Environment Agency

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

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

The Permit number is: EPR/FP3139FN/V009
The Operator is: Essar Oil (UK) Limited
The Installation is: Stanlow Manufacturing Complex
This Variation Notice number is: EPR/ FP3139FN/V009

Consultation commenced on: 13 August 2018
Consultation ended on: 10 September 2018

What this document is about

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

We have reviewed the permit for this installation against the revised BAT Conclusions for the Refining of Mineral Oil and Gas industry sector published on 28 October 2014. This is our decision document, which explains the reasoning for the consolidated variation notice that we are issuing.

It explains how we have reviewed and considered the techniques used by the operator in the operation and control of the plant and activities of the installation. This review has been undertaken with reference to the decision made by the European Commission establishing best available techniques (BAT) conclusions ('BAT Conclusions') for the Refining of Mineral Oil and Gas as detailed in document reference IEDC-7-1. It is our record of our decision-making process and shows how we have taken into account all relevant factors in reaching our position. It also provides a justification for the inclusion of any specific conditions in the permit that are in addition to those included in our generic permit template.

As well as considering the review of the operating techniques used by the operator for the operation of the plant and activities of the installation, the consolidated variation notice takes into account and brings together in a single document all previous variations that relate to the original permit

issued. It also modernises the entire permit to reflect the conditions contained in our current generic permit template.

The introduction of new template conditions makes the permit consistent with our current general approach and philosophy and with other permits issued to installations in this sector. Although the wording of some conditions has changed, while others have been removed because of the new regulatory approach, it does not reduce the level of environmental protection achieved by the permit in any way. In this document we therefore address only our determination of substantive issues relating to the new BAT Conclusions.

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

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

How this document is structured

Glossary of acronyms used in this document

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

AAD	Ambient Air Directive (2008/50/EC)
APC	Air Pollution Control
BAT	Best Available Technique(s)
BAT-AEL	BAT Associated Emission Level
BATc	BAT conclusion
BREF	Best available techniques reference document
CEM	Continuous emissions monitor
CHP	Combined heat and power
COMEAP	Committee on the Medical Effects of Air Pollutants
CROW	Countryside and rights of way Act 2000
CV	Calorific value
DAA	Directly associated activity – Additional activities necessary to be carried out to allow the principal activity to be carried out
DD	Decision document
Derogation	from BAT AELs stated in BAT Conclusions under specific circumstances as detailed under Article 15(4) of IED where an assessment shows that the achievement of emission levels associated with the best available techniques as described in BAT conclusions would lead to disproportionately higher costs
EAL	Environmental assessment level
EIONET	European environment information and observation network is a partnership network of the European Environment Agency
ELV	Emission limit value derived under BAT or an emission limit value set out in IED
EMS	Environmental Management System
EPR	Environmental Permitting (England and Wales) Regulations 2016 (SI 2010 No. 1154)
EQS	Environmental quality standard
EU-EQS	European Union Environmental Quality Standard
Eunomia	Ballinger, Holland & Hogg (2011) Use of Damage Cost Data for BAT Decision Making: Report for the Environment Agency of England & Wales
EWC	European waste catalogue
FGD	Flue Gas Desulphurisation
FSA	Food Standards Agency
GWP	Global Warming Potential
HMT GB	Her Majesty's Treasury The Green Book - Appraisal and Evaluation in Central Government
HW	Hazardous waste
IED	Industrial Emissions Directive (2010/75/EU)
IED Guidance	Industrial Emissions Directive EPR Guidance on Part A installations – Defra February 2013
IPPCD	Integrated Pollution Prevention and Control Directive (2008/1/EC) – now superseded by IED
I-TEF	Toxic Equivalent Factors set out in Annex VI Part 2 of IED

I-TEQ	Toxic Equivalent Quotient calculated using I-TEF
LADPH	Local Authority Director(s) of Public Health
LCP	Large Combustion Plant subject to Chapter III of IED
LCPD	Large Combustion Plant Directive (2001/80/EC) – now superseded by IED
MSUL/MSDL	Minimum start up load/minimum shut-down load
NOx	Oxides of nitrogen (NO plus NO_2 expressed as NO_2)
NPV	Net Present Value
PAH	Polycyclic Aromatic Hydrocarbons
PC	Process Contribution
PEC	Predicted Environmental Concentration
PHE	Public Health England
POP(s)	Persistent organic pollutant(s)
PPS	Public participation statement
PR	Public register
PXDD	Poly-halogenated di-benzo-p-dioxins
PXB	Poly-halogenated biphenyls
PXDF	Poly-halogenated di-benzo furans
RGS	Regulatory Guidance Series
SAC	Special Area of Conservation
SGN	Sector guidance note
SHPI(s)	Site(s) of High Public Interest
SPA(s)	Special Protection Area(s)
SSSI(s)	Site(s) of Special Scientific Interest
TDI	Tolerable daily intake
TEF	Toxic Equivalent Factors
TGN	Technical guidance note
TOC	Total Organic Carbon
US EPA	United States Environmental Protection Agency
WFD	Water Framework Directive (2000/60/EC)
WHO	World Health Organisation

1 Our decision

We have decided to issue the consolidated variation notice to the operator. This will allow it to continue to operate the installation, subject to the conditions in the consolidated variation notice.

As part of our decision we have decided to grant the operator's request for a derogation from the requirements of the BAT AELs associated with BAT Conclusions 12, 27, 34 and 52 as identified in the Refining of Mineral Oil and Gas BAT Conclusions document. The way we assessed the operator's requests for derogation and how we subsequently arrived at our conclusion is recorded in Section 7 of this document.

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

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

2 How we reached our decision

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

We issued a Notice under Regulation 61 of the Environmental Permitting (England and Wales) Regulations 2010 (a Regulation 61 Notice) on 5 August 2015 requiring the operator to provide information to demonstrate how the operation of their installation currently meets, or will subsequently meet, the revised standards described in the relevant BAT Conclusions document. The Notice also required that where the revised standards are not currently met, the operator should provide information that:

- Describes the techniques that will be implemented before 28 October 2018, which will then ensure that operations meet the revised standard, or
- Justifies why standards will not be met by 28 October 2018, and confirmation of the date when the operation of those processes will cease within the installation or an explanation of why the revised BAT standard is not applicable to those processes, or
- Justifies why an alternative technique will achieve the same level of environmental protection equivalent to the revised standard described in the BAT Conclusions.

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

The initial Regulation 61 Notice response from the operator was received on 5 February 2016.

We considered that the response did not contain sufficient information for us to commence the permit review. We therefore issued a number of further information requests to the operator and received a number of responses. The response received 24 October 2017 superseded all previous responses and was the basis for this permit review decision.

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

The operator claimed that certain information was commercially confidential and should be withheld from the public register. We considered this request and determined that: all derogation submissions and associated covering letters, supporting information and cost benefit analysis (CBA) data submitted in response to the Refinery BREF (BAT reference document) Regulation 61 Notice dated 5 August 2015 and those Regulation 61 submissions made before 13 June 2016 should be withheld from the public register as the release of this information would severely influence the outcome of tender process and the information meets the criteria in Regulation 51(c) (i), (ii) and (iii).

(i) The information is commercial
(ii) Its confidentiality is provided by law to protect a legitimate economic interest, and
(iii) In all the circumstances, the public interest in maintaining the confidentiality of the information outweighs the public interest in including it on the register.

We re-assessed the confidentiality of the derogation submissions for emissions to air (BAT Conclusions 27, 34 & 52) and agreed to withhold the following information:

- Detailed financial information relating to compliance – CBA tool (for all derogations)
- Some operational information (for example details of the equipment used and detailed project schedules)
- Some information relating to future impact on the environment, only if explicitly connected to the confidential information above (for example, the project schedule will drive the reduction in the environmental impact at specific points in time).

This assessment was completed before we fully assessed the derogation applications. We re-assessed the confidentiality claims prior to public consultation on our minded to decision.

Separate derogation documents redacting the information set out above were made available on the public register.

Apart from the issues and information just described, we have not received any information in relation to the Regulation 61 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 a number of the BAT Conclusions we agree with the operator in respect to their current stated capability as recorded in their Regulation 61 Notice response that improvements are required.

We have therefore included improvement conditions in the consolidated variation notice, which requires them to upgrade their operational techniques so that the requirements of the BAT Conclusions are delivered. This is discussed in more detail in Section 6 of this document.

2.3 Summary of how we considered the responses from public consultation.

We consulted on our draft decision from 13 August 2018 to 10 September 2018. A summary of the consultation responses and how we have taken into account all relevant representations is shown in Annex 3. The responses to the consultation did not lead to any amendments to the draft permit on which we consulted.

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 ELV's in line with the BAT Conclusions (BAT AELs) other than for those parameters for which a derogation was sought as detailed in Section 7 of this document.

In line with Defra IED Guidance, where the BAT AELs are expressed as a range, the ELV has been set on the basis of the top of the relevant BAT AEL range (the highest associated emission level) unless compliance with a lower ELV has been demonstrated and has been retained to ensure no deterioration. The emission limits and monitoring tables have been incorporated into Schedule 3 of the permit.

4 Overview of the site and installation

Stanlow Manufacturing Complex is situated south of the Mersey Estuary near Ellesmere Port and is operated by Essar Oil (UK) Limited. The Mersey Estuary is within 10km of the site and identified as a Special Protection Area (SPA) and Ramsar site. The Manchester Ship Canal (MSC) is located to the north, with the villages of Ince and Elton to the north east and the village of Thornton-le- Moors to the south.

Refinery activities (Primary activity)

The installation processes crude oil in a refinery which includes crude distillation units (CDU-3 and CDU-4), a fluid catalytic cracker, alkylation unit, platformer and hydrodesulphurisation plant.

In general terms, crude oil is imported by ship into tankage at the Tranmere Oil Terminal some 15 miles away on the Mersey. The Tranmere Oil Terminal is subject to a separate EPR Permit (EPR/YP3238FT). Crude oil is transferred by pipeline to tankage at Stanlow. This is the main feed-stock for crude distillation, which separates the crude oil into fuel gas, liquefied petroleum gases (LPGs), naphtha, kerosene, gas oil and a residue for further processing.

The naphtha (gasoline) fraction from distillation is the feed for the platformer which reforms it into high octane motor gasoline. The product from the platformer is fed to the aromatics plant, which produces aromatic hydrocarbons such as benzene, toluene and xylene. The kerosene and gas oil streams are treated to remove sulphur before sale.

The bottom product of the distillation, termed 'long residue' is the feed for the catalytic cracking unit and high viscosity index (HVI) lube-oil complexes. The fluidised catalytic cracker and its associated gas separation units produce fuel gas, LPG, high octane motor gasoline, gas oil, and fuel oil. LPG streams from the cracker and distillation provide the feed for the Alkylation plant, which converts them into motor gasoline.

Other cracker LPG streams are feedstock for chemicals production both on and off-site. The fuel gas from the cracker and benzene from the Aromatics plant are the feed-stocks for the production of ethyl benzene, which is exported for conversion to styrene.

The oil movements include receipts and storage of oil (and chemical) feed-stocks, for the collection, storage, blending and internal distribution of products and for those parts of ship and road loading of products and intermediates.

Finished products are exported by pipeline then transported either by road tanker from the loading terminal or by water via the Manchester Ship Canal.
The utilities plants supply cooling, fire and process water, steam, electricity, nitrogen and instrument air to most of the site. The utilities area also includes units for extracting hydrogen sulphide from refinery sour water and processing to produce elemental sulphur.

These activities fall under the following descriptions in Part 2 of Schedule 1 of the Environmental Permitting Regulations (EPR) 2016:

- Section 1.2 Part A(1)(d) – Refining mineral oil (cracking, secondary processes and distillation).
- Section 1.2 Part A(1)(e) - The loading, unloading or other handling of, the storage of, or the physical, chemical or thermal treatment of crude oil (oil movements).

Chemical activities

The refinery is integrated with adjoining chemicals plants. Although some feeds for the chemical production units are or can be received from other units on site, these are essentially stand-alone chemical plants, based almost entirely on imported feed-stocks. The 'naphtha' feed for the Synthesis Gas unit is the only refinery stream still processed by the chemical plants. They use the utilities and general facilities of the Stanlow site.

The chemical plants fall under the following Schedule 1 listed activity descriptions:

- Section 4.1 Part A(1)(a)(i) - Producing organic chemicals such as hydrocarbons (linear or cyclic, saturated or unsaturated, aliphatic or aromatic) (Shell Higher Olefins Process (SHOP)).
- Section 4.1 Part A(1)(a)(ii) - Producing organic chemicals such as organic compounds containing oxygen (Alcohols (Neodol and Linevol) and production of syngas and epoxy resins).
- Section 4.2 Part A(1)(a)(v) – Producing inorganic chemicals such as, non-metals, metal oxides, metal carbonyls or other inorganic compounds (for example calcium carbide, silicon, silicon carbide, titanium dioxide) (Amine recovery unit , amine systems, sour water stripper units and sulphur recovery unit plants)

Incineration activity (Energy Recovery Plant)

Process wastes arising from the oils and chemicals production (and other Essar UK sites such as the Tranmere Oil Terminal) are disposed of by incineration which is subject to the conditions in Chapter IV of the IED.

Incineration falls under the following Schedule 1 listed activity description:

- Section 5.1 Part A(1)(a) - The incineration of hazardous waste in a waste incineration plant with a capacity exceeding 10 tonnes per day.

Combustion activities

The installation also operates a number of combustion plant, some of which are categorised as large combustion plant (LCP), defined as LCP 138 to 143. Some of these are included in the refining and chemicals activities; however they fall under the following Schedule 1 listed activity description:

- Section 1.1 Part A(1)(a) - Burning any fuel in an appliance with a rated thermal input of 50 or more megawatts (HPBH and Medium Pressure Boiler House Boiler (MPBH)).

Installation emissions

The site effluent is treated by a combination of physico-chemical and biological treatments on-site and off-site. Treated effluent is discharged to the River Gowy, Manchester Ship Canal or the Ellesmere Port Waste Water Treatment Works dependant on composition. Improvements are being made to secure compliance with BAT Conclusion 12 which requires a reduction in the emission load of pollutants in the waste water discharge to the receiving body.

The installation releases a number of pollutants to air, including sulphur dioxide (SO_2), NOx, particulates and VOCs. These are from the activities described above and also from the burning of sour and sweet gases at flares. Improvements are being made to secure compliance with BAT Conclusions 34 (NOx) and 52 (VOCs) which require the reduction of the emission load of pollutants to air.

Waste recovery/disposal

There are a number of waste recovery/disposal activities taking place at the installation which fall under the following Schedule 1 listed activity descriptions:

- Section 5.3 Part A(1)(a)(i)(ii) - Disposal or recovery of hazardous waste with a capacity exceeding 10 tonnes per day involving biological treatment & physico-chemical treatment.

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

5 Key Issues

The key issues arising during this permit review are:

- The review and assessment of the derogation applications from meeting BAT Conclusions 12, 27, 34 and 52.
- Emissions to water particularly in the setting of water quality limits to minimise waste water discharge to controlled waters in line with BAT Conclusions 10, 11 and 12.
- BAT Conclusions 55 and 56 to reduce emissions to air from flares.
- BAT Conclusions 57 and 58 to use an integrated emission management technique for oxides of nitrogen (NOx) and sulphur dioxide (SO_2) emissions.

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

6 Decision checklist regarding relevant BAT Conclusions

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

This section provides a record of decisions made in relation to each relevant BAT Conclusion applicable to the installation. This section 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	CC	The operator has confirmed that all the features specified by the BAT Conclusion are incorporated into the existing Environmental Management System (EMS) which is externally certified to ISO14001. References were provided for each sub-paragraph, along with a copy of their ISO 14001:2004 Management System Certificate which is valid to 15 September 2018 (Certificate No: 189212-2015-AE-GBR-UKAS). We agree with the operator's stated compliance.	1.1

<table>
<tr><th>BAT Conclusion Number</th><th>Summary of BAT Conclusion requirement</th><th>Status NA/ CC / FC / NC</th><th>Assessment of the installation capability and any alternative techniques proposed by the operator to demonstrate compliance with the BAT Conclusion requirement</th><th>Relevant permit condition(s)</th></tr>
<tr><td></td><td>plant, and throughout its operating life;
ix. application of sectoral benchmarking on a regular basis.

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

<table><tr><th>Technique</th><th>Description</th></tr><tr><td>i. Design techniques</td><td></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>ii. Process control and maintenance techniques</td><td></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><tr><td>c. Use of energy</td><td>Use of energy benchmark. Participation in</td></tr></table></td><td>CC</td><td>The Operator states that they minimise energy consumption by employing sound design techniques and process control and maintenance techniques.

The site is not ISO 50001 certified.

The site have combined heat and power (CHP) and generate electricity as a by-product of making steam.

i. <u>Design Techniques</u>

a. Numerous pinch studies have been performed on the main crude distiller on site. One of these studies resulted in a major heat integration project being implemented on the unit in the mid-eighties to dramatically improve the heat integration.

b. Heat integration is adopted on all units on site where possible to recover as much heat as possible, thereby minimising fuel consumption.

c. The fluidised catalytic cracker (FCC) is a power recovery train and a waste heat boiler is installed to maximise heat recovery from the FCC regeneration flue gases.

Platformer 3 has a hot oil loop incorporated in its furnace convection bank which recovers heat from the flue gas into the hot oil system used on secondary processes. This minimises the required duty on the Aromatics hot oil</td><td>1.2</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)
	benchmarking: ranking and benchmarking activities in order to achieve continuous improvement by learning from best practice iii. Energy efficient production techniques and description a. Use of combined heat and power.: System designed for the co-production (or the cogeneration) of heat (e.g. steam) and electric power from the same fuel b. Integrated gasification combined cycle (IGCC).: 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		furnaces F5901A/B. ii. Process control and maintenance techniques a. All combustion units on site have automated controlled combustions system designed to safely operate the units whilst minimising energy consumption. b. NA c. The site participates in major Solomon benchmarking studies which amongst other things benchmarks energy performance of the site with other sites. iii. Energy efficient production techniques and description a. Yes (see above) b. NA BAT is to use an appropriate combination of techniques. The operator confirmed in their response received 6 April 2018 that an Energy Saving Opportunities Scheme (ESOS) assessment was completed and submitted in December 2015. The ESOS is a government scheme which requires accreditation every four years. We agree with the operator's stated compliance.	

<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>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>CC</td><td>The operator states that all fresh catalyst stored on site is done so in enclosed containers or sealed bags. FCC catalyst is stored in fresh catalyst hoppers which are enclosed vessels. Waste catalyst from the FCC is stored in enclosed vessels equipped with a cyclone in the gas outlet to minimise any release of fines to atmosphere.

i. NA
ii Yes, see above
iii NA
iv NA

BAT is to use one or a combination of techniques.

We agree with the operator’s stated compliance.</td><td>3.2</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>SO_X, NO_X and dust emissions</td><td>Catalytic cracking</td><td>continuous</td><td>Direct measurement</td></tr>
<tr><td></td><td>Combustion units ≥ 100MW ([3]) and calcining units</td><td>continuous</td><td>Direct measurement ([4])</td></tr>
<tr><td></td><td>Combustion units of 50 to 100 MW ([3])</td><td>continuous</td><td>Direct measurement or indirect monitoring</td></tr>
<tr><td></td><td>Combustion units < 50 MW</td><td>once a year and after</td><td>Direct measurement</td></tr>
</table>
</td><td>CC/FC/NA</td><td>SO_X, NO_X and dust emissions
<u>Catalytic cracking</u> (CC)
CO boiler, emission point ref A-11, CEMS Installed for SOx, NOx and dust monitoring.

<u>Combustion units ≥ 100 MW</u> (CC)
CDU-4, emission point ref A-2, CEMS installed for SOx, NOx and dust monitoring.

HPBH, emission point ref A-4, CEMS installed for SOx, NOx and dust monitoring.

Platformer and HDT3, emission point ref A-5, CEMS installed for SOx, NOx and dust monitoring.

Secondary Processes, emission point ref A-6, CEMS installed for SOx, NOx and dust monitoring.

<u>Combustion units 50 to 100 MW</u> (FC)
CDU-3, emission point ref A-1, No CEMS, currently mothballed. The operator confirms that CEMS will be installed when CDU-3 is restarted.</td><td>3.5.1</td></tr>
</table>

BAT Conclusion Number	Summary of BAT Conclusion requirement	Status NA/ CC / FC / NC	Assessment of the installation capability and any alternative techniques proposed by the operator to demonstrate compliance with the BAT Conclusion requirement	Relevant permit condition(s)

	([3])	significant fuel changes	or indirect monitoring
	Sulphur recovery units (SRU)	continuous for SO2 only	Direct measurement or indirect monitoring ([6])
NH_3 emissions	All units equipped with SCR or SNCR	continuous	Direct measurement
CO emissions	Catalytic Cracking and combustion units >= 100MW ([3])	continuous	Direct measurement
	Other combustion units	once every 6 months ([5])	Direct measurement
Metal emissions: Nickel (Ni) Antimony (Sb) Vanadium (V)	Catalytic cracking	once every 6 months and after significant changes to the unit ([5])	Direct measurement or analysis based on metals content in the catalyst fines and in the fuel
	Combustion units ([8])		
Polychlorinated 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

MPBH, emission point ref A-12, we will require periodic monitoring for NOx and SOx.

For units between 50 – 100 MW indirect continuous monitoring can be used through oxygen measurement and representative measurement of the fuel.

For CDU-3, compliance with a pre-operational condition is necessary prior to unit start up. We have amended the condition to take into account the requirements of the BAT Conclusions for the Refining of Mineral Oil & Gas.

Combustion units <50 MW **(CC)**

SOx, NOx and dust emissions are undertaken indirectly by calculation.

Monthly calculation and reporting of NOx and SOx to the Environment Agency.

Dust is calculated on a monthly basis but not reported. externally.

For units below 20MW we will not require any monitoring.

Molecular sieve CD4 (2.4 MWth), emission point ref A-3, we will require NOx and SOx by calculation.

HDT2 (17.4 MWth), emission point ref A-7, we will require NOx and SOx by calculation.

HD Select (7.0 MWth), emission point ref A-8, we will require NOx and SOx by calculation.

EBU (9.45 MWth), emission point ref A-9, we will require NOx and SOx by calculation.

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)
	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		SRU **(CC)** SRU, emission point ref A-10, CEMS installed for SO_2 monitoring. We agree with the operator's stated compliance. **NH_3 emissions NA** NA - SCR/SNCR not installed. We agree with the operator's stated compliance. **CO emissions** Catalytic Cracking and combustion units >= 100MW **(CC)** CO Boiler, emission point ref A-11, CEMS installed for CO monitoring. CDU-4, emission point ref A-2, CEMS installed for CO monitoring. HPBH, emission point ref A-4, CEMS installed for CO monitoring. Platformer and HDT3, emission point ref A-5, CEMS installed for CO monitoring. Secondary Processes, emission point ref A-6, CEMS installed for CO monitoring. Other combustion units **(FC)** CDU-3, emission point ref A-1, quarterly testing carried out until 2014 (now mothballed). We will require monitoring at least every six months if the unit is brought into operation. CD4 molecular sieve, emission point ref A-3, will measure from October 2018 as required. For units below 20MW	

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)
			(2.4 MWth) we will not require any monitoring. HDT2, emission point ref A-7, will measure from October 2018 as required. For units below 20MW (17.4 MWth) we will not require any monitoring. HD Select, emission point ref A-8, will measure from October 2018 as required. For units below 20MW (7.0 MWth) we will not require any monitoring. EBU, emission point ref A-9, will measure from October 2018 as required. For units below 20MW (9.45 MWth) we will not require any monitoring. MPBH, emission point reference A-12, will measure from October 2018 as required. We will require monitoring at least every six months. We agree with the operator's stated compliance. **Metal emissions: Nickel (Ni) Antimony (Sb) Vanadium (V)** Catalytic cracking **(CC)** CO Boiler, emission point ref A-11, indirect measurement based on catalyst fines and liquid fuel analysis. Combustion units We have set metals monitoring requirements as detailed below. CDU-3, emission point ref A-1, monitoring will be required if this unit comes into operation, currently mothballed and only when firing on liquid fuel. Compliance with a pre-operational condition is necessary	

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)
			prior to unit start up. We have amended the condition to take into account the requirements of the BAT Conclusions for the Refining of Mineral Oil & Gas. CDU-4, emission point ref A-2, required when firing on liquid fuel. HPBH, emission point ref A-4, required. Platformer and HDT3, emission point ref A-5, not required as firing 100% gaseous fuel only (RFG). Secondary Processes, emission point ref A-6, not required when firing 100% gaseous fuel only (RFG). We will require when firing on liquid/multi-fuel. MPBH, not required for standby plant. For units below 20MW we will <u>not</u> require any monitoring: Molecular sieve CD4 (2.4 MWth), emission point ref A-3. HDT2 (17.4 MWth), emission point ref A-7. HD Select (7.0 MWth), emission point ref A-8. EBU (9.45 MWth), emission point ref A-9. We agree with the operator's stated compliance. **Polychlorinated dibenzodioxins/furans (PCDD/F) emissions (FC)** <u>Catalytic reformer</u> The operator commits to measure from October 2018 annually as required. We have specified this requirement in the permit at emission point A-5.	

<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>We agree with the operator’s stated compliance.

For monitoring that is not CC (FC), the operator commits to achieving compliance by October 2018.</td><td></td></tr>
<tr><td>5</td><td>BAT is to monitor the relevant process parameters linked to pollutant emissions, at catalytic cracking and combustion units by using appropriate techniques and with at least the frequency given below.

<table><tr><th>Description</th><th>Minimum frequency</th></tr><tr><td>Monitoring of parameters linked to pollution emissions, e.g. O_2 content in flue-gas, N and S content in fuel or feed (1)</td><td>Continuous for O_2 content. For N and S content, periodic at a frequency based on significant fuel/feed changes.</td></tr></table>(1) N and S monitoring in fuel or feed may not be necessary when continuous emission measurement of NO_X and SO_2 are carried out at the stack.</td><td>CC</td><td>CDU-3, emission point A-1
This unit is currently mothballed; however if it comes into operation periodic monitoring will be carried out.

We will not require continuous oxygen monitoring where sites are carrying out periodic monitoring, in line with the Chapter III Protocol, subject to no backsliding.

We have retained periodic monitoring in line with Chapter III Protocol.

CDU-4, emission point ref A-2
HPBH, emission point ref A-4
Platformer and HDT3, emission point ref A-5
Secondary Processes, emission point ref A-6

For the above units there is continuous monitoring of O_2 in the flue gas and continuous monitoring of NOx and SO_2.

We have retained these requirements (no requirement to monitor N and S in the fuel/feed).

CD4 molecular sieve, emission point ref A-3
HDT2, emission point ref A-7
HD Select, emission point reference A-8
EBU, emission point ref A-9
MPBH, emission point ref A-12

The sulphur content of refinery fuel gas, refinery liquid fuels is measured on a weekly basis.

NOx emissions are calculated from NOx factors, which are based on standard industry factors from CONCAWE.</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)
			We have not required monitoring for O_2. For units below 20MW we will not require any monitoring. CO Boiler, emission point ref A-11 Continuous monitoring of O_2 in the flue gas. The sulphur and nitrogen content of the FCC feed is measured on a daily basis. Continuous monitoring of NOx and SO_2 at the CO boiler stack. We have retained the continuous monitoring for NOx and SO_2 (no requirement to monitor N and S in the fuel/feed) and added continuous monitoring for O_2. We agree with the operator's stated compliance.	
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 states that they have had an established LDAR programme dating from 1995. The programme includes the use of both a conventional VOC monitor and optical gas imaging (OGI) techniques. Quantification is based on Leak/No Leak factors generated by the USEPA. They do not use correlation factors as Method EN15446:2008. Fugitive emissions are currently reported on an annual basis as part of the Pollution Inventory submission. Chronic emissions (Tank Storage and Waste Water Treatment Plants) are calculated using emission factors. These calculations are not validated by measurements. i. They do not use correlation factors as Method EN15446:2008. There is a commitment to introducing the requirements by October 2018.	3.2

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 They use a conventional VOC monitor and optical gas imaging (OGI) techniques. Quantification is based on Leak/No Leak factors generated by the USEPA. iii. Chronic emissions (tank storage and waste water treatment plants) are calculated using emission factors. These calculations are not validated by measurements. BAT is to use all of the techniques. The operator state they are partially complaint and will be compliant by October 2018. We agree with the operator's stated compliance. We have set an improvement condition to secure compliance.	
7	**In order to prevent or reduce emissions to air, BAT is to operate the acid gas removal units, sulphur recovery units and all other waste gas treatment systems with a high availability and at optimal capacity.** Special procedures can be defined for other than normal operating conditions, in particular: i. During start-up and shut-down 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.	FC	The installation has two sulphur recovery units which spare each other. Each unit has a design throughput of 120T/D of H_2S. The H_2S comes from the main Amine Regeneration Unit (ARU), the site Sour Water Stripper (SWS) and an ARU on HDS2. Spare sulphur recovery units ensure 100% availability. The SWS has an emergency sour water storage tank to ensure storage of sour water in the event of an outage on the SWS. The storage tanks have three days ullage available at normal production rates of sour water. i. The main ARU is run as a critical unit which is only shut-down during major TAs, i.e. when all process units are shut-down. For a Refinery TA the Sulphur units are shutdown last and started up first, in order to be ready to process and recover sulphur as soon as possible. There are two Sulphur Recovery Units (SRUs) to ensure that one is always available.	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)
			Start-up and shut-down use best practice to minimise flaring duration. ii. The sparing philosophy for the SWS is based on ullage in sour water tanks, i.e. if equipment cannot be repaired within the three days available then it is spared. A second SWS is being installed in the 2018 TA. The sour water tanks are shared between both SWSs. The ARU is only shut-down during a TA with equipment sparing to facilitate this. The SRU can be maintained outside of a TA as there are two units. iii. The SRU is designed for a high turn-down ratio. In the event of very low throughput fuel gas is burned to supplement the waste gas flow. The operator confirms that there are no formal procedures in place that cover specific events and that these will be developed by October 2018. We have incorporated specific requirements into Table S1.2 of the permit to secure compliance. These requirements are applicable to oil and gas refineries which have acid gas removal systems, including amine treatment and aqueous and alkali scrubbing systems. We agree with the operator's stated compliance.	
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.**	NA	The operator states that there is no SCR/SNCR at the installation. We agree with the operator's status.	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></td><td>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.

