ENI Liverpool Bay Operating Company

Review of Gas Refineries BAT Conclusions

Point of Ayr Gas Terminal

June 2016

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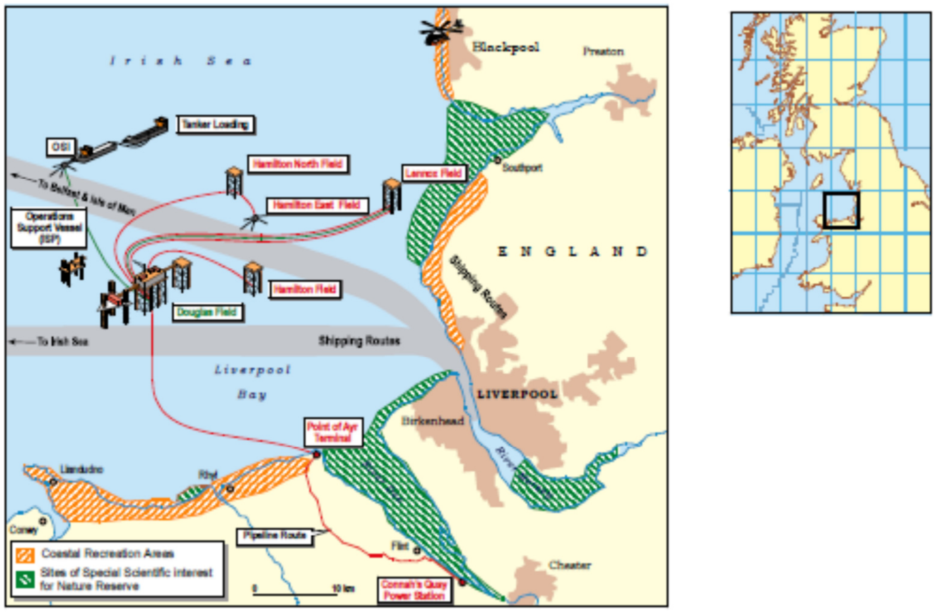
1. INSTALLATION BACKGROUND

Eni Liverpool Bay Operating Company's (hereby ELBOC) Point of Ayr Gas Terminal (hereby POA) is located on the southern shore of the Dee Estuary in Liverpool Bay (Figure 1.1).

Figure 1.1: POA geographical location



Natural gas produced offshore is piped to the onshore Gas Terminal at Point of Ayr for further treatment. The gas is treated to sales quality and exported to the power station at Connah's Quay. The terminal is able to treat approximately 335,000 m^3 of gas per hour. The gas treatment process (Figure 1.2) involves the removal of hydrogen sulphide (H_2S), other sulphurous compounds (chiefly mercaptans), heavy hydrocarbons and water from the gas. Sulphur compounds are converted to elemental sulphur for reuse by third parties; hydrocarbon condensate and water are returned to the offshore Douglas Production Platform for further processing.

The main process area is located in the south of the site, with the administration and workshop buildings to the west (Figure 1.2). The firewater pond and surge pond lie towards the northwest of the site. A large grassed area lies open in the centre of the site, this is where another two process lines were originally planned, but never built.

Figure 1.2: Terminal photographs

2. GENERAL BAT CONCLUSIONS

2.1 Environmental Management System (BAT 1)

BAT 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 top management (commitment of the top management is regarded as a precondition for a successful application of other features of the EMS)
II. definition of an environmental policy that includes continuous improvement for the installation by top management
III. planning and establishing the necessary procedures, objectives and targets, in conjunction with financial planning and investment
IV. implementation of the procedures, paying particular attention to:
    i. structure and responsibility
    ii. training, awareness and competence
    iii. communication
    iv. employee involvement
    v. documentation
    vi. efficient process control
    vii. maintenance programme
    viii. emergency preparedness and response
    ix. safeguarding compliance with environmental legislation.
V. checking performance and taking corrective action, paying particular attention to:
    i. monitoring and measurement (see also the BAT Reference Document on the General Principles of Monitoring)
    ii. corrective and preventive action
    iii. maintenance of records
    iv. independent (where practicable) internal 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 top management.

Environmental management systems BAT assessment

The ELBOC Environmental Management System (EMS) is registered to ISO 14001 by LRQA. Registration to ISO14001 requires a commitment to continual improvement in environmental performance and covers all of the elements described above. The EMS certificate, the scope of which covers oil and gas operations at the Liverpool Bay Offshore Facilities, processing of gas at the Point of Ayr Gas Terminal and associated support services at Llaneurgain House, was last issued by LRQA on 5th January 2016, for 3 years' duration.

ELBOC has an overriding commitment to safety and environmental responsibility as described in its Health, Safety, and Environment Policy and recognises that the company will only be successful when the communities in which it works value its citizenship.

It is a fundamental aim of the management systems in place at ELBOC to prevent emergency situations. Should one occur however, a set of procedures are in place to ensure that quick and efficient action is taken to minimise the impact of such an occurrence. Responsibilities of key personnel in the event of an unplanned release are defined within these procedures.

BAT Achieved

2.2 Energy Management (BAT 2)

BAT 2: In order to use energy efficiently, BAT is to use an appropriate combination of the following techniques:

I. Design techniques:
   i. pinch analysis,
   ii. heat integration,
   iii. heat and power recovery
II. Process control and maintenance techniques:
   i. process optimisation,
   ii. management and reduction of steam consumption,
   iii. use of energy benchmark
III. Energy efficient production techniques:
   i. use of Combined Heat and Power (CHP)

Energy efficiency

Pinch technology is in use, heat generated in the process is reused in other parts of the process to increase energy efficiency (turbine waste heat recovery unit, amine exchangers, waste heat boiler, solvent exchanger, gas exchangers and refrigerant economiser).

Controlled heat-up procedures are used for all fired equipment.

Routine maintenance regimes delivered on all plant equipment, including turbine and standby boiler.

The POA turbine is run at maximum fuel efficiency/waste heat recovery unit (WHRU) efficiency, supplying sufficient heat to satisfy process requirements.

The POA Gas Terminal WHRU qualifies as good quality CHP (power efficiency equals or exceeds 20%).

