eni Liverpool Bay Operating Company Limited

Point of Ayr Site Energy Efficiency Report

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Minimum Review Period Since Last Issue (Months): 48 Months

1	June 2014	Revised for 4 yearly submission to NRW.	EK	CJ	RP
REV	**DATE**	**DESCRIPTION**	**BY**	**REVIEW**	**APP'D (OWNER)**

1 INTRODUCTION AND SCOPE

This is the 4-yearly update to the eni Liverpool Bay Operating Company Limited (eni LBOC) Point of Ayr (POA) Gas Terminal Energy Efficiency Report. This document is required to be submitted to the regulator (NRW) within 2 months of the date of issue of the site Environmental Permit, and to be reviewed at least every 4 years.

This document was originally submitted to the Environment Agency in pursuance of Condition 1.3 of former Environmental Permit No. ZP3331LM, issued to BHP Billiton.

The POA Gas Terminal was operated by BHP Billiton up to 31st March 2014. On April 1st 2014 the operatorship was transferred to eni LBOC. The eni site environmental permit is now issued by Natural Resources Wales (NRW) and has reference number EPR/DP3934EW.

2 CURRENT ENERGY USE

Energy consumed at the Gas Terminal is a mix of electrical, chemical and heat energy.

2.1 POWER GENERATION

Power is primarily provided by a gas turbine generator using HP fuel gas drawn from the gas processed at the Terminal. The electrical distribution configuration allows the Terminal to export surplus power to the National Grid or draw power from it. There is also a diesel Essential Services Generator. The overall 2013 power consumption of 19,644MWh of electricity, of which 3551.48 MWh was imported, equates to a primary energy consumption of 51,076 MWh (based on a conversion factor of 2.6), which equates to 0.025 MWh/tonne product.

If electricity is imported it is currently purchased from EDF (2014). During 2013 3551 MWh of electricity was purchased and 29,765 MWh was sold (to NPower).

LP fuel gas is used to warm heat transfer oil, which is then used for indirect process heating and steam generation. A separate LP gas steam boiler can also provide steam.

PoA Power Generators

Energy Consumer	Energy Generator (electrical, chemical or thermal)	Power Output (MW)
Gas turbine	Electricity	5.6
	Stack waste heat recovery unit recovering heat from turbine exhaust gases	4.6
Feed gas heaters	Recovered heat from treated amine	Energy within process
Lean/rich amine exchanger	Recovered heat from treated amine	Energy within process
Dewpoint control gas/gas exchanger	Recovered energy from cold sales gas	Energy within process
Sulphur plant waste heat boiler	Generating steam	Energy within process
Sulphur plant 2nd, 3rd and 4th stage coolers	Generating steam	Energy within process
Tail gas unit reactor effluent cooler	Generating steam	Energy within process
Tail gas unit lean/rich solvent exchanger	Recovered heat from rich amine solution	Energy within process
Other electricity consumers	Lighting, pumps	Energy within process
Fired heaters	Thermal	Varies
Steam boiler	Generating steam	Varies
Others	Energy within process	Energy within process

2.2 ENERGY CONSUMPTION

PoA Energy Consumers

Energy Consumer	Energy Use (typical)(electrical, chemical or thermal)
Amine reboilers A/B	Indirect thermal: 3,000 kW hot oil
Sulphur plant reaction furnace	Thermal: 80 m^3/h Fuel Gas; 430 m^3/h Acid Gas; 140 m^3/h recycle gas
Sulphur plant gas reheaters (3 off)	Indirect thermal: cascade heat exchange
Amine surge tank heater	Electric: 50 kw. Only used in very cold weather
Glycol regeneration reboiler	Indirect thermal: heat exchange hot oil 6,060 kg/h 50°C td.
Tail gas unit reboiler	Indirect thermal: 1,250 kW hot oil
Propane refrigerant compressors	Electrical: 2x600 kW. Current operation 1x300 kW
Sulphur plant acid gas cooler/dew point chiller	Indirect thermal (cooling) refrigerant duty 300 kW
Sulphur plant combustion air package	Electrical: air 1,250 sm^3/h 0.13bar
Steam boiler	Thermal: 50 sm^3/h (44 kg/h) LPFG. Diesel alternate fuel.
Thermal oxidiser	Thermal: 790 m^3/h FG plus incinerated Tail Gas
Flares	Thermal: 55 m^3/h FG pilot & support gas + PG (varies)
Sulphur pit heating coils	Thermal: unmetered steam
Recycle gas compressor	Electric: intermittent usage (start-up)
Gas turbine generator	Thermal: 2,300 m^3/h generating 7 MW elect + 4.58 MW hourly average heat recovery (2009) into Hot Oil.
Fired Heaters	Thermal: 40 m^3/h upwards (dependent on WHRU)
Flash gas compressor	Not used
Essential Services Generator	Intermittent, low diesel usage
Firewater Pump	Intermittent, low diesel usage
Office complex	Variable depending on occupancy

Electrical power generation and hot oil heating dominate energy use.