<table><tr><th>Parameter</th><th>BAT-AEL (monthly average mg/m^3)</th></tr><tr><td>Ammonia expressed as NH_3</td><td><5 - 15mg/Nm^3 ([1]) ([2])</td></tr><tr><td colspan="2">([1]) the higher end of the range is associated with higher inlet NO_X concentrations, higher NO_X reduction rates and the ageing of the catalyst
([2]) The lower end of the range is associated with the use of the SCR technique.</td></tr></table></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>CC</td><td>The operator state that all sour water on site is processed via the main sour water stripper unit, U5950. Sour gas from this unit is routed directly to a sulphur recovery unit. No untreated sour water stripper gas is incinerated.

We agree with the operator’s stated compliance.</td><td>2.3.1</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 (See BAT 12 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.</td><td>NC Derogation See BAT 12</td><td>See BAT 12 below</td><td>3.5.1</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</td><td>Generally applicable for new units. For existing</td></tr></table></td><td>CC</td><td>i. The crude distiller collects all process condensate from the unit and reuses this as desalter wash water.

Likewise, stripped sour water from the sour water stripper is reused on the FCC as wash water for the column overheads.

Process condensate on HDS2 is used as wash water at</td><td>1.3.1</td></tr>
</table>

BAT Conclusion Number	Summary of BAT Conclusion requirement			Status NA/ CC / FC / NC	Assessment of the installation capability and any alternative techniques proposed by the operator to demonstrate compliance with the BAT Conclusion requirement	Relevant permit condition(s)
		internal reuse of water streams from e.g. cooling, condensates, especially for use in crude desalting	units, applicability may require a complete rebuilding of the unit or the installation		various locations in the unit. Boot drain water is used as a desalter on the CDU. These techniques minimise the use of fresh water. ii. The installation has a sour water stripper and process effluent is treated in a dedicated dissolved air flotation (DAF) unit. iii. As an existing installation it is not practical to segregate the drains. iv. The installation has risk based inspection procedures. In addition there is spill kit and emergency procedures. Interceptors are actively de-sludged. We have however set an improvement condition. We are setting this requirement for the sector where segregation of waste water streams is poor. We agree with the operator's stated compliance.	
	ii. water and drainage system for segregation of contaminated water streams	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	Generally applicable for new units. For existing units, applicability may require a complete rebuilding of the unit or the installation			
	iii. segregation of non-contaminated water streams (e.g. once-through cooling, rain water)	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	Generally applicable for new units. For existing units, applicability may require a complete rebuilding of the unit or the installation			
	iv. prevention of spillages and leaks	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.	Generally applicable			
12	**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.**			NC Derogation	i. The installation has interceptors, oil skim on effluent tanks and DAF systems. ii. The installation has interceptors, API, CPI, PPI and	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. Removal of insoluble substances by recovering oil</td><td>See Section 1.21.2, Annex 1.</td><td>Generally applicable</td></tr>
<tr><td>ii. Removal of insoluble substances by recovering suspended solids and dispersed oil</td><td>See Section 1.21.2, Annex 1.</td><td>Generally applicable</td></tr>
<tr><td>iii. Removal of insoluble substances including biological treatment and clarification.</td><td>See Section 1.21.2, Annex 1.</td><td>Generally applicable</td></tr>
</table>
BAT – associated emission levels – see Table 3
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)</td><td>mg/l</td><td>1 – 25 (6)</td><td>Daily</td></tr>
</table>
</td>
<td></td>
<td>
DAF units.
iii. The installation has bio-treatment on two of the effluent streams.
Deficiencies are being addressed under the derogation.
An effluent treatment project is underway and a derogation has been applied for and approved.
Each emission point is addressed separately.
There can only be partial compliance regarding composite sampling as a sampler needs to be relocated as part of the effluent treatment project.
Derogations are required for the following parameters at the following emission points:
<table>
<tr><th>Emission Point</th><th>BAT AEL derogations requested</th></tr>
<tr><td>W1–SDAF</td><td>Hydrocarbon Oil Index (HOI)</td></tr>
<tr><td>W2–NDAF</td><td>HOI
Total suspended solids (TSS)
Chemical oxygen demand (COD)</td></tr>
<tr><td>W3 – N38</td><td>HOI
Total suspended solids (TSS)
Benzene</td></tr>
</table>
</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>expressed as N</td><td></td><td></td><td></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>
<tr><td>Phenol index</td><td>mg/l</td><td>No BAT - AEL</td><td>Monthly
EN 14402</td></tr>
<tr><td>Benzene, toluene, ethyl benzene, xylene (BTEX)</td><td>mg/l</td><td>Benzene
0.001 – 0.050
No BAT – AEL for T, E, X</td><td>Monthly</td></tr>
<tr><td colspan="4">(1) Not all parameters and sampling frequencies are applicable to effluent from gas refining sites
(2) Refers to a flow-proportional composite sample taken over period of 24 hours, or provided that sufficient flow stability is demonstrated, a time-proportional sample
(3) Moving from the current method to EN 9377-2 may require an adaptation period
(4) Where on-site correlation is available, COD may be replaced by TOC. The correlation between COD and TOC should be elaborated on a case-by-case basis. TOC monitoring would be the preferred option because it does not rely on the use of very toxic compounds
(5) Where total-nitrogen is the sum of the total Kjedahl nitrogen (TKN), nitrates and nitrites
(6) When nitrification/denitrification is used, levels below 15 mg/l can be achieved</td></tr>
</table>
</td>
<td></td>
<td>
<table>
<tr><td>W4–North Site Interceptors (N19)</td><td>HOI
Total nitrogen, expressed as N
Lead, expressed as Pb
Cadmium, expressed as Cd
Nickel, expressed as Ni
Mercury, expressed as Hg</td></tr>
</table>
<table>
<tr><td>W5</td><td>NA</td></tr>
<tr><td>W6</td><td>NA</td></tr>
<tr><td>W7</td><td>NA</td></tr>
<tr><td>W8</td><td>NA</td></tr>
<tr><td>W9</td><td>NA</td></tr>
<tr><td>W10</td><td>NA</td></tr>
<tr><td>W12</td><td>NA</td></tr>
<tr><td>W13</td><td>NA</td></tr>
<tr><td>W14</td><td>NA</td></tr>
<tr><td>W15</td><td>NA</td></tr>
<tr><td>W16</td><td>NA</td></tr>
</table>
Refer to Section 7 of this document for our assessment of the derogation request.

Following completion of the improvements the emissions to water will be as follows:
</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)

Outfall no.	Description	Future position (from 31 March 2021)
W1	SDAF to Thornton Brook	W1 to remain in place, normally no flow
W2	NDAF to River Gowy	W2 to remain in plane, normally no flow
W3	N38 to Manchester Ship Canal (PDAF, T1402, Demin, Hill site runoff, OTCW)	W3 to remain in place, reduced flow (Demin, Hill site runoff). Will meet BAT-AELs.
W4	N19 to River Gowy	W4 will remain in place, reduced flow (N55, N56, N1B removed). Will meet BAT-AELs.
W5	Ince purge cooling water	No change
W6	Redundant rail loading runoff to River Gowy	No change
W7	LPG spheres runoff to Mill Brook	No change
W8	LPG Firewater Deluge to Mill Brook	No change
W9	SHOP Runoff to River Gowy [3]	No change
W10	LPG Firewater Deluge to River Gowy	No change
W12	T1403/T1404 overflow to Thornton Brook	No change, normally no flow
W13	T1405A/B overflow to River Gowy	No change, normally no flow
W14	T1402A/B Overflow to Gale Brook	No change, normally no flow
W15	T7801/T7802 overflow to Gale Brook	No change, normally no flow
W16	Surface water from car parking, road and Track A to Gale Brook	No change
S1	U7800 effluent to United Utilities	Additional effluents to be sent to UU for biological treatment: SDAF (redirected from W1) NDAF (redirected from W2) PDAF (redirected from W3) T1402A/B (redirected from W3)
New outfall	T4082/T4084 overflow	New outfall required for tank emergency overflow. (Normally no flow)

[3] W9 has not been discussed in this document, since it is a discharge from a chemicals plant and therefore not covered by the requirements of the Refinery BREF.

W12 to W15 are storm water over-flows and are subject to compliance with storm overflow procedures.

We have set monitoring requirements in the permit to deliver compliance in accordance with the derogation.

We have retained Table S3.2 with no changes, which is applicable to 28 October 2018.

We have added Table S3.2(a), which applies from 28 October 2018 up to the completion of the BAT 12 derogation set out in the improvement condition in Table S1.3 of the permit (no later than 30 September 2021). This covers the period of the derogation.

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)
			We have added Table S3.2(b), which applies following completion of the BAT 12 derogation set out in the improvement condition in Table S1.3 of the permit – applicable no later than the 30 September 2021. This contains the BAT AELs. We have included separate tables for each stage to future proof the permit allowing the deletion of the appropriate tables in future variations. Other parameters already in the permit will not require monitoring to be continued and have been removed e.g. As, Cr, Cu, Zn etc. We have included footnotes to tables S3.2(a) & S3.2(b) for COD, hydrocarbon oil index and phenol index. These are required for the validation of current monitoring methods against new methods required by the BREF. The operator confirmed that their analytical laboratory participates in a proficiency scheme. They provided a comparison of the results obtained in the proficiency scheme for both the colorimetric phenol method (current method UK497/ISO 6439) and the flow injection analysis (BAT method EN14402). For the eleven separate scheme samples there was no statistical difference between the median results reported by all participants for both methods. The operator's analytical laboratory results were also within statistical reporting limits for all the scheme samples showing as a laboratory they are in good agreement with both methods. We accept that the current method is equivalent to the BAT method and have set the current monitoring method in the permit. The operator will be required to validate this periodically.	

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 outcome of IC5 was that no composite is sampling required at W1; however composite sampling at the other emission points is required. We have updated the relevant tables from 'spot samples' to 'composite samples' for all emission points except W1. A footnote is also added requiring installation of the sampler to implement 24 hour flow proportional sampling, in accordance with the improvement condition for the BAT Conclusion 12 derogation in Table S1.3 of the permit. Until this time collection of representative spot samples shall apply at W1. Where existing monitoring standards / frequencies/ limits are tighter we have retained the existing requirements on the basis of no backsliding, e.g. W1/W2/W3 - limits for Total nitrogen, Pb, Cd, Ni & Hg set lower than the BAT AEL. On completion of the improvements defined by BAT 12 and the transfer of effluent to the third party waste water treatment works (WWTW), the emission points W1 & W2 will remain in place. This is required in the event that the effluents cannot be discharged to the WWTW during which time it is proposed to hold up the effluent where possible on-site. Where this is not possible it is proposed to discharge via the current outfalls. The Operator state that the environmental impact of this is considered to be less than the impact of shutting the refinery down. We will require specific procedures setting out requirements and the impacts associated with any release and have secured this requirement by inclusion in the improvement condition for BAT 12. The BAT AELs are set for emissions directly from effluent treatment.	

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)
			Where effluent treatment is undertaken by a third party off-site then a treatment factor is applied to the BAT AEL, so that a limit can be set at the point of discharge from the installation at emission point S1. We have added Table S3.3(a) to include limits at S1 following completion of the improvements. We have set an improvement condition which will provide the necessary information to set these limits. e.g.: If the BAT AEL for a pollutant is 10 mg/l and the off-site abatement can achieve 60% reduction in that pollutant then limit would be set at 25 mg/l. This interpretation of the above is solely in relation to the BREF and not the Water Framework Directive (WFD). Additional demonstration in relation to WFD requirements will be considered separately and are being addressed via improvement conditions. We have set an improvement condition to track progress of the improvements and to address deficiencies. We have also included deficiencies identified in a report submitted for IC9 and subsequently identified this IC as complete. We agree with the operator's stated compliance.	
13	**When further removal of organic substances or nitrogen is needed, BAT is to use an additional treatment step as described in Section 1.21.2 (see Annex 1).**	NA	We agree with the operator's status.	NA

<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>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>The operator are committed to the application of the Waste Hierarchy as required under the Waste (England & Wales) Regulations. A dedicated Waste Management Department has been appointed to coordinate and advise on all waste disposal matters. This department approves all contracts involving the off-site management of waste. The team actively seeks opportunities to increase the percentage of total waste recovered. The quantity of waste generated on site is decreasing and typically over 70% of the waste is recovered.

We agree with the operator’s stated compliance.</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 pre-treatment</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>i. All sludges are put through a three stage centrifuge to separate oil and water from the solids prior to incineration on-site.

We agree with the operator’s stated compliance.</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>16</td><td>In order to reduce the generation of spent solid catalyst waste, BAT is to use one or a combination of the techniques given below.

<table><tr><th>Technique</th><th>Description</th></tr><tr><td>i. Spent solid catalyst management</td><td>Scheduled and safe handling of the materials used as catalyst (e.g. by contractors) in order to recover or reuse them in off-site facilities. These operations depend on the type of catalyst and process</td></tr><tr><td>ii. Removal of catalyst from slurry decant oil</td><td>Decanted oil sludge from process units (e.g. FCC unit) can contain significant concentrations of catalyst fines. These fines can be separated prior to the reuse of decant oil as a feedstock.</td></tr></table></td><td>CC</td><td>i. Spent catalyst is sent to a third party company for regeneration or recovery of precious metals. Alumina based spent catalysts are incinerated on-site.

We agree with the operator’s stated compliance.</td><td>1.4.1</td></tr>
<tr><td>17</td><td>In order to prevent or reduce noise, BAT is to use one or a combination of the techniques given below:

i. Make an environmental noise assessment and formulate a noise management plan as appropriate to the local environment;
ii. Enclose noisy equipment/operation in a separate structure/unit;
iii. Use embankments to screen the source of noise;
iv. Use noise protection walls;</td><td>CC</td><td>Noise monitoring will be carried out if required. Noise is assessed as part of any project when designing new equipment. Complaints are monitored and the risk of noise generation from new site activities and turnarounds is assessed.

i. Off-site monitoring has been undertaken, with the most recent data being in 2016. The number of noise complaints is at a very low level. More routine monitoring will only be required if noise becomes an issue for the site.

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

<table><tr><th>Technique</th><th>Description</th><th>Applicability</th></tr><tr><td>I. Techniques related to</td><td>i. Limiting the number of potential emission sources</td><td>Applicability may be</td></tr></table></td><td>CC</td><td>I. For installation of new plants or upgrades to existing plants, the site applies industry design standards. These standards cover minimising leak sources by e.g. minimising use of flanges. Any process relief or vents are routed to the site flare system. Hazard and Operability Studies and Instrumented Protective Function Reviews all</td><td>3.2.1</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)
	plant design. — ii. Maximising inherent process containment features; iii. Selecting high integrity equipment; iv. Facilitating monitoring and maintenance activities by ensuring access to potentially leaking components — limited for existing units II. Techniques related to plant installation and commissioning — i. Well defined procedures for construction and assembly; ii. Robust commissioning and hand-over procedures to ensure that the plant is installed in line with the design requirements. — Applicability may be limited for existing units III. Techniques related to plant operation — 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 — Generally applicable		require consideration of environmental consequences when assessing the integrity of equipment and barriers required. Plant layout reviews also take into account the ease of maintenance for equipment that may require regular inspection and maintenance. II. All construction, assembly, commissioning and handover procedures are covered within an Engineering & Projects Management System. Leak minimisation is taken into account via appropriate pressure testing of equipment and appropriate checks by operations during start-up to ensure any leaks that do occur are quickly identified and acted upon. III. The installation has a LDAR programme which consists of surveys carried out on each relevant unit. The frequency is based on risk. Monitoring is carried out using an FLIR (Forward Looking Infra Red) camera. The data from these surveys is used in conjunction with tank emissions data to assess total fugitive emissions from the refinery. We agree with the operator's stated compliance.	
19	**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.	CC	The HFA has a dedicated acid relief header which is routed to a knockout vessel, V6101. Gases from V6101 are routed to a scrubber column, C6061, where any trace HF is removed using potassium hydroxide (KOH). The treated gases are then vented to flare. The neutralising basin, T6101, and acid deluge holding pit, T6103, are sealed and any gases from T6101/3 are routed through scrubber vessels, V6105A/B before being vented to atmosphere. We agree with the operator's stated compliance.	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>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>CC</td><td>i. Any water on the unit is routed via the acid drain sewer or rainwater sewer to the neutralising basin, T6101, where it is neutralised using KOH. The neutralised water is then pumped to V6103 where it is mixed with fresh KOH solution and stored in the additive storage drum, V6065, before use.

ii. The neutralising basin, T6101, acts as a settling basin. KF2 is periodically removed from T6101.

We agree with the operator’s stated compliance.</td><td>2.3.1</td></tr>
<tr><td>21</td><td>In order to reduce the emissions to water from the sulphuric acid alkylation process, BAT is to reduce the use of sulphuric acid by regenerating the spent acid and to neutralise the waste water generated by this process before routing to waste water treatment.</td><td>NA</td><td>The operator confirm that this is not applicable to the installation.

We agree with the operator’s status.</td><td>NA</td></tr>
<tr><td>22</td><td>In order to prevent and reduce the emissions of hazardous substances to air and water from base oil production processes, BAT is to use one or a combination of the techniques given below.

<table><tr><th>Technique</th><th>Description</th><th>Applicability</th></tr><tr><td>i. Closed process with a solvent</td><td>Process where the solvent, after being used during base oil manufacturing (e.g. in</td><td>Generally applicable</td></tr></table></td><td>CC</td><td>i. The base oil HVI unit uses furfural as an extraction solvent and MEK as a de-waxing solvent. Both solvents are recovered through distillation and stripping to minimise hazardous emissions. The base oil units are currently mothballed.

We agree with the operator’s stated compliance.</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)
	recovery	extraction, de-waxing units), is recovered through distillation and stripping steps. See Section 1.20.7, Annex 1.				
	ii. Multi-effect extraction solvent-based process	Solvent extraction process including several stages of evaporation (e.g. double or triple effect) for a lower loss of containment	Generally applicable to new units. The use of a triple effect process may be restricted to non-fouling feed stocks			
	iii. Extraction unit processes using less hazardous substances	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	Generally applicable to new units. Converting existing units to another solvent-based process with different physico-chemical properties may require substantial modifications			
	iv. Catalytic processes based on hydrogenation	Processes based on conversion of undesired compounds via catalytic hydrogenation similar to hydrotreatment.	Generally applicable to new units			

<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>23</td><td>In order to prevent and reduce emissions to air from the bitumen production process, BAT is to treat the gaseous overhead by using one of the techniques given below

<table><tr><th>Technique</th><th>Description</th><th>Applicability</th></tr><tr><td>i. Thermal oxidation of gaseous overhead over 800 °C</td><td>See Section 1.20.6, Annex 1.</td><td>Generally applicable for the bitumen blowing unit</td></tr><tr><td>ii. Wet scrubbing of gaseous overhead</td><td>See Section 1.20.3, Annex 1.</td><td>Generally applicable for the bitumen blowing unit</td></tr></table></td><td>NA</td><td>The operator confirm that there is no bitumen unit at the installation.

We agree with the operator’s status.</td><td>NA</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></table></td><td>CC</td><td>The FCC is an existing unit, built in the mid 1980's and operates in partial combustion mode. Process optimisation is the only technique employed to reduce NOx emissions from the FCC. Monthly average NOx emissions during 2016 on the FCC were 265 mg/Nm^3. The operator intends to include the unit in the NOx emissions bubble.

I. i. The CO Boiler is air staged with excess air target at 1.6%. NOx emissions are below the BAT AEL of 400 mg/Nm^3.

II. No secondary techniques are currently employed to reduce NOx as the unit currently operates below the BAT AEL.

We have retained the limit; however this emission is to be included in the NOx bubble.

We agree with the operator’s stated compliance.</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>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>
<tr><td>iii. Specific additive for NO_X reduction</td><td>Use of specific catalyst additives for enhancing the reduction of NO by CO</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>
II Secondary or end-of-pipe techniques such as:
<table>
<tr><th>Technique</th><th>Description</th><th>Applicability</th></tr>
<tr><td>i. Selective catalytic reduction (SCR)</td><td>See section 1.20.2, Annex 1.</td><td>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.</td></tr>
</table>
</td><td></td><td></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. Selective non-catalytic reduction (SNCR)	See section 1.20.2, Annex 1.	For partial combustion FCCs with CO boilers, a sufficient residence time at the appropriate temperature is required. For full combustion FCCs without auxiliary boilers, additional fuel injection (e.g. hydrogen) may be required to match a lower temperature window.			
		See section 1.20.2, Annex 1.	Need for additional scrubbing capacity. Ozone generation and the associated risk management need to be properly addressed. The applicability may be limited by the need for additional waste water treatment and related cross-media effects (e.g. nitrate emissions) and by an insufficient supply of liquid oxygen (for ozone generation). The applicability of the technique may be limited by space availability.			

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

Parameter	Type of unit/combustion mode	BAT-AEL (monthly average) Mg/Nm^3
NO_X expressed as NO_2	New unit/all combustion mode	<30 – 100

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

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

<table>
<tr><th>Technique</th><th>Description</th><th>Applicability</th></tr>
<tr><td>i. Use of an attrition-resistant catalyst</td><td>Selection of catalyst substance that is able to resist abrasion and fragmentation in order to reduce dust emissions.</td><td>Generally applicable provided the activity and selectivity of the catalyst are sufficient</td></tr>
<tr><td>ii. Use of low sulphur feedstock (e.g. by feedstock selection or hydrotreatment of feed)</td><td>Feedstock selection favours low sulphur feed-stocks among the possible sources. Hydrotreatment aims at reducing the sulphur, nitrogen and metal contents of the feed.</td><td>Requires sufficient availability of low sulphur feed-stocks, hydrogen production and hydrogen sulphide (H2S) treatment capacity (e.g. amine and Claus units)</td></tr>
</table>

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

<table>
<tr><th>Technique</th><th>Description</th><th>Applicability</th></tr>
<tr><td>i. Electrostatic precipitator (ESP)</td><td>See section 1.20.1, Annex1.</td><td>For existing units, the applicability may</td></tr>
</table>
</td><td>CC</td><td>The FCC is an existing unit, built in the mid 80's and operates in partial combustion mode. Catalyst selection and multistage cyclone separators are techniques employed to reduce dust and metals emissions.

The 2016 average dust emission (excluding soot blowing) was 32 mg/Nm^3.

I. i. The operator works with catalyst suppliers to provide a bespoke catalyst for the FCC, which conforms to various requirements amongst which is minimising attrition rates and therefore dust emissions.

I. ii. Low sulphur feedstock is selected and used on site, however, this is mainly employed to control SOx emissions rather than dust.

II. ii. A tertiary stage cyclone is installed on the flue gas outlet of the regenerator on the FCC to minimise loss of catalyst to the atmosphere. The overall removal efficiency is between 95% and 97%.

Dust emissions - 2016 monthly average (excluding soot blowing) (mg/Nm^3):
January = 34 / February = 25 / March = 26
April = 34 / May = 28 /June = 32 / July = 31
August = 31 / September = 34 / October = 40
November = 42 / December = 43

We have replaced the dust limit of 100 mg/Nm^3 with the</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)

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

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

Parameter	Type of unit	BAT-AEL (monthly average) ([1]) Mg/Nm^3
Dust	New unit	10 – 25
	Existing unit	10 – 50 (2)

(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

The associated monitoring is in BAT 4.

BAT AEL limit of 50 mg/Nm^3.

We agree with the operator's stated compliance.

<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>26</td><td>In order to prevent or reduce SO_X emissions to air from the catalytic cracking process (regenerator), BAT is to use one or a combination of the techniques given below.

I. Primary or process-related techniques such as:

<table><tr><th>Technique</th><th>Description</th><th>Applicability</th></tr><tr><td>i. Use of SO_X reducing catalyst additives</td><td>Use of a substance that transfers the sulphur associated with coke from the regenerator back to the reactor.</td><td>Applicability may be restricted by regenerator conditions design. Requires appropriate hydrogen sulphide abatement capacity (e.g. SRU)</td></tr><tr><td>ii. Use of low sulphur feedstock (e.g. by feedstock selection of by hydrotreatment of the feed)</td><td>Feedstock selection favours low sulphur feed-stocks 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 feed-stocks, hydrogen production and hydrogen sulphide (H_2S) treatment capacity (e.g. amine and Claus units)</td></tr></table>
II. Secondary or end-of pipe techniques, such as:

<table><tr><th>Technique</th><th>Description</th><th>Applicability</th></tr><tr><td>i. Non-regenerative scrubbing</td><td>Wet scrubbing or seawater scrubbing</td><td>The applicability may be limited in arid areas and in the case where the by-</td></tr></table></td><td>CC</td><td>The FCC is an existing unit, built in the mid 80's and operates in partial combustion mode. Low sulphur feedstock selection is the only method used to reduce SO_2 emissions on the FCC.

Monthly average SOx emissions from the FCC (emission point A-11) for 2016 were 1120 mg/Nm^3. The operator intends to include the unit in the BREF SO_2 emissions bubble.

I. ii. Low sulphur feedstock selection is used on site to control SO_2 emissions on the FCC. Maximum feedstock sulphur level will vary according to reactor kinetics, coke burn and the site SO_2 bubble.

II. No secondary techniques are currently employed to reduce SO_2.

SO_2 emissions - 2016 monthly average (mg/Nm^3):
January = 1215 / February = 1329 / March = 1271
April = 1372 / May = 1474 / June = 1215 / July = 1149
August = 1155 / September = 1174 / October = 1179
November = 1214 / December = 1232

The existing limit of 1510 mg/Nm^3 is higher than the BAT AEL of 1200 mg/Nm^3. We have included the BAT AEL, with compliance via the site SO_2 bubble.

Compliance will be achieved by using low sulphur feedstock selection to control SO_2 emissions on the FCC. Maximum feedstock sulphur level will vary according to reactor kinetics, coke burn and the site SO_2 bubble.

We don’t agree with the operator’s stated compliance of CC as during 2016 the monthly average was exceeded eight times. Compliance will be achieved via the site SO_2</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)

		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	≤ 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		

bubble.

<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>≤600 mg/Nm^3

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

<table>
<tr><th>Technique</th><th>Description</th><th>Applicability</th></tr>
<tr><td>i. Combustion operation control</td><td>See section 1.20.5, Annex 1.</td><td>Generally applicable</td></tr>
<tr><td>ii. Catalysts with carbon monoxide (CO) oxidation promoters</td><td>See section 1.20.5, Annex 1.</td><td>Generally applicable only for full combustion mode</td></tr>
<tr><td>iii. Carbon monoxide (CO) boiler</td><td>See section 1.20.5, Annex 1.</td><td>Generally applicable only for partial combustion mode</td></tr>
</table>
Table 7 BAT- associated emission levels for carbon monoxide emissions to air from the regenerator in the catalytic cracking process for partial combustion mode.

<table>
<tr><th>Parameter</th><th>Combustion mode</th><th>BAT-AEL (monthly average) mg/Nm3</th></tr>
<tr><td>Carbon monoxide expressed as CO</td><td>Partial combustion mode</td><td>≤ 100 (1)</td></tr>
<tr><td colspan="3">(1) May not be achievable when not operating the CO boiler at full load.</td></tr>
</table>
The associated monitoring is in BAT 4</td><td>NC Derogation for the life time of the BREF</td><td>The FCC is an existing unit, built in the mid 80's and operates in partial combustion mode with a CO boiler downstream of the regenerator to combust CO. The CO boiler is co-fired with fuel gas. No air staging system is employed.

Monthly average normalised CO emissions (emission point REF-A-11) for 2016 were 610 mg/Nm^3.

Current CO emissions exceed the BAT AEL of 100 mg/Nm^3. An investigation has been carried out to ascertain the causes of the high CO emissions and how to minimise CO emissions whilst maintaining good NOx performance.

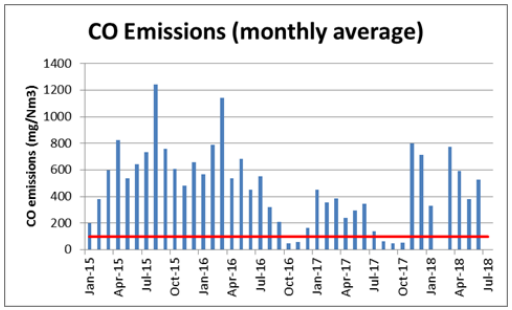
i. Cause of high CO levels has been identified. Work ongoing to identify a potential solution.

iii. The unit is equipped with a CO Boiler which reduces CO content of flue gases and recovers energy.

CO emissions - 2016 monthly average emissions (mg/Nm^3):
January = 568 / February = 791 / March = 1145
April = 980 / May = 686 / June = 272 / July = 923
August = 386 / September = 212 / October = 51
November = 64 / December = 165

A derogation has been applied for. Refer to Section 7 of this document for our assessment of the derogation request.

