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 (as amended)

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

The Permit number is: EPR/NP3033LN
The Operator is: ConocoPhillips Petroleum Company UK Ltd.
The Installation is: Teesside Crude Oil Stabilisation Terminal
This Variation Notice number is: EPR/NP3033LN/V007

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 BAT conclusions.

We have reviewed the permit for this installation against the revised BAT Conclusions for the Refining of Mineral Oil and Gas industry sector published on 28 October 2014. 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 the Refining of Mineral Oil and Gas 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.

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.)

AAD	Ambient Air Directive (2008/50/EC)
APC	Air Pollution Control
BAT	Best Available Technique(s)
BAT-AEL	BAT Associated Emission Level
BATc	BAT conclusion
BREF	Best available techniques reference document
CEM	Continuous emissions monitor
CHP	Combined heat and power
COMEAP	Committee on the Medical Effects of Air Pollutants
CROW	Countryside and rights of way Act 2000
CV	Calorific value
DAA	Directly associated activity – Additional activities necessary to be carried out to allow the principal activity to be carried out
DD	Decision document
Derogation	from BAT AELs stated in BAT Conclusions under specific circumstances as detailed under Article 15(4) of IED where an assessment shows that the achievement of emission levels associated with the best available techniques as described in BAT conclusions would lead to disproportionately higher costs
DFO	Distillate Fuel Oil
EAL	Environmental assessment level
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 2010 (SI 2010 No. 675) as amended
EQS	Environmental quality standard
EU-EQS	European Union Environmental Quality Standard
Eunomia	Ballinger, Holland & Hogg (2011) Use of Damage Cost Data for BAT Decision Making: Report for the Environment Agency of England & Wales
EWC	European waste catalogue
FGD	Flue Gas Desulphurisation
FSA	Food Standards Agency
GWP	Global Warming Potential
HMT GB	Her Majesty's Treasury The Green Book - Appraisal and Evaluation in Central Government
HW	Hazardous waste
IED	Industrial Emissions Directive (2010/75/EU)
IPPCD	Integrated Pollution Prevention and Control Directive (2008/1/EC) – now superseded by IED
I-TEF	Toxic Equivalent Factors set out in Annex VI Part 2 of IED
I-TEQ	Toxic Equivalent Quotient calculated using I-TEF

LADPH	Local Authority Director(s) of Public Health
LCP	Large Combustion Plant subject to Chapter III of IED
LCPD	Large Combustion Plant Directive (2001/80/EC) – now superseded by 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
PAH	Polycyclic Aromatic Hydrocarbons
PC	Process Contribution
PEC	Predicted Environmental Concentration
PHE	Public Health England
POP(s)	Persistent organic pollutant(s)
PPS	Public participation statement
PR	Public register
PXDD	Poly-halogenated di-benzo-p-dioxins
PXB	Poly-halogenated biphenyls
PXDF	Poly-halogenated di-benzo furans
RGS	Regulatory Guidance Series
SAC	Special Area of Conservation
SGN	Sector guidance note
SHPI(s)	Site(s) of High Public Interest
SPA(s)	Special Protection Area(s)
SSSI(s)	Site(s) of Special Scientific Interest
TDI	Tolerable daily intake
TEF	Toxic Equivalent Factors
TGN	Technical guidance note
TOC	Total Organic Carbon
TOG	Terminal Off Gas
US EPA	United States Environmental Protection Agency
WFD	Waste Framework Directive (2008/98/EC)
WHO	World Health Organisation

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 have not received a request for a derogation from the requirements of BAT Conclusions as identified in the Refining of Mineral Oil and Gas BAT Conclusions document.

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 the Refining of Mineral Oil and Gas.

We issued a notice under Regulation 61 of the Environmental Permitting (England and Wales) Regulations 2016 (a Regulation 61 Notice) on 19 November 2015 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 relevant 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 28 October 2018, which will then ensure that operations meet the revised standard, or
- Justifies why standards will not be met by 28 October 2018, 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.

The Regulation 61 Notice response from the operator was received on 29 January 2016.

We considered that the response did not contain sufficient information for us to commence the permit review. We therefore issued a further information request to the operator on 23 January 2017. Further information was provided by the operator on 25 January 2017.

We considered it was in the correct form and contained sufficient information for us to begin our determination of the permit review but not that it necessarily contained all the information we would need to complete that review.

We received additional information from the operator. We considered that the response 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.

We have included an improvement condition in the consolidated variation notice, which requires them to upgrade their operational techniques so that the requirements of the BAT Conclusions are delivered. Details of this are provided in Section 6 and Annex 2 of this document.

3 The legal framework

The consolidated variation notice will be issued, if appropriate, 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, if it is issued, 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.

We have set the emission limit values (ELVs) in line with the BAT Conclusions, unless a tighter limit was previously imposed and these limits have been carried forward. The emission limits and monitoring tables have been incorporated into Schedule 3 of the permit.

4 Overview of the site and installation

The installation is located at Seal Sand, Middlesbrough at national grid reference NZ53502530.

The Crude Oil Stabilisation Process

Section 1.2 Part A(1)(e): The loading, unloading, handling or storage of, or the physical, chemical or thermal treatment of: (i) crude oil; and (ii) stabilised crude petroleum.

The process is a crude oil stabilisation plant in which light hydrocarbons such as methane, ethane, propane and butane - termed Natural Gas Liquids (NGL's) – and contaminant water are removed from crude oil in large-scale continuous plant. The stabilised crude and the separated, purified NGL's are then exported both locally by pipe-line and by ship for further processing and use. The process has been operating since 1975 and has a nominal design throughput of 1 million barrels of crude per day. Since 1998, segregated NGL's have been imported from the Central Area Transmission System (CATS) gas terminal for further processing and export using the established routes and processes permitted here.

The process comprises six main units as follows:-

- *Crude Oil receipt and storage* – including North Sea pipe-line from the first onshore isolation valve and four storage spheres.
- *Oil Stabilisation Trains* – six parallel streams containing washing; heating; degassing, cooling and compression units.
- *NGL Plant* – converts the raw NGL feed mixture into individual constituent products; including distillation; cooling; compression; purification; and storage units.
- *Product export* – including metering stations; pipe-lines from the Seal Sands Terminal to the Greatham Tank Farm and for export; ship loading jetties.
- *VOC Recovery Plant* – The volatile organic compound (VOC) vapours emitted from oil tankers during crude loading are collected. The unit uses a carbon bed absorption system to remove the VOC's from the ships vapour stream.
- *Effluent treatment* – including storage for untreated ballast water & process waste waters; plate separators; dissolved air flotation and chemical dosing (peroxide & flocculants). The final effluent is pumped to a third party for final (biological) treatment.

  Section 5.3 Part A1)(a)(ii): Disposal or recovery of hazardous waste with a capacity exceeding 10 tonnes per day by physico-chemical treatment.

  Section 5.4 Part A(1)(a)(ii): Disposal of non-hazardous waste with a capacity exceeding 50 tonnes per day by physico-chemical treatment.

Flaring also takes place at either the main elevated flare or the standby flare, air emission points A16 and A17.

The Combustion process

The combustion processes at the installation fall under the Environmental Permitting Regulation Schedule 1 listed activity:

Section 1.1 Part A(1)(a): Burning any fuel in an appliance with a rated thermal input of 50 megawatts or more.

This scheduled activity consists of the following processes within the installation:

- Large combustion plant (LCP) comprising three gas turbines (31.2 MWth each) and three steam boilers (104 MWth each) which form one integrated steam raising plant (LCP 62).

The three gas turbines drive propane compressors in the propane refrigeration system which forms part of the crude oil stabilisation plant described above. The pass-out gases from the turbines have a high oxygen content (16%) and are normally routed to the combustion chambers of the steam boilers (emission points A8 & A9) as part of the combustion air supply, i.e. heat recovery between the gas turbines and steam boilers.

In the event of unavailability of the steam boilers the pass-out gases can also be vented to atmosphere via three 18 metre standby stacks at emission points A11 to A13. This however is an infrequent event.

The three steam boilers raise process steam for the crude oil stabilisation plant. Each boiler discharges to one of two shared 45 metre stacks at emission points A8 and A9, with the two stacks forming two large combustion plants (LCP). The feed water treatment plant associated with the steam boilers is included in this permit.

- Six crude oil stabilisation “reboilers”.

The six “reboilers” (Numbers 2 to 7 inclusive, each at 40 MWth) heat crude oil as part of the crude oil stabilisation plant. Each “reboiler” discharges to a dedicated 61 metre stack at emission points A2 to A7.

The gas turbines operate on a high pressure fuel consisting mainly of methane. The boilers and reboilers are fuelled by, a mixture of methane, ethane, propane and butane.

Both fuels are derived from the stabilisation and fractionation process and are described as process gas. Natural gas is available as a back-up fuel in the event that inadequate plant fuel is produced. There are no fuel storage facilities and no abatement plant associated with the process.

The permit includes provision for a Combined Heat and Power (CHP) plant, subject to the completion of pre-operational conditions in Table S1.4 of this permit. The proposed plant would comprise of the following:

- Two gas turbines, each at 278 MWe, discharging at emission points A20 and A21.
- Two auxiliary boilers, each at 150 MWe, discharging at emission points A22 and A23.

Emissions

The main pollutants of concern from the installation are sulphur dioxide (SO_2) and oxides of nitrogen (NOx) from combustion. Low sulphur fuels are used on the site as well as low NOx burners on the stabilisation train reboiler exhausts and the LCP 62 gas turbines. These emissions have been shown to be insignificant at sensitive receptors.

An on-site effluent treatment plant (ETP) consisting of primary and secondary treatment facilities is used for all liquid effluent. Effluent is then transferred to the Bran Sands sewage treatment plant where further treatment is carried out prior to discharge to the River Tees.

The ETP also accepts non-hazardous liquid emissions from the adjacent RWE nPower Cogen facility (permit EPR/RP3130LN).

Management

The site environmental management system is certified to ISO14001 standards.

The site is a top tier COMAH (Control of Major Accident Hazards) site.

5 Key Issues

The key issues arising during this permit review are:

- The most apt description of the installation (refining activity).
- The definition of the off-gases from the stabilisation process (refinery fuel gas/process gas).
- The setting of combustion limits in accordance with **BAT Conclusions 34 to 37**.
- Reviewing the effectiveness of the treatment of effluent at the sewage treatment works compared with treatment at an on-site effluent treatment plant, **BAT Conclusion 12**.
- Reviewing the impact of effluent emissions from the sewage treatment plant to determine whether the discharge could cause a receiving water body to deteriorate from one **Water Framework Directive (WFD)** status class to another or cause significant localised impacts that could contribute to this happening or prevent or undermine action to get the water body to a good status.
- Determining under what circumstances and under what conditions an emergency release should be permitted from their emergency release point in order that it doesn't lead to a deterioration in the WFD class of the water body.

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

6 Decision checklist regarding relevant BAT Conclusions

BAT Conclusions for the Refining of Mineral Oil and Gas, were published by the European Commission on 28 October 2014. There are 58 BAT Conclusions.

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

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

BAT Conclusion 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	Relevant permit condition(s)
General				
1	**In order to improve the overall environmental performance of the plants for the refining of mineral oil and gas, 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	CC	The operator confirms that an ISO14001 approved system in place and is subject to full audit and verification from regulatory authorities and internal parties. We agree with the operator's status of compliance.	1.1

<table>
<tr><th>BAT Conclusion 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><th>Relevant permit condition(s)</th></tr>
<tr><td></td><td></td><td colspan="3"></td></tr>
<tr><td></td><td>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.

Applicability. The scope (e.g. level of detail) and nature of the EMS (e.g. standardised or non-standardised) will generally be related to the nature, scale and complexity of the installation, and the range of environmental impacts it may have.</td><td></td><td></td><td></td></tr>
<tr><td>2</td><td>In order to use energy efficiently, BAT is to use an appropriate combination of the techniques given below.

<table>
<tr><th colspan="2">Technique</th><th>Description</th></tr>
<tr><td colspan="3">i. Design techniques</td></tr>
<tr><td>a.</td><td>Pinch analysis</td><td>Methodology based on a systematic calculation of thermodynamic targets for minimising energy consumption of processes. Used as a tool for the evaluation of total systems designs</td></tr>
<tr><td>b.</td><td>Heat integration</td><td>Heat integration of process systems ensures that a substantial proportion of the heat required in various processes is provided by exchanging heat between streams to be heated and streams to be cooled</td></tr>
<tr><td>c.</td><td>Heat and power recovery</td><td>Use of energy recovery devices e.g.
• waste heat boilers
• expanders/power recovery in the FCC unit
• use of waste heat in district heating</td></tr>
<tr><td colspan="3">ii. Process control and maintenance techniques</td></tr>
<tr><td>a.</td><td>Process optimisation</td><td>Process optimisation. Automated controlled combustion in order to lower the fuel consumption per tonne of feed processed, often combined with heat integration for improving furnace efficiency</td></tr>
<tr><td>b.</td><td>Management and reduction of steam</td><td>Management and reduction of steam consumption. Systematic mapping of drain valve systems in order to reduce steam consumption</td></tr>
</table></td><td>CC</td><td>The operator confirms that the installation operations are ESOS compliant. ISO 50001 certification is not in place. The below techniques are employed.

a. Pinch analysis - Yes

b. Heat integration - Yes - All stabilisation units and raw crude oil feed is pre-heated by the hot rundown stabilised crude oil.

c. Heat and power recovery– Yes - Gas turbine exhaust gases feed three steam raising boilers as combustion air at the boiler burners.

a. Yes

b. Yes</td><td>1.2</td></tr>
</table>

<table>
<tr><th>BAT Conclusion 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><th>Relevant permit condition(s)</th></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td>
<table>
<tr><td></td><td>consumption</td><td>and optimise its use</td></tr>
<tr><td>c.</td><td>Use of energy benchmarking</td><td>Use of energy benchmark. Participation in ranking and benchmarking activities in order to achieve continuous improvement by learning from best practice</td></tr>
<tr><td colspan="3">iii. Energy efficient production techniques and description</td></tr>
<tr><td>a.</td><td>Use of combined heat and power.</td><td>System designed for the co-production (or the cogeneration) of heat (e.g. steam) and electric power from the same fuel</td></tr>
<tr><td>b.</td><td>Integrated gasification combined cycle (IGCC).</td><td>Technique whose purpose is to produce steam, hydrogen (optional) and electric power from a variety of fuel types (e.g. heavy fuel oil or coke) with a high conversion efficiency</td></tr>
</table>
</td><td></td><td>c. No/Not applicable

a. Yes - Gas turbine exhaust gases feed into three steam raising boilers as combustion air at the boiler burners.

b. No/Not applicable

We agree with the operator’s status of compliance.</td><td></td></tr>
<tr><td>3</td><td>In order to prevent or, where that is not practicable, to reduce dust emissions from the storage and handling of dusty materials, BAT is to use one or a combination of the techniques given below:
i. store bulk powder materials in enclosed silos equipped with a dust abatement system (e.g. fabric filter);
ii. store fine materials in enclosed containers or sealed bags;
iii. keep stockpiles of coarse dusty material wetted, stabilise the surface with crusting agents, or store under cover in stockpiles;
iv. use road cleaning vehicles</td><td>N/A</td><td>We agree this BAT Conclusion is not applicable to the relevant activities carried out at this installation.</td><td></td></tr>
<tr><td>4</td><td>BAT is to monitor emissions to air by using the monitoring techniques with at least the minimum 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>Description</th><th>Unit</th><th>Minimum frequency</th><th>Monitoring technique</th></tr>
<tr><td rowspan="2">SO_X, NO_X and dust emissions</td><td>Catalytic cracking</td><td>continuous</td><td>Direct measurement</td></tr>
<tr><td>Combustion units ≥ 100MW</td><td>continuous</td><td>Direct measurement</td></tr>
</table>
</td><td>CC</td><td>The operator confirms that a Continuous Emissions Monitoring System (CEM) is in place on all applicable units as per BS EN 14181.
<table>
<tr><th>Description</th><th>Unit</th><th>Operator’s proposed assessment</th></tr>
<tr><td rowspan="2">SO_X, NO_X and dust emissions</td><td>Catalytic cracking</td><td>No/Not applicable</td></tr>
<tr><td>Combustion units ≥ 100MW</td><td>Yes/steam raising boilers</td></tr>
</table>
</td><td>3.5.1</td></tr>
</table>

BAT Conclusion 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			Relevant permit condition(s)
		(3) and calcining units		(4)			(3) and calcining units		
		Combustion units of 50 to 100 MW (3)	continuous	Direct measurement or indirect monitoring			Combustion units of 50 to 100 MW (3)	No/Not applicable	
		Combustion units < 50 MW (3)	once a year and after significant fuel changes	Direct measurement or indirect monitoring			Combustion units < 50 MW (3)	Yes/Gas turbines exhaust into the steam raising boilers and the emissions exit via the boiler stacks. Stabilisation unit reboilers (x6) emissions from stack.	
		Sulphur recovery units (SRU)	continuous for SO2 only	Direct measurement or indirect monitoring (6)			Sulphur recovery units (SRU)	No/Not applicable	
	NH_3 emissions	All units equipped with SCR or SNCR	continuous	Direct measurement		NH_3 emissions	All units equipped with SCR or SNCR	No/Not applicable	
	CO emissions	Catalytic Cracking and combustion units >= 100MW (3)	continuous	Direct measurement		CO emissions	Catalytic Cracking and combustion units >= 100MW (3)	No/Not applicable/see below	
		Other combustion units	once every 6 months (5)	Direct measurement			Other combustion units	No/Not applicable/see below	
	Metal emissions: Nickel (Ni) Antimony (Sb) Vanadium (V)	Catalytic cracking	once every 6 months and after significant changes to the unit (5)	Direct measurement or analysis based on metals content in the catalyst fines and in the fuel					
		Combustion units (8)							
	Polychlorinated	Catalytic	once a year or	Direct		Metal	Catalytic	No/Not	

BAT Conclusion 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	Relevant permit condition(s)
	dibenzodioxins / furans (PCDD/F) emissions | reformer | once a regeneration, whichever is longer | measurement (1) Continuous measurement of SO2 emissions may be replaced by calculations based on measurements of the sulphur content of the fuel or the feed; where it can be demonstrated that this leads to an equivalent level of accuracy (2) Regarding SO_X, only SO_2 is continuously measured while SO_3 is only periodically measured (e.g. during calibration of the SO_2 monitoring system) (3) Refers to the total rated thermal input of all combustion units connected to the stack where emissions occur. (4) Or indirect monitoring of SO_X (5) Monitoring frequencies may be adapted if, after a period of one year, the data series clearly demonstrate a sufficient stability. (6) SO_2 emissions measurements from SRU may be replaced by continuous material balance or other relevant process parameter monitoring, provided appropriate measurements of SRU efficiency are based on periodic (e.g. once every 2 years) plant performance tests. (7) Antimony (Sb) is monitored only in catalytic cracking units when Sb injection is used in the process (e.g. for metals passivation) (8) With the exception of combustion units firing only gaseous fuel		emissions: Nickel (Ni) Antimony (Sb) Vanadium (V) | cracking | applicable Combustion units ([8]) | No/Not applicable Polychlorinated dibenzodioxins / furans (PCDD/F) emissions | Catalytic reformer | No/Not applicable The operator confirms that the installation operates solely to remove low molecular weight hydrocarbon components from the offshore raw crude feed to enable subsequent safe transport of the stabilised oil via ocean going tanker. They also confirm that methane from the crude is used as a fuel in the combustion units; but there are no refining operations carried out at the site. We do not agree with the operator's assumptions: The 'Scope' section of the BAT Conclusions states that: Combustion units for energy production means combustion units burning refinery fuels, **excluding units using only conventional or commercial fuels.** The facility carries out a basic refining activity (see BAT 34) and as such the process gas/methane is a Refinery fuel gas (RFG). The BAT Conclusions definition of RFG is, 'off-gases from distillation or conversion units used as a fuel'. Their process fuel gas cannot be considered conventional or commercial fuel, as per the definition in	

<table>
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<tr><td></td><td></td><td></td><td>the BAT Conclusions because it is not treated to a standard for exporting as natural gas in the grid for use as a commercial fuel.

We do not agree with the operator's status of compliance. We have identified that CO monitoring is not currently undertaken and the operator confirms that it is not applicable. We have imposed the necessary monitoring requirement in the permit.</td><td></td></tr>
<tr><td>5</td><td>BAT is to monitor the relevant process parameters linked to pollutant emissions, at catalytic cracking and combustion units by using appropriate techniques and with at least the frequency given below.

<table><tr><th>Description</th><th>Minimum frequency</th></tr><tr><td>Monitoring of parameters linked to pollution emissions, e.g. O_2 content in flue-gas, N and S content in fuel or feed ([1])</td><td>Continuous for O_2 content. For N and S content, periodic at a frequency based on significant fuel/feed changes.</td></tr><tr><td colspan="2">[1] N and S monitoring in fuel or feed may not be necessary when continuous emission measurement of NO_X and SO_2 are carried out at the stack.</td></tr></table></td><td>CC</td><td>The operator confirms that flue gas oxygen content is measured via the CEMs in place on the boiler and reboiler stacks.

Where necessary, continuous monitoring of NOx and SO_2 is undertaken.

We agree with the operator's status of compliance.</td><td>3.5.1</td></tr>
<tr><td>6</td><td>BAT is to monitor diffuse VOC emissions to air from the entire site by using all of the following techniques:
i. sniffing methods associated with correlation curves for key equipment;
ii. optical gas imaging techniques;
iii. calculations of chronic emissions based on emissions factors periodically (e.g. once every two years) validated by measurements.

