(s)</th><th>Monitoring</th></tr>
<tr><td rowspan="3">Flue-gas</td><td>Flow</td><td>Periodic or continuous determination</td></tr>
<tr><td>Oxygen content, temperature, and pressure</td><td rowspan="2">Periodic or continuous measurement</td></tr>
<tr><td>Water vapour content (3)</td></tr>
<tr><td>Waste water from flue-gas treatment</td><td>Flow, pH, and temperature</td><td>Continuous measurement</td></tr>
</table></td><td>FC</td><td>The Operator has confirmed that LCP415 (Gas Turbine 3/HRSG 3) is currently compliant with the requirements of this BAT conclusion: oxygen content, temperature and pressure are measured continuously; the flue-gas flow rate is continuously determined from the measurement of fuel consumption; the sampled flue gas is dried before analysis for emissions and therefore measurement of water vapour content is not necessary.

For LCP188, the Operator has confirmed the following:

Auxiliary Boilers 1 and 2 – currently compliant: oxygen content, temperature, pressure are measured continuously; the flue-gas flow rate is continuously determined from the measurement of fuel</td></tr>
</table>

<table>
<tr><th>BAT C. No.</th><th>Summary of BAT Conclusion requirement</th><th>Status NA/ CC / FC / NC</th><th>Assessment of the installation capability and any alternative techniques proposed by the Operator to demonstrate compliance with the BAT Conclusion requirement</th></tr>
<tr><td></td><td></td><td></td><td>consumption; the sampled flue gas is dried before analysis for emissions and therefore measurement of water vapour content is not necessary.

Gas Turbine 1/HRSG 1 and Gas Turbine 2/HRSG 2 – compliant in the future: oxygen content, temperature, are measured continuously; the flue-gas flow rate is continuously determined from the measurement of fuel consumption; the sampled flue gas is dried before analysis for emissions and therefore measurement of water vapour content is not necessary. However, pressure measurement is currently not in place.

In response to the additional Regulation 61(1) Notice served on 19/11/2019 and responded on 20/12/2019, the Operator had confirmed that pressure sensors will be installed in GT 1/HRSG 1 and 2 by the compliance date of 17/08/2021. We have set an improvement condition (IC19) to reflect this requirement.</td></tr>
<tr><td>4</td><td>BAT is to monitor emissions to air with at least the frequency given below and in accordance with EN standards. If EN standards are not available, BAT is to use ISO, national or other international standards that ensure the provision of data of an equivalent scientific quality.
<table>
<tr><th>Substance/Parameter</th><th>Fuel/Process/Type of combustion plant</th><th>Combustion plant total rated thermal input</th><th>Standard(s) [4]</th><th>Minimum monitoring frequency [5]</th><th>Monitoring associated with</th></tr>
<tr><td>NH_3</td><td>— When SCR and/or SNCR is used</td><td>All sizes</td><td>Generic EN standards</td><td>Continuous [6] [7]</td><td>BAT 7</td></tr>
<tr><td>NO_X</td><td>— Coal and/or lignite including waste co-incineration
— Solid biomass and/or peat including waste co-incineration
— HFO- and/or gas-</td><td>All sizes</td><td>Generic EN standards</td><td>Continuous [6] [8]</td><td>BAT 20
BAT 24
BAT 28
BAT 32
BAT 37
BAT 41
BAT 42
BAT 43
BAT 47
BAT 48</td></tr>
</table></td><td>CC</td><td>The Operator has provided information confirming that they comply with the requirements of this BAT conclusion. The details are described in the following.

LCP188:
Gas Turbines and HRSG 1 & 2, fired on natural gas, include continuous monitoring for NOx & CO.
The current permit, also includes emission limits for SO_2 and a requirement for continuous monitoring of this pollutant in GT/HRSG 1 and 2. However, in response to the additional Regulation 61(1) Notice served on 19/11/2019 and responded on 20/12/2019, the Operator has clarified that they considered this requirement a legacy from when these gas turbines and HRSGs were permitted to operate with refinery off-gas as a fuel. Therefore, the Operator has requested that the requirement for continuous monitoring of SO2 in these two emission points is removed from the varied and consolidated permit. We agree that emissions of SO2 from the combustion of natural gas are not a concern, due to the low sulphur content of this fuel. We have therefore accepted the request made by the Operator and specified in the varied and consolidated permit that emissions of</td></tr>
</table>

BAT C. No.	Summary of BAT Conclusion requirement						Status NA/ CC / FC / NC	Assessment of the installation capability and any alternative techniques proposed by the Operator to demonstrate compliance with the BAT Conclusion requirement
		oil-fired boilers and engines — Gas-oil-fired gas turbines — Natural-gas-fired boilers, engines, and turbines — Iron and steel process gases — Process fuels from the chemical industry — IGCC plants				BAT 56 BAT 64 BAT 65 BAT 73		SO2 from these two emission points will need to be reported by calculation, based on the sulphur content in the natural gas. We have also removed the emission limit value for SO2 from these two emission points, since there is no requirement to specify this emission limit for gas turbines operating on natural gas, in either IED Chapter III, Annex V or the LCP BAT conclusions and we consider that the use of natural gas, which is specified to contain low sulphur concentrations, ensures that emissions of this pollutant are maintained low. Auxiliary Boilers 1 & 2 fired on natural gas and refinery fuel gas, include continuous monitoring for NOx, SO2 and dust (the latter fully installed and being connected to the DCS as 20/12/2019). LCP415: Gas Turbine 3 is fired on natural gas and the associated HRSG 3 is fired either or natural gas or refinery fuel gas. LCP415 includes continuous monitoring for NOx, CO and SO_2.
		— Combustion plants on offshore platforms	All sizes	EN 14792	Once every year [9]	BAT 53		
	N_2O	— Coal and/or lignite in circulating fluidised bed boilers — Solid biomass and/or peat in circulating fluidised bed boilers	All sizes	EN 21258	Once every year [10]	BAT 20 BAT 24		
	CO	— Coal and/or lignite including waste co-incineration — Solid biomass and/or peat including waste co-incineration — HFO- and/or gas-oil-fired boilers and engines — Gas-oil-fired gas turbines — Natural-gas-fired boilers, engines, and turbines	All sizes	Generic EN standards	Continuous [6] [8]	BAT 20 BAT 24 BAT 28 BAT 33 BAT 38 BAT 44 BAT 49 BAT 56 BAT 64 BAT 65 BAT 73		

BAT C. No.	Summary of BAT Conclusion requirement						Status NA/ CC / FC / NC	Assessment of the installation capability and any alternative techniques proposed by the Operator to demonstrate compliance with the BAT Conclusion requirement
		— Iron and steel process gases — Process fuels from the chemical industry — IGCC plants						
		— Combustion plants on offshore platforms	All sizes	EN 15058	Once every year [9]	BAT 54		
	SO_2	— Coal and/or lignite incl waste co-incineration — Solid biomass and/or peat incl waste co-incineration — HFO- and/or gas-oil-fired boilers — HFO- and/or gas-oil-fired engines — Gas-oil-fired gas turbines — Iron and steel process gases — Process fuels from the chemical industry in boilers — IGCC plants	All sizes	Generic EN standards and EN 14791	Continuous [6] [11] [12]	BAT 21 BAT 25 BAT 29 BAT 34 BAT 39 BAT 50 BAT 57 BAT 66 BAT 67 BAT 74		
	SO_3	— When SCR is used	All sizes	No EN standard available	Once every year	—		
	Gaseous chlorides, expressed as HCl	— Coal and/or lignite — Process fuels from the chemical industry in boilers	All sizes	EN 1911	Once every three months [6] [13] [14]	BAT 21 BAT 57		
		— Solid biomass and/or peat	All sizes	Generic EN standards	Continuous [15] [16]	BAT 25		

BAT C. No.	Summary of BAT Conclusion requirement						Status NA/ CC / FC / NC	Assessment of the installation capability and any alternative techniques proposed by the Operator to demonstrate compliance with the BAT Conclusion requirement
		— Waste co-incineration	All sizes	Generic EN standards	Continuous [6] [16]	BAT 66 BAT 67		
	HF	— Coal and/or lignite — Process fuels from the chemical industry in boilers	All sizes	No EN standard available	Once every three months [6] [13] [14]	BAT 21 BAT 57		
		— Solid biomass and/or peat	All sizes	No EN standard available	Once every year	BAT 25		
		— Waste co-incineration	All sizes	Generic EN standards	Continuous [6] [16]	BAT 66 BAT 67		
	Dust	— Coal and/or lignite — Solid biomass and/or peat — HFO- and/or gas-oil-fired boilers — Iron and steel process gases — Process fuels from the chemical industry in boilers — IGCC plants — HFO- and/or gas-oil-fired engines — Gas-oil-fired gas turbines	All sizes	Generic EN standards and EN 13284-1 and EN 13284-2	Continuous [6] [17]	BAT 22 BAT 26 BAT 30 BAT 35 BAT 39 BAT 51 BAT 58 BAT 75		
		— Waste co-incineration	All sizes	Generic EN standards and EN 13284-2	Continuous	BAT 68 BAT 69		
	Metals and metalloids except mercury (As, Cd, Co, Cr, Cu, Mn, Ni, Pb, Sb, Se, Tl, V, Zn)	— Coal and/or lignite — Solid biomass and/or peat — HFO- and/or gas-oil-fired boilers and engines	All sizes	EN 14385	Once every year [18]	BAT 22 BAT 26 BAT 30		
		— Waste co-	< 300 MW_{th}	EN 14385	Once every six months [13]	BAT 68 BAT 69		