2013 Energy Consumption in MWh

	Imported	Exported	Generated	Consumed
Electricity from gas/coal	3,551	29,765	45,858	19,644

2.3 CO_2 EMISSIONS

PoA 2013 CO_2 Emission Points

ID	Source
A2	Turbine Generator
A3/A4	Hot Oil Heaters
A5	Steam Boiler
A6	Essential Services Generator Stack
A7	HP and LP Gas Flares
A8	TOX unit Stack
A9	SRU Reaction Furnace stack
A10	TGU reducing Gas generator stack
A11	Firewater pump diesel engine exhaust
A12	Inherent CO2 from sales gas

POA 2013 CO_2 Emissions

Source Stream	Emissions Points	CO_2 Emission
High Pressure Natural Gas	A2, A7	36,595.13
Low Pressure Natural Gas	A3,A4,A5,A8,A9,A10	15,520.70
Gas/Diesel Oil	A11,A5,A6	433.074
Process Gas	A10,A7,A8,A9	23.16
Propane	A7	306.12
Inherent CO2	A12	2834.62
TOTAL		55,712.804

2.4 ENERGY PERFORMANCE INDICATORS

The following Energy Performance Indicators (EPI's) provide useful data to clarify energy efficiency aspects.

Energy Performance Indicators

Energy Metrics (Energy Performance Indicator (EPI)		Value	Unit
1	Energy consumed as percentage of energy throughput	2.47	%
2	Energy flared as percentage of energy throughput	0.09	%
3	Power generation	46.18	%
4	Fired heaters	52	%

2.4.1 EPI1 - Energy Consumed as Percentage of Energy Throughput

Calculation of annual energy consumed.

2013 Energy Consumption in GJ

	Mass(t)	NCV (GJ/t)	Energy (GJ)
HP Fuel Gas consumed (excl flare)	14,192	42.142	598,079
LP Fuel Gas consumed (in fired heaters, steam boilers and TOX)	6,362	42.504	270,410
Diesel consumed	135.76	43.12	5,854
Flares	779.75	42.142	32,860
Electricity imported	3,551MWh		12,784
Total Energy Consumed			919,987

Net calorific Values and emission factors are calculated from gas compositions.

2013 Average Gas Composition (mole percent)

Component	HP Fuel / Sales Gas	LP Fuel Gas	Process Gas	Flare Gas (Same as HP FG)
Nitrogen	9.92	9.396	10.08	9.92
Mercaptans	0	0	0	0
Carbon Dioxide	0.036	0.049	0.19	0.036
Methane	78.181	76.643	77.92	78.181
Ethane	6.382	7.375	6.41	6.382
Propane	3.394	4.279	3.48	3.394
Iso-butane	0.531	0.671	0.55	0.531
n-Butane	0.888	1.135	0.90	0.888
Iso-Pentane	0.131	0.16	0.13	0.131
n-Pentane	0.101	0.122	0.09	0.101
Hexanes	0.032	0.004	0.0	0.032
Heptanes	0.006	0.005	0.01	0.006

Component	HP Fuel / Sales Gas	LP Fuel Gas	Process Gas	Flare Gas (Same as HP FG)
Octanes	0.001	0.0	0.05	0.001
Nonanes	0	0	0	0
Decanes +	0	0	0	0
Net Calorific Value	42.142GJ/t	42.504GJ/t	41.90GJ/t	42.142GJ/t
CO_2 emission factor (tonnes of CO_2 per tonne of gas)	2.4077 t/t	2.4398t/t	2.40t/t	2.4077 t/t

Calculation of annual energy exported.

