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/YP3133LL
The Operator is: Keadby Generation Limited
The Installation is: Keadby Power Station
This Variation Notice number is: EPR/YP3133LL/V009

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
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
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 it to continue to operate the Installation, subject to the conditions in the consolidated variation notice.

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

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

2 How we reached our decision

2.1 Requesting information 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 30/10/2018 and an amended version with new operating hours and modes was received 19/09/2019..

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

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.

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 energy efficiency levels associated with the Best Available Techniques (BAT-AEELs)
- The review and assessment of the availability of BAT for gas turbines operating <500 hours per year
- Inclusion of black start condition and associated Improvement condition IC9

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 LCP(s) on site consist of

LCP Number	Plant type	Fuel	Proposed operating hours
LCP202	CCGT	Natural Gas	>1500 hours
LCP203	CCGT	Natural Gas	>1500 hours
LCP202	**OCGT**	Natural Gas	<1500 hours
LCP203	**OCGT**	Natural Gas	<1500 hours
LCP204	**OCGT**	Natural Gas	<1500 hours
LCP204	**OCGT**	Gas Oil	<500 Hours

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 operating regimes in the above table:

- LCP202 and LCP203 in CCGT burning natural gas - unlimited hours
- LCP202, LCP203 and LCP204 in OCGT burning natural gas <1500 hours operation
- LCP204 in OCGT burning gas oil - <500 hours operation

The following tables outline the limits that have been incorporated into the permit for LCP202, LCP203 and LCP204, where these were derived from, where the backsliding principle has been followed, 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%, oxygen concentration in flue gases. The emission limits and monitoring requirements have been incorporated into Schedule 3 of the permit.

For gas turbines operating <500 hours/year:
Under Chapter III gas turbines and gas engines operating for less than 500 hours per year are considered to be emergency plant and therefore were not covered by the emission limits set out in IED Annex V. However, for the purposes of the LCP BAT review, plants operated for emergency use may only be defined as plants which operate for the sole purpose of providing power at a site during an onsite emergency and/or during a black start and which do not provide balancing services or demand side response services. As this site runs commercially on an intermittent basis to support the Grid, it is not considered emergency plant and therefore indicative BAT applies.

We have set the indicative limits requiring validation through emission factors based on the principle that we will not require plant to fire up with the sole purpose of performing an emission measurement, as set out the UK Regulators Interpretation Document.

Where standby fuel is used on site <10 days:
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. We expect the site to have demonstrated that the site will be operated in a manner such that use of the standby fuel is minimised.

For plant in the TNP:
By the end of the TNP on 30 June 2020, as a minimum plant must meet the limits set out in Annex V of the Industrial Emission Directive subject to BAT assessment and the principle of no backsliding. From the implementation date of the BAT Conclusion in 2021 the relevant AELs will also apply.

LCP202 and LCP203

The tables below reflect the limits set out in the BREF to be applied from 17/08/2021.

Type **Combined Cycle Gas Turbine**
Age Permitted **before** publication of the LCP BREF
Operating Hours Unlimited
Fuel Natural gas
P

NOx limits (mg/Nm^3)						
Averaging	**IED (Annex V Part 1) - existing**	**BREF (Table 24 BAT-c)**	**Expected permit limits**	**Basis**	**Limits apply**	**Monitoring**
Annual	**None**	**40**	**40**	**BREF**	**E-DLN**	**Continuous**
Monthly	**50**	**None**	**50**	**IED**	**E-DLN**	
Daily	**55**	**50**	**50**	**BREF**	**E-DLN**	
95th %ile of hr means	**100**	**None**	**75* (No back sliding)**	**IED**	**E-DLN**	

* already in current permit, have applied the principal of no back sliding

CO limits (mg/Nm^3)						
Averaging	**IED (Annex V Part 1) - existing**	**BREF (Table 24 BAT-c)**	**Expected permit limits**	**Basis**	**Limits apply**	**Monitoring**
Annual	**None**	**30**	**100 * (Indicative BAT)**	**BREF**	**E-DLN**	**Continuous**
Monthly	**100**	**None**	**100**	**IED**	**E-DLN**	
Daily	**100**	**None**	**100**	**BREF**	**E-DLN**	
95th %ile of hr means	**200**	**None**	**200**	**IED**	**E-DLN**	

*Indicative BAT, the operator has supplied evidence to show CO increases exponentially as the gas turbine approaches the emission compliance boundary defined by the combustion system. For this reason, hourly CO emissions are often close to the current 100mg/m^3 ELV when the plant is operating at its stable operating limit (SEL) and gas turbine load is at its minimum (see data in BAT 44 evidence). A reduction in the current ELV would therefore necessitate raising SEL which in turn would impact on the commercial viability of the plant remaining operational at night. A potential consequence would be increased "two-shifting" and hence an increase in the total annual emissions of both CO and NOx attributable to the greater number of plant starts. From a holistic perspective, it is believed therefore that reducing the existing ELV for CO to 30mg/m^3 could actually have a negative environmental impact.

The applicable top-of-range indicative CO Annual BAT-AEL is 30 mg/m^3. The proposed ELV increases the indicative BAT-AEL to 100 mg/m^3 to allow for the combustion characteristics of this gas turbine and potential combustor degradation relating to combustor air in-leakage.

LCP202 and LCP203 and LCP204

The tables below reflect the limits set out in the BREF to be applied from 17/08/2021.

