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/BS5215IZ
The Operator is: Eastham Refinery Limited
The Installation is: Eastham Refinery
This Variation Notice number is: EPR/BS5215IZ/V005

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 9th 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.

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

How this document is structured

Glossary of acronyms used in this document

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

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
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
EAL	Environmental assessment level
ELV	Emission limit value derived under BAT or an emission limit value set out in IED
EMS	Environmental Management System
EPR	Environmental Permitting (England and Wales) Regulations 2016 (SI 2016 No. 1154) as amended
EQS	Environmental quality standard
ERL	Eastham Refinery Limited
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
FCC	Fluid Catalytic Cracking
FGD	Flue Gas Desulphurisation
HMT GB	Her Majesty's Treasury The Green Book - Appraisal and Evaluation in Central Government
IED	Industrial Emissions Directive (2010/75/EU)
IPPCD	Integrated Pollution Prevention and Control Directive (2008/1/EC) – now superseded by IED
LCP	Large Combustion Plant subject to Chapter III of IED
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)
PAH	Polycyclic Aromatic Hydrocarbons
PC	Process Contribution
PEC	Predicted Environmental Concentration
PPS	Public participation statement
PR	Public register
RGS	Regulatory Guidance Series
SGN	Sector guidance note

TGN	Technical guidance note
TOC	Total Organic Carbon
WFD	Water Framework Directive (2000/60/EC)

1 Our decision

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

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

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

2 How we reached our decision

2.1 Requesting information to demonstrate compliance with BAT Conclusions for the refining of mineral oil and gas.

We issued a Notice under Regulation 60(1) of the Environmental Permitting (England and Wales) Regulations 2010 (a Regulation 60 Notice) on 10/11/15 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 09/10/18, which will then ensure that operations meet the revised standard, or
- Justifies why standards will not be met by 09/10/18, 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 60 Notice response from the Operator was received on 14/01/16.

We considered that the response did not contain sufficient information for us to commence the permit review.

Following discussions with the Operator suitable further information was provided by the Operator on the 10/1/17. An email requesting further information was sent to the Operator on the 18/1/17 and a response was received on the 6/2/17. A further Regulation 60 Notice was served on the operator on the 23/1/17 to correct an error and an omission in the original notice. A response to this Notice was received on the 3/2/17. An updated plan showing emission points was received on 11/04/17.

We have not received any information in relation to the Regulation 60 Notice response that appears to be confidential in relation to any party.

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

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

In relation to BAT Conclusion(s) 6, 10, 11 and 12 we agree with the operator in respect to their current stated capability as recorded in their Regulation 60 Notice response that improvements are required.

We have therefore included improvement conditions:

- IC3 (BATc 6),
- IC4 and IC5 (BATc 10 and BATc12) and
- IC7 (BATc11)

in the Consolidated Variation Notice, which requires them to upgrade their operational techniques so that the requirements of the BAT Conclusion are delivered by 09/10/18. This is discussed in more detail in Annex 2.

3 The legal framework

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

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

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

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

We have set the 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 Key Issues

The key issues arising during this permit review are:

- Reviewing the effectiveness of the treatment of effluent at the sewage treatment works to achieve BAT-AELs (BAT 12)
- Reviewing the impact of effluent emissions from the sewage treatment plant to see whether the discharge on the receiving water body (WFD)
- Agreeing an appropriate Leak Detection and Repair Programme to reduce VOC emissions (BAT 6).
- Reviewing the options available for segregation of water streams (BAT 11).

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

5 Decision checklist regarding relevant BAT Conclusions

BAT Conclusions for the refining of mineral oil and gas, were published by the European Commission on 9th 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 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	CC	ISO 14001(Certificate No. EMS 57606 Expiry 2017) internal audits conducted by ERL and external audits conducted by BSI. ERL is now in 3 year transition to the new standard ISO 14001:2015 . ERL has a HSSEQ Management System	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>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>Technique</th><th>Description</th></tr>
<tr><td colspan="2">i. Design techniques</td></tr>
<tr><td>a. 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. 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. 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="2">ii. Process control and maintenance techniques</td></tr>
<tr><td>a. 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. Management and reduction of steam consumption</td><td>Management and reduction of steam consumption. Systematic mapping of drain valve systems in order to reduce steam consumption and optimise its use</td></tr>
</table></td><td>CC

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-</td><td>Metrics/benchmarking/KPI’s in place. ERL currently not register to ISO 50001.

High degree of heat integration on the site and regular reviews by external consultants are carried out to identify any opportunities. In the most recent review Q3 2015 no cost effective opportunities were identified and the consultants stated that the refinery was in the top quartile of refineries for energy efficiency

The refinery recovers waste heat where practical. Examples include generating steam by cooling bitumen streams down, pre heating boiler feed water using heat from the process that was previously exhausted to air. In 2013 new steam raising boilers were installed and these included economiser as a part of the design. There is still a significant amount of low grade heat available on the site but there is no heat sink in the area where the heat could be utilised.