2013 Energy Exported in GJ

	Volume/ amount	NCV	Energy (GJ)
Sales Gas	944,000,000m^3	39.117 MJ/sm^3	36,926,450
Condensate to Douglas	Est. 12.34 m^3/d	46.93 GJ/tonne	122,065
Sulphur	Est. 5 t/d	9.163 MJ/kg	15,393
Electricity (exported)	29,765 MWh		107,154
Total			37,171,062

EPI 1 = GJ Energy Consumed/GJ Energy Exported = 2.47%

2.4.2 Energy Flared as Percentage of Energy Throughput

Calculation of energy lost through flaring.

2013 Flaring Energy Loss in GJ

	Mass	Net CV	Energy (GJ)
Flare Pilots, Support and PG	779.75tt	42.142 GJ/t	32,860

EPI 2 = GJ Energy Flared/GJ Energy Exported = 0.09 %

2.4.3 Power Generation

Calculation of the power output from the gas turbine power generation system (GJ).

This is the sum of the electricity generated and the heat recovered in the waste heat recovery unit.

2013 values are 45,858 MWh electricity and 30,863 MWh recovered waste heat, which gives a total electricity generated figure of 276,196 GJ.

Calculation of the thermal capacity of the fuel used to run the turbine; based on consumption of 14,192t of HP fuel gas this is 598,079GJ

EPI 3 = GJ Energy Generated/GJ Energy Consumed = 46.18%

2.4.4 Fired heaters

The WHRU provides the majority of heat input into the hot oil system. The fired heaters only top up and act as stand-by. Typical consumption is one heater (pilots and 1 of 8 burners 150 sm^3/h LP FG, second heater pilot is also approximately 150 m^3/h LP FG).

Calculate the incremental power output from the fired heaters (MW). This is the difference between the energy content of the hot oil going into the heaters and the energy content of the hot oil coming out of the heaters. The amount of heat needed to heat a subject from one temperature level to another can be expressed as:

$$Q = cp\ m\ \Delta T$$

Where
Q = amount of heat (kJ)
cp = specific heat capacity (kJ/kg K) (the cp of oil is 1.67 kJ/kg K)
m = mass (kg)
ΔT = temperature difference between hot and cold side

The typical daily value is 1.3 MW.

Calculation of the thermal capacity of the fuel used to fire the heaters. Based on consumption of 1,707,314m^3 of LP fuel gas in 2013 this is approximately 2.5 MW.

EPI 4 = MW Energy Generated/MW Energy Consumed = 52 %

2.5 ENERGY VALUE

The Point of Ayr Terminal uses a small proportion of the gas that it processes as fuel, the remainder is sold to EoN's 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.

This sales gas has a remaining sales value of 24.83 pence per Therm[1]. Thus, saving and exporting 1 mmscfd of fuel/flare gas per day has the potential to contribute a value of £906,295 per year in additional revenue. Offshore gas supply capacity no longer exceeds the amount of gas that can be sold to EoN under current contractual arrangements; therefore the gas used to fuel the Gas Terminal is of economic value to eni LBOC as it could be sold.

A similar calculation can be made for diesel fuel. The cost of diesel supplied to the Gas Terminal is ~£640/ tonne or £748.80/m^3. Thus saving 1m^3/day of diesel would contribute an annual value of £273,312.

From the above it is possible to calculate the benefits of reduced power consumption. Since 16,895,578 m^3 of fuel gas and 158.84 m^3 of diesel are used to generate 45,858 MWh of electricity and 30,863 MWH of recovered heat.

Theoretically, with emissions of CO_2 being charged under the EU Emission Trading Scheme, a value can also be allocated to emissions of CO_2. The current trading value is estimated at €5.50 (£4.50) per tonne of CO_2, these charges apply to every tonne of CO_2 emitted in excess of the PoA Gas Terminal's free allocation of EU ETS EUAs.

[1] One Therm is a non-SI unit of heat energy equal to 100,000 British thermal units (BTU). It is approximately the energy equivalent of burning 100 cubic feet of natural gas.