Type Open Cycle Gas Turbine
Age Permitted **before** publication of the LCP BREF but operational after 27 November 2003
Operating Hours Less than 1,500 hours/year
Fuel Natural gas

NOx limits (mg/Nm^3)						
Averaging	**IED (Annex V Part 1) - existing**	**BREF (Table 24 BAT-c)**	**Expected permit limits**	**Basis**	**Limits apply**	**Monitoring**
Annual	**None**	**None**	**None**	**-**	**-**	**-**
Monthly	**50**	**None**	**None**	**-**	**-**	**-**
Daily	**55**	**55**	**55**	**BREF**	**E-DLN**	**Continuous**
95th %ile of hr means	**100**	**None**	**50**	**IED**	**E-DLN**	**Continuous**

CO limits (mg/Nm^3)						
Averaging	**IED (Annex V Part 1) - existing**	**BREF (Table 24 BAT-c)**	**Expected permit limits**	**Basis**	**Limits apply**	**Monitoring**
Annual	**None**	**None**	**None**	**BREF**	**E-DLN**	**Continuous**
Monthly	**100**	**None**	**None**	**IED**	**E-DLN**	
Daily	**110**	**None**	**None**	**BREF**	**E-DLN**	
95th %ile of hr means	**200**	**None**	**None**	**IED**	**E-DLN**	

Note, LCP204, is <100MWth and operates <1500hr/yr hence only requires periodic monitoring and a daily limit.

LCP204

Type Open Cycle Gas Turbine
Age Permitted **before** publication of the LCP BREF but operational after 27 November 2003
Operating Hours Less than 500 hours/year
Fuel Gas Oil

We have reviewed the monitoring requirements included in the existing permit. We consider that in line with the Joint Emissions Protocol document '*BAT for existing Gas and Liquid fuel fired OCGTs, CCGTs, and Dual Fuel GTs with a Thermal Input Rating of 50MWth or more operating <500 Hours Per Year', we will not require <500 hour plant to run solely for the purpose of monitoring.* We have taken the fact that gas oil will only be used in emergencies and for <500 hours per year to indicate that it is equivalent in risk to gas turbines running on gas oil for <500 hour plant. *We have therefore removed the periodic monitoring requirement.* In some instances we have specified the monitoring requirements after the implementation date for the LCP BAT Conclusions in 2021 to be determined through 'concentration by calculation', however, this is usually where the plant itself doesn't run over >500 hours and we want to ensure that the plant is maintained with the emission limit in mind. For this particular plant the overall turbine runs more frequently and will be monitored and reported against existing limits for operation on natural gas which will ensure that it is maintained. We have not therefore included ELVs to be measured through concentration by calculation for operation on standby fuel for <500 hours.

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.

LCP204 <500hrs/yr when burning gas oil.

Table 21 of the LCP BAT Conclusions specifies that the BAT-AEELs for this type of plant are not applicable to plant operating less than 1500 hours per year. We have therefore not assessed this operational aspect of the plant. We have however included a process monitoring requirement in table S3.4 of the consolidated variation notice. This is required to demonstrate that efficiency levels are maintained following any significant overhauls of equipment in order to fulfil the requirement of BAT Conclusion 2. For <500 hour plant we have specified that the assessment of efficiency can be based on calculation. This is because we will not require plant to fire up with the sole purpose of carrying out an assessment of efficiency.

LCP202, LCP203 Unlimited hours/year burning natural gas

The table 23 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. The evidence provided to demonstrate that the AEELs are met was in the form of

Keadby PS BATC LCP returns spreadsheet V6 amended, 18/09/19. We consider this plant is BAT in relation to the AEELs.

BAT AEELs (%)			Plant efficiency (%)		
Net electrical efficiency	**Net total fuel utilisation**	**Net mechanical efficiency**	**Net electrical efficiency**	**Net total fuel utilisation**	**Net mechanical efficiency**
LCP202 and LCP203: CCGT ≥600MWth, unlimited hours burning natural gas					
50-60	**None**	**None**	**55%**	**NA**	**NA**
LCP202 and LCP203: OCGT ≥50MWth, <1500hours burning natural gas					
33-41.5	**None**	**None**	**36.2**	**NA**	**NA**

4.3 The review and assessment of BAT for gas turbines operating < 500 hours per year

Joint Environmental Programme (JEP) produced a document *'BAT Assessment for Existing Gas and Liquid Fuel Fired OCGTs, CCGTs and Dual-fuel GTs with a Thermal Input Rating of 50MWth or Greater Operating <500 Hours Per Year'* dated October 2018. The content of this document has been agreed in principle by the Environment Agency and we have therefore taken the document into account during our determination of this variation.

BAT 37 identifies for gas oil fuelled OCGTs operated <500hrs Water / Steam Addition and Low NOx Burners are the only potentially applicable techniques. SCR is not applicable for <500hrs.

Water injection is the process used at site to reduce NOx emissions when utilising Gas Oil. Low-NOx burner are not available on the market for the gas turbines at site. Retrofitting of a selective catalytic reduction system is not applicable to combustion plant operated <500 h/yr.

BAT 38 identifies for gas oil fuelled OCGTs operated <500hrs combustion optimisation, which is generally applicable and Oxidation catalysts. The combustion system is maintained according to original equipment manufacturers recommendations. Retrofitting of a oxidation catalyst system is not applicable to combustion plant operated <500 h/yr.