The site is converting its instrumentation to foundation fieldbus standard, this smart instrumentation provides warnings when instrument performance deviates from norm.

Majority of combustion plant has continuous oxygen monitoring which allows the combustion efficiency to be optimised. Hence 99.8% of the site combustion energy usage has continuous O2 monitoring.

There is an active steam reduction programme. The site has implemented changes in operating practise in certain areas so that steam tracing doesn’t need to be permanently on.</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>
<table>
<tr><td></td><td></td></tr>
<tr><td>c. 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="2">iii. Energy efficient production techniques and description</td></tr>
<tr><td>a. 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. 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>The site has been benchmarked at least 3 times in the last 12 years and has had a high ranking in each benchmarking exercise.

Not cost effective, reviewed by external consultant-KBC. The last CHP analysis was in 2015.

N/A</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>N/A</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="3">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 ([3]) and calcining units</td><td>continuous</td><td>Direct measurement ([4])</td></tr>
<tr><td>Combustion units of 50 to 100 MW ([3])</td><td>continuous</td><td>Direct measurement</td></tr>
</table>
</td><td>CC</td><td>N/A

N/A

N/A</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)
				or indirect monitoring		Only the main process furnace (at 30MWth) is monitored as required by the existing permit. The majority of non-measured emissions are from gas fired units installed in 2015/2016. The frequency of monitoring under the existing permit is every 6 months. However reflecting the minimum monitoring frequency requirement of BAT 4 and the consistent level of compliance demonstrated by the Operator the frequency has been reduced to annually. The test method for NO2: BSEN 14792.Test method for total particulates matter: BSEN 13284-1. The EA has decided not to require monitoring on combustion plant below 20 MW thermal input unless previously required by the permit.	
		Combustion units < 50 MW ([3])	once a year and after significant fuel changes	Direct measurement or indirect monitoring		N/A	
		Sulphur recovery units (SRU)	continuous for SO2 only	Direct measurement or indirect monitoring ([6])		N/A	
	NH_3 emissions	All units equipped with SCR or SNCR	continuous	Direct measurement		N/A	
	CO emissions	Catalytic Cracking and combustion units >= 100MW ([3])	continuous	Direct measurement		CO is currently measured to agreed EA standards. Whilst measured it has not previously been listed in Table S3.1. In line with the requirements with BAT 37 this has been introduced to Table S3.1 for emission point A1. The frequency of monitoring is every 6 months. However reflecting the consistent level of compliance previously demonstrated by the Operator the frequency has been reduced to annually in line with other parameters in line with footnote (5).	
		Other combustion units	once every 6 months ([5])	Direct measurement		N/A	
	Metal emissions:	Catalytic cracking	once every 6 months and	Direct measurement			

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)
	Nickel (Ni) Antimony (Sb) Vanadium (V) — Combustion units ([8]) — after significant changes to the unit ([5]) — or analysis based on metals content in the catalyst fines and in the fuel Polychlorinated dibenzodioxins / furans (PCDD/F) emissions — Catalytic reformer — once a year or once a regeneration, whichever is longer — Direct 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		N/A	
5	**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.** **Description** — **Minimum frequency** Monitoring of parameters linked to pollution emissions, e.g. O_2 content in flue-gas, N and S content in fuel or feed ([1]) — Continuous for O_2 content. For N and S content, periodic at a frequency based on significant fuel/feed changes.	N/A	We agree this BAT Conclusion is not applicable to the relevant activities carried out at this installation. Note: Continuous O_2 (monitoring) is in place for emission point A1. S and liquid fuels are monitored. The majority of the sites combustion by natural gas. No Nitrogen monitoring performed. Plant fuel oil is monitored for Sulphur (3x per week) using IP336.This also includes all	3.5.1

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)
	(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.		incoming fuel oils. All results are stored on a LIMS System. There is a requirement for periodic NOx and SOx monitoring in the current permit.	
6	**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. **Description**. See section 1.20.6, Annex 1.	FC	The operator does not currently use all three techniques so an improvement condition has been imposed requiring the operator to agree an appropriate programme.	IC3
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.	N/A	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)	N/A	We agree this BAT Conclusion is not applicable to the relevant activities carried out at this installation.	

<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>(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.</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 an SRU or any equivalent gas treatment system.

It is not BAT to directly incinerate the untreated sour water stripping gases.</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>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>
<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>
</table></td><td>FC</td><td>There is no direct discharge to water from the main site effluent system. This system discharges water to United Utilities works for biological treatment. Parameters are agreed with UU and are well within their consent. There is a small amount of water from the back wash of the sand filters (for boiler water treatment) to the Manchester Ship Canal. This is checked for check for PH, 4 times/year- section S3.2 of the existing permit- BS6068).