BAT C. No.	Summary of BAT Conclusion requirement						Status NA/ CC / FC / NC	Assessment of the installation capability and any alternative techniques proposed by the Operator to demonstrate compliance with the BAT Conclusion requirement

	incineration	≥ 300 MW_{th}	EN 14385	Once every three months [19] [13]	
	— IGCC plants	≥ 100 MW_{th}	EN 14385	Once every year [18]	BAT 75
Hg	— Coal and/or lignite including waste co-incineration	< 300 MW_{th}	EN 13211	Once every three months [13] [20]	BAT 23
		≥ 300 MW_{th}	Generic EN standards and EN 14884	Continuous [16] [21]	
	— Solid biomass and/or peat	All sizes	EN 13211	Once every year [22]	BAT 27
	— Waste co-incineration with solid biomass and/or peat	All sizes	EN 13211	Once every three months [13]	BAT 70
	— IGCC plants	≥ 100 MW_{th}	EN 13211	Once every year [23]	BAT 75
TVOC	— HFO- and/or gas-oil-fired engines — Process fuels from chemical industry in boilers	All sizes	EN 12619	Once every six months [13]	BAT 33 BAT 59
	— Waste co-incineration with coal, lignite, solid biomass and/or peat	All sizes	Generic EN standards	Continuous	BAT 71
Formaldehyde	— Natural-gas in spark-ignited lean-burn gas and dual fuel engines	All sizes	No EN standard available	Once every year	BAT 45
CH_4	— Natural-gas-fired engines	All sizes	EN ISO 25139	Once every year [24]	BAT 45
PCDD/F	— Process fuels from chemical industry in boilers — Waste co-incineration	All sizes	EN 1948-1, EN 1948-2, EN 1948-3	Once every six months [13] [25]	BAT 59 BAT 71

<table>
<tr><th>BAT C. No.</th><th>Summary of BAT Conclusion requirement</th><th>Status NA/ CC / FC / NC</th><th>Assessment of the installation capability and any alternative techniques proposed by the Operator to demonstrate compliance with the BAT Conclusion requirement</th></tr>
<tr><td>5</td><td>BAT is to monitor emissions to water from flue-gas treatment with at least the frequency given below and in accordance with EN standards. If EN standards are not available, BAT is to use ISO, national or other international standards that ensure the provision of data of an equivalent scientific quality.
<table>
<tr><th colspan="2">Substance/Parameter</th><th>Standard(s)</th><th>Minimum monitoring frequency</th><th>Monitoring associated with</th></tr>
<tr><td colspan="2">Total organic carbon (TOC) ([26])</td><td>EN 1484</td><td rowspan="12">Once every month</td><td>BAT 15</td></tr>
<tr><td colspan="2">Chemical oxygen demand (COD) ([26])</td><td>No EN standard available</td><td></td></tr>
<tr><td colspan="2">Total suspended solids (TSS)</td><td>EN 872</td><td></td></tr>
<tr><td colspan="2">Fluoride (F^-)</td><td>EN ISO 10304-1</td><td></td></tr>
<tr><td colspan="2">Sulphate (SO_4^{2-})</td><td>EN ISO 10304-1</td><td></td></tr>
<tr><td colspan="2">Sulphide, easily released (S^{2-})</td><td>No EN standard available</td><td></td></tr>
<tr><td colspan="2">Sulphite (SO_3^{2-})</td><td>EN ISO 10304-3</td><td></td></tr>
<tr><td rowspan="7">Metals and metalloids</td><td>As</td><td rowspan="7">Various EN standards available (e.g. EN ISO 11885 or EN ISO 17294-2)</td><td></td></tr>
<tr><td>Cd</td><td></td></tr>
<tr><td>Cr</td><td></td></tr>
<tr><td>Cu</td><td></td></tr>
<tr><td>Ni</td><td></td></tr>
<tr><td>Pb</td><td></td></tr>
<tr><td>Zn</td><td></td></tr>
<tr><td></td><td>Hg</td><td>Various EN standards available (e.g. EN ISO 12846 or EN ISO 17852)</td><td></td></tr>
<tr><td colspan="2">Chloride (Cl^-)</td><td>Various EN standards available (e.g. EN ISO 10304-1 or EN ISO 15682)</td><td>—</td></tr>
<tr><td colspan="2">Total nitrogen</td><td>EN 12260</td><td>—</td></tr>
</table></td><td>NA</td><td>We agree that this BAT Conclusion is not applicable to the activities carried out at the installation as flue-gas treatment techniques are not implemented at the installation.</td></tr>
</table>

<table>
<tr><th>BAT C. No.</th><th>Summary of BAT Conclusion requirement</th><th>Status NA/ CC / FC / NC</th><th>Assessment of the installation capability and any alternative techniques proposed by the Operator to demonstrate compliance with the BAT Conclusion requirement</th></tr>
<tr><td>6</td><td>In order to improve the general environmental performance of combustion plants and to reduce emissions to air of CO and unburnt substances, BAT is to ensure optimised combustion and to use an appropriate combination of the techniques given below.
<table>
<tr><th colspan="2">Technique</th><th>Description</th><th>Applicability</th></tr>
<tr><td>a.</td><td>Fuel blending and mixing</td><td>Ensure stable combustion conditions and/or reduce the emission of pollutants by mixing different qualities of the same fuel type</td><td rowspan="2">Generally applicable</td></tr>
<tr><td>b.</td><td>Maintenance of the combustion system</td><td>Regular planned maintenance according to suppliers' recommendations</td></tr>
<tr><td>c.</td><td>Advanced control system</td><td>See description in Section 8.1</td><td>The applicability to old combustion plants may be constrained by the need to retrofit the combustion system and/or control command system</td></tr>
<tr><td>d.</td><td>Good design of the combustion equipment</td><td>Good design of furnace, combustion chambers, burners and associated devices</td><td>Generally applicable to new combustion plants</td></tr>
<tr><td>e.</td><td>Fuel choice</td><td>Select or switch totally or partially to another fuel(s) with a better environmental profile (e.g. with low sulphur and/or mercury content) amongst the available fuels, including in start-up situations or when back-up fuels are used</td><td>Applicable within the constraints associated with the availability of suitable types of fuel with a better environmental profile as a whole, which may be impacted by the energy policy of the Member State, or by the integrated site's fuel balance in the case of combustion of industrial process fuels.
For existing combustion plants, the type of fuel chosen may be limited by the configuration and the design of the plant</td></tr>
</table></td><td>CC</td><td>The Operator has confirmed that an appropriate combination of techniques is used, as described below:
a. Refinery off gas is gradually mixed with NG during the combustion phase to ensure stable conditions are maintained.
b. Maintenance of the combustion system by regular planned maintenance according to suppliers' recommendations.
c. Advanced control system by use of a computer-based automatic system to control the combustion efficiency and support the prevention and/or reduction of emissions and also includes the use of high-performance monitoring.
d. Good design of the combustion equipment by use of latest design of combustion burners and associated devises.
e. For back up firing of the auxiliary boilers gas oil not exceeding 0.1% sulphur content is specified.</td></tr>
</table>

BAT C. No.	Summary of BAT Conclusion requirement	Status NA/ CC / FC / NC	Assessment of the installation capability and any alternative techniques proposed by the Operator to demonstrate compliance with the BAT Conclusion requirement
7	In order to reduce emissions of ammonia to air from the use of selective catalytic reduction (SCR) and/or selective non-catalytic reduction (SNCR) for the abatement of NO_X emissions, BAT is to optimise the design and/or operation of SCR and/or SNCR (e.g. optimised reagent to NO_X ratio, homogeneous reagent distribution and optimum size of the reagent drops). **BAT-associated emission levels** The BAT-associated emission level (BAT-AEL) for emissions of NH_3 to air from the use of SCR and/or SNCR is < 3–10 mg/Nm^3 as a yearly average or average over the sampling period. The lower end of the range can be achieved when using SCR and the upper end of the range can be achieved when using SNCR without wet abatement techniques. In the case of plants combusting biomass and operating at variable loads as well as in the case of engines combusting HFO and/or gas oil, the higher end of the BAT-AEL range is 15 mg/Nm^3.	NA	Not applicable as there are no emissions of ammonia or abatement of NOx emissions.
8	In order to prevent or reduce emissions to air during normal operating conditions, BAT is to ensure, by appropriate design, operation and maintenance, that the emission abatement systems are used at optimal capacity and availability.	NA	Not applicable as there are no emissions abatement systems.
9	In order to improve the general environmental performance of combustion and/or gasification plants and to reduce emissions to air, BAT is to include the following elements in the quality assurance/quality control programmes for all the fuels used, as part of the environmental management system (see BAT 1): (i) Initial full characterisation of the fuel used including at least the parameters listed below and in accordance with EN standards. ISO, national or other international standards may be used provided they ensure the provision of data of an equivalent scientific quality; (ii) Regular testing of the fuel quality to check that it is consistent with the initial characterisation and according to the plant design specifications. The frequency of testing and the parameters chosen from the table below are based on the variability of the fuel and an assessment of the relevance of pollutant releases (e.g. concentration in fuel, flue-gas treatment employed); (iii) Subsequent adjustment of the plant settings as and when needed and practicable (e.g. integration of the fuel characterisation and control in the advanced control system (see description in Section 8.1)). ***Description*** Initial characterisation and regular testing of the fuel can be performed by the operator and/or the fuel supplier. If performed by the supplier, the full results are provided to the operator in the form of a product (fuel) supplier specification and/or guarantee.	CC	The following fuels are used at this installation: 1. Natural gas, supplied from the National Grid; 2. Refinery fuel gas (also referred to as refinery off-gas (ROG) throughout this document and the permit), imported from Phillips 66 Humber Oil Refinery; 3. Liquid fuel oil (distillate oil), used as back-up fuel in Auxiliary Boilers 1 and 2, only in case of emergency interruption to the gas supply. Compliance with the requirements of BAT conclusion 9 for each of these three fuels, as described by the operator in response to the Regulation 61(1) Notices, is addressed in the following: 1. We consider that for plants which burn natural gas from the National Grid as a fuel that it is not necessary for the Operator to replicate the testing carried out by the National Grid. 2. The refinery fuel gas was initially analysed by external laboratories to provide full analysis. This included: - Determination of hydrocarbons from methane to hexadecane and