The site will operate an appropriate maintenance regime to ensure that emissions performance does not degrade beyond the range appropriate to the generation technology, the fired fuel and, where present, the emission control technology

4.4 Fuel characterisation

BAT 9 requires the operator to carry out fuel characterisation. This also applies to standby fuel.

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.

This plant also burns gas oil as standby fuel and has confirmed by email on the 16/01/2020 that they will comply with the Joint Environmental Programme (JEP) report – 'Characterisation of power plant fuels for compliance with LCP BREF Conclusion BAT 9' issued October 2019, this has been incorporated into table S1.2 of the permit.

5 Decision checklist regarding relevant 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 conditions	Permit tables
Environmental Management System	1.1.1	S1.2
BAT AELs	3.1.1 and 3.5.1	S3.1,S3.1a and S3.1b
Monitoring	2.3, 3.5 and 3.6	S1.2, S1.4, S1.5 and S3.1b
Energy efficiency	1.2 and 2.3	S3.4
Noise	3.4 and 2.3	S2.1
Other operating techniques	2.3	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

The Table below has been compiled to include all operating modes/fuels used on site assuming CCGT unlimited hours unless otherwise specified. See appropriate headings within the assessment column. (Other plant and fuels which are not used on site but are included in the BAT conclusions have been removed from the table below).

BAT Concn. Number	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. etc - see BAT Conclusions	CC	The station operates an EMS which is fully integrated and certified to ISO14001:2015 Certificate No: GB17/873624.03. The EMS incorporates all the features described in BAT1 (i to Xiii), and the station has specific procedures and systems in place to address relevant topics listed in BAT1 x to xvi were practicable to do so. In relation to xi, xiv & xvi we would note the following: 1) xvi - It is not considered necessary to have an odour management plan as the LCP's operations do not involve the combustion of malodourous substances, therefore this is not considered to be an environmental risk. However, there are procedures in place to review any complaints received which could include those related to odour. 2)xiv - It is not considered necessary to have an dust management plan as the LCP's operations do not involve the handling of dust producing substances, therefore this is not considered to be an environmental risk. However, there are procedures in place to review any complaints received which could include those related

<table>
<tr><th>BAT Concn. Number</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>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>to dust 3) xi. - see response to BAT 10/11. (See BAT 1 Evidence)</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>Performance tests are completed to the required EN/ISO standards as detailed within BAT 2. Performance tests were completed during commissioning of the LCP and after each modification which could significantly affect performance (See BAT 2 Evidence)</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>CC</td><td>The monitoring of the specified parameters identified with in BAT 3 are conducted as follows;
Flow - Continuous Determination
Oxygen Content, Temperature & Pressure - Continuous Measurement
Water Vapour - The sampled flue gas is dried before analysis therefore not required.</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>
</table></td><td>FC</td><td>The site monitors CO and NOX as required by BAT 4 for dual fired turbines. Monitoring is carried out continuously in accordance with EN14181, Local site procedures give specific details of the monitors used.

IED Annex V Part 3 (2) (1) Continuous monitoring of SO2 is not required for plants firing</td></tr>
</table>

BAT Concn. Number	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
	NO_X	— 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 — Iron and steel process gases — Process fuels from the chemical industry — IGCC plants	All sizes	Generic EN standards	Continuous [6] [8]	BAT 20 BAT 24 BAT 28 BAT 32 BAT 37 BAT 41 BAT 42 BAT 43 BAT 47 BAT 48 BAT 56 BAT 64 BAT 65 BAT 73		Natural gas and for unabated plants firing oil with a known sulphur content. BAT 4 Item 8 As an alternative to the continuous measurement in the case of plants combusting oil with a known sulphur content and where there is no flue- gas desulphurisation system, periodic measurements at least once every three months and/or other procedures ensuring the provision of data of an equivalent scientific quality may be used to determine the SO2 emissions. Therefore, Gas oil not to exceed 0.1% w/w sulphur content. Natural Gas SO2 concentration by calculation as agreed in writing with the Environment Agency (JEP Compliance Protocol).
		— 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 Concn. Number	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		
		— Waste co-incineration	All sizes	Generic EN standards	Continuous [6] [16]	BAT 66 BAT 67		
	HF	— Coal and/or lignite	All sizes	No EN standard available	Once every three months [6] [13] [14]	BAT 21 BAT 57		

BAT Concn. Number	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
		— Process fuels from the chemical industry in boilers						
		— 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-incineration	< 300 MW_{th}	EN 14385	Once every six months [13]	BAT 68 BAT 69		
			≥ 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		< 300 MW_{th}	EN 13211	Once every three months [13] [20]	BAT 23		

BAT Concn. Number	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
		— Coal and/or lignite including waste co-incineration	≥ 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		
5	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. **Substance/Parameter** / **Standard(s)** / **Minimum monitoring frequency** / **Monitoring associated with** Total organic carbon (TOC) [26] / EN 1484 / Once every month / BAT 15						NA	The LCP does not operate a flue-gas treatment system

BAT Concn. Number	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 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="8">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 rowspan="9"></td></tr><tr><td>Cd</td></tr><tr><td>Cr</td></tr><tr><td>Cu</td></tr><tr><td>Ni</td></tr><tr><td>Pb</td></tr><tr><td>Zn</td></tr><tr><td>Hg</td><td>Various EN standards available (e.g. EN ISO 12846 or EN ISO 17852)</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>		
6	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>Generally applicable</td></tr></table>	CC	The site is a CCGT and utilises the combination of two or more thermodynamic cycles, e.g. 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). The

BAT Concn. Number	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
	b. Maintenance of the combustion system — Regular planned maintenance according to suppliers' recommendations c. Advanced control system — See description in Section 8.1 — The applicability to old combustion plants may be constrained by the need to retrofit the combustion system and/or control command system d. Good design of the combustion equipment — Good design of furnace, combustion chambers, burners and associated devices — Generally applicable to new combustion plants e. Fuel choice — 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 — 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		combustion system is maintained according to original equipment manufacturers recommendations and fitted with an advanced computer based control system to control the combustion efficiency and support the prevention and/or reduction of emissions.
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	The LCP does not operate a SCR or SNCR
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	The LCP does not operate an emissions abatement system.