An Improvement condition is required to demonstrate that the discharge to sewer does not have a greater impact that it would have otherwise done had there been a direct discharge from a tertiary treatment plant.

At present there is no requirement for limits in the permit, but this might change following completion of IC4 & IC5</td><td>IC4 & IC5</td></tr>
</table>

<table>
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<tr><td></td><td>
<table>
<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>
</table>
(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><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.
<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>
</table>
</td><td>FC</td><td>Some segregation in place- clean water to canal; leak/spillage programs in place.

N/A

N/A</td><td>1.3.1</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>
<table>
<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>
</td><td></td><td>N/A

The site is totally contained, any spill will be directed to the sites oil water system where the oil will be recovered before discharge to the local sewage works for biological treatment.

An Improvement Condition has been put in all permits to see if more can be done to segregate water streams.</td><td>IC7</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 soluble 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</td><td>FC</td><td>Process wastewater streams from various plant knock-out (KO) pots and dewatering vessels pass into the sour water vessel, in which oil is collected in a central chamber and the water overflows a weir into a sump and pumped to the site API interceptor. Oil is separated by gravity within the interceptor and removed by a “Vikoma” oil skimmer. The clarified water is pumped from the interceptor to storage tanks. A floating skimmer within the tank removes any further free oil, which is returned to the API interceptor. From storage the wastewater is pumped through a sub-surface tilted plate oil separator prior to discharge to sewer.

BAT 12 requires that soluble substances are treated by biological treatment

An improvement condition was included requiring the operator to demonstrate that the discharge to the STW is equivalent to on-site biological treatment including reduction factors</td><td>2.3.1

IC4 & IC5</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>13</td><td>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).</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>14</td><td>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.</td><td>CC</td><td>Waste contract in place with recycling/reuse/recovery and disposal with the following waste types and quantities recorded in 2014:
17-03-02 Bitumen Mixtures 126.85t
20-01-01 Paper Cardboard 10.20t(recycled)
20-03-01 Mixed Municipal Waste 13.54t.</td><td>1.4.1</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>Only small quantities of sludge are generated.

Sludge is allowed to settle in a dedicated tank. The sludge is dewater by recovering water to the API. The sludge is sent for processing off site.

Pollution Inventory returns for 2014 show that 14.7 tonnes of interceptor sludge (EWC code 13 05 03) and no sludge removal in 2015.</td><td>2.3.1</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></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. Removal of catalyst from slurry decant oil: 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.			
17	**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;	CC	Noise assessment; acoustic enclosures. i. Noise assessment conducted once a year for onsite and offsite ii. Gas compressor are in acoustic enclosure iii. N/A iv. N/A	3.4.1
18	**In order to prevent or reduce diffuse VOC emissions, BAT is to apply the techniques given below.** **Technique** / **Description** / **Applicability** I. Techniques related to plant design. — 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 ensuring access to potentially leaking components — Applicability may be limited for existing units II. Techniques related to plant installation and — i. Well defined procedures for construction and assembly; ii. Robust commissioning and hand-over procedures to ensure that the plant is	FC	A rudimentary LDAR program is in place. Due to the heavy oils processed onsite VOC emissions are minimal, the most volatile oil, Naphtha, is stored in a floating roof tank to minimise losses, for other oils they are stored well below their initial boiling point. Use of flanges on Naphtha systems are minimised to reduce leak potential. Eastham Refinery Limited (ERL) plant commissioning procedure in place	3.2.1

<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><table>
<tr><td>commissioning</td><td>installed in line with the design requirements.</td><td></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></td><td></td><td>There are frequent and regular checks carried out on the integrity of pipe lines and equipment and issues identified are dealt with via the sites plant defect report system. IC3 has been included to ensure the operator meets the requirements of BAT 6.</td><td>IC 3</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>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>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>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>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>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>
</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>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 processes based on hydrogenation</td><td>Processes based on conversion of undesired compounds via catalytic hydrogenation similar to hydrotreatment.</td><td>Generally applicable to new units</td></tr></table></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>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></table></td><td>CC</td><td>Thermal oxidation and scrubbing processes in place</td><td>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>
<table>
<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></td><td>Gases either combusted in the crude distillation unit furnaces or in a dedicated incinerator which operates at 850°C

Gaseous overhead wet scrubbed prior to incineration</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>
<tr><td>i. Process optimisation</td><td>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.</td><td>Generally applicable</td></tr>
<tr><td>ii. Low-NO_X CO oxidation promoters</td><td>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.</td><td>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</td></tr>
</table>
</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>
</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)

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:

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.