3 ENERGY POLICY

3.1 ENI UK HSE & INTEGRITY POLICY

Policy

Health, safety and the environment

The safety and health of eni's people, of the community and of its partners and the protection of the environment are top priorities for eni in all its activities

eni uk

eni UK endorse eni SpA 'health, safety and environment' Policy and commits to adopt it in all its operations

September 2013

Philip Hemmens
Managing Director eni UK

Policy

The culture of integrity in operations

The pursuit of integrity in our operations, meaning the protection, in eni's activities, of people, partners, company assets and the environment, is a top priority and a shared value among eni's people

eni uk

eni UK endorse eni SpA 'culture of integrity in operations' Policy and commits to adopt it in all its operations

September 2013

Philip Hemmens
Managing Director eni UK

3.2 EU ETS

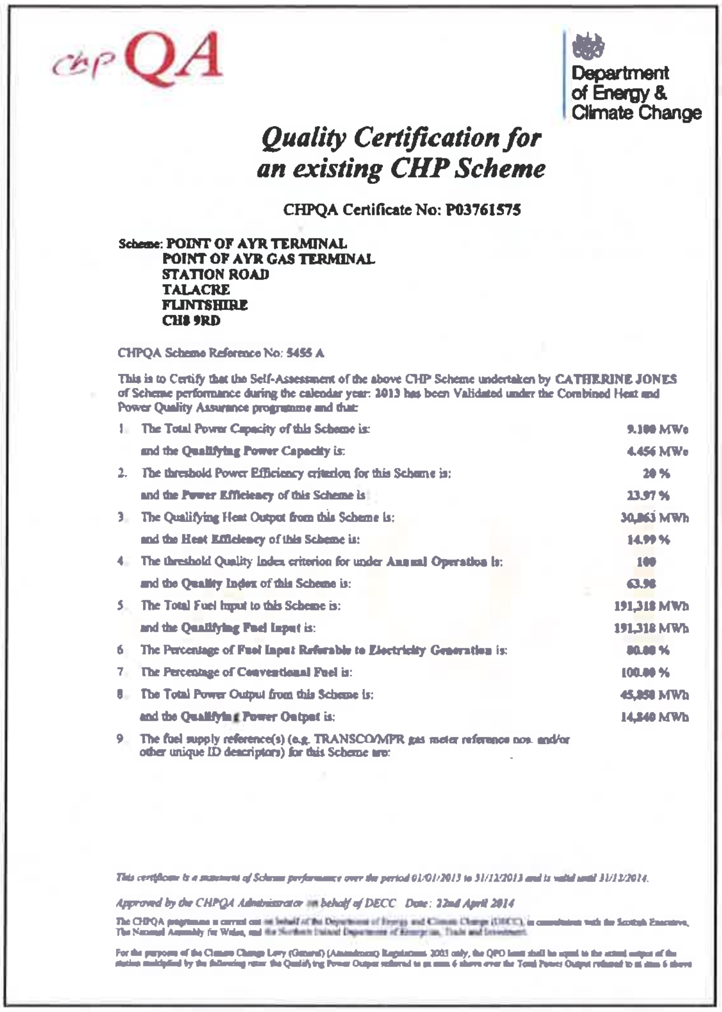
PoA Gas Terminal has an EU ETS Permit, issued by NRW, reference number UK-W-IN-13016.

3.3 ENVIRONMENTAL PERMIT (IED/PPC)

PoA Gas Terminal has an Environmental Permit, issued by NRW, reference number EPR/DP3934EW.

3.4 COMBINED HEAT AND POWER SCHEME – QUALITY CERTIFICATION

The PoA Gas Terminal Waste Heat Recovery Unit qualifies as good quality CHP (power efficiency equals or exceeds 20%).



chp QA

Department of Energy & Climate Change

Quality Certification for an existing CHP Scheme

CHPQA Certificate No: P03761575

Scheme: POINT OF AYR TERMINAL
POINT OF AYR GAS TERMINAL
STATION ROAD
TALACRE
FLINTSHIRE
CH8 9RD

CHPQA Scheme Reference No: 5455 A

This is to Certify that the Self-Assessment of the above CHP Scheme undertaken by **CATHERINE JONES** of Scheme performance during the calendar year: **2013** has been Validated under the Combined Heat and Power Quality Assurance programme and that:

1.	The Total Power Capacity of this Scheme is:	9.100 MWe
	and the **Qualifying Power Capacity** is:	4.456 MWe
2.	The threshold Power Efficiency criterion for this Scheme is:	20 %
	and the **Power Efficiency** of this Scheme is:	23.97 %
3.	The Qualifying Heat Output from this Scheme is:	30,863 MWh
	and the **Heat Efficiency** of this Scheme is:	14.99 %
4.	The threshold Quality Index criterion for under **Annual Operation** is:	100
	and the **Quality Index** of this Scheme is:	63.98
5.	The Total Fuel Input to this Scheme is:	191,318 MWh
	and the **Qualifying Fuel Input** is:	191,318 MWh
6.	The Percentage of **Fuel Input Referable to Electricity Generation** is:	80.00 %
7.	The Percentage of **Conventional Fuel** is:	100.00 %
8.	The Total Power Output from this Scheme is:	45,858 MWh
	and the **Qualifying Power Output** is:	14,840 MWh
9.	The fuel supply reference(s) (e.g. TRANSCO/MPR gas meter reference nos. and/or other unique ID descriptors) for this Scheme are:	