<table>
<tr><th>BAT Concn. Number</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>9</td><td>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.
<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>
</table></td><td>CC</td><td>The fuel gas supplied to the site has been assessed in accordance with technique (i) and is continuously monitored in accordance with technique (ii) Measurement of LHV, CH4, C2H6,C3, C4+, CO2 and Wobbe index is carried out continuously using an online gas chromatograph which carries out calculations in accordance with ISO6976. The gas chromatograph is calibrated annually in accordance with ISO17025. The data supplied from the gas monitoring system is used to assess the performance of the plant in accordance with technique (iii).

The Gas Oil supplied to site is tested by the supplier and the results provided for Ash, N, C & S in the form of supplier specification.</td></tr>
</table>

BAT Concn. Number	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>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 — Metals and metalloids (As, Cd, Co, Cr, Cu, Hg, Mn, Ni, Pb, Sb, Tl, V, Zn)</td></tr></table>		
10	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.	CC	Sites do not have a specific OTNOC management plan, however the EMS incorporates many of the key aspects of BAT 10 & 11. The site operates a risk based review with the EMS (Aspects and impacts) which includes a review of potential impacts of OTNOC. A) Gas turbine starts are optimised based on plant condition (i.e. warmth category) along with advanced control systems (Auto tune and LVE) which enable DLN in the early stages of the firing sequence to minimise emissions during start-up. B) All plant components are included within the site

BAT Concn. Number	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
			specific preventative maintenance programmes, the frequency of maintenance is dependent on operation of the site. BAT 11: Emissions during start-up and shutdown operations are monitored and reviewed to identify if corrective actions are required. Emissions to atmosphere are assessed as part of the annual environmental performance review carried out by sites. In the event of an accident or environmental incident, we would review the emissions, cause etc. as part of our incident investigation process and ensure any relevant corrective and / or preventive action is implemented. Start-up emissions are atypical during plant commissioning since there is a requirement to deviate from normal gas turbine load and/or exhaust temperature profiles in order to complete essential testing and/or control system tuning activities. In such cases, commissions plans are arranged to minimise additional emissions so far as is reasonable practicable.
11	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.	FC	The site monitors CO and NOX as required. Monitoring is carried out continuously in accordance with EN14181, Local site procedures

<table>
<tr><th>BAT Concn. Number</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>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></td><td>give specific details of the monitors used.

SO2 concentration by calculation as agreed in writing with the Environment Agency.</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 minimises the content of unburnt substances in the flue-gases and in solid combustion residues</td><td>Generally applicable</td></tr>
<tr><td>b.</td><td>Optimisation of the working medium conditions</td><td>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</td><td></td></tr>
<tr><td>c.</td><td>Optimisation of the steam cycle</td><td>Operate with lower turbine exhaust pressure by utilisation of the lowest possible temperature of the condenser cooling water, within the design conditions</td><td></td></tr>
<tr><td>d.</td><td>Minimisation of energy consumption</td><td>Minimising the internal energy consumption (e.g. greater efficiency of the feed-water pump)</td><td></td></tr>
<tr><td>e.</td><td>Preheating of combustion air</td><td>Reuse of part of the heat recovered from the combustion flue-gas to preheat the air used in combustion</td><td>Generally applicable within the constraints related to the need to control NO_X emissions</td></tr>
<tr><td>f.</td><td>Fuel preheating</td><td>Preheating of fuel using recovered heat</td><td>Generally applicable within the constraints associated with the boiler design and the need to control NO_Xemissions</td></tr>
<tr><td>g.</td><td>Advanced control system</td><td>See description in Section 8.2.</td><td>Generally applicable to new units. The applicability to old units may be constrained</td></tr>
</table></td><td>CC</td><td>Operator employs techniques a,b,c,d, and h, none of the other techniques are applicable to the technology/plant on site.

Please note when operating under 1500hrs/yr. BAT 12 does not apply.</td></tr>
</table>

BAT Concn. Number	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
			Computerised control of the main combustion parameters enables the combustion efficiency to be improved	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 by cogeneration (CHP)	Recovery of heat (mainly from the 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	Applicable within the constraints 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		

BAT Concn. Number	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

			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 limited retrofit possibilities offered by some boiler designs or plant configurations
p.	Minimisation of heat losses	Minimising residual heat losses, e.g. those that occur via the slag or those that can be reduced by insulating radiating sources	Only applicable to solid-fuel-fired combustion units and to gasification/IGCC units
q.	Advanced materials	Use of advanced materials proven to be capable of withstanding high operating temperatures and pressures and thus to achieve increased steam/combustion process efficiencies	Only applicable to new plants
r.	Steam turbine upgrades	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	The applicability may be restricted by demand, steam conditions and/or limited plant lifetime
s.	Supercritical and ultra-supercritical steam conditions	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	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