<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>
<table>
<tr><td></td><td>See section 1.20.2, Annex 1.</td><td>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.</td></tr>
</table>
Table 4 BAT- associated emission levels for NO_X emissions to air from the regenerators in the catalytic cracking process
<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</td><td>Generally applicable provided the activity</td></tr>
</table>
</td><td>N/A</td><td>N/A</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)

	abrasion and fragmentation in order to reduce dust emissions.	and selectivity of the catalyst are sufficient
ii. Use of low sulphur feedstock (e.g. by feedstock selection or hydrotreatment of feed)	Feedstock selection favours low sulphur feedstocks among the possible sources. Hydrotreatment aims at reducing the sulphur, nitrogen and metal contents of the feed.	Requires sufficient availability of low sulphur feedstocks, hydrogen production and hydrogen sulphide (H2S) treatment capacity (e.g. amine and 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.

<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>
<table>
<tr><th>Parameter</th><th>Type of unit</th><th>BAT-AEL (monthly average) (1) Mg/Nm^3</th></tr>
<tr><td rowspan="2">Dust</td><td>New unit</td><td>10 – 25</td></tr>
<tr><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 slelction 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 anf hydrogen sulphide (H_2S) treatment capacity (e.g. amine and Claus units)</td></tr>
</table>
II. Secondary or end-of pipe techniques, such as:</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>
</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)

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/Nm^3
SO_2	New units	$\leq$ 300
	Existing units/full combustion	<100 – 800([1])
	Existing units/partial combustion	100 – 1 200 ([1])
(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 $\leq$600 mg/Nm^3		

The associated monitoring is in BAT 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></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>

The associated monitoring is in BAT 4</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>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>
</table></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>
</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>
<table>
<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></td><td></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:
<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</td><td>For existing units, the applicability of the techniques may be limited by space availability</td></tr>
</table>
</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>
</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><table><tr><td></td><td>to treating the gas from the coking unit.</td><td></td></tr></table></td><td></td><td></td><td></td></tr>
<tr><td>30</td><td>In order to reduce NOx 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>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>31</td><td>In order to reduce SOx 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 SOx 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. See Section 5.20.3, Annex 1.</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>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>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.</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>
</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>
<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><th>Parameter</th><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></td><td></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 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,</td><td>Generally applicable</td></tr>
</table>
</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>
</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>electric field potential for coalescence) steps</td><td></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 optimum interface level controllers</td><td>Generally applicable</td></tr></table>			
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.**	CC	Gas firing/low NOx burners in place; emissions meet BAT. Refinery fuel oil with sulphur content less than 1%. Three of process distillation unit furnaces are vertical up fired with low NOx burners burning natural gas with continuous O_2 and flammables measurements, burners replaced in 2013. Cochran A and Cochran B boilers horizontally fired gas boilers with continuous O_2,CO and NOx monitoring installed 2013. Cochran C boiler horizontally fired burning less than 1% sulphur fuel oil, only used when A&B undergoing statutory inspections. Two of offsite heaters vertical down fired units with continuous O_2 monitoring burning natural gas. Installed 2016. Beverley 1 thermal oil horizontally fired heater burning natural gas with continuous O_2 monitoring, burner replaced Q4 2015. Beverley 2/ Heiza horizontally fired thermal oil heater burning less than 1% gas oil. Incinerator vertically up fired unit burning less than 1% gas oil.	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)
	I. Primary or process-related techniques, such as:			

Technique	Description	Applicability
i. Selection or treatment of fuel		
(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
(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)
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
(b) Optimisation of combustion	See section 1.20.2, Annex 1.	Generally applicable
(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. The applicability may be restricted to retrofitting external flue-gas recirculation to units

99.8% sites combustion capacity is gas fired, for the remaining units it's not cost effective to convert to natural gas.

Minimal use of liquid fuels onsite.

Yes

Yes

No

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)

		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
(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 to low hydrogen content fuels (generally < 10 %)

N/A

Yes

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

Technique	Description	Applicability
i. Selective catalytic reduction (SCR)	See section 1.20.2, Annex 1.	Generally applicable for new units. For existing units, the applicability may be constrained due to the

N/A

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)
			requirements for significant space and optimal reactant injection			
	ii. Selective non-catalytic reduction (SNCR)	See section 1.20.2, Annex 1.	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		N/A	
	iii. Low temperature oxidation	See section 1.20.2, Annex 1.	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 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		N/A	
	iv. SNO_X combined technique	See section 1.20.4, Annex 1.	Applicable only for high flue-gas (e.g. > 800 000 Nm3/h) flow and when combined NO_X and SO_X abatement is needed		N/A	
	BAT- associated emission levels: See Table 9, Table 10 and Table 11					

<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>
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 (IGCC))</td><td>40 - 120 (existing gas turbine)</td></tr>
<tr><td>20 - 50 (new turbine) (2)</td></tr>
<tr><td colspan="3">(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</td></tr>
</table>
Table 10 BAT- associated emission levels for NOX emissions to air from a gas-fired combustion unit, with the exception of gas turbines
</td><td></td><td>N/A