Thermal oxidiser (TOX) optimisation.

BAT Achieved

2.3 Solids Materials Storage and Handling (BAT 3)

BAT 3: 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 these following techniques:

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 use road cleaning vehicles.

Solids Material Storage and Handling

Not applicable at POA, no materials which generate dust are handled or stored (carbon filters/catalysts present onsite are sealed units/non-dusty).

BAT Not Applicable

2.4 Monitoring of Emissions to Air and Key Process Parameters

2.4.1 BAT 4

BAT 4 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.

Description	Process unit	min frequency	Monitoring technique
Monitoring of SOx, NOx & dust emissions	Combustion units ≥ 100mw	continuous (2,4)	Direct measurement
Monitoring of SOx, NOx & dust emissions	Combustion units: 50-100MW (6)	continuous (2,4)	Direct measurement (5)
	Combustion units< 50MW	Once a yr and after sigif. fuel changes	Direct measurement or indirect monitoring
	Sulphur recovery units	Continuous for SO2 only (4)	Direct measurement or indirect monitoring
Monitoring of NH3 emissions	All units equipped with SCR/SNCR	Continuous	Direct measurement
Monitoring of CO emissions	Combustion units ≥ 100mw	Continuous	Direct measurement
	Combustion units< 100MW	once every 6mths (1)	Direct measurement
Monitoring of metals emissions (Nickel (Ni), Antimony (Sb), Vanadium (V))	Combustion units (8)	once every 6 mths and after a significant change to the unit (1)	Direct measurement or analysis based on the metals content in the fuel.
Monitoring of polychlorinated dibenzodioxins/furans (PCDD/F) emissions	Catalytic reformer (not applicable to gas refineries)	once a year or once a regeneration, whichever is longer	Direct measurement

(1) Monitoring frequencies may be adapted if, after a period of one year, the data series clearly demonstrate a sufficient stability.
(2) 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.
(3) SO2 emissions measurements from SRU may be replaced by a 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.
(4) Only SO2 is continuously measured, SO3 is only periodically measured (e.g. during calibration of the SO2 monitoring system).
(5) Or indirect monitoring of SOx.
(6) Refers to the capacity connected to the stack where emissions occur.
(7) Sb to be 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 refinery fuel gas.

Monitoring of emissions to air in accordance with EN standards

Gas turbine thermal input is 37.6MW, biannual emissions monitoring regime in place. The assigned ELBOC contractor (Environmental Scientifics Group Limited) is commissioned to carry out this stack emissions monitoring to determine release of prescribed pollutants from the gas turbine under normal operating conditions.

CEMS is in place for thermal oxidiser emissions, continuous direct emissions measurement.

POA plant process includes a Sulphur Recovery Unit (SRU)

SCR/SNCR not used.

Highlighted rows above are those relevant at POA.

BAT Achieved

2.4.2 BAT 5

BAT 5 is to monitor the relevant process parameters by using the monitoring techniques and the minimum frequency given:

I. Monitoring of parameters linked to pollutant emissions e.g. O2 content in flue gas, N and S content in fuel:
II. Frequency:
    i. Continuous for O2 content.
    ii. For N & S content, periodic at a frequency based on fuel changes.

* N and S monitoring in fuel or feed may not be necessary when continuous emission measurement of NOx and SO2 are carried out at the stack

Monitoring of emissions

Fuel gas used at site has grid quality sulphur specification.

Thermal oxidizer CEMS system monitors NO_X and SOX emissions.

Thermal oxidizer CEMS also has O_2 measurement.

Combustion Unit Description	Size (MW)
Gas Turbine	37.63
Hot Oil Heater A	15.33
Hot Oil Heater B	15.33
Steam Boiler	2.06
Essential Services Generator	1.86
TOX unit	5.84
Total	**78.04**

Total site combustion capacity is rated at 78MW thermal input, the main fuel user at the site being a gas turbine, rated at 37.6 MW, which uses gas from the High Pressure (HP) system to generate heat and electricity for the site's operations. The heat produced from the generator exhaust gases is recovered and used to pre-heat a hot oil system, which in turn is used to deliver heat to various processes. The remaining processes consuming gas are fed from a Low Pressure (LP) gas system. Two gas furnaces, rated at 15.3 MW each, are used to heat the oil to the required temperature. Steam is generated from heat recovery in various processes related to the Sulphur Recovery Unit (SRU), the Tail Gas Unit (TGU) and the Thermal Oxidiser (TOX), all using a certain quantity of gas for combustion (including some 'process gas' which contains acid gases and amines). A back up steam boiler package, rated at 2.06MW, is fired intermittently in order to keep the system at operating temperature in the event that the steam pressure drops and the steam generator is fully required. The stand-by steam boiler can use both fuel gas and diesel.

BAT Achieved

2.4.3 BAT 6

BAT 6 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 2 yrs) validated by measurements.

Monitoring of VOC emissions to air

All VOC emissions arising onsite are methane, and BAT 6 relates to non-methane VOCs.

BAT Not Applicable

2.5 Operation of Waste Gas Treatment Systems

2.5.1 BAT 7

BAT 7: In order to prevent, or reduce emissions to air, BAT 7 is to operate acid gas removal units, sulphur recovery units and all other waste gas treatment systems with a high availability and at optimal capacity.

BAT 7 is generally applicable if sulphur recovery installed.

Special procedures can be defined for other than normal operating conditions, in particular those:

I. during start-up and shutdown operations;
II. during other circumstances that could affect the proper functioning of the systems (e.g. regular and extraordinary maintenance work and cleaning operations of the units and/or of the waste gas treatment system);
III. in case of insufficient waste gas flow or temperature which prevents the use of the waste gas treatment system at full capacity.

Reduction of emissions to air

Sulphur is recovered from the gas in a two-step process. The Sulphur Recovery Unit (SRU) is the first stage in the acid gas treatment and sulphur recovery process that continues in the downstream Tail Gas Unit (TGU). It is designed to process acid gas from the amine regenerators (in the Gas Sweetening Units) and recycle gas from the solvent regenerator (in the Tail Gas Unit), in order to convert the hydrogen sulphide present in these gases into elemental sulphur. Ultimately, this reduces POA emissions of sulphur dioxide to an acceptable level.