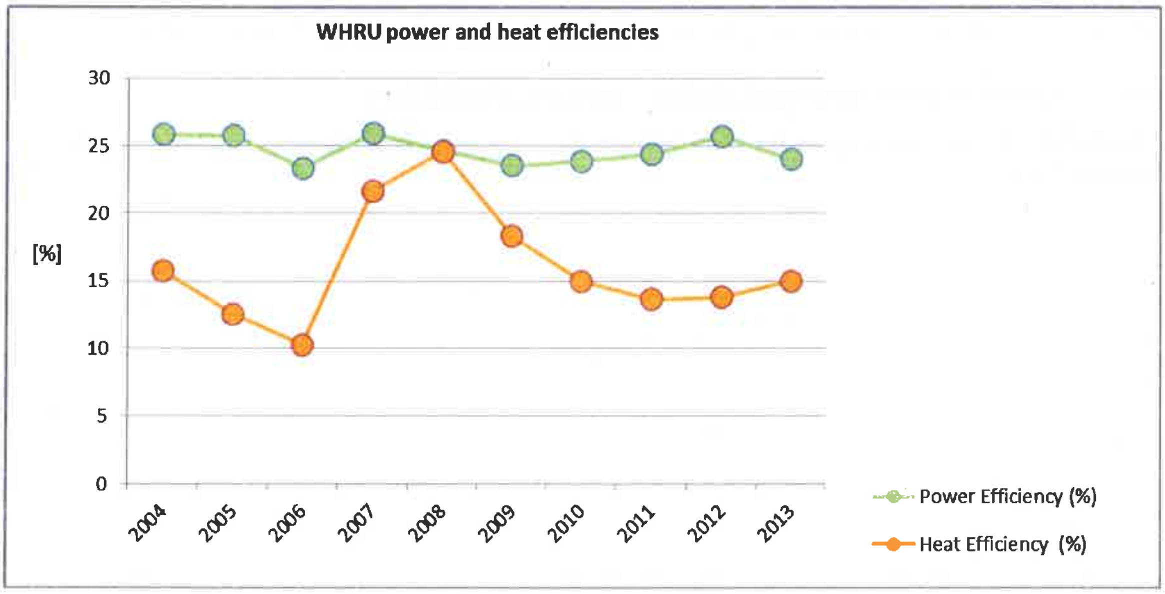
This certificate is a statement of Scheme performance over the period 01/01/2013 to 31/12/2013 and is valid until 31/12/2014.

Approved by the CHPQA Administrator on behalf of DECC Date: 22nd April 2014

The CHPQA programme is carried out on behalf of the Department of Energy and Climate Change (DECC), in consultation with the Scottish Executive, The National Assembly for Wales, and the Northern Ireland Department of Enterprise, Trade and Investment.