Existing limits in the permit are retained as they are compliant with the requirements of BAT 34 . The EA has not imposed limits on any combustion plant with a thermal input of less than 20 MW thermal input unless the permit already required lower limits.</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>
<table>
<tr><th>Parameter:</th><th>Type of combustion</th><th>BAT-AEL (monthly average) mg/Nm^3</th></tr>
<tr><td rowspan="2">NOx, expressed as NO_2</td><td rowspan="2">Gas firing</td><td>30 - 150 for existing unit (1)</td></tr>
<tr><td>30 - 100 for new unit</td></tr>
<tr><td colspan="3">(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</td></tr>
</table>
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
<table>
<tr><th>Parameter:</th><th>Type of combustion</th><th>BAT-AEL (monthly average) mg/Nm^3</th></tr>
<tr><td>NO_X expressed as NO_2</td><td>Multi-fuel fired combustion unit</td><td>30 -3—for existing unit ([1]) ([2])</td></tr>
<tr><td colspan="3">(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</td></tr>
</table>
The associated monitoring is in BAT 4
</td><td></td><td></td><td></td></tr>
<tr><td>35</td><td>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:
<table>
<tr><th>Technique</th><th>Description</th><th>Applicability</th></tr>
<tr><td colspan="3">Selection or treatment of fuel</td></tr>
<tr><td>(a) Use of gas to replace liquid fuel</td><td>Gas instead of liquid combustion leads to lower level of dust emissions
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</td></tr>
</table>
</td><td>CC</td><td>Existing limits in the permit are retained as they are compliant with the requirements of BAT 35 The EA has not imposed limits on any combustion plant with a thermal input of less than 20 MW thermal input unless the permit already required lower limits.

Yes</td><td>2.3.1</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)

		natural gas which may be impacted by the energy policy of the Member State
(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)
Combustion modifications		
(a) Optimisation of combustion	See section 1.20.2, Annex 1.	Generally applicable to all types of combustion
(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

II Secondary or end-of-pipe techniques, such as:

Technique	Description	Applicability
i. Electrostatic precipitator (ESP)	See section 1.20.1, Annex 1.	For existing units, the applicability may be limited by space availability
ii. Third stage blowback filter	See section 1.20.1, Annex 1.	Generally applicable

N/A

Yes

N/A- Burning gas

N/A- Burning gas

N/A- Burning 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>
<table>
<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 rowspan="2">Dust</td><td rowspan="2">Multi-fuel firing</td><td>5 – 50 for existing unit (1) (2)</td></tr>
<tr><td>5 – 25 for new unit < 50 MW</td></tr>
<tr><td colspan="3">(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</td></tr>
</table>
The associated monitoring is in BAT 4
</td><td></td><td>N/A- Burning gas

N/A

N/A</td><td></td></tr>
<tr><td>36</td><td>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</td><td>CC</td><td>There is no applicable BAT-AEL for natural gas fired plant in BAT 36 however there is an existing ELV. The requirement for an ELV and ongoing monitoring for sulphur dioxide has been reviewed. Due to the sulphur content of natural gas being the constraining factor this ELV has now been removed and there is no requirement for ongoing monitoring.</td><td>2.3.1</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)
			The EA has not imposed limits on any combustion plant with a thermal input of less than 20 MW thermal input unless the permit already required lower limits.	

Technique	Description	Applicability	
i. Use of gas to replace liquid fuel	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	Yes
ii. Treatment of refinery fuel gas (RFG)	Residual H2S concentration in RFG depends on the treatment process parameter, e.g. the amine-scrubbing pressure. See Section 1.20.3, Annex 1.	For low calorific gas containing carbonyl sulphide (COS) e.g. from coking units, a converter may be required prior to H_2S removal	N/A
iii. Use of low sulphur refinery fuel oil (RFO) e.g. by RFO selection or by hydrotreatment 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 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	N/A

II. Secondary or end-of-pipe techniques

Technique	Description	Applicability	
i. Non-regenerative scrubbing	Wet scrubbing or seawater scrubbing. See Section 1.20.3, Annex 1.	The applicability may be limited in arid areas and in the case where the by-products from treatment (including	N/A

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)

		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

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

Parameter	BAT-AEL (monthly average) mg/Nm^3
SO2	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	

The associated monitoring is in BAT 4

N/A

Table 14 BAT- associated emission levels 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

The associated monitoring is in BAT 4

N/A

<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>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>≤ 100</td></tr></table>
Associated monitoring is in BAT 4.</td><td>CC</td><td>Majority of combustion plant has continuous oxygen monitoring which allows the combustion efficiency to be optimised. Hence 99.8% of the site combustion energy usage has continuous O_2 monitoring.