The unit is capable of producing approximately 20 tonnes of elemental sulphur per day.

The sulphur recovery in this unit is carried out by partial oxidation and chemical conversion, and utilises chemical processes. The elemental sulphur produced by the unit is stored as a liquid on-site and exported by road tanker (used as a chemical feedstock).

The second stage of the process is a TGU. This improves the overall recovery of sulphur (to >99.5% efficiency) by converting remaining SO_2 into H_2S, which is then recycled through the SRU. The TGU consists of two sections; a catalytic converter section and an amine section. The amine section is similar in operation to the main gas sweetening unit and absorbs the H2S from the tail gas.

The cleaned tail gas flows to the thermal oxidiser for the conversion of any residual H_2S to SO_2 and is subsequently discharged to atmosphere via a 45 m high stack.

BAT Achieved

2.5.2 BAT 8

BAT 8: In order to prevent and reduce ammonia (NH3) emissions to air when applying selective catalytic reduction (SCR) or selective non-catalytic reduction (SNCR) techniques, BAT 8 is to maintain suitable operating conditions of the SCR or SNCR waste gas treatment systems, with the aim of limiting emissions of unreacted NH3

BAT associated emission levels for ammonia (NH_3) emissions to air for a combustion or process unit where SCR or SNCR techniques are used	
Parameter	**BAT - AEL (monthly average)**
Ammonia expressed as NH_3	<5 - 15 mg/Nm^3
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 The lower end of the range is associated with the use of SCR	

Reduction of ammonia emissions to air

BAT 8 is not applicable for Point of Ayr.

The Gas Sweetening Unit is designed to remove hydrogen sulphide (H_2S) and other sulphurous compounds from the main gas stream. These units produce gas that meets the sales gas specification, which is a hydrogen sulphide (H_2S) content of 3.3ppmv and total Sulphur (S_8) content of 35ppmv.

The gas sweetening process is carried out using an amine solvent solution to selectively absorb the H_2S from the gas stream while minimising the pick-up of Carbon Dioxide (CO_2). The amine solution presently used is HS103 as manufactured by Dow Chemicals, and works by forming a complex with the acid gases. The amine is a proprietary chemical solution consisting of alkanolamines with various chemical additives. It is used in an aqueous solution with 40% chemical and 10% physical aqueous solution.

BAT Not Applicable

2.5.3 BAT 9

BAT 9: In order to prevent and reduce emissions to air when using a sour water steam stripping unit, BAT 9 is to route the acid off-gases from this unit to an SRU or any equivalent gas treatment process. It is not BAT to directly incinerate the untreated sour water stripping gases.

Reduction of emissions to air

The sulphur recovery unit (SRU) is designed to process acid gas from two sources. One source is from the amine regenerators included in the gas sweetening units (GSUs) and the second is acid gas recycled from the solvent regenerator at the TGU. Acid offgases from the TGU are returned to the SRU for reprocessing. Sour water is sent to the TOX (there is no sour water steam stripping unit).

Acid gases from the gas sweetening units contain hydrogen sulphide, mercaptans, methanol vapour, hydrocarbon, carbon dioxide and water vapour.

BAT Achieved

2.6 Monitoring of Emissions to Water

2.6.1 BAT 10

BAT 10: BAT is to monitor emissions to water by using the monitoring techniques with at least the minimum frequency presented in the below Table 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.

BAT associated emission levels for direct waste water discharges from the refining of mineral oil and gas and monitoring frequencies associated with BAT		
Parameter	**BAT - AEL (yearly average)**	**Monitoring frequency and analytical method (standard)**
Hydrocarbon oil index (HOI)	0.1 - 2.5 mg/l	Daily with EN9377-2 analytical method
Total suspended solids (TSS)	5 - 25 mg/l	Daily
Chemical oxygen demand (COD)	30 - 125 mg/l	Daily
BOD_5	No BATAEL	weekly
Total nitrogen (expressed as N)	1 - 25 mg/l	Daily
Lead, express as Pb	0.005 - 0.030 mg/l	Quarterly
Cadmium, express as Cd	0.002 - 0.008 mg/l	Quarterly
Nickel, express as Ni	0.005 - 0.100 mg/l	Quarterly
Mercury, express as Hg	0.0001 - 0.001 mg/l	Quarterly
Vanadium	No BATAEL	Quarterly
Phenol Index	No BATAEL	Monthly EN 14402
Benzene, toluene, ethyl benzene, xylene (BTEX)	Benzene 0.001 - 0.050 mg/l No BAT-AEL for T, E, X	Monthly

Monitoring of emissions to water

The POA process removes water and high molecular weight hydrocarbons from the inlet gas, in order to achieve the sales gas dewpoint specification. This water/liquid hydrocarbon mix is collected and exported back offshore, either for re-injection into the wells, mixing with the crude oil product or permitted discharge overboard.

The POA drains system is separated into open and closed drains. The open drains system is designed to cope with the disposal of surface runoff water. Effluents from the open drains ultimately converge at the Outfall Pond (via an oil interceptor) from where they are pumped into the local watercourse periodically, depending upon the results of effluent analysis. Surface runoff from areas subject to potential contamination and oily liquids from equipment sumps (except the Pig Receiver Collection Sump) are routed through the closed (oily water) drains to a tilted plate separator (TPS). This TPS removes any free oil present, to less than 15ppm, before the water again flows to the Outfall Pond for discharge into the local watercourse periodically, depending upon the results of effluent analysis. Oily sludges from the Pig Receiver, and pig washdown water, flow into the Pig Receiver Sump from which liquids are periodically removed by tanker and disposed of offsite by a licensed contractor. There are no releases to groundwater from the installation and only domestic sewage is released to sewer.

BAT Not Applicable

2.6.2 BAT 11

BAT 11: In order to reduce water consumption and the volume of contaminated water, BAT is to use all of the following techniques:

I. Water stream integration (Reduction of process water produced at the unit level prior to discharge by the internal reuse of water streams from e.g. cooling, condensates, especially for use in crude desalting; generally applicable for new units; for existing units, applicability may require a complete rebuilding of the unit or the installation);
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.).