The operator provided additional information 18 July 2018</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)
			as set out below. This included more recent CO emissions data following modifications carried out during a recent refinery shut-down: The CO limit requested in the derogation was 1300 mg/Nm^3 (monthly average). The derogation included a chart showing CO emissions up to May 2017. The chart below shows that post shut-down, the CO levels are at the higher end of the data seen.  The proposed ELV was to allow some headroom above the highest result (1241 mg/Nm^3 in Aug 2015). This approach is consistent with other permitting decisions. There was no limit set in the existing permit. We have set a limit of 1300 mg/Nm^3 to allow some headroom above the highest result. The permit contains provision for this limit to be reviewed every 12 months. An improvement condition has also been set which includes investigation into modification of the boiler.	

<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>We agree with the operator’s stated compliance.</td><td></td></tr>
<tr><td>28</td><td>In order to reduce emissions of polychlorinated dibenzodioxins/furans (PCDD/F) to air from the catalytic reforming unit, BAT is to use one or a combination of the techniques given below

<table>
<tr><th>Technique</th><th>Description</th><th>Applicability</th></tr>
<tr><td>i. Choice of the catalyst promoter</td><td>Use of catalyst promoter in order to minimise polychlorinated dibenzodioxins/furans (PCDD/F) formation during regeneration. See section 1.20.7, Annex 1.</td><td>Generally applicable</td></tr>
<tr><td colspan="3">ii Treatment of the regeneration flue-gas</td></tr>
<tr><td>a) Regeneration gas recycling loop with adsorption bed</td><td>Waste gas from the regeneration step is treated to remove chlorinated compounds (e.g. dioxins)</td><td>Generally applicable to new units. For existing units the applicability may depend of the current regeneration unit design</td></tr>
<tr><td>b) Wet scrubbing</td><td>See section 1.20.3, Annex 1.</td><td>Not applicable to semi-regenerative reformers</td></tr>
<tr><td>c) Electrostatic precipitator (ESP)</td><td>See section 1.20.1, Annex 1.</td><td>Not applicable to semi-regenerative reformers</td></tr>
</table></td><td>CC</td><td>A catalyst promoter is used to minimise PCDD/F formation. Regeneration gases are treated via wet scrubbing.

i. Perchloroethylene is used as a catalyst promoter on the Platformer to minimise formation of PCDD/F.

ii. b) Regeneration gases are passed through a scrubber column, C9401, which uses demineralised water to extract HCL, PCDD/F and chlorine. The acidic effluent is routed to the plant drain and neutralised using 22wt% caustic before entering the plant interceptor pit, S42. A pH probe in S42 regulates the amount of caustic that is injected.

We have set monitoring for this parameter at emission point A-5 in accordance with the BREF.

We agree with the operator’s stated compliance.</td><td>2.3.1</td></tr>
<tr><td>29</td><td>In order to reduce emissions to air from the coking production processes, BAT is to use one or a combination of the techniques given below:</td><td>NA</td><td>The installation does not have a coker.

We agree with the operator’s status.</td><td>NA</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>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 blow down system</td><td>Arrestment system for pressure relief from the coke drum</td><td>Generally applicable</td></tr>
<tr><td>iv. Recovery of gas (including the venting prior to the drum being opened to atmosphere) as a component of refiner fuel gas (RFG)</td><td>Carrying venting from the coke drum to the gas compressor to recover as RFG rather than flaring. For the flexicoking process, a conversion step (to convert the carbonyl sulphide (COS) into S_2S) is needed prior to treating the gas from the coking unit.</td><td>For existing units, the applicability of the techniques may be limited by space availability</td></tr>
</table>
</td><td></td><td></td><td></td></tr>
</table>

<table>
<tr><th>BAT Conclusion Number</th><th>Summary of BAT Conclusion requirement</th><th>Status NA/ CC / FC / NC</th><th>Assessment of the installation capability and any alternative techniques proposed by the operator to demonstrate compliance with the BAT Conclusion requirement</th><th>Relevant permit condition(s)</th></tr>
<tr><td>30</td><td>In order to reduce NO_X emissions to air from the calcining of green coke process, BAT is to use selective non-catalytic reduction (SNCR).

Description: See section 1.20.2, Annex 1.
Applicability: The applicability of the SNCR technique (especially with respect to residence time and temperature window) may be restricted due to the specificity of the calcining process.</td><td>NA</td><td>The installation does not have a calciner.

We agree with the operator’s status.</td><td>NA</td></tr>
<tr><td>31</td><td>In order to reduce SO_X emissions to air from the calcining of green coke process, BAT is to use one or a combination of the techniques given below.

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

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

We agree with the operator’s status.</td><td>NA</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>See Section 5.20.3, Annex 1.</td><td></td></tr></table></td><td></td><td></td><td></td></tr>
<tr><td>32</td><td>In order to reduce dust emissions to air from the calcining of green coke process, BAT is to use a combination of the techniques given below.

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

<table><tr><th>Parameter</th><th>BAT-AEL (monthly average) mg/Nm^3</th></tr><tr><td>Dust</td><td>10 - 50 ($^{1, 2}$)</td></tr><tr><td colspan="2">(1) The lower end of the range can be achieved with a 4-field ESP
(2) When an ESP is not applicable, values of up to 150 mg/Nm^3 may occur.</td></tr></table>
The associated monitoring is in BAT 4.</td><td>NA</td><td>The installation does not have a calciner.

We agree with the operator’s status.</td><td>NA</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</td><td>CC</td><td>Desalters on CDU-4 reduce water usage by recycling, using low shear mixing devices and consistent monitoring</td><td>1.3.1
2.3.1</td></tr>
</table>

<table>
<tr><th>BAT Conclusion Number</th><th>Summary of BAT Conclusion requirement</th><th>Status NA/ CC / FC / NC</th><th>Assessment of the installation capability and any alternative techniques proposed by the operator to demonstrate compliance with the BAT Conclusion requirement</th><th>Relevant permit condition(s)</th></tr>
<tr>
<td></td>
<td>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, electric field potential for coalescence) steps</td><td>Generally applicable</td></tr>
<tr><td>ii. Multistage desalter</td><td>Multistage desalters operate with water addition and dehydration, repeated through two stages or more for achieving a better efficiency in the separation and therefore less corrosion in further processes</td><td>Applicable for new units</td></tr>
<tr><td>iii. Additional separation step</td><td>An additional enhanced oil/water and solid/water separation designed for reducing the charge of oil to the waste water treatment plant and recycling it to the process. This includes, e.g. settling drum, the use of optimum interface level controllers</td><td>Generally applicable</td></tr>
</table>
</td>
<td></td>
<td>and optimising of desalter performance.

Two stage desalting is used on CDU-4 and effluent from the desalters is treated via a dissolved air flotation unit to remove solids and entrained oil. Stripped sour water is not used in the desalters.

Average wash water consumption is 700 tonnes per day (t/d) of which 350 t/d is process condensate and 350 t/d is water from the River Dee.

i. All condensate and sour water produced on CDU-4 is collected in a sour water vessel, V801. The water from V801 is pumped into the second stage desalter, V102. From V102, the water is then "reused" in the first stage desalter, V101.

Low shear mixing valves are located on the crude inlet to each desalter downstream of where the wash water is injected. The pressure drop across these mixing valves is monitored every day to ensure it remains within a specified range.

Desalter performance is monitored by operations three times per shift and by a third party contractor, three times per week to ensure performance is optimised. No stripped sour water is used. Make up water is from the River Dee.

ii. CDU-4 operates with 2 stage desalting.

iii. Effluent water from the desalter is routed to a dissolved air flotation unit called the PDAF where oil and solids are removed.

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

<table>
<tr><th>BAT Conclusion Number</th><th>Summary of BAT Conclusion requirement</th><th>Status NA/ CC / FC / NC</th><th>Assessment of the installation capability and any alternative techniques proposed by the operator to demonstrate compliance with the BAT Conclusion requirement</th><th>Relevant permit condition(s)</th></tr>
<tr>
<td>34
CDU-3 Emission point A-1</td>
<td>
BAT 34. In order to prevent or reduce NO_X emissions to air from the combustion units, BAT is to use one or a combination of the techniques given below.

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

<table>
<tr><th>Technique</th><th>Description</th><th>Applicability</th></tr>
<tr><td colspan="3">i. Selection or treatment of fuel</td></tr>
<tr><td>(a) Use of gas to replace liquid fuel</td><td>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.</td><td>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</td></tr>
<tr><td>(b) Use of low nitrogen refinery fuel oil (RFO) e.g. by RFO selection or by hydrotreatment of RFO</td><td>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.</td><td>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)</td></tr>
<tr><td colspan="3">ii. Combustion modifications</td></tr>
<tr><td>(a) Staged combustion:
• air staging
• fuel staging</td><td>See section 1.20.2, Annex 1.</td><td>Fuel staging for mixed or liquid firing may require a specific burner design</td></tr>
</table>
</td>
<td>NC mothballed</td>
<td>
Crude distillation unit 3 (CDU-3)
The unit is currently mothballed.

CDU-3 has 3 combustion units used for heating crude oil and atmospheric residue. The total rated thermal input of the LCP is 98.8 MW.

Each unit burns a mixture of liquid fuel and fuel gas.

I. i. a) Gas burning would be maximised if the units are restarted.

I. ii. b) Furnaces are fitted with air fuel ratio and excess O_2 automatic control to ensure combustion is optimised at all times.

I. ii. e) Units are currently mothballed, however, low NOx burners would be installed on all three furnaces if a decision was made to restart the unit.

The BAT AEL for existing multi fuel fired combustion units is 300 mg/Nm^3; however up to 450 may be applicable (see Note 1 to Table 11 of BAT Conclusion).

2013 Periodic monitoring results (mg/Nm^3):
February = 270 / May = 374
August = 241 / December = 292

The operator intends to include this unit in the NOx emissions bubble. This will be reviewed should the unit be restarted. The operator will also be required to take account of the requirements for mothballed plant in the bubble emissions methodology as set out in Section 1.3.

Setting NOx Limits:
We have set NOx limits as follows:

<table>
<tr><td>Liquid/multifuel</td><td>450 mg/Nm^3</td></tr>
</table>
</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)
	(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 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			
					With a footnote to the table: 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. We have set the limit in accordance with the BAT AEL for multi-fuel firing, with compliance via the site bubble, subject to condition 2.3.5 and Pre-operational Condition to be fulfilled prior to CDU-3 operation following Section 6 III (a) of the MFF Protocol. Limits shall apply from 28 October 2018. We agree with the operator's stated compliance.	

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)

		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 %)

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 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
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

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)

		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
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

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

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

Parameter	Type of equipment	BAT-AEL (1) (monthly average) mg/Nm³ at 15% O_2
NOx, expressed as NO_2	Gas turbine (including combined cycle gas	40 - 120 (existing gas turbine)

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)

	turbine – CCGT) and integrated gasification combined cycle turbine (IGCC))	20 - 50 (new turbine) (2)

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

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

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

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

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

Parameter:	Type of combustion	BAT-AEL (monthly average) mg/Nm^3
NO_X expressed as NO_2	Multi-fuel fired combustion unit	30 -300—for existing unit (1) (2)

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) 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 The associated monitoring is in BAT 4			
34 **CDU-4 Emission point A-2**	As above	NC Derogation	**Crude distillation unit 4 (CDU-4) – LCP 139** CDU-4 has four furnaces, F201A/B/C and F202 which discharge into a common stack. The total rated thermal input of the LCP is 220.1 MWth. Each furnace has the capability to burn both oil and gas. The furnaces are started up on oil and typically run on 100% gas during normal operation. F202 also burns waste gas from the vacuum accumulators, V208 and V209 and from the sour water stripper, C801. During 2016 the unit burnt 100% gas. The operator provided the following information on the H_2 content of the refinery fuel gas (RFG):	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)
			H2 IN REFINERY FUEL GAS Refinery Fuel Gas (RFG) is sampled from 2 vessels in the RFG network: V4808 and V4809. The samples are analysed and sample results are available in the LIMS Sample Manager system. The following sheets contain LIMS data for H2 in RFG from V4808 and V4809. This data is summarised below: Average H2 (% mole) / Average flow (t/d) / Average H2 (% mole) Period / V4808 / V4809 / V4808 / V4809 2014 52.0 58.7 527 291 **54.4** 2015 50.4 63.8 595 331 **55.2** 2016 46.8 65.3 577 308 **53.2** 2017 50.1 63.3 762 159 **52.4** 07/2014 - 06/2017 48.9 64.3 589 317 **54.3** This data demonstrates that the RFG supply contains > 50% H2. We agree that the data demonstrates that the H_2 content of the RFG is >50% and that Note 1 to Table 10 of this BAT Conclusion is applicable, i.e. the upper end of the BAT AEL range is 200 mg/Nm^3 when gas firing. The operator intends to include the furnaces in the NOx emissions bubble. To comply with the NOx emissions bubble, it is anticipated that three of the furnaces require modification with low NOx burners. Initially, one burner will be included in the NOx emissions bubble. Once the derogation is complete, it is anticipated that the remaining three, modified burners will also be included in the NOx emissions bubble. The permit contains provision for this. I. i. a) Gas firing can be maximised to reduce NOx	

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)
			emissions I. ii. b) Furnaces are equipped with automatic air/fuel ratio and excess O_2 control which ensures combustion is optimised at all times. A device that measures CO is also located on the stack and is alarmed to warn operations of inefficient combustion conditions on the furnaces. I. ii. e) A project proposal is being developed to install low NOx burners on three of the furnaces. This has been assessed as the most cost effective method of reducing NOx emissions on the furnaces to meet the BAT AELs of 200 mg/Nm^3 for gas fired and up to 450 mg/Nm^3 for multi-fuel fired combustion units. A time based derogation has been submitted for this proposal. 2016 monthly average NOx emissions (mg/Nm^3): January = 723 / February = 572 / March = 357 April = 465 / May = 276 / June = 278 / July = 287 August = 200 / September = 197 / October = 233 November = 228 / December = 248 Refer to Section 7 of this document for our assessment of the derogation and how we have addressed this in the consolidated variation notice. **Setting NOx Limits:** We have set NOx limits as follows: Current permit limits i.e. derogated limits will apply to three of the furnaces up to 2022. The BAT AELs will apply after this time when the low NOx burners are installed. The limits in the table below are the BAT AELs; however it is intended that compliance will be via the site bubble. **Gas firing** | 200 mg/Nm^3 with footnote to table:	

<table>
<tr><th>BAT Conclusion Number</th><th>Summary of BAT Conclusion requirement</th><th>Status NA/ CC / FC / NC</th><th>Assessment of the installation capability and any alternative techniques proposed by the operator to demonstrate compliance with the BAT Conclusion requirement</th><th>Relevant permit condition(s)</th></tr>
<tr><td></td><td></td><td></td><td>
<table>
<tr><td></td><td>For an existing unit using high air pre-heat (i.e. > 200 C) or with H_2 content in the fuel gas higher that 50% the upper end of the BAT-AEL range is 200 mg/Nm^3</td></tr>
<tr><td>Liquid/multifuel</td><td>450 mg/Nm^3 with footnote to table:
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.</td></tr>
</table>

We agree with the operator’s stated compliance.</td><td></td></tr>
<tr><td>34
CD4 F650 Emission point A-3</td><td>As above</td><td>NC</td><td>CD4 Molecular sieve start up heater
The existing unit, F650 (2.4 MWth) is a natural draught rocket furnace operated on 100% gas. The furnace is not operated continuously, rather it is only fired when regenerating the unit molecular sieves.

There are no NOx reduction measures employed on this unit. Emissions from this furnace are not tested due to the size of the unit. NOx emissions from this furnace are calculated using a NOx factor of 3.5kg NOx per tonne of fuel gas, which is derived from standard industry factors from CONCAWE.

The calculated monthly average NOx emission was 277 mg/Nm^3 for 2016. The operator intends to include the F650 unit in the NOx emissions bubble.

Setting NOx Limits:
For units below 20 MW we will <u>not</u> set a limit unless there is an existing limit for no backsliding. In this case there was no limit.</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)
			See BAT57 We agree with the operator's stated compliance.	
34 HPBH **Emission point A-4**	As above	NC	**High Pressure Boiler House (HHPH)-Boilers 21 to 26 – LCP 140** Boilers B21 to B26 are part of the HPBH producing high pressure steam for electricity production and steam consumption on site. Each boiler has a thermal input of 104 MWth. The boilers are arranged in pairs such that each pair shares a common flue and continuous emissions monitor (CEM), and the three flues exhaust via a common stack at emission point reference A-4. The boilers are existing units that operate continuously on a mixture of natural gas (NG), refinery fuel gas (RFG), flushing oil (FO) and refinery liquid fuel (RLFS). The operator intends to include the units in the NOx emissions bubble. Although these units have low NOx burners, NOx emissions are still above the BAT AEL of 300 (450) mg/Nm^3 for multi-fuel fired combustion units, and compliance will be achieved via the NOx emissions bubble. See BAT57. **Boilers B21 to B26** I. i. a) Use of gas instead of liquid fuel is used on the boilers however it is very much predicted on SOx emissions and not NOx emissions at present.	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. ii. b) Boilers are fitted with air fuel ratio and excess O_2 automatic control to ensure combustion is optimised at all times. I. ii. c) This technique is being considered as an option to reduce NOx as part of the derogation request. I. ii. e) Boilers 21, 22 and 24 are fitted with low NOx burners installed in 1987. I. ii. e) Boilers B23, B25 and B26 are fitted with low NOx burners installed in 1997. A time based derogation has been submitted which includes LNBs and flue gas recirculation (FGR). 2016 monthly average NOx emissions (not including 20% deduction for confidence interval) (mg/Nm^3): **Boilers B21/B22** January = 390 / February = 359 / March = 351 April = 430 / May = 417 / June = 436 / July = 307 August = 317 / September = 289 / October = 288 November = 290 / December = 247 **Boilers B23/B24** January = 312 / February = 199 / March = 391 April = 446 / May = 482 / June = 453 / July = 394 August = 390 / September = 382 / October = 411 November = 408 / December = 441 **Boilers B25/B26** January = 212 / February = 486 / March = 479 April = 524 / May = 480 / June = 390 / July = 506 August = 422 / September = 361 / October = 532 November = 533 / December = 560	

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)
			Setting NOx Limits: Current permit limits will apply up to 28 October 2018. The BAT AEL will apply after this time and compliance will be achieved via the NOx emissions bubble. **Multi-fuel firing** — 450 mg/Nm^3 with footnote: 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. We agree with the operator's stated compliance.	
34 **PF3 Emission point A-5**	As above	CC	**Platformer 3 and HDT3 - LCP 142** The platformer furnaces comprise five individual furnaces, F9401/2/3/4 & F9301 with a common stack. The total rated thermal input of the LCP is 135.2 MW. The operator intends to include the furnaces in the NOx emission bubble. I. i. a) All furnaces burn 100% gas. I. ii. b) All furnaces are fitted with air fuel ratio and excess O_2 automatic control to ensure combustion is optimised at all times. I. ii. e) LNBs were installed on all five furnaces in 2007. H_2 content in fuel gas is > 50% (see emission point A-2 above), therefore the upper end of the BAT AEL range is applicable (200 mg/Nm^3).	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)
			2016 monthly average NOx emissions (mg/Nm^3): June = 145 / July = 136 / August = 153 September = 154 / October = 150 / November = 177 December = 167 **Setting NOx Limits:** Limits shall apply from 28 October 2018. **Gas firing** — 200 mg/Nm^3 with footnote: For an existing unit using high air pre-heat (i.e. > 200 C) or with H_2 content in the fuel gas higher that 50% the upper end of the BAT-AEL range is 200 mg/Nm^3 We agree with the operator's stated compliance.	
34 **HVI emission point A-6**		NC mothballed	**HVI – LCP 141** The unit is currently mothballed. Compliance with a pre-operational condition is necessary prior to unit start up. We have amended the condition to take into account the requirements of the BAT Conclusions for the Refining of Mineral Oil & Gas. The HVI consists of four existing furnaces; two process furnaces, F4101 and F4102 and hot oil furnace, F4901A/B. The total rated thermal input of the HVI furnaces is 139.1 MW. I. i. a) the furnaces would burn 100% RFG. The operator confirmed in their response received 6 April 2018 that the unit is multi-fuel fired.	2.3.1

<table>
<tr><th>BAT Conclusion Number</th><th>Summary of BAT Conclusion requirement</th><th>Status NA/ CC / FC / NC</th><th>Assessment of the installation capability and any alternative techniques proposed by the operator to demonstrate compliance with the BAT Conclusion requirement</th><th>Relevant permit condition(s)</th></tr>
<tr><td></td><td></td><td></td><td>I. ii. b) Furnaces are fitted with air fuel ratio and excess O_2 automatic control to ensure combustion is optimised at all times.

I. ii. e) Units are currently mothballed, however, low NOx burners would be installed on furnaces if a decision was made to restart the unit.

The BAT AEL for existing multi-fuel fired combustion units is 300 (450) mg/Nm^3.

2013 monthly average NOx emissions (not including 20% deduction for confidence interval) (mg/Nm^3):
January = 144 / February = 187 / March = 162
April = 145 / May = 139 / June = 161 / July = 187
August = 164 / September = 135 / October = 2
November = 43 / December = 85

The operator intends to include the furnaces in the NOx emissions bubble.

Setting NOx Limits:

<table><tr><td>Liquid/multifuel</td><td>300 mg/Nm^3 with footnote to table:
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.</td></tr></table>
Condition 2.3.5 and Pre-operational Condition to be fulfilled prior to operation following Sections 5 and 6 of the MFF Protocol. Limits shall apply from 28 October 2018.

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

BAT Conclusion Number	Summary of BAT Conclusion requirement	Status NA/ CC / FC / NC	Assessment of the installation capability and any alternative techniques proposed by the operator to demonstrate compliance with the BAT Conclusion requirement	Relevant permit condition(s)
34 **Aromatics/ Secondary Processes & HDS2 Combined Emission point A-6**	As above	CC	**Aromatics/Secondary processes – LCP 141 & HDS2** **Aromatics and HDS2 furnaces share a common stack.** **Aromatics** The existing combustion units on Aromatics are used to heat up heat oil that is used as a heat medium on the process unit. There are two furnaces, F5901A/B with a common convection bank. The total rated thermal input of the Aromatic furnaces is 126.2 MW. The BAT AEL is 150 mg/Nm^3. I. i. a) Furnaces burn 100% refinery fuel gas. I. ii. b) All furnaces are fitted with air fuel ratio and excess O_2 automatic control to ensure combustion is optimised at all times. I. ii. e) Furnaces are fitted with "medium NOx" burners to reduce NOx formation. **HDS2** The existing combustion unit on HDS2, F6301, is used to preheat feed to the main reactors and is operated continuously on 100% gas. The total rated thermal input of the HDS2 furnace is 18.3 MW. I. i. a) Furnaces burn 100% gas. I. ii. b) All furnaces are fitted with air fuel ratio and excess O_2 automatic control to ensure combustion is optimised at all times.	2.3.1

<table>
<tr><th>BAT Conclusion Number</th><th>Summary of BAT Conclusion requirement</th><th>Status NA/ CC / FC / NC</th><th>Assessment of the installation capability and any alternative techniques proposed by the operator to demonstrate compliance with the BAT Conclusion requirement</th><th>Relevant permit condition(s)</th></tr>
<tr><td></td><td></td><td></td><td>I. ii. e) Furnaces are fitted with LNBs.

2016 monthly average NOx emissions from Aromatics & HDS2 (mg/Nm^3):

June = 33 / July = 33 / August = 41 / September = 47
October = 51 / November = 46 / December = 50

The operator intends to include the furnaces in the NOx emission bubble.

H_2 content in fuel gas is > 50% (see emission point A-2 above), therefore the upper end of the BAT AEL range is applicable (200 mg/Nm^3).

Setting NOx Limits:
Limits shall apply from 28 October 2018.

<table><tr><td>Gas firing</td><td>200 mg/Nm^3 with footnote to table:
For an existing unit using high air pre-heat (i.e. > 200 C) or with H_2 content in the fuel gas higher that 50% the upper end of the BAT-AEL range is 200 mg/Nm^3</td></tr></table>
We agree with the operator’s stated compliance.</td><td></td></tr>
<tr><td>34
HDT2 Emission point A-7</td><td>As above</td><td>NC</td><td>HDT2
HDT2 is an existing single combustion unit, F501 (17.4 MWth), that is designed to run continuously.

NOx emissions from this furnace are not measured. NOx is calculated using a NOx factor of 2.2kg NOx per tonne of fuel burnt, derived from standard industry factors from CONCAWE. The calculated monthly average NOx</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)
			emission was 175mg/Nm^3 for 2016. The operator intends to include the furnaces in the NOx emission bubble. The H_2 content in fuel gas is > 50%, therefore the upper end of BAT AEL range is applicable (200 mg/Nm^3). I. i. a) Furnace burns 100% gas. I. ii. b) All furnaces are fitted with air fuel ratio and excess O_2 automatic control to ensure combustion is optimised at all times. I. ii. e) Furnaces are fitted with LNBs. **Setting NOx Limits:** For units below 20MW we will <u>not</u> set a limit unless there is an existing limit for no backsliding. In this case there was no limit. We agree with the operator's stated compliance.	
34 **HD Select Emission point A-8**	As above	NC	**HD Select** HDSelect is a single existing combustion unit, F4001 (7.0 MWth), designed to run continuously. I. i. a) Furnace burns 100% gas. I. ii. b) All furnaces are fitted with air fuel ratio and excess O_2 automatic control to ensure combustion is optimised at all times. I. ii. e) Furnaces are fitted with LNBs. The H_2 content in fuel gas is > 50%, therefore the upper end of BAT AEL range is applicable (200 mg/Nm^3). NOx emissions from this furnace are not measured.	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)
			NOx is calculated using a NOx factor of 3.5kg NOx per tonne of fuel burnt, which is derived from standard industry factors from CONCAWE. The calculated monthly average NOx emission has been calculated at 275mg/Nm3 for 2016. The operator intends to include the furnace in theNOx emission bubble. See BAT58 **Setting NOx Limits:** For units below 20MW we will <u>not</u> set a limit unless there is an existing limit for no backsliding. In this case there was no limit. We agree with the operator's stated compliance.	
34 **EBU Emission point A-9**	As above	NC	**Ethyl benzene unit (EBU)** The EBU is an existing combustion unit, F6800 (9.45 MWth), which is designed to operate continuously. The furnace fires a mixture of "Dry Gas" (Cracker off gas) and Refinery Fuel Gas. More recently the unit has burned on average 65% refinery fuel gas and 35% dry gas. Furnaces are fitted with medium NOx burners. I. i. a) Furnace burns 100% gas. I. ii. b) All furnaces are fitted with air fuel ratio and excess O_2 automatic control to ensure combustion is optimised at all times. The H_2 content in fuel gas is > 50%, therefore the upper end of the BAT AEL range is applicable (200 mg/Nm^3). NOx emissions from this furnace are not measured.	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)
			NOx is calculated using a NOx factor of 2.2kg NOx per tonne of fuel burnt, which is derived from standard industry factors from CONCAWE. The calculated monthly average NOx emission has been 175 mg/Nm^3 for 2016. The operator intends to include the furnace in the NOx emission bubble. See BAT57 **Setting NOx Limits:** For units below 20MW we will not set a limit unless there is an existing limit for no backsliding. In this case there was no limit. We agree with the operator's stated compliance.	
34 **MPBH Emission point A-12**		NC	**Medium pressure boiler house (MPBH)** The MPBH consists of two existing package boilers that provide backup MP steam to the site in the event that the HPBH cannot supply enough steam. The units typically operate on standby, ramping up supply as and when required. The units were originally designed to burn liquid fuel (gasoil) but were switched to natural gas firing in 2014. Firing of gasoil is possible. The units have burned 100% natural gas during 2016. I. i. a) Furnace burns 100% gas. I. ii. b) All furnaces are fitted with air fuel ratio and excess O_2 automatic control to ensure combustion is optimised at all times. The operator has chosen the BAT AEL of 300 mg/Nm^3 for	2.3.1

<table>
<tr><th>BAT Conclusion Number</th><th>Summary of BAT Conclusion requirement</th><th>Status NA/ CC / FC / NC</th><th>Assessment of the installation capability and any alternative techniques proposed by the operator to demonstrate compliance with the BAT Conclusion requirement</th><th>Relevant permit condition(s)</th></tr>
<tr><td></td><td></td><td></td><td>multi-fuel fired units; however the BAT AEL of 150 mg/Nm^3 for gas fired units would be applicable in this case.

NOx emissions from these units are not tested but are calculated based on a NOx factor of 3.5kg NOx per tonne of fuel burnt, which is derived from standard industry factors from CONCAWE.

Based on these calculations the monthly average NOx emissions for 2016 have been 275 mg/Nm^3.

The operator intends to include these units in the NOx emissions bubble.

See BAT57

Setting NOx Limits:
Limits shall apply from 28 October 2018.

<table><tr><td>Gas firing</td><td>150 mg/Nm^3 with footnote to table:
For an existing unit using high air pre-heat (i.e. > 200 C) or with H_2 content in the fuel gas higher that 50% the upper end of the BAT-AEL range is 200 mg/Nm^3</td></tr></table>
We agree with the operator’s stated compliance.</td><td></td></tr>
<tr><td>35
CDU-3

Emission point A-1</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></table></td><td>CC mothballed</td><td>Crude distillation unit 3
The unit is currently mothballed.