Carbon monoxide, expressed as CO. Existing monitoring (monthly average) 5.5 mg/Nm^3. A new requirement to achieve this BAT AEL has been included in Table S3.1.</td><td>2.3.1

3.3.1</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>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>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>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>40</td><td>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.</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>41</td><td>In order to reduce sulphur dioxide emissions to air from the natural gas plant, BAT is to apply BAT 54.</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>42</td><td>In order to reduce nitrogen oxides (NO_X) emissions to air from the natural gas plant, BAT is to apply BAT 34</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>43</td><td>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.</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>44</td><td>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</td><td>CC</td><td>Liquid ring pumps and condensers in place</td><td>2.3.1</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)
	needed to achieve a high volume (10 mm Hg). Also, a spare should be available in case the vacuum pump fails.			
45	**In order to prevent or reduce water pollution from the distillation process, BAT is to route sour water to the stripping unit.**	N/A	N/A in bitumen refineries with <1 t/d sulphur compounds Note the pollution inventory submission verifies there are <1 t/d sulphur compounds.	2.3.1
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.	N/A	N/A in bitumen refineries with <1 t/d sulphur compounds Note the pollution inventory submission verifies there are <1 t/d sulphur compounds.	
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.	CC	Process off gases are combusted either in the main process unit furnaces or the incinerator.	2.3.1
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.**	N/A	We agree this BAT Conclusion is not applicable to the relevant activities carried out at this installation.	2.3.1
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	Floating roof and high efficiency seals in place on naphtha tanks.	2.3.1
50	**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.**	CC		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><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></td><td>Manual tank cleaning in place per inspection schedule for naphtha tank (CMMS).

Naphtha is the only “volatile liquid hydrocarbon compound” handled on site. See 52 below for more information.</td><td></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.

<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</td><td>Generally applicable</td></tr></table></td><td>CC</td><td>Tank inspection program in place; all oil bunds have 110% volume of the largest tank or 25% of the aggregate tank capacity, whichever is largest. Eastham Tank farm lined with concrete; clay layer acts as secondary barrier on the main site

Tanks are routinely inspected to relevant standard, tanks have radar gauges with readout and alarms in manned control room; secondary level devices in place; plant reconciliation performed twice a week.</td><td>1.1
2.3.1
3.2.3</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>before spills can reach the groundwater. To be especially reinforced during maintenance periods</td><td></td></tr><tr><td>ii. Double bottomed tanks</td><td>A second impervious bottom that provides a measure of protection against releases from the first material</td><td>Generally applicable for new tanks and after an overhaul of existing tanks (1)</td></tr><tr><td>iii. Impervious membrane liners</td><td>A continuous leak barrier under the entire bottom surface of the tank</td><td>Generally applicable for new tanks and after an overhaul of existing tanks ([1])</td></tr><tr><td>iv. Sufficient tank farm bund containment</td><td>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</td><td>Generally applicable</td></tr><tr><td colspan="3">(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</td></tr></table>		No No	
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 %.** <table><tr><th>Technique</th><th>Description</th><th>Applicability</th></tr><tr><td>Vapour recovery by: i. Condensation ii. Absorption iii. Adsorption</td><td>See section 1.20.6, Annex 1.</td><td>Generally applicable to loading/unloading operations where annual throughput is</td></tr></table>	N/A	With the exception of the naphtha, the crude oil, bitumen and gas oils have low vapour pressures and therefore this BAT conclusion does not apply to them. Naphtha is the only material that is handled that is classified as a volatile liquid hydrocarbon (i.e. a material with a RVP > 4kPa). Naphtha is produced from the refinery process and is exported in bulk from the refinery via a pipeline on to ship(s). < 10kt/year and therefore <1 million m^3/yr therefore, this is below the threshold that applies to loading and unloading operations and therefore Eastham do not meet the applicability criteria required by BAT 52	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>
<table>
<tr><td>iv. Membrane separation
v. Hybrid systems</td><td></td><td>> 5 000 m^3/yr. Not applicable to loading/unloading operations for sea-going vessels with an annual throughput < 1 million m^3/yr (1)</td></tr>
<tr><td colspan="3">(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</td></tr>
</table>
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
<table>
<tr><th>Parameter</th><th>BAT-AEL (hourly average) (1)</th></tr>
<tr><td>NMVOC</td><td>0.15 - 10g/Nm^3 (2) (3)</td></tr>
<tr><td>Benzene (3)</td><td><1 mg/Nm^3</td></tr>
<tr><td colspan="2">(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.</td></tr>
</table>
</td><td></td><td>To take account of the threshold applicability criteria Table S1.1 has been updated with amended “Limits of specified activity “</td><td>Table S1.1</td></tr>
<tr><td>53</td><td>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.</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>54</td><td>In order to reduce sulphur emissions to air from off-gases containing hydrogen sulphides (H_2S), BAT is to use all of the 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</td></tr>
</table>
</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>
</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>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> 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).**	N/A	We agree this BAT Conclusion is not applicable to the relevant activities carried out at this installation.	
56	**In order to reduce emissions to air from flares when flaring is unavoidable, BAT is to use the techniques given below.** <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></table>	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)
	iii. Correct flaring devices design — See section 1.20.7, Annex 1. — Applicable to new units iv. Monitoring and reporting — See section 1.20.7, Annex 1. — Generally applicable			
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 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 that would enable the units concerned to meet the following:	N/A	The operator has not requested to use an integrated emission management technique.	