<table>
<tr><th>BAT C. No.</th><th>Summary of BAT Conclusion requirement</th><th>Status NA/ CC / FC / NC</th><th>Assessment of the installation capability and any alternative techniques proposed by the Operator to demonstrate compliance with the BAT Conclusion requirement</th></tr>
<tr><td></td><td>
<table>
<tr><th>Fuel(s)</th><th>Substances/Parameters subject to characterisation</th></tr>
<tr><td rowspan="2">Biomass/peat</td><td>— LHV
— moisture</td></tr>
<tr><td>— Ash
— C, Cl, F, N, S, K, Na
— Metals and metalloids (As, Cd, Cr, Cu, Hg, Pb, Zn)</td></tr>
<tr><td rowspan="3">Coal/lignite</td><td>— LHV
— Moisture
— Volatiles, ash, fixed carbon, C, H, N, O, S</td></tr>
<tr><td>— Br, Cl, F</td></tr>
<tr><td>— Metals and metalloids (As, Cd, Co, Cr, Cu, Hg, Mn, Ni, Pb, Sb, Tl, V, Zn)</td></tr>
<tr><td>HFO</td><td>— Ash
— C, S, N, Ni, V</td></tr>
<tr><td>Gas oil</td><td>— Ash
— N, C, S</td></tr>
<tr><td>Natural gas</td><td>— LHV
— CH_4, C_2H_6, C_3, C_4+, CO_2, N_2, Wobbe index</td></tr>
<tr><td>Process fuels from the chemical industry ([27])</td><td>— Br, C, Cl, F, H, N, O, S
— Metals and metalloids (As, Cd, Co, Cr, Cu, Hg, Mn, Ni, Pb, Sb, Tl, V, Zn)</td></tr>
<tr><td>Iron and steel process gases</td><td>— LHV, CH_4 (for COG), C_XH_Y (for COG), CO_2, H_2, N_2, total sulphur, dust, Wobbe index</td></tr>
<tr><td>Waste ([28])</td><td>— LHV
— Moisture
— Volatiles, ash, Br, C, Cl, F, H, N, O, S</td></tr>
</table>
</td><td></td><td>inert gases in natural and associated petroleum gases (according to standards: ASTM D1945-03, ISO 6974-1:2001, ISO 6974-6:2002 and ISO 6975:1997) and by gas chromatography (UKAS Accredited Tests)
- Calculation of density, relative density, calorific value, Wobbe index and apparent molecular weight from gas composition by ISO 6976
- Determination of calorific value & relative density according to standards ASTM D3588-1991, density @ base conditions – AGA 8 - 1985 (Non UKAS Accredited Tests)
The ROG is continuously analysed by gas chromatography and verified as required for the EUETS.
Although requirements for refinery fuel gas are not included in BAT 9, we consider that the initial characterisation and monitoring routine described by the Operator meets the intent of this BAT conclusion and is therefore satisfactory.

3. Distillate fuel oil is tested by the supplier prior to delivery into the storage tank according to standard BS 2869:2010 + A2011. The Operator has confirmed that BAT 9 is complied for this fuel through the implementation within the site EMS of the operating techniques described in section 4 of the Joint Environmental Programme (JEP) document ‘Characterisation of power plant fuels for compliance with LCP BREF Conclusion BAT 9’.

We consider the operating techniques stated by the Operator are compliant with this BAT conclusion.</td></tr>
</table>

<table>
<tr><th>BAT C. No.</th><th>Summary of BAT Conclusion requirement</th><th>Status NA/ CC / FC / NC</th><th>Assessment of the installation capability and any alternative techniques proposed by the Operator to demonstrate compliance with the BAT Conclusion requirement</th></tr>
<tr><td></td><td><table><tr><td></td><td>— Metals and metalloids (As, Cd, Co, Cr, Cu, Hg, Mn, Ni, Pb, Sb, Tl, V, Zn)</td></tr></table></td><td></td><td></td></tr>
<tr><td>10</td><td>In order to reduce emissions to air and/or to water during other than normal operating conditions (OTNOC), BAT is to set up and implement a management plan as part of the environmental management system (see BAT 1), commensurate with the relevance of potential pollutant releases, that includes the following elements:
— appropriate design of the systems considered relevant in causing OTNOC that may have an impact on emissions to air, water and/or soil (e.g. low-load design concepts for reducing the minimum start-up and shutdown loads for stable generation in gas turbines),
— set-up and implementation of a specific preventive maintenance plan for these relevant systems,
— review and recording of emissions caused by OTNOC and associated circumstances and implementation of corrective actions if necessary,
— periodic assessment of the overall emissions during OTNOC (e.g. frequency of events, duration, emissions quantification/estimation) and implementation of corrective actions if necessary.</td><td>CC</td><td>The Operator has confirmed the following provisions of OTNOC:

- Low load design concepts in A1 and A2; combustion tuning in A3 + A4 to ensure that the duration of start-up and shut-down periods are minimised during operation.
- All site combustion assets are part of a preventative maintenance plan, specifically an Engineering Strategy (VPII-BUP-PR-0031) and a rolling asset care plan is in place for the GT's with the manufacturer (GE). For water treatment assets this is also the case, some of which are with the OEM for proprietary water treatments.
- Emissions caused by OTNOC are still recorded on site as mass emissions. These are recorded and reported as per mass emission requirements. For water emissions these are still recorded and reported as required.
- Fugitive emissions are calculated on the basis of standardised amounts and number of plant trips / purges of gases are recorded for quantification and inclusion with the site Pollution Inventory return.</td></tr>
<tr><td>11</td><td>BAT is to appropriately monitor emissions to air and/or to water during OTNOC.
Description
The monitoring can be carried out by direct measurement of emissions or by monitoring of surrogate parameters if this proves to be of equal or better scientific quality than the direct measurement of emissions. Emissions during start-up and shutdown (SU/SD) may be assessed based on a detailed emission measurement carried out for a typical SU/SD procedure at least once every year, and using the results of this measurement to estimate the emissions for each and every SU/SD throughout the year.</td><td>CC</td><td>The Operator has confirmed that emissions caused by OTNOC are still recorded. These include emissions recorded by the CEMS during start-up and shut-down (0 load to maximum continuous rate / base load).</td></tr>
<tr><td>12</td><td>In order to increase the energy efficiency of combustion, gasification and/or IGCC units operated ≥ 1 500 h/yr, BAT is to use an appropriate combination of the techniques given below.<table><tr><th colspan="2">Technique</th><th>Description</th><th>Applicability</th></tr><tr><td>a.</td><td>Combustion optimisation</td><td>See description in Section 8.2. Optimising the combustion</td><td>Generally applicable</td></tr></table></td><td>CC</td><td>The Operator has confirmed that an appropriate combination of techniques is used, as described below:

a. Combustion Optimisation: Measures taken to maximise the efficiency of energy conversion, e.g. in the furnace/boiler, while minimising emissions (in particular of CO). This is achieved by a</td></tr>
</table>

BAT C. No.	Summary of BAT Conclusion requirement				Status NA/ CC / FC / NC	Assessment of the installation capability and any alternative techniques proposed by the Operator to demonstrate compliance with the BAT Conclusion requirement
						combination of techniques including good design of the combustion equipment, optimisation of the temperature (e.g. efficient mixing of the fuel and combustion air) and residence time in the combustion zone, and use of an advanced control system. b. Optimisation of the working medium conditions: use of combined cycle - combination of two thermodynamic cycles, i.e. a Brayton cycle (gas turbine/combustion engine) with a Rankine cycle (steam turbine/boiler), to convert heat loss from the flue-gas of the first cycle to useful energy by subsequent cycle(s). c. Optimisation of the steam cycle: - Steam Turbine major overhaul as part of outage, (ST1 /2 2017 and ST3 2018) - To increase the vacuum within the steam cycle, periodic air ingress surveys are undertaken to identify leaks. - Overall Cooling Tower and Air Cooling Condenser efficiency improvements to lower the condenser cooling water, therefore increasing the vacuum effect. - Periodic condenser cleaning in accordance with the site maintenance strategy. d. Minimisation of energy consumption: the operator has implemented energy reduction measures, one example is the installation of a 'gale breaker' curtain on the air cooled condenser. This design improves fan efficiency by reducing wind shear and turbulence, therefore minimising energy consumption in this area. e. Preheating of combustion air: Flue Gas Recirculation System on the Auxiliary Boilers, primarily aimed at reducing NOx it does some heating effect on the combustion air entering the boilers. f. Fuel Preheating: Natural gas is preheated prior to being burnt in the gas turbines, the heat provided comes from hot water tapped off from the associated HRSG. g. Advanced control system: The use of a computer-based automatic system to control the combustion efficiency and support
			minimises the content of unburnt substances in the flue-gases and in solid combustion residues			
	b.	Optimisation of the working medium conditions	Operate at the highest possible pressure and temperature of the working medium gas or steam, within the constraints associated with, for example, the control of NO_X emissions or the characteristics of energy demanded			
	c.	Optimisation of the steam cycle	Operate with lower turbine exhaust pressure by utilisation of the lowest possible temperature of the condenser cooling water, within the design conditions			
	d.	Minimisation of energy consumption	Minimising the internal energy consumption (e.g. greater efficiency of the feed-water pump)			
	e.	Preheating of combustion air	Reuse of part of the heat recovered from the combustion flue-gas to preheat the air used in combustion	Generally applicable within the constraints related to the need to control NO_X emissions		
	f.	Fuel preheating	Preheating of fuel using recovered heat	Generally applicable within the constraints associated with the boiler design and the need to control NO_X emissions		
	g.	Advanced control system	See description in Section 8.2. Computerised control of the main combustion parameters enables the combustion efficiency to be improved	Generally applicable to new units. The applicability to old units may be constrained by the need to retrofit the combustion system and/or control command system		
	h.	Feed-water preheating using recovered heat	Preheat water coming out of the steam condenser with recovered heat, before reusing it in the boiler	Only applicable to steam circuits and not to hot boilers. Applicability to existing units may be limited due to constraints associated with the plant configuration and the amount of recoverable heat		
	i.	Heat recovery	Recovery of heat (mainly from the	Applicable within the constraints		