Compliance with a pre-operational condition is necessary prior to unit start up. We have amended the condition to take into account the requirements of the BAT Conclusions for the Refining of Mineral Oil & Gas.</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 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 natural gas which may be impacted by the energy policy of the Member State</td></tr>
<tr><td>(b) Use of low sulphur refinery fuel oil (RFO) e.g. by RFO selection or by hydro-treatment of RFO</td><td>Refinery fuel oil selection favours low sulphur liquid fuels among the possible sources to be used at the unit. Hydrotreatment aims at reducing the sulphur, nitrogen and metal contents of the fuel
See section 1.20.3, Annex 1.</td><td>The applicability 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)</td></tr>
<tr><td colspan="3">Combustion modifications</td></tr>
<tr><td>(a) Optimisation of combustion</td><td>See section 1.20.2, Annex 1.</td><td>Generally applicable to all types of combustion</td></tr>
<tr><td>(b) Atomisation of liquid fuel</td><td>Use of high pressure to reduce the droplet size of liquid fuel. Recent optimal</td><td>Generally applicable to liquid fuel firing</td></tr>
</table>
</td>
<td></td>
<td>I. Selection or treatment of fuel. a) yes. See BAT 34

I. Combustion modifications. a) yes. See BAT 34
b) Liquid fuel to these furnaces is pressure atomised to reduce droplet size.

Setting dust limits:

<table><tr><td>Multi-fuel firing</td><td>5 to 50 mg/Nm^3</td></tr></table>
We have retained the current limit for multi-fuel firing which is consistent with the BAT AEL.

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

BAT Conclusion Number	Summary of BAT Conclusion requirement	Status NA/ CC / FC / NC	Assessment of the installation capability and any alternative techniques proposed by the operator to demonstrate compliance with the BAT Conclusion requirement	Relevant permit condition(s)

	burner designs generally include steam atomisation	

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
iii. Wet scrubbing	See section 1.20.1, Annex 1.	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
iv. Centrifugal washers	See section 1.20.1, Annex 1.	Generally applicable

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>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">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></td><td></td></tr>
<tr><td>35

CDU-4

Emission point A-2</td><td>As above</td><td>CC</td><td>Crude distillation unit 4 – LCP 139

I. Selection or treatment of fuel. a) yes. See BAT 34

I. Combustion modifications. a) yes. See BAT 34
b) Burners are dual fuel burners. The fuel oil guns are pressure atomised by operating the fuel oil pressure at a minimum pressure. This reduces the droplet size, therefore improving combustion and minimising dust emissions.

BAT AEL for multi-fuel firing is 50 mg/Nm^3.

2016 monthly average dust emissions (not including 30% deduction for confidence interval) (mg/Nm^3):

January = 14 / February = 2 / March = 3 / April = 2
May = 2 / June = 2 / July = 2 / August = 14
September = 13 / October = 11 / November = 14
December = 8

Setting dust Limits:</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)
			Multi-fuel firing | 50 mg/Nm^3 We have retained the current permit limit which is consistent with the BAT AEL. We agree with the operator's stated compliance.	
35 **CD4 molecular sieve** **Emission point A-3**	As above	CC	**CD4 Molecular sieve start up heater** I. Selection or treatment of fuel. a) yes. See BAT 34 I. Combustion modifications. a) yes. See BAT 34 **Setting dust limits:** For units below 20 MW we will not set a limit unless there is an existing limit for no backsliding. In this case there is no limit. We agree with the operator's stated compliance.	2.3.1
35 **HPBH** **Emission point A-4**	As above	CC (B21 to B24) FC (B25/B26)	**High Pressure Boiler House (HHPH)-Boilers 21 to 26 – LCP 140** I. Selection or treatment of fuel. a) yes. See BAT 34 I. Combustion modifications. a) yes. See BAT 34 b) Liquid fuel is steam atomised to ensure efficient and complete combustion. BAT AEL for multi-fuel firing is 50 mg/Nm^3. 2016 monthly average dust emissions (not including 30% deduction for confidence interval) (mg/Nm^3): **B21/B22** January = 53 / February = 48 / Mach = 34 April = 22 / May = 28 / June = 5 / July = 6	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)
			August = 6 / September = 3 / October = 4 November = 21 / December = 6 **B23/B24** February = 6 / March = 6 / April = 6 / May = 10 June = 12 / July = 8 / August = 11 / September = 12 October = 8 / November = 10 / December = 13 **B25/B26** January = 7 / February = 31 / March = 30 April = 31 / May = 30 / June = 59 / July = 44 August = 48 / September = 64 / October = 71 November = 88 / December = 93 The limit applies across the stack, three flues in a common stack, 2 boilers per flue. **Setting dust Limits:** **Multi-fuel firing** | 37 mg/Nm^3 We have retained the current permit limit which is tighter than the BAT AEL. We have retained this limit on the basis of no backsliding. We agree with the operator's stated compliance.	
35 **Platformer 3 and HDT3** **Emission point A-5**	As above	CC	**Platformer 3 and HDT3 - LCP 142** I. Selection or treatment of fuel. a) yes. See BAT 34 I. Combustion modifications. a) yes. See BAT 34 Dust emission data has not been available since 2013 due to the PF3 convection bank being offline. In 2012, the average dust emissions were 0.5 mg/Nm^3. Following reinstatement of the convection in January 2016, dust	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)
			emissions are continuously measured. **Setting dust limits:** **Gas firing** | 5 mg/Nm^3 We have retained the current permit limit on the basis of no back sliding, which is consistent with the BAT AEL. We agree with the operator's stated compliance.	
35 **Aromatics and HDS2** **Emission point A-6**	As above	CC	**Aromatics/Secondary processes – LCP 141 & HDS2** **Aromatics and HDS2 furnaces share a common stack.** **Aromatics/HDS2** I. Selection or treatment of fuel. a) yes. See BAT 34 I. Combustion modifications. a) yes. See BAT 34 **Setting dust limits:** **gas firing** | 5 mg/Nm^3 We have retained the current limit for gas firing on the basis of no backsliding. We agree with the operator's stated compliance.	
35 **HVI** **Emission point A-6**	As above	CC mothballed	**HVI – LCP 141** The unit is currently mothballed. Compliance with a pre-operational condition is necessary prior to unit start up. We have amended the condition to take into account the requirements of the BAT Conclusions for the Refining of Mineral Oil & Gas.	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. Selection or treatment of fuel. a) yes. See BAT 34 I. Combustion modifications. a) yes. See BAT 34 2013 monthly average dust emissions (not including 30% deduction for confidence interval) (mg/Nm^3): January = 1 / February = 1 / March = 2 /April = 2 May = 2 /June = 1 / July = 1 / August = 3 September = 4 / October = 7 / November = 26 December = 3 **Setting dust limits:** **Multi-fuel firing** | 5 to 50 mg/Nm^3 We have set the limit consistent with the BAT AEL for multi-fuel firing. We agree with the operator's stated compliance.	
35 **HDT2** **Emission point A-7**	As above	CC	**HDT2** I. Selection or treatment of fuel. a) yes. See BAT 34 I. Combustion modifications. a) yes. See BAT 34 **Setting dust limits:** For units below 20MW we will <u>not</u> set a limit unless there is an existing limit for no backsliding. In this case there was no limit. We agree with the operator's stated compliance.	2.3.1
35 **HDSelect**	As above	CC	**HDSelect** I. Selection or treatment of fuel. a) yes. See BAT 34	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)
Emission point A8			I. Combustion modifications. a) yes. See BAT 34 **Setting dust limits:** For units below 20MW we will <u>not</u> set a limit unless there is an existing limit for no backsliding. In this case there was no limit. We agree with the operator's stated compliance.	
35 **EBU** **Emission point A-9**	As above	CC	**Ethyl benzene unit (EBU)** I. Selection or treatment of fuel. a) yes. See BAT 34 I. Combustion modifications. a) yes. See BAT 34 **Setting dust limits:** For units below 20MW we will <u>not</u> set a limit unless there is an existing limit for no backsliding. In this case there was no limit. We agree with the operator's stated compliance.	2.3.1
35 **MPBH** **Emission point A-12**	As above	CC	**Medium pressure boiler house (MPBH)** I. Selection or treatment of fuel. a) yes. See BAT 34 I. Combustion modifications. a) yes. See BAT 34 **Setting dust limits:** **Multi-fuel firing** | 100 $mgNm^3$ The current permit limit of 100 mg/m^3 is an hourly result, which is equivalent to 2 x the monthly average i.e. 2 x 50 mg/m^3. We have retained the current limit on the basis of	2.3.1

<table>
<tr><th>BAT Conclusion Number</th><th>Summary of BAT Conclusion requirement</th><th>Status NA/ CC / FC / NC</th><th>Assessment of the installation capability and any alternative techniques proposed by the operator to demonstrate compliance with the BAT Conclusion requirement</th><th>Relevant permit condition(s)</th></tr>
<tr><td></td><td></td><td></td><td>no backsliding.

We agree with the operator's stated compliance.</td><td></td></tr>
<tr><td>36

CDU-3

Emission point A-1</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

<table>
<tr><th>Technique</th><th>Description</th><th>Applicability</th></tr>
<tr><td>i. Use of gas to replace liquid fuel</td><td>See section 1.20.3, Annex 1.</td><td>The applicability may be limited by the constraints associated with the availability of low sulphur fuels such as natural gas, which may be impacted by the energy policy of the Member State</td></tr>
<tr><td>ii. Treatment of refinery fuel gas (RFG)</td><td>Residual H2S concentration in RFG depends on the treatment process parameter, e.g. the amine-scrubbing pressure.
See Section 1.20.3, Annex 1.</td><td>For low calorific gas containing carbonyl sulphide (COS) e.g. from coking units, a converter may be required prior to H_2S removal</td></tr>
<tr><td>iii. Use of low sulphur refinery fuel oil (RFO) e.g. by RFO selection or by hydrotreatment of RFO</td><td>Refinery fuel oil selection favours low sulphur liquid fuels among the possible sources to be used at the unit. Hydrotreatment aims</td><td>The applicability is limited by the availability of low sulphur liquid fuels, hydrogen production and the hydrogen sulphide (H_2S)</td></tr>
</table></td><td>NC mothballed</td><td>Crude distillation unit 3
The unit is currently mothballed.

CDU-3 has 3 combustion units used for heating crude oil and atmospheric residue. The total rated thermal input of the LCP is 98.8 MW.

Each unit burns a mixture of liquid fuel and fuel gas.

Compliance with a pre-operational condition is necessary prior to unit start up. We have amended the condition to take into account the requirements of the BAT Conclusions for the Refining of Mineral Oil & Gas.

I. i Gas firing could be maximised on these furnaces.

The operator intends to include the unit in the SOx emissions bubble, see BAT58. The operator will also be required to take account of the requirements for mothballed plant in the bubble emissions methodology as set out in Section 1.3.

BAT AEL is 600 mg/Nm^3 for multi-fuel fired units.

2013 Periodic monitoring results (mg/Nm^3):

February = 341 / May = 1270
August = 567 / December = 305

Setting SO_2 Limits:

<table>
<tr><td>Multi-fuel firing</td><td>600 mg/Nm^3</td></tr>
</table></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)
			We have set in accordance with the BAT AEL for multi-fuel firing, with compliance via the site bubble, subject to condition 2.3.5 and Pre-operational Condition to be fulfilled prior to CDU-3 operation following Section 6 III (a) of the MFF Protocol. Limits shall apply from 28 October 2018. We agree with the operator's stated compliance.	

	at reducing the sulphur, nitrogen and metal contents of the fuel. See Section 1.20.3, Annex 1.	treatment capacity (e.g. amine and Claus units

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 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	

<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>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

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

<table><tr><th>Parameter</th><th>BAT-AEL (monthly average) mg/Nm^3</th></tr><tr><td>SO_2</td><td>35 - 600</td></tr></table>
The associated monitoring is in BAT 4</td><td></td><td></td><td></td></tr>
<tr><td>36
CDU-4

Emission point A-2</td><td>As above</td><td>NC</td><td>Crude distillation unit 4 – LCP 139

I. i Fuel substitution is the primary method used to ensure compliance with the site SO_2 bubble (see BAT58)

2016 monthly average SO_2 emissions (not including 20% deduction for confidence interval) (mg/Nm^3):

January = 181 / February = 187 / March = 124
April = 134 / May = 146 / June = 115 / July = 108
August = 193 / September = 212 / October = 212
November = 283 / December = 323

During 2016 the unit burnt 100% gas and therefore the 35 mg/m^3 limit is applicable.

Setting SO_2 Limits:

<table><tr><td>RFG</td><td>35 mg/Nm^3</td></tr><tr><td>Multi-fuel firing</td><td>600 mg/Nm^3</td></tr></table></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)
			We have set in accordance with the BAT AELs for RFG and multi-fuel firing, with compliance via the site bubble. We agree with the operator's stated compliance.	
36 **CD4 molecular sieve** **Emission point A-3**	As above	NC	**CD4 Molecular sieve start up heater** I. i Unit burns 100% gas (see BAT58) BAT AEL is 35 mg/Nm^3 for units firing RFG. SOx emissions from this unit are not measured but are calculated based on the RFG sulphur content. On this basis, the monthly average SOx emissions from this furnace have been 295 mg/Nm^3. The operator intends to include this unit in the SOx emissions bubble. For units below 20MW we will <u>not</u> set a limit unless there is an existing limit for no backsliding. In this case there is no limit. We agree with the operator's stated compliance.	2.3.1
36 **HPBH** **Emission point A-4**	As above	NC	**High Pressure Boiler House (HHPH)-Boilers 21 to 26 – LCP 140** I. i Fuel substitution is the primary method used to ensure compliance with the site SOx bubble (see BAT58). BAT AEL is 600 mg/Nm^3 for multi-fuel fired units. 2016 monthly average SO_2 emissions (not including 20% deduction for confidence interval) (mg/Nm^3): **B21/B22** January = 1210 / February = 1025 / March = 664	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)
			April = 400 / May = 690 / June = 351 / July = 346 August = 439 / September = 310 / October = 446 November = 578 / December = 382 **B23/B24** January = 746 / February = 827 / March = 664 April = 783 / May = 1496 / June = 1130 / July = 757 August = 793 / September = 767 / October = 812 November = 865 / December = 1199 **B25/B26** January = 336 / February = 1208 / March = 1188 April = 1253 / May = 1289 / June = 1128 / July = 1402 August = 1065 / September = 857 / October = 1595 November = 1633 / December = 1634 **Setting SO_2 Limits:** **Multi-fuel firing** | 600 mg/Nm^3 We have set in accordance with the BAT AEL for multi-fuel firing, with compliance via the site bubble. We agree with the operator's stated compliance.	
36 **Platformer 3 and HDT3** **Emission point A-5**	As above	NC	**Platformer 3 and HDT3 - LCP 142** The RFG is not treated to remove sulphur compounds. The operator intends to achieve compliance by including PF3 in the site SO_2 bubble. See BAT58 I. i Unit burns 100% gas (see BAT58) BAT AEL is 35 mg/Nm^3 for units firing RFG. 2016 monthly average SO_2 emissions (mg/Nm^3):	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)
			June = 59 / July = 60 / August = 148 September = 134 / October = 70 / November = 50 December = 125 **Setting SO_2 Limits:** **RFG** | 35 mg/Nm^3 We have set in accordance with the BAT AEL for RFG, with compliance via the site bubble. We agree with the operator's stated compliance.	
36 **Aromatics & HDS2** **Emission point A-6**	As above	NC	**Aromatics/Secondary processes – LCP 141 & HDS2** **Aromatics and HDS2 furnaces share a common stack.** **Aromatics/HDS2** I. i Furnaces burn 100% gas (see BAT58) the operator intends to achieve compliance by inclusion in the SOx emissions bubble, see BAT58. BAT AEL is 35 mg/Nm^3 for units firing RFG. 2016 monthly average SO_2 emissions (mg/Nm^3): June = 49 / July = 48 / August = 94 September = 91 / October = 88 / November = 63 December = 104 **Setting SO_2 Limits:** **RFG** | 35 mg/Nm^3	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)
			We have set in accordance with the BAT AEL for RFG, with compliance via the site bubble. We agree with the operator's stated compliance.	
36 **HVI** **Emission point A-6**	As above	NC mothballed	**HVI – LCP 141** The unit is currently mothballed. Compliance with a pre-operational condition is necessary prior to unit start up. We have amended the condition to take into account the requirements of the BAT Conclusions for the Refining of Mineral Oil & Gas. I. i Furnaces are multi-fuel fired (Regulation 61 response was incorrect in stating that they burn 100% gas (see BAT58) The unit is to be included in a SO_2 emissions bubble, see BAT58. BAT AEL is 600 mg/Nm^3 for multi-fuel fired units. 2013 monthly average SO_2 emissions (not including 20% deduction for confidence interval) (mg/Nm^3): January = 58 / February = 147 / March = 133 April = 165 / May = 166 / June = 151 / July = 185 August = 205 / September = 109 / October = 6 November = 18 / December = 49 **Setting SO_2 Limits:** **Multi-fuel** | 600 mg/Nm^3 We have set in accordance with the BAT AEL for multi-fuel firing, with compliance via the site bubble.	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)
			We agree with the operator's status.	
36 **HDT2** **Emission point A-7**	As above	NC	**HDT2** I. i Furnaces burn 100% gas (see BAT58) The operator confirms that compliance is to be achieved by inclusion in the SOx emissions bubble, see BAT58. BAT AEL is 35 mg/Nm^3 for units firing RFG. Emissions are calculated based on the sulphur content of the fuel gas. The calculated monthly average SOx emissions have been 39 mg/Nm^3 for 2016. **Setting SO_2 Limits:** For units below 20MW we will not set a limit unless there is an existing limit for no backsliding. In this case there was no limit. We agree with the operator's stated compliance.	2.3.1
36 **HDSelect** **Emission point A-8**	As above	NC	**HDSelect** I. i Furnaces burn 100% gas (see BAT58) The operator confirms that compliance is to be achieved by inclusion in the SOx emissions bubble, see BAT58. BAT AEL is 35 mg/Nm^3 for units firing RFG. SOx emissions from this furnace are not measured. Emissions are calculated based on the sulphur content of the fuel gas. The calculated monthly average SOx emissions have been 676 mg/Nm^3 for 2016. **Setting SO_2 Limits:** For units below 20MW we will not set a limit unless there is an existing limit for no backsliding. In this case there	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)
			was no limit. We agree with the operator's stated compliance.	
36 **EBU** **Emission point A-9**	As above	CC	**Ethyl benzene unit (EBU)** I. i Furnaces burn 100% gas (see BAT58) The operator intends to include this furnace in the SOx emissions bubble, see BAT58. BAT AEL is 35 mg/Nm^3 for units firing RFG. SOx emissions are not measured but rather calculated based on fuel consumption. The average monthly SOx emissions have been 22 mg/Nm^3 for 2016. **Setting SO_2 Limits:** For units below 20MW we will not set a limit unless there is an existing limit for no backsliding. In this case there was no limit. We agree with the operator's stated compliance.	2.3.1
36 **MPBH** **Emission point A-12**	As above	CC	**Medium pressure boiler house (MPBH)** I. i Furnaces burn 100% gas (see BAT58) The operator intends to include the unit in the SOx emissions bubble, see BAT58. BAT AEL is 35 mg/Nm^3 for units firing RFG. There have been no emissions during 2016 as the unit has not been operational. **Setting SO_2 Limits:** **RFG** | 35	2.3.1

<table>
<tr><th>BAT Conclusion Number</th><th>Summary of BAT Conclusion requirement</th><th>Status NA/ CC / FC / NC</th><th>Assessment of the installation capability and any alternative techniques proposed by the operator to demonstrate compliance with the BAT Conclusion requirement</th><th>Relevant permit condition(s)</th></tr>
<tr><td></td><td></td><td></td><td><table><tr><td></td><td>mg/Nm^3</td></tr></table>
We have set in accordance with the BAT AEL for RFG, with compliance via the site bubble.

We agree with the operator’s stated compliance.</td><td></td></tr>
<tr><td>37</td><td>In order to reduce carbon monoxide (CO) emissions to air from the combustion units, BAT is to use a combustion operation control.

Description: See section 1.20.5, Annex 1.

Table 15 BAT – associated emission levels for carbon monoxide emissions to air from combustion unit
<table><tr><th>Parameter</th><th>BAT- AEL (monthly average) mg/Nm^3</th></tr><tr><td>Carbon monoxide expressed as CO</td><td>$\leq$ 100</td></tr></table>
Associated monitoring is in BAT 4.

Continuous monitoring is required for combustion units >= 100MW in accordance with BAT 4.</td><td>CC</td><td>Crude distillation unit 3
Emission point A-1
The unit is currently mothballed.

2013 Periodic monitoring results (mg/Nm^3):
February = 6.2 / May = 17.9 / August = 3.6
December = 12.2

We have set a limit of 100 mg/Nm^3 in accordance with the BAT AEL.

Crude distillation unit 4 – LCP 139
Emission point A-2
2016 monthly average CO emissions (including 10% deduction for confidence interval) (mg/Nm^3):

January = 53 / February = 31 / March = 8
April = 18 / May = 4 / June = 4
July = 5 / August = 3</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)
			September = 4 / October = 4 November = 3 / December = 4 We have set a limit of 100 mg/Nm^3 in accordance with the BAT AEL. **CD4 Molecular sieve start up heater** **Emission point A-3** Furnace is operated with maximum air to ensure complete combustion at all times. CO emissions are not measured on this furnace. For units below 20MW we will <u>not</u> set an ELV unless there is an existing ELV for no backsliding. In this instance there was no limit. **HPBH – LCP 140** **Emission point A-4** 2016 monthly average CO emissions (for HPBH as a whole) (mg/Nm^3): January = 5 / February = 8 / March = 7 April = 6 / May = 10 / June = 9 July = 4 / August = 5 / September = 6 October = 6 / November = 8 / December = 5 We have set a limit of 100 mg/Nm^3 in accordance with the BAT AEL.	

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)
			Platformer 3 and HDT3 - LCP 142 **Emission point A-5** 2016 monthly average CO emissions (including 10% deduction for confidence interval) (mg/Nm^3): June = 4 / July = 5 / August = 4 / September = 4 / October = 3 / November = 3 / December = 4 We have set a limit of 100 mg/Nm^3 in accordance with the BAT AEL. **Aromatics/Secondary processes – LCP 141 & HDS2** **Aromatics and HDS2 furnaces share a common stack.** **Emission point A-6** **Aromatics/HDS2** 2016 monthly average CO emissions from Arom/HDS2 (including 10% deduction for confidence interval) (mg/Nm^3): June = 5 / July = 7 /August = 10 /September = 11 October = 15 /November = 18 /December = 12 We have set a limit of 100 mg/Nm^3 in accordance with the BAT AEL.	

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)
			HVI – LCP 141 **Emission point A-6** The unit is currently mothballed. 2013 periodic monitoring results (mg/Nm^3): February = 11.1 / May = 6.7 / September = 53.3 We have set a limit of 100 mg/Nm^3 in accordance with the BAT AEL. **HDT2** **Emission point A-7** All furnaces are fitted with air fuel ratio and excess O_2 automatic control to ensure combustion is optimised at all times. CO emissions are not measured. For units below 20MW we will not set an ELV unless there is an existing ELV for no backsliding. In this instance there was no limit. **HDSelect** **Emission point A-8** All furnaces are fitted with air fuel ratio and excess O_2 automatic control to ensure combustion is optimised at all times. CO emissions are not measured. For units below 20MW we will not set an ELV unless there is an existing ELV for no backsliding. In this instance there was no limit.	

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)
			Ethyl benzene unit (EBU) **Emission point A-9** All furnaces are fitted with air fuel ratio and excess O_2 automatic control to ensure combustion is optimised at all times. CO emissions are not measured. For units below 20MW we will not set an ELV unless there is an existing ELV for no backsliding. In this instance there was no limit. **Medium pressure boiler house (MPBH)** **Emission point A-12** All furnaces are fitted with air fuel ratio and excess O_2 automatic control to ensure combustion is optimised at all times. CO emissions are not measured. Monitoring requirements do not apply to standby plant. Standby plant (for proper back up not duty standby) run for < 500 hours do not require monitoring. A limit of 150 mg/m^3 was set by the previous permit; we have retained this limit on the basis of no backsliding. We agree with the operator's stated compliance.	2.3.1
38	**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.**	NA	No etherification on site. We agree with the operator's status.	NA
39	**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.**	NA	No biotreatment on site. We agree with the operator's status.	NA

BAT Conclusion Number	Summary of BAT Conclusion requirement	Status NA/ CC / FC / NC	Assessment of the installation capability and any alternative techniques proposed by the operator to demonstrate compliance with the BAT Conclusion requirement	Relevant permit condition(s)
40	**In order to reduce emissions to air of chlorinated compounds, BAT is to optimise the use of chlorinated organic compounds used to maintain catalyst activity when such a process is in place or to use non-chlorinated catalytic systems.**	CC	The butamer unit, U6020, uses an isomerisation process to convert n-butane to isobutane. The process uses Perchloroethylene as a catalyst promoter to maintain catalyst activity. Any HCl formed in the reaction process is neutralised using caustic in a gas scrubber column, C6021. We agree with the operator's stated compliance.	2.3.1
41	**In order to reduce sulphur dioxide emissions to air from the natural gas plant, BAT is to apply BAT 54.**	NA	Not applicable to an oil refinery.	NA
42	**In order to reduce nitrogen oxides (NO_X) emissions to air from the natural gas plant, BAT is to apply BAT 34**	NA	Not applicable to an oil refinery.	NA
43	**In order to prevent emissions of mercury when present in raw natural gas, BAT is to remove the mercury and recover the mercury-containing sludge for waste disposal.**	NA	Not applicable to an oil refinery.	NA
44	**In order to prevent or reduce waste water flow generation from the distillation process, BAT is to use liquid ring vacuum pumps or surface condensers.** **Applicability**. May not be applicable in some retrofit cases. For new units, vacuum pumps, either in or not in combination with the steam ejectors, may be needed to achieve a high volume (10 mm Hg). Also, a spare should be available in case the vacuum pump fails.	-	Steam ejectors are used on CDU-4. Sour water is collected in V208 and then pumped to collection vessel V801 and used as wash water for the desalter. Water from the desalter is routed through stripper column, C801 to remove light hydrocarbons and a small amount of sour components. The waste water is treated in accordance with BAT45. We accept that the use of steam ejectors is acceptable in this application. The operator did not confirm their status. We conclude that they are currently compliant.	2.3.1
45	**In order to prevent or reduce water pollution from the distillation process, BAT is to route sour water to the stripping unit.**	CC	All process water from CDU-4 is collected in the sour water vessel, V801. From here it is used as wash water for the desalter. Water from the desalter is routed through stripper column, C801 to remove light hydrocarbons. We agree with the operator's stated compliance.	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)
46	In order to prevent or reduce emissions to air from distillation units, BAT is to ensure the appropriate treatment of process off-gases, especially incondensable off-gases, by acid gas removal prior to further use. **Applicability**. Generally applicable for crude and vacuum distillation units. May not be applicable for standalone lubricant and bitumen refineries, with emissions of less than 1 t/d of sulphur compounds. In specific refinery configurations, applicability may be restricted, due to the need for e.g. large piping, compressors or additional amine treating capacity.	NA	No off-gases from CDU-4 are amine treated. Incondensable gases from the vacuum columns have been calculated to be 1 tonne/day containing a maximum of 2wt% H_2S which is equivalent to 0.2 tonnes/day of sulphur compounds, therefore the requirement to treat these gases is not applicable. Off-gases from CDU-4 enter the refinery fuel gas main. The operator intends to demonstrate through BAT58 that the site is compliant with the SOx bubble and therefore treatment of off-gases is not required. We agree with the operator's status.	NA
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	The reactor section of the kerosene merox treater, KMT2, has been shut-down for many years, therefore no venting of odorous spent air occurs. The gasoline sweetening section on the FCC Gas Plant is also mothballed. U3850 on the Gas Plant is the spent caustic regeneration unit which uses air to regenerate caustic. The off-gases from this unit are routed to the CO Boiler where they are burnt. We agree with the operator's stated compliance.	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)
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.**	CC	Caustic is used in two locations at the installation. On KMT2, a 2% caustic solution is used to remove naphthenic acids from kerosene. This system uses a caustic recycle with a fresh caustic make-up and spent caustic bleed to minimise caustic usage. The spent caustic is routed to the Spent Caustic Neutralisation Unit (SCNU), where the caustic is neutralised using sulphuric acid before being routed to the Process Dissolved Air Flotation Unit, PDAF. On the Gas Plant, 2% caustic is used to treat LPG. The spent caustic from this process is regenerated in U3850 to minimise caustic consumption. A spent caustic bleed is routed to tankage. From here it is pumped to the SCNU. We have however set an improvement condition for a caustic use minimisation plan which is relevant to all oil refineries. We agree with the operator's stated compliance.	2.3.1 2.4.1

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)
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	Volatile liquid hydrocarbons are stored in floating roof tanks that are equipped with high efficiency seals (primary and secondary seals). Naphtha tanks T4123/T4124/T4125 are fixed roof tanks. These tanks have recently been fitted with a nitrogen blanketing system, which means that the tanks operate at a slightly elevated pressure. This purpose of this is to reduce the concentration of volatiles in the vapour space. Toluene tanks T557, T559, T561, and T563 are fixed roof tanks. The vapour pressure of toluene is 3.6 kPa. There is no data to show that toluene meets the definition of a volatile liquid hydrocarbon, therefore the operator does not believe that BAT 49 applies to these tanks. We conclude that toluene is a volatile liquid hydrocarbon and BAT 49 does apply. We don't agree with the operator's status and have set an improvement condition to address this.	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>50</td><td>In order to reduce VOC emissions to air from the storage of volatile liquid hydrocarbon compounds, BAT is to use one or a combination of the techniques given below.