13	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.			CC	Water usage is optimised and minimised where plant design allows. The site is fitted with a once through cooling system resulting in excellent condenser

Technique	Description	Applicability

BAT Concn. Number	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
	a. Water recycling — Residual aqueous streams, including run-off water, from the plant are reused for other purposes. The degree of recycling is limited by the quality requirements of the recipient water stream and the water balance of the plant — Not applicable to waste water from cooling systems when water treatment chemicals and/or high concentrations of salts from seawater are present b. Dry bottom ash handling — 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. — Only applicable to plants combusting solid fuels. There may be technical restrictions that prevent retrofitting to existing combustion plants		efficiency and minimal water usage (losses). The water used within the cooling water system is not of suitable quality to be re-used in other processes on site. Process water usage including boiler feedwater is optimised through minimisation of blowdown from the water steam cycle. The water recovered from this process (when quality allows) is reused within the water treatment plant reducing water usage.
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	All waste water streams are separated physically, in addition, waste water drains are colour coded to prevent accidental cross contamination of clean water runoff. Surface water run off from possible oil contaminated areas are protected by oil/water separators.
15	In order to reduce emissions to water from flue-gas treatment, BAT is to use an appropriate combination of the techniques given in BAT 15, and to use secondary techniques as close as possible to the source in order to avoid dilution.	NA	The LCP does not operate a flue-gas treatment system.
16	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; (b) waste preparation for reuse, e.g. according to the specific requested quality criteria; (c) waste recycling;	CC	The BAT techniques detailed within BAT 16 are not directly applicable. However, the site follows the principles of the waste hierarchy; Reduce, Reuse, Recycle, Recover and finally disposal for all waste generated at the site. The process for waste

<table>
<tr><th>BAT Concn. Number</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>(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>disposal is detailed within a local approved procedure.</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.
<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</td><td>Generally applicable</td></tr>
</table></td><td>CC</td><td>The following noise control measures are currently in place at the site.
• Detailed Inspection and Maintenance regime including any plant or equipment whose deterioration may give rise to increase in noise.</td></tr>
</table>

BAT Concn. Number	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
						• Scheduled vibration monitoring to indicate potential failures, reducing potential noise sources. • The structure of the waste heat recovery boiler (WHRB) building plays an important part in the overall noise attenuation scheme. Both boilers are located within a single boiler house, which also encloses the feed pumps and chemical dosing sets and sampling points. Anti-vibration lattice baffles and de-tuning baffles are fitted to the tube banks in various positions within the gas passes to prevent boiler tube vibration. The de-tuning baffles streamline the gas flow preventing the “Tuning Fork effect”. Each WHRB is fitted with a high-performance attenuator in the exhaust duct directly above each unit to reduce stack outlet generated noise. • Thermal and acoustic insulation is fitted along the gas ductwork to the base of the stack. Above this level thermal insulation and cladding are applied to the main stack to protect the stack for acid dew point corrosion particularly when firing on distillate oil. The insulation is attached to the external surfaces of the casing and protected by metal cladding, which is virtually maintenance
			— avoidance of noisy activities at night, if possible — provisions for noise control during maintenance activities			
		b.	Low-noise equipment	This potentially includes compressors, pumps and disks	Generally applicable when the equipment is new or replaced	
		c.	Noise attenuation	Noise propagation can be reduced by inserting obstacles between the emitter and the receiver. Appropriate obstacles include protection walls, embankments and buildings	Generally applicable to new plants. In the case of existing plants, the insertion of obstacles may be restricted by lack of space	
		d.	Noise-control equipment	This includes: — noise-reducers — equipment insulation — enclosure of noisy equipment — soundproofing of buildings	The applicability may be restricted by lack of space	
		e.	Appropriate location of equipment and buildings	Noise levels can be reduced by increasing the distance between the emitter and the receiver and by using buildings as noise screens	Generally applicable to new plant	

BAT Concn. Number	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
			free. In areas of casing where there is a requirement for noise attenuation, there is a thick slab of dense material approximately 300mm, then clad in layer of steel sheeting. • Heavy weight composite acoustic cladding (double skinned) is present on the gas and steam turbine buildings. The gas turbines are fitted with a double skin acoustic enclosure to reduce noise levels inside the gas turbine building. • The gas turbine and steam turbine buildings were designed to reduce environmental noise. The perforated metal inner lining of the buildings was designed to expose an absorptive lining to further moderate room noise levels by controlling reverberation within the building. • Most doors in the power house buildings are fitted with high performance acoustic door sets and are kept closed except for access and egress. All ventilation openings are fitted with high performance attenuators to reduce noise breakout from the buildings. • High performance noise attenuators are fitted to the main stacks.