BAT C. No.	Summary of BAT Conclusion requirement				Status NA/ CC / FC / NC	Assessment of the installation capability and any alternative techniques proposed by the Operator to demonstrate compliance with the BAT Conclusion requirement
						the prevention and/or reduction of emissions. This also includes the use of high-performance monitoring on the gas turbines. h. Feed water preheating using recovered heat: feed water is pre heated on both auxiliary boilers by using an economiser transferring heat from the flue gas to the feed water. i. Heat recovery by cogeneration (CHP): the steam produced is used by 2 adjacent oil refineries. r. Steam turbine upgrades: Please see c above.
		by cogeneration (CHP)	steam system) for producing hot water/steam to be used in industrial processes/activities or in a public network for district heating. Additional heat recovery is possible from: — flue-gas — grate cooling — circulating fluidised bed	associated with the local heat and power demand. The applicability may be limited in the case of gas compressors with an unpredictable operational heat profile		
	j.	CHP readiness	See description in Section 8.2.	Only applicable to new units where there is a realistic potential for the future use of heat in the vicinity of the unit		
	k.	Flue-gas condenser	See description in Section 8.2.	Generally applicable to CHP units provided there is enough demand for low-temperature heat		
	l.	Heat accumulation	Heat accumulation storage in CHP mode	Only applicable to CHP plants. The applicability may be limited in the case of low heat load demand		
	m.	Wet stack	See description in Section 8.2.	Generally applicable to new and existing units fitted with wet FGD		
	n.	Cooling tower discharge	The release of emissions to air through a cooling tower and not via a dedicated stack	Only applicable to units fitted with wet FGD where reheating of the flue-gas is necessary before release, and where the unit cooling system is a cooling tower		
	o.	Fuel pre-drying	The reduction of fuel moisture content before combustion to improve combustion conditions	Applicable to the combustion of biomass and/or peat within the constraints associated with spontaneous combustion risks (e.g. the moisture content of peat is kept above 40 % throughout the delivery chain). The retrofit of existing plants may be restricted by the extra calorific value that can be obtained from the drying operation and by the		

<table>
<tr><th>BAT C. No.</th><th>Summary of BAT Conclusion requirement</th><th>Status NA/ CC / FC / NC</th><th>Assessment of the installation capability and any alternative techniques proposed by the Operator to demonstrate compliance with the BAT Conclusion requirement</th></tr>
<tr><td></td><td>
<table>
<tr><td></td><td></td><td></td><td>limited retrofit possibilities offered by some boiler designs or plant configurations</td></tr>
<tr><td>p.</td><td>Minimisation of heat losses</td><td>Minimising residual heat losses, e.g. those that occur via the slag or those that can be reduced by insulating radiating sources</td><td>Only applicable to solid-fuel-fired combustion units and to gasification/IGCC units</td></tr>
<tr><td>q.</td><td>Advanced materials</td><td>Use of advanced materials proven to be capable of withstanding high operating temperatures and pressures and thus to achieve increased steam/combustion process efficiencies</td><td>Only applicable to new plants</td></tr>
<tr><td>r.</td><td>Steam turbine upgrades</td><td>This includes techniques such as increasing the temperature and pressure of medium-pressure steam, addition of a low-pressure turbine, and modifications to the geometry of the turbine rotor blades</td><td>The applicability may be restricted by demand, steam conditions and/or limited plant lifetime</td></tr>
<tr><td>s.</td><td>Supercritical and ultra-supercritical steam conditions</td><td>Use of a steam circuit, including steam reheating systems, in which steam can reach pressures above 220,6 bar and temperatures above 374 °C in the case of supercritical conditions, and above 250 – 300 bar and temperatures above 580 – 600 °C in the case of ultra-supercritical conditions</td><td>Only applicable to new units of ≥ 600 MW_{th} operated > 4 000 h/yr.
Not applicable when the purpose of the unit is to produce low steam temperatures and/or pressures in process industries.
Not applicable to gas turbines and engines generating steam in CHP mode.
For units combusting biomass, the applicability may be constrained by high-temperature corrosion in the case of certain biomasses</td></tr>
</table>
</td><td></td><td></td></tr>
<tr><td>13</td><td>In order to reduce water usage and the volume of contaminated waste water discharged, BAT is to use one or both of the techniques given below.
<table>
<tr><th colspan="2">Technique</th><th>Description</th><th>Applicability</th></tr>
<tr><td>a.</td><td>Water recycling</td><td>Residual aqueous streams, including run-off water, from the plant are reused for</td><td>Not applicable to waste water from cooling systems when</td></tr>
</table>
</td><td>CC</td><td>a. Water recycling techniques are applied as follows: treated wastewater that would be discharged to the environment from Phillips 66 Humber Oil Refinery is received and processed to use as make-up water for the wet cooling tower system: the treated effluent from the P66 Humber refineries effluent treatment plant is then</td></tr>
</table>

BAT C. No.	Summary of BAT Conclusion requirement	Status NA/ CC / FC / NC	Assessment of the installation capability and any alternative techniques proposed by the Operator to demonstrate compliance with the BAT Conclusion requirement
	<table><tr><td></td><td></td><td>other purposes. The degree of recycling is limited by the quality requirements of the recipient water stream and the water balance of the plant</td><td>water treatment chemicals and/or high concentrations of salts from seawater are present</td></tr><tr><td>b.</td><td>Dry bottom ash handling</td><td>Dry, hot bottom ash falls from the furnace onto a mechanical conveyor system and is cooled down by ambient air. No water is used in the process.</td><td>Only applicable to plants combusting solid fuels. There may be technical restrictions that prevent retrofitting to existing combustion plants</td></tr></table>		blended with cooling tower water (as a form of side stream filtration) and passed through a Zenon Ultra filtration system. The water is further blended with Anglian industrial water and passed through reverse osmosis membranes before being sent to the cooling towers as make up water. There is currently a project being installed to further recycle Demin Reverse osmosis system backwash water through the process described above to offset some of the Anglian industrial water requirement– therefore saving water. Steam sent to Customers (Phillips 66 Humber Oil Refinery and TOTAL Lindsey Oil Refinery) is returned as condensate and processed to produce demineralised water. The remaining techniques are deemed not applicable. b. Dry bottom ash handling: N/A as not solid fuel
14	In order to prevent the contamination of uncontaminated waste water and to reduce emissions to water, BAT is to segregate waste water streams and to treat them separately, depending on the pollutant content. ***Description*** Waste water streams that are typically segregated and treated include surface run-off water, cooling water, and waste water from flue-gas treatment. ***Applicability*** The applicability may be restricted in the case of existing plants due to the configuration of the drainage systems.	CC	The operator has addressed compliance with this BAT conclusion, in response to the additional Regulation 61(1) Notice served on 19/11/2019 and responded on 20/12/2019. Segregation of waste water streams is implemented as follows: - Surface Water: This is captured within the site drainage system whereby it is routed into the holding pond (M2). Where there is a risk of oil contamination in the collecting areas the drainage system is routed through an oily water separator. - Process Water: The water discharged from the process is predominately blowdown from the cooling water circuit, this is discharged to prevent a build-up of dissolved solids, due to the evaporative losses from the cooling system. This water is held in the M1 holding pond, tested in accordance with the permit and then pumped forward to the M2 holding pond ready for discharge. As LCP 415 utilises an air cooling condenser, there isn't the amount of wasted water so holding pond M3 is much smaller. This holding pond also collects the condensate from the steam cycle of the site. Water is tested in accordance with the permit and then pumped forward to M2. - Final discharge: Water is then released from site at one outfall point (W1).