<table><tr><th>Technique</th><th>Description</th><th>Applicability</th></tr><tr><td>i. Manual crude oil tank cleaning</td><td>Oil tank cleaning is performed by workers entering the tank and removing sludge manually</td><td>Generally applicable</td></tr><tr><td>ii. Use of a closed-loop system</td><td>For internal inspections, tanks are periodically emptied, cleaned and rendered gas-free. This cleaning includes dissolving the tank bottom. Closed-loop systems that can be combined with end-of-pipe mobile abatement techniques prevent or reduce VOC emissions</td><td>The applicability may be limited by e.g. the type of residues, tank roof construction or tank materials</td></tr></table></td><td>CC</td><td>i. Oil tank cleaning involves various techniques such as re-suspension of sludge, dissolving/cleaning with hot gasoil and/or workers entering a tank and manually removing sludge. The use of each technique or combination of techniques is performed on a case by case basis based on the size of the tank and the amount of sludge to be removed.

We agree with the operator’s stated compliance.</td><td>2.3.1</td></tr>
<tr><td>51</td><td>In order to prevent or reduce emissions to soil and groundwater from the storage of liquid hydrocarbon compounds, BAT is to use one or a combination of the techniques given below.

<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</td><td>Generally applicable</td></tr></table></td><td>CC</td><td>Emissions to soil and groundwater are minimised by employing a robust maintenance programme along with program of installing an impervious membrane beneath tank floors as and when they come up for renewal. All tanks are enclosed in tank bunds which conform to regulations.

i. The storage tanks within Oil Movements PU are installed with a range of instruments, often dependent on the fluid being stored. The information is relayed back to the CCR and the tank operation is monitored remotely</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)
		risk-based inspection procedures on tanks at intervals to prove their integrity, and maintenance to improve tank containment. It also includes a system response to spill consequences to act before spills can reach the groundwater. To be especially reinforced during maintenance periods			from the CCR. Warning alarms are generated when a reading moves outside the normal operating window. The priority for the alarms is determined using the site ESP procedure. Relevant alarms for a storage tank are as follows: • High level • Low level • Level stuck alarm (tank level expected to move but has not done so) • Level movement alarm (tank level has moved when it should be static) Each of the alarms will require operator intervention. Details of the individual alarms for each tank can be found in the white oils or black oils ACM. All tanks on site are subject to a Risk Based Inspection Process with clear inspection scopes and independent inspection teams who carry out relevant inspections and recommend any necessary remedial work. Details of all procedures can be found in the HSE Management system for the site. iii. An impervious membrane is being installed on all tanks on site as and when the tank floors come up for renewal. iv. Most of the storage tanks are contained in bunded areas which drain, via normally closed penstock valves, to a site interceptor / drainage system. Draining of tank compounds is covered by OMS local rule 3. At the time of the permit review, the site was conducting a survey of all tank compounds to assess gaps as compared against the Containment Policy. Following completion of this survey a plan will be drawn up to close those gaps based on the risks posed.	
	ii. Double bottomed tanks	A second impervious bottom that provides a measure of protection against releases from the first material	Generally applicable for new tanks and after an overhaul of existing tanks (1)			
	iii. Impervious membrane liners	A continuous leak barrier under the entire bottom surface of the tank	Generally applicable for new tanks and after an overhaul of existing tanks ([1])			
	iv. Sufficient tank farm bund containment	A tank farm bund is designed to contain large spills potentially caused by a shell rupture or overfilling (for both environmental and safety reasons). Size and associated building rules are generally defined by	Generally applicable			

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)
	local regulations (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		The operator's status of CC is unclear until the results of the survey are submitted. We have set an improvement condition to ensure any deficiencies are addressed.	
52	**In order to prevent or reduce VOC emissions to air from loading and unloading operations of volatile liquid hydrocarbon compounds, BAT is to use one or a combination of the techniques given below to achieve a recovery rate of at least 95 %.** **Technique** / **Description** / **Applicability** Vapour recovery by: i. Condensation ii. Absorption iii. Adsorption iv. Membrane separation v. Hybrid systems See section 1.20.6, Annex 1. Generally applicable to loading/unloading operations where annual throughput is > 5 000 m^3/yr. Not applicable to loading/unloading operations for sea-going vessels with an annual throughput < 1 million m^3/yr (1) (1) A vapour destruction unit (e.g. by incineration) may be substituted for a vapour recovery unit, if vapour recovery is unsafe or technically impossible because of the volume of return vapour **Table 16 BAT- associated emission levels for non-methane VOC and benzene emissions to air from loading and unloading operations of volatile liquid hydrocarbon compounds** **Parameter** / **BAT-AEL (hourly average) (1)**	NC derogation	The throughput of volatile liquid hydrocarbons 2015-16: White Oil Docks = 1.95M m^3/annum A VRU is not installed at White Oil Docks. A derogation has been submitted on the basis that some product movements will be moved away from this location. We have limited loading/unloading to <1 million m^3/annum from 1 January 2021 in table S1.1 of the permit in accordance with the approved derogation. Refer to Section 7 of this document for our assessment of the derogation and how we have addressed this in the consolidated variation notice. Road terminal (not part of the installation) = >5000 m^3/annum A VRU is installed at the road terminal. Hydrocarbon vapours displaced from the road-cars as they are being filled are displaced to a VRU. The vapours are recovered and returned into a Refinery ULG storage tank. The road terminal is regulated as a Part B process by the local authority. The performance of the VRU was tested in August 2016 and a performance factor of 0.99 was reported based on total organic carbon (TOC).	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)
	NMVOC: 0.15 - 10g/Nm^3 (2) (3) Benzene (3): <1 mg/Nm^3 (1) Hourly values in continuous operation expressed and measured according to Directive 94/63/EA (2) Lower value achievable with two-stage hybrid systems. Upper value achievable with single-stage adsorption or membrane system (3) Benzene monitoring may not be necessary where emissions of NMVOC are at the lower end of the range.		Throughputs at the following locations are reported at < 1 million m^3/annum: Ince Oil Berth - vapour return system installed Ince Coaster Berth - VRU installed to absorb vapours when loading/unloading ships containing benzene or ethyl benzene. Any condensed hydrocarbon is pumped into the site slops system whilst any benzene vapours are absorbed using activated charcoal. Layby Berth - operations do not include volatile liquid hydrocarbons (high flash material only). We have included an improvement condition in Table S1.3 of the permit to implement a monitoring programme. We have added process monitoring to Table S3.5 of the permit to include monitoring at the locations where VRU is installed. This is required even if below the threshold which requires BAT AELs, see above. These requirements are applicable to all sites which store liquid hydrocarbons. We agree with the operator's stated compliance.	
53	**In order to reduce emissions to water from visbreaking and other thermal processes, BAT is to ensure the appropriate treatment of waste water streams by applying the techniques of BAT 11.**	NA	This is not a process that takes place at the installation. We agree with the operator's status.	NA
54	**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.** **Technique** / **Description** / **Applicability** i. Acid gas removal e.g. by amine treating / See section 1.20.3, Annex 1. / Generally applicable	CC	i. Site uses amine treating to remove acid gases from the majority of off-gases containing H_2S. ii. The acid gas is then passed to a SRU. The site recovers sulphur from acid gas using the Claus process. iii. A tail gas unit (SCOT) sits on the back of the SRU to recover any unreacted H_2S and SO_2 from the SRU in order to achieve greater than 98.5% sulphur recovery	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)

ii. Sulphur recovery unit (SRU), e.g. by Claus process	See section 1.20.3, Annex 1.	Generally applicable
iii. Tail gas treatment unit (TGTU)	See section 1.20.3, Annex 1.	For retrofitting existing SRU, the applicability may be limited by the SRU size and configuration of the units and the type of sulphur recovery process already in place
(1) My not be applicable for stand-alone lubricant or bitumen refineries with a release of sulphur compounds of less than 1 t/d		

Table 17 BAT-associated environmental performance levels for a waste gas sulphur (H_2S) recovery system

	BAT-associated environmental performance level (monthly average)
Acid gas removal	Achieve hydrogen sulphides (H2S) removal in the treated RFG in order to meet gas firing BAT-AEL for BAT 36
Sulphur recovery efficiency (1)	New unit: 99.5 – > 99.9 % Existing unit: ≥ 98.5 %
(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	

The associated monitoring is described in BAT 4.

efficiency.

Acid gas removal:
See BAT58

Sulphur (S) recovery efficiency:
Calculated as ((Total S in feed to SRU) – (S in stack))/ (Total S in feed to SRU) x 100

Where (Total S in feed to SRU) is calculated from flow-rates of sour gases (from HDS2, ADIP, SCOT, SWS) and weight fraction S in each stream.

2016 monthly average S removal efficiency (%):

January = 99.6 / February = 99.7 / March = 99.6
April = 99.8 / May = 99.8 / June = 99.2
July = 100 / August = 100 / September = 100
October = 100 / November = 100
December = 100

We have incorporated specific requirements into Table S1.2 of the permit which are applicable to oil and gas refineries which use refinery process off-gas streams as a gaseous fuel.

We have added process monitoring into Table S3.5 to include the S content of RFG and a refinery S balance which is applicable to refineries which use refinery process off-gas streams as a gaseous fuel.

We have also added the BAT AEPL into Table S3.5 of the permit to ensure that all streams containing H_2S are treated to the BAT standard.

We agree with the operator's stated compliance.

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)
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).**	CC	Hydrocarbon to flare is measured, reported and reviewed on a daily basis by the operations teams. The site has a key performance indicator (KPI) for the amount of hydrocarbon flared which is regularly reviewed. In the event of unplanned flaring, an investigation into the source of flaring is immediately initiated. Operations are equipped with a Flare Checklist which is methodically followed to identify any unnecessary flaring. Flaring incidents must be classified, investigated and reported as per the operator's HSSE control framework. Additionally, flaring performance is reviewed by the operational leadership team on a weekly basis to ensure flaring is within expected targets. There are two types of flaring: (1) Baseline, or routine flaring which must be managed and minimised, as this is routine disposal of a waste gas stream by incineration. (2) Non-routine flaring events which occur when certain process units are shut down. The emphasis for this source of flaring is on minimising the frequency of such events and reducing their duration. The management of flaring and its minimisation of events has been addressed through an improvement condition, monitoring and subsequent reporting requirements. Also see BAT 56 below. We agree with the operator's stated compliance.	2.3.1
56	**In order to reduce emissions to air from flares when flaring is unavoidable, BAT is to use the techniques given below.**	CC	The flares receive flare gas from the various process units via four main flare headers. These headers serve: • CCU2 / GSU2 / HFA / EBU / IPU	2.3.1

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<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>
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<table>
<tr><th>Technique</th><th>Description</th><th>Applicability</th></tr>
<tr><td>i. Correct plant design</td><td>See section 1.20.7, Annex 1.</td><td>Applicable to new units.
Flare gas recovery system may be retrofitted in existing units</td></tr>
<tr><td>ii. Plant management</td><td>See section 1.20.7, Annex 1.</td><td>Generally applicable</td></tr>
<tr><td>iii. Correct flaring devices design</td><td>See section 1.20.7, Annex 1.</td><td>Applicable to new units</td></tr>
<tr><td>iv. Monitoring and reporting</td><td>See section 1.20.7, Annex 1.</td><td>Generally applicable</td></tr>
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<td></td>
<td>• CDU-3 / CDU-4 / KMT2
• PF2 / PF3 / Aromatics / HVI / HDS2
• SRU / Alcohols

An additional header system carries sour gas (rich in H_2S) from HDS2, and the Utilities units ARU and SWS.

To reduce nuisance flaring to a minimum when the total amount of gas released to the flare system from sources such as passing relief valves, vents and pressure controllers is relatively low, the refinery flare system is equipped with a flare gas recovery compressor, K3.

i. The flare system has a flare gas recovery compressor sized for 60 tonnes/day which recovers any gases that can only be routed to flare under normal operation. Normal flow-rate to the flare system is 10-12 tonnes per day.

ii. The RFG system pressure is controlled using advanced process control to ensure it is operating in the optimal pressure range. RFG firing on the HPBH is used as a swing consumer to control RFG main pressure. This ensures flaring from the RFG main is minimised at all times.

iii. The flare stacks themselves are purged continuously with nitrogen to prevent back flow of air into stacks when flaring is very low, thereby preventing the possibility of an explosive mixture being formed within the stacks.

In addition, MP steam is fed to the flare tips, controlled according to the quantity of flare gas being flared, in order to ensure smokeless combustion at the tip. Each flare stack is also equipped with three pilot burners which ensure combustion of the flare gases following a period of low flare activity. CCTV cameras and operational visual inspection ensure that the pilot burners remain alight at all</td>
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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)
			times. Flare stacks 3 and 4 are equipped with facilities to burn hydrogen sulphide H_2S in the event that the gas cannot be processed in the sulphur recovery units. Sour gas is routed from HDS2, ARU and SWS via a combined header to join the gas going to stacks 3 or 4 downstream from the seal pots to prevent admitting H_2S to the entire flare system. To ensure complete combustion of the H_2S, support fuel gas is added to the stream before it enters the flare facilities. iv. See BAT 55. The operator requested a sour flaring limit of 10 tonnes of SO_2 in 24 hours based on the following: • The flow-rate of gas to the “sour flare” is measured continuously – this flow-meter measures the total flow-rate (i.e. hydrocarbons, N_2, H_2S, inerts). There is typically a baseline flow of ~5 tonnes/day. • For any events leading to a flare flow above this baseline the source of flaring is reviewed. A “H_2S factor” is applied dependent on the source of flaring to determine the amount of H_2S that goes to flare. • The amount of SO_2 released is calculated assuming that all H_2S is converted to SO_2. Based on historical performance the number of events emitting more than 10 tonnes of SO_2 in 24 hours was: Year: 2015 — No. of events emitting more than 10 tonnes SO2 in a 24 hour period: 8 Year: 2016 — 3 Year: 2017 — 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)
			We have set a lower 24 hour mass limit of 6.4 tonnes of SO_2. This is based on modelling of sour flaring, using the Environment Agency's refinery tool. Assuming that the SO_2 emission rate from a sour flaring event will trace a bell shaped curve then the total mass should be set at double the maximum tolerable peak flow, which the refinery tool identifies as 3.2 tonnes/hour, under average refinery operating conditions. We have removed the notification threshold of 0.47 tonnes/hour sulphur dioxide and associated Note 8 to Table S3.1(a). This is replaced by the notification condition 4.3.9 which includes the notification limit of 6.4 tonnes of SO_2 in 24 hours. The emission limit of 0.47 tonnes/hour for SO_2 emissions from flaring was averaged over a 72 hour period. This permits up to 33.84 tonnes of SO_2 to be emitted over a 72 hour period. This is not consistent with the approach for other oil refineries, where either an hourly limit or a 24 hour mass limit have been set. This BAT relates to the efficiency of flaring to minimise emissions, when flaring cannot be avoided. The management of flaring and assessment of performance of the flare has been addressed through permit conditions including monitoring and reporting requirements. We have added standard conditions to Sections 4.2 (Reporting) and 4.3 (Notifications) of the permit which are	

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)
			applicable to all sites with flares. We have also set an improvement condition which is applicable to all sites with a flaring system. We have added the relevant reporting forms to Table S4.5 of the permit. We agree with the operator's stated compliance.	
57	**In order to achieve an overall reduction of NO_x emissions to air from combustion units and fluid catalytic cracking (FCC) units, BAT is to use an integrated emission management technique as an alternative 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	NC derogation	A time based derogation has been agreed for NOx reduction proposals on three of the CDU-4 furnaces. The remaining furnace will be included in the NOx emissions bubble. We have added a standard condition in Section 3.7 (Emissions and monitoring) of the permit which is applicable to all sites that have requested to use the integrated emissions monitoring technique in order to comply with BAT 24 and BAT 34. We have also added standard condition 4.3.10 to the Notifications section of the permit. We have added an improvement condition requiring the submission of an integrated air emissions management protocol for approval. There is provision to incorporate any approved protocol into table S1.2, operating techniques. We have amended pre-operational conditions POC3 & POC4 to include the necessary site bubble calculations for CDU-3 and the HVI unit, should they become operational. If this is the case they will be classed as 'existing units' for the purpose of the bubble calculations. We have also added the specific limits and monitoring requirements into Table S3.1(d) of the permit for Integrated Emissions Management.	2.3.1 2.4.1 3.7.1 4.3.10

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)
	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: (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		We have included the specific reporting requirements in table S4.1 of the permit and the new reporting form in Table S4.5 of the permit. We agree with the operator's stated compliance.	

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)
	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; • 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	CC	We have added a standard condition in Section 3.7 (Emissions and monitoring) of the permit which is applicable to all sites that have requested to use the integrated emissions monitoring technique in order to comply with BAT 26, BAT 36 and BAT 54. We have also added standard condition 4.3.10 to the Notifications section of the permit. We have added an improvement condition requiring the submission of an integrated air emissions management	2.3.1 2.4.1 3.7.2 4.3.9

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)
	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** 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		protocol for approval. There is provision to incorporate any approved protocol into table S1.2, operating techniques. We have also added the specific limits and monitoring requirements into table S3.1(d) of the permit for Integrated Emissions Management. This includes the addition of an hourly average limit of 1,400 mg/Nm^3 based on the following: In 2007 hourly average bubble emission limits were set for SO_2 emissions from oil refineries by the Environment Agency to protect local air quality, in particular to prevent exceedances of the 15 minute UK air quality objective (AQO) of 266 $\mu g/Nm^3$. Whilst a limit of 1,400 mg/Nm^3 was set for the refinery, this was suspended following completion of the relevant improvement condition, see table below. REF-A-1; REF-A-2; REF-A-3; REF-A-4; REF-A-5; REF-A-6; REF-A- 7; REF-A-8; REF-A-9; REF-A-10; REF-A-11 | Sulphur dioxide | CDU-3; CDU-4; F-650; HP21-HP26; PF3; Sec proc; HDT2; HD Select; EBU; SRU; CCU CO Boiler | 1400 mg/m^3 (from 1 January 2009) | Hourly | Continuous | To be agreed in response to completion of relevant improvement item, see table s1.3 As part of this permit review, our agreed approach is to retain these limits across the sector. A limit has been set for the refinery to be consistent with the sector policy; however the permit contains provision for this limit to be reviewed based on current operations.	

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)
	following: (a) for catalytic cracking process (regenerator) units: the BAT-AEL ranges set out in Table 6 (BAT 26); (b) for combustion units burning refinery fuels alone or simultaneously with other fuels: the BAT-AEL ranges set out in Table 13 and in Table 14 (BAT 36); and (c) for waste gas sulphur recovery units: the BAT-AEPL ranges set out in Table 17 (BAT 54). 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 the 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**		We require evidence to evaluate the risk of potential exceedances of the short-term 15 minute AQO and to determine a realistic hourly bubble limit. This evidence will include the following: 1. Data for a number of representative years for current/future operations, including release profiles, peak emissions and how frequent these peaks are likely to be. ○ Hourly SO_2 concentrations from the SRU and the CO boiler, with a comparison to values used in the CERC report [Note 1]. ○ Hourly bubble SO_2 concentration (using CDU-4, HPBH, CO boiler and SRU). 2. Discussion and interpretation of these release profiles and peak concentrations with consideration to: ○ Operational scenario (e.g. potential unit off-sets, unusually high sulphur crudes, etc.) ○ Frequency of peaks within the year and their likelihood within upcoming years. ○ How CERC's modelled values may or may not represent these short-term peaks Note 1: CERC report Dispersion modelling of SO_2 emissions from Stanlow refinery, Cheshire. Draft report (Ref: FM1080/R3/16, dated 12 August 2016) produced by Cambridge Environmental Research Consultants (CERC), for Cheshire West and Chester Council. The emissions data provided by the operator for this report were based on daily average concentrations. This time base is unlikely to capture the peak concentrations and a shorter time base is required. We have set an improvement condition to gather the evidence required to determine a realistic hourly bubble	

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**		limit. We have included the specific reporting requirements in table S4.1 of the permit and the new reporting form in table S4.5 of the permit. We agree with the operator's stated compliance.	
A number of definitions were added to Schedule 6 – Interpretation of the permit as a requirement of the BAT conclusions. These included: Acid gas, BAT, BAT AEL, bubble emission limit, flaring event, integrated emissions management technique, normal operation, off-gas, operational hours, other than normal operating conditions, standard contribution value and the BREF.				

7 Review and assessment of derogation requests made by the operator in relation to BAT Conclusions which include an associated emission level (AEL) value

Article 15(4)

The IED enables a competent authority to allow derogations from BAT AELs stated in BAT Conclusions under specific circumstances as detailed under Article 15(4):

By way of derogation from paragraph 3, and without prejudice to Article 18, the competent authority may, in specific cases, set less strict emission limit values. Such a derogation may apply only 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 compared to the environmental benefits due to:

> *(a) the geographical location or the local environmental conditions of the installation concerned; or*
>
> *(b) the technical characteristics of the installation concerned.*

Cost Benefit Analysis

If a derogation is applicable under Article 15(4) of the IED, then Cost Benefit Analysis (CBA) is undertaken. The CBA allows calculation to indicate whether the costs of compliance are greater or less than the environmental benefits.

It essentially groups all the costs on one side, with all the benefits, as far as possible, on the other side. It then includes the effect of time on the value of those costs and benefits in order to produce a Net Present Value (NPV).

This gives an indication of whether those costs are disproportionate or not, but there are many sensitivities in the analysis and many aspects of the environment that cannot yet be monetised so the actual decision on disproportionality rests with the National Derogation Panel (NDP).

Where the NPV is positive, this indicates that the cost of compliance with the BAT AEL(s) does not outweigh the environmental benefits.

Where the NPV is negative, this indicates that the costs of compliance with the BAT AEL(s) outweigh the environmental benefits.

Derogation requests

As part of their Regulation 61 Notice response, the operator has requested derogations from compliance with the AEL values included in BAT Conclusions 12, 27, 34 and 52 for the Refining of Mineral Oil and Gas.

The relevant BAT Conclusions and the duration of the derogation requests are as follows:

BAT Conclusion	**Derogation request**
BAT 12	Time limited to 30 September 2021.
BAT 27	Non time limited until review of the permit is triggered by an event stipulated in article 21 of the Industrial Emissions Directive 2010.
BAT 34 (CDU-4)	Time limited to 31 December 2022.
BAT 52	Time limited to 31 December 2020.

A derogation for NOx emissions from the HPBH (BAT 34), agreed by the National Derogation Panel 05 March 2018 was subsequently withdrawn by the operator 20 April 2018. This was done on the basis that compliance will be achieved via the site NOx emissions bubble (BAT 57).

BAT 12 and BAT 34 (CDU-4) derogations were amended and resubmitted 22 June 2018 and 24 May 2018 respectively. These amended versions completely supersede the earlier submissions, with our assessments being based entirely on the May and June information.

Although information was provided in their response to allow us to commence assessment of the derogation requests it was insufficient to enable us to complete the determination and further information was requested and subsequently supplied as set out in the permit status log.

We have decided to grant the derogations requested by the operator in respect to the AEL values described in BAT Conclusions 12, 27, 34 and 52. We have set ELVs that are higher than the BAT AELs in the consolidated variation notice that will ensure suitable protection of the environment.

The justification for our decision to allow derogations in respect of the AEL values associated with the BAT Conclusions is set out below.

7.1 Derogation from BAT Conclusion 12 - Reduce pollutants in waste water discharge

To reduce emission loads of pollutants in the waste water discharge to the receiving water body, BAT is to remove insoluble substances by recovering oil, suspended solids and dispersed oil and to remove soluble substances using biological treatment and clarification.

7.1.1 Technical characteristics

Due to the size of site and the range of activities, the installation has a range of existing effluent management systems and technologies in place.

The existing permit authorises 16 discharges to surface water (mostly to the River Gowy & its tributaries and the Manchester Ship Canal (MSC)) which all eventually flow into the River Mersey.

Only emission points associated with refinery processes are considered as part of this derogation; however other releases associated with the installation (chemical and incineration operations) are still captured by the effluent project.

The operator have had a longstanding commitment to improve effluent treatment across the installation.

Their proposed solution for compliance requires the use of a third party to treat their effluent at a local waste water treatment works (WwTW). This will still require significant on site works which will not be completed until December 2020. Allowing nine months for commissioning of the third party facilities gives an overall project completion date of 30 September 2021.

The WWTW has committed to treating this effluent, with their project anticipated to be complete by 31 March 2020. Details of the additional treatment are provided below in the ‘proposed solution’

The project for the proposed derogation has been underway for a number of years already with commitment and buy in from both parties. Given the scale and nature of the works, and the progress to date, there is no other clear alternative, other than tankering the effluent off-site for disposal.

Derogations are sought from the BAT AELs for a number of parameters at emission points W1 to W4 until 30 September 2021, based on the technical characteristics of the installation.

Parameter mg/l	BAT AEL (yearly average)	W1		W2		W3		W4	
		Current mg/l	Proposed mg/l	Current mg/l	Proposed mg/l	Current mg/l	Proposed mg/l	Current mg/l	Proposed mg/l
Hydrocarbon oil index (HOI)	**0.1 – 2.5**	10	10	10	10	10	10	10	10
Total suspended solids (TSS)	**5 – 25**	-	-	45	45	45	45	-	-
Chemical oxygen demand (COD)	**30 – 125**	-	-	250	250	-	-	-	-
Total nitrogen expressed as N	**1 – 25**	-	-	-	-	-	-	No limit Note 1	No limit Note 1
Lead expressed as Pb	**0.005 – 0.03**	-	-	-	-	-	-	No limit Note 1	No limit Note 1
Cadmium expressed as Cd	**0.002 – 0.008**	-	-	-	-	-	-	No limit Note 1	No limit Note 1
Nickel expressed as Ni	**0.005 – 0.1**	-	-	-	-	-	-	No limit Note 1	No limit Note 1
Mercury expressed as Hg	**0.0001 – 0.001**	-	-	-	-	-	-	No limit Note 1	No limit Note 1
Benzene	**0.001 – 0.05**	-	-	-	-	No limit Note 2	No limit Note 2	-	-

Note 1: We are unable to set limits at this stage as the parameters are not currently measured. The permit contains provision for limits to be set based on a representative set of monitoring data.

Note 2: We have set a limit of 0.3 mg/l based on average results obtained in 2015. The permit contains provision for this to be reviewed.

The installation is unique because the age and configuration of the refinery's effluent management systems makes it more technically difficult and costly to comply.

The operator has supplied a valid derogation request against the BAT conclusion, BAT 12 based on the technical characteristics of the installation.

7.1.2 Options

The operator has described two relevant options for achieving the BAT AELs and justified the screening out of seven other options. We agree with the screening out of these options. The two options for meeting the BAT AEL are:

Option 1
BAT AELs – Dispose of effluent from SDAF, NDAF, PDAF units and T1402 off-site by road tanker by 2018. This is a temporary solution to dispose of effluent in the interim period until the WwTW can accept effluent by no later than 30 September 2021. BAT achieved by 28 October 2018.

Option 2
Proposed derogation - bio-treatment process located at off-site WwTW by 30 September 2021. Transfer of effluent from SDAF, NDAF, PDAF and T1402 to the WwTW for biological treatment with BAT achieved no later than 30 September 2021.

7.1.3 Costs and benefits consideration for BAT 12

The proposed derogation and BAT AEL option were taken forward to conduct a cost benefit analysis (CBA).

The central NPV for the options are:

Option	**Central NPV (£millions)**
BAT AEL Dispose of effluent off-site by tanker until 30 September 2021 then transfer to off-site WwTW	-3,942
Proposed derogation Effluent to off-site WwTW.	-

As part of our review, we carried out a number sensitivity checks around the data inputs. The results of these checks did not change the overall outcome of the assessments.

The tankering costs are significant, with the operator calculating costs for tankering effluent off-site at £300/tonne (m^3). We ran the CBA tool using £30/tonne (m^3). Even with this significant reduction in costs the difference

between the NPV of the BAT EAL option and the NPV of the proposed derogation is **-£463 million**.

In conclusion the CBA shows that the costs of meeting BAT AELs outweigh the environmental benefits by -£3,942 million. Compliance with the BAT AELs can therefore be demonstrated as disproportionately costly compared to the environmental benefits.

7.1.4 Environmental consequences of allowing a derogation for BAT 12 and other considerations

The 2016 annual emissions of the parameters requiring a derogation were:

Parameter	**Annual release (kg)**
Oil	Not currently reported
Total suspended solids (TSS)	Not currently reported
Chemical oxygen demand (COD)	(total organic carbon 427,044.3)
Benzene	1247.55
Total nitrogen	102,800.73
Lead	4.11
Cadmium	1.45
Nickel	94.17
Mercury	0.79

Release concentrations would reduce between two and four fold (with a corresponding reduction in the annual release) if the BAT AELs were met in accordance with the timeline set by the IED. The operator's proposal will mean that the current level of emissions would be retained and there would be no deterioration.

It is anticipated that the on-site "upstream" and "downstream" improvements will be completed by December 2020. This will result in improvements in the quality of some effluents prior to the time limited derogation date of 30 September 2021.

A contractual commitment has also been made by the sewerage undertaker to completing the work by 31 March 2020.

The operator has recently undertaken an assessment of the environmental impact on the water environment around the site in response to improvement condition 38 in the existing permit. This includes an assessment of the impact on the Mersey Estuary, a Special Protection Area (SPA) and Ramsar site.

We agree with the overall conclusion of the assessment, that for current releases W1, W2, W3, W4 and S1 and the future release S1, a number of chemical species cannot be screened out as insignificant. We have highlighted a number of discrepancies in this assessment. At this stage however we cannot be certain about the level of significance and the full range of species to which this applies.

At this stage we are also unable to determine whether the improvements will be able to deliver the requirements of the Water Framework Directive (WFD); however improvement conditions will be imposed to continue this conversation and address this. This approach will allow the operator to continue to operate whilst the necessary improvements are carried out.

There will be no increase in emissions, and impacts at sensitive receptors. Releases at current levels have already been assessed and permitted as part of the permitting process.