The screening and quantification of site emissions by periodic campaigns with optical absorption-based-techniques, such as differential absorption light detection and ranging (DIAL) or solar occultation flux (SOF) is a useful complementary technique.</td><td>CC</td><td>The operator confirms that there is a combination of fugitive emission detection programme using an FLIR camera system and calculations based on factors supplied and agreed by the regulatory authorities.

i. No/Not applicable
ii. Yes
iii. Yes

BAT is to use all techniques. It was confirmed that the methods used are appropriate for the activities carried out at the facility.</td><td>2.4</td></tr>
</table>

BAT Conclusion 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	Relevant permit condition(s)
	Description. See section 1.20.6, Annex 1.		We agree with the operator's status of compliance.	
7	**In order to prevent or reduce emissions to air, BAT is to operate the acid gas removal units, sulphur recovery units and all other waste gas treatment systems with a high availability and at optimal capacity.** Special procedures can be defined for other than normal operating conditions, in particular: i. During start-up and shutdown operations. ii. during other circumstances that could affect the proper functioning of the systems (e.g. regular and extraordinary maintenance work and cleaning operations of the units and/or of the waste gas treatment system); iii. in case of insufficient waste gas flow or temperature which prevents the use of the waste gas treatment system at full capacity.	NA	We agree this BAT Conclusion is not applicable to the relevant activities carried out at this installation.	
8	**In order to prevent and reduce ammonia (NH_3) emissions to air when applying selective catalytic reduction (SCR) or selective non-catalytic reduction (SNCR) techniques, BAT is to maintain suitable operating conditions of the SCR or SNCR waste gas treatment systems, with the aim of limiting emissions of unreacted NH_3.** Table 2 BAT- associated emission levels for ammonia (NH_3) emissions to air for a combustion process unit where SCR or SNCR techniques are used. **Parameter** | **BAT-AEL (monthly average mg/m³)** Ammonia expressed as NH_3 | <5 - 15mg/Nm³ (1) (2) (1) the higher end of the range is associated with higher inlet NO_X concentrations, higher NO_X reduction rates and the ageing of the catalyst (2) The lower end of the range is associated with the use of the SCR technique.	NA	We agree this BAT Conclusion is not applicable to the relevant activities carried out at this installation.	

<table>
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<tr><td></td><td></td><td colspan="3"></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>9</td><td>In order to prevent and reduce emissions to air when using a sour water steam stripping unit, BAT is to route the acid off-gases from this unit to a SRU or any equivalent gas treatment system.

It is not BAT to directly incinerate the untreated sour water stripping gases.</td><td>NA</td><td>We agree this BAT Conclusion is not applicable to the relevant activities carried out at this installation.</td><td></td></tr>
<tr><td>10</td><td>BAT is to monitor emissions to water by using the monitoring techniques with at least the frequency given in Table 3 (as 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 3 BAT – associated emission levels for direct waste water discharges from the refining of mineral oil and gas monitoring frequencies associated with BAT ([1])

<table>
<tr><th>Parameter</th><th>Unit</th><th>BAT – AEL (yearly average)</th><th>Monitoring ([2]) frequency and analytical method (standard)</th></tr>
<tr><td>Hydrocarbon oil index (HOI)</td><td>mg/l</td><td>0.1 – 2.5</td><td>Daily
EN 9377-2</td></tr>
<tr><td>Total suspended solids (TSS)</td><td>mg/l</td><td>5 - 25</td><td>Daily</td></tr>
<tr><td>Chemical oxygen demand (COD) (4)</td><td>mg/l</td><td>30 - 125</td><td>Daily</td></tr>
<tr><td>BOD 5</td><td>mg/l</td><td>No BAT - AEL</td><td>Weekly</td></tr>
<tr><td>Total nitrogen (5) expressed as N</td><td>mg/l</td><td>1 – 25 (6)</td><td>Daily</td></tr>
<tr><td>Lead, expressed as Pb</td><td>mg/l</td><td>0.005 – 0.030</td><td>Quarterly</td></tr>
<tr><td>Cadmium expressed as Cd</td><td>mg/l</td><td>0.002 – 0.008</td><td>Quarterly</td></tr>
</table>
</td><td>NA</td><td>The operator confirms that all waste water is partially treated on-site and then exported via pipeline to the local municipal water treatment plant under a commercial agreement. There are no discharges to the River Tees or groundwater systems. There is an emergency provision in the permit for a release to the river, but this has not been used to date.

The BAT AELs apply to direct waste water discharges and there are none during ‘normal’ operation.

We have set an improvement condition for the operator to demonstrate that the discharge to sewer does not have a greater impact than it would have otherwise done had there been a direct discharge from an on-site tertiary treatment plant. This also includes the requirement to assess the emergency discharge and its potential to cause deterioration of the water body.

At present there is no requirement for limits in the permit, but this may change following completion of the improvement condition.

We agree this BAT Conclusion is not applicable to the relevant activities carried out at this installation.</td><td></td></tr>
</table>

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<tr><td></td><td></td><td colspan="3"></td></tr>
<tr><td></td><td>
<table>
<tr><td>Nickel, expressed as Ni</td><td>mg/l</td><td>0.005 – 0.100</td><td>Quarterly</td></tr>
<tr><td>Mercury, expressed as Hg</td><td>mg/l</td><td>0.0001 – 0.001</td><td>Quarterly</td></tr>
<tr><td>Vanadium</td><td>mg/l</td><td>No BAT - AEL</td><td>Quarterly</td></tr>
<tr><td>Phenol index</td><td>mg/l</td><td>No BAT - AEL</td><td>Monthly
EN 14402</td></tr>
<tr><td>Benzene, toluene, ethyl benzene, xylene (BTEX)</td><td>mg/l</td><td>Benzene
0.001 – 0.050
No BAT – AEL for T, E, X</td><td>Monthly</td></tr>
<tr><td colspan="4">(1) Not all parameters and sampling frequencies are applicable to effluent from gas refining sites
(2) Refers to a flow-proportional composite sample taken over period of 24 hours, or provided that sufficient flow stability is demonstrated, a time-proportional sample
(3) Moving from the current method to EN 9377-2 may require an adaptation period
(4) Where on-site correlation is available, COD may be replaced by TOC. The correlation between COD and TOC should be elaborated on a case-by-case basis. TOC monitoring would be the preferred option because it does not rely on the use of very toxic compounds
(5) Where total-nitrogen is the sum of the total Kjedahl nitrogen (TKN), nitrates and nitrites
(6) When nitrification/denitrification is used, levels below 15 mg/l can be achieved</td></tr>
</table>
</td><td></td><td></td><td></td></tr>
<tr><td>11</td><td>In order to reduce water consumption and the volume of contaminated water, BAT is to use all of the techniques given below.</td><td>CC</td><td>The operator confirms that all waste water is partially treated on-site and then exported via pipeline to the local municipal water treatment plant under a commercial agreement. There are no discharges to the River Tees or groundwater systems. There is an emergency provision in the permit for a discharge to the river, but this discharge has not been used.</td><td>1.3.1</td></tr>
</table>

BAT Conclusion 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	Relevant permit condition(s)
	<table><tr><th>Technique</th><th>Description</th><th>Applicability</th></tr><tr><td>i. water stream integration</td><td>Reduction of process water produced at the unit level prior to discharge by the internal reuse of water streams from e.g. cooling, condensates, especially for use in crude desalting</td><td>Generally applicable for new units. For existing units, applicability may require a complete rebuilding of the unit or the installation</td></tr><tr><td>ii. water and drainage system for segregation of contaminated water streams</td><td>Design of an industrial site to optimise water management, where each stream is treated as appropriate, by e.g. routing generated sour water (from distillation, cracking, coking units, etc.) to appropriate pre-treatment, such as a stripping unit</td><td>Generally applicable for new units. For existing units, applicability may require a complete rebuilding of the unit or the installation</td></tr><tr><td>iii. segregation of non-contaminated water streams (e.g. once-through cooling, rain water)</td><td>Design of a site in order to avoid sending non-contaminated water to general waste water treatment and to have a separate release after possible reuse for this type of stream</td><td>Generally applicable for new units. For existing units, applicability may require a complete rebuilding of the unit or the installation</td></tr><tr><td>iv. prevention of spillages and leaks</td><td>Practices that include the utilisation of special procedures and/or temporary equipment to maintain performances when necessary to manage special circumstances such as spills, loss of containment, etc</td><td>Generally applicable</td></tr></table>		i. Water usage at the desalters is optimised and the interface controlled to immunise water requirements. ii. Drains are segregated into storm water, open drain, oily water drains and accidentally contaminated drains. Bunding systems are in place to capture all drainage and route the streams to collection sumps for pre-treatment at the site effluent plant. This treated water is then exported to the local municipal treatment plant. iii. as ii above iv. All systems are drained and vented as far as possible before break in. Drip tray, portable bunds etc. are used routinely to ensure collection of spills.	

<table>
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<tr><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td>Drainage of large pieces of equipment is via the drains systems described above.

We agree with the operator’s status of compliance.</td><td></td></tr>
<tr><td>12</td><td>In order to reduce the emission load of pollutants in the waste water discharge to the receiving water body, BAT is to remove insoluble and soluble polluting substances by using all of the techniques given below.

<table><tr><th>Technique</th><th>Description</th><th>Applicability</th></tr><tr><td>i. Removal of insoluble substances by recovering oil</td><td>See Section 1.21.2, Annex 1.</td><td>Generally applicable</td></tr><tr><td>ii. Removal of insoluble substances by recovering suspended solids and dispersed oil</td><td>See Section 1.21.2, Annex 1.</td><td>Generally applicable</td></tr><tr><td>iii. Removal of insoluble substances including biological treatment and clarification.</td><td>See Section 1.21.2, Annex 1.</td><td>Generally applicable</td></tr></table>
BAT – associated emission levels – see Table 3 above</td><td>CC</td><td>The operator confirms that all waste water is partially treated onsite and then exported via pipeline to the local municipal water treatment plant under a commercial agreement. The levels of insoluble substances, solids and oil is carried out on site to a commercial specification agreed between the company and the receiving municipal water treatment plant.

i. See above.

ii. See above.

iii. See above.

We do not fully agree with the operator’s status of compliance. This BAT Conclusion is actually not applicable as there is no direct discharge to water.

The operator was concerned that they have no control or means of tracing the processing of its effluent water after it has entered the Bran Sands site. They also</td><td>2.3.1

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

BAT Conclusion 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	Relevant permit condition(s)
			stated that the Bran Sands site is subject to regulatory checks by the Environment Agency. The operator has a duty to ensure that the effluent treatment provided by a third party is suitable for treating their effluent and will deliver equivalent treatment performance to that which would be delivered under the BREF if it were treated on site. We recognise that Bran Sands have not shared the necessary information, so we have set an improvement condition. We may be required to provide assistance in obtaining the information from the Bran Sands site. The improvement condition requires demonstration that the discharge to the sewage treatment works is equivalent to on-site biological treatment including reduction factors i.e. that the discharge is equivalent to BAT.	
13	**When further removal of organic substances or nitrogen is needed, BAT is to use an additional treatment step as described in Section 1.21.2 (see Annex 1).**	NA	We agree this BAT Conclusion is not applicable to the relevant activities carried out at this installation.	
14	**In order to prevent or, where that is not practicable, to reduce waste generation, BAT is to adopt and implement a waste management plan that, in order of priority, ensures that waste is prepared for reuse, recycling, recovery or disposal.**	CC	The operator confirms that an ISO14001 approved system in place and is subject to full audit and verification from regulatory authorities and internal parties. All waste is reported annually in the Pollution Inventory system. Approximately 6,000 tonnes of waste is produced annually with 80% recycling of the material. We agree with the operator's status of compliance.	1.4.1

<table>
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<tr><td></td><td></td><td colspan="3"></td></tr>
<tr><td>15</td><td>In order to reduce the amount of sludge to be treated or disposed of, BAT is to use one or a combination of the techniques given below.

<table><tr><th>Technique</th><th>Description</th><th>Applicability</th></tr><tr><td>i Sludge pretreatment</td><td>Prior to final treatment (e.g. in a fluidised bed incinerator), the sludges are dewatered and/or de-oiled (by e.g. centrifugal decanters of steam dryers) to reduce their volume and to recover oil from slop equipment.</td><td>Generally applicable</td></tr><tr><td>ii Reuse of sludge in process units</td><td>Certain types of sludge (e.g. oily sludge) can be processed in units (e.g. coking) as part of the feed due to their oil content.</td><td>Applicability is restricted to sludges that can fulfil the requirements to be processed in units with appropriate treatment</td></tr></table></td><td>CC</td><td>The operator confirms that the sludge is handled in accordance with the site waste management systems. The amount of sludge is decreasing annually as improved methods of cleaning vessels internals are employed e.g. chemical cleaning rather than manual removal and disposal.

i. No/Not applicable

ii. No/Not applicable

The sludge produced is not process related, it is primarily from tank and equipment cleaning and as such there is no opportunity to reduce.

We agree with the operator’s status of compliance.</td><td>2.3.1</td></tr>
</table>

<table>
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<tr><td></td><td></td><td colspan="3"></td></tr>
<tr><td>16</td><td>In order to reduce the generation of spent solid catalyst waste, BAT is to use one or a combination of the techniques given below.
<table><tr><th>Technique</th><th>Description</th></tr><tr><td>i. Spent solid catalyst management</td><td>Scheduled and safe handling of the materials used as catalyst (e.g. by contractors) in order to recover or reuse them in off-site facilities. These operations depend on the type of catalyst and process</td></tr><tr><td>ii. Removal of catalyst from slurry decant oil</td><td>Decanted oil sludge from process units (e.g. FCC unit) can contain significant concentrations of catalyst fines. These fines can be separated prior to the reuse of decant oil as a feedstock.</td></tr></table></td><td>NA</td><td>We agree this BAT Conclusion is not applicable to the relevant activities carried out at this installation.</td><td></td></tr>
</table>

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<tr><td></td><td></td><td colspan="3"></td></tr>
<tr><td>17</td><td>In order to prevent or reduce noise, BAT is to use one or a combination of the techniques given below:

i. Make an environmental noise assessment and formulate a noise management plan as appropriate to the local environment;
ii. Enclose noisy equipment/operation in a separate structure/unit;
iii. Use embankments to screen the source of noise;
iv. Use noise protection walls;</td><td>CC</td><td>The operator confirms that various surveys of noise effects on local flora and fauna have been carried out as part of project work on site. This work has been in conjunction with a local ecology partner and Natural England.

They also confirm that the level of work carried out is appropriate to the sensitivity of the flora and fauna and the remote location of the plant.

There are no residential areas in the vicinity of the site. Areas of plant are segregated into sections where hearing protection is mandatory due to noisy equipment. The company provides all necessary personal protective equipment (PPE) to manage the noise levels that individuals are exposed to.

i. Yes
ii. Yes
iii. No
iv. No

We agree with the operator’s status of compliance.</td><td>3.4.1</td></tr>
<tr><td>18</td><td>In order to prevent or reduce diffuse VOC emissions, BAT is to apply the techniques given below.

<table>
<tr><th>Technique</th><th>Description</th><th>Applicability</th></tr>
<tr><td>I. Techniques related to plant design.</td><td>i. Limiting the number of potential emission sources
ii. Maximising inherent process containment features
iii. Selecting high integrity equipment
iv. Facilitating monitoring and maintenance activities by</td><td>Applicability may be limited for existing units</td></tr>
</table>
</td><td>CC</td><td>The operator confirms that there are a combination of fugitive emissions detection programmes using an FLIR camera system and calculations based on factors supplied and agreed by the regulatory authorities.

I. Yes</td><td>3.2.1

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

BAT Conclusion 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	Relevant permit condition(s)
	<table><tr><td></td><td>ensuring access to potentially leaking components</td><td></td></tr><tr><td>II. Techniques related to plant installation and commissioning</td><td>i. Well defined procedures for construction and assembly ii. Robust commissioning and hand-over procedures to ensure that the plant is installed in line with the design requirements.</td><td>Applicability may be limited for existing units</td></tr><tr><td>III. Techniques related to plant operation</td><td>Use of a risk based leak detection and repair (LDAR) programme in order to identify leaking components, and to repair these leaks. See table 1.20.6 under BAT 6</td><td>Generally applicable</td></tr></table>		II. Yes III. Yes The operator provided VOC emissions data in their further information response sent 06 September 2018. <table><tr><td>No Leak' Data from EA</td><td>Number on Site</td><td>kg/h</td><td>kg/y</td><td>t/y</td></tr><tr><td>Connectors /Flanges</td><td>40000</td><td>0.00006</td><td>0.53</td><td>21.0</td></tr><tr><td>Valves Gas</td><td>1980</td><td>0.0006</td><td>5.26</td><td>10.4</td></tr><tr><td>Valves light liquid</td><td>11220</td><td>0.0017</td><td>14.89</td><td>167.1</td></tr><tr><td>Pump seals</td><td>55</td><td>0.012</td><td>105.12</td><td>5.8</td></tr><tr><td>Compressors</td><td>15</td><td>0.0894</td><td>783.14</td><td>11.7</td></tr><tr><td>Pressure relief valves</td><td>45</td><td>0.0447</td><td>391.57</td><td>17.6</td></tr><tr><td>Sample connections</td><td>70</td><td>0.0015</td><td>13.14</td><td>0.9</td></tr><tr><td></td><td></td><td></td><td></td><td>VOCs</td></tr><tr><td>No Leaks Total</td><td></td><td></td><td></td><td>234.6 tes</td></tr></table> They also provided details of their LDAR system 11 September 2018, which included our Complaince Assessment Report (CAR) form ID NP3033LN/0312422. Fugitive surveys are carried out on a routine basis using a Forward Looking Infrared Radiometer (FLIR) to quantify leaks providing both a risk based approach to preventative and reactive maintenance and justification for loss initiatives. We confirmed that their approach represents best	

<table>
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<tr><td></td><td></td><td colspan="3"></td></tr>
<tr><td></td><td></td><td></td><td>practice.

We agree with the operator’s status of compliance.</td><td></td></tr>
<tr><td>19</td><td>In order to prevent hydrofluoric acid (HF) emissions to air from the hydrofluoric acid alkylation process, BAT is to use wet scrubbing with alkaline solution to treat incondensable gas streams prior to venting to flare.

Description: See section 1.20.3, Annex 1.
Applicability: Generally applicable. Safety requirements, due to the hazardous nature of hydrofluoric acid, are to be considered.</td><td>NA</td><td>We agree this BAT Conclusion is not applicable to the relevant activities carried out at this installation.</td><td></td></tr>
<tr><td>20</td><td>In order to reduce emissions to water from the hydrofluoric acid alkylation process, BAT is to use a combination of the techniques given below.

<table>
<tr><th>Technique</th><th>Description</th><th>Applicability</th></tr>
<tr><td>i. Precipitation / Neutralisation step</td><td>Precipitation (with e.g. calcium or aluminium-based additives) or neutralisation (where the effluent is indirectly neutralised with potassium hydroxide (KOH))</td><td>Generally applicable. Safety requirements due to the hazardous nature of hydrofluoric acid (HF) are to be considered.</td></tr>
<tr><td>ii Separation step</td><td>The insoluble compounds produced at the first step (e.g. CaF_2 or AlF_3) are separated in e.g. settlement basin.</td><td>Generally applicable</td></tr>
</table></td><td>NA</td><td>We agree this BAT Conclusion is not applicable to the relevant activities carried out at this installation.</td><td></td></tr>
</table>

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<tr><td></td><td></td><td colspan="3"></td></tr>
<tr><td>21</td><td>In order to reduce the emissions to water from the sulphuric acid alkylation process, BAT is to reduce the use of sulphuric acid by regenerating the spent acid and to neutralise the waste water generated by this process before routing to waste water treatment.</td><td>NA</td><td>We agree this BAT Conclusion is not applicable to the relevant activities carried out at this installation.</td><td></td></tr>
<tr><td>22</td><td>In order to prevent and reduce the emissions of hazardous substances to air and water from base oil production processes, BAT is to use one or a combination of the techniques given below.

<table><tr><th>Technique</th><th>Description</th><th>Applicability</th></tr><tr><td>i. Closed process with a solvent recovery</td><td>Process where the solvent, after being used during base oil manufacturing (e.g. in extraction, dewaxing units), is recovered through distillation and stripping steps.
See Section 1.20.7, Annex 1.</td><td>Generally applicable</td></tr><tr><td>ii. Multi-effect extraction solvent-based process</td><td>Solvent extraction process including several stages of evaporation (e.g. double or triple effect) for a lower loss of containment</td><td>Generally applicable to new units. The use of a triple effect process may be restricted to non-fouling feed stocks</td></tr><tr><td>iii. Extraction unit processes using less hazardous substances</td><td>Design (new plants) or implement changes (into existing) so that the plant operates a solvent extraction process with the use of a less hazardous solvent: e.g. converting furfural or phenol extraction into the n-methylpyrrolidone (NMP) process</td><td>Generally applicable to new units. Converting existing units to another solvent-based process with different physico-chemical properties may require substantial modifications</td></tr><tr><td>iv. Catalytic</td><td>Processes based on</td><td>Generally</td></tr></table></td><td>NA</td><td>We agree this BAT Conclusion is not applicable to the relevant activities carried out at this installation.</td><td></td></tr>
</table>

<table>
<tr><th>BAT Conclusion 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><th>Relevant permit condition(s)</th></tr>
<tr><td></td><td></td><td colspan="3"></td></tr>
<tr><td></td><td><table><tr><td>processes based on hydrogenation</td><td>conversion of undesired compounds via catalytic hydrogenation similar to hydrotreatment.</td><td>applicable to new units</td></tr></table></td><td></td><td></td><td></td></tr>
<tr><td>23</td><td>In order to prevent and reduce emissions to air from the bitumen production process, BAT is to treat the gaseous overhead by using one of the techniques given below

<table><tr><th>Technique</th><th>Description</th><th>Applicability</th></tr><tr><td>i. Thermal oxidation of gaseous overhead over 800 °C</td><td>See Section 1.20.6, Annex 1.</td><td>Generally applicable for the bitumen blowing unit</td></tr><tr><td>ii. Wet scrubbing of gaseous overhead</td><td>See Section 1.20.3, Annex 1.</td><td>Generally applicable for the bitumen blowing unit</td></tr></table></td><td>NA</td><td>We agree this BAT Conclusion is not applicable to the relevant activities carried out at this installation.</td><td></td></tr>
<tr><td colspan="2">BAT conclusions for the fluid catalytic cracking process</td><td></td><td></td><td></td></tr>
<tr><td>24</td><td>In order to prevent or reduce NO_X emissions to air from the catalytic cracking process (regenerator), BAT is to use one or a combination of the techniques given below.