<table>
<tr><th>BAT Concn. Number</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>• Acoustic enclosures are present on the demineralisation water pumps in the water treatment plant and the distillate tank transfer pumps (outdoor pump units).
• Heavy weight composite acoustic cladding is present on the cooling water pump house.
• Suitably trained and experienced staff are employed for plant operations.
• Inspections and Maintenance activities are subject to rigorous planning where all environmental issues are considered and managed appropriately.</td></tr>
<tr><td colspan="4">Combustion of liquid fuels</td></tr>
<tr><td>36</td><td>In order to increase the energy efficiency of gas oil combustion in gas turbines, 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 units operated ≥ 1 500 h/yr.
Applicable to existing units within the constraints associated with the steam cycle design and the space availability.
Not applicable to existing units operated < 1 500 h/yr</td></tr>
</table>
BAT-associated energy efficiency levels (BAT-AEELs) for gas-oil-fired gas turbines
<table>
<tr><th rowspan="2">Type of combustion unit</th><th colspan="2">BAT-AEELs ([132])</th></tr>
<tr><th colspan="2">Net electrical efficiency (%) ([133])</th></tr>
<tr><th>New unit</th><th>Existing unit</th></tr>
<tr><td>Gas-oil-fired open-cycle gas turbine</td><td>> 33</td><td>25–35,7</td></tr>
<tr><td>Gas-oil-fired combined cycle gas turbine</td><td>> 40</td><td>33–44</td></tr>
</table></td><td>NA</td><td>LCP204 burning gas oil <500hrs/yr - Not applicable to existing gas turbines operated <1500 h/yr</td></tr>
</table>

<table>
<tr><th>BAT Concn. Number</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>37</td><td>In order to prevent or reduce NO_X emissions to air from the combustion of gas oil in gas turbines, 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>Water/steam addition</td><td rowspan="3">See description in Section 8.3</td><td>The applicability may be limited due to water availability</td></tr>
<tr><td>b.</td><td>Low-NO_X burners (LNB)</td><td>Only applicable to turbine models for which low-NO_X burners are available on the market</td></tr>
<tr><td>c.</td><td>Selective catalytic reduction (SCR)</td><td>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.
Retrofitting existing combustion plants may be constrained by the availability of sufficient space</td></tr>
</table></td><td>CC</td><td>LCP204 burning gas oil <500hrs/yr - In response to BAT 37 the Electricity Supply Industry Joint Environmental Programme prepared a BAT assessment methodology that was agreed with the EA and completed an industry BAT assessment using plant data from the JEP members. A copy of this methodology and assessment are provided as Appendix 3. BAT 37 identifies for gas oil fueled OCGTs operated <500hrs Water / Steam Addition and Low NOx Burners are the only potentially applicable techniques. SCR is not applicable for <500hrs.

Water injection is the process used at site to reduce Nox emissions when utilising Gas Oil. Low-Nox burner are not available on the market for the gas turbines at site. Retrofitting of a selective catalytic reduction system is not applicable to combustion plant operated <500 h/yr

In addition to the BAT Assessment a study was completed by the Joint Environmental Programme to characterise the emissions performance of OCGTs and demonstrate that the emissions remain stable and under control.</td></tr>
</table>

<table>
<tr><th>BAT Concn. Number</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>This report ('Maintaining the Emissions Performance of Open Cycle Gas Turbines that operate for less than 500 hours per year') is presented as Appendix 4.

The site will operate an appropriate maintenance regime to ensure that emissions performance does not degrade beyond the range appropriate to the generation technology, the fired fuel and, where present, the emission control technology

Further information on appropriate maintenance regimes can be found within a separate report "GRAHAM D P and DUNCAN S (2018) Maintaining the Emissions Performance of Open Cycle Gas Turbines that operate for less than 500 hours per year. JEP Report UTG/18/ERG/CT/773/R, October 2018."</td></tr>
<tr><td>38</td><td>In order to prevent or reduce CO emissions to air from the combustion of gas oil in gas turbines, 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>Combustion optimisation</td><td rowspan="2">See description in Section 8.3</td><td>Generally applicable</td></tr>
<tr><td>b.</td><td>Oxidation catalysts</td><td>Not applicable to combustion plants operated < 500 h/yr. Retrofitting existing combustion plants may be constrained by the availability of sufficient space</td></tr>
</table></td><td>CC</td><td>LCP204 burning gas oil <500hrs/yr - the combustion system is maintained according to original equipment manufacturers recommendations. Retrofitting of a oxidation catalyst system is not applicable to combustion plant operated <500 h/yr</td></tr>
</table>

<table>
<tr><th>BAT Concn. Number</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 emission level for NO_X emissions to air from the combustion of gas oil in dual fuel gas turbines for emergency use operated < 500 h/yr will generally be 145–250 mg/Nm^3 as a daily average or average over the sampling period.</td><td></td><td></td></tr>
<tr><td>39</td><td>In order to prevent or reduce SO_X and dust emissions to air from the combustion of gas oil in gas turbines, BAT is to use the technique given below.
<table>
<tr><th colspan="2">Technique</th><th>Description</th><th>Applicability</th></tr>
<tr><td>a.</td><td>Fuel choice</td><td>See description in Section 8.4</td><td>Applicable within the constraints associated with the availability of different types of fuel, which may be impacted by the energy policy of the Member State</td></tr>
</table>
BAT-associated emission levels for SO_2 and dust emissions to air from the combustion of gas oil in gas turbines, including dual fuel gas turbines
<table>
<tr><th rowspan="3">Type of combustion plant</th><th colspan="4">BAT-AELs (mg/Nm^3)</th></tr>
<tr><th colspan="2">SO_2</th><th colspan="2">Dust</th></tr>
<tr><th>Yearly average (134)</th><th>Daily average or average over the sampling period (135)</th><th>Yearly average (134)</th><th>Daily average or average over the sampling period (135)</th></tr>
<tr><td>New and existing plants</td><td>35–60</td><td>50–66</td><td>2–5</td><td>2–10</td></tr>
</table></td><td>CC</td><td>LCP204 burning gas oil <500hrs/yr - IED Annex V Part 3 (2) (1) Continuous monitoring of SO2 is not required for plants firing Natural gas and for unabated plants firing oil with a known sulphur content. BAT 4 Item 8 As an alternative to the continuous measurement in the case of plants combusting oil with a known sulphur content and where there is no flue- gas desulphurisation system, periodic measurements at least once every six months and/or other procedures ensuring the provision of data of an equivalent scientific quality may be used to determine the SO2 emissions. Therefore, Gas oil not to exceed 0.1% w/w sulphur content. Natural Gas SO2 concentration by calculation as agreed in writing with the Environment Agency (JEP Compliance Protocol).