7.1.5 Permit conditions

We have set the following requirements:

- Table S1.3 of the permit sets an improvement condition:

  To address any potential uncertainties about the quality of the remaining surface water within the intermittent discharges, which will no longer receive DAF treatment. This will include a review of these releases to confirm the requirement for any future monitoring that may be required to determine the significance of any residual impacts.

  That delivers the requirements of the WFD.

  That tracks progress of upgrades and new plant fitting as proposed. The operator will be required to provide regular updates on progress for achieving the BAT AELs by 30 September 2021.

- Table S3.2(a) of the permit maintains the current permit limits for a number of parameters at emission points W1 to W4 in the interim period. This means that there will be no backsliding / deterioration.

- Table S3.2(b) of the permit sets the BAT AELs for all relevant parameters at all relevant emission points, effective no later than 30 September 2021.

7.1.6 Conclusion

The Environment Agency has reviewed the derogation request and concluded that:

We are satisfied that the operator has demonstrated that the cost of complying with the BAT AELs by 28 October 2018 by tankering effluent off-site, is disproportionate to the value of damage to the environment caused by allowing the current emissions for a number of parameters to continue until 30 September 2021.

That allowing the proposed derogation would not cause any deterioration from the current situation, by maintaining the current permit limits i.e. no backsliding / deterioration.

It is anticipated that the on-site “upstream” and “downstream” improvements will be completed by June 2019. This will result in improvements in the quality of some effluents prior to 30 September 2021.

A contractual commitment has also been made by the third party to completing the work by 31 March 2020.

The project for the proposed derogation has been underway for a number of years already with commitment and buy in from both parties. Given the scale and nature of the works, and the progress to date, there is no other clear alternative, other than tankering the effluent off-site for disposal at significant cost.

The National Derogation Panel agreed with our conclusions 03 July 2018.

7.2 Derogation from BAT 27 – Reduce CO emissions to air from catalytic cracking

To reduce CO emissions to air from the catalytic cracking process (regenerator) at emission point A-11 which operates in the partial combustion mode, using one or a combination of techniques as described in the BAT Conclusions.

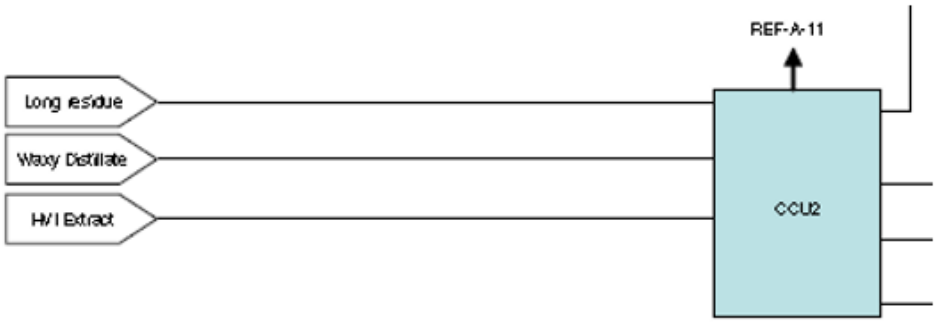
The catalytic cracking unit (CCU) is a Long Residue Catalytic Cracker consisting of the reactor and regenerator section, the main fractionator distillation column and a CO boiler.

The primary purpose of the CO boiler is to reduce CO emissions.

The CCU has been in operation since 1988. Coke is one of the by-products of cracking and adheres itself to the surface of the catalyst. The coke is combusted as the catalyst flows through a regenerator.

The CCU is a partial burn unit, i.e. not all of the coke is fully combusted to carbon dioxide (CO_2) in the regenerator, with some leaving as CO. The flue

gases from the regenerator pass to the CO boiler where the CO is combusted to CO_2, using supplementary fuel (refinery fuel gas (RFG)) to control the overall combustion chamber temperature.



The CO boiler generates up to 4000 tonnes per day (t/day) of very high pressure (VHP) steam at approximately 110 barg and supplies about **25%** of the **VHP steam load** for the refinery.

The CCU CO boiler exhaust discharges through emission point reference A-11, see above.

7.2.1 Technical characteristics

A derogation is sought from the CO BAT AEL from emission point A-11 based on the technical characteristics of the installation until a review of the permit is triggered by an event stipulated in article 21 of the Industrial Emissions Directive 2010.

BAT AEL (mg/Nm^3) Monthly average	**Proposed limit (mg/Nm^3) Monthly average**
≤ 100	1,300

The installation is unique because of the age and throughput of the catalytic cracker and CO boiler; specifically there is a play off between CO emissions and NOx emissions from the catalytic cracker due to operation at high throughput and high temperatures which means that any reduction in CO emissions results in an increase in NOx emissions.

The operation at a high throughput generates a large quantity of CO. Increased CO destruction would further raise the operating temperature, generating more thermal NOx. For this reason the derogation is requested until the next permit review i.e. for the life-time of the BREF.

The operator has supplied a valid derogation request against the BAT conclusion, BAT 27 based on the technical characteristics of the installation.

7.2.2 Options

The operator has described three relevant options for achieving the BAT AEL. The BAT AEL options and proposed derogation are:

Option 1
BAT AEL - BAT for CO achieved 2018

Reduce CO emissions at the expense of increasing NOx emissions up to the BAT AEL of 400 mg/Nm^3; however it may not be practical or possible to meet both BAT AELs consistently.

Option 2
Install a new CO boiler - BAT achieved 2022 (earliest)

A CO boiler is designed to meet BAT AELs for CO and NOx. This option assumes that the new CO boiler is installed during periodic maintenance in 2022, which is likely to involve an extended shutdown.

Option 3
Proposed derogation, no change - Continue operation of the existing CO boiler, with CO emissions exceeding the BAT AEL.

The derogation request includes a proposed non time limited ELV of 1,300 mg/Nm^3 for CO. The operator are not proposing to make any modifications to reduce CO emissions at this time, however they commit to completing further work to investigate the impact on CO and NOx emissions of modifications to the air flow within the CO Boiler. Practicality of making changes (i.e. internal changes to combustion chamber) was assessed during the first quarter of 2018. Any modifications based on the findings would need to be designed for implementation in a later refinery maintenance window. This will form an important part of ongoing improvements at the site.

7.2.3 Costs and benefits consideration for BAT 27

The proposed derogation and BAT AEL options were taken forward to conduct a CBA.

The basis of the CBA is that CO emissions are reduced to the BAT AEL of 100 mg/Nm^3 and NOx emissions increase to the BAT AEL of 400 mg/Nm^3, as shown in the table below. Note that it may not be possible to control operations to meet both BAT AELs consistently.

	CO emission (t/a)	NOx emissions (t/a)
2016 actual	1620	1008
2016 BAT AEL	354	1414
Difference	-1266	+407

The central NPV for the options are:

Option	Central Net Present Value (NPV) (£millions)
BAT AEL	- 117
New CO Boiler	- 174
Proposed derogation	-

As part of our review, we carried out a number sensitivity checks around the data inputs. The results of these checks did not change the overall outcome of the assessments.

In conclusion the CBA shows that the costs of meeting BAT AEL outweigh the environmental benefits by -£117 million. The costs of installing a new CO boiler outweigh the environmental benefits by -£174 million. Compliance with the BAT AELs can therefore be demonstrated as disproportionately costly compared to the environmental benefits.

7.2.4 Environmental consequences of allowing a derogation for BAT 27 and other considerations

Allowing the proposed derogation would not cause any significant pollution or prevent a high level of protection of the environment as a whole to be achieved.

There are no local issues with CO, and in any event the impact from CO emissions at their current level screen out as insignificant at 5.76% (<10%) of the environmental standard (ES).

The annual emissions of CO from the activity are currently 1,620 tonnes/annum and these would reduce to at least 354 tonnes/annum if the BAT AEL was met in accordance with the timeline set by the IED. The Operator's proposal will mean that CO emissions will continue at their current level as any reduction results in an increase in NOx emissions.

Emissions of CO are covered by the EC Directive 2008/50/EC. We are legally obliged to ensure that our regulated sites do not cause an exceedance of the

ES or make a significant contribution to an exceedance. In this instance emissions are well below the ES at 5.76%.

There are no ceilings for CO (unlike NOx) in either the Gothenburg Protocol or the National Emissions Ceilings Directive. It's also not a substance that we report trends of in our 'Regulating for people, the environment and growth' report.

7.2.5 Permit conditions

We have set the following requirements:

- Table S1.3 of the permit sets an improvement condition:

  Requiring the operator to complete further work to investigate the impact on CO and NOx emissions of modifications to the air flow within the CO Boiler. The practicality of making changes (i.e. internal changes to combustion chamber) was assessed during periodic maintenance in the first quarter of 2018. Modifications based on the findings need to then be designed for implementation in a later refinery maintenance window.

- Table S3.1(a) of the permit sets a CO limit of 1,300 mg/Nm^3 from 28 October 2018. Previously no limit was set which is reflected in Table S3.1 of this permit, and is applicable until 28 October 2018.

7.2.6 Conclusion

The Environment Agency has reviewed the derogation request and concluded that:

We are satisfied that the operator has demonstrated that the cost of complying with the BAT AEL by 28 October 2018 (which will result in an increase in NOx emissions) or by 2022 (by replacing the CO boiler during an extended shut-down) is disproportionate to the damage to the environment caused by allowing emissions of CO to continue at their current concentration of 1,300 mg/Nm^3 until the next permit review.

There are no local issues with CO (unlike NOx) and the impact from CO emissions at their current level screen out as insignificant.

Allowing the proposed derogation would not cause any significant pollution or prevent a high level of protection of the environment as a whole to be achieved.

The impact of increasing NOx emissions as a result of a reduction in CO is more significant. The UK is committed to achieving reductions in NOx emissions and therefore it is difficult to justify a reduction in CO at the expense of an increase in NOx emissions.

BAT 24 also requires the operator to reduce NOx emissions to air from the same emission point and sets a BAT AEL of 100 to 400 mg/Nm^3, a level the plant can meet without the need for a derogation.

The National Derogation Panel agreed with our conclusions 05 February 2018.

7.3 Derogation from BAT 34 (CDU-4) – Reduce NOx emissions from combustion

To reduce NOx emissions from combustion at the crude distillation unit (CDU-4) at emission point A-2, using one or a combination of primary and secondary techniques as described by the BAT Conclusion.

Each furnace has the capability to burn both oil and gas. The furnaces are started up on oil and typically run on 100% gas during normal operation, although liquid firing may be required, for example as fouling builds up over the operating run in the period prior to a planned maintenance event.

NOx emissions are minimised by burning 100% gas when possible, and optimising furnace operation in terms of excess oxygen (O_2) control. No other NOx reduction measures are employed on these furnaces.

The CDU-4 consists of four furnaces which are used to heat crude oil and intermediate residue for fractionation. Fractional distillation or “fractionation” is the key unit operation within a CDU, where the crude oil is distilled into different fractions or components. This takes a significant amount of heat, supplied by the four combustion units.

All four combustion units are fitted with conventional burners i.e. not low NOx and all discharge through a common stack at emission point reference A-2.

A derogation from the BAT Conclusion 34 NOx AELs is requested for three of the four furnaces (combustion units) on CDU-4.

The combustion units requiring a derogation are identified as F201 A (58.9 MW), F201 B (58.9 MW) and F201 C (49 MW).

Combustion unit F202 is not part of this derogation and will achieve compliance with BAT through BAT Conclusion 57.

BAT Conclusion 57

In order to achieve an overall reduction of NOx emissions to air from combustion units (and other applicable units), BAT is to use an integrated emission management technique as an **alternative to applying BAT 34**.

The technique consists of managing NOx emissions from several or all combustion units (and other 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 34.

This technique is recognised for the installation due to:

- site complexity, multiplicity of combustion and process units interlinked in terms of their feedstock and energy supply;
- frequent process adjustments required in function of the quality of the crude received;
- technical necessity to use process residues (e.g. refinery fuel gas (RFG)) as combustion fuel, causing frequent adjustments of the fuel mix according to process requirements.
- BAT AELs are set out in Table 18 of BAT Conclusion 57.

In addition, for each new combustion unit (and other applicable new units) included in the NOx integrated emission management system, the BAT AELs set out under BAT 34 remain applicable.

7.3.1 Technical characteristics

CDU-4 furnaces were commissioned in 1973 at which time the furnaces /combustion units were not designed to meet current emission limits. The four combustion units are equipped with conventional burners i.e. not low NOx and the operator is required to upgrade three of the four units. The most cost-effective solution is to upgrade them during their normal maintenance times. Upgrading them all during the next planned maintenance event in 2022 is considered a valid technical characteristic for seeking a derogation that will deliver compliance by 31 December 2022.

It is not possible to shut down CDU-4 independent of the rest of the refinery as it is the primary unit which supplies feed-stocks to the other units.

The high hydrogen content of the RFG and the high air pre-heating also increases NOx emissions. The BAT Conclusion makes an allowance for this (Note 1 to the tables).

Derogations from the BAT AELs are sought as follows:

Gas firing

BAT AEL (mg/Nm^3) Monthly average	Applicable BAT AEL (mg/Nm^3) Monthly average	Proposed limit (mg/Nm^3) Monthly average
150 Note 1	200	300

Note 1: For an existing unit using high air pre-heat (i.e. > 200 ^oC) or with H_2 content in the fuel gas higher than 50 %, the upper end of the BAT-AEL range is 200 mg/Nm^3.

Multi-fuel firing

BAT AEL (mg/Nm^3) Monthly average	Applicable BAT AEL (mg/Nm^3) Monthly average	Proposed limit (mg/Nm^3) Monthly average
300 Note 1	Up to 450	450

Note 1: For existing units < 100 MW firing fuel oil with a nitrogen content higher than 0,5 % (w/w) or with liquid firing > 50 % or using air preheating, values up to 450 mg/Nm^3 may occur.

The operator has supplied a valid derogation request against the BAT conclusion, BAT 34 based on the technical characteristics of the installation.

7.3.3 Options

The operator has described three relevant options for achieving the BAT AEL with all options taken forward to conduct a CBA.

Option 1
BAT AEL option - Shut-down refinery to install low-NOx burners

This option is based on shutting the refinery down in October 2018 to install low-NOx burners on all four furnaces. The operator estimated that a 12 month shut-down would be required.

We also carried out the CBA assessment with a three month refinery shut-down.

Option 2
Proposed option – Low NO_x burners on three combustion units

The proposed solution is to install low NO_x burners on three of the CDU-4 combustion units during the next planned maintenance event in 2022. This date is the earliest date by which the three combustion units can be modified.

Option 3

Low NO_x burners on two combustion units.

Installing low NOx burners on two of the combustion units to achieve lower NOx emissions. Low NOx burners would be installed during the next planned maintenance event in 2022. It is unlikely that this option will be able to consistently meet the BAT AELs.

7.3.3 Costs and benefits consideration for BAT 34

The proposed derogation and BAT AEL option were taken forward to conduct a CBA.

The central NPV for the options are:

Option	**Central Net Present Value (NPV) (£millions)**
BAT AEL	-272
Low NOx burners on two combustion units Proposed derogation	0.07
Low NOx burners on three combustion units	-

As part of our review, we carried out a number sensitivity checks around the data inputs. The results of these checks did not change the overall outcome of the assessments.

We challenged the requirement for the refinery to be shut-down for 12 months to install low NOx burners on the three furnaces. We ran the CBA tool based on the refinery shutting down for three months. The results were as follows:

Option	**Central Net Present Value (NPV) (£millions)**
BAT AEL	-66

Even with these significant changes to the CBA, the costs of meeting the BAT AEL outweigh the monetised benefits in comparison to the proposed derogation (i.e. NPV < 0). The difference between the NPV of the BAT EAL option and the NPV of the proposed derogation is **-£66 million**.

It is worth noting that we didn't explore the idea of the three month refinery shut-down any further with the operator for the BAT AEL option as the NPV remained significantly negative, even if much reduced compared with the 12 month scenario.

In conclusion the CBA shows that the costs of meeting BAT AEL outweigh the environmental benefits by -£272 million. Compliance with the BAT AEL can therefore be demonstrated as disproportionately costly compared to the environmental benefits.

7.3.4 Environmental consequences of allowing a derogation for BAT 34 and other considerations

Allowing the proposed derogation would not cause any significant pollution or prevent a high level of protection of the environment as a whole to be achieved.

The impact of derogating from the BAT AEL for NOx is summarised below:

- The current limit is based on IED Chapter III limits for Large Combustion Plant (LCP). This limit is a backstop that will not be exceeded.
- Under the current permit the operator currently discharge at this level and are not aware of any adverse environmental impact. See also notes on Ambient Air Quality below.
- The impact assessment undertaken when the current ELV was set, demonstrated no significant impact. That situation remains the same and will be improved once the new burners are installed.
- There is not a local issue with NO_x emissions. This is supported by measurements from local air quality monitoring stations.

Using the Environment Agency guidance for air emissions risk assessment the NO_x emissions from the CDU-4 do not exceed the Ambient Air Directive Limit Values for NO_x:

Substance	**Emission Period**	**Limit (average)**
Nitrogen dioxide	1 hour	200 µg/m^3
Nitrogen oxides (as NO_2)	Annual	40 µg/m^3

Using 2016 annual NOx emissions of 402.36 tonnes and a stack height of 143m the calculated Process Contribution (PC) of 0.64 µg/m^3 from the CDU-4 stack is **~ 1.6%** of the annual limit. The PC is **0.32%** of the short-term limit so screens out as insignificant.

Although this is not low enough for NOx emissions to be screened out as insignificant for the annual limit (i.e. insignificant when PC <1% of the annual limit value), it does demonstrate that the impact of NOx emissions from CDU-4 are low.

In view of the conservative nature of the assumptions used in the calculation of the PC:

- The H1 tool methodology calculates figures which give 'worst case' estimates, which means that PCs may be higher than if they were calculated using other methods, for example dispersion modelling software (which analyses how air pollutants disperse in the atmosphere).
- The PC calculated is the point of maximum impact; whereas modelling predicts impacts at specific sensitive receptors.

We can therefore conclude that the PC is negligible.

There will be no increase in NOx emissions, and impacts at sensitive receptors at current levels have already been assessed as part of the permitting process. The operator has provided the necessary information to demonstrate that the impact of NO_x emissions from CDU-4 are low.

7.3.5 Permit conditions

We have set the following requirements:

- Table S1.3 of the permit sets an improvement condition requiring periodic updates on the modification programme to ensure that the project proposal for delivery of the improvements are on track for 2022.
- Table S3.1 of the permit retains the current NOx limits on the basis of no backsliding / deterioration.
- Table S3.1(a) of the permit sets the BAT AEL for the three combustion units following completion of the improvements in 2022.
- The operating techniques for this BAT Conclusion are incorporated into Table S1.2 of the permit.

7.3.6 Conclusion

The Environment Agency has reviewed the derogation request and concluded that:

We are satisfied that the operator has demonstrated that the cost of complying with the BAT AELs for gas and multi-fuel firing by 28 October 2018 by shutting down the refinery (for a three month or a 12 month period), is disproportionate to the value of damage to the environment caused by allowing NOx emissions to continue at their current levels (of 300 mg/Nm^3 for gas firing and 450 mg/Nm^3 for liquid fuel firing) until completion of the improvements in 2022.

That allowing the proposed derogation would not cause any deterioration from the current situation, by maintaining the current permit limits i.e. no backsliding / deterioration.

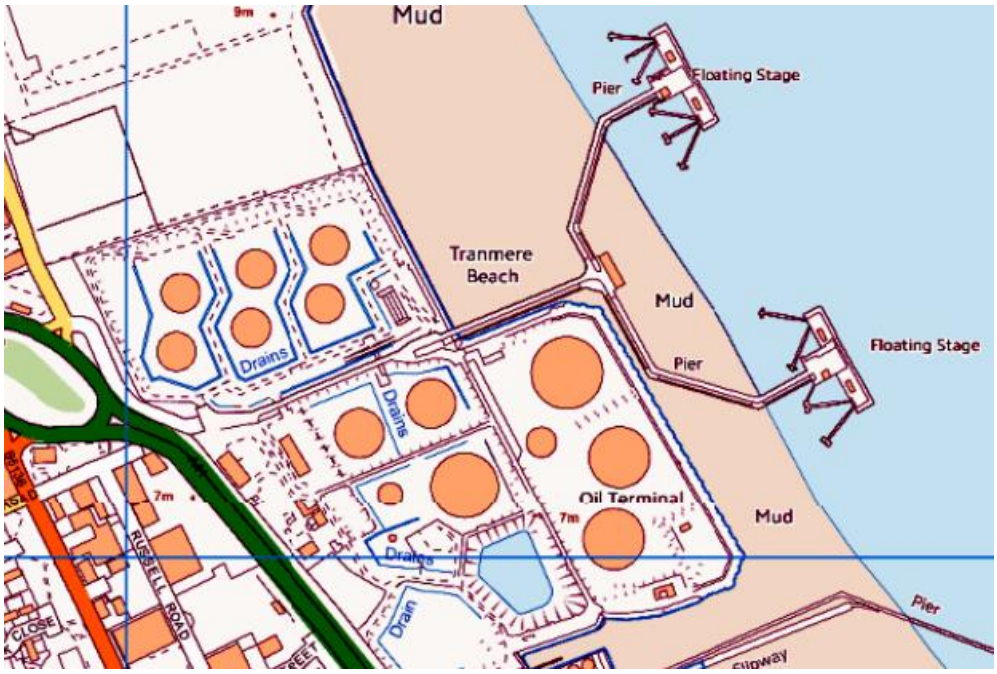
The National Derogation Panel agreed with our conclusions 03 July 2018.

7.4 BAT 52 - Reduce VOC emissions from loading / unloading operations

To reduce Volatile Organic Compounds (VOCs) emissions to air from loading and unloading operations for sea going vessels, BAT is to use vapour recovery. The applicability limit is relevant to facilities transferring more than 1 million m^3 / annum from sea going vessels.

Crude oil is received from a separate EPR installation (EPR/YP3238FT) at the Tranmere Oil Terminal on the Mersey, 13.5 km to the north west of the installation. The Tranmere Oil Terminal is more accessible to ships and road vehicles and used for the storage of hydrocarbon based liquids which are loaded and unloaded from ships. These liquids are transferred by pipelines to and from Stanlow. Tranmere is covered under a separate permit, which is not part of the review of this derogation.

Tranmere location

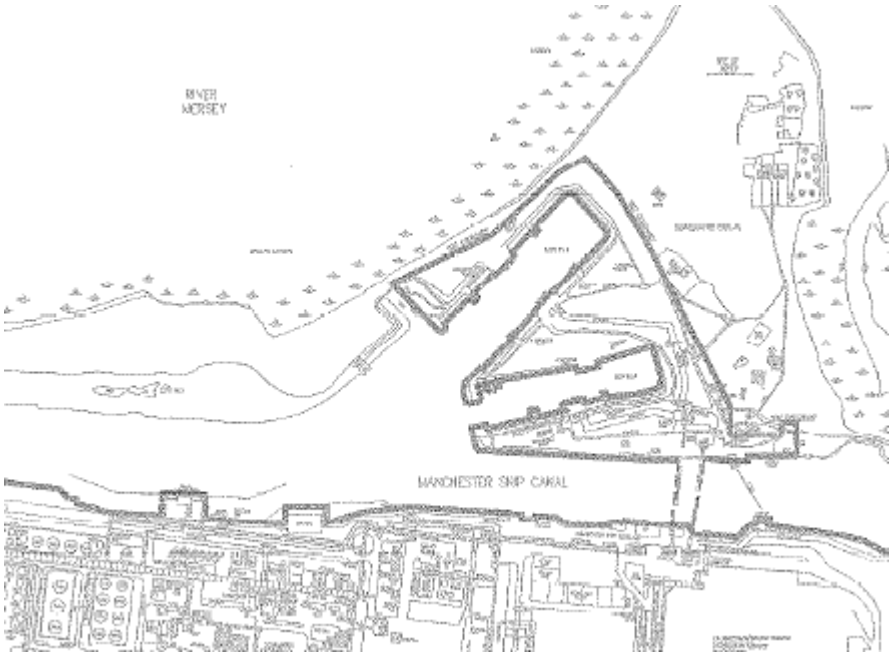


Throughput at the White Oil Docks berth on the Manchester Ship Canal (MSC) is currently above the threshold. The operator is implementing a project independent of this derogation to provide more resilience & flexibility within all the berths Stanlow use. This will move some loading operations from White Oil Docks on the MSC to the Tranmere Terminal by the end of 2020. At that point, throughput at White Oil Docks will fall below threshold. The project includes the construction of a BAT 52 compliant vapour recovery unit (VRU) at Tranmere.

7.5.1 Technical characteristics

The construction cost of a VRU at White Oil Docks would be higher than normally encountered due to the complex location on the Dock on Stanlow Island, located on the opposite side of the MSC to the refinery. There is no road access to Stanlow Island, therefore all equipment & resources would have to be moved using floating cranes & barges. This significantly increases the cost of the project compared with the proposed installation of a VRU at Tranmere in 2020, a much less complex location.

Stanlow Island location



The BAT AELs for emissions to air of non-methane VOCs (NMVOCs) and benzene will not apply after 31 December 2020 following completion of the VRU at Tranmere. The duration that emissions would be above the BAT AELs would be 27 months i.e. October 2018 to December 2020.

Derogations from the BAT AELs are sought as follows:

Parameter	**BAT AEL Monthly average**	**Current limit**	**Proposed limit**
NMVOCs	0.15 – 10 g/Nm^3	No limit	No limit
Benzene	<1 mg/Nm^3	No limit	No limit

The operator has supplied a valid derogation request against the BAT conclusion, BAT 52 based on the technical characteristics of the installation.

When setting ELVs we are also required to have regard to Article 14(1)(a) of the IED. This requires us to set ELVs for polluting substances listed in Annex II of the Directive, in this instance VOCs. An ELV is only required for VOCs emitted in significant quantities. In this case, emissions are only just above the insignificance threshold of 1% of the ES, refer to Section 7.5.4 below. On this basis we do not propose to include ELVs for NMVOCs and benzene.

7.5.2 Options

The operator has described three relevant options for achieving the BAT AEL as follows:

Option 1
BAT AEL option - Limit loading / unloading rates

The BAT AELs are not applicable to loading / unloading operations for sea-going vessels with an annual throughput < 1 million m^3/annum. The cost of capping imports and exports has been included. BAT achieved 2018.

Option 2
Install VRU at White Oil Docks

An option to install a VRU at this location has been considered. It would take approximately two years to progress a project to install a VRU. Thus a VRU could not be installed until the end of 2019, which is later than the date required by the BREF. The BAT AELs would not be applicable after 31 December 2020 once the loading / unloading operations fall below the 1 million m^3 / annum threshold. Whilst this is the case, the assessment is based on the VRU being in operation at White Oil Docks for the life-time of the plant i.e. 20 years. BAT achieved 1 January 2020

Option 3
Proposed derogation

To move some loading / unloading operations to Tranmere by the end of 2020. This would result in loading/unloading rates falling below the 1 million m^3 / annum at White Oil Docks, therefore BAT AELs would not be applicable. Emissions during the period October 2018 to December 2020 would not meet the BAT AELs. BAT achieved 1 January 2021.

The proposed derogation and the other two options were taken forward to conduct a CBA.

7.5.3 Costs and benefits consideration for BAT 52

The proposed derogation and BAT AEL options were taken forward to conduct a CBA.

The central NPV for the options are:

Option	**Central Net Present Value (NPV) £million**
BAT AEL	-402
VRU at White Oil Docks	-26
Proposed derogation	-

As part of our review, we carried out a number sensitivity checks around the data inputs. The results of these checks did not change the overall outcome of the assessments.

In conclusion the CBA shows that the costs of meeting BAT AEL outweigh the environmental benefits by -£402 million. Compliance with the BAT AEL can therefore be demonstrated as disproportionately costly compared to the environmental benefits.

The CBA also shows that the costs of installing VRU at White Oil Docks outweigh the environmental benefits by -£26 million and is therefore disproportionately costly compared to the environmental benefits.

7.5.4 Environmental consequences of allowing a derogation for BAT 52 and other considerations

Allowing the proposed derogation would not cause any significant pollution or prevent a high level of protection of the environment as a whole to be achieved.

The impact of derogating from the NMVOC and benzene BAT AELs has been carried out. We conclude that the impact from emissions is low, with the process contribution (PC) only just above the 1% insignificance threshold as follows:

Long-term PC = 0.059 $\mu g/m^3$

- Long-term PC is 1.18% (0.059/5) of the long-term benzene ES.
- Long-term PC is 2.62% (0.059/2.25) of the long-term 1,3 butadiene ES.

Based on this, the information provided and our experience in regulation of the installation, we are satisfied that the impact from the current emissions from the loading / unloading operations at White Oil Docks are minimal.

The impact of releases to air on designated habitats sites within 10km of the installation were considered as part of the permit review in 2007. We concluded there was no adverse effect or potential damage from aerial emissions from the site. Allowing the derogation will not increase the emissions from loading / unloading at the site and therefore presents no additional risk.

The UK has reached its targets for reducing NMVOC under the National Emissions Ceiling Directive to date and is on track to meet 2020 targets. However, it is anticipated that we will not meet 2030 targets. The permit will ensure that appropriate measures are taken on site to manage and minimise VOC emissions in the future.

7.5.5 Permit conditions

We have set the following requirements:

- Table S1.3 of the permit sets an improvement condition requiring a regular review of the progress towards achieving compliance with BAT 52.
- Table S1.1 of the permit limits the loading / unloading at White Oil Docks to <1 million m^3/annum from 1 January 2021.
- The proposed derogation will require a variation to the Tranmere permit to include the installation of VRU in accordance with BAT 52.
- The increased loading / unloading at Tranmere cannot take place until a variation has been issued which authorises this change.
- The operator will be unable to transfer loading / unloading movements to Tranmere until the Tranmere permit is varied.