I. Primary or process-related techniques, such as:<table><tr><th>Technique</th><th>Description</th><th>Applicability</th></tr><tr><td colspan="3">Process optimisation and use of promoters or additives</td></tr></table></td><td>NA</td><td>We agree this BAT Conclusion is not applicable to the relevant activities carried out at this installation.</td><td></td></tr>
</table>

BAT Conclusion 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	Relevant permit condition(s)
	i. Process optimisation	Combination of operating conditions or practices aimed at reducing NO_X formation, e.g. lowering the excess oxygen in the flue-gas in full combustion mode, air staging of the CO boiler in partial combustion mode, provided that the CO boiler is appropriately designed.	Generally applicable			
	ii. Low-NO_X CO oxidation promoters	Use of a substance that selectively promotes the combustion of CO only and prevents the oxidation of the nitrogen that contain intermediates to NO_X e.g. non-platinum promoters.	Applicable only in full combustion mode for the substitution of platinum-based CO promoters. Appropriate distribution of air in the regenerator may be required to obtain the maximum benefits			
	iii. Specific additive for NO_X reduction	Use of specific catalyst additives for enhancing the reduction of NO by CO	Applicable only in full combustion mode for the substitution of platinum-based CO promoters. Appropriate distribution of air in the regenerator may be required to obtain the maximum benefits.			
	II Secondary or end-of-pipe techniques such as:					

BAT Conclusion 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	Relevant permit condition(s)

Technique	Description	Applicability
i. Selective catalytic reduction (SCR)	See section 1.20.2, Annex 1.	To avoid potential fouling downstream, additional firing might be required upstream of the SCR. For existing units, the applicability may be limited by space availability.
ii. Selective non-catalytic reduction (SNCR)	See section 1.20.2, Annex 1.	For partial combustion FCCs with CO boilers, a sufficient residence time at the appropriate temperature is required. For full combustion FCCs without auxiliary boilers, additional fuel injection (e.g. hydrogen) may be required to match a lower temperature window.
	See section 1.20.2, Annex 1.	Need for additional scrubbing capacity. Ozone generation and the associated risk management need to be properly addressed. The applicability may be limited by the need for additional waste water treatment and related cross-media effects (e.g. nitrate emissions) and by an insufficient supply of liquid oxygen (for ozone generation). The applicability of the technique may be limited by space availability.

Table 4 BAT- associated emission levels for NO_X emissions to air from the regenerators in the catalytic cracking process

<table>
<tr><th>BAT Conclusion 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><th>Relevant permit condition(s)</th></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td>
<table>
<tr><th>Parameter</th><th>Type of unit/combustion mode</th><th>BAT-AEL (monthly average) Mg/Nm^3</th></tr>
<tr><td>NO_X expressed as NO_2</td><td>New unit/all combustion mode</td><td><30 – 100</td></tr>
<tr><td></td><td>Existing unit/full combustion mode</td><td><100 – 300 (1)</td></tr>
<tr><td></td><td>Existing unit/partial combustion mode</td><td>100 - 400 (1)</td></tr>
<tr><td colspan="3">When antimony (Sb) injection is used for metal passivation, NO_X levels up to 700 mg/Nm^3 may occur. The lower end of the range can be achieved by using the SCR technique.</td></tr>
</table>
</td><td></td><td></td><td></td></tr>
<tr><td>25</td><td>In order to reduce dust and metals emissions to air from the catalytic cracking process (regenerator), BAT is to use one or a combination of the techniques given below.

I. Primary or process-related techniques, such as:

<table>
<tr><th>Technique</th><th>Description</th><th>Applicability</th></tr>
<tr><td>i. Use of an attrition-resistant catalyst</td><td>Selection of catalyst substance that is able to resist abrasion and fragmentation in order to reduce dust emissions.</td><td>Generally applicable provided the activity and selectivity of the catalyst are sufficient</td></tr>
<tr><td>ii. Use of low sulphur feedstock (e.g. by feedstock selection or hydrotreatment of feed)</td><td>Feedstock selection favours low sulphur feedstocks among the possible sources. Hydrotreatment aims at reducing the sulphur, nitrogen and metal contents of the</td><td>Requires sufficient availability of low sulphur feedstocks, hydrogen production and hydrogen sulphide (H2S) treatment capacity (e.g. amine and</td></tr>
</table>
</td><td>NA</td><td>We agree this BAT Conclusion is not applicable to the relevant activities carried out at this installation.</td><td></td></tr>
</table>

BAT Conclusion 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	Relevant permit condition(s)

	feed.	Claus units)

II. secondary or end-of-pipe techniques, such as:

Technique	Description	Applicability
i. Electrostatic precipitator (ESP)	See section 1.20.1, Annex1.	For existing units, the applicability may be limited by space availability
ii. Multistage cyclone separators	See section 1.20.1, Annex1.	Generally applicable
iii. Third stage blowback filter	See section 1.20.1, Annex1.	Applicability may be restricted
iv. Wet scrubbing	See section 1.20.3, Annex1.	The applicability may be limited in arid areas and in the case where the by-products from treatment (including e.g. waste water with high level of salts) cannot be reused or appropriately disposed of. For existing units, the applicability may be limited by space availability.

Table 5 BAT – associated emission levels for dust emissions to air form the regenerator in the catalytic cracking process.

Parameter	Type of unit	BAT-AEL (monthly average) ([1]) Mg/Nm^3
Dust	New unit	10 – 25

<table>
<tr><th>BAT Conclusion 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><th>Relevant permit condition(s)</th></tr>
<tr><td></td><td></td><td colspan="3"></td></tr>
<tr><td></td><td>
<table>
<tr><td></td><td>Existing unit</td><td>10 – 50 (2)</td></tr>
<tr><td colspan="3">(1) Soot blowing in CO boiler and through the gas cooler is excluded
(2) The lower end of the range can be achieved with a 4-field ESP</td></tr>
</table>
The associated monitoring is in BAT 4.</td><td></td><td></td><td></td></tr>
<tr><td>26</td><td>In order to prevent or reduce SO_X emissions to air from the catalytic cracking process (regenerator), BAT is to use one or a combination of the techniques given below.

I. Primary or process-related techniques such as:

<table>
<tr><th>Technique</th><th>Description</th><th>Applicability</th></tr>
<tr><td>i. Use of SO_X reducing catalyst additives</td><td>Use of a substance that transfers the sulphur associated with coke from the regenerator back to the reactor.</td><td>Applicability may be restricted by regenerator conditions design. Requires appropriate hydrogen sulphide abatement capacity (e.g. SRU)</td></tr>
<tr><td>ii. Use of low sulphur feedstock (e.g. by feedstock selection of by hydrotreatment of the feed)</td><td>Feedstock selection favours low sulphur feedstocks among the possible sources to be processed at the unit. Hydrotreatment aims at reducing the sulphur, nitrogen and metal contents of the feed. Section 1.20.3, Annex1</td><td>Requires sufficient availability of low sulphur feedstocks, hydrogen production and hydrogen sulphide (H_2S) treatment capacity (e.g. amine and Claus units)</td></tr>
</table></td><td>NA</td><td>We agree this BAT Conclusion is not applicable to the relevant activities carried out at this installation.</td><td></td></tr>
</table>

BAT Conclusion 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	Relevant permit condition(s)
	II. Secondary or end-of pipe techniques, such as: **Technique** / **Description** / **Applicability** i. Non-regenerative scrubbing — Wet scrubbing or seawater scrubbing — The applicability may be limited in arid areas and in the case where the by-products form the treatment (including e.g. waste water with high levels of salts) cannot be reused or appropriately disposed of. ii. Regenerative scrubbing — Use of a specific SO_X absorbing reagent (e.g. absorbing solution) which generally enables the recovery of sulphur as a by-product during a regenerating cycle where the reagent is reused Section 1.20.3, Annex1 — The applicability is limited to the case where regenerated by-products can be sold. For existing units, the applicability may be limited by the existing sulphur recovery capacity as well as by space availability **Table 6 BAT-associated emission levels for SO_2 emissions to air from the regenerator in the catalytic cracking process** **Parameter** / **Type of units/mode** / **BAT-AEL (monthly average) mg/Nm³** SO_2 — New units — ≤ 300			

<table>
<tr><th>BAT Conclusion 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><th>Relevant permit condition(s)</th></tr>
<tr><td></td><td></td><td colspan="3"></td></tr>
<tr><td></td><td>
<table>
<tr><td></td><td>Existing units/full combustion</td><td><100 – 800(1)</td></tr>
<tr><td></td><td>Existing units/partial combustion</td><td>100 – 1 200 (1)</td></tr>
<tr><td colspan="3">(1) Where selection of low sulphur (e.g. < 0.5% w/w) feed (or hydrotreatment) and/or scrubbing is applicable, for all combustion modes, the upper end of the BAT-AEL range is ≤600 mg/Nm3</td></tr>
</table>

The associated monitoring is in BAT 4.</td><td></td><td></td><td></td></tr>
<tr><td>27</td><td>In order to reduce carbon monoxide (CO) emissions to air from the catalytic cracking process (regenerator), BAT is to use one or a combination of the techniques given below.

<table>
<tr><th>Technique</th><th>Description</th><th>Applicability</th></tr>
<tr><td>i. Combustion operation control</td><td>See section 1.20.5, Annex 1.</td><td>Generally applicable</td></tr>
<tr><td>ii. Catalysts with carbon monoxide (CO) oxidation promoters</td><td>See section 1.20.5, Annex 1.</td><td>Generally applicable only for full combustion mode</td></tr>
<tr><td>iii. Carbon monoxide (CO) boiler</td><td>See section 1.20.5, Annex 1.</td><td>Generally applicable only for partial combustion mode</td></tr>
</table>

Table 7 BAT- associated emission levels for carbon monoxide emissions to air from the regenerator in the catalytic cracking process for partial combustion mode.

<table>
<tr><th>Parameter</th><th>Combustion mode</th><th>BAT-AEL (monthly average) mg/Nm3</th></tr>
<tr><td>Carbon monoxide expressed as CO</td><td>Partial combustion mode</td><td>≤ 100 (1)</td></tr>
<tr><td colspan="3">(1) May not be achievable when not operating the CO boiler at full load.</td></tr>
</table></td><td>NA</td><td>We agree this BAT Conclusion is not applicable to the relevant activities carried out at this installation.</td><td></td></tr>
</table>

<table>
<tr><th>BAT Conclusion 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><th>Relevant permit condition(s)</th></tr>
<tr><td></td><td></td><td colspan="3"></td></tr>
<tr><td></td><td>The associated monitoring is in BAT 4</td><td></td><td></td><td></td></tr>
<tr><td>28</td><td>In order to reduce emissions of polychlorinated dibenzodioxins/furans (PCDD/F) to air from the catalytic reforming unit, BAT is to use one or a combination of the techniques given below

<table>
<tr><th>Technique</th><th>Description</th><th>Applicability</th></tr>
<tr><td>i. Choice of the catalyst promoter</td><td>Use of catalyst promoter in order to minimise polychlorinated dibenzodioxins/furans (PCDD/F) formation during regeneration. See section 1.20.7, Annex 1.</td><td>Generally applicable</td></tr>
<tr><td colspan="3">ii Treatment of the regeneration flue-gas</td></tr>
<tr><td>a) Regeneration gas recycling loop with adsorption bed</td><td>Waste gas from the regeneration step is treated to remove chlorinated compounds (e.g. dioxins)</td><td>Generally applicable to new units. For existing units the applicability may depend of the current regeneration unit design</td></tr>
<tr><td>b) Wet scrubbing</td><td>See section 1.20.3, Annex 1.</td><td>Not applicable to semi-regenerative reformers</td></tr>
<tr><td>c) Electrostatic precipitator (ESP)</td><td>See section 1.20.1, Annex 1.</td><td>Not applicable to semi-regenerative reformers</td></tr>
</table></td><td>NA</td><td>We agree this BAT Conclusion is not applicable to the relevant activities carried out at this installation.</td><td></td></tr>
<tr><td>29</td><td>In order to reduce emissions to air from the coking production processes, BAT is to use one or a combination of the techniques given below:</td><td>NA</td><td>We agree this BAT Conclusion is not applicable to the relevant activities carried out at this installation.</td><td></td></tr>
</table>

<table>
<tr><th>BAT Conclusion 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><th>Relevant permit condition(s)</th></tr>
<tr><td></td><td></td><td colspan="3"></td></tr>
<tr><td></td><td>
<table>
<tr><th>Applicability</th><th>Description</th><th>Applicability</th></tr>
<tr><td>i. Collection and recycling of coke fines</td><td>Systematic collection and recycling of coke fines generated during the whole coking process (drilling, handling, crushing, cooling etc)</td><td>Generally applicable</td></tr>
<tr><td>ii. Handling and storage of coke according to BAT 3</td><td>See BAT 3</td><td>Generally applicable</td></tr>
<tr><td>iii. Use of a closed blowdown system</td><td>Arrestment system for pressure relief from the coke drum</td><td>Generally applicable</td></tr>
<tr><td>iv. Recovery of gas (including the venting prior to the drum being opened to atmosphere) as a component of refiner fuel gas (RFG)</td><td>Carrying venting from the coke drum to the gas compressor to recover as RFG rather than flaring. For the flexicoking process, a conversion step (to convert the carbonyl sulphide (COS) into S_2S) is needed prior to treating the gas from the coking unit.</td><td>For existing units, the applicability of the techniques may be limited by space availability</td></tr>
</table>
</td><td></td><td></td><td></td></tr>
</table>

<table>
<tr><th>BAT Conclusion 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><th>Relevant permit condition(s)</th></tr>
<tr><td></td><td></td><td colspan="3"></td></tr>
<tr><td>30</td><td>In order to reduce NO_X emissions to air from the calcining of green coke process, BAT is to use selective non-catalytic reduction (SNCR).

Description: See section 1.20.2, Annex 1.
Applicability: The applicability of the SNCR technique (especially with respect to residence time and temperature window) may be restricted due to the specificity of the calcining process.</td><td>NA</td><td>We agree this BAT Conclusion is not applicable to the relevant activities carried out at this installation.</td><td></td></tr>
<tr><td>31</td><td>In order to reduce SO_X emissions to air from the calcining of green coke process, BAT is to use one or a combination of the techniques given below.

<table>
<tr><th>Technique</th><th>Description</th><th>Applicability</th></tr>
<tr><td>i. Non-regenerative scrubbing</td><td>Wet scrubbing or seawater scrubbing.

See Section 5.20.3</td><td>The applicability may be limited in arid areas and in the case where the by-products from treatment (including e.g. waste water with high level of salts) cannot be reused or appropriately disposed of.
For existing units, the applicability may be limited by space availability</td></tr>
<tr><td>ii. Regenerative scrubbing</td><td>Use of a specific SO_X absorbing reagent (e.g. absorbing solution) which generally enables the recovery of sulphur as a by-product during a regenerating cycle where the reagent is reused.</td><td>The applicability is limited to the case where regenerated by-products can be sold.
For existing units, the applicability may be limited by the existing sulphur recovery capacity as well as by space availability</td></tr>
</table></td><td>NA</td><td>We agree this BAT Conclusion is not applicable to the relevant activities carried out at this installation.</td><td></td></tr>
</table>

<table>
<tr><th>BAT Conclusion 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><th>Relevant permit condition(s)</th></tr>
<tr><td></td><td></td><td colspan="3"></td></tr>
<tr><td></td><td><table><tr><td></td><td>See Section 5.20.3, Annex 1.</td><td></td></tr></table></td><td></td><td></td><td></td></tr>
<tr><td>32</td><td>In order to reduce dust emissions to air from the calcining of green coke process, BAT is to use a combination of the techniques given below.

<table><tr><th>Technique</th><th>Description</th><th>Applicability</th></tr><tr><td>i. Electrostatic precipitator (ESP)</td><td>See section 1.20.1, Annex 1.</td><td>For existing units, the applicability may be limited by space availability.
For graphite and anode coke calcining production, the applicability may be restricted due to the high resistivity of the coke particles</td></tr><tr><td>ii. Multistage cyclone separators</td><td>See section 1.20.1, Annex 1.</td><td>Generally applicable</td></tr></table>
Table 8 BAT- associated emission levels of dust emissions to air from a unit for the calcining of green coke

<table><tr><td>Parameter</td><td>BAT-AEL (monthly average) mg/Nm^3</td></tr><tr><td>Dust</td><td>10 - 50 ($^{1, 2}$)</td></tr><tr><td colspan="2">(1) The lower end of the range can be achieved with a 4-field ESP
(2) When an ESP is not applicable, values of up to 150 mg/Nm^3 may occur.</td></tr></table>
The associated monitoring is in BAT 4.</td><td>NA</td><td>We agree this BAT Conclusion is not applicable to the relevant activities carried out at this installation.</td><td></td></tr>
<tr><td>33</td><td>In order to reduce water consumption and emissions to water from the desalting process, BAT is to use one or a combination of the</td><td>CC</td><td>The operator confirms that water usage at the desalters is optimised and the interface controlled to minimise</td><td>1.3.1
2.3.1</td></tr>
</table>

<table>
<tr><th>BAT Conclusion 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><th>Relevant permit condition(s)</th></tr>
<tr><td></td><td></td><td colspan="3"></td></tr>
<tr><td></td><td>techniques given below.

<table><tr><th>Technique</th><th>Description</th><th>Applicability</th></tr><tr><td>i. Recycling water and optimisation of the desalting process</td><td>An ensemble of good desalting practices aiming at increasing the efficiency of the desalter and reducing wash water usage e.g. using low shear mixing devices, low water pressure. It includes the management of key parameters for washing (e.g. good mixing) and separation (e.g. pH, density, viscosity, electric field potential for coalescence) steps</td><td>Generally applicable</td></tr><tr><td>ii. Multistage desalter</td><td>Multistage desalters operate with water addition and dehydration, repeated through two stages or more for achieving a better efficiency in the separation and therefore less corrosion in further processes</td><td>Applicable for new units</td></tr><tr><td>iii. Additional separation step</td><td>An additional enhanced oil/water and solid/water separation designed for reducing the charge of oil to the waste water treatment plant and recycling it to the process. This includes, e.g. settling drum, the use of</td><td>Generally applicable</td></tr></table></td><td></td><td>water requirements. Good mixing techniques are applied prior to water/oil entry into desalting vessel. Six trains with two desalters vessels each. Units can be placed in series as required.

Waste water from the desalters enters the effluent plant where settling tanks separate the oil/water mix. Oil is removed from the water using corrugated plate separators and dissolved air flotation (DAF) units.

i. Yes - Good mixing technique applied prior to water/oil entry into desalting vessel.

ii. Yes - Six trains with two desalters vessels each. Units can be placed in series as required.

iii. Yes - Waste water from the de-salters enters the effluent plant where settling tanks separate the oil/water mix. Oil is removed from the water using DAF units.

We agree with the operator’s status of compliance.</td><td></td></tr>
</table>

BAT Conclusion 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	Relevant permit condition(s)
	optimum interface level controllers			
34	**BAT 34. In order to prevent or reduce NO_x emissions to air from the combustion units, BAT is to use one or a combination of the techniques given below.** I. Primary or process-related techniques, such as:	CC	The operator states that the installation is not a refinery so the term 'refinery gas' is not strictly applicable. Process gas is used to fuel all process combustion units with back up from the national grid when required. Despite the operator's statement on the terminology to describe their process fuel gas, the regulation 61 response does actually consider that the requirements of this BAT Conclusion are applicable to the installation. Despite the refinery fuel gas definition, we agree with the operator on the fundamental that BAT 34 is applicable to their facility. The process of crude stabilisation involves removing low molecular weight hydrocarbon components from the crude to enable subsequent safe transport of the stabilised crude via ocean going tanker. Methane from the crude is used as a fuel in the boilers/heaters with back up from the national grid when required. Ethane/propane/butane are recovered, stored and sold as natural gas liquid (NGL) product. <u>Refining/RFG</u> Our definition of 'Refining' from Regulatory Guidance Note RGN2 is, '***any activity undertaken to purify substances and separate them into their component parts***. *However, removing water and dust so that a gas can be used immediately as fuel, and*	2.3.1

BAT Conclusion 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	Relevant permit condition(s)
			using filters to protect machines from dust, would not be considered refining. The activity of refining gas also does not include the separation of oxygen and other gases from air. The reference to "use … of gas" means refining such gas as feedstock and not gas burnt for ancillary purposes.' We do not agree that the installation is not a refinery. The facility carries out a basic refining activity as defined above and as such the process gas/off-gas used to fuel the combustion units is a RFG. The BAT Conclusions definition of RFG is, 'off-gases from distillation or conversion units used as a fuel'. The optimisation of oxygen content in the combustion units was submitted as the two biggest opportunities for energy reduction. Gas turbine combustion exhaust gas is routed to the combustion chambers of the steam raising boilers (heat recovery boilers). Low NOx burners are fitted to the reboilers and gas turbines.	