<table>
<tr><th>BAT C. No.</th><th>Summary of BAT Conclusion requirement</th><th>Status NA/ CC / FC / NC</th><th>Assessment of the installation capability and any alternative techniques proposed by the Operator to demonstrate compliance with the BAT Conclusion requirement</th></tr>
<tr><td>15</td><td>In order to reduce emissions to water from flue-gas treatment, BAT is to use an appropriate combination of the techniques given below, and to use secondary techniques as close as possible to the source in order to avoid dilution.
<table>
<tr><th colspan="2">Technique</th><th>Typical pollutants prevented/abated</th><th>Applicability</th></tr>
<tr><td colspan="4">Primary techniques</td></tr>
<tr><td>a.</td><td>Optimised combustion (see BAT 6) and flue-gas treatment systems (e.g. SCR/SNCR, see BAT 7)</td><td>Organic compounds, ammonia (NH_3)</td><td>Generally applicable</td></tr>
<tr><td colspan="4">Secondary techniques [29]</td></tr>
<tr><td>b.</td><td>Adsorption on activated carbon</td><td>Organic compounds, mercury (Hg)</td><td>Generally applicable</td></tr>
<tr><td>c.</td><td>Aerobic biological treatment</td><td>Biodegradable organic compounds, ammonium (NH_4^+)</td><td>Generally applicable for the treatment of organic compounds. Aerobic biological treatment of ammonium (NH_4^+) may not be applicable in the case of high chloride concentrations (i.e. around 10 g/l)</td></tr>
<tr><td>d.</td><td>Anoxic/anaerobic biological treatment</td><td>Mercury (Hg), nitrate (NO_3^-), nitrite (NO_2^-)</td><td>Generally applicable</td></tr>
<tr><td>e.</td><td>Coagulation and flocculation</td><td>Suspended solids</td><td>Generally applicable</td></tr>
<tr><td>f.</td><td>Crystallisation</td><td>Metals and metalloids, sulphate (SO_4^{2-}), fluoride (F^-)</td><td>Generally applicable</td></tr>
<tr><td>g.</td><td>Filtration (e.g. sand filtration, microfiltration, ultrafiltration)</td><td>Suspended solids, metals</td><td>Generally applicable</td></tr>
<tr><td>h.</td><td>Flotation</td><td>Suspended solids, free oil</td><td>Generally applicable</td></tr>
<tr><td>i.</td><td>Ion exchange</td><td>Metals</td><td>Generally applicable</td></tr>
<tr><td>j.</td><td>Neutralisation</td><td>Acids, alkalis</td><td>Generally applicable</td></tr>
<tr><td>k.</td><td>Oxidation</td><td>Sulphide (S^{2-}), sulphite (SO_3^{2-})</td><td>Generally applicable</td></tr>
</table></td><td>NA</td><td>Not applicable - there is no flue-gas treatment</td></tr>
</table>

<table>
<tr><th>BAT C. No.</th><th>Summary of BAT Conclusion requirement</th><th>Status NA/ CC / FC / NC</th><th>Assessment of the installation capability and any alternative techniques proposed by the Operator to demonstrate compliance with the BAT Conclusion requirement</th></tr>
<tr><td></td><td>
<table>
<tr><td>l.</td><td>Precipitation</td><td>Metals and metalloids, sulphate (SO_4^{2-}), fluoride (F^-)</td><td>Generally applicable</td></tr>
<tr><td>m.</td><td>Sedimentation</td><td>Suspended solids</td><td>Generally applicable</td></tr>
<tr><td>n.</td><td>Stripping</td><td>Ammonia (NH_3)</td><td>Generally applicable</td></tr>
</table>
The BAT-AELs refer to direct discharges to a receiving water body at the point where the emission leaves the installation.
BAT-AELs for direct discharges to a receiving water body from flue-gas treatment
<table>
<tr><th colspan="2" rowspan="2">Substance/Parameter</th><th>BAT-AELs</th></tr>
<tr><th>Daily average</th></tr>
<tr><td colspan="2">Total organic carbon (TOC)</td><td>20–50 mg/l [30] [31] [32]</td></tr>
<tr><td colspan="2">Chemical oxygen demand (COD)</td><td>60–150 mg/l [30] [31] [32]</td></tr>
<tr><td colspan="2">Total suspended solids (TSS)</td><td>10–30 mg/l</td></tr>
<tr><td colspan="2">Fluoride (F^-)</td><td>10–25 mg/l [32]</td></tr>
<tr><td colspan="2">Sulphate (SO_4^{2-})</td><td>1,3–2,0 g/l [32] [33] [34] [35]</td></tr>
<tr><td colspan="2">Sulphide (S^{2-}), easily released</td><td>0,1–0,2 mg/l [32]</td></tr>
<tr><td colspan="2">Sulphite (SO_3^{2-})</td><td>1–20 mg/l [32]</td></tr>
<tr><td rowspan="8">Metals and metalloids</td><td>As</td><td>10–50 µg/l</td></tr>
<tr><td>Cd</td><td>2–5 µg/l</td></tr>
<tr><td>Cr</td><td>10–50 µg/l</td></tr>
<tr><td>Cu</td><td>10–50 µg/l</td></tr>
<tr><td>Hg</td><td>0,2–3 µg/l</td></tr>
<tr><td>Ni</td><td>10–50 µg/l</td></tr>
<tr><td>Pb</td><td>10–20 µg/l</td></tr>
<tr><td>Zn</td><td>50–200 µg/l</td></tr>
</table>
</td><td></td><td></td></tr>
<tr><td>16</td><td>In order to reduce the quantity of waste sent for disposal from the combustion and/or gasification process and abatement techniques, BAT is to organise operations so as to maximise, in order of priority and taking into account life-cycle thinking:
(a) waste prevention, e.g. maximise the proportion of residues which arise as by-products;</td><td>NA</td><td>Not applicable. There is no waste from the gas fired combustion processes.</td></tr>
</table>

<table>
<tr><th>BAT C. No.</th><th>Summary of BAT Conclusion requirement</th><th>Status NA/ CC / FC / NC</th><th>Assessment of the installation capability and any alternative techniques proposed by the Operator to demonstrate compliance with the BAT Conclusion requirement</th></tr>
<tr><td></td><td>(b) waste preparation for reuse, e.g. according to the specific requested quality criteria;
(c) waste recycling;
(d) other waste recovery (e.g. energy recovery),
by implementing an appropriate combination of techniques such as:
<table>
<tr><th colspan="2">Technique</th><th>Description</th><th>Applicability</th></tr>
<tr><td>a.</td><td>Generation of gypsum as a by-product</td><td>Quality optimisation of the calcium-based reaction residues generated by the wet FGD so that they can be used as a substitute for mined gypsum (e.g. as raw material in the plasterboard industry). The quality of limestone used in the wet FGD influences the purity of the gypsum produced</td><td>Generally applicable within the constraints associated with the required gypsum quality, the health requirements associated to each specific use, and by the market conditions</td></tr>
<tr><td>b.</td><td>Recycling or recovery of residues in the construction sector</td><td>Recycling or recovery of residues (e.g. from semi-dry desulphurisation processes, fly ash, bottom ash) as a construction material (e.g. in road building, to replace sand in concrete production, or in the cement industry)</td><td>Generally applicable within the constraints associated with the required material quality (e.g. physical properties, content of harmful substances) associated to each specific use, and by the market conditions</td></tr>
<tr><td>c.</td><td>Energy recovery by using waste in the fuel mix</td><td>The residual energy content of carbon-rich ash and sludges generated by the combustion of coal, lignite, heavy fuel oil, peat or biomass can be recovered for example by mixing with the fuel</td><td>Generally applicable where plants can accept waste in the fuel mix and are technically able to feed the fuels into the combustion chamber</td></tr>
<tr><td>d.</td><td>Preparation of spent catalyst for reuse</td><td>Preparation of catalyst for reuse (e.g. up to four times for SCR catalysts) restores some or all of the original performance, extending the service life of the catalyst to several decades. Preparation of spent catalyst for reuse is integrated in a catalyst management scheme</td><td>The applicability may be limited by the mechanical condition of the catalyst and the required performance with respect to controlling NO_X and NH_3 emissions</td></tr>
</table></td><td></td><td></td></tr>
<tr><td>17</td><td>In order to reduce noise emissions, BAT is to use one or a combination of the techniques given below.</td><td>CC</td><td>The Operator has confirmed that an appropriate combination of noise control techniques are used, as described below:</td></tr>
</table>

<table>
<tr><th>BAT C. No.</th><th>Summary of BAT Conclusion requirement</th><th>Status NA/ CC / FC / NC</th><th>Assessment of the installation capability and any alternative techniques proposed by the Operator to demonstrate compliance with the BAT Conclusion requirement</th></tr>
<tr><td></td><td>
<table>
<tr><th colspan="2">Technique</th><th>Description</th><th>Applicability</th></tr>
<tr><td>a.</td><td>Operational measures</td><td>These include:
— improved inspection and maintenance of equipment
— closing of doors and windows of enclosed areas, if possible
— equipment operated by experienced staff
— avoidance of noisy activities at night, if possible
— provisions for noise control during maintenance activities</td><td>Generally applicable</td></tr>
<tr><td>b.</td><td>Low-noise equipment</td><td>This potentially includes compressors, pumps and disks</td><td>Generally applicable when the equipment is new or replaced</td></tr>
<tr><td>c.</td><td>Noise attenuation</td><td>Noise propagation can be reduced by inserting obstacles between the emitter and the receiver. Appropriate obstacles include protection walls, embankments and buildings</td><td>Generally applicable to new plants. In the case of existing plants, the insertion of obstacles may be restricted by lack of space</td></tr>
<tr><td>d.</td><td>Noise-control equipment</td><td>This includes:
— noise-reducers
— equipment insulation
— enclosure of noisy equipment
— soundproofing of buildings</td><td>The applicability may be restricted by lack of space</td></tr>
<tr><td>e.</td><td>Appropriate location of equipment and buildings</td><td>Noise levels can be reduced by increasing the distance between the emitter and the receiver and by using buildings as noise screens</td><td>Generally applicable to new plant</td></tr>
</table>
</td><td></td><td>a. Operational measures: Equipment is maintained with a maintenance management system employing preventive measures. The plant is operated by experienced staff. Start-up and shut-down of plant is avoided at night when possible taking into account the commercial requirement for plant operation.