Reduction of water consumption and the volume of contamination

Water supplied from the town main is used as potable water, non-potable utility water and finally occasionally to make up the Firewater Pond, if required. See Section 2.6, no process waste water emissions are made onshore.

Procedures are in place to minimise spills, plus the site is fitted with a dedicated Chemical Storage Area, complete with its own drainage/bund system.

BAT Achieved

2.6.3 BAT 12

BAT 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 following techniques:

I. Removal of insoluble substances by recovering oil
II. Removal of insoluble substances by recovering suspended solids and dispersed oil.
III. Removal of soluble substances including biological treatment and clarification.

Reduction of pollutants in waste water discharges

See Section 2.6, no process waste water emissions are made onshore.

BAT Not Applicable

2.6.4 BAT 13

BAT 13: When further removal of organic substances or nitrogen is needed, BAT is to use an additional treatment step as described:

I. Removal of insoluble substances by recovering oil; these techniques include:
   i. API Separators (APIs)
   ii. Corrugated Plate Interceptors (CPIs)
   iii. Parallel Plate Interceptors (PPIs)
   iv. Tilted Plate Interceptors (TPIs)
   v. Buffer and/or equalisation tanks

II. Removal of insoluble substances by recovering suspended solid and dispersed oil; these techniques include:
   i. Dissolved Gas Flotation (DGF)
   ii. Induced Gas Flotation (IGF)
   iii. Sand Filtration

III. Removal of soluble substances including biological treatment and clarification; the biological treatment techniques may include:
   i. Fixed bed systems (fixed bed systems may include a biofilter or trickling filter);
   ii. Suspended bed systems (one of the most commonly used suspended bed system in refineries WWTP is the activated sludge process).

IV. 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.

Waste Water Treatment Plant

No further removal of organic substances or nitrogen from waste water required.

BAT Not Applicable

2.7 Waste Generation and Management

2.7.1 BAT 14

BAT14: 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 and disposal.

Waste Management

All staff (including contractors) are required to follow procedural waste management requirements, designed to deliver compliance with regulatory requirements, by using waste receptacles correctly and ensuring that waste generated is correctly managed ready for collection and disposal.

BAT Achieved

2.7.2 BAT 15

BAT 15: In order to reduce the amount of sludge to be treated or disposed of, BAT is to use one or a combination of the following techniques:

I. Sludge pre-treatment (Prior to final treatment, e.g. in a fluidised bed incinerator, the sludges are dewatered and/or de-oiled (by e.g. centrifugal decanters or steam dryers) to reduce their volume and to recover oil from slop equipment)
II. Re-use of sludge in process units (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

Sludge pre-treatment

Not applicable, sludge is not generated from the POA process.

Liquids are periodically removed from sumps, during routine sump cleaning processes, by tanker and disposed of offsite by a licensed contractor.

BAT Not Applicable

2.7.3 BAT 16

BAT 16: In order to reduce the generation of spent solid catalyst waste, BAT is to use one or a combination of the following techniques:

I. Spent solid catalyst management (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.)
II. Removal of catalyst from slurry decant oil (Decanted oil sludge from process units (e.g. FCC unit) can contain significant concentrations of catalyst fines. These fines need to be separated prior to the reuse of decant oil as a feedstock.)

NOTE: This is only applicable to gas refineries if solid catalytic treatment is undertaken

Spent catalyst

Spent catalyst arises very infrequently from change-outs during shut-downs. It is stored in sealed bags then drums and then placed in the chemical and waste storage area for collection by a specialist contractor.

BAT Achieved

2.8 Noise Emissions (BAT 17)

BAT 17: In order to prevent or reduce noise, BAT is to use one or a combination of the following techniques:

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.

Noise emission may be applicable in relation to combustion plant and compressors.

Noise emissions

A noise assessment was conducted for the original PPC application, and routine monitoring (biannual survey) is carried out.
Flare stack located at extremity of site boundary.
Planning conditions with respect to noise are met, consultation with local community prior to any planned blow-down events.
Noisy activities are located in buildings with acoustic padding. Particularly gas turbine is located in a dedicated insulated structure, to provide insulation from the noise.

BAT Achieved

2.9 Integrated Refinery Management (BAT 18)

BAT 18: In order to prevent or reduce VOC emissions, BAT is to apply these techniques:

V. Techniques related to plant design;
VI. Techniques related to plan installation and commissioning;
VII. Techniques related to plant operation.

VOC emission

All VOC emissions arising onsite are methane, and BAT 18 relates to non-methane VOCs.

BAT Not Applicable

3. BAT CONCLUSIONS FOR COMBUSTION UNITS

3.1 BAT 34

BAT 34: In order to prevent or reduce NO_X emissions to air from the combustion units, BAT is to use one or a combination of the following techniques:

I. Primary or process related techniques, such as:
   i. Selection or treatment of fuel;
      a. Use of gas to replace liquid fuel (Gas generally contains less nitrogen than liquid and its combustion leads to a lower level of NO_X emissions);
      b. Use of low nitrogen refinery fuel oil (RFO) e.g. by RFO selection or by hydrotreatment of RFO (Refinery fuel oil selection favours low nitrogen liquid fuels among the possible sources to be used at the unit. Hydrotreatment aims at reducing the sulphur, nitrogen and metal contents of the fuel.);
   ii. Combustion modifications
      a. Staged combustion (air staging or fuel staging; fuel staging for mixed or liquid firing may require a specific burner design);
      b. Optimisation of combustion (Based on permanent monitoring of parameters such as oxygen, fuel to air ratio, carbon monoxide, unburnt fuel in the exhaust gases to optimise combustion efficiency.);
      c. Flue-gas recirculation (Reinjection of waste gas from the furnace into the flame to reduce the oxygen content of the combustion chamber and so reduce the flame temperature.);
      d. Diluent injection (Injection of an inert diluent such as steam, water or nitrogen to reduce the oxygen concentration and therefore the flame temperature.);
      e. Use of low-NO_X burners (LNB) (Low NOx burners are designed to reduce flame temperature, delay completion of combustion and promote effective heat transfer from the flame.).