Technique	Description	Applicability
i. Selection or treatment of fuel		

BAT Conclusion 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	Relevant permit condition(s)
	(a) Use of gas to replace liquid fuel	Gas generally contains less nitrogen than liquid and its combustion leads to a lower level of NO_X emissions. See section 1.20.3, Annex 1.	The applicability may be limited by the constraints associated with the availability of low sulphur gas fuels, which may be impacted by the energy policy of the Member State		I. i. (a) Gaseous fuels are used exclusively on the site. There is no liquid fuel used in the combustion units.	
	(b) Use of low nitrogen refinery fuel oil (RFO) e.g. by RFO selection or by hydrotreatment of RFO	Refinery fuel oil selection favours low nitrogen liquid fuels among the possible sources to be used at the unit. Hydrotreatment aims at reducing the sulphur, nitrogen and metal contents of the fuel. See section 1.20.3, Annex 1.	Applicability is limited by the availability of low nitrogen liquid fuels, hydrogen production and hydrogen sulphide (H_2S) treatment capacity (e.g. amine and Claus units)		I. i. (b) Process gas/RFG is used to fuel all process combustion units with back up from the national grid when required.	
	ii. Combustion modifications					
	(a) Staged combustion: • air staging • fuel staging	See section 1.20.2, Annex 1.	Fuel staging for mixed or liquid firing may require a specific burner design		I. ii. (a) No/Not applicable	
	(b) Optimisation of combustion	See section 1.20.2, Annex 1.	Generally applicable		I. ii. (b) Yes - ESOS compliant. There is optimisation of oxygen content in the combustion units.	
	(c) Flue-gas recirculation	See section 1.20.2, Annex 1.	Applicable through the use of specific burners with internal recirculation of the flue-gas.		I. ii. (c) Yes - Gas turbine combustion exhaust gas is routed to the combustion chambers of the steam raising boilers.	

BAT Conclusion 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	Relevant permit condition(s)
			The applicability may be restricted to retrofitting external flue-gas recirculation to units with a forced/induced draught mode of operation			
	(d) Diluent injection	See section 1.20.2, Annex 1.	Applicable for gas turbines where appropriate inert diluents are available		I. ii. (d) No/Not applicable	
	(e) Use of low-NO_X burners (LNB)	See section 1.20.2, Annex 1.	Generally applicable for new units taking into account, the fuel-specific limitation (e.g. for heavy oil). For existing units, applicability may be restricted by the complexity caused by site-specific conditions e.g. furnaces design, surrounding devices. In very specific cases, substantial modifications may be required. The applicability may be restricted for furnaces in the delayed coking process, due to possible coke generation in the furnaces. In gas turbines, the applicability is restricted		I. ii. (e) Yes - Low NOx burners are fitted to the reboiler units (x6) and the gas turbines.	

<table>
<tr><th>BAT Conclusion 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><th>Relevant permit condition(s)</th></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td>
<table>
<tr><td></td><td></td><td>to low hydrogen content fuels (generally < 10 %)</td></tr>
</table>

II. Secondary or end-of-pipe techniques, such as:
<table>
<tr><th>Technique</th><th>Description</th><th>Applicability</th></tr>
<tr><td>i. Selective catalytic reduction (SCR)</td><td>See section 1.20.2, Annex 1.</td><td>Generally applicable for new units.
For existing units, the applicability may be constrained due to the requirements for significant space and optimal reactant injection</td></tr>
<tr><td>ii. Selective non-catalytic reduction (SNCR)</td><td>See section 1.20.2, Annex 1.</td><td>Generally applicable for new units.
For existing units, the applicability may be constrained by the requirement for the temperature window and the residence time to be reached by reactant injection</td></tr>
<tr><td>iii. Low temperature oxidation</td><td>See section 1.20.2, Annex 1.</td><td>The applicability may be limited by the need for additional scrubbing capacity and by the fact that ozone generation and the associated risk management need to be properly addressed.
The applicability may be limited by the need for additional waste water</td></tr>
</table>
</td><td></td><td>II.i. No/Not applicable

II.ii. No/Not applicable

II.iii. No/Not applicable</td><td></td></tr>
</table>

<table>
<tr><th>BAT Conclusion 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><th>Relevant permit condition(s)</th></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td>
<table>
<tr><td></td><td></td><td>treatment and related cross-media effects (e.g. nitrate emissions) and by an insufficient supply of liquid oxygen (for ozone generation). For existing units, the applicability of the technique may be limited by space availability</td></tr>
<tr><td>iv. SNO_X combined technique</td><td>See section 1.20.4, Annex 1.</td><td>Applicable only for high flue-gas (e.g. > 800 000 Nm3/h) flow and when combined NO_X and SO_X abatement is needed</td></tr>
</table>

BAT- associated emission levels: See Table 9, Table 10 and Table 11

Table 9 BAT-associated emission levels for NO_X emissions to air from a gas turbine

<table>
<tr><th>Parameter</th><th>Type of equipment</th><th>BAT-AEL (1) (monthly average) mg/Nm^3 at 15% O_2</th></tr>
<tr><td rowspan="2">NOx, expressed as NO_2</td><td rowspan="2">Gas turbine (including combined cycle gas turbine – CCGT) and integrated gasification combined cycle turbine</td><td>40 - 120 (existing gas turbine)</td></tr>
<tr><td>20 - 50 (new turbine) (2)</td></tr>
</table>
</td><td></td><td>II.iv. No/Not applicable

The operator confirm the following combustion units:
<table>
<tr><th>Emission points</th><th>Combustion units</th><th>Thermal input</th></tr>
<tr><td>A2 to A7</td><td>Stabilisation Reboilers x 6 Direct fired gas heaters</td><td>40 MWth each</td></tr>
<tr><td>A8 & A9 Gas turbine exhausts via the heat recovery boilers-normal operation</td><td>Gas turbines x3

Heat recovery boilers - Gas fired steam raising boilers x3</td><td>31.2 MWth each
104 MWth each</td></tr>
<tr><td>A11, A12, A13</td><td>Gas Turbines</td><td>31.2 MWth</td></tr>
</table>
</td><td></td></tr>
</table>

BAT Conclusion 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	Relevant permit condition(s)

	(IGCC))	

(1) BAT-AEL refers to combined emissions from the gas turbine and the supplementary firing recovery boiler, where present
(2) For fuel with high H_2 content (i.e. above 10%), the upper end of the range is 75 mg/Nm^3

Table 10 BAT- associated emission levels for NOX emissions to air from a gas-fired combustion unit, with the exception of gas turbines

Parameter:	Type of combustion	BAT-AEL (monthly average) mg/Nm^3
NOx, expressed as NO_2	Gas firing	30 - 150 for existing unit (1)
		30 - 100 for new unit
(1) For an existing unit using high air pre-heat (i.e. > 200 C) or with H2 content in the fuel gas higher that 50% the upper end of the BAT-AEL range is 200 mg/Nm^3		

Table 11 BAT –associated emission levels for NO_X emissions to air from a multi-fuel fired combustion unit with the exception of gas turbines

Parameter:	Type of combustion	BAT-AEL (monthly average) mg/Nm^3
NO_X expressed as NO_2	Multi-fuel fired combustion unit	30 -300—for existing unit (^{1}) (^{2})
(1) For existing units < 100 MW firing fuel oil with a nitrogen content higher that 0.5% (w/w) or with liquid firing > 50% or using air		

Other than normal operation, boilers unavailable	x3 - Gas fired	each
Subject to completion of pre-operational conditions in Table S1.4 of the permit		
A20 & A21	CHP Gas turbines	278 MWe each
A22 & A23	CHP Auxiliary boilers	150 MWe each

All the above combustion units are existing. The BAT Conclusion definitions are:

"New" unit: A unit first permitted on the site of the installation following the publication of these BAT conclusions or a complete replacement of a unit on the existing foundations of the installation following the publication of these BAT conclusions.

"Existing" unit: A unit which is not a new unit"

The CHP was permitted 10 February 2011 (EPR/NP3033LN/V003).

Normal operation
2 x boilers
1 x GT
5 x Reboilers

The operator does not intend to achieve compliance via a NOx emissions bubble allowed by BAT Conclusion 57.

Refer to Section 6.1 below for setting limits.

BAT Conclusion 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	Relevant permit condition(s)
	preheating values up to 450 mg/Nm^3 may occur (2) The lower end of the range can be achieved by using the SCR technique The associated monitoring is in BAT 4		We agree with the operator's status of compliance and have set the appropriate limits in the permit.	
35	**In order to prevent or reduce dust and metal emissions to air from the combustion units, BAT is to use one or a combination of the techniques given below.** I. Primary or process-related techniques, such as: **Technique** | **Description** | **Applicability**	CC	The operator confirm that there are no particulates in the gaseous fuels used on the site. No liquid, oil or solid fuel are used in the combustion units. They also confirm that the installation is not a refinery so the term 'refinery gas' is not strictly applicable. Process gas is used to fuel all process combustion units with back up from the national grid when required. We don't agree with the above assumptions, see BAT 34 above.	2.3.1 2.4

BAT Conclusion 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	Relevant permit condition(s)
	Selection or treatment of fuel					
	(a) Use of gas to replace liquid fuel	Gas instead of liquid combustion leads to lower level of dust emissions See section 1.20.3, Annex 1.	The applicability may be limited by the constraints associated with the availability of low sulphur fuels such as natural gas which may be impacted by the energy policy of the Member State		I. Selection or treatment of fuel (a) Gaseous fuels are used exclusively on the site. Currently there is no liquid fuel used in the combustion units.	
	(b) Use of low sulphur refinery fuel oil (RFO) e.g. by RFO selection or by hydro-treatment of RFO	Refinery fuel oil selection favours low sulphur liquid fuels among the possible sources to be used at the unit. Hydrotreatment aims at reducing the sulphur, nitrogen and metal contents of the fuel See section 1.20.3, Annex 1.	The applicability may be limited by the availability of low sulphur liquid fuels, hydrogen production and the hydrogen sulphide (H_2S) treatment capacity (e.g. amine and Claus units)		I. Selection or treatment of fuel (b) Process gas is used to fuel all process combustion units with back up from the national grid when required. The operator confirms that they do not use refinery gas by the strict legal definition. There is no amine treating for the preferred fuelling options. On rare occasions that the DeMethaniser overhead product is used as fuel then this material will have passed though amine treatment as part of the process for scrubbing out H_2S and CO_2 in preparation for ethane export, but not as a fuel gas treatment.	
	Combustion modifications					
	(a) Optimisation of combustion	See section 1.20.2, Annex 1.	Generally applicable to all types of combustion		I. Combustion modifications (a) Combustion control is optimised.	
	(b) Atomisation of liquid fuel	Use of high pressure to reduce the droplet size of liquid fuel. Recent optimal burner designs generally include steam atomisation	Generally applicable to liquid fuel firing		I. Combustion modifications (b) The site uses gas.	

<table>
<tr><th>BAT Conclusion 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><th>Relevant permit condition(s)</th></tr>
<tr><td></td><td></td><td colspan="3"></td></tr>
<tr><td></td><td>II Secondary or end-of-pipe techniques, such as:

<table>
<tr><th>Technique</th><th>Description</th><th>Applicability</th></tr>
<tr><td>i. Electrostatic precipitator (ESP)</td><td>See section 1.20.1, Annex 1.</td><td>For existing units, the applicability may be limited by space availability</td></tr>
<tr><td>ii. Third stage blowback filter</td><td>See section 1.20.1, Annex 1.</td><td>Generally applicable</td></tr>
<tr><td>iii. Wet scrubbing</td><td>See section 1.20.1, Annex 1.</td><td>The applicability may be limited in arid areas and in the case where by-products from treatment (including e.g. waste water with a high level of salt) cannot be reused or appropriately disposed of. For existing units, the applicability of the technique may be limited by space availability</td></tr>
<tr><td>iv. Centrifugal washers</td><td>See section 1.20.1, Annex 1.</td><td>Generally applicable</td></tr>
</table>

Table 12 BAT – associated emission levels of dust emissions to air from a multi-fuel fired combustion unit with the exception of gas turbines

<table>
<tr><th>Parameter</th><th>Type of combustion</th><th>BAT-AEL (monthly average) mg/Nm^3</th></tr>
<tr><td>Dust</td><td>Multi-fuel firing</td><td>5 – 50 for existing</td></tr>
</table></td><td></td><td>II.i. Not Applicable

II.ii. Not Applicable

II.iii. Not Applicable

II.iv. Not applicable

<u>Metal emissions</u>
Are not applicable where the combustion units are firing only gaseous fuel as is the case.

<u>Dust emissions</u>
Are not applicable as multi-fuel firing is not taking place.</td><td></td></tr>
</table>

BAT Conclusion 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	Relevant permit condition(s)
	<table><tr><td></td><td></td><td>unit (1) (2)</td></tr><tr><td></td><td></td><td>5 – 25 for new unit < 50 MW</td></tr></table> (1) The lower end of the range is achievable for units with the use of end-of-pipe techniques (2) The upper end of the range refers to the use of a high percentage of oil burning and where only primary techniques are applicable The associated monitoring is in BAT 4		Refer to Section 6.1 below for setting limits. We agree with the operator's status of compliance and have set the appropriate limits in the permit.	
36	**In order to prevent or reduce SO_X emissions to air from the combustion units, BAT is to use one or a combination of the techniques given below.** I. Primary or process-related techniques	CC	The operator confirms that no liquid, oil or solid fuel are used in the combustion units. They also confirm that the installation is not a refinery so the term 'refinery gas' is not strictly applicable. Process gas is used to fuel all process combustion units with back up from the national grid when required. We don't agree with the above assumptions, see BAT 34 above.	2.3.1

<table>
<tr><th>BAT Conclusion 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><th>Relevant permit condition(s)</th></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td>
<table>
<tr><th>Technique</th><th>Description</th><th>Applicability</th></tr>
<tr><td>i. Use of gas to replace liquid fuel</td><td>See section 1.20.3, Annex 1.</td><td>The applicability may be limited by the constraints associated with the availability of low sulphur fuels such as natural gas, which may be impacted by the energy policy of the Member State</td></tr>
<tr><td>ii. Treatment of refinery fuel gas (RFG)</td><td>Residual H2S concentration in RFG depends on the treatment process parameter, e.g. the amine-scrubbing pressure.
See Section 1.20.3, Annex 1.</td><td>For low calorific gas containing carbonyl sulphide (COS) e.g. from coking units, a converter may be required prior to H_2S removal</td></tr>
<tr><td>iii. Use of low sulphur refinery fuel oil (RFO) e.g. by RFO selection or by hydrotreatment of RFO</td><td>Refinery fuel oil selection favours low sulphur liquid fuels among the possible sources to be used at the unit.
Hydrotreatment aims at reducing the sulphur, nitrogen and metal contents of the fuel.
See Section 1.20.3, Annex 1.</td><td>The applicability is limited by the availability of low sulphur liquid fuels, hydrogen production and the hydrogen sulphide (H_2S) treatment capacity (e.g. amine and Claus units</td></tr>
</table>
</td><td></td><td>I.i. Gaseous fuels are used exclusively on the site. Currently there is no liquid fuel used in the combustion units.

I.ii. Process gas is used to fuel all process combustion units with back up from the national grid when required. There is no amine treating for the preferred fuelling options. On rare occasions that the DeMethaniser overhead product is used as fuel then this material will have passed though amine treatment as part of the process for scrubbing out H_2S and CO_2 in preparation for ethane export, but not as a fuel gas treatment.

I.iii. Not applicable, no burning of liquid fuels?</td><td></td></tr>
</table>

<table>
<tr><th>BAT Conclusion 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><th>Relevant permit condition(s)</th></tr>
<tr><td></td><td></td><td colspan="3"></td></tr>
<tr><td></td><td>
II. Secondary or end-of-pipe techniques
<table>
<tr><th>Technique</th><th>Description</th><th>Applicability</th></tr>
<tr><td>i. Non-regenerative scrubbing</td><td>Wet scrubbing or seawater scrubbing. See Section 1.20.3, Annex 1.</td><td>The applicability may be limited in arid areas and in the case where the by-products from treatment (including e.g. waste water with high level of salts) cannot be reused or appropriately disposed of.
For existing units, the applicability of the technique may be limited by space availability</td></tr>
</table>
Table 13 BAT – associated emission levels for SO_2 emissions to air from combustion unit firing refinery fuel gas (RFG), with the exception of gas turbines
<table>
<tr><th>Parameter</th><th>BAT-AEL (monthly average) mg/Nm^3</th></tr>
<tr><td>SO_2</td><td>5 – 35 (1)</td></tr>
<tr><td colspan="2">(1) In the specific configuration of RFG treatment with a low scrubber operative pressure and with refinery fuel gas with an H/C molar ratio above 5, the upper end of the BAT-AEL range can be as high as 45 mg/Nm3</td></tr>
</table>
The associated monitoring is in BAT 4
Table 14 BAT- associated emission levels for SO_2 emissions to air
</td><td></td><td>II.i. Not applicable

The operator’s review against Table 13 is missing in the Regulation 61 response.

Refer to Section 6.1 below for setting limits.

We agree with the operator’s status of compliance.</td><td></td></tr>
</table>

<table>
<tr><th>BAT Conclusion 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><th>Relevant permit condition(s)</th></tr>
<tr><td></td><td></td><td colspan="3"></td></tr>
<tr><td></td><td>from multi-fuel fired combustion units, with the exception of gas turbines and stationary engines

<table><tr><th>Parameter</th><th>BAT-AEL (monthly average) mg/Nm^3</th></tr><tr><td>SO_2</td><td>35 - 600</td></tr></table>
The associated monitoring is in BAT 4</td><td></td><td></td><td></td></tr>
<tr><td>37</td><td>In order to reduce carbon monoxide (CO) emissions to air from the combustion units, BAT is to use a combustion operation control.

Description: See section 1.20.5, Annex 1.

Table 15 BAT – associated emission levels for carbon monoxide emissions to air from combustion unit

<table><tr><th>Parameter</th><th>BAT- AEL (monthly average) mg/Nm^3</th></tr><tr><td>Carbon monoxide expressed as CO</td><td>$\leq$ 100</td></tr></table>
Associated monitoring is in BAT 4.</td><td>CC</td><td>Refer to Section 6.1 below for setting limits.

We agree with the operator’s status of compliance.</td><td>2.3.1</td></tr>
<tr><td>38</td><td>In order to reduce emissions to air from the etherification process, BAT is to ensure the appropriate treatment of process off-gases by routing them to the refinery fuel gas system.</td><td>NA</td><td>We agree this BAT Conclusion is not applicable to the relevant activities carried out at this installation.</td><td></td></tr>
<tr><td>39</td><td>In order to prevent upset of the biotreatment, BAT is to use a storage tank and an appropriate unit production plan management to control the toxic components dissolved content (e.g. methanol, formic acid, ethers) of the waste water stream prior to final treatment.</td><td>NA</td><td>We agree this BAT Conclusion is not applicable to the relevant activities carried out at this installation.</td><td></td></tr>
</table>

BAT Conclusion 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	Relevant permit condition(s)
40	**In order to reduce emissions to air of chlorinated compounds, BAT is to optimise the use of chlorinated organic compounds used to maintain catalyst activity when such a process is in place or to use non-chlorinated catalytic systems.**	NA	We agree this BAT Conclusion is not applicable to the relevant activities carried out at this installation.	
41	**In order to reduce sulphur dioxide emissions to air from the natural gas plant, BAT is to apply BAT 54.**	NA	We agree this BAT Conclusion is not applicable to the relevant activities carried out at this installation.	
42	**In order to reduce nitrogen oxides (NO_X) emissions to air from the natural gas plant, BAT is to apply BAT 34**	NA	We agree this BAT Conclusion is not applicable to the relevant activities carried out at this installation.	
43	**In order to prevent emissions of mercury when present in raw natural gas, BAT is to remove the mercury and recover the mercury-containing sludge for waste disposal.**	NA	We agree this BAT Conclusion is not applicable to the relevant activities carried out at this installation.	
44	**In order to prevent or reduce waste water flow generation from the distillation process, BAT is to use liquid ring vacuum pumps or surface condensers.** **Applicability**. May not be applicable in some retrofit cases. For new units, vacuum pumps, either in or not in combination with the steam ejectors, may be needed to achieve a high volume (10 mm Hg). Also, a spare should be available in case the vacuum pump fails.	NA	We agree this BAT Conclusion is not applicable to the relevant activities carried out at this installation.	
45	**In order to prevent or reduce water pollution from the distillation process, BAT is to route sour water to the stripping unit.**	NA	We agree this BAT Conclusion is not applicable to the relevant activities carried out at this installation.	
46	In order to prevent or reduce emissions to air from distillation units, BAT is to ensure the appropriate treatment of process off-gases, especially incondensable off-gases, by acid gas removal prior to further use. **Applicability**. Generally applicable for crude and vacuum distillation units. May not be applicable for standalone lubricant and bitumen refineries, with emissions of less than 1 t/d of sulphur compounds. In specific refinery configurations, applicability may be restricted, due to the need for e.g. large piping, compressors or additional amine treating capacity.	NA	We agree this BAT Conclusion is not applicable to the relevant activities carried out at this installation.	

BAT Conclusion 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	Relevant permit condition(s)
47	**In order to reduce emissions to air from the products treatment process, BAT is to ensure the appropriate disposal of off-gases, especially odorous spent air from sweetening units, by routing them to destruction, e.g. by incineration.** **Applicability**. Generally applicable to products treatment processes where the gas streams can be safely processed to the destruction units. May not be applicable to sweetening units, due to safety reasons.	NA	We agree this BAT Conclusion is not applicable to the relevant activities carried out at this installation.	
48	**In order to reduce waste and waste water generation when a products treatment process using caustic is in place, BAT is to use cascading caustic solution and a global management of spent caustic, including recycling after appropriate treatment, e.g. by stripping.**	NA	We agree this BAT Conclusion is not applicable to the relevant activities carried out at this installation.	