b. Low noise equipment: Noise levels are taken into account when replacing legacy equipment.

c. Noise attenuation: High noise equipment is contained within acoustic enclosures. High noise maintenance activities are planned to be shielded to reduce noise emissions.

d. Noise-control equipment: Equipment is insulated where required and high noise areas have acoustic enclosures.
e. Appropriate location of equipment and buildings: There are buildings between the site and the nearest residential location. Noise surveys are carried out every year at the nearest receptor that show the noise emission to be within the required permitted compliance limit.</td></tr>
<tr><td colspan="4">Combustion of liquid fuels</td></tr>
<tr><td colspan="4">Not applicable. The installation uses distillate fuel oil as back-up fuel in the auxiliary boilers of LCP188, for emergency scenarios when the supply of natural gas is interrupted. This operation is restricted in the permit to ‘no more than 500 hours per calendar year with a maximum period of 240 hours’, in line with the requirements of Article 30(6) of IED and its interpretation made by the UK Regulators at the time of the IED Chapter III implementation.
BAT conclusions 18 to 39 for combustion of liquid fuels are not applicable to scenarios permitted according to Article 30(6) of IED.</td></tr>
</table>

<table>
<tr><th>BAT C. No.</th><th>Summary of BAT Conclusion requirement</th><th>Status NA/ CC / FC / NC</th><th>Assessment of the installation capability and any alternative techniques proposed by the Operator to demonstrate compliance with the BAT Conclusion requirement</th></tr>
<tr><td colspan="4">Combustion of gaseous fuels</td></tr>
<tr><td>40</td><td>In order to increase the energy efficiency of natural gas combustion, BAT is to use an appropriate combination of the techniques given in BAT 12 and below.
<table>
<tr><th colspan="2">Technique</th><th>Description</th><th>Applicability</th></tr>
<tr><td>a.</td><td>Combined cycle</td><td>See description in Section 8.2</td><td>Generally applicable to new gas turbines and engines except when operated < 1 500 h/yr.
Applicable to existing gas turbines and engines within the constraints associated with the steam cycle design and the space availability.
Not applicable to existing gas turbines and engines operated < 1 500 h/yr.
Not applicable to mechanical drive gas turbines operated in discontinuous mode with extended load variations and frequent start-ups and shutdowns.
Not applicable to boilers</td></tr>
</table>
BAT-associated energy efficiency levels (BAT-AEELs) for the combustion of natural gas
<table>
<tr><th rowspan="2">Type of combustion unit</th><th colspan="4">BAT-AEELs [136] [137]</th></tr>
<tr><th colspan="2">Net electrical efficiency (%)</th><th>Net total fuel utilisation (%) [138] [139]</th><th colspan="2">Net mechanical energy efficiency (%) [139] [140]</th></tr>
<tr><th>New unit</th><th>Existing unit</th><th></th><th>New unit</th><th>Existing unit</th></tr>
<tr><td>Gas engine</td><td>39,5–44 [141]</td><td>35–44 [141]</td><td>56–85 [141]</td><td colspan="2">No BAT-AEEL.</td></tr>
<tr><td>Gas-fired boiler</td><td>39–42,5</td><td>38–40</td><td>78–95</td><td colspan="2">No BAT-AEEL.</td></tr>
<tr><td>Open cycle gas turbine, ≥ 50 MWth</td><td>36–41,5</td><td>33–41,5</td><td>No BAT-AEEL</td><td>36,5–41</td><td>33,5–41</td></tr>
<tr><td colspan="6">Combined cycle gas turbine (CCGT)</td></tr>
<tr><td>CCGT, 50–600 MW_{th}</td><td>53–58,5</td><td>46–54</td><td>No BAT-AEEL</td><td colspan="2">No BAT-AEEL</td></tr>
<tr><td>CCGT, ≥ 600 MW_{th}</td><td>57–60,5</td><td>50–60</td><td>No BAT-AEEL</td><td colspan="2">No BAT-AEEL</td></tr>
<tr><td>CHP CCGT, 50–</td><td>53–</td><td>46–54</td><td>65–95</td><td colspan="2">No BAT-AEEL</td></tr>
</table></td><td>CC</td><td>The installation consists of combined cycle (CCGT), operation in CHP mode.
The Operator has reported a net electrical efficiency of 52% for the combined operation of LCP188 and LCP415 (CHP CCGT, ≥ 600 MWth), which is within the applicable BAT-AEEL range. Refer to section 4.2 of this document for additional details.</td></tr>
</table>

<table>
<tr><th>BAT C. No.</th><th>Summary of BAT Conclusion requirement</th><th>Status NA/ CC / FC / NC</th><th>Assessment of the installation capability and any alternative techniques proposed by the Operator to demonstrate compliance with the BAT Conclusion requirement</th></tr>
<tr><td></td><td>
<table>
<tr><td>600 MW_{th}</td><td>58,5</td><td></td><td></td><td></td></tr>
<tr><td>CHP CCGT, ≥ 600 MW_{th}</td><td>57–60,5</td><td>50–60</td><td>65–95</td><td>No BAT-AEEL</td></tr>
</table>
</td><td></td><td></td></tr>
<tr><td>41</td><td>In order to prevent or reduce NO_X emissions to air from the combustion of natural gas in boilers, BAT is to use one or a combination of the techniques given below.
<table>
<tr><th colspan="2">Technique</th><th>Description</th><th>Applicability</th></tr>
<tr><td>a.</td><td>Air and/or fuel staging</td><td>See descriptions in Section 8.3. Air staging is often associated with low-NO_X burners</td><td rowspan="3">Generally applicable</td></tr>
<tr><td>b.</td><td>Flue-gas recirculation</td><td rowspan="2">See description in Section 8.3</td></tr>
<tr><td>c.</td><td>Low-NO_X burners (LNB)</td></tr>
<tr><td>d.</td><td>Advanced control system</td><td>See description in Section 8.3. This technique is often used in combination with other techniques or may be used alone for combustion plants operated < 500 h/yr</td><td>The applicability to old combustion plants may be constrained by the need to retrofit the combustion system and/or control command system</td></tr>
<tr><td>e.</td><td>Reduction of the combustion air temperature</td><td rowspan="2">See description in Section 8.3</td><td>Generally applicable within the constraints associated with the process needs</td></tr>
<tr><td>f.</td><td>Selective non–catalytic reduction (SNCR)</td><td>Not applicable to combustion plants operated < 500 h/yr with highly variable boiler loads.
The applicability may be limited in the case of combustion plants operated between 500 h/yr and 1 500 h/yr with highly variable boiler loads</td></tr>
</table>
</td><td>CC</td><td>LCP188 (Auxiliary Boilers 1, 2)

The Operator has confirmed that an appropriate combination of techniques is used, as described below:

b. Flue-gas recirculation – This is a feature of the auxiliary boilers. Recirculation is an operational function which is armed and enabled when the boiler is released to modulate.

d. Advanced Control System – There is an advance control system that meets the description at table 8.1 of the BAT conclusion document. This is a computer based automatic system to control the combustion efficiency and support the prevention and / or reduction of emissions.</td></tr>
</table>

BAT C. No.	Summary of BAT Conclusion requirement	Status NA/ CC / FC / NC	Assessment of the installation capability and any alternative techniques proposed by the Operator to demonstrate compliance with the BAT Conclusion requirement
	g. Selective catalytic reduction (SCR) — Not applicable to combustion plants operated < 500 h/yr. Not generally applicable to combustion plants of < 100 MW_{th}. There may be technical and economic restrictions for retrofitting existing combustion plants operated between 500 h/yr and 1 500 h/yr		
42	In order to prevent or reduce NO_X emissions to air from the combustion of natural gas in gas turbines, BAT is to use one or a combination of the techniques given below.	CC	LCP188 (GT 1/HRSG 1, GT 2/HRSG 2) The Operator has confirmed that an appropriate combination of techniques is used consisting of: a. Advanced control system, with variable load path; c. Dry low-NOx burners. LCP415 (GT 3/HRSG 3) The Operator has confirmed that an appropriate combination of techniques is used consisting of: a. Advanced control system; c. Dry low-NOx burners.