II. Primary II. Secondary or end-of pipe techniques, such as:
   i. Selective catalytic reduction (SCR)
   ii. Selective non-catalytic reduction (SNCR)
   iii. Low temperature oxidation
   iv. SNOX combined technique

BAT AELs associated with BAT34 for NOx emissions to air from a gas turbine		
Parameter	**Type of equipment**	**BAT-AEL (monthly average) mg/Nm3 at 15% O_2**
NOx, expressed as NO_2	Gas turbine (including combined cycle gas turbine – CCGT) and integrated gasification combined cycle turbine (IGCC))	40 - 120 (existing gas turbine)
		20 - 50 (new turbine) [(2)]

Reduction of NOx emissions

The Turbine Generator Package provides the primary power supply for POA, it is driven by a turbine utilising HP fuel gas from the fuel gas system. The Turbine Generator is fitted with low NO_X burners in order to reduce NO_X emissions to the atmosphere.

Some of the heat in the turbine exhaust gases is recovered via the Waste Heat Recovery Unit which heats the terminal's hot oil heating medium before the exhaust gases are routed safely to atmosphere at a point 15m above ground level.

During normal plant operation, steam is produced from the Waste Heat Boiler and the condensers in the Sulphur Recovery Unit, and the Reactor Effluent Cooler in the Tail Gas Unit. However, if the Sulphur Recovery Unit is out of action the Standby Steam Boiler Package is used to fulfil the requirements of the plant steam system.

This boiler is fired using fuel gas or diesel oil, has a 16m high stack and is equipped with low NO_X burners to reduce NO_X emissions. Although this boiler will only be used at full duty during a period of unavailability of the Sulphur Recovery Unit, it is necessary to keep it continuously in a hot standby condition during normal plant operations. For this reason the boiler is fired to full pressure on a periodic, "standby" basis.

Fuel gas is the normally used fuel; diesel fuel is only used at times of terminal shutdown when fuel gas may not be available.

In summary, the optimisation of combustion is in place through the use of the gas turbine to provide heat (steam) to offset the demand for the fired heaters.

The existing POA Environmental Permit NOX AEL for emissions from the gas turbine is the same as the BAT AEL given in the table on the previous page, for existing gas turbines. NOX emissions from the POA gas turbine meet these AELs.

BAT Achieved

3.2 BAT 35

BAT 35: In order to prevent or reduce dust and metal emissions to air from the combustion units, BAT is to use one or a combination of the following techniques:

I. Primary or process related techniques, such as: selection or treatment of fuel
   i. Use of gas to replace liquid fuel (Gas instead of liquid combustion leads to lower level of dust emissions);
   ii. Use of low sulphur refinery fuel oil (RFO) e.g. by RFO selection or by hydrotreatment of RFO (It is unlikely that a gas refinery will produce refinery fuel oil.);

II. Primary or process related techniques, such as:
   i. Optimisation of combustion
   ii. Atomisation of liquid fuel (Use of high pressure to reduce the droplet size of liquid fuel. Recent optimal burner designs generally include steam atomisation.);

III. Secondary or end-of pipe techniques, such as:
   i. Electrostatic precipitator (ESP)
   ii. Third stage blowback filter
   iii. Wet scrubbing
   iv. Centrifugal washers

BAT associated emission levels for dust emissions to air from a multi-fuel fired combustion unit with the exception of gas turbines		
Parameter	**Type of equipment**	**BAT-AEL (monthly average) mg/Nm^3**
Dust	Multi-fuel firing	5 – 50 for existing unit
		5 - 25 for new unit < 50MW

Reduction of dust and metal emissions

Gas is used as the primary source of fuel at POA, with low sulphur fuel oil/diesel as back-up.

BAT not applicable as no multi fuel firing present.

BAT Not Applicable

3.3 BAT 36

BAT 36: In order to prevent or reduce SO_X emissions to air from the combustion units, BAT is to use one or a combination of the following techniques:

I. Primary or process-related techniques based on a selection or a treatment of the fuel, such as:
   i. Use of gas to replace liquid fuel
   ii. Treatment of refinery fuel gas (RFG) (Residual H_2S concentration in RFG depends on the treatment process parameter, e.g. the amine-scrubbing pressure.);
   iii. Use of low sulphur refinery fuel oil (RFO) e.g. by RFO selection or by hydrotreatment of RFO (It is unlikely that a gas refinery will produce refinery fuel oil);

II. Secondary or end-of-pipe techniques:
   i. Non-regenerative scrubbing (Wet scrubbing or seawater scrubbing.);
   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.)
   iii. SNO_X combined technique

BAT AELs associated with BAT36 for SO_2 emissions to air from a combustion unit firing refinery fuel gas (RFG), with the exception of gas turbines	
Parameter	**BAT-AEL (monthly average) mg/Nm^3**
SO_2	5 - 35

This BAT conclusion is only relevant if the gas fired is sour, i.e. has a sulphur content > 5ppm.

Reduction of SOx emissions

Table states ‘except gas turbines’, and POA turbines use sales gas, therefore BAT is not applicable.

BAT Not Applicable

3.4 BAT 37

BAT 37: In order to reduce carbon monoxide (CO) emissions to air, BAT is to use combustion operation control.

BAT-associated emission levels for carbon monoxide emissions to air from a combustion unit	
Parameter	**BAT-AEL (monthly average) mg/Nm^3**
Carbon Monoxide, expressed as CO. Associated monitoring requirements are in BAT 4.	≤ 100

Reduction of carbon monoxide (CO) emissions

Combustion control systems are in place at POA, and a specified excess O_2 is maintained in the TOX to ensure complete combustion.

Emissions monitoring reports for stack emissions from the TOX and turbines present carbon monoxide emission levels below this limit. However the existing POA Environmental Permit contains no AEL for CO.

See Section 2.4.2 for all combustion equipment present.

BAT Achieved

4. BAT CONCLUSIONS FOR THE NATURAL GAS REFINERY

POA uses a small proportion of the gas that it processes as fuel, the remainder is sold to the Connah's Quay Power Station where it is either used as turbine fuel or passed through a nitrogen rejection unit and then sold into the National Grid.