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) 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 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;			

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 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 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**	N/A	The operator has not requested to use an integrated emission management technique.	

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 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 cacking 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). This BAT-AEL is expressed by the following formula: $\frac{\Sigma\,[(\text{flue gas flow rate of the unit concerned}) \times (SO_2 \text{ concentration that would be achieved for that unit})]}{\Sigma(\text{flue gas flow rate of all units concerned})}$ 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 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)
	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 (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**			

6 Emissions to Water

The consolidated permit incorporates the two current discharges to controlled waters identified as W1 and W2. These relate to the discharge from the water softening plant and surface water run off to the Manchester Ship Canal respectively. There have been and there are no current plans to change the quantity or components of these discharges as a result of complying with the BAT conclusions. This Permit review against the BAT Conclusions for the Refining of Mineral Oil and Gas has not identified any additional monitoring and compliance requirements. The monitoring requirements and limits of the existing permit have been retained.

There are also emissions to sewer which discharges process effluents to a third party sewage treatment works via S1. There have been and there are no current plans to change the quantity or components of these discharges as a result of complying with the BAT conclusions. This Permit review against the BAT Conclusions for the Refining of Mineral Oil and Gas has not identified any additional monitoring and compliance requirements.

However compliance with the requirements of BATc 12 cannot be adequately demonstrated by the Operator. Improvement Conditions 4 & 5 have been added to Table S1.3 Improvement Programme Requirements to address this. Details of the Improvement Conditions are included in Annex 2 below.

In addition to the review of compliance against the relevant BATc for emissions to water, this Permit review also provides an opportunity to consider whether the discharge to sewer will maintain River Quality Objectives (RQOs) in the receiving watercourse to ensure the water quality objectives under Water Framework Directive will be met.

The Operator does not currently have sufficient information for this assessment to be made. Improvement Conditions 4 & 6 have been added to Table S1.3 Improvement Programme Requirements to address this. Details of the Improvement Conditions are included in Annex 2 below.

7 Additional IED Chapter II requirements:

Condition 3.1.3 relating to protection of soil, groundwater and groundwater monitoring, has been retained in compliance with IED requirements. Conditions 4.3.1 has been amended to reflect the current permit template and condition 4.3.2 relating to notifications have been retained in compliance with IED requirements.

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

This document should be read in conjunction with the application, supporting information and 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 response to the Regulation 60 Notice that we consider to be confidential. The decision was taken in accordance with our guidance on commercial confidentiality.
Scope of consultation	The consultation requirements were reviewed and did not need to be implemented. The decision was taken in accordance with the Environmental Permitting Regulations and our public participation statement.
Control of the facility	We are satisfied that the operator is the person who will have control over the operation of the facility after the issue of the consolidation. The decision was taken in accordance with our guidance on legal operator for environmental permits.
Applicable directives	All applicable European directives have been considered in the determination of the application.
Extent of the site of the facility	The operator has provided a plan which we consider is satisfactory, showing the 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. 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).

Aspect considered	Justification / Detail
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 site(s)/species/habitat has not been carried out as part of the permitting process. We consider that the review will not affect the features of the site/species/habitat.
Operating techniques	We have reviewed the techniques, where relevant to the BAT Conclusions, used by the operator and compared these with the relevant guidance notes. We consider that the emission limits included in the installation permit reflect the BAT for the sector.
Updating permit conditions during consolidation.	We have updated previous permit conditions to those in the new generic permit template as part of permit consolidation. The new conditions have the same meaning as those in the previous permit(s). Reporting form E1 has been updated to reflect the change to using natural gas as a fuel. The operator has agreed that the new conditions are acceptable.
Use of conditions other than those from the template	Based on the information in the application, we consider that we do 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.
Pre-operational conditions	Not Applicable
Improvement conditions	Based on the information on the application, we consider that we need to impose improvement conditions. We have imposed improvement conditions to ensure that: • The Operator submits a VOC monitoring plan to the Environment Agency for written approval (to ensure compliance with BAT conclusion 6).