BAT Conclusion 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	Relevant permit condition(s)
49	**In order to reduce VOC emissions to air from the storage of volatile liquid hydrocarbon compounds, BAT is to use floating roof storage tanks equipped with high efficiency seals or a fixed roof tank connected to a vapour recovery system.** **Description**. High efficiency seals are specific devices for limiting losses of vapour e.g. improved primary seals, additional multiple (secondary or tertiary) seals (according to quantity emitted). **Applicability**. The applicability of high efficiency seals may be restricted for retrofitting tertiary seals in existing tanks.	CC	The operator confirms that stabilised crude oil (RVP 7 psi) is stored in a tank farm. There are ten tanks at 750,000 barrels capacity each. These are floating roof tanks with high efficiency seals. Liquefied and refrigerated products are stored in fixed roof tanks with a pressure maintenance system routed to the plant flares. (Ethane, propane and butanes). Note that fixed roof tanks go to flare rather than vapour recovery. The operator provided VOC emissions data in their further information response sent 06 September 2018. They estimate tank losses at 6.6 tonnes per annum. We don't agree with the operator's stated compliance as the fixed roof tanks go to flare rather than vapour recovery; however we have not required an improvement condition to address this. This is based on the small loss recorded which is not substantial enough to warrant investment in abatement measures. The operator already has a fugitive VOC monitoring programme to minimise releases. If subsequently fugitive VOC monitoring shows those emissions are increasing, we may revisit this.	2.3.1 2.4

<table>
<tr><th>BAT Conclusion 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><th>Relevant permit condition(s)</th></tr>
<tr><td></td><td></td><td colspan="3"></td></tr>
<tr><td>50</td><td>In order to reduce VOC emissions to air from the storage of volatile liquid hydrocarbon compounds, BAT is to use one or a combination of the techniques given below.

<table><tr><th>Technique</th><th>Description</th><th>Applicability</th></tr><tr><td>i. Manual crude oil tank cleaning</td><td>Oil tank cleaning is performed by workers entering the tank and removing sludge manually</td><td>Generally applicable</td></tr><tr><td>ii. Use of a closed-loop system</td><td>For internal inspections, tanks are periodically emptied, cleaned and rendered gas-free. This cleaning includes dissolving the tank bottom. Closed-loop systems that can be combined with end-of-pipe mobile abatement techniques prevent or reduce VOC emissions</td><td>The applicability may be limited by e.g. the type of residues, tank roof construction or tank materials</td></tr></table></td><td>CC</td><td>i. The operator confirms that crude oil storage tanks are shutdown, cleaned and repaired on a planned schedule. One tank at a time is released for the work which usually takes 18 months to complete. Tank entry is necessary during this work to ensure the vessel is clean enough for fabrication repairs etc.

ii. No

We agree with the operators stated compliance.</td><td>2.3.1</td></tr>
<tr><td>51</td><td>In order to prevent or reduce emissions to soil and groundwater from the storage of liquid hydrocarbon compounds, BAT is to use one or a combination of the techniques given below.</td><td>CC</td><td>The operator confirms that crude oil storage tanks are fitted with automatic and manual level measurements devices linked to an alarm and emergency shutdown system to guard against over filling. Liquefied and refrigerated liquid gas tanks have similar devices. All tanks are monitored by a central control room panel operator and outside area operators 24/7. All tanks</td><td>1.1
2.3.1
3.2.3</td></tr>
</table>

<table>
<tr><th>BAT Conclusion 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><th>Relevant permit condition(s)</th></tr>
<tr><td></td><td></td><td colspan="3"></td></tr>
<tr><td></td><td>
<table>
<tr><th>Technique</th><th>Description</th><th>Applicability</th></tr>
<tr><td>i. Maintenance programme including corrosion monitoring, prevention and control</td><td>A management system including leak detection and operational controls to prevent overfilling, inventory control and risk-based inspection procedures on tanks at intervals to prove their integrity, and maintenance to improve tank containment. It also includes a system response to spill consequences to act before spills can reach the groundwater. To be especially reinforced during maintenance periods</td><td>Generally applicable</td></tr>
<tr><td>ii. Double bottomed tanks</td><td>A second impervious bottom that provides a measure of protection against</td><td>Generally applicable for new tanks and after an overhaul of existing tanks (1)</td></tr>
</table>
</td><td></td><td>have a bund system as primary spill containment and this is part of the site COMAH case. A series of boreholes which are regularly sampled and analysed are located around the terminal and give prior warning of soil or groundwater contamination. In the event of a spill they would be an important part of remediation and reporting activities.

i. Yes- see above comments

ii. No</td><td></td></tr>
</table>

BAT Conclusion 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	Relevant permit condition(s)
	releases from the first material			
	iii. Impervious membrane liners: A continuous leak barrier under the entire bottom surface of the tank — Generally applicable for new tanks and after an overhaul of existing tanks (1)		iii. No	
	iv. Sufficient tank farm bund containment: A tank farm bund is designed to contain large spills potentially caused by a shell rupture or overfilling (for both environmental and safety reasons). Size and associated building rules are generally defined by local regulations — Generally applicable		iv. Yes - All tanks at the crude oil tank far are protected by bunds. These are part of the COMAH case for the plant. We agree with the operators stated compliance.	
	(1) Techniques ii and iii may be generally applicable where tanks are dedicated to products that require heat for liquid handling (e.g. bitumen) and where no leak is likely because of solidification			
52	**In order to prevent or reduce VOC emissions to air from loading and unloading operations of volatile liquid hydrocarbon compounds, BAT is to use one or a combination of the techniques given below to achieve a recovery rate of at least 95 %.** **Technique** / **Description** / **Applicability** Vapour recovery by: i. Condensation ii. Absorption iii. Adsorption iv. Membrane separation v. Hybrid systems — See section 1.20.6, Annex 1. — Generally applicable to loading/unloading operations where annual throughput is > 5 000 m^3/yr. Not applicable to loading/unloading operations for sea-	NA	The operator confirms that there is a Volatile Organic Compound (VOC) recovery plant in use during ocean going crude oil tanker loading. They also confirm in their response sent 04 October 2018, 14,731,311 m^3 of crude oil was exported in 2017. Similar volumes are expected in the foreseeable future. The operator provided VOC emissions data in their further information response sent 06 September 2018. They estimate 710 tonnes per annum from ship loading. The ships VOC emissions data is provided below this BAT Conclusion. There are no continuous measurement units on the	2.3.1 2.4 3.5

BAT Conclusion 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	Relevant permit condition(s)

		going vessels with an annual throughput < 1 million m^3/yr (1)

(1) A vapour destruction unit (e.g. by incineration) may be substituted for a vapour recovery unit, if vapour recovery is unsafe or technically impossible because of the volume of return vapour

Table 16 BAT- associated emission levels for non-methane VOC and benzene emissions to air from loading and unloading operations of volatile liquid hydrocarbon compounds

Parameter	BAT-AEL (hourly average) (1)
NMVOC	0.15 - 10g/Nm^3 (2) (3)
Benzene (3)	<1 mg/Nm^3

(1) Hourly values in continuous operation expressed and measured according to Directive 94/63/EA
(2) Lower value achievable with two-stage hybrid systems. Upper value achievable with single-stage adsorption or membrane system
(3) Benzene monitoring may not be necessary where emissions of NMVOC are at the lower end of the range.

ships stacks so measurement is not possible. The operator calculates the tonnage of VOC emitted from ship loading based on periodic estimates of the VOC recovery unit efficiency and an estimate of the mass of VOCs emitted in total during a crude tanker loading operation (see below).

The operator provided additional information 08 and 09 October 2018 as follows:

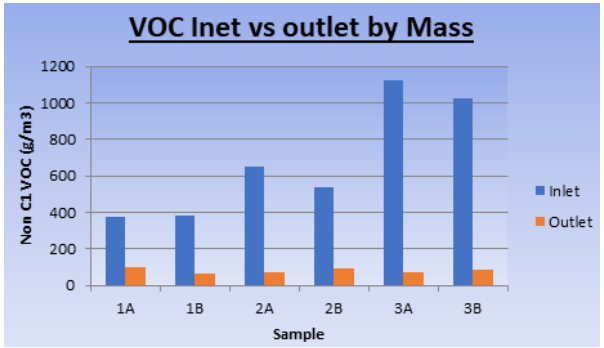
2017		
No of Ships Loaded	136	
Total VOC from Ships	8832	tes
VOC Adsorbed	8122	tes
Total VOC emissions	710	tes

In 2017 the ships emitted 710 tonnes - 710000000 g and exported 15,000,000 m^3 of oil. This equates to 47 g/m^3.

The "VOC BAT Assessment" document provided summarises the design considerations in the selection of the VOC recovery unit. The technology selected and commissioned in 2009 comprises carbon adsorption of VOCs and vacuum regeneration of the carbon beds, followed by recovery by absorption into the crude stream.

Page 4 of the document states that the VOC recovery unit is designed to recover minimum 85% of VOCs.

The calculation on page 13 of the document estimates an emission rate of butane (taken as representative VOC) of 72.5 g/s, that with an hourly loading rate of 8000 m^3/hr (stated in the same document) corresponds

BAT Conclusion 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	Relevant permit condition(s)
			to approximately 33 g/m^3. This figure is reasonably consistent with the 2017 data outlined above, i.e. 47 g/m^3. The measurement of the efficiency of the VOC recovery unit was provided as follows: Measurement is based on the inlet gas concentration to the VOC recovery plant, and the outlet vapour concentration. The inlet concentration varies throughout the load, and the VOC concentration increases as the load progresses. This was last checked by the operator in September 2014 with the inlet reaching a maximum of 1125 g/m^3, see graph below:  There is no vapour recovery system on the liquefied gas loading jetties. The operator confirmed in their	

BAT Conclusion 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	Relevant permit condition(s)
			further information response sent 06 September 2018 that liquefied gas ships do not vent vapours to atmosphere, therefore VOC recovery plant is not required. They also confirmed in their further information response received 20 September 2018 that in any event the annual throughput is below the BAT applicability threshold of 1 million m^3/year. In 2017 the throughput was 793,504 m^3 of liquefied gas. We agree with the operator's stated compliance, that this BAT Conclusion is not applicable to the relevant activities carried out at the installation. We consider that this BAT Conclusion is not applicable to the stabilised crude oil because: 1. BAT 52 applies to the "loading and unloading operations of volatile liquid hydrocarbon compounds" according to the interpretation table included in the BAT Conclusions document. 2. Volatile liquid hydrocarbon compounds are defined in the BAT Conclusions document as "Petroleum derivatives…". Using a "plain English interpretative rule", Crude Oil is simply not a "petroleum derivative" it is the unprocessed "feedstock". 3. Table 4.104 of the BREF states that the BAT-AEL of 0.15-10 g/Nm^3 relates to data from "loading of motor gasolines" i.e. petroleum derivatives and not from Crude Oil. 4. The ASTM Method D323 differentiates between the definitions of "petroleum products" and "crude oils" In addition to the above, the wording in section	

BAT Conclusion 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	Relevant permit condition(s)
			4.23.6.2 'Vapour recovery units (VRU)' of the BREF (part of section 4 – 'Techniques to consider in the determination of BAT'): *"A vapour recovery system for the loading of crude oil vessels can collect about 85 % of the total VOCs, which are condensed and reinjected into the crude feedstock."* As the VRU achieves >85% VOC recovery, we are satisfied that the technique implemented meets BAT. Based on this high recovery rate we have not set any limits in the permit for the vapour recovery system at emission point A19. Annex II of the IED only requires limits to be set for substances that are released in significant quantities. The release does however rely on abatement, so the permit includes a requirement for the operator to report annually on the VOC recovery. We have also set process monitoring to require monitoring of the VOC recovery rate at emission point A19.	

BAT Conclusion 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	Relevant permit condition(s)

	VOC Adsorbed (tes/month)	VOC to PAU stack (tes/month) (stream A19 on permit)	VOC direct to Ships mast Riser (tes/month)	No of Ships that used VOCR for all or part of load per month	No of Ships sending all vapours mast riser per month	% of ships using VOCR per month	
January	660.7	49.1	5.2	11	0	99.3%	
February	602.6	44.8	2.6	10	0	99.6%	
March	721.2	53.6	5.2	12	0	99.3%	
April	599.6	44.6	5.8	10	0	99.1%	
May	702.0	52.2	22.1	12	0	93.5%	
June	605.0	45.0	0.0	10	0	100.0%	
July	750.3	55.8	35.0	13	0	94.5%	
August	658.2	49.0	7.8	11	0	98.9%	
September	724.8	53.9	1.3	12	0	99.8%	
October	665.5	49.5	0.0	11	0	100.0%	
November	587.5	43.7	18.8	10	0	96%	
December	844.6	62.8	2.6	14	0	100%	
Total	**8122**	**604.0**	**106.4**	**136**	**0**	98.3%	Average

2017		
No of Ships Loaded	136	
Total VOC from Ships	8832	tes
VOC Adsorbed	8122	tes
Total VOC emissions	710	tes

53	**In order to reduce emissions to water from visbreaking and other thermal processes, BAT is to ensure the appropriate treatment of waste water streams by applying the techniques of BAT 11.**	NA	We agree this BAT Conclusion is not applicable to the relevant activities carried out at this installation.	
54	**In order to reduce sulphur emissions to air from off-gases containing hydrogen sulphides (H_2S), BAT is to use all of the**	NA	We did not require the operator to answer this question on the original Notice.	

<table>
<tr><th>BAT Conclusion 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><th>Relevant permit condition(s)</th></tr>
<tr><td></td><td></td><td colspan="3"></td></tr>
<tr><td></td><td>
techniques given below.
<table>
<tr><th>Technique</th><th>Description</th><th>Applicability</th></tr>
<tr><td>i. Acid gas removal e.g. by amine treating</td><td>See section 1.20.3, Annex 1.</td><td>Generally applicable</td></tr>
<tr><td>ii. Sulphur recovery unit (SRU), e.g. by Claus process</td><td>See section 1.20.3, Annex 1.</td><td>Generally applicable</td></tr>
<tr><td>iii. Tail gas treatment unit (TGTU)</td><td>See section 1.20.3, Annex 1.</td><td>For retrofitting existing SRU, the applicability may be limited by the SRU size and configuration of the units and the type of sulphur recovery process already in place</td></tr>
<tr><td colspan="3">(1) My not be applicable for stand-alone lubricant or bitumen refineries with a release of sulphur compounds of less than 1 t/d</td></tr>
</table>
Table 17 BAT-associated environmental performance levels for a waste gas sulphur (H_2S) recovery system
<table>
<tr><th></th><th>BAT-associated environmental performance level (monthly average)</th></tr>
<tr><td>Acid gas removal</td><td>Achieve hydrogen sulphides (H2S) removal in the treated RFG in order to meet gas firing BAT-AEL for BAT 36</td></tr>
<tr><td>Sulphur recovery efficiency ([1])</td><td>New unit: 99.5 – > 99.9 %
Existing unit: ≥ 98.5 %</td></tr>
<tr><td colspan="2">(1) Sulphur recovery efficiency is calculated over the whole treatment chain (including SRU and TGTU) as the fraction of sulphur in the feed that is recovered in the sulphur stream routed to the collection pots. When the applied technique does not include a recovery of sulphur (e.g. seawater scrubber) it refers to the sulphur removal efficiency, as the % of sulphur removed by the whole treatment chain</td></tr>
</table>
</td><td></td><td>The operator confirmed that the amount of sulphur in the off-gases is minimal i.e. less than 1 tonne per day.

We agree this BAT conclusion is not applicable to the relevant activities carried out at this installation.</td><td></td></tr>
</table>

BAT Conclusion 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	Relevant permit condition(s)
	The associated monitoring is described in BAT 4.			
55	**In order to prevent emissions to air from flares, BAT is to use flaring only for safety reasons or for non-routine operational conditions (e.g. start-ups, shutdown).**	NA	The operator confirms that the flare systems are primary safety relief devices, but they are also in constant use as part of the process. The flares deal with relief exhausts, purging operations etc. but also vent the waste gases from the DEA system on 24 hr 365 days a year basis. Procedures are in place to minimise heavy flaring events and also to mitigate and report these events should they occur. We agree with the operators stated compliance. Conditions in the permit secure the necessary controls.	
56	**In order to reduce emissions to air from flares when flaring is unavoidable, BAT is to use the techniques given below.**	CC	The operator confirms that the flare system consists of a main elevated flare (emission point A16) for venting of relief systems from the process and online process gases. This flare has a maximum rated throughput of 300,000 kg/hr. There is a standby flare system (emission point A17) which is used when the main flare is under maintenance. There are also three ground flares (emission point A14) which vent the gases from the refrigerated natural gas liquids storage tanks as part of the pressure management of these vessels. The operator confirmed in their response sent 06 September 2018 that these flares are the pressure control system for the NGL tanks. The composition is 5 ppm butane with sulphur species and ethane at less than 1ppm. We have not set an SO_2 limit or a requirement to calculate the release due to the very low	2.3.1

<table>
<tr><th>BAT Conclusion 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><th>Relevant permit condition(s)</th></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td>
<table>
<tr><th>Technique</th><th>Description</th><th>Applicability</th></tr>
<tr><td>i. Correct plant design</td><td>See section 1.20.7, Annex 1.</td><td>Applicable to new units.
Flare gas recovery system may be retrofitted in existing units</td></tr>
<tr><td>ii. Plant management</td><td>See section 1.20.7, Annex 1.</td><td>Generally applicable</td></tr>
<tr><td>iii. Correct flaring devices design</td><td>See section 1.20.7, Annex 1.</td><td>Applicable to new units</td></tr>
<tr><td>iv. Monitoring and reporting</td><td>See section 1.20.7, Annex 1.</td><td>Generally applicable</td></tr>
</table>
</td><td></td><td>levels emitted.

Both flare systems also vent purge gases (mainly N_2) during large equipment shut down for maintenance and provide relief to the jetties tanker loading section of the operation after loading is completed.

Heavy flaring and smokey plumes are minimised and there are procedures in place to minimise these events and give instruction on reporting if an incident should occur.

i. No – Existing units; the amount of sulphur released is around 27 tonnes per year, which is not sufficient to justify recovery.

ii. Yes

iii. Yes

iv. Yes

The operator provided VOC emissions data in their further information response sent 06 September 2018. They estimate 111 tonnes of VOCs per annum.

They also provided flare data as verified for the EU ETS submittal in 2017 which was 16,652.8 tonnes, which equates to approximately 2.0 tonnes per hour. They have requested a reporting figure of 4.0 tonnes per hour.

If they cannot directly load propane to a ship, then they</td><td></td></tr>
</table>

BAT Conclusion 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	Relevant permit condition(s)
			need to flare and this is captured as a site incident. The management of flaring and assessment of performance of the flare has been addressed through permit conditions including monitoring and reporting requirements. We have added reporting conditions 4.2.6 to 4.2.9 required for all sites with flares (reporting figure 4.0 tonnes/hour). We have not added the additional notification condition required for sites with flares, in the event that more than two tonnes of SO_2 are emitted in a 24 hour period. The operator confirmed that SO_2 emissions from the flare systems are calculated monthly and reported to us via the annual Pollution Inventory (PI). SO_2 emissions from the flare systems were 27.4 tonnes in 2017, which equates to 3 kg/hr, below the PI reporting threshold. We agree that emissions are very low and sour flaring is not a significant issue at this site. We have added monitoring of flaring events in process monitoring in Table S3.4 of the permit. We have added the necessary reporting forms to Table S4.4 of the permit. We agree with the operator's stated compliance.	
57	**In order to achieve an overall reduction of NO_X emissions to air from combustion units and fluid catalytic cracking (FCC) units, BAT is to use an integrated emission management technique as an alternative**	N/A	We agree this BAT Conclusion is not applicable to the relevant activities carried out at this installation.	

BAT Conclusion 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	Relevant permit condition(s)
	to applying BAT 24 and BAT 34. **Description:** The technique consists of managing NO_x emissions from several or all combustion units and FCC units on a refinery site in an integrated manner, by implementing and operating the most appropriate combination of BAT across the different units concerned and monitoring the effectiveness thereof, in such a way that the resulting total emissions are equal to or lower than the emissions that would be achieved through a unit-by-unit application of the BAT-AELs referred to in BAT 24 and BAT 34. This technique is especially suitable to oil refining sites: • with a recognised site complexity, multiplicity of combustion and process units interlinked in terms of their feedstock and energy supply; • with frequent process adjustments required in function of the quality of the crude received; • with a technical necessity to use a part of process residues as internal fuels, causing frequent adjustments of the fuel mix according to process requirements. **BAT-associated emission levels: See Table 18.** In addition, for each new combustion unit or new FCC unit included in the integrated emission management system, the BAT-AELs set out under BAT 24 and BAT 34 remain applicable. **Table 18 BAT associated emission levels for NOX emissions to air when applying BAT 58** The BAT-AEL for NO_x emissions from the units concerned by BAT 57, expressed in mg/Nm^3 as a monthly average value, is equal to or less than the weighted average of the NO_x concentrations (expressed in mg/Nm^3 as a monthly average) that would be achieved by applying in practice at each of those units techniques			

BAT Conclusion 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	Relevant permit condition(s)
	that would enable the units concerned to meet the following: (a) for catalytic cracking process (regenerator) units: the BAT-AEL range set out in Table 4 (BAT 24); (b) for combustion units burning refinery fuels alone or simultaneously with other fuels: the BAT-AEL ranges set out in Tables 9, 10 and 11 (BAT 34). This BAT-AEL is expressed by the following formula: Σ [(flue gas flow rate of the unit concerned) x (NO_x concentration that would be achieved for that unit)] --- Σ(flue gas flow rate of all units concerned) Notes 1. The applicable reference conditions for oxygen are those specified in Table 1. 2. The weighing of the emission levels of the individual units is done on the basis of the flue-gas flow rate of the unit concerned, expressed as a monthly average value (Nm^3/hour), which is representative for the normal operation of that unit within the refinery installation (applying the reference conditions under Note 1). 3. In case of substantial and structural fuel changes which are affecting the applicable BAT-AEL for a unit or other substantial and structural changes in the nature or functioning of the units concerned, or in case of their replacement or extension or the addition of combustion units or FCC units, the BAT-AEL defined in Table 18 needs to be adjusted accordingly. Monitoring associated with BAT 57 BAT for monitoring emissions of NO_x under an integrated emission			

BAT Conclusion 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	Relevant permit condition(s)
	management technique is as in BAT 4, complemented with the following: • a monitoring plan including a description of the processes monitored, a list of the emission sources and source streams (products, waste gases) monitored for each process and a description of the methodology (calculations, measurements) used and the underlying assumptions and associated level of confidence; • continuous monitoring of the flue-gas flow rates of the units concerned, either through direct measurement or by an equivalent method; • a data management system for collecting, processing and reporting all monitoring data needed to determine the emissions from the sources covered by the integrated emission management technique.			
58	**In order to achieve an overall reduction of SO_2 emissions to air from combustion units, fluid catalytic cracking (FCC) units and waste gas sulphur recovery units, BAT is to use an integrated emission management technique as an alternative to applying BAT 26, BAT 36 and BAT 54.** **Description:** The technique consists of managing SO_2 emissions from several or all combustion units, FCC units and waste gas sulphur recovery units on a refinery site in an integrated manner, by implementing and operating the most appropriate combination of BAT across the different units concerned and monitoring the effectiveness thereof, in such a way that the resulting total emissions are equal to or lower than the emissions that would be achieved through a unit-by-unit application of the BAT-AELs referred to in BAT 26 and BAT 36 as well as the BAT-AEPL set out under BAT 54. This technique is especially suitable to oil refining sites: • with a recognised site complexity, multiplicity of combustion and process units interlinked in terms of their feedstock and	NA	We agree this BAT Conclusion is not applicable to the relevant activities carried out at this installation.	