Technique		Description	Applicability
a.	Advanced control system	See description in Section 8.3. This technique is often used in combination with other techniques or may be used alone for combustion plants operated < 500 h/yr	The applicability to old combustion plants may be constrained by the need to retrofit the combustion system and/or control command system
b.	Water/steam addition	See description in Section 8.3	The applicability may be limited due to water availability
c.	Dry low-NO_X burners (DLN)		The applicability may be limited in the case of turbines where a retrofit package is not available or when water/steam addition systems are installed
d.	Low-load design concept	Adaptation of the process control and related equipment to maintain good combustion efficiency when the demand in energy varies, e.g. by improving the inlet airflow control capability or by splitting the combustion process into decoupled combustion stages	The applicability may be limited by the gas turbine design
e.	Low-NO_X burners (LNB)	See description in Section 8.3	Generally applicable to supplementary firing for heat recovery steam generators (HRSGs) in the case of combined-cycle gas turbine (CCGT) combustion plants

<table>
<tr><th>BAT C. No.</th><th>Summary of BAT Conclusion requirement</th><th>Status NA/ CC / FC / NC</th><th>Assessment of the installation capability and any alternative techniques proposed by the Operator to demonstrate compliance with the BAT Conclusion requirement</th></tr>
<tr><td></td><td>
<table>
<tr><td>f.</td><td>Selective catalytic reduction (SCR)</td><td></td><td>Not applicable in the case of combustion plants operated < 500 h/yr.
Not generally applicable to existing combustion plants of < 100 MW_{th}.
Retrofitting existing combustion plants may be constrained by the availability of sufficient space.
There may be technical and economic restrictions for retrofitting existing combustion plants operated between 500 h/yr and 1 500 h/yr</td></tr>
</table>
</td><td></td><td></td></tr>
<tr><td>43</td><td>In order to prevent or reduce NO_X emissions to air from the combustion of natural gas in engines, BAT is to use one or a combination of the techniques given below.
<table>
<tr><th colspan="2">Technique</th><th>Description</th><th>Applicability</th></tr>
<tr><td>a.</td><td>Advanced control system</td><td>See description in Section 8.3. This technique is often used in combination with other techniques or may be used alone for combustion plants operated < 500 h/yr</td><td>The applicability to old combustion plants may be constrained by the need to retrofit the combustion system and/or control command system</td></tr>
<tr><td>b.</td><td>Lean-burn concept</td><td>See description in Section 8.3. Generally used in combination with SCR</td><td>Only applicable to new gas-fired engines</td></tr>
<tr><td>c.</td><td>Advanced lean-burn concept</td><td rowspan="2">See descriptions in Section 8.3</td><td>Only applicable to new spark plug ignited engines</td></tr>
<tr><td>d.</td><td>Selective catalytic reduction (SCR)</td><td>Retrofitting existing combustion plants may be constrained by the availability of sufficient space.
Not applicable to combustion plants operated < 500 h/yr.
There may be technical and economic restrictions for retrofitting existing combustion plants operated between 500 h/yr and 1 500 h/yr</td></tr>
</table>
</td><td>NA</td><td>Not applicable as there are no engines at Immingham CHP Power Plant.</td></tr>
</table>

<table>
<tr><th>BAT C. No.</th><th>Summary of BAT Conclusion requirement</th><th>Status NA/ CC / FC / NC</th><th>Assessment of the installation capability and any alternative techniques proposed by the Operator to demonstrate compliance with the BAT Conclusion requirement</th></tr>
<tr><td>44</td><td>In order to prevent or reduce CO emissions to air from the combustion of natural gas, BAT is to ensure optimised combustion and/or to use oxidation catalysts.
Description - See descriptions in Section 8.3.
BAT-associated emission levels (BAT-AELs) for NO_X emissions to air from the combustion of natural gas in gas turbines
<table>
<tr><th rowspan="2">Type of combustion plant</th><th rowspan="2">Combustion plant total rated thermal input (MW_{th})</th><th colspan="2">BAT-AELs (mg/Nm^3) (142) (143)</th></tr>
<tr><th>Yearly average (144) (145)</th><th>Daily average or average over the sampling period</th></tr>
<tr><td colspan="4">Open-cycle gas turbines (OCGTs) (146) (147)</td></tr>
<tr><td>New OCGT</td><td>≥ 50</td><td>15–35</td><td>25–50</td></tr>
<tr><td>Existing OCGT (excluding turbines for mechanical drive applications) — All but plants operated < 500 h/yr</td><td>≥ 50</td><td>15–50</td><td>25–55 (148)</td></tr>
<tr><td colspan="4">Combined-cycle gas turbines (CCGTs) (146) (149)</td></tr>
<tr><td>New CCGT</td><td>≥ 50</td><td>10–30</td><td>15–40</td></tr>
<tr><td>Existing CCGT with a net total fuel utilisation of < 75 %</td><td>≥ 600</td><td>10–40</td><td>18–50</td></tr>
<tr><td>Existing CCGT with a net total fuel utilisation of ≥ 75 %</td><td>≥ 600</td><td>10–50</td><td>18–55 (150)</td></tr>
<tr><td>Existing CCGT with a net total fuel utilisation of < 75 %</td><td>50–600</td><td>10–45</td><td>35–55</td></tr>
<tr><td>Existing CCGT with a net total fuel utilisation of ≥ 75 %</td><td>50–600</td><td>25–50 (151)</td><td>35–55 (152)</td></tr>
<tr><td colspan="4">Open- and combined-cycle gas turbines</td></tr>
<tr><td>Gas turbine put into operation no later than 27 November 2003, or existing gas turbine for emergency use and operated < 500 h/yr</td><td>≥ 50</td><td>No BAT-AEL</td><td>60–140 (153) (154)</td></tr>
<tr><td>Existing gas turbine for mechanical drive applications — All but plants operated < 500 h/yr</td><td>≥ 50</td><td>15–50 (155)</td><td>25–55 (156)</td></tr>
</table></td><td>CC</td><td>Optimised combustion is implemented as a technique to prevent or reduce CO emissions to air from the combustion of natural gas at the installation.

Gas turbines
For the gas turbines at the installation (emission points A1, A2 and A5), we have set BAT-AEL emission limits in the varied and consolidated permit as follows:

NOx yearly average: 40 mg/m^3
NOx daily average: 50 mg/m^3
CO annual average: 50 mg/m^3 (low load operation)

The Operator has confirmed that the installation is currently compliant with these emission limits.

Refer to section 4 of this document for additional details on the application of emission limits and BAT-AEL.

Auxiliary boilers
Refer to section 4 of this document for application of emission limits and BAT-AEL to the auxiliary boilers 1, 2 of LCP188.

The annual BAT-AEL for NOx at 100 mg/m^3 is the same of the current monthly emission limit for this parameter, specified in the permit according to IED before this variation. Therefore compliance with the current permit monthly emission limit for NOx ensures that the annual BAT-AEL for this parameter will be met.

The Operator has proposed to set the annual emission limit for CO emitted from these boilers at the 40 mg/m^3, in line with the indicative BAT-AEL set in the LCP BAT conclusions. We have set the annual emission limit in the varied and consolidated permit according to this.</td></tr>
</table>

<table>
<tr><th>BAT C. No.</th><th>Summary of BAT Conclusion requirement</th><th>Status NA/ CC / FC / NC</th><th>Assessment of the installation capability and any alternative techniques proposed by the Operator to demonstrate compliance with the BAT Conclusion requirement</th></tr>
<tr><td></td><td>
As an indication, the yearly average CO emission levels for each type of existing combustion plant operated ≥ 1 500 h/yr and for each type of new combustion plant will generally be as follows:

New OCGT of ≥ 50 MW_{th}: < 5–40 mg/Nm^3. For plants with a net electrical efficiency (EE) greater than 39 %, a correction factor may be applied to the higher end of this range, corresponding to [higher end] × EE/39, where EE is the net electrical energy efficiency or net mechanical energy efficiency of the plant determined at ISO baseload conditions.
Existing OCGT of ≥ 50 MW_{th} (excluding turbines for mechanical drive applications): < 5–40 mg/Nm^3. The higher end of this range will generally be 80 mg/Nm^3 in the case of existing plants that cannot be fitted with dry techniques for NO_X reduction, or 50 mg/Nm^3 for plants that operate at low load.
New CCGT of ≥ 50 MW_{th}: < 5–30 mg/Nm^3. For plants with a net electrical efficiency (EE) greater than 55 %, a correction factor may be applied to the higher end of the range, corresponding to [higher end] × EE/55, where EE is the net electrical energy efficiency of the plant determined at ISO baseload conditions.
Existing CCGT of ≥ 50 MW_{th}: < 5–30 mg/Nm^3. The higher end of this range will generally be 50 mg/Nm^3 for plants that operate at low load.
Existing gas turbines of ≥ 50 MW_{th} for mechanical drive applications: < 5–40 mg/Nm^3. The higher end of the range will generally be 50 mg/Nm^3 when plants operate at low load.

In the case of a gas turbine equipped with DLN burners, these indicative levels correspond to when the DLN operation is effective.
BAT-associated emission levels (BAT-AELs) for NO_X emissions to air from the combustion of natural gas in boilers and engines
<table>
<tr><th rowspan="2">Type of combustion plant</th><th colspan="4">BAT-AELs (mg/Nm^3)</th></tr>
<tr><th colspan="2">Yearly average ([157])</th><th colspan="2">Daily average or average over the sampling period</th></tr>
<tr><th>New plant</th><th>Existing plant ([158])</th><th>New plant</th><th>Existing plant ([159])</th></tr>
<tr><td>Boiler</td><td>10–60</td><td>50–100</td><td>30–85</td><td>85–110</td></tr>
<tr><td>Engine ([160])</td><td>20–75</td><td>20–100</td><td>55–85</td><td>55–110 ([161])</td></tr>
</table>
As an indication, the yearly average CO emission levels will generally be:

< 5–40 mg/Nm^3 for existing boilers operated ≥ 1 500 h/yr,
< 5–15 mg/Nm^3 for new boilers,
30–100 mg/Nm^3 for existing engines operated ≥ 1 500 h/yr and for new engines.