As sales gas has significant value, saving and exporting is has the potential to contribute additional revenue. Offshore gas supply capacity no longer exceeds the amount of gas that can be sold to Connah's Quay under current contractual arrangements; therefore the gas used to fuel the turbine is of economic value as it could be sold.

4.1 BAT 41

BAT 41: In order to reduce sulphur dioxide emissions to air from the natural gas plant, BAT is to apply BAT 54.

BAT 54: In order to reduce sulphur emissions to air from off-gases containing hydrogen sulphides (H_2S), BAT is to use all of the following techniques:

I. Acid gas removal e.g. by amine treating
II. Sulphur recovery units (SRU) e.g. by Claus process
III. Tail gas treatment unit (TGTU) (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

BAT-associated environmental performance levels for a waste gas sulphur (H_2S) recovery system	
Parameters	**BAT-associated environmental performance level (monthly average) (mg/Nm^3)**
Acid gas removal	Achieve hydrogen sulphides (H_2S) removal in the treated RFG in order to meet gas firing BAT-AEL for BAT 36
Sulphur recovery efficiency	New units: 99.5 – >99.9 % Existing units: ≥ 98.5 %
(1) Sulphur recovery efficiency of the whole treatment chain (e.g. including SRU and TGTU) is calculated as removal efficiency, as the % of sulphur removed by the whole treatment chain	

Reduction of sulphur emissions to air

All stated techniques are in use at POA.

The gas sweetening process is carried out by contacting the gas with an amine solvent, which absorbs acid gases. The acid gases are then liberated from the solvent by heating and they provide the feed to the Sulphur Recovery Unit and the associated Tail Gas Unit. These units recover in excess of 99% of the sulphur in the acid gases. Any sulphur compounds not converted to elemental sulphur in the SRU are incinerated in the TOX at a temperature high enough to convert them to sulphur dioxide (SO_2) which is then safely discharged to atmosphere.

BAT Achieved

4.2 BAT 42

BAT 42: In order to reduce nitrogen oxides (NO_X) emissions to air from the natural gas plant, BAT is to apply BAT 34.

Reduction of NOx emissions

As described in Section 3.1 (BAT 34) low NO_X burners are in place and combustion is optimised through the use of the gas turbine to provide heat (steam) to offset the demand for the fired heaters.

BAT Achieved

4.3 BAT 43

BAT 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.

Reduction of mercury emissions

Not applicable, no mercury present in fuel streams/raw natural gas, see analysis.

POA and Mercury Analysis

Well No: Sample No: Sampling Date	110/13-4 DST 1 7 13.04.91	110/13-4 DST 1A 8 16.04.91	110/13-5 DST 2 16 17.05.91
PARAFFINS (% Vol.) (including Napthenes)	97.0	97.0	93.8
OLEFINS (% Vol.)	0.7	1.8	2.4
AROMATICS (% Vol.)	2.3	1.2	3.8
MERCURY CONTENT, ppm w/w	<0.002	<0.002	<0.002

The analysis presented here dates from mid-1990s, therefore ELBOC commits to obtaining current analysis by the end of 2016.

BAT Not Applicable

5. BAT CONCLUSIONS FOR WASTE GAS SULPHUR TREATMENT, FLARES AND INTEGRATED EMISSIONS MANAGEMENT

Flaring currently constitutes around 1.5% of POA annual CO_2 emissions. A large percentage of this consists of pilot gas (>90%) which is dependent on wind conditions. In order to prevent the flare from extinguishing, and thus preventing emissions of toxic and odorous H_2S emissions, pilot support gas is fed to the flare at a rate of approximately 50 m^3 per hour. Under high wind conditions, this can increase. To ensure that the flare is lit at all times, two cameras are pointed at the flare and images displayed in the control room.

5.1 BAT 54

BAT 54: In order to reduce sulphur emissions to air from off-gases containing hydrogen sulphides (H_2S), BAT is to use all of the following techniques:

I. Acid gas removal e.g. by amine treating
II. Sulphur recovery units (SRU) e.g. by Claus process
III. Tail gas treatment unit (TGTU) (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

BAT-associated environmental performance levels for a waste gas sulphur (H_2S) recovery system	
Parameters	**BAT-associated environmental performance level (monthly average) (mg/Nm³)**
Acid gas removal	Achieve hydrogen sulphides (H_2S) removal in the treated RFG in order to meet gas firing BAT-AEL for BAT 36
Sulphur recovery efficiency	New units: 99.5 – >99.9 % Existing units: ≥ 98.5 %
(1) Sulphur recovery efficiency of the whole treatment chain (e.g. including SRU and TGTU) is calculated as removal efficiency, as the % of sulphur removed by the whole treatment chain	

Reduction of sulphur emissions to air

As described in Section 4.1 (BAT 41) all stated techniques are in use at POA.

BAT Achieved

5.2 BAT 55

BAT 55: In order to prevent emissions to air from flares, BAT is to use flaring only for safety reasons or non-routine operational conditions (e.g. start-ups, shutdown).

Prevent flare emissions to air

Flaring is required for the safe disposal of hydrocarbon gases. Contributors to the POA flare are:

- Relief valves (equipment is protected from overpressure by relief valves and instrumentation systems provide primary protection to prevent overpressure). Relief valve operation only occurs after failure of these systems or in the event of fire.
- Depressurisation following emergency shutdown (POA has emergency depressurisation facilities to enable reduction in pressure of all gas inventories). Simultaneous depressurisation of all process units is only initiated in the event of a major fire or gas leak. Emergency depressurisation of one or more process units, at a much lower flaring rate occurs in the event of a localised fire or gas leak. Emergency depressurisation is always manually initiated.
- Maintenance equipment (prior to maintenance, equipment is vented, through the flare, at a manually controlled low rate).
- Storage Tank Blanket Gas (a gas blanket is required above the liquid inventory of most storage tanks to prevent ingress of air). Changes in liquid levels and tank temperatures cause outbreathing of the blanket vapours. These gases are flared for safe disposal.

To summarise, flaring is only used for safety; depressuring of equipment for maintenance and emergency purposes, for example opening of the pig receiver for pig removal.