BAT Conclusion 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	Relevant permit condition(s)
	energy supply; • with frequent process adjustments required in function of the quality of the crude received; • with a technical necessity to use a part of process residues as internal fuels, causing frequent adjustments of the fuel mix according to process requirements. **BAT associated emission level**: See Table 19. In addition, for each new combustion unit, new FCC unit or new waste gas sulphur recovery unit included in the integrated emission management system, the BAT-AELs set out under BAT 26 and BAT 36 and the BAT- AEPL set out under BAT 54 remain applicable. **Table 19 BAT associated emission level for SO_2 when applying BAT 58** The BAT-AEL for SO_2 emissions from the units concerned by BAT 58, expressed in mg/Nm_3 as a monthly average value, is equal to or less than the weighted average of the SO_2 concentrations (expressed in mg/Nm_3 as a monthly average) that would be achieved by applying in practice at each of those units techniques that would enable the units concerned to meet the following: (a) for catalytic cracking process (regenerator) units: the BAT-AEL ranges set out in Table 6 (BAT 26); (b) for combustion units burning refinery fuels alone or simultaneously with other fuels: the BAT-AEL ranges set out in Table 13 and in Table 14 (BAT 36); and (c) for waste gas sulphur recovery units: the BAT-AEPL ranges set out in Table 17 (BAT 54).			

BAT Conclusion 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	Relevant permit condition(s)
	This BAT-AEL is expressed by the following formula: Σ [(flue gas flow rate of the unit concerned) x (SO_2 concentration that would be achieved for that unit)] --- Σ(flue gas flow rate of all units concerned) Notes: 1. The applicable reference conditions for oxygen are those specified in Table 1. 2. The weighing of the emission levels of the individual units is done on the basis of the flue-gas flow rate of the unit concerned, expressed as the monthly average value (Nm^3/hour), which is representative for the normal operation of that unit within the refinery installation (applying the reference conditions under Note 1). 3. In case of substantial and structural fuel changes which are affecting the applicable BAT-AEL for a unit or other substantial and structural changes in the nature or functioning of the units concerned, or in case of their replacement, extension or the addition of combustion, FCC, or waste gas sulphur recovery units, the BAT-AEL defined in Table 19 needs to be adjusted accordingly. **Monitoring associated with BAT 58** **BAT for monitoring emissions of SO_2 under an integrated emission management approach is as in BAT 4, complemented with the following:** • **a monitoring plan including a description of the processes monitored, a list of the emission sources and source streams (products, waste gases) monitored for each process and a description of the methodology**			

BAT Conclusion 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	Relevant permit condition(s)
	(calculations, measurements) used and the underlying assumptions and associated level of confidence; • **continuous monitoring of the flue-gas flow rates of the units concerned, either through direct measurement or by an equivalent method;** • **a data management system for collecting, processing and reporting all monitoring data needed to determine the emissions from the sources covered by the integrated emission management technique**			
A number of definitions were added to Schedule 6 – Interpretation of the permit as a requirement of the BAT conclusions. These included: BAT, BAT AEL, normal operation, other than normal operating conditions and the BREF.				

6.1 Setting limits - BAT Conclusions 34 to 37

LCP BREF
We have not implemented the LCP BREF as this was published after the refinery BREF. The LCP BREF will be implemented when we undertake the next permit review.

Applicability
The limits set by BAT Conclusions 34 to 37 are only applicable when the gas turbines/combustion units are firing RFG/process gas.

We have only included natural gas firing where there are changes to emission limits.

Reference periods
The BAT AELs are monthly averages. Hourly and daily limits are calculated as set out below; however this is also subject to no backsliding from existing limits.

The hourly limit is 200 % of the monthly limit.

The daily limit is 110% of the monthly limit.

LCP 62 applicable limits
For emission points A8 and A9 (LCP 62), we have implemented a 'weighted' ELV based on the gas turbine supplementary fired 'duty' boiler and the standby 'support' boiler, based on their heat inputs. The weighted limit has an oxygen reference condition of 15%.

The operator provided additional information on the boiler loads which is summarised as follows:

To be available on demand, the standby 'support' boiler is always running to provide some steam for the plant which will flex in response to the demand from the plant or a reduction in performance of the 'duty' boiler.

Taking the operational data provided by the operator for September 2018, which is representative of normal operation, the contributions are as follows:

57% from the gas turbine supplementary fired 'duty' boiler
43% from the standby 'support' boiler

We have calculated weighted monthly limits at 15% O_2 for NOx, SO_2, CO and dust, according to the following principles:

1. Identifying the applicable ELV at 15% and 3% oxygen reference conditions for each pollutant.
2. Multiplying the 15% limit by 0.57 to obtain the contribution of the supplementary firing 'duty' boiler to the new ELV.

3. Converting the 3% limit to 15% oxygen reference conditions and multiplying by 0.43, to obtain the standby 'support' boiler contribution to the new ELV.
4. Summing (2) and (3) above to obtain the new ELV (see table below).

Limit Calc.	NOx		SO_2		CO		Dust	
	15% O_2	3% O_2	15% O_2	3% O_2	15% O_2	3% O_2	15% O_2	3% O_2
(1)	120	150	12	35	12	35	2	5
(2) & (3)	68.4	21.5	7	5	7	5	1	0.73
(4) **New limit @15% O_2**		**90**		**12**		**12**		**2**

6.1.1 BAT Conclusion 34 - NOx emissions

BAT Conclusion 34 AELs are set out in Tables 9, 10 and 11 of the BAT Conclusion, see below.

Table 9 BAT AELs for NO_X emissions to air from a gas turbine

Parameter	Type of equipment	BAT-AEL (1) (monthly average) mg/Nm^3 at 15% O_2
NOx, expressed as NO_2	Gas turbine (including combined cycle gas turbine – CCGT) and integrated gasification combined cycle turbine (IGCC))	40 - 120 (existing gas turbine)
		20 - 50 (new turbine) (2)
(1) BAT-AEL refers to combined emissions from the gas turbine and the supplementary firing recovery boiler, where present (2) For fuel with high H_2 content (i.e. above 10%), the upper end of the range is 75 mg/Nm^3		

Table 10 BAT AELs for NOX emissions to air from a gas-fired combustion unit, with the exception of gas turbines

Parameter:	Type of combustion	BAT-AEL (monthly average) mg/Nm^3
NOx, expressed as NO_2	Gas firing	30 - 150 for existing unit (1)
		30 - 100 for new unit

(1) For an existing unit using high air pre-heat (i.e. > 200 C) or with H2 content in the fuel gas higher that 50% the upper end of the BAT-AEL range is 200 mg/Nm^3

Table 11 BAT –associated emission levels for NO_X emissions to air from a multi-fuel fired combustion unit with the exception of gas turbines

Parameter:	Type of combustion	BAT-AEL (monthly average) mg/Nm^3
NO_X expressed as NO_2	Multi-fuel fired combustion unit	30 -300—for existing unit (1) (2)
(1) For existing units < 100 MW firing fuel oil with a nitrogen content higher that 0.5% (w/w) or with liquid firing > 50% or using air preheating values up to 450 mg/Nm^3 may occur (2) The lower end of the range can be achieved by using the SCR technique		

a) Reboilers A2 to A7 (boiler limits)

We have set the NOx limit of 150 mg/Nm^3 for gas firing in accordance with Table 10 of the BAT Conclusions for the Refining of Mineral Oil and Gas.

The existing (set at V003) and new permit limits are tabulated below:

Process gas

Parameter Note 2	Existing (V003) mg/m^3	Reference Period	BAT AEL mg/m^3	New Permit limit mg/m^3
NO_x	300 Note 1	Hourly averages	-	300 Note 1
	-	Daily averages	-	-
	-	Monthly averages	150 Note 1	150 Note 1

Note 1: Boilers at 3% O_2 reference conditions.

b) LCP 62 A8 & A9 (weighted limit)

Process gas

We have considered setting the NOx limit for gas firing in accordance with Tables 9 and 10 of the BAT Conclusions for the Refining of Mineral Oil and Gas, see above.

Table 9 is applicable to the combined emissions from the gas turbine and the supplementary firing recovery boiler (Note 1 to Table 9), which is the configuration of the 'duty' boiler (supplementary firing recovery boiler), downstream of the gas turbine.

Table 10 is applicable to the standby 'support' boiler.

The existing emission limits included in the permit were set according to Chapter III of the Industrial Emissions Directive (IED).

We have compared the monthly BAT AELs specified in Tables 9 and 10 of the BAT Conclusion against the existing monthly average limit set by IED Chapter III to determine whether the BAT AEL is more stringent and therefore the current limit has to be superseded.

We have set limits based on the gas turbine 15% oxygen reference conditions. The existing limits, determined in accordance with IED Chapter III, were referred to an oxygen reference condition of 3%. Therefore we have applied the appropriate conversion factors, to compare the BAT AEL against the existing emission limits on a consistent oxygen reference basis.

The weighted limit is calculated as set out in Section 6.1 above.

	NOx	
Limit Calc.	**15% O_2**	**3% O_2**
(1)	120	150
(2) & (3)	68.4	21.5
(4) **New limit @15% O_2**	**90**	

The historic (V003), existing (V005) and new permit limits are tabulated below:

Process Gas

Parameter Note 2	**Historic (V003) mg/m³**	**Existing (Chapter III V005) mg/m³**	**Reference Period**	**BAT AEL mg/m³**	**New Permit limit mg/m³**
NO_x	300	300 Note 1	Hourly averages	-	90 Note 2
		300 Note 1	Daily averages	-	90 Note 2
		300 Note 1	Monthly averages	120 Note 2	90 Note 2

Note 1: 3% O_2 reference conditions.
Note 2: 15% O_2 reference conditions.

Natural gas

Under normal operating conditions the LCP is fuelled using process gases which are contained in the crude oil supply to the plant. During a cessation of oil import, for instance during planned maintenance and shut-down, natural gas is imported from the grid to maintain operation of the LCP as required.

The operator confirmed that under normal fuelling conditions the NOx emissions from the boiler stacks are 200 – 250 mg/m³ @ 3% O_2.

The data shows that the NOx emissions do not differ significantly under different fuelling options i.e. process gas/natural gas.

The burners in the LCP cannot meet the existing 100 mg/m^3 NOx at 3% O_2 when fuelling natural gas as stipulated in variation EPR/NP3033LN/V006.

The IED Chapter III monthly mean NOx limit is actually the gas turbine limit of 50 mg/m^3 at 15% O_2, which equates to 150 mg/m^3 NOx at 3% O_2. The operator is still unable to comply with this limit.

Limits do not apply during start-up and shut-down and this scenario is not classed as 'normal operation'.

For natural gas firing (back-up fuel) we have retained the process gas limits for the reasons set out above.

The historic (V003), existing (V005) and new permit limits are tabulated below:

Natural Gas

Parameter Note 2	**Historic (V003) mg/m^3**	**Existing (Chapter III V005) mg/m^3**	**Reference Period**	**BAT AEL mg/m^3**	**New Permit limit mg/m^3** Note 3
NO_x	300	200 Note 1	Hourly averages	-	90 Note 2
		110 Note 1	Daily averages	-	90 Note 2
		100 Note 1	Monthly averages	NA	90 Note 2

Note 1: 3% O_2 reference conditions.
Note 2: 15% O_2 reference conditions.
Note 3: Refer to the response to improvement condition 19.

c) Existing gas turbines A11 to A13

These are the by-pass stacks for the three gas turbines. In this configuration each gas turbine is separate and does not comprise an LCP.

The current permit does not include limits for NOx and CO. These parameters are monitored by calculation every 4,380 hours or 2 years whichever comes soonest.

We have not set NOx limits for process or natural gas firing. The operator confirmed in their further information response sent 06 September 2018 that operation in this scenario is limited:

Year	% on-line time	% NOx emissions
2015	0.25	0.03
2016	2.99	0.36
2017	2.22	0.25
2018	2.92	0.36

We have included a requirement in the permit for the operator to report annually on the number of hours operated in this configuration, and the cause of the event.

d) Proposed CHP – gas turbines A20 & A21

We have set the monthly average at 50 mg/Nm^3. This is lower than the BAT AEL for 'existing' plant in Table 9 of this BAT Conclusion. This is required to ensure no backsliding i.e. ½ of the existing hourly limit of 100 mg/Nm^3.

We have retained the daily average of 50 mg/Nm^3 on the basis of no backsliding.

The historic (V003), existing (V005) and new permit limits are tabulated below:

Process Gas

Parameter Note 2	Historic (V003) mg/m^3	Existing (Chapter III V005) mg/m^3	Reference Period	BAT AEL mg/m^3	New Permit limit mg/m^3
NO_x	100 Note 1	100 Note 1	Hourly averages	-	100 Note 1
	50 Note 1	50 Note 1	Daily averages	-	50 Note 1
	-	-	Monthly averages	120 Note 1	50 Note 1

Note 1: 15% O_2 reference conditions.

e) Proposed CHP – auxiliary boilers A22 & A23

We have set the monthly average at 150 mg/Nm^3 in accordance with Table 10 of this BAT Conclusion, compliant with the BAT AEL for 'existing' plant.

We have set the daily average at 165 mg/Nm^3 i.e. 110% of the monthly average.

We have set the hourly average at 300 mg/Nm^3 i.e. 2 x the monthly average.

The historic (V003), existing (V005) and new permit limits are tabulated below:

Process Gas

Parameter Note 2	**Historic (V003) mg/m^3**	**Existing (Chapter III V005) mg/m^3**	**Reference Period**	**BAT AEL mg/m^3**	**New Permit limit mg/m^3**
NO_x	400	400 Note 1	Hourly averages	-	300 Note 1
	200	200 Note 1	Daily averages	-	165 Note 1
	-	-	Monthly averages	150 Note 1	150 Note 1

Note 1: 3% O_2 reference conditions.

6.1.2 BAT Conclusion 35 - Dust and metal emissions

BAT Conclusion 35 AELs are set out in Table 12 of the BAT Conclusion, see below.

Table 12 BAT AELs of dust emissions to air from a multi-fuel fired combustion unit with the exception of gas turbines

Parameter	**Type of combustion**	**BAT-AEL (monthly average) mg/Nm^3**
Dust	Multi-fuel firing	5 – 50 for existing unit ([1]) ([2])
		5 – 25 for new unit < 50 MW
(1) The lower end of the range is achievable for units with the use of end-of-pipe techniques (2) The upper end of the range refers to the use of a high percentage of oil burning and where only primary techniques are applicable		

a) Reboilers A2 to A7 (boilers)

No limits were previously set. Table 12 of this BAT Conclusion sets a limit for multi fuel firing which is not applicable to this facility.

We have not set limits for dust.

b) LCP A8 & A9 (weighted limit)

Process gas
The BAT Conclusion does not set dust limits for gas firing.

The historic limit set by V003 was 5 mg/m^3 @ 3% O_2. Chapter III limits were set based on this limit at 3% oxygen.

We have set a weighted limit calculated as set out in Section 6.1 above at 15 % oxygen reference conditions.

Limit Calc.	**Dust**	
	15% O_2	**3% O_2**
(1)	2	5
(2) & (3)	1	0.73
(4) **New limit @15% O_2**	**2**	

The historic (V003), existing (V005) and new permit limits are tabulated below:

Process Gas

Parameter Note 2	**Historic (V003) mg/m^3**	**Existing (Chapter III V005) mg/m^3**	**Reference Period**	**BAT AEL mg/m^3**	**New Permit limit mg/m^3**
Particulate matter	5 Note 1	5 Note 1	Hourly averages	-	2 Note 2
	-	5 Note 1	Daily averages	-	-
	-	5 Note 1	Monthly averages	-	-

Note 1: 3% O_2 reference conditions.
Note 2: 15% O_2 reference conditions.

c) Existing gas turbines A11 to A13

The BAT Conclusion does not set dust limits for gas turbines.

There were no limits set by V003 or V005.

We have not set dust limits.

d) Proposed CHP – gas turbines A20 & A21

The BAT Conclusion does not set dust limits for gas turbines.

Historic limits were set by V003 which were carried over to V005.

We have retained the existing limits on the basis of no backsliding.

The historic (V003), existing (V005) and new permit limits are tabulated below:

Process Gas

Parameter Note 2	Historic (V003) mg/m^3	Existing (Chapter III V005) mg/m^3	Reference Period	BAT AEL mg/m^3	New Permit limit mg/m^3
Particulate matter	20 Note 1	20 Note 1	Hourly averages	-	20 Note 1
	10 Note 1	10 Note 1	Daily averages	-	10 Note 1
	-	-	Monthly averages	-	-

Note 1: 15% O_2 reference conditions.

e) Proposed CHP – auxiliary boilers A22 & A23

The BAT Conclusion only sets limits for multi-fuel firing, which is not applicable to this facility, i.e. gas firing only.

Historic limits were set by V003 which were carried over to V005.

We have retained the existing limits when firing on process gas on the basis of no backsliding.

The historic (V003), existing (V005) and new permit limits are tabulated below:

Process Gas

Parameter Note 2	Historic (V003) mg/m^3	Existing (Chapter III V005) mg/m^3	Reference Period	BAT AEL mg/m^3	New Permit limit mg/m^3
Particulate matter	10 Note 1	10 Note 1	Hourly averages	-	10 Note 1
	5 Note 1	5 Note 1	Daily averages	-	5 Note 1
	-	-	Monthly averages	-	-

Note 1: 3% O_2 reference conditions.

6.1.3 BAT Conclusion 36 – SO_2 emissions

BAT Conclusion 36 AELs are set out in Tables 13 and 14 of the BAT Conclusion, see below.

Table 13 BAT AELs for SO_2 emissions to air from combustion unit firing refinery fuel gas (RFG), with the exception of gas turbines

Parameter	BAT-AEL (monthly average) mg/Nm^3
SO_2	5 – 35 (1)
(1) In the specific configuration of RFG treatment with a low scrubber operative pressure and with refinery fuel gas with an H/C molar ratio above 5, the upper end of the BAT-AEL range can be as high as 45 mg/Nm3	

Table 14 BAT AELs for SO_2 emissions to air from multi-fuel fired combustion units, with the exception of gas turbines and stationary engines

Parameter	BAT-AEL (monthly average) mg/Nm^3
SO_2	35 - 600

a) Reboilers A2 to A7 (boilers)

A historic limit was set by V003 which was carried over to V005.

We have set the BAT AEL of 35 mg/m^3 consistent with Table 13 of this BAT Conclusion.

The historic (V003), existing (V005) and new permit limits are tabulated below:

Process Gas

Parameter Note 2	Historic (V003) mg/m^3	Existing (Chapter III V005) mg/m^3	Reference Period	BAT AEL mg/m^3	New Permit limit mg/m^3
SO_2	50 Note 1	50 Note 1	-	-	-
	-	-	Monthly averages	-	35 Note 1

Note 1: 3% O_2 reference conditions.

b) LCP A8 & A9 (weighted limit)

Process gas
The BAT Conclusion does not set SO_2 limits for gas turbines; however the limit is applicable to the standby 'support' boiler configuration as set out in Table 13 above.

The existing monthly average limit is expressed as 15% O_2, according to the following calculation:

35 mg/m^3 @ 3% = 35 * (21-15)/(21-3) = 12 mg/m^3 @ 15%

The weighted limit is calculated as set out in Section 6.1 above. We have also calculated the weighted limit for the daily and hourly average concentrations.

	SO_2	
Limit Calc.	**15% O_2**	**3% O_2**
(1)	12	35
(2) & (3)	7	5
(4) **New limit @15% O_2**	**12**	

The historic (V003), existing (V005) and new permit limits are tabulated below:

Process Gas

Parameter Note 2	**Historic (V003) mg/m^3**	**Existing (Chapter III V005) mg/m^3**	**Reference Period**	**BAT AEL mg/m^3**	**New Permit limit mg/m^3**
SO_2	50 Note 1	50 Note 1	Hourly averages	-	17 Note 2
	-	38.5 Note 1	Daily averages	-	13 Note 2
	-	35 Note 1	Monthly averages	-	12 Note 2

Note 1: 3% O_2 reference conditions.
Note 2: 15% O_2 reference conditions.

c) Existing gas turbines A11 to A13

The BAT Conclusion does not set SO_2 limits for gas turbines.

There were no limits set by V003 or V005.

We have not set SO_2 limits.

d) Proposed CHP – gas turbines A20 & A21

The BAT Conclusion does not set SO_2 limits for gas turbines.

Historic limits were set by V003 which were carried over to V005.