</td><td></td><td></td></tr>
</table>

<table>
<tr><th>BAT C. No.</th><th>Summary of BAT Conclusion requirement</th><th>Status NA/ CC / FC / NC</th><th>Assessment of the installation capability and any alternative techniques proposed by the Operator to demonstrate compliance with the BAT Conclusion requirement</th></tr>
<tr><td>45</td><td>In order to reduce non-methane volatile organic compounds (NMVOC) and methane (CH_4) emissions to air from the combustion of natural gas in spark-ignited lean-burn gas engines, BAT is to ensure optimised combustion and/or to use oxidation catalysts.
Description
See descriptions in Section 8.3. Oxidation catalysts are not effective at reducing the emissions of saturated hydrocarbons containing less than four carbon atoms.
BAT-associated emission levels (BAT-AELs) for formaldehyde and CH_4 emissions to air from the combustion of natural gas in a spark-ignited lean-burn gas engine
<table>
<tr><th rowspan="3">Combustion plant total rated thermal input (MW_{th})</th><th colspan="3">BAT-AELs (mg/Nm^3)</th></tr>
<tr><th>Formaldehyde</th><th colspan="2">CH_4</th></tr>
<tr><th colspan="3">Average over the sampling period</th></tr>
<tr><th></th><th>New or existing plant</th><th>New plant</th><th>Existing plant</th></tr>
<tr><td>≥ 50</td><td>5–15 (162)</td><td>215–500 (162) (163)</td><td>215–560 (162) (163)</td></tr>
</table></td><td>NA</td><td>Not applicable as there are no spark-ignited lean-burn gas engines at Immingham CHP Power Plant</td></tr>
<tr><td>46</td><td>In order to increase the energy efficiency of the combustion of iron and steel process gases, BAT is to use an appropriate combination of the techniques given in BAT 12 and below.
<table>
<tr><th colspan="2">Technique</th><th>Description</th><th>Applicability</th></tr>
<tr><td>a.</td><td>Process gas management system</td><td>See description in Section 8.2</td><td>Only applicable to integrated steelworks</td></tr>
</table>
BAT-associated energy efficiency levels (BAT-AEELs) for the combustion of iron and steel process gases in boilers
<table>
<tr><th rowspan="2">Type of combustion unit</th><th colspan="2">BAT-AEELs (164) (165)</th></tr>
<tr><th>Net electrical efficiency (%)</th><th>Net total fuel utilisation (%) (166)</th></tr>
<tr><td>Existing multi-fuel firing gas boiler</td><td>30–40</td><td>50–84</td></tr>
<tr><td>New multi-fuel firing gas boiler (167)</td><td>36–42,5</td><td>50–84</td></tr>
</table>
BAT-associated energy efficiency levels (BAT-AEELs) for the combustion of</td><td>NA</td><td>Not applicable to Immingham CHP Power Plant</td></tr>
</table>

<table>
<tr><th>BAT C. No.</th><th>Summary of BAT Conclusion requirement</th><th>Status NA/ CC / FC / NC</th><th>Assessment of the installation capability and any alternative techniques proposed by the Operator to demonstrate compliance with the BAT Conclusion requirement</th></tr>
<tr><td></td><td>
iron and steel process gases in CCGTs
<table>
<tr><th rowspan="2">Type of combustion unit</th><th colspan="3">BAT-AEELs ([168]) ([169])</th></tr>
<tr><th colspan="2">Net electrical efficiency (%)</th><th>Net total fuel utilisation (%) ([170])</th></tr>
<tr><th>New unit</th><th>Existing unit</th><th></th></tr>
<tr><td>CHP CCGT</td><td>> 47</td><td>40–48</td><td>60–82</td></tr>
<tr><td>CCGT</td><td>> 47</td><td>40–48</td><td>No BAT-AEEL</td></tr>
</table>
</td><td></td><td></td></tr>
<tr><td colspan="4">Combustion for multi-fuel-fired plants</td></tr>
<tr><td colspan="4">The BAT conclusions presented in section 5 of the LCP BAT Conclusions document are applicable to the combustion of process fuels from the chemical industry. The installation makes use of refinery fuel gas imported from the nearby Philips 66 Humber Oil Refinery. As detailed in section 4 of this decision document, we have determined BAT for the combustion of this fuel according to the requirements of the BAT Conclusions on the refining of mineral oil and gas (EU Commission implementing decision 2014/738/EU) (REF BAT conclusions), which include specific provisions and BAT-AELs for the combustion of this fuel. We have therefore considered the relevant parts of the REF BAT conclusions applicable to this installation, as a comparable process according to the provisions of Article 14(6) of the Industrial Emissions Directive. We consider that Section 5 of the LCP BAT conclusions is not applicable to this installation.
Refer to Section 4 of this document for additional details on the determination of BAT according to the REF BAT conclusions.</td></tr>
</table>

6. Emissions to water

The consolidated permit incorporates one current discharge to controlled waters identified as W1.

There are no BAT AELs specified in the BAT Conclusions for this type of plant. There are also no additional treatment options identified as BAT for the installation. We have therefore not carried out any additional assessment of the emissions to water as part of this review.

7. Additional IED Chapter II requirements

In the event of a black out National Grid would call on combustion plant to operate and may require them to do so outside their permitted conditions. We have dedicated black start plant and they are permitted to run as such but this scenario is relevant to the rest of the large combustion plant which could be called depending on the circumstances.

A risk assessment will be carried out by Energy UK/Joint Environmental Programme on behalf of Large Combustion Plant connected to the National Transmission System. Air emissions modelling will be based on generic black start scenarios to establish whether they have the potential to have local impact on the environment or not (on a national basis). If the modelling demonstrates that no significant impacts are likely, the plant can operate under condition 2.3.9. This conditions allows the hourly ELVs for plants operating under a black start instruction to be discounted for the purpose of reporting. We would also require there to be a procedure in place for minimisation of emissions in the case of a black start event and for reporting in the event of a black start. This modelling and the procedures have not been agreed in advance of the issue of the permit review and therefore a condition linking back to an improvement condition have been included in the permit.

8. Review and assessment of changes that are not part of the BAT Conclusions derived permit review

This document should be read in conjunction with the application, supporting information and notice.

Aspect considered	Decision
Receipt of application	
Confidential information	A claim for commercial or industrial confidentiality has not been made.
Identifying confidential information	We have not identified information provided as part of the application that we consider to be confidential. The decision was taken in accordance with our guidance on confidentiality.
The site	
Biodiversity, heritage, landscape and nature conservation	The application is within the relevant distance criteria of a site of heritage, landscape or nature conservation, and/or protected species or habitat. A full assessment of the application and its potential to affect the site(s)/species/habitat has not been carried out as part of the permit review process. We consider that the review will not affect the features of the site(s)/species/habitat as the conditions will provide at least the same level of protection as those in the previous permit and in some cases will provide a higher level of protection to those in the previous permit. We have not consulted Natural England on the application. The decision was taken in accordance with our guidance.
Operating techniques	
General operating techniques	We have reviewed the techniques used by the Operator where they are relevant to the BAT Conclusions and compared these with the relevant guidance notes. The permit conditions ensure compliance with the relevant BREF, BAT Conclusions. The ELVs deliver compliance with the BAT-AELs.
Permit conditions	
Updating permit conditions during consolidation	We have updated permit conditions to those in the current generic permit template as part of permit consolidation. The conditions will provide at least the same level of protection as those in the previous permit and in some cases will provide a higher level of

Aspect considered	Decision
	protection to those in the previous permit.
Changes to the permit conditions due to an Environment Agency initiated variation	We have varied the permit as stated in the variation notice.
Improvement programme	Based on the information on the application, we consider that we need to impose an improvement programme. We have imposed an improvement programme to ensure that: • the Operator will install pressure sensors in the flues of GT 1/HRSG 1 and 2 in line with BAT 3; • the Operator will develop a plan to report and assess compliance of the emissions from the multi-fuel combustion equipment of LCP188 and LCP415 against the multi-fuel weighted emission limits calculated from the limits specified in Tables S3.1 and S3.1a, according to the formulae provided in IED Article 40(2), following the methodologies described in the document titled 'IED Chapter III Protocol for Multi-fuel Firing Refinery Combustion Plants granted a Permit prior to 7th January 2013' We have also removed the completed improvement conditions from the permit.
Emission limits	We have decided that emission limits should be set for the parameters listed in the permit. These are described in Section 4 of this document and in the relevant BAT Conclusions in Section 5 of this document. It is considered that the ELVs/equivalent parameters or technical measures described above will ensure that significant pollution of the environment is prevented and a high level of protection for the environment is secured.
Monitoring	We have decided that monitoring should be carried out for the parameters listed in the permit, using the methods detailed and to the frequencies specified. These are described in the relevant BAT Conclusions in Section 5 of this document. Table S3.4 Process monitoring requirements was added to include the requirement to monitor energy efficiency after overhauls on site in line with BAT2.
Reporting	We have specified reporting in the permit for the following parameters: • Nitrogen dioxide

Aspect considered	Decision
	• Carbon monoxide • Sulphur dioxide • Dust These are described in the relevant BAT Conclusions in Section 5 of this document.
Operator competence	
Management system	There is no known reason to consider that the Operator will not have the management system to enable them to comply with the permit conditions.
Growth Duty	
Section 108 Deregulation Act 2015 – Growth duty	We have considered our duty to have regard to the desirability of promoting economic growth set out in section 108(1) of the Deregulation Act 2015 and the guidance issued under section 110 of that Act in deciding whether to grant this permit. Paragraph 1.3 of the guidance says: "The primary role of regulators, in delivering regulation, is to achieve the regulatory outcomes for which they are responsible. For a number of regulators, these regulatory outcomes include an explicit reference to development or growth. The growth duty establishes economic growth as a factor that all specified regulators should have regard to, alongside the delivery of the protections set out in the relevant legislation." We have addressed the legislative requirements and environmental standards to be set for this operation in the body of the decision document above. The guidance is clear at paragraph 1.5 that the growth duty does not legitimise non-compliance and its purpose is not to achieve or pursue economic growth at the expense of necessary protections. We consider the requirements and standards we have set in this permit are reasonable and necessary to avoid a risk of an unacceptable level of pollution. This also promotes growth amongst legitimate operators because the standards applied to the Operator are consistent across businesses in this sector and have been set to achieve the required legislative standards.