The site has no historical data for dust emissions to be able gauge the correct level of ELV. Therefor the site is requesting the top of the banding for Dust. SOx would be managed by the agency setting</td></tr>
</table>

<table>
<tr><th>BAT Concn. Number</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>maximum sulphur content within Gas Oil purchased.</td></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="3">Type of combustion unit</th><th colspan="4">BAT-AEELs (136) (137)</th></tr>
<tr><th colspan="2">Net electrical efficiency (%)</th><th rowspan="2">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>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, 50–600 MW_{th}</td><td>53–58,5</td><td>46–54</td><td>65–95</td><td colspan="2">No BAT-AEEL</td></tr>
<tr><td>CHP CCGT, ≥ 600 MW_{th}</td><td>57–60,5</td><td>50–60</td><td>65–95</td><td colspan="2">No BAT-AEEL</td></tr>
</table></td><td>CC</td><td>LCP's 202 & 203 operating >1500hrs/yr in CCGT mode are the power units for the CCGT station. Last performance data shows a Station Net Efficiency LHV of 55% (see performance data TN-GEN-AM-COMM-477-011 (BAT 2 Evidence). The bottom-of-range BAT-AEEL values are appropriate.

LCPs 202 & 203 could operate <1500hrs/year in OCGT where the BAT-AEEL’s would not be applicable.</td></tr>
</table>

<table>
<tr><th>BAT Concn. Number</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>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="3">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>
<tr><td>g.</td><td>Selective catalytic reduction (SCR)</td><td>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</td></tr>
</table></td><td>Narrative</td><td>NA for the site, no combustion of natural gas in the boilers</td></tr>
<tr><td>42</td><td>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.
<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.</td><td>The applicability to old combustion plants may be constrained by the need</td></tr>
</table></td><td>CC</td><td>The combustion system is maintained according to original equipment manufacturers recommendations and fitted with an advanced computer based control system to control the</td></tr>
</table>

BAT Concn. Number	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
						combustion efficiency and support the prevention and/or reduction of emissions. This also includes the use of high performance monitoring. The Gas turbines are fitted with dry low NOx burners that include the premixing of the air and fuel before entering the combustion zone. By mixing air and fuel before combustion, a homogeneous temperature distribution and a lower flame temperature are achieved, resulting in lower NOX emissions. Retrofitting of selective catalytic reduction (SCR) is constrained by the availability of sufficient space. The ISO Base Load Combined Cycle Gas Turbine (CCGT) Plant Efficiency, when firing on Natural Gas, is 55% based on historic performance testing, as declared previously. The associated Plant Net Thermal Input is 1339 MWth. The applicable top-of-range NOx BAT-AELs for this Natural Gas fired, Dry Low NOx (DLN), combustion system are: Annual 40 mg/m3 and Daily 50 mg/m3 at 15% O2, dry. These BAT-AELs are the proposed Emission Limit Values (ELVs), applicable only when the DLN system is fully effective.
			This technique is often used in combination with other techniques or may be used alone for combustion plants operated < 500 h/yr	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		
	f.	Selective catalytic reduction (SCR)		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		

BAT Concn. Number	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 DLN system premixes the fuel with a large excess of combustion air, upstream of the combustor. The lean premix combustion system is much more complex, and more dependent on precision engineered components, than conventional diffusion flame systems and the NOx can increase over time, across outage cycles, due to degradation of the fuel injection system, air leakage into the combustor and/or instrumentation issues. The NOx emissions are also more sensitive to fluctuations in fuel quality and ambient conditions. For all of these reasons, the top-of-range BAT-AEL values are appropriate. The data supplied within BAT 42 NOx Evidence clearly supports the above summary. The raw data supplied is the hourly and daily emissions when in compliance mode 6.3. The site environmental permit also specifies additional Monthly ELVs of 50 mg/m3 for NOx. Also Annual Hourly Percentile ELVs of 75 mg/m3 for NOx. **OCGT Operation - as above except for**

<table>
<tr><th>BAT Concn. Number</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>The ISO Base Load Gas Turbine (OCGT) Plant Efficiency, when firing on Natural Gas is; GT1 36.2% at 244MW, GT2 36.4% at 244 MW based on historic performance testing. The associated Plant Net Thermal Input is 1339 MWth.