We have retained the existing limits on the basis of no backsliding.

The historic (V003), existing (V005) and new permit limits are tabulated below:

Process Gas

Parameter Note 2	**Historic (V003) mg/m³**	**Existing (Chapter III V005) mg/m³**	**Reference Period**	**BAT AEL mg/m³**	**New Permit limit mg/m³**
SO_2	20 Note 1	20 Note 1	Hourly averages	-	20 Note 1
	10 Note 1	10 Note 1	Daily averages	-	10 Note 1
	-	-	Monthly averages	-	-

Note 1: 15% O_2 reference conditions.

e) Proposed CHP – auxiliary boilers A22 & A23

We have set the BAT AEL of 35 mg/m³ consistent with Table 13 of this BAT Conclusion.

Historic limits were set by V003 which were carried over to V005.

We have retained the existing limits on the basis of no backsliding.

The historic (V003), existing (V005) and new permit limits are tabulated below:

Process Gas

Parameter Note 2	**Historic (V003) mg/m³**	**Existing (Chapter III V005) mg/m³**	**Reference Period**	**BAT AEL mg/m³**	**New Permit limit mg/m³**
SO_2	70 Note 1	70 Note 1	Hourly averages	-	70 Note 1
	35 Note 1	35 Note 1	Daily averages	-	35 Note 1
	-	-	Monthly averages	35	35 Note 1

Note 1: 3% O_2 reference conditions.

6.1.4 BAT Conclusion 37 - CO emissions

BAT Conclusion 37 AEL is set out in Table 15 of the BAT Conclusion, see below.

Table 15 BAT AEL for carbon monoxide emissions to air from combustion unit

Parameter	BAT- AEL (monthly average) mg/Nm^3
Carbon monoxide expressed as CO	≤ 100

a) Reboilers A2 to A7 (boiler limits)

We have set a lower CO limit of 35 to 50 mg/Nm^3 on the basis of no backsliding and to allow some headroom. The existing hourly average is 70 mg/Nm^3, with the monthly average being half the hourly average. We require more data to be confident that the lower limit can be consistently achieved.

The historic (V003), existing (V005) and new permit limits are tabulated below:

Process gas

Parameter Note 2	Historic (V003) mg/m^3	Existing (Chapter III V005) mg/m^3	Reference Period	BAT AEL mg/m^3	New Permit limit mg/m^3
CO	70 Note 1	70 Note 1	Hourly averages	-	70 Note 1
	-	-	Monthly averages	100	35 to 50 Note 1

Note 1: Boilers at 3% O_2

b) LCP A8 & A9 (weighted limit)

Process gas

We have set limits based on the gas turbine oxygen reference condition of 15%. The existing chapter III oxygen reference condition is 3%.

The existing hourly limit is expressed at 15% O_2 (for consistency with the reference conditions applicable to gas turbines) according to the following calculation:

70 mg/m^3 @ 3% = 70 * (21-15)/(21-3) = 23 mg/m^3 @ 15% O_2.

The hourly limit is 200% of the monthly limit.

We have then calculated the monthly weighted limit as set out in Section 6.1 above.

Limit Calc.	CO	
	15% O_2	**3% O_2**
(1)	12	35
(2) & (3)	7	5
(4) **New limit @15% O_2**	**12**	

The current hourly limit is 23 mg/m^3 @ 15% O_2.

We have set the monthly average at 12 mg/m^3 i.e. ½ the hourly limit, on the basis of no backsliding.

The historic (V003), existing (V005) and new permit limits are tabulated below:

Process gas

Parameter Note 2	**Historic (V003) mg/m^3**	**Existing (Chapter III V005) mg/m^3**	**Reference Period**	**BAT AEL mg/m^3**	**New Permit limit mg/m^3**
CO	70 Note 1	70 Note 1	Hourly averages	-	23 Note 2
	-	-	Monthly averages	100	12 Note 2

Note 1: 3% O_2 reference conditions.
Note 2: 15% O_2 reference conditions.

Natural gas
For natural gas firing (back-up fuel) the Refining BAT Conclusion limits are not applicable.

We have set limits as 15% oxygen reference conditions. The existing chapter III oxygen reference condition is 3%.

The existing limits are retained on the basis of no backsliding, but expressed at 15% O_2 (for consistency with the reference conditions applicable to gas turbines) according to the following calculation:

200 mg/m^3 @ 3% = 200 * (21-15)/(21-3) = 67 mg/m^3 @ 15% O_2.

The current hourly limit is 67 mg/m^3 @ 15% O_2.

The current daily limit is 37 mg/m^3 @ 15% O_2.

The current monthly limit is 34 mg/m^3 @ 15% O_2.

The historic (V003), existing (V005) and new permit limits are tabulated below:

Natural Gas

Parameter Note 2	Historic (V003) mg/m^3	Existing (Chapter III V005) mg/m^3	Reference Period	BAT AEL mg/m^3	New Permit limit mg/m^3
CO	300	200 Note 1	Hourly averages	-	67 Note 2
		110 Note 1	Daily averages	-	37 Note 2
		100 Note 1	Monthly averages	NA	34 Note 2

Note 1: 3% O_2 reference conditions.
Note 2: 15% O_2 reference conditions.

c) Existing gas turbines A11 to A13

These are the by-pass stacks for the three gas turbines. In this configuration each gas turbine is separate and does not comprise an LCP.

Variation EPR/NP3033LN/V005 which implemented Chapter III of the IED did not require limits for CO. These parameters are monitored by calculation every 4,380 hours or 2 years whichever comes soonest.

We have not set CO limits. The operator confirmed that operation in this scenario is limited, refer to BAT Conclusion 34 above.

We have included a requirement in the permit for the operator to report annually on the number of hours operated in this configuration, and the cause of the event.

d) Proposed CHP – gas turbines A20 & A21

We have set the BAT AEL of 100 mg/m^3 consistent with Table 15 of this BAT Conclusion and the existing limit.

We have also retained the existing periodic limit on the basis of no backsliding.

The historic (V003), existing (V005) and new permit limits are tabulated below:

Process Gas

Parameter Note 2	Historic (V003) mg/m^3	Existing (Chapter III V005) mg/m^3	Reference Period	BAT AEL mg/m^3	New Permit limit mg/m^3
CO	100	100 Note 1	Periodic over min 4 hour period	-	100 Note 1
	-	-	Monthly averages	100	100 Note 1

Note 1: 15% O_2 reference conditions.

e) Proposed CHP – auxiliary boilers A22 & A23

We have set the BAT AEL of 100 mg/m^3 consistent with Table 15 of this BAT Conclusion. This is lower than the existing limit.

We have also retained the existing periodic limit on the basis of no backsliding.

The historic (V003), existing (V005) and new permit limits are tabulated below:

Process Gas

Parameter Note 2	Historic (V003) mg/m^3	Existing (Chapter III V005) mg/m^3	Reference Period	BAT AEL mg/m^3	New Permit limit mg/m^3
CO	150 Note 1	150 Note 1	Periodic over min 4 hour period	-	150 Note 1
	-	-	Monthly averages	100	100 Note 1

Note 1: 3% O_2 reference conditions.

7 Emissions to Water

The consolidated permit incorporates the current discharge to sewer (emission point S1) to the Northumbrian Water Bran Sands treatment facility from the on-site effluent treatment plant (ETP). The ETP also accepts non-hazardous liquid emissions from the adjacent RWE nPower Cogen facility (permit EPR/RP3130LN).

It also includes W1 and W2, which are emergency discharges and are only available under abnormal or emergency conditions when S1 is unavailable. For this reason, BAT AELs are not applicable.

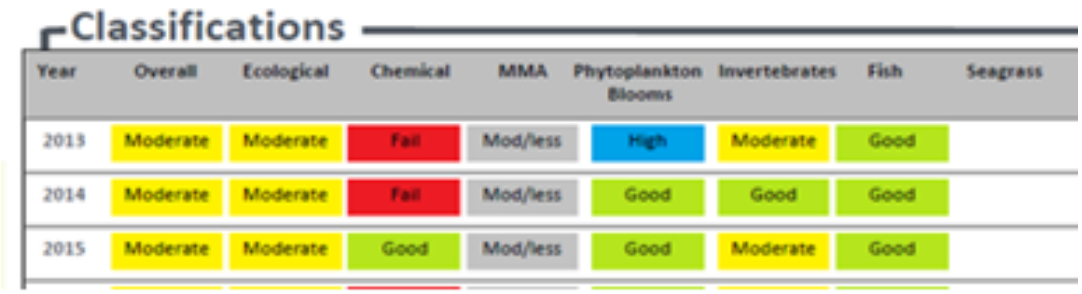
Our review of the emission limits considered the BAT conclusions and also whether the current limits will maintain River Quality Objectives (RQOs) in the receiving watercourse to ensure the water quality objectives under Water Framework Directive (WFD) will be met.

The relevant waste water BAT Conclusions for emissions to water are:

- BAT Conclusion 10 - monitoring emissions to water;
- BAT conclusion 11 - to reduce water consumption and the volume of contaminated water;
- BAT Conclusion 12 - to reduce the emission load of pollutants in the waste water discharge to the receiving water body, with BAT AELs applicable to direct discharges to water;
- BAT Conclusion 13 - when further treatment of organic substances or nitrogen is needed, BAT is to use an additional treatment step.

Where amendments are required for reasons other than achieving these BAT AELs, they are driven by recent ecological studies and other WFD assessments.

A summary of the classification for the Tees Lower and Estuary Trac is shown below:



Classifications

Year	Overall	Ecological	Chemical	MMA	Phytoplankton Blooms	Invertebrates	Fish	Seagrass
2013	Moderate	Moderate	Fail	Mod/less	High	Moderate	Good	
2014	Moderate	Moderate	Fail	Mod/less	Good	Good	Good	
2015	Moderate	Moderate	Good	Mod/less	Good	Moderate	Good	

Saltmarsh	Fucoid Extent	Opportunistic Macroalgae	Rocky Shore Macroalgae	Dissolved Oxygen	DIN	Hydrological Regime	Specific Pollutants
Moderate		Moderate		High	Moderate	Sup Good	High
Moderate		Moderate		Good	Moderate	Sup Good	High
Moderate		Moderate		Good	Moderate	Sup Good	High

We have secured compliance with the WFD at emission points S1, W1 and W2 through improvement conditions requiring monitoring and assessment of hazardous pollutants. The setting of limits (if required) will be based on the outcome of this assessment.

8 Additional IED Chapter II requirements:

Table S1.1 Activities (and non-technical summary)	
Listed activity Section 1.2 A(1) (h) (i) and (ii) for Gasification, Liquefaction and Refining Activities	Updated to: Section 1.2 Part A(1)(e): The loading, unloading, handling or storage of, or the physical, chemical or thermal treatment of: (i) crude oil; and (ii) stabilised crude petroleum
Listed activity Section 1.1 Part A(1)(a)	Updated to reference the 2 x 278 MWe gas turbines and the 2 x 150 MWe steam turbines as Combined Heat and Power (CHP) plant and to reference the pre-operational conditions. Updated to reference the 2 x auxiliary boilers as new boiler plant for the CHP and to reference the pre-operational conditions.
Listed activity Section 5.4 Part A(1)(a)(ii) Disposal of non-hazardous waste in a facility with a capacity of more than 50 tonnes per day by physico-chemical treatment.	Listed twice in previous permit, activity references A5 & A6. Removed A5 which incorrectly referenced wastes containing oil, covered by activity reference A4.
Listed activity Section 5.1 Part A(1)(a) The incineration of hazardous waste in a waste incineration plant or waste co-incineration plant with a capacity exceeding 10 tonnes per day.	Added due to continuous flaring of waste gas at emission points A16 and A17.
Table S1.2 Operating techniques	
Schedule 4 Notice Request dated 04/01/07	Amended to 03/01/07, consistent with status log of permit.
Receipt of additional information to application 10/11/15	Amended to18/11/15, consistent with status log of permit.
Table S1.4 Pre-operational measures	
Note 1 to the table added	To reference relevant emission points A20 to A23 for the CHP plant.
P05	Amended to reference correct permit condition; 2.7.2 replaced with 1.1.1 (a).

P06	Amended to reference correct permit condition; 2.8.2 replaced with 3.1.3. Site protection and monitoring programme replaced with site condition report.
P09	Amended to reference the most recent BAT Conclusions for the Refining of Mineral Oil and Gas. This is to ensure that if necessary there is a re-assessment of the impact of emissions and the technology proposed and comparison with the relevant standards.
Table S1.5 Start-up and Shut-down thresholds	
Subject to outcome of IC18	Deleted following completion and approval of the submission.
Table S2.1 Raw materials and fuels	
Crude oil	Deleted as no limits specified.
Plant fuel gas	Renamed to process gas for consistency.
Distillate fuel oil (DFO)	Deleted as only used on the fire water pumps and emergency generators which are not part of the installation.
Liquid nitrogen	Deleted as no limits specified.
Table S2.2 waste types	
16 07 08	Amended to correctly classify to 16 07 08*
Table S3.1 Point source emissions to air	
Table S3.1 from last variation EPR/NP3033LN/V006	This table is deleted, and replaced with the new table implementing the relevant refinery limits as specified in Section 6.1 of this document. This table, along with the rest of the notice will be effective from 28 October 2018.
Emission point A14 added	This was previously omitted in error.
Emission points A22 & A23	SO_2 and dust monitoring requirements added.
	Deleted the periodic monitoring and limit for CO, which is replaced with continuous monitoring and the monthly average BAT AEL limit
Table S4.3 Process monitoring	
Gas turbine stack usage, emission points A11 to A13	We have not set the relevant refinery combustion limits at these emission points based on the very limited operation in this configuration. We have included a requirement for the operator to report the usage of these vents as justification for the omission of the limits.
Schedule 6 - Interpretation	
Deleted DFO	Not used at the installation.
Deleted site protection and monitoring programme	Condition 3.1.3 replaces these requirements.

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 permit/notice.

Aspect considered	Justification / Detail
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 commercial confidentiality.
Control of the facility	We are satisfied that the operator is the person who has control over the operation of the facility. The decision was taken in accordance with EPR RGN 1 Understanding the meaning of operator.
Applicable directives	All applicable European directives have been considered in the determination of the application.
Extent of the site of the facility	A plan is included in the permit and the operator is required to carry on the permitted activities within the site boundary.
Site condition report	The operator has provided a description of the condition of the site. The 'First Phase Reporting, Site Protection and Monitoring Programme' dated May 2008. We consider this description is satisfactory. The decision was taken in accordance with our guidance on site condition reports and baseline reporting under IED– guidance and templates (H5).
Biodiversity, Heritage, Landscape and Nature Conservation	The installation 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 habitats has **not** been carried out as part of the permitting process, as this has been assessed previously.
Operating techniques	We have reviewed the techniques used by the operator and compared these with the relevant BAT conclusions. Most of the existing techniques/emission levels for priorities for control are in line with the benchmark levels

Aspect considered	Justification / Detail
	contained in the BAT conclusions and we consider them to represent appropriate techniques for the facility. However, the operator does not have certain information available to make a full assessment. We have set improvement conditions in the permit to address these deficiencies. The permit conditions ensure compliance with relevant BREFs and BAT Conclusions, and ELVs deliver compliance with BAT AELs.
Updating permit conditions during consolidation.	We updated previous permit conditions to those in the new generic permit template as part of permit consolidation when the permit was last varied 08 February 2016. The new conditions have the same meaning as those in the previous permit.
Use of conditions other than those from the template	Based on the information in the Regulation 61 Notice response, we did not need to impose conditions other than those in our permit template, which was developed in consultation with industry having regard to the relevant legislation.
Raw materials	We have retained the specified limits and controls on the use of raw materials and fuels specified in Schedule 2 of the permit.
Improvement conditions	Based on the information contained in the Regulation 61 Notice response, we consider that we need to impose improvement conditions. Details of these are provided in Section 6 of this document.
Incorporating the application	We have specified that the operator must operate the permit in accordance with descriptions in the Regulation 61 Notice response, including all additional information received as part of the determination process following receipt of the Regulation 61 Notice response.
Emission limits	We have decided that emission limits should be set for the parameters listed in the permit. NOx, SO_2 and CO have been identified as being emitted in significant quantities and ELVs based on BAT Conclusions 34, 36 and 37 have been set for those substances as set out in Section 6.1 of this document. Existing dust limits have been retained in the permit and new limits for non-methane VOC's and benzene have been included, as required by the BAT Conclusions and set out in Section 6 of this document.

Aspect considered	Justification / Detail
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 monitoring requirements have been imposed in order to meet the requirements of BAT Conclusion 4 for emissions to air.
Reporting	We have specified reporting in the permit. We have based the reporting on the requirements on the most onerous requirements of the existing permit and the requirements of the BAT Conclusions as required by our position on “no back sliding”.
Environment management system	There is no known reason to consider that the operator will not have the management systems to enable it to comply with the permit conditions. The decision was taken in accordance with RGN 5 on Operator Competence.

Annex 1: BAT conclusions for the Refining of Mineral Oil and Gas - Glossary

1.20 Description of techniques for the prevention and control of emissions to air.

1.20.1 Dust

Technique	Description
Electrostatic precipitator (ESP)	Electrostatic precipitators operate such that particles are charged and separated under the influence of an electrical field. Electrostatic precipitators are capable of operating under a wide range of conditions. Abatement efficiency may depend on the number of fields, residence time (size), catalyst properties and upstream particles removal devices. At FCC units, 3-field ESPs and 4-field ESPs are commonly used. ESPs may be used on a dry mode or with ammonia injection to improve the particle collection. For the calcining of green coke, the ESP capture efficiency may be reduced due to the difficulty for coke particles to be electrically charged
Multistage cyclone separators	Cyclonic collection device or system installed following the two stages of cyclones. Generally known as a third stage separator, common configuration consists of a single vessel containing many conventional cyclones or improved swirl-tube technology. For FCC, performance mainly depends on the particle concentration and size distribution of the catalyst fines downstream of the regenerator internal cyclones
Centrifugal washers	Centrifugal washers combine the cyclone principle and an intensive contact with water e.g. venturi washer
Third stage blowback filter	Reverse flow (blowback) ceramic or sintered metal filters where, after retention at the surface as a cake, the solids are dislodged by initiating a reverse flow. The dislodged solids are then purged from the filter system

1.20.2. Nitrogen oxides (NO_X)

Technique	Description
Combustion modifications	
Staged combustion	– Air staging — involves substoichiometric firing in a first step and the subsequent addition of the remaining air or oxygen into the furnace to complete combustion – Fuel staging — a low impulse primary flame is developed in the port neck; a secondary flame covers the root of the primary flame reducing its core temperature
Flue-gas recirculation	Reinjection of waste gas from the furnace into the flame to reduce the oxygen content and therefore the temperature of the flame. Special burners using the internal recirculation of combustion gases to cool the root of the flames and reduce the oxygen content in the hottest part of the flames

Use of low-NO_X burners (LNB)	The technique (including ultra-low-NO_X burners) is based on the principles of reducing peak flame temperatures, delaying but completing the combustion and increasing the heat transfer (increased emissivity of the flame). It may be associated with a modified design of the furnace combustion chamber. The design of ultra-low-NOX burners (ULNB) includes combustion staging (air/fuel) and flue-gas recirculation. Dry low-NO_X burners (DLNB) are used for gas turbines
Optimisation of combustion	Based on permanent monitoring of appropriate combustion parameters (e.g. O_2, CO content, fuel to air (or oxygen) ratio, unburnt components), the technique uses control technology for achieving the best combustion conditions
Diluent injection	Inert diluents, e.g. flue-gas, steam, water, nitrogen added to combustion equipment reduce the flame temperature and consequently the concentration of NO_X in the flue-gases
Selective catalytic reduction (SCR)	The technique is based on the reduction of NO_X to nitrogen in a catalytic bed by reaction with ammonia (in general aqueous solution) at an optimum operating temperature of around 300-450 °C. One or two layers of catalyst may be applied. A higher NO_X reduction is achieved with the use of higher amounts of catalyst (two layers)
Selective non-catalytic reduction (SNCR)	The technique is based on the reduction of NOX to nitrogen by reaction with ammonia or urea at a high temperature. The operating temperature window must be maintained between 900 °C and 1 050 °C for optimal reaction
Low temperature NO_X oxidation	The low temperature oxidation process injects ozone into a flue-gas stream at optimal temperatures below 150 °C, to oxidise insoluble NO and NO_2 to highly soluble N_2O_5. The N_2O_5 is removed in a wet scrubber by forming dilute nitric acid waste water that can be used in plant processes or neutralised for release and may need additional nitrogen removal