BAT Achieved

5.3 BAT 56

BAT 56: In order to reduce emissions to air from flares when flaring is unavoidable, BAT is to use the following techniques:

I. 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, shut down, emergency).

II. Plant management: includes organizational and control measures to reduce the case of flaring by e.g. balancing RFG system, using advanced process control.

III. Flares 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.

IV. 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. mixture flow gas and heat content, ratio of assistance, velocity, purge gas flowrate, pollutant emissions).

V. Reporting of flaring events makes possible to use flaring

VI. Ratio as a requirement included in the EMS and to prevent the future ones.

VII. Visual remote monitoring of the flare can also be carried out by using colour TV monitors during flare events

Reduce flare emissions to air

The only operational flaring requirement is for the storage tank outbreathing and it is at a very low rate. Blanket gas will normally be fuel gas with propane as backup.

All listed techniques are in use, except there is no continuous monitoring of total gas flow to flare, nor continuous monitoring of emissions from the flare.

Additionally a flare system for both the LP and HP gas systems is installed on site which is used during specific stages of the gas treatment process such as depressurisation. The flare stacks utilise gas for the pilot light and natural gas and process gas routing to flare occurs only if and when a part of the facility is depressurised. The HP Fuel gas is used to support combustion of the flare system.

POA EU ETS flare volume is determined using a by-difference methodology, using data from two metering systems, as described in the EU ETS Permit.

BAT Achieved

6. BAT CONCLUSIONS FOR THE DISTILLATION PROCES

6.1 BAT 44

BAT 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.

Only applicable if vacuum distillation processes undertaken at the gas refinery

May not be applicable in some retrofit cases. For new units, vacuum pumps, either in or not in combination with steam ejectors, may be needed to achieve a high vacuum (10 mm Hg). Also, a spare should be available in case the vacuum pump fails.

Not applicable because there is no crude distillation process.

6.2 BAT 45

BAT 45: In order to prevent or reduce water pollution from the distillation process, BAT is to route sour water to the stripping unit.

Only applicable if sour water generated

Not applicable because there is no crude distillation process.

6.3 BAT 46

BAT 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.

Only applicable if distillation processes are undertaken at the gas refinery.

In specific refinery configurations, applicability may be restricted, due to the need for e.g. large piping, compressors or additional amine treating capacity.

Not applicable because there is no crude distillation process.

7. BAT CONCLUSIONS FOR THE PRODUCTS TREATMENT PROCESS

7.1 BAT 47

BAT 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 by e.g. incineration

Reduction of emission to air from the products treatment process

The TOX is one source of continuous gaseous discharge from POA and as such has permitted AELs.

The TOX consists of a forced draft burner, thermal oxidiser and flue gas exhaust stack designed to incinerate hydrogen, light hydrocarbons and other combustibles present in the nine waste gas streams and sour water stream. Except on start up/shut down of the plant, when the thermal oxidiser is used to process feed gas streams, exit gases should contain no greater than limits as presented in the Environmental Permit (EPR/DP3934EW).

The TOX is a horizontal, cylindrical furnace supported in two saddles and complete with integral ducting for connection to the exhaust stack. The furnace is designed to maintain the combustion process at the specified temperature for sufficient time and with sufficient turbulence to ensure near complete thermal oxidation of the waste gases.

The furnace is lined throughout in high quality refractory materials suitable for hot face temperatures in excess of any likely normal operating temperatures. As the products of the combustion process are potentially highly corrosive, the thermal resistance of the lining is designed to maintain the carbon steel oxidiser shell (cold face) at a temperature in excess of the acid dewpoint temperature of $176^{O}C$.

Waste gas streams are fed to the Thermal Oxidiser via a manifold and six inlet nozzles arranged around the upper oxidiser body near to the burner end. The acid gas stream is fed via a manifold and three inlet nozzles in the upper section of the oxidiser burner front. Sour waste feed is fed into the oxidiser via a spray nozzle situated centrally in one of the six secondary air nozzles located on the burner front.

BAT Achieved

7.2 BAT 48

BAT 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 global management of spent caustic, including recycling after appropriate treatment e.g. by stripping

Reduction of waste and waste water generation

See Section 2.7, BAT not applicable.

BAT Not Applicable

8. BAT CONCLUSIONS FOR STORAGE AND HANDLING PROCESSES

8.1 BAT 49

BAT 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.

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).

The applicability of high efficiency seals may be restricted for retrofitting tertiary seals in existing tanks.

Reduction of VOC emissions

Diesel is stored onsite, gas condensate is returned offshore. Methanol is stored under an N2 blanket in a fixed roof tank with a vent to atmosphere. There is no vapour recovery system in place.

Methanol is used for hydrate inhibition offshore, and is supplied from POA by pipeline. Methanol is delivered to POA by dedicated 30m3 road tankers for storage in the 100m3 Methanol Storage Tank (operating volume is 81m3).

Methanol storage is considered to be BAT for this site, because of the volume present and the method of storage in place, as it achieves an equivalent level of environmental protection as the method discussed in the BAT recommendation.

BAT Achieved

8.2 BAT 50

BAT 50: In order to reduce VOC emissions to air from the storage of volatile liquid hydrocarbon compounds, BAT is to use one or a combination of the following techniques:

I. Manual crude oil tank cleaning (Oil tank cleaning is performed by workers entering the tank and removing sludge manually; this may be applicable to cleaning of gas condensate tanks, if sludges accumulate)

II. Use of a closed-loop cleaning system (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. This may be applicable to gas condensate tanks if deposits build up at the base of the tank. The applicability may be limited by e.g. the type of residues, tank roof construction or tank materials.)

Reduction of VOC emissions

All VOC emissions arising onsite are methane, and BAT 50 relates to non-methane VOCs.

BAT Not Applicable

8.3 BAT 51

BAT 51: 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 following techniques below:

I. Maintenance programme including corrosion monitoring, prevention and control (A management system including leak detection and operational controls to prevent overfilling, inventory control and risk-based inspection procedures on tanks at intervals to prove their integrity, and maintenance to improve tank containment. It also includes a system response to spill consequences to act before spills can reach the groundwater. To be especially reinforced during maintenance periods. Applicable to gas condensate storage.)