The applicable top-of-range NOx BAT-AELs for this Natural Gas fired, Dry Low NOx (DLN), combustion system are: Daily 50 mg/m3 at 15% O2, dry. These BAT-AELs are the proposed Emission Limit Values (ELVs), applicable only when the DLN system is fully effective.</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.</td></tr>
</table></td><td>NA</td><td>No natural gas fired engines on site.</td></tr>
</table>

<table>
<tr><th>BAT Concn. Number</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>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>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>
</table>
</td><td>CC</td><td>The combustion system is maintained according to original equipment manufacturers recommendations and fitted with an advanced computer based control system to control the combustion efficiency and support the prevention and/or reduction of emissions. This also includes the use of high performance monitoring. Oxidation catalysts is constrained by the availability of sufficient space.
Unlike NOx, CO increases exponentially as the gas turbine approaches the emission compliance boundary defined by the combustion system. For this reason, hourly CO emissions are often close to the current 100mg/m3 ELV when the plant is operating at its stable operating limit (SEL) and gas turbine load is at its minimum (see data in BAT 44 evidence). A reduction in the current ELV would therefore necessitate raising SEL which in turn would impact on the commercial viability of the plant remaining operational at night. A potential consequence would be increased "two-shifting" and</td></tr>
</table>

BAT Concn. Number	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

Existing gas turbine for mechanical drive applications — All but plants operated < 500 h/yr	≥ 50	15–50 (155)	25–55 (156)

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

Type of combustion plant	BAT-AELs (mg/Nm^3)			
	Yearly average (157)		Daily average or average over the sampling period	
	New plant	Existing plant (158)	New plant	Existing plant (159)
Boiler	10–60	50–100	30–85	85–110
Engine (160)	20–75	20–100	55–85	55–110 (161)

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.

hence an increase in the total annual emissions of both CO and NOx attributable to the greater number of plant starts. From a holistic perspective, it is believed therefore that reducing the existing ELV for CO to 30mg/m3 could actually have a negative environmental impact.

The applicable top-of-range indicative CO Annual BAT-AEL is 30 mg/m3. The proposed ELV increases the indicative BAT-AEL to 100 mg/m3 to allow for the combustion characteristics of this gas turbine and potential combustor degradation relating to combustor air in-leakage.

The site environmental permit also specifies additional Monthly ELVs of 100 mg/m3 for CO. Also Annual Hourly Percentile ELVs of 100 mg/m3 for CO. Effective-DLN (E-DLN) is defined as the operating point above which compliance with the above Annual NOx and CO ELVs can be achieved with the DLN combustion system. Effective-DLN (E-DLN) also requires compliance with the above Monthly, Daily and Hourly Percentile ELV requirements.

BAT Concn. Number	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 proposed E-DLN operating point is defined by the following DLN operational mode/parameter(s): Emissions Compliance Mode (6.3) with 166 MWe (equivalent to 70% of ISO Base Load) as a fail-safe, back-stop E-DLN reporting threshold Both E-DLN and MSUL are defined in relation to the current combustion and emissions characteristics whilst also taking into account potential future mechanical degradation of the gas turbine and the, as yet unknown, post-2021 operating regimes. **OCGT operation** The combustion system is maintained according to original equipment manufacturer's recommendations and fitted with an advanced computer based control system to control the combustion efficiency and support the prevention and/or reduction of emissions. This also includes the use of high performance monitoring. Oxidation catalysts is constrained by the availability of sufficient space. Unlike NOx, CO increases exponentially as the gas turbine

BAT Concn. Number	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
			approaches the emission compliance boundary defined by the combustion system. For this reason, hourly CO emissions are often close to the current 100mg/m3 ELV when the plant is operating at its stable operating limit (SEL) and gas turbine load is at its minimum (see data in BAT 44 evidence). A reduction in the current ELV would therefore necessitate raising SEL which in turn would impact on the commercial viability of the plant remaining operational at night. A potential consequence would be increased "two-shifting" and hence an increase in the total annual emissions of both CO and NOx attributable to the greater number of plant starts. BRef is silent on this but from a holistic perspective, it is believed therefore that reducing the existing ELV could actually have a negative environmental impact. The site environmental permit also specifies additional Monthly ELVs of 100 mg/m3 for CO. Also Annual Hourly Percentile ELVs of 100 mg/m3 for CO. Effective-DLN (E-DLN) is defined as the operating point above which compliance with the above

BAT Concn. Number	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
			Annual NOx and CO ELVs can be achieved with the DLN combustion system. Effective-DLN (E-DLN) also requires compliance with the above Monthly, Daily and Hourly Percentile ELV requirements. The proposed E-DLN operating point is defined by the following DLN operational mode/parameter(s): Emissions Compliance Mode (6.3) with 166 MWe (equivalent to 70% of ISO Base Load) as a fail-safe, back-stop E-DLN reporting threshold Both E-DLN and MSUL are defined in relation to the current combustion and emissions characteristics whilst also taking into account potential future mechanical degradation of the gas turbine and the, as yet unknown, post-2021 operating regimes.

6. Emissions to Water

The consolidated permit incorporates the eight current discharges to controlled waters identified as W1-W3 and W5-W9 (W4 removed via partial surrender) .

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.

9 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 protection to those in the previous permit.

Aspect considered	Decision
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 condition (IC9) to ensure that: there is no significant environmental risk associated with black start operations. A written report shall be submitted to the Environment Agency for approval. See section 7 of this document for further detail.
Emission limits	We have decided that emission limits should be set for the parameters listed in the permit. These are described 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 amended to include the requirement to monitor energy efficiency after overhauls on site in line with BAT2. Based on the information in the application we are [not fully] satisfied that the operator's techniques, personnel and equipment have either MCERTS certification or MCERTS accreditation as appropriate.
Reporting	We have specified reporting in the permit for the following parameters: • Nitrogen dioxide • Carbon monoxide • Sulphur dioxide • Dust These are described in the relevant BAT Conclusions in Section 5 of this document.

Aspect considered	Decision
Operator competence	
Management system	There is no known reason to consider that the operator will not have the management system to enable it 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.