7.5.6 Conclusion

The Environment Agency has reviewed the derogation request and concluded that:

We are satisfied that the operator has demonstrated that the cost of complying with the BAT AEL by limiting loading / unloading or installing VRU at White Oil Docks is disproportionate to the value of damage to the environment caused by allowing VOC emissions to continue at their current levels until 31 December 2020.

Emissions will reduce significantly from 01 January 2021 when some of the loading / unloading operations move to the Tranmere Terminal. The impact from current operations is low and will be reduced from 01 January 2021.

The National Derogation Panel agreed with our conclusions 05 March 2018.

8 Emissions to Water

The consolidated permit incorporates 17 discharges to controlled waters identified as W1 to W17 (new outfall).

Outfall no.	Description	Future position (from 31 March 2021)
W1	SDAF to Thornton Brook	W1 to remain in place, normally no flow
W2	NDAF to River Gowy	W2 to remain in plane, normally no flow
W3	N38 to Manchester Ship Canal (PDAF, T1402, Demin, Hill site runoff, OTCW)	W3 to remain in place, reduced flow (Demin, Hill site runoff). Will meet BAT-AELs.
W4	N19 to River Gowy	W4 will remain in place, reduced flow (N55, N56, N1B removed). Will meet BAT-AELs.
W5	Ince purge cooling water	No change
W6	Redundant rail loading runoff to River Gowy	No change
W7	LPG spheres runoff to Mill Brook	No change
W8	LPG Firewater Deluge to Mill Brook	No change
W9	SHOP Runoff to River Gowy [3]	No change
W10	LPG Firewater Deluge to River Gowy	No change
W12	T1403/T1404 overflow to Thornton Brook	No change, normally no flow
W13	T1405A/B overflow to River Gowy	No change, normally no flow
W14	T1402A/B Overflow to Gale Brook	No change, normally no flow
W15	T7801/T7802 overflow to Gale Brook	No change, normally no flow
W16	Surface water from car parking, road and Track A to Gale Brook	No change
S1	U7800 effluent to United Utilities	Additional effluents to be sent to UU for biological treatment: SDAF (redirected from W1) NDAF (redirected from W2) PDAF (redirected from W3) T1402A/B (redirected from W3)
New outfall	T4082/T4084 overflow	New outfall required for tank emergency overflow. (Normally no flow)

[3] W9 has not been discussed in this document, since it is a discharge from a chemicals plant and therefore not covered by the requirements of the Refinery BREF.

Our review of the emission limits considered the BAT Conclusions and the relevant waste water BAT AELs from BAT Conclusion 12. We have set ELVs and monitoring in accordance with Table 3 referenced in BAT Conclusions 10 and 12 as detailed in Section 6 of this document, other than those covered by the derogation set out in Section 7.1 of this document.

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

The operator has submitted an initial screening assessment in response to existing improvement condition IC38; however we identified some deficiencies and discrepancies which will be addressed separate to this determination. We

have extended the submission date for this to 31 March 2019. We have also amended the wording of IC38 to incorporate our findings/deficiencies, 'The assessment shall be undertaken in accordance with the timescales in the Environment Agency document titled 'Essar ERA Issues Schedule 130918'. This will ensure that deficiencies are addressed.

We have included an additional improvement condition to ensure that the requirements of the WFD are delivered following completion of the effluent project being delivered by the derogation from BAT Conclusion 12. Details of the improvement condition are included in Annex 2 of this document. If the requirements of this improvement condition are delivered through IC38 then this improvement condition will automatically be completed.

9 Additional IED Chapter II requirements

9.1 Energy from waste / Incineration of hazardous waste

We have updated the requirements for the incineration listed activity i.e. Section 5.1 Part A(1)(a) in accordance with our energy from waste installation permit template. This ensures consistency with the specific requirements for this type of activity.

Conditions and Tables updated in accordance with Chapter IV of the IED as follows:

Conditions	
Condition 1.2.2	added for energy recovery
Condition 2.3.9	amended to remove 'throughputs, calorific values and pollutant compositions are within the ranges' as these parameters are not specified in table S2.3 of the permit The original decision on granting of the permit 21 December 2007 states: *'description of each waste type (mass flow, CV & composition) : the Agency accepted in the determination for the variation of IPC authorisation that the plant was designed around specific waste parameters. The Operator undertakes analysis of regular routine waste on an annual basis and less frequent wastes are analysed as and when required depending on the waste source. New wastes are analysed prior to disposal. In general waste types are of a consistent nature and composition, and as such the parameters of the ERP ensure that the ELVS as defined within the Authorisation are not exceeded.* *The Operator stated that the calorific value of the waste is not currently a process operating control parameter for the ERP and there is no current calorific value data available. Current information indicates that for the process sludge type waste, the gross calorific value ranges from 0 to 55 MJ/kg and for the liquid hydrocarbon*

	the range is 40 to 55 MJ/kg and for the solid mixed waste it is between 0 and 30 MJ/kg. The Agency considers this information as adequate to comply with the specific part of Article 4(5)(b) of the WID.'
Table S3.1(b)	
Continuous monitoring standard BS EN 14181	updated to include BS EN 15267-3
CO half hourly average limit	reduced from 150 mg/m^3 to 100 mg/m^3
NOx daily average of 400 mg/m^3	amended to half hourly average
NOx daily average limit of 200 mg/m^3	added
Dioxins / furans (WHO-TEQ Humans / Mammals / Fish / Birds)	monitoring requirements added
Dioxin-like PCBs (WHO-TEQ Humans / Mammals / Fish / Birds)	
Specific individual poly-cyclic aromatic hydrocarbons (PAHs), as specified in Schedule 6.	
Table S3.5	
Exhaust gas water vapour content, temperature, pressure & oxygen	continuous monitoring added
Combustion chamber temperature	measurement added
Tables S3.6	
Bottom ash and APC residue	added monitoring requirements
S4.1	
Reporting periods	updated to quarterly
Bottom ash and APC residues	added
Functioning and monitoring of incineration plant	added
S4.2	
Electrical energy parameters	added
S4.3	
Performance parameters	added
S4.5	
Residue quality form	added

9.2 General permit amendments include

Introductory note	updated to reference the permit for the Tranmere Oil Terminal in 'Other Part A installation permits relating to this installation
	updated to remove sulpholane production, see Table S1.1 section below.
Condition 4.3.1	amended to include the highlighted text: in the event of a breach of permit condition which poses an immediate danger to human health or threatens to cause an immediate significant adverse effect on the environment, the operator must immediately suspend the operation of the activities or the relevant part of it in a safe and controlled manner until compliance with the permit conditions has been restored.
Condition 4.4.2	amended 'Interpretation' condition to include 'immediately' consistent with the current permit template
Table S1.1	amended cracking activity description to better reflect operations, see figure below
	updated listed activities (Section 5.3 Part A(1)(a)(i)(ii) & Section 5.4 Part A(1)(a)(ii)) to incorporate changes to effluent treatment
	removed the listed activity for sulpholane production. The operator confirmed that there is no sulpholane production on site and that the plant was shut-down some time ago and demolished in 2008.
Table S1.2	updated to include operating procedure provided in response to IC4 in Table S1.3
	updated to include the operating technique provided in response to POC1 in Table S1.4
Table S1.3	changes are included in Annex 2 of this document
Table S1.4	deleted POC1 and POC2 which have been completed
	updated POC3 & POC4 to include the

	BAT Conclusions and the bubble
Emissions to air	
Table S3.1	amended table title to include, '**applicable until 28 October 2018'** removed emission limits and monitoring requirements for 'normal operation' of the Energy Recovery Plant and included in new/separate table S3.1(b)
	REF-A-2-CDU-4 added 'Back-up non-commercial liquid fuel firing' to the gas fired limits section of the tables. This is required to accommodate a change in operation on the run up to maintenance which can require a small amount of liquid fuel to be introduced to reduce furnace skin temperatures. The gas fired limits will still apply during this mode of operation.
Table S3.1(a)	added to implement the BAT Conclusion AELs, **applicable from 28 October 2018** previous table S3.1(a) becomes S3.1(c) REF-A-2-CDU-4 added 'Back-up non-commercial liquid fuel firing' to the gas fired limits section of the tables. This is required to accommodate a change in operation on the run up to maintenance which can require a small amount of liquid fuel to be introduced to reduce furnace skin temperatures. The gas fired limits will still apply during this mode of operation.
	REF-A-3-CD4 molecular sieve removed 'dust' as no limit set and no requirement to monitor.

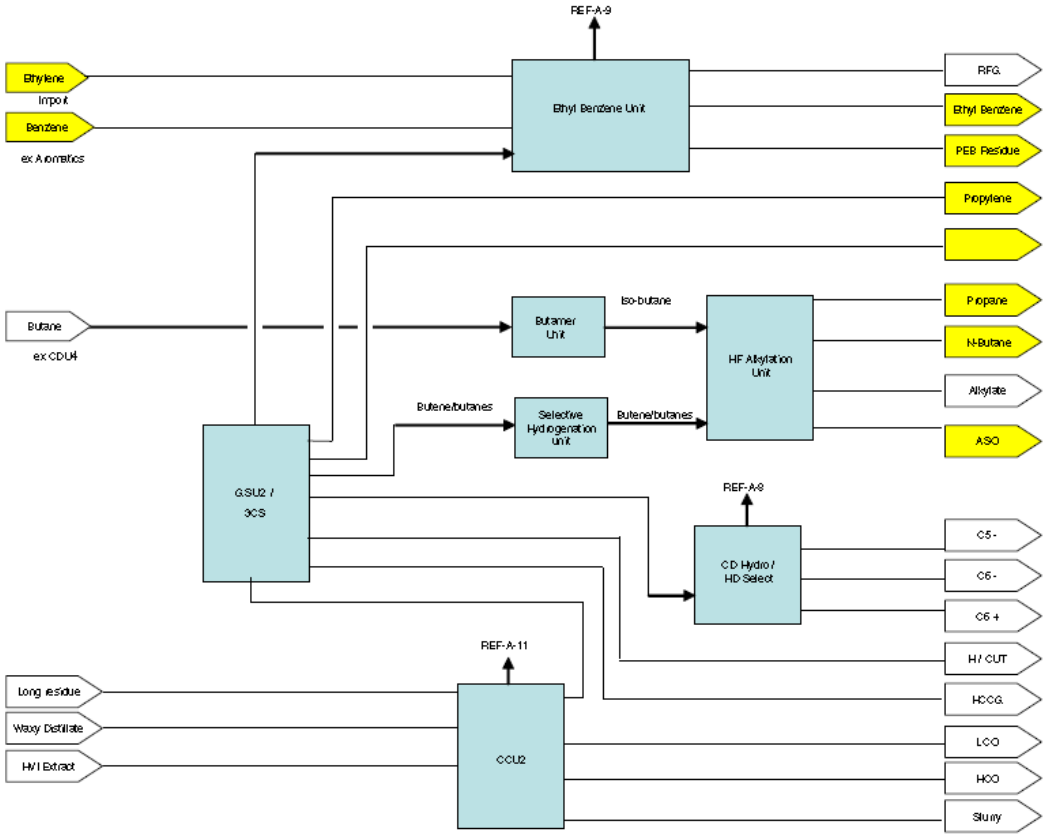
Table S3.1(b)	added to include emission limits and monitoring requirements for the normal operation of the Energy Recovery Plant previous table S3.1(b) becomes S3.1(d)
Table S3.1(c)	added to include emission limits and monitoring requirements for abnormal operation of the Energy Recovery Plant previous table S3.1(c) becomes S3.1(e)
Table S3.1(d)	added to include emission limits and monitoring requirements for the refinery bubble previous table S3.1(d) becomes S3.1(f)
	for requirements that apply until 28 October 2018, 'to be agreed' amended to 'agreed'
Table S3.1(e)	added to include emissions during normal operation where there are no limits
	amended to remove the resins plant which has been demolished
Table S3.1(f)	added to include emissions during abnormal operation where there are no limits
Emissions to water/sewer	
Tables S3.2, S3.2(a), S3.2(b), S3.3(a)	changes to laboratory test methods in response to an email from the operator received 06 September 2018: <u>BTEX</u> Test method changed from BS EN 15680 to ISO 11423-1. We also amended the reference period from a composite to a spot sample due to the volatility of these compounds which means that they may be lost in a composite sample. <u>Cd, Pb, Ni, V</u> Test method changed from BS EN

	ISO 15586 to BS EN ISO 17294. <u>Cyanide</u> Test method changed from BS EN ISO 14403-2 to ISO 6703-1. <u>Sulphide</u> Test method changed from Silver nitrate titration Method (Sulphide in Waters and Effluents 1983 ISBN 0117517186) to ISO 10530.

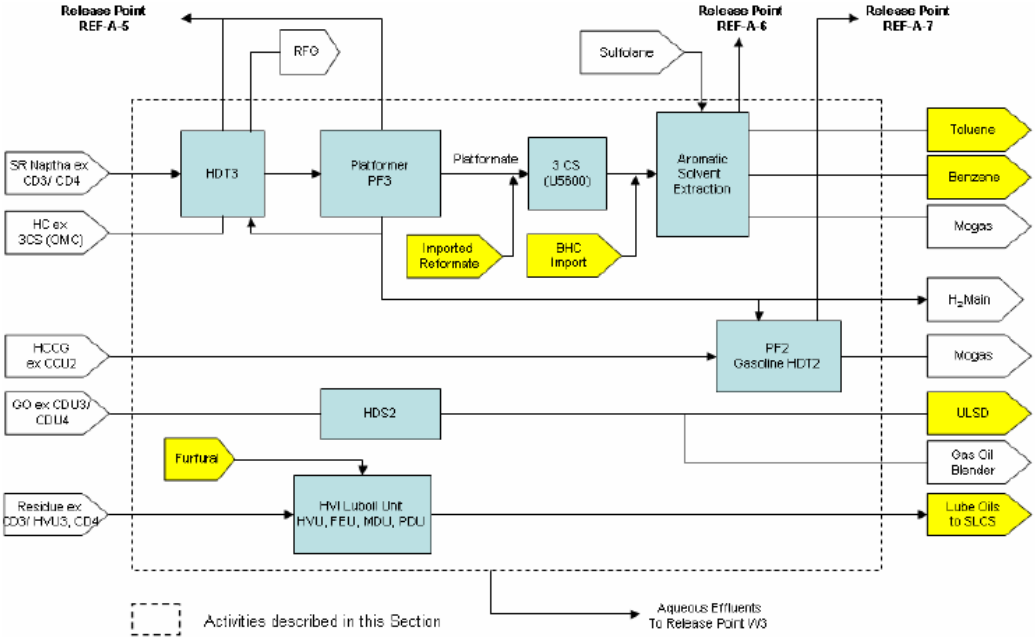
Table S3.2	amended table title to include, '**applicable until 28 October 2018'**
Table S3.2(a)	added to implement the BAT Conclusion AELs, **applicable from 28 October 2018 to completion of the BAT 12 derogation** Included a requirement to visually inspect the release at emission point W3 for oil on a daily basis.
Table S3.2(b)	Added, **applicable from completion of the BAT 12 derogation** Included a requirement to visually inspect the release at emission point W3 for oil on a daily basis.
Emissions to sewer	
Table S3.3	amended table title to include, '**applicable until completion of the BAT 12 derogation'**
Table S3.3(a)	Added, **applicable from completion of the BAT 12 derogation**
Annual limits	
Table S3.4	amended to remove limits applicable from 2012 to 2016
Process monitoring	
Table S3.5	amended to include measurement of sulphur content of RFG and sulphur balance
	deleted 'Fugitive emissions of VOCs from operational plant at the installation', which is now covered by the improvement condition for BAT Conclusion 6.
	deleted 'RFG sulphur monitoring' as required by the former hourly refinery bubble limit.
	added monitoring of mercury (Hg) in RFG. Crude oil is known to be a significant source of mercury, a proportion of which ends up in the sites RFG system or emitted by cracker regeneration. CONCAWE Report 9/16 on 'Emission Factors for metals from combustion of refinery fuel gas and residual fuel oil'

	published in 2016; based on a dataset gathered from European refineries, shows significant mercury emissions from combustion and cracking. Although there is no requirement to monitor emissions to air of mercury under the Refining Mineral Oil and Gas BREF, reporting of annual mass is required for the pollution inventory. Measurement of Hg in the RFG will be indicative of the quantity of mercury emissions to air, recorded by the pollution inventory.
Reporting	
Table S4.1	updated in accordance with the current permit template and to include all relevant parameters and emissions
Reporting forms	
Table S4.5	updated to include all relevant forms
Schedule 6 Interpretation	
Emissions to land	added
Hazardous property	amended
Schedule 7 Site plan	
Installation boundary	amended to include White Oil Docks and to remove areas of land previously included in error

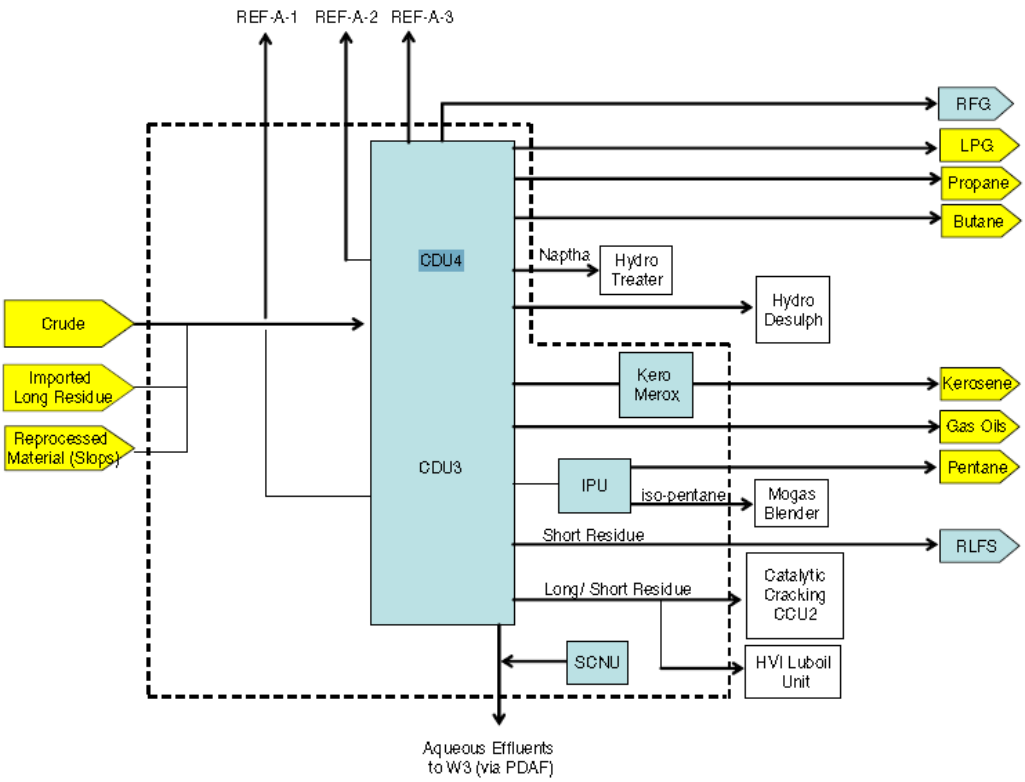
Cracking process unit (Table S1.1 of the permit)



Secondary processes (Table S1.1 of the permit)



Distillation process unit (Table S1.1 of the permit)



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

This document should be read in conjunction with the Regulation 61 response, supporting information and permit/notice.

Aspect considered	Justification / Detail
Confidential information	A claim for commercial or industrial confidentiality has been made. This was on the basis that trade secrets would be put at risk and this could also potentially breach UK and European Competition Law. We have accepted that some elements of the information are confidential. We consider that the inclusion of the relevant information on the public register would prejudice the operator's interests to an unreasonable degree. The reasons for this are given in the notice of determination for the claim. The decision was taken in accordance with our guidance on commercial confidentiality.
Identifying confidential information	We have identified information provided as part of the Regulation 61 response 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 were only relevant to our 'minded to' stage of the process. Consultation is relevant for derogations and we have consulted on our 'minded to' (draft) decision. The decision was taken in accordance with the Environmental Permitting Regulations and our public participation statement.
Responses to consultation and web publicising	The web publicising and consultation responses (Annex 3) were taken into account in the decision. The decision was taken in accordance with our guidance.
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 consolidated variation notice. 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 Regulation 61 response.

Aspect considered	Justification / Detail
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. The plan was amended to: - include White Oil Docks; - to remove the road terminal which is subject to a local authority permit; and - to remove some areas of land included in error when the plan showing the boundary was originally submitted. 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 requirements are being delivered through existing improvement conditions IC34 to IC36 in table S1.3 of the permit.
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 sites and habitats has been carried out as part of the earlier permitting process. The changes to the permit as a result of this review will result in stricter emission limits to air and water and as such we consider that changes will not affect the features of the sites and habitats. We have not formally consulted on the Regulation 61 response. The decision was taken in accordance with our guidance.
Operating techniques	We have reviewed the techniques used by the operator and compared these with the relevant guidance notes. The permit conditions ensure compliance with the BREF for the Refining of Mineral Oil and Gas and associated BAT Conclusions, and ELVs deliver compliance with BAT AELs. Where this is not the case the operator has sought derogations. Our assessment of these is detailed in Section 7 of this document.
Updating permit conditions	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

Aspect considered	Justification / Detail
during consolidation.	meaning as those in the previous permit. 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 specified limits and controls on the use of raw materials and fuels in Schedule 2 of the permit.
Pre-operational conditions	We have retained the pre-operational conditions required by the previous permit and updated them to incorporate the requirements of the relevant BAT Conclusions.
Improvement conditions	Based on the information in the Regulation 61 response, we consider that we need to impose improvement conditions. We have imposed improvement conditions to ensure that: ➢ the derogations are delivered as specified by the proposals. ➢ appropriate measures are in place to contain liquid hydrocarbons. ➢ appropriate measures are in place to ensure that energy is used efficiently**.** ➢ appropriate measures are in place to ensure the efficient use of raw materials and water. ➢ appropriate measures are in place to deliver the requirements of the WFD. ➢ appropriate controls are in place for flaring. ➢ the appropriate measures are in place to prevent and monitor fugitive emissions.
Incorporating the application	We have specified that the operator must operate the permit in accordance with descriptions in the Regulation 61 response, 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 emission limits should be set for the parameters listed in the permit. These are described at the relevant BAT Conclusion in

Aspect considered	Justification / Detail
	Section 6 of this document.
Monitoring	We have decided that monitoring should be carried out for the parameters listed in the permit, using the methods detailed and to the frequencies specified. These are described at the relevant BAT Conclusion in Section 6 of this document. Based on the information in the application we are satisfied that the operator's techniques, personnel and equipment have either MCERTS certification or MCERTS accreditation as appropriate.
Reporting	We have specified reporting in the permit. These are described at the relevant BAT Conclusion in Section 6 of this document.
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 Act 2015 – Growth duty	We have considered our duty to have regard to the desirability of promoting economic growth set out in section 108(1) of the Deregulation Act 2015 and the guidance issued under section 110 of that Act in deciding whether to grant this permit. Paragraph 1.3 of the guidance says: "The primary role of regulators, in delivering regulation, is to achieve the regulatory outcomes for which they are responsible. For a number of regulators, these regulatory outcomes include an explicit reference to development or growth. The growth duty establishes economic growth as a factor that all specified regulators should have regard to, alongside the delivery of the protections set out in the relevant legislation." We have addressed the legislative requirements and environmental standards to be set for this operation in the body of the decision document above. The guidance is clear at paragraph 1.5 that the growth duty does not legitimise non-compliance and its purpose is not to achieve or pursue economic growth at the expense of

Aspect considered	Justification / Detail
	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: Glossary - BAT conclusions for the Refining of Mineral Oil and Gas.

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

1.20.1 Dust

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

1.20.2. Nitrogen oxides (NO_X)

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

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

1.20.3. Sulphur oxides (SO_X)

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

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

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

1.20.4. Combined techniques (SOx, NOx and dust)

Technique	Description
Wet scrubbing	See Section 1.20.3
SNO_X combined technique	Combined technique to remove SOX, NOX and dust where a first dust removal stage (ESP) takes place followed by some specific catalytic processes. The sulphur compounds are recovered as commercial-grade concentrated sulphuric acid, while NO_X is reduced to N_2. Overall SO_X removal is in the range: 94-96.6 %. Overall NO_X removal is in the range: 87-90 %

1.20.5. Carbon monoxide (CO) Technique

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

with carbon monoxide (CO) oxidation promoters	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 de-oiled wax and another one for the soft wax. Both consist of heat-integrated flash drums and a vacuum stripper. Streams from the de-waxed 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 pre-treatment

Pre-treatment of sour water streams before reuse or treatment	Send generated sour water (e.g. from distillation, cracking, coking units) to appropriate pre-treatment (e.g. stripper unit)
Pre-treatment of other waste water streams prior to treatment	To maintain treatment performance, appropriate pre-treatment 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 bio-filter or trickling filter
Additional treatment step	A specific waste water treatment intended to complement the previous treatment steps e.g. for further reducing nitrogen or carbon compounds. Generally used where specific local requirements for water preservation exist.

Annex 2: Improvement Conditions

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

Existing improvement conditions

Table S1.3 Improvement programme requirements		
Ref:	**Requirement**	**Date**
IC1	A written procedure shall be submitted to the Agency detailing the measures to be used so that monitoring equipment, personnel and organisations employed for monitoring programme for emissions to air shall have either MCERTS certification or accreditation in accordance with condition 3.5.3. The notification requirements of condition 2.4.2 shall be deemed to have been complied with on submission of the procedure. The procedure shall be implemented by the operator from the date of approval in writing by the Agency	Complete Deleted
IC2	A written plan shall be submitted to the Agency for approval detailing the results of a survey of hard-standing, kerbing and secondary containment for raw material, intermediate, product and waste storage areas and the measures to comply with the requirements of sections 2.2.2. and 2.2.5 of TGN S1.02 and section 2.2.5 of TGN S 4.01, including but not limited to: kerbing at HVI lube plant and north site berths; materials of construction of acids and alkali storages at HVI lube oil and alcohols plants; basis of design for bunding for D17 gas oil area, EOG, WOG T site storage, NDAF and NO3 VRU ballast Where appropriate the plan shall contain dates for the implementation of individual measures. The notification requirements of condition 2.4.2 shall be deemed to have been complied with on submission of the plan. The plan shall be implemented by the operator from the date of approval by the Agency.	To be delivered through IC34 Retained, IC34 references this improvement condition

Table S1.3 Improvement programme requirements		
Ref:	**Requirement**	**Date**
IC3	A written plan shall be submitted to the Agency for approval detailing the results of review of the abatement measures (the effluent treatment plant) used to control emissions to the River Gowy, Thornton Brook and Manchester Ship Canal and the measures to comply with the requirements of sections 2.2.2 and the benchmark ELVs in section 3 of TGN S1.02. Where appropriate the plan shall contain dates for the implementation of individual measures. The notification requirements of condition 2.5.2 shall be deemed to have been complied with on submission of the plan. The plan shall be implemented by the operator from the date of approval by the Agency	Complete 17/07/15 Deleted
IC4	A written plan shall be submitted to the Agency for approval detailing the measures to be taken to cease burning of the remaining sour water stripper off-gases in combustion plant at the installation (i.e. from HDS2 sour water stripper, C6501) and to ensure that their sulphur content is recovered via the sulphur recovery unit. Where appropriate the plan shall contain dates for the implementation of individual measures. The notification requirements of condition 2.5.2 shall be deemed to have been complied with on submission of the plan. The plan shall be implemented by the operator from the date of approval by the Agency.	Complete 13/11/13 Deleted Operating technique included in Table S1.2 of the permit

Table S1.3 Improvement programme requirements		
Ref:	**Requirement**	**Date**
IC5	A written plan shall be submitted to the Agency for approval detailing the measures be taken to achieve flow proportional sampling of the process effluent release at W1, W2, W3 and N19. Where appropriate the plan shall contain dates for the implementation of individual measures. The notification requirements of condition 2.5.2 shall be deemed to have been complied with on submission of the plan. The plan shall be implemented by the operator from the date of approval by the Agency.	Complete 30/09/16 Deleted The compliance officer confirmed that the outcome of this IC was that no composite is sampling required at w1; however composite sampling at the other emission points is required. We have updated the relevant tables from 'spot samples' to 'composite samples' for all emission points except W1.