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 overhaul of existing tanks.)

III. Impervious membrane liners (A continuous leak barrier under the entire bottom surface of the tank. Generally applicable for new tanks and after overhaul of existing tanks.)

IV. Sufficient tank farm bund containment (A tank farm bund is designed to contain large spills potentially caused by a shell rupture or overfilling (for both environmental and safety reasons). Size and associated building rules are generally defined by local regulations.)

Reduction of emissions to soil and groundwater

Diesel is stored onsite and gas condensate is returned offshore.

Methanol is stored under an N2 blanket in a fixed roof tank with a vent to atmosphere. There is no vapour recovery system in place.

A maintenance programme is in place, including corrosion monitoring, prevention and control. A chemical injection system is in place, to inject various liquid chemicals into systems to reduce fouling and corrosion, and to control foaming.

Storage containers have been designated to be appropriate for the substance they contain. All chemicals and wastes are stored in the dedicated chemical storage area. All tanks onsite are suitable bunded.

Chemical deliveries are made under the supervision of a member of the Operations Team. An inventory of chemicals stored at the CWSA is taken every week.

BAT Achieved

8.4 BAT 52

BAT 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 reach a recovery rate of at least 95 %:

I. Condensation
II. Absorption
III. Adsorption
IV. Membrane separation
V. Hybrid systems
VI. Vapour recovery

Reduction of VOC emissions

All VOC emissions arising onsite are methane, and BAT 52 relates to non-methane VOCs.

BAT Not Applicable

9. BAT CONCLUSIONS FOR INTEGRATED EMISSION MANAGEMENT

9.1 BAT 57

BAT 57: In order to achieve an overall reduction of NOx 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.

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.

Applicable to combustion units on a gas refinery only BAT 34 is relevant.

Monitoring associated with BAT 57

BAT for monitoring emissions of NOx under an integrated emission management technique is as in BAT 4, complemented with the following:

I. a monitoring plan including a description of the processes monitored,

II. a list of the emission sources 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;

III. continuous monitoring of the flue gas flow rates of the units concerned, either through direct measurement of by an equivalent method;

IV. 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.

Reduction of NOx emissions

As described in Section 3.1 (BAT 34) low NO_X burners are in place.

The optimisation of combustion is in place through the use of the gas turbine to provide heat (steam) to offset the demand for the fired heaters.

Application of a bubble limit approach to AEL management is not considered to be appropriate.

BAT Not Applicable

9.2 BAT 58

BAT 58: In order to achieve an overall reduction of SO2 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.

The technique consists of managing SO_2 emissions from several or all combustion units, FCC units and waste gas sulphur recovery units on a refinery site in an integrated manner, by implementing and operating the most appropriate combination of BAT across the different units concerned and monitoring the effectiveness thereof, in such a way that the resulting total emissions are equal to or lower than the emissions that would be achieved through a unit-by-unit application of the BAT-AELs referred to in BAT 26 and BAT 36 as well as the BAT-AEPL set out under BAT 54.

Monitoring associated with BAT 57

BAT for monitoring emissions of SO_2 under an integrated emission management approach is as in BAT 4, complemented with the following:

I. a monitoring plan including a description of the processes monitored,

II. 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;

III. continuous monitoring of the flue-gas flow rates of the units concerned, either through direct measurement or by an equivalent method;

IV. 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.

Reduction of SOx emissions

Referring to sections 2.4 and 4.1, the following table summarises the environmental monitoring which takes place:

Regulator	Permit Type and Number	Plant/ Equipment	Activity	Specified Limits	When to Report	Reporting Responsibility	How to Report
Natural Resources Wales (formerly Environment Agency)	Environmental Permit (PPC) EPR/DP3934EW	Thermal Oxidiser (TOX)	Operating temperature	TOX operating temperature not to fall below 850 °c.	If TOX operating temp falls below 850 °c or if any TOX equipment fails.	Production Supervisor informs Plant Manager of excursion, and report made to NRW by Plant Manager. HSE Team consulted if necessary. Plant Manager to ensure any necessary item/s are also reported into the BHPB incident reporting system. Also see BHPB POA Standing Instruction 29 continuous emissions monitoring systems (CEMS).	To notify NRW of the breach of any limit or of the failure of any equipment, Part A of the notification section in PPC permit (page 16) must be submitted to NRW within 24 hours. The Part A notification must be followed up by the Part B notification as soon as is practicable, to update NRW on status of excursion.
		Thermal Oxidiser (TOX)	Emissions to air of oxides of nitrogen (NO & NO_2 expressed together as 'NOX')	TOX NOX emissions to be maintained below 120 mg/m³.	If NOX emissions exceed 120 mg/m³ or if any TOX equipment fails.		
		Thermal Oxidiser (TOX)	Emissions to air of Sulphur Dioxide (SO_2)	TOX SO_2 emissions to be maintained below 190 mg/m³.	If SO_2 emissions exceed 190 mg/m³ or if any TOX equipment fails.		
		Turbine Generator	Emissions to air of oxides of nitrogen (NO & NO_2 expressed together as 'NOX')	Turbine NOX emissions to be maintained below 120 mg/m³.	If NOX emissions exceed 120 mg/m³ or if any turbine equipment fails.		
		POA site water outfall pond	BOD of water discharge to external drainage (brook).	Biological oxygen demand not to exceed 15 mg/ml.	No water discharges must take place unless within specified limit.	If a discharge is made outside of these limits, Production Supervisor informs Plant Manager of excursion, and report made to NRW by Plant Manager. HSE Team consulted if necessary.	If a discharge is made outside of these limits, follow reporting process above.
		POA site Water outfall pond	pH of water discharge to external drainage (brook).	pH to be within the range 6 – 9.	No water discharges must take place unless within specified range.		
		POA site operational activities	Noise emissions	Excessive Noise and vibration from BHPB activities.	See eni LBOC community complaints procedure H-000-GG-099.	Plant Manager and eni LBOC External Affairs.	See eni LBOC community complaints procedure H-000-GG-099.
		POA site operational activities	Odour emissions	Odour emission levels likely to cause annoyance.		Plant Manager and eni LBOC External Affairs.	

BAT Not Applicable