Aspect considered	Justification / Detail
	• The Operator undertakes an assessment of the effectiveness of the treatment of their effluent at the United Utilities treatment works and compare this with the effectiveness of onsite treatment using biological treatment and clarification (to ensure compliance with BAT conclusion 12). • The Operator submits a surface water risk assessment report that investigates and reviews the emissions of effluent from Emission Point S1 to the receiving water body following the treatment of their effluent at the United Utilities treatment works (to assess the impact under the WFD). • The Operator carries out an assessment of the options available for segregation of water streams (to ensure compliance with BAT 11)
Incorporating the application	We have specified that the applicant must operate the permit in accordance with descriptions in the application, including all additional information received as part of the determination process. These descriptions are specified in the Operating Techniques table in the permit.
Emission limits	We have decided that no additional emission limits should be set in the varied permit. Responses to IC5 will determine whether further limits will need to be incorporated into the permit.
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.
Reporting	We have specified reporting in the permit. The reporting frequencies reflect that of the permit before it was varied.
Management system	There is no known reason to consider that the operator will not have the management system to enable it to comply with the permit conditions. The decision was taken in accordance with the guidance on operator competence and how to develop a management system for environmental permits.
Section 108 Deregulation	We have considered our duty to have regard to the desirability of promoting economic growth set out in section 108(1) of the Deregulation Act 2015 and the guidance

Aspect considered	Justification / Detail
Act 2015 – Growth duty	issued under section 110 of that Act in deciding whether to grant this permit. Paragraph 1.3 of the guidance says: “The primary role of regulators, in delivering regulation, is to achieve the regulatory outcomes for which they are responsible. For a number of regulators, these regulatory outcomes include an explicit reference to development or growth. The growth duty establishes economic growth as a factor that all specified regulators should have regard to, alongside the delivery of the protections set out in the relevant legislation.” We have addressed the legislative requirements and environmental standards to be set for this operation in the body of the decision document above. The guidance is clear at paragraph 1.5 that the growth duty does not legitimise non-compliance and its purpose is not to achieve or pursue economic growth at the expense of necessary protections. We consider the requirements and standards we have set in this permit are reasonable and necessary to avoid a risk of an unacceptable level of pollution. This also promotes growth amongst legitimate operators because the standards applied to the operator are consistent across businesses in this sector and have been set to achieve the required legislative standards.

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

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 replace liquid fuel	Decrease the use of liquid refinery fuel (generally heavy 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	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

catalysts additives	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 monoxide (CO) oxidation promoters	Use of a substance which selectively promotes the oxidation of CO into CO_2 (combustion
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

Based in the information in the Operators Regulation 60 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**
IC3	The Operator shall submit a diffuse VOC monitoring plan to the Environment Agency for written approval. This shall include but not be limited to: • The nature of the material handled; • The sources of emissions; • Justification of the monitoring techniques selected • How the monitoring data will be recorded and reviewed The plan shall take into account the appropriate techniques for VOC monitoring specified in BAT conclusion 6 for the Refining of Mineral Oil and Gas. The Operator shall implement the approved plan and produce and submit an annual report on the results of the monitoring undertaken under the plan.	30/11/2017
IC4	The operator shall submit a written monitoring plan to the Environment Agency for approval that includes proposals to undertake representative monitoring of the parameters of a) hazardous pollutants (as set out in the Environment Agency's Surface Water Pollution Risk Assessment guidance; and b) the "BAT Conclusions for the Refining of Mineral Oil and Gas" BAT Conclusion 12 Table 3) in the discharge to sewer from point S1. The plan shall include 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.	28/02/2018
IC5	The operator shall submit a written report to the Environment Agency for approval that includes: a) results of an assessment of the impact of the emissions to surface water from the site for the parameters listed in "BAT Conclusions for the Refining of Mineral Oil and Gas" BAT Conclusion 12 Table 3 following the treatment of the effluent at the United Utilities treatment works in accordance with the Environment Agency's Surface Water Pollution Risk Assessment Guidance available on our website demonstration that the discharging of waste water to sewer for treatment is equivalent to the technique given in BAT 12 and that this treatment achieves the BAT-associated emission levels set out in BAT Conclusion Table 3.	31/03/2018

Table S1.3 Improvement programme requirements		
Reference	**Requirement**	**Date**
IC6	The operator shall submit a written report to the Environment Agency for approval 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 United Utilities treatment works in accordance with the Environment Agency's Surface Water Pollution Risk Assessment Guidance available on our website. The report shall: (a) be based on the parameters monitored in IC4(a) above; and 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.	30/09/2018
IC7	The Operator shall carry out an assessment of the options available for segregation of water streams to reduce the volume of process water produced, as detailed in BAT conclusion 11 for the Refining of Mineral Oil and Gas. A written report summarising the findings shall be submitted to the Agency for approval, along with a timetable for implementing improvements. The Operator shall implement the improvements to the approved timetable.	31/03/2018