Table S1.3 Improvement programme requirements		
Ref:	**Requirement**	**Date**
IC6	A written plan shall be submitted to the Agency for approval detailing the measures be taken to achieve a consistent particulate emission concentration from the FCCU regenerator of 20 mg/m3 (at 6% oxygen). Where appropriate the plan shall contain dates for the implementation of individual measures. The notification requirements of condition 2.5.2 shall be deemed to have been complied with on submission of the plan. The plan shall be implemented by the operator from the date of approval by the Agency.	Complete 05/11/15 Deleted
IC7	A written plan shall be submitted to the Agency for approval detailing the measures be taken to achieve continuous measurement of oxides of nitrogen in the emissions to air from the FCCU regenerator. Where appropriate the plan shall contain dates for the implementation of individual measures. The notification requirements of condition 2.5.2 shall be deemed to have been complied with on submission of the plan. The plan shall be implemented by the operator from the date of approval by the Agency.	Complete 13/11/13 Deleted
IC8	A written report shall be submitted to the Agency for approval detailing the work to be undertaken to improve the identification of fugitive VOCs across all plant and pipework at the refinery installation. An interim report shall detail the effectiveness of the FLIR camera for this purpose. Where appropriate the plan shall contain dates for the implementation of individual measures. The notification requirements of condition 2.5.2 shall be deemed to have been complied with on submission of the plan. The plan shall be implemented by the operator from the date of approval by the Agency.	Complete 14/05/15 Deleted

Table S1.3 Improvement programme requirements		
Ref:	**Requirement**	**Date**
IC9	A written plan shall be submitted to the Agency for approval detailing the results of a review of work to be undertaken to achieve MCERTS accreditation for effluent flow on release points W1, W2 and W3. Where appropriate the plan shall contain dates for the implementation of individual measures. The notification requirements of condition 2.4.2 shall be deemed to have been complied with on submission of the plan. The plan shall be implemented by the operator from the date of approval by the Agency.	30/04/17 Deleted Delivered through IC for BAT Conclusion 12 derogation
IC10	A written plan shall be submitted to the Agency for approval detailing the method to be used to obtain, update and validate oxides of nitrogen (NOx) emission factors for non-LCP units within the refinery installation. The plan shall demonstrate how the NOx factors will be used in the calculation of NOx emissions for non-LCP units. Where appropriate the plan shall contain dates for the implementation of individual measures. The notification requirements of condition 2.4.2 shall be deemed to have been complied with on submission of the plan. The plan shall be implemented by the operator from the date of approval by the Agency.	Complete Deleted
IC11	A written plan shall be submitted to the Agency for approval detailing the results of a review to minimising flaring from SHOP plant including, but not limited to the provision of a flare gas recovery system Where appropriate, the plan shall contain the dates for the implementation of individual measures. The notification requirements of condition 2.5.2 shall be deemed to have been complied with on submission of the plan. The plan shall be implemented by the operator from the date of approval by the Agency.	Complete 14/05/15 Deleted

Table S1.3 Improvement programme requirements		
Ref:	**Requirement**	**Date**
IC12	A written plan shall be submitted to the Agency for approval detailing the measures be taken to ensure necessary monitoring and infrastructure is in place at the installation to allow the Operator to demonstrate compliance against an hourly bubble limit for sulphur dioxide from 1 January 2009. Where appropriate the plan shall contain dates for the implementation of individual measures, including but not limited to agreement on methodologies for REF-A-4 (secondary processes) and REF-A-6 (HPBH). The notification requirements of condition 2.4.2 shall be deemed to have been complied with on submission of the plan. The plan shall be implemented by the operator from the date of approval by the Agency.	30/06/17 Deleted Superseded by the setting of an hourly SO_2 limit in Table S3.1(d) of the permit
IC13	The Operator shall review BAT for operation of the floating roof tanks. The Operator shall provide a report to the Agency summarising the findings. Where appropriate the plan shall contain dates for the implementation of individual measures. The notification requirements of condition 2.5.2 shall be deemed to have been complied with on submission of the plan. The plan shall be implemented by the operator from the date of approval by the Agency	Complete 14/05/15 Deleted
IC14	A written plan shall be submitted to the Agency for approval detailing the measures to be taken to minimise visible plume from combustion products. Where appropriate the plan shall contain dates for the implementation of individual measures. The notification requirements of condition 2.5.2 shall be deemed to have been complied with on submission of the plan. The plan shall be implemented by the operator from the date of approval by the Agency.	Complete 14/05/15 Deleted

Table S1.3 Improvement programme requirements		
Ref:	**Requirement**	**Date**
IC15	A written plan shall be submitted to the Agency for approval detailing the improved quantification and speciation of sulphur bearing compounds in the refinery fuel gas in order to identify sources and propose suitable treatment techniques. Where appropriate the plan shall contain dates for the implementation of individual measures. The notification requirements of condition 2.5.2 shall be deemed to have been complied with on submission of the plan. The plan shall be implemented by the operator from the date of approval by the Agency.	Complete 02/01/14 Deleted
IC16	A written plan shall be submitted to the Agency for approval detailing the results of a review to identify options to ensure that the concentration of Class B Volatile Organic Compounds from Alcohols emission points ALC-A-3 and ALC- A-4 are continually as low as practicable through reliable operation of the ejector vacuum and condenser systems. The review shall have regard to the sector benchmarks in section 3 of the Environment Agency Sector Guidance Note IPPC S4.01. Where appropriate, the plan shall contain the dates for the implementation of individual measures. The notification requirements of condition 2.5.2 shall be deemed to have been complied with on submission of the plan. The plan shall be implemented by the operator from the date of approval by the Agency.	Complete 14/05/15 Deleted

Table S1.3 Improvement programme requirements		
Ref:	**Requirement**	**Date**
IC17	A written plan shall be submitted to the Agency for approval detailing the results of a review to identify options to minimising emissions from VOC emissions from SHOP hotwell vessels. The review shall have regard to the sector benchmarks in section 3 of the Environment Agency Sector Guidance Note IPPC S4.01. Where appropriate, the plan shall contain the dates for the implementation of individual measures. The notification requirements of condition 2.5.2 shall be deemed to have been complied with on submission of the plan. The plan shall be implemented by the operator from the date of approval by the Agency.	Complete 14/05/15 Deleted
IC18	A written plan shall be submitted to the Agency for approval detailing the results of a review to identify options to reduce the emissions of class B volatile organic compounds in the emission from ERP-A-2. The review shall have regard to the sector benchmarks in section 3 of the Environment Agency Sector Guidance Note IPPC S4.01. Where appropriate, the plan shall contain the dates for the implementation of individual measures. The notification requirements of condition 2.5.2 shall be deemed to have been complied with on submission of the plan. The plan shall be implemented by the operator from the date of approval by the Agency.	Complete 02/01/14 Deleted

Table S1.3 Improvement programme requirements		
Ref:	**Requirement**	**Date**
IC19	A written plan shall be submitted to the Agency for approval detailing the timescale to address the issues identified in the Application Site Report sections D2A and D2B with regard to potential for pollution Where appropriate, the plan shall contain the dates for the implementation of individual measures. The notification requirements of condition 2.4.2 shall be deemed to have been complied with on submission of the plan. The plan shall be implemented by the operator from the date of approval by the Agency.	To be delivered through IC34 Retained for reference
IC20	A written plan shall be submitted to the Agency for approval detailing the feasibility of routing aqueous effluents from the north site interceptors W4 and W9 to the North Dissolved Air Flotation unit. Where appropriate the plan shall contain dates for the implementation of individual measures. The notification requirements of condition 2.5.2 shall be deemed to have been complied with on submission of the plan. The plan shall be implemented by the operator from the date of approval by the Agency.	Complete 17/07/15 Deleted
IC21	A written plan shall be submitted to the Agency for approval detailing the results of routine noise monitoring of the installation to BS4142:1997. Where appropriate, the plan shall contain the dates for the implementation of individual measures. The notification requirements of condition 2.5.2 shall be deemed to have been complied with on submission of the plan. The plan shall be implemented by the operator from the date of approval by the Agency.	Complete 14/05/15 Deleted

Table S1.3 Improvement programme requirements		
Ref:	**Requirement**	**Date**
IC22	A written plan shall be submitted to the Agency for approval detailing the method to be used to obtain, update and validate sulphur balance and methodology for the sulphur recovery unit and refinery installation The plan shall demonstrate how the availability and utilization are used in the calculation of sulphur recovery. The notification requirements of condition 2.5.2 shall be deemed to have been complied with on submission of the plan. The plan shall be implemented by the operator from the date of approval by the Agency.	Complete 14/05/15 Deleted
IC23	A written plan shall be submitted to the Agency for approval detailing the results of a review to scrubbing the exhaust of the platformer 3 regenerator, including but not limited to an environmental risk assessment for the failure of the scrubber. Where appropriate, the plan shall contain the dates for the implementation of individual measures. The notification requirements of condition 2.5.2 shall be deemed to have been complied with on submission of the plan. The plan shall be implemented by the operator from the date of approval by the Agency.	Complete 14/05/15 Deleted
IC24	A written plan shall be submitted to the Agency for approval detailing the work to be undertaken to monitor and measure COD in outfalls W1, W2 and W3 to replace BOD measurement by 31 October 2009. Where appropriate the plan shall contain dates for the implementation of individual measures including but not limited to agreement of limits. The notification requirements of condition 2.5.2 shall be deemed to have been complied with on submission of the plan. The plan shall be implemented by the operator from the date of approval by the Agency.	Complete 02/01/14 Deleted

Table S1.3 Improvement programme requirements		
Ref:	**Requirement**	**Date**
IC25	A written plan shall be submitted to the Agency for approval detailing the results of a review of progress against the improvement programme with respect to reduction in emissions of oxides of nitrogen and particulates submitted 31/08/07. The review will include any additional measures considered including but not limited to burner improvements on HPBH. Where appropriate, the plan shall contain the dates for the implementation of individual measures. The notification requirements of condition 2.5.2 shall be deemed to have been complied with on submission of the plan. The plan shall be implemented by the operator from the date of approval by the Agency.	Complete 02/01/14 Deleted
IC26	A written plan shall be submitted to the Agency for approval detailing the results of a review of progress against the improvement programme with respect to reduction in emissions of sulphur dioxide submitted 23/08/07. The review will include any additional measures considered including but not limited to the addition of deSOx additive to the FCCU. Where appropriate, the plan shall contain the dates for the implementation of individual measures. The notification requirements of condition 2.5.2 shall be deemed to have been complied with on submission of the plan. The plan shall be implemented by the operator from the date of approval by the Agency.	Complete 02/01/14 Deleted

Table S1.3 Improvement programme requirements		
Ref:	**Requirement**	**Date**
IC27	A written report shall be submitted to the Agency for approval. The report shall contain a protocol for a monitoring programme to assess changes in acidification and eutrophication deposition and ecological effects at an appropriate Natura 2000 site. The protocol will include the selection of the Natura 2000 sites and a time scale for implementation of the programme. The notification requirements of condition 2.5.2 shall be deemed to have been complied with on submission of the report. The protocol detailed in the report shall be implemented by the Operator from the date of approval by the Environment Agency.	Complete 22/12/16 Deleted
IC28	A written plan shall be submitted to the Agency for approval detailing the results of a review to identify options to reduce the concentration of isopropyl alcohol, 1,3 butadiene and sulphur dioxide in the emission from Sulpholane emission point, SUL-A-3. The review shall have regard to the sector benchmarks in section 3 of the Environment Agency Sector Guidance Note IPPC S4.01. Where appropriate, the plan shall contain the dates for the implementation of individual measures. The notification requirements of condition 2.5.2 shall be deemed to have been complied with on submission of the plan. The plan shall be implemented by the operator from the date of approval by the Agency.	Complete 23/06/08 Deleted
IC29	The operator shall produce a report for the approval of the Environment Agency identifying the maximum extent to which SO_2 reduction can be achieved through fuel switching to natural gas and an implementation plan that will recompense for the temporary deviation from indicative BAT allowed in 2012 and 2013 in the shortest possible time. Once approved this plan shall be implemented.	Complete 12/12/12 Deleted

Table S1.3 Improvement programme requirements		
Ref:	**Requirement**	**Date**
IC30	A written report shall be submitted to the Environment Agency for approval undertaking an updated detailed Best Available Technique (BAT) assessment (particularly in regards to both energy efficiency and reducing SO_2 emissions) for the following techniques described by variation application EPR/ FP3139FN/ V003, taking account of the installation of natural gas to the installation: • increased energy efficiency via 'Liquid Coupled Air Preheater (LCAP) reinstatement', • increased energy efficiency via 'Furnace Finned Tubes' • 'Heat Integration Project' and in regards to further reductions of $SO_2$and NO_x emissions: • Developments on FCC DeSOx Additives for partial burn FCCU regenerators • 'FCCU Waste Gas Non-regenerative scrubber' and regenerative scrubber abatement of emissions from the CO Boiler • current and future opportunities to reduce the sulphur content of the crude feed to the refinery by the purchase of lower sulphur crudes. • Increase the use of natural gas on other combustion processes on the installation The report shall include proposals to implement suitable techniques with timescales. These proposals shall be implemented following approval by the Environment Agency.	Complete 06/09/13 Deleted
IC31	A written report shall be submitted to the Environment Agency for approval, providing a summary of six months of monitoring data for emissions to air for all emission points on combustion processes where natural gas is used.	Complete 10/04/15 Deleted
IC32	A written report shall be submitted to the Environment Agency for approval, providing a summary of six months of monitoring data following commencement of continuous monitoring of the CO Boiler exhaust stack (REF-A-11)	Complete 02/09/15 Deleted

Table S1.3 Improvement programme requirements		
Ref:	**Requirement**	**Date**
IC33	The Operator shall undertake a review of the existing screening measures at the intakes and outfalls which provide and discharge water to and from the Installation. The review shall be undertaken with reference to the Eels (England and Wales) Regulations 2009 (SI 2009/3344) and the Environment Agency ''Safe Passage for Eel'' Regulatory Position Statement version 1 dated July 2012. The Operator shall submit details of the arrangement suitable to meet the requirements for the safe passage of eels [of the Eels (England and Wales) Regulations 2009 (SI 2009/3344)] by either:- • Providing a written proposal for the installation of an eel screen. • Providing a written proposal to the modification of existing screening arrangements. • Providing a written response with an explanation and description of how the existing screening arrangements can be regarded to meet the requirements for the safe passage of eels [of SI 2009/3344] either without change or with mitigation measures. • Providing a written response setting out a case for an exemption In all cases, the proposal shall be submitted in writing for the approval of the Environment Agency. Where appropriate, each proposal shall contain an assessment of alternative options considered including impacts on other fish species and an explanation of why the proposed option has been chosen. Where installation of eel screen; modification of existing arrangements; or mitigation measures are proposed, the submission shall contain relevant timescales for installation in accordance with the Safe Passage of Eel Regulatory Position Statement version 1 dated July 2012. The proposals shall be implemented in accordance with the Environment Agency's written approval.	Complete 10/04/15 Deleted

Table S1.3 Improvement programme requirements		
Ref:	**Requirement**	**Date**
IC34	The Operator shall prepare and submit a desk top study in line with Stages 1–7 set out within the European Commission Guidance concerning baseline reports dated 5th May 2014 (Ref: 2014/C 136/03) and the Environment Agency's H5 guidance to the Environment Agency for review and approval. This shall include but not be limited to the following: • An assessment to determine whether there is a possibility of soil and / or groundwater contamination from relevant hazardous substances (RHS) used, stored or released from site; • A review of existing soil and groundwater measurements to determine whether an appropriate baseline can be established for RHS in the locations that they will be used, stored or released, having regard to the possibility of soil and/or groundwater contamination; • Proposals to undertake site investigation works should additional soil and groundwater measurements be required to enable an baseline to be established for RHS in the locations that they will be used, stored or released, having regard to the possibility of soil and/or groundwater contamination; and • An assessment to demonstrate that the requirements of improvement conditions IC2 and IC19 have been addressed.	28/02/18 Submission date extended to 31/10/18

Table S1.3 Improvement programme requirements		
Ref:	**Requirement**	**Date**
IC35	The Operator shall undertake any relevant intrusive works identified within IC34 to enable an adequate baseline to be established for relevant hazardous substances (RHS) in the locations that they will be used, stored or released, having regard to the possibility of soil and/or groundwater contamination in line with the requirements set out within Stage 7 of European Commission Guidance concerning baseline reports dated 5th May 2014 (Ref: 2014/C 136/03) and the Environment Agency's H5 guidance; and Prepare and submit a baseline report to the Environment Agency for approval in line with the requirements set out within Stage 8 of the European Commission Guidance concerning baseline reports dated 5th May 2014 (Ref: 2014/C 136/03) and the Environment Agency's H5 guidance.	30/06/19 Submission date extended to 31/08/19
IC36	The Operator shall submit an updated site condition report to the Environment Agency for review. The Report shall include, but not be limited to, the following: • The baseline report required by IC35 above; • Baseline reference data for any 'other polluting substances'; and • A soil and groundwater monitoring plan, to demonstrate proposed compliance with permit condition 3.2.4 in respect of periodic monitoring of relevant hazardous substances (RHS) in soil and groundwater and proposed monitoring for 'any other polluting substances'. Further information in respect of setting baseline reference data for any other polluting substances is detailed within the Environment Agency's H5 guidance.	31/12/19 Submission date extended to 31/12/19

Table S1.3 Improvement programme requirements		
Ref:	**Requirement**	**Date**
IC37	The operator shall submit, to the Environment Agency, a written technical report in relation to the high pressure boiler house (HPBH) which addresses the following: 1. identify the operating envelope of the HPBH, including fuel mixes and maximum and minimum firing rates. 2. Associated with this operating envelope, the operator shall quantify the emissions of oxides of nitrogen from the HPBH (LCP 138, emission point REF-A 4). 3. identify changes in operating philosophy, improvements to existing oxides of nitrogen reduction technology and/or further reduction techniques. This should include an assessment of the level of reduction in nitrogen oxide releases which will be achieved through application of these modifications. 4. a project plan, including timescales, for implementation of the improvements identified in 3 above The plan presented in 4 above shall be implemented by the operator, following approval by the Environment Agency.	30/06/17 Deleted Superseded by the CDU-4 derogation and the site NOx emissions bubble
IC38	The Operator shall undertake an impact assessment in accordance with the methodology in the Environment Agency H1 screening tool for all determinands listed in Schedule 3 Table S3.2 for emissions points to water W1, W2, W3 and W4. Based on the outcomes of the H1 screening and IC5, the Operator shall propose a revised Table S3.2, including applicable emission limit values, a monitoring schedule, and a revised Table S3.4 annual limit for oil in water (total). These shall be submitted in writing to the Environment Agency for approval.	31/03/17 Submission date extended to 31/03/19

Improvement conditions resulting from this permit review variation

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

Table S1.3 Improvement programme requirements		
Ref:	**Requirement**	**Date**
IC39	BAT Conclusion 6 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 (in accordance with permit condition 4.2.2) on the results of the monitoring undertaken under the plan.	31/10/18
IC40	BAT Conclusion 11 The Operator shall carry out an assessment of the options available for segregation of waste water streams and the viability of their implementation; 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 Environment Agency for approval, along with a timetable for implementing viable improvements identified. The Operator shall implement the improvements to the approved timetable.	31/07/19

Table S1.3 Improvement programme requirements		
Ref:	**Requirement**	**Date**
IC41	<u>BAT Conclusion 12</u> The Operator shall submit, for approval by the Environment Agency, reports setting out progress to achieving compliance with the BAT 12 AELs by no later than **30 September 2021**for this **time limited** derogation. The report shall include, but not be limited to, the following: • Current performance against the BAT Conclusion 12 AELs. • Methodology for reaching the AELs. • Associated targets / timelines for reaching compliance by **30 September 2021** at W1 to W4 defined in Tables S3.2, S3.2(a) and S3.2(b) of this permit for emissions of: Hydrocarbon oil index (HOI) at W1 to W4 Chemical Oxygen Demand (COD) at W2 Total Suspended Solids (TSS) at W2 & W3 Benzene at W3 Total nitrogen expressed as N at W4 Lead, cadmium, nickel & mercury at W4 • Address any potential uncertainties about the quality of the remaining surface water within the intermittent discharges, which will no longer receive DAF treatment. This shall include a review of these releases to confirm the requirement for any future monitoring that may be required to determine the significance of any residual impacts. • Procedures to control effluent releases at W1 & W2 in the event that they cannot be discharged to the third party waste water treatment works. These shall include an assessment of the impact of any such releases. • Any alterations to the initial plan – for progress reports. • Address each deficiency identified in the Flowcheck Ltd. Report No. SV1160F, dated 7 March 2012. The Operator shall submit reports on progress with the approved compliance plan on a six monthly frequency specified by this condition. The final report shall be submitted three months after the compliance date specified by this condition.	Initial Report 31/12/18 Progress reports by 30/06/19 31/12/19 30/06/20 31/12/20 30/06/21 Final Report 31/12/21

Table S1.3 Improvement programme requirements		
Ref:	**Requirement**	**Date**
IC42	<u>BAT Conclusion 27</u> The Operator shall submit, for approval by the Environment Agency, a summary report of the investigations carried out to assess the impact of modifications to the CO boiler for this **non time limited** derogation. The report shall include, but not be limited to the following: • The findings of the 'internal' assessment of the associated equipment carried out in 2018. • Implementation dates for any changes/modifications to the air flow. • The findings of the further simulation and design work, along with 'internal' inspection to assess the practicality of enhancing CO combustion by installation of a baffle in the combustion section of the CO boiler. • The changes to the CO/NOx emissions profile as a result of any changes/modifications identified. The Operator shall submit initial and final reports as specified by this condition.	Initial Report 31/12/18 Final Report 31/07/19
IC43	<u>BAT Conclusion 34 – CDU-4</u> The Operator shall submit, for approval by the Environment Agency, reports setting out progress to achieving compliance with the BAT 34 NOx AEL. Compliance shall be achieved no later than 31 December 2022, for this **time limited** derogation. The report shall include any alterations to the initial plan – for progress reports. The Operator shall submit reports on progress with the approved compliance plan on a twelve monthly frequency specified by this condition. The final report shall be submitted as specified by this condition.	Initial Report 31/12/18 Progress reports by 31/12/19 31/12/20 31/12/21 Final Report 31/12/22

Table S1.3 Improvement programme requirements		
Ref:	**Requirement**	**Date**
IC44	BAT Conclusion 48 The Operator shall prepare a caustic use minimisation plan, which shall consider: 1. Uses of caustic, including volume and caustic strength, in; i. Product treatment processes such as neutralisation of acid from the alkylation process, caustic washing of hydrocarbon streams leaving the FCC, caustic washing of propylene or butylene feeds to polymerisation units to remove mercaptans, gasoline sweetening. ii. Gas treatment, such as SRU off-gas scrubbing, tail-gas scrubbing, and FCC regeneration vent gas scrubbing. iii. Corrosion protection of atmospheric distillation unit (ADU) overhead, steam conditioning, effluent pH adjustment. 2. Whether spent caustic streams generated from any of the processes in (i) above could be used as a raw material for the processes in (ii) or (iii) above. 3. Whether any other caustic minimisation measures could be applied, such as regeneration of caustic washings. The Operator shall implement measures identified in 2 & 3 above and provide the Environment Agency with a written copy of the plan for approval.	30/04/19
IC45	BAT Conclusion 49 The Operator shall undertake an assessment of measures to reduce point source and fugitive emissions of VOCs from the storage of liquid hydrocarbons. The assessment shall take into account the techniques identified in BAT Conclusion 49 for the Refining of Mineral Oil and Gas, together with any other suitable reduction techniques. A written report summarising the findings shall be submitted to the Environment Agency, along with a timetable for implementing improvements. The Operator shall implement the improvements identified to a timetable approved in writing with the Environment Agency.	31/08/19

Table S1.3 Improvement programme requirements		
Ref:	**Requirement**	**Date**
IC46	BAT Conclusion 51 The Operator shall review all secondary containment measures, provided for liquid hydrocarbons that are stored or held on site, (excluding those bunds in scope of the COMAH Containment Policy). The review shall verify whether all storage tanks and areas designed for the storage of drums/IBCs and other portable liquid containers, within the installation; are sited on an impermeable base and with sufficient bunding as specified in the CIRIA C736 Guidance. Where containment provisions do not meet this standard, the Operator shall identify improvements, or alternative measures (such as additional primary or tertiary containment measures) to provide an equivalent level of protection. The Operator shall provide the Environment Agency with a written report of the review and shall implement identified improvements to a timescale approved in writing with the Environment Agency.	30/06/19
IC47	BAT Conclusion 52 The Operator shall submit, for approval by the Environment Agency, reports setting out progress to achieving compliance with BAT 52 by no later than **31 December 2020** for this **time limited** derogation. The report shall include, but not be limited to, the following: • A regular review of the progress to reduce loading/unloading operations at White Oil Docks to < 1 million m^3/annum by 1 January 2021 as specified in Table S1.1 of this permit. • Any alterations to the initial plan – for progress reports. The Operator shall submit reports on progress with the approved compliance plan as specified by this condition. The final report shall be submitted as specified by this condition.	Initial Report 31/12/18 Progress reports by 30/06/19 31/12/19 30/06/20 31/12/20 Final Report 30/06/21

Table S1.3 Improvement programme requirements		
Ref:	**Requirement**	**Date**
IC48	<u>BAT Conclusion 52</u> The Operator shall develop a monitoring programme for measuring point source emissions of non-methane volatile organic compounds and benzene from the loading and unloading of liquid hydrocarbons as specified in BAT conclusion 52 for the Refining of Mineral Oil and Gas. The monitoring programme and associated methodologies shall be approved in writing with the Environment Agency having regard to the Environment Agency M2 and M16 Guidance Notes. Routine benzene monitoring is not required where it can be demonstrated that benzene emissions are consistently less than 1 mg/Nm^3 from a point source.	31/10/18
IC49	<u>BAT Conclusions 55 & 56</u> The Operator shall carry out a study of the flaring system and flare sources for the purpose of reducing baseline flaring. The study shall include: • Options to improve flare flow metering from individual sources. • Options to reduce arising of gases requiring flaring, giving consideration to the requirements of BAT Conclusions 55 and 56 for the Refining of Mineral Oil and Gas. • Assessment of the feasibility of installing a flare gas recovery system to minimise the base load to current flare systems, including arising from planned shut-downs. The Operator shall submit a written report, to the Environment Agency providing details of the findings of the study and a timetable for implementation of any improvements identified.	31/08/19

Table S1.3 Improvement programme requirements		
Ref:	**Requirement**	**Date**
IC50	BAT Conclusion 57 Note 1 The Operator shall submit, for approval by the Environment Agency, the design for the fixed NOx emissions bubble for the installation and an associated monitoring programme to demonstrate compliance with the bubble. The bubble design and associated monitoring programme shall be in accordance with the principals described in the 'Integrated Air Emissions Management Protocol'. The bubble design shall specify, but not be limited to: 1. A description of the units to be included in the bubble including; the type of unit, the fuel fired, the representative flue gas flow-rate, the applicable BAT AEL for that unit, calculation of the fixed bubble limit. 2. A demonstration, using historic data from a representative period that the operations can comply with the bubble limit. The monitoring protocol shall include but not be limited to: 3. A description of the monitoring provision, or surrogate measure, for each unit included in the bubble. 4. Identification of the abnormal operating conditions for each unit, and specification of the 'standard contribution value' for each unit, equal to the representative flow-rate multiplied by the applicable BAT AEL, which will be used as a surrogate value during periods of abnormal operation.	28/10/18

Table S1.3 Improvement programme requirements		
Ref:	**Requirement**	**Date**
IC51	BAT Conclusion 58 Note 1 The Operator shall submit, for approval by the Environment Agency, the design for the fixed SO_2 emissions bubble for the installation and an associated monitoring programme to demonstrate compliance with the bubble limit. The bubble design and associated monitoring programme shall be in accordance with the principals described in the 'Integrated Air Emissions Management Protocol' The bubble design shall specify, but not be limited to: 1. A description of the units to be included in the bubble including; the type of unit, the fuel fired, the representative flue gas flow-rate, the applicable BATAEL for that unit, formulae for the calculation of the fixed bubble limit. 2. A demonstration, using historic data from a representative period that the operations can comply with the fixed bubble limit. The monitoring procedures shall specify, but not be limited to: 3. A description of the monitoring provision, or surrogate measure, for each unit included in the bubble. 4. The formulae that will be used to calculate the monthly average compliance value. 5. Identification of the abnormal operating conditions for each unit, and specification of the 'standard contribution value' for each unit, equal to the representative flow-rate multiplied by the applicable BAT AEL, which will be used as a surrogate value during periods of abnormal operation.	28/10/18

Table S1.3 Improvement programme requirements		
Ref:	**Requirement**	**Date**
IC52	<u>BAT Conclusion 58</u> The Operator shall submit a written report to the Environment Agency for approval which provides evidence to evaluate the risk of potential exceedances of the short-term 15 minute SO_2 air quality objective. The purpose of this is to determine an hourly bubble SO_2 limit to replace the current limit in table S3.1(d) of this permit (Integrated Emissions Management). This evidence shall include the following: 3. Data for a number of representative years for current and future operations, including release profiles, peak emissions and how frequent these peaks are likely to be. • Hourly SO_2 concentrations from the SRU and the CO boiler; with a comparison to values used in the CERC report [Note 2]. • Hourly bubble SO_2 concentration (using CDU-4, HPBH, CO boiler and SRU). 4. Discussion and interpretation of these release profiles and peak concentrations with consideration to: • Operational scenario (e.g. potential unit off-sets, unusually high sulphur crudes, etc.); • Frequency of peaks within the year and their likelihood within future years; • How CERC's modelled values may or may not represent these short-term peaks.	31/12/18

Table S1.3 Improvement programme requirements		
Ref:	**Requirement**	**Date**
IC53	WFD - sewer 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 a representative monitoring dataset of hazardous pollutants. (b) 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. (c) Propose emission limit values at the point of discharge from the installation at S1. These limits shall be based on the treatment factor from the third party treatment works that shall be applied to each AEL associated with BAT Conclusion 12. (d) The outcomes shall also be used to propose a revised annual limit for oil in water in Table S3.4 (annual limits) of this permit.	31/03/19

Note 1: The bubble design and monitoring protocol shall be incorporated into Table S1.2 of the permit, subject to written approval by the Environment Agency.

Note 2: CERC report - Dispersion modelling of SO_2 emissions from Stanlow refinery, Cheshire. Draft report (Ref: FM1080/R3/16, dated 12 August 2016) produced by Cambridge Environmental Research Consultants (CERC), for Cheshire West and Chester Council.

Annex 3: Advertising and consultation on the draft decision

This section reports on the outcome of the public consultation on our draft decision carried out between 13 August 2018 to 10 September 2018.

We did not receive any representations.