1.20.3. Sulphur oxides (SO_X)

Technique	Description
Treatment of refinery fuel gas (RFG)	Some refinery fuel gases may be sulphur-free at source (e.g. from catalytic reforming and isomerisation processes) but most other processes produce sulphur-containing gases (e.g. off-gases from the visbreaker, hydrotreater or catalytic cracking units). These gas streams require an appropriate treatment for gas desulphurisation (e.g. by acid gas removal — see below — to remove H_2S) before being released to the refinery fuel gas system
Refinery fuel oil (RFO)	desulphurisation by hydrotreatment In addition to selection of low-sulphur crude, fuel desulphurisation is achieved by the hydrotreatment process (see below) where hydrogenation reactions take place and lead to a reduction in sulphur content
Use of gas to	Decrease the use of liquid refinery fuel (generally heavy fuel

replace liquid fuel	oil containing sulphur, nitrogen, metals, etc.) by replacing it with on-site Liquefied Petroleum Gas (LPG) or refinery fuel gas (RFG) or by externally supplied gaseous fuel (e.g. natural gas) with a low level of sulphur and other undesirable substances. At the individual combustion unit level, under multi-fuel firing, a minimum level of liquid firing is necessary to ensure flame stability
Use of SO_X reducing catalysts additives	Use of a substance (e.g. metallic oxides catalyst) that transfers the sulphur associated with coke from the regenerator back to the reactor. It operates most efficiently in full combustion mode rather than in deep partial-combustion mode. NB: SO_X reducing catalysts additives might have a detrimental effect on dust emissions by increasing catalyst losses due to attrition, and on NO_X emissions by participating in CO promotion, together with the oxidation of SO_2 to SO_3
Hydrotreatment	Based on hydrogenation reactions, hydrotreatment aims mainly at producing low-sulphur fuels (e.g. 10 ppm gasoline and diesel) and optimising the process configuration (heavy residue conversion and middle distillate production). It reduces the sulphur, nitrogen and metal content of the feed. As hydrogen is required, sufficient production capacity is needed. As the technique transfer sulphur from the feed to hydrogen sulphide (H_2S) in the process gas, treatment capacity (e.g. amine and Claus units) is also a possible bottleneck
Acid gas removal e.g. by amine treating	Separation of acid gas (mainly hydrogen sulphide) from the fuel gases by dissolving it in a chemical solvent (absorption). The commonly used solvents are amines. This is generally the first step treatment needed before elemental sulphur can be recovered in the SRU
Sulphur recovery unit (SRU)	Specific unit that generally consists of a Claus process for sulphur removal of hydrogen sulphide (H_2S)-rich gas streams from amine treating units and sour water strippers. SRU is generally followed by a tail gas treatment unit (TGTU) for remaining H_2S removal
Tail gas treatment unit (TGTU)	A family of techniques, additional to the SRU in order to enhance the removal of sulphur compounds. They can be divided into four categories according to the principles applied: – direct oxidation to sulphur – continuation of the Claus reaction (sub-dewpoint conditions) – oxidation to SO_2 and recovering sulphur from SO_2 – reduction to H_2S and recovery of sulphur from this H_2S (e.g. amine process)
Wet scrubbing	In the wet scrubbing process, gaseous compounds are dissolved in a suitable liquid (water or alkaline solution). Simultaneous removal of solid and gaseous compounds may be achieved. Downstream of the wet scrubber, the flue-

	gases are saturated with water and a separation of the droplets is required before discharging the flue-gases. The resulting liquid has to be treated by a waste water process and the insoluble matter is collected by sedimentation or filtration According to the type of scrubbing solution, it can be: – a non-regenerative technique (e.g. sodium or magnesium-based) – a regenerative technique (e.g. amine or soda solution) According to the contact method, the various techniques may require e.g.: – Venturi using the energy from inlet gas by spraying it with the liquid – packed towers, plate towers, spray chambers. Where scrubbers are mainly intended for SO_X removal, a suitable design is needed to also efficiently remove dust. The typical indicative SO_X removal efficiency is in the range 85-98 %.
Non-regenerative scrubbing	Sodium or magnesium-based solution is used as alkaline reagent to absorb SO_X generally as sulphates. Techniques are based on e.g.: — wet limestone — aqueous ammonia — seawater (see infra)
Seawater scrubbing	A specific type of non-regenerative scrubbing using the alkalinity of the seawater as solvent. Generally requires an upstream abatement of dust
Regenerative scrubbing	Use of specific SO_X absorbing reagent (e.g. absorbing solution) that generally enables the recovery of sulphur as a by-product during a regenerating cycle where the reagent is reused

1.20.4. Combined techniques (SOx, NOx and dust)

Technique	Description
Wet scrubbing	See Section 1.20.3
SNO_X combined technique	Combined technique to remove SOX, NOX and dust where a first dust removal stage (ESP) takes place followed by some specific catalytic processes. The sulphur compounds are recovered as commercial-grade concentrated sulphuric acid, while NO_X is reduced to N_2. Overall SO_X removal is in the range: 94-96,6 %. Overall NO_X removal is in the range: 87-90 %

1.20.5. Carbon monoxide (CO) Technique

Technique	Description
Combustion operation control	The increase in CO emissions due to the application of combustion modifications (primary techniques) for the reduction of NO_X emissions can be limited by a careful control of the operational parameters
Catalysts with carbon	Use of a substance which selectively promotes the oxidation of CO into CO_2 (combustion

monoxide (CO) oxidation promoters	
Carbon monoxide (CO) boiler	Specific post-combustion device where CO present in the flue-gas is consumed downstream of the catalyst regenerator to recover the energy It is usually used only with partial-combustion FCC units

1.20.6. Volatile organic compounds (VOC)

Technique	Description
Vapour recovery	Volatile organic compounds emissions from loading and unloading operations of most volatile products, especially crude oil and lighter products, can be abated by various techniques e.g.: – Absorption: the vapour molecules dissolve in a suitable absorption liquid (e.g. glycols or mineral oil fractions such as kerosene or reformate). The loaded scrubbing solution is desorbed by reheating in a further step. The desorbed gases must either be condensed, further processed, and incinerated or re-absorbed in an appropriate stream (e.g. of the product being recovered) – Adsorption: the vapour molecules are retained by activate sites on the surface of adsorbent solid materials, e.g. activated carbon (AC) or zeolite. The adsorbent is periodically regenerated. The resulting desorbate is then absorbed in a circulating stream of the product being recovered in a downstream wash column. Residual gas from wash column is sent to further treatment – Membrane **gas separation**: the vapour molecules are processed through selective membranes to separate the vapour/air mixture into a hydrocarbon- enriched phase (permeate), which is subsequently condensed or absorbed, and a hydrocarbon-depleted phase (retentate). – Two**-stage refrigeration/condensation**: by cooling of the vapour/gas mixture the vapour molecules condense and are separated as a liquid. As the humidity leads to the icing-up of the heat exchanger, a two-stage condensation process providing for alternate operation is required. – Hybrid **systems**: combinations of available techniques *NB* Absorption and adsorption processes cannot notably reduce methane emissions
Vapour destruction	Destruction of VOCs can be achieved through e.g. **thermal oxidation** (incineration) or **catalytic oxidation** when recovery is not easily feasible. Safety requirements (e.g. flame arrestors) are needed to prevent explosion. **Thermal oxidation** occurs typically in single chamber, refractory-lined oxidisers equipped with gas burner and a stack. If gasoline is present, heat exchanger efficiency is

	limited and preheat temperatures are maintained below 180 °C to reduce ignition risk. Operating temperatures range from 760 °C to 870 °C and residence times are typically 1 second. When a specific incinerator is not available for this purpose, an existing furnace may be used to provide the required temperature and residence times. **Catalytic oxidation** requires a catalyst to accelerate the rate of oxidation by adsorbing the oxygen and the VOCs on its surface The catalyst enables the oxidation reaction to occur at lower temperature than required by thermal oxidation: typically ranging from 320 °C to 540 °C. A first preheating step (electrically or with gas) takes place to reach a temperature necessary to initiate the VOCs catalytic oxidation. An oxidation step occurs when the air is passed through a bed of solid catalysts
LDAR (leak detection and repair) programme	An LDAR (leak detection and repair) programme is a structured approach to reduce fugitive VOC emissions by detection and subsequent repair or replacement of leaking components. Currently, sniffing (described by EN 15446) and optical gas imaging methods are available for the identification of the leaks. **Sniffing method**: The first step is the detection using hand-held VOC analysers measuring the concentration adjacent to the equipment (e.g. by using flame ionisation or photo-ionisation). The second step consists of bagging the component to carry out a direct measurement at the source of emission. This second step is sometimes replaced by mathematical correlation curves derived from statistical results obtained from a large number of previous measurements made on similar components. **Optical gas imaging methods**: Optical imaging uses small lightweight hand- held cameras which enable the visualisation of gas leaks in real time, so that they appear as 'smoke' on a video recorder together with the normal image of the component concerned to easily and rapidly locate significant VOC leaks. Active systems produce an image with a back-scattered infrared laser light reflected on the component and its surroundings. Passive systems are based on the natural infrared radiation of the equipment and its surroundings
VOC diffuse emissions monitoring	Full screening and quantification of site emissions can be undertaken with an appropriate combination of complementary methods, e.g. Solar occultation flux (SOF) or differential absorption lidar (DIAL) campaigns. These results can be used for trend evaluation in time, cross checking and updating/validation of the ongoing LDAR programme. **Solar occultation flux (SOF)**: The technique is based on the recording and spectrometric Fourier Transform analysis of a broadband infrared or ultraviolet/ visible sunlight spectrum along a given geographical itinerary, crossing the wind direction and cutting through VOC plumes.

	Differential absorption LIDAR (DIAL): DIAL is a laser-based technique using differential adsorption LIDAR (light detection and ranging) which is the optical analogue of sonic radio wave-based RADAR. The technique relies on the back-scattering of laser beam pulses by atmospheric aerosols, and the analysis of spectral properties of the returned light collected with a telescope
High-integrity equipment	High-integrity equipment includes e.g.: – valves with double packing seals – magnetically driven pumps/compressors/agitators – pumps/compressors/agitators fitted with mechanical seals instead of packing – high-integrity gaskets (such as spiral wound, ring joints) for critical applications

1.20.7. Other techniques

Techniques to prevent or reduce emissions from flaring	**Correct plant design**: includes sufficient flare gas recovery system capacity, the use of high-integrity relief valves and other measures to use flaring only as a safety system for other than normal operations (start-up, shutdown, emergency). **Plant management**: includes organisational and control measures to reduce flaring events by balancing RFG system, using advanced process control, etc. **Flaring devices design**: includes height, pressure, assistance by steam, air or gas, type of flare tips, etc. It aims at enabling smokeless and reliable operations and ensuring an efficient combustion of excess gases when flaring from non- routine operations. **Monitoring and reporting**: Continuous monitoring (measurements of gas flow and estimations of other parameters) of gas sent to flaring and associated parameters of combustion (e.g. flow gas mixture and heat content, ratio of assistance, velocity, purge gas flow rate, pollutant emissions). Reporting of flaring events makes it possible to use flaring ratio as a requirement included in the EMS and to prevent future events. Visual remote monitoring of the flare can also be carried out by using colour TV monitors during flare events
Choice of the catalyst promoter to avoid dioxins formation	During the regeneration of the reformer catalyst, organic chloride is generally needed for effective reforming catalyst performance (to re-establish the proper chloride balance in the catalyst and to assure the correct dispersion of the metals). The choice of the appropriate chlorinated compound will have an influence on the possibility of emissions of dioxins and furans
Solvent recovery for base oil production processes	The **solvent recovery** unit consists of a distillation step where the solvents are recovered from the oil stream and a stripping step (with steam or an inert gas) in a fractionator. The solvents used may be a mixture (DiMe) of 1,2-dichloroethane (DCE) and dichloromethane (DCM). In wax-processing units, solvent recovery (e.g. for DCE) is

	carried out using two systems: one for the deoiled wax and another one for the soft wax. Both consist of heat-integrated flashdrums and a vacuum stripper. Streams from the dewaxed oil and waxes product are stripped for removal of traces of solvents

1.21. Description of techniques for the prevention and control of emissions to water

1.21.1. Waste water pretreatment

Pretreatment of sour water streams before reuse or treatment	Send generated sour water (e.g. from distillation, cracking, coking units) to appropriate pretreatment (e.g. stripper unit)
Pretreatment of other waste water streams prior to treatment	To maintain treatment performance, appropriate pretreatment may be required

1.21.2. Waste water treatment

Removal of insoluble substances by recovering oil	These techniques generally include: – API Separators (APIs) – Corrugated Plate Interceptors (CPIs) – Parallel Plate Interceptors (PPIs) – Tilted Plate Interceptors (TPIs) – Buffer and/or equalisation tanks
Removal of insoluble substances by recovering suspended solid and dispersed oil	These techniques generally include: – Dissolved Gas Flotation (DGF) – Induced Gas Flotation (IGF) – Sand Filtration
Removal of soluble substances including biological treatment and clarification	Biological treatment techniques may include: – Fixed bed systems – Suspended bed systems. One of the most commonly used suspended bed system in refineries WWTP is the activated sludge process. Fixed bed systems may include a biofilter or trickling filter
Additional treatment step	A specific waste water treatment intended to complement the previous treatment steps e.g. for further reducing nitrogen or carbon compounds. Generally used where specific local requirements for water preservation exist.

Annex 2: Improvement Conditions

We have taken the opportunity to remove completed improvement conditions and make amendments to existing improvement conditions as follows:

Existing improvement conditions

Table S1.3 Improvement programme requirements		
Ref:	**Requirement**	**Date**
IP1	A written procedure shall be submitted to the agency detailing the measures to be used so that monitoring equipment, personnel and organisations employed for the emissions monitoring programme shall have either MCERTS certification or accreditation in accordance with condition 3.6.3. The notification requirements of condition 2.5.2 shall be deemed to have been complied with on submission of the procedure. The procedure shall be implemented by the operator from the date of approval in writing by the Agency	Complete deleted
IP2	A written plan shall be submitted to the Agency for approval detailing the results of a survey of bunding, hard-standing, kerbing and secondary containment for raw material, intermediate, product and waste storage areas and the measures to comply with the requirements of the Sector Guidance Note S 1.02. Where appropriate the plan shall contain dates for the implementation of individual measures. The notification requirements of condition 2.5.2 shall be deemed to have been complied with on submission of the plan. The plan shall be implemented by the operator from the date of approval by the Agency.	Complete deleted
IP3	The operator shall implement a formal procedure for the inspection and subsequent maintenance of underground tanks, drains and collection sumps with the purpose of preventing fugitive releases to ground, and to meet the requirements of section 2.2. of Sector Guidance Note S 1.02. Where appropriate the plan shall contain dates for the implementation of individual measures. The notification requirements of condition 2.5.2 shall be deemed to have been complied with on submission of the plan. A copy of the procedure shall be submitted to the Agency.	Complete deleted

Table S1.3 Improvement programme requirements		
Ref:	**Requirement**	**Date**
IP4	The operator shall establish a procedure for timely replacement of unmade surfaces in vulnerable locations e.g. Earth drainage ditches, earth bunds, gravel areas especially where there is storage, unloading and loading of materials, overhead pipelines etc. to meet the requirements of section 2.2. of Sector Guidance Note S 1.02. Where appropriate the plan shall contain dates for the implementation of individual measures. The notification requirements of condition 2.5.2 shall be deemed to have been complied with on submission of the plan. A copy of the procedure shall be submitted to the Agency	Complete deleted
IP5	The operator shall establish a formal pipework and pipeline integrity management programme with the purpose of preventing fugitive releases to comply with the requirements of the Sector Guidance Note S 1.02. Where appropriate the plan shall contain dates for the implementation of individual measures. The notification requirements of condition 2.5.2 shall be deemed to have been complied with on submission of the plan. A copy of the procedure shall be submitted to the Agency.	Complete deleted

Table S1.3 Improvement programme requirements		
Ref:	**Requirement**	**Date**
IP6	A written plan shall be submitted to the Agency for approval detailing the measures to be taken to achieve flow proportional sampling of the process effluent release at W1 / S1. Where appropriate the plan shall contain dates for the implementation of individual measures. The notification requirements of condition 2.5.2 shall be deemed to have been complied with on submission of the plan. The plan shall be implemented by the operator from the date of approval by the Agency.	Complete deleted
IP7	The operator shall establish a site closure plan having regard for the Agency Sector Guidance Note IPPC S1.02, section 2.11. The notification requirements of condition 2.5.2 shall be deemed to have been complied with on submission of the plan. A copy of the plan shall be submitted to the Agency.	Complete deleted
IP8	The operator shall measure and verify the design performance of the VOC Recovery Unit (release point A19). The notification requirements of condition 2.5.2 shall be deemed to have been complied with on submission of the plan. Progress report to be submitted to the Agency A copy of the final report shall be submitted to the Agency.	Complete deleted
IP9	The operator shall measure and verify the emission of Oxides of Sulphur to atmosphere on completion of the Flare recovery project. The notification requirements of condition 2.5.2 shall be deemed to have been complied with on submission of the plan. A copy of the plan shall be submitted to the Agency.	Complete deleted
IP10	The operator shall notify the Agency of the date when the commissioning of the CHP is complete.	Within 7 days of completion
IP11	The operator shall provide a post commissioning report to the Agency. The report shall include a review of the operational performance of the CHP against the design parameters in the application. A review of process performance and emissions performance shall be included in the report.	Within 3 months of the date notified in IP10
IP12	The operator shall submit a report on the efficiency of the gas turbine at ISO base load conditions. The report shall compare the performance of the gas turbine with the target efficiency of 75% for CHP systems set out in Chapter III of the Industrial Emission Directive.	Within 3 months of the date notified in IP10
IP13	The operator shall carry out measurements to verify the predictions contained within the application for Environmental Noise.	Within 12 months of the date notified in IP10

Table S1.3 Improvement programme requirements		
Ref:	**Requirement**	**Date**
IP14	The operator shall provide a report on its progress on the implementation and accreditation of its Environmental Management System ISO14001, together with an action plan should accreditation not have been achieved.	Within 12 months of the date notified in IP10
IP15	The operator shall update the air quality impact assessment submitted with the application to take account of actual emissions from the installation taken from emissions monitoring data form the first 12 months of operation.	Within 15 months of the date notified in IP10
IC16	For LCPD LCP 28 (now LCP 62 under IED). Annual emissions of dust, sulphur dioxide and oxides of nitrogen including energy usage for the year 01/01/2015 to 31/12/2015 shall be submitted to the Environment Agency using form AAE1 via the NERP Registry. If the LPCD LCP was a NERP plant the final quarter submissions shall be provided on the RTA 1 form to the NERP Registry.	Complete deleted

Table S1.3 Improvement programme requirements		
Ref:	**Requirement**	**Date**
IP17	The operator shall provide a report in writing to the Environment Agency for acceptance which provides the net rated thermal input for LCP 62 (3 x 31.2 MW Gas Turbines and 3 x 104 MW boilers). The net rated thermal input is the 'as built' value unless the plant has been modified significantly resulting in an improvement of the plant efficiency or output that increases the rated thermal input (which typically requires a performance test to demonstrate that guaranteed improvements have been realised). Evidence to support this figure, in order of preference, shall be in the form of:- a) Performance test results* during contractual guarantee testing or at commissioning (quoting the specified standards or test codes), b) Performance test results after a significant modification (quoting the specified standards or test codes), c) Manufacturer's contractual guarantee value, d) Published reference data, e.g., Gas Turbine World Performance Specifications (published annually); e) Design data, e.g., nameplate rating of a boiler or design documentation for a burner system; f) Operational efficiency data as verified and used for heat accountancy purposes, g) Data provided as part of Due Diligence during acquisition, *Performance test results shall be used if these are available.	Complete deleted

Table S1.3 Improvement programme requirements		
Ref:	**Requirement**	**Date**
IP18	The operator shall submit a report in writing to the Environment Agency for acceptance. The report shall define and provide a written justification of the "minimum start up load" and "minimum shut-down load", for LCP 62 (3 x 31.2 MW Gas Turbines and 3 x 104 MW boilers) as required by the Implementing Decision 2012/249/EU in terms of: i. The output load (i.e. electricity, heat or power generated) (MW); and ii. This output load as a percentage of the rated thermal output of the combustion plant (%). And / Or iii. At least three criteria (operational parameters and / or discrete processes as detailed in the Annex) or equivalent operational parameters that suit the technical characteristics of the plant, which can be met at the end of start-up or start of shut-down as detailed in Article (9) 2012/249/EU.	Complete deleted
IP19	The operator shall submit a report in writing to the Environment Agency detailing the emissions of Oxides of Nitrogen to air from the LCP when operating on 100% natural gas. The report shall include a) Historical data, performance test data or manufacturer's data; and b) Data obtained under current operational conditions The Environment Agency shall be advised at earliest opportunity should it not be possible to carry out the trialling specified under b) by the completion date.	Complete deleted

Improvement conditions resulting from this permit review variation

Based in the information in the operators Regulation 61 Notice responses and our own records of the capability and performance of the installation at this site, we consider that we need to set improvement conditions so that the outcome of the techniques detailed in the BAT Conclusions are achieved by the installation. These additional improvement conditions are set out below - justifications for them are provided at the relevant section of the decision document.

Table S1.3 Improvement programme requirements		
Reference	Requirement	Date
IP20	BAT Conclusion 12 The Operator shall undertake an assessment of the effectiveness of the treatment of their effluent at the sewage treatment works and compare this with the effectiveness of on-site treatment using biological treatment and clarification providing details of reduction factors of individual pollutants. The assessment shall take into account the requirements of BAT Conclusion 12 for the Refining of Mineral Oil and Gas. A written report summarising the findings shall be submitted to the Environment Agency, along with a timetable for implementing improvements, if required, and this shall be agreed in writing with the Environment Agency prior to implementation.	28/10/19

Table S1.3 Improvement programme requirements		
Reference	Requirement	Date
IP21	Water Framework Directive The Operator shall submit a written monitoring plan to the Environment Agency for approval that includes proposals to undertake representative monitoring of hazardous pollutants (as set out in the Environment Agency's Surface Water Pollution Risk Assessment guidance) in the discharge to sewer from emission point S1 including the parameters to be monitored, frequencies of monitoring and methods to be used. The Operator shall carry out the monitoring in accordance with the Environment Agency's written approval.	28/10/19

Table S1.3 Improvement programme requirements		
Reference	Requirement	Date
IP22	<u>Water Framework Directive</u> The Operator shall submit a written report to the Environment Agency for approval in accordance with the Environment Agency's Surface Water Pollution Risk Assessment Guidance available on our website that includes: • The results of an assessment of the impact of the emissions to surface water from the site following the treatment of the effluent at the sewage treatment works. • The results of an assessment of the impact of the emissions to surface water from the emergency discharge points W1 & W2. • The report shall: - Be based on the parameters monitored in IP21 above; - Include proposals for appropriate measures to mitigate the impact of any emissions where the assessment determines they are liable to cause pollution, including timescales for implementation of individual measures. - Confirm what constitutes an emergency discharge and under what circumstances such a discharge would not lead to a deterioration of the receiving water.	31/03/20