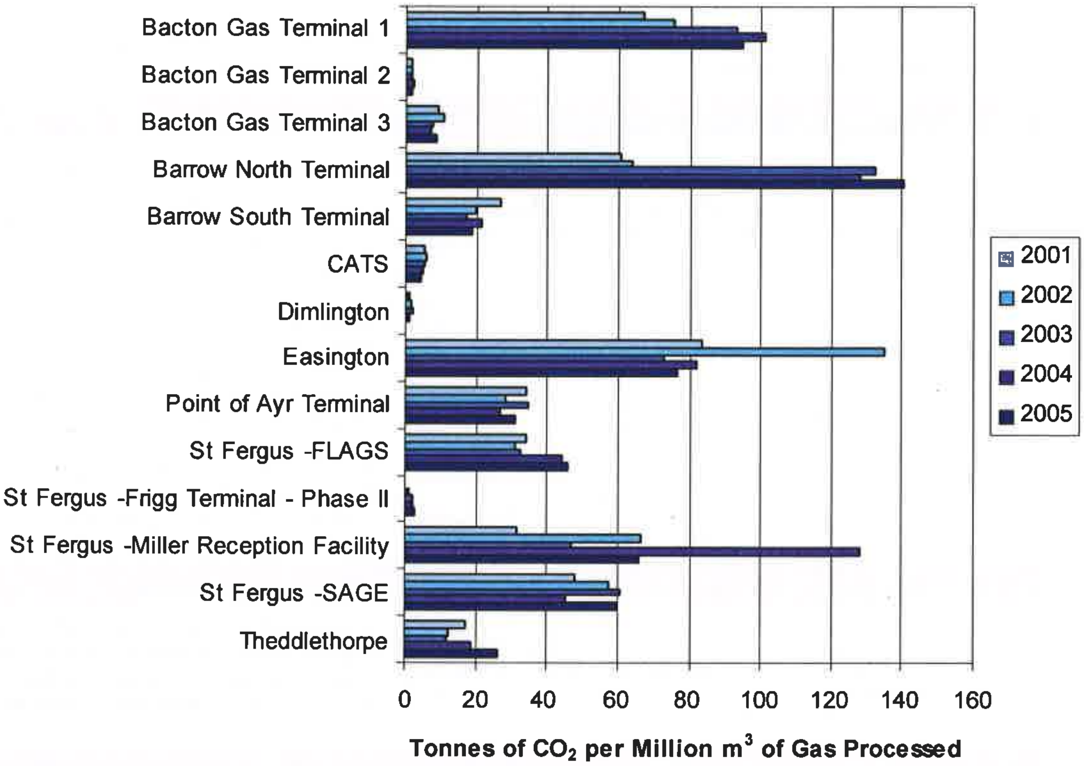
For the purposes of the Climate Change Levy (General) (Amendment) Regulations 2003 only, the QPO limit shall be equal to the actual output of the station multiplied by the following ratio: the Qualifying Power Output referred to at item 8 above over the Total Power Output referred to at item 8 above

WHRU Power and Heat Efficiencies, 2004-2013



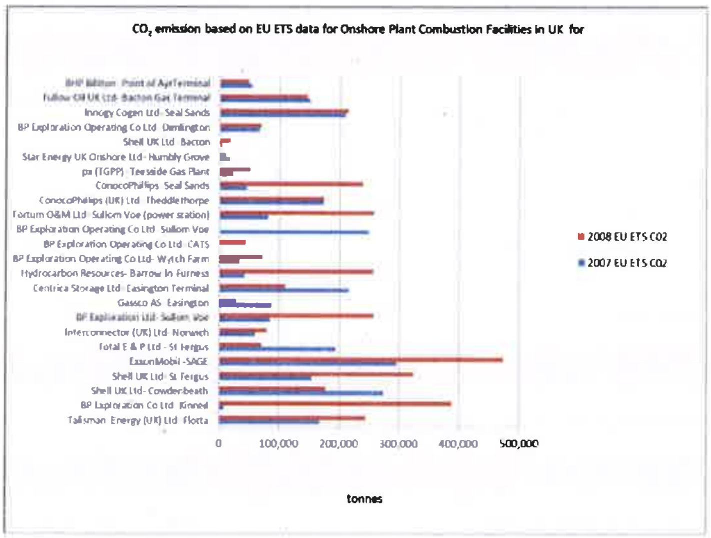
3.6 BENCHMARKING

The following chart benchmarks PoA emissions with those of other UK gas terminals between 2001 and 2005. PoA relative CO_2 emissions of 25-35 tonnes of CO_2 per million m^3 of gas processed compare favourably with those of many other UK terminals.



The following chart benchmarks EU ETS data from 2008 & 2009, POA terminal shows the insignificant CO_2 emission.

UK Terminals' CO_2 Emissions, 2007 & 2008



4 OPPORTUNITIES FOR IMPROVEMENT

1. REDUCE FLARING	POA Improvement Summary
To configure the hardware (incl. flare tip) so that lower purge rates are possible	Purge rates are always optimized due to flare height and distraction to neighbouring community.
To fit cameras with infrared filters to that there is greater confidence in the flare being alight at lower purge rates.	Flare currently monitored using cameras & visible checks on a continuous basis.
2. REDUCE THE UTILISATION OF THE FIRED HEATERS	**POA Improvement Summary**
Both heaters are fitted with 8 burners and 8 pilots. Only a single process train is in operation and about 50% of the waste heat capacity of the gas turbine is being utilised, with about 10% of the heat requirements being delivered by the fired heaters.	The Waste Heat Recovery Unit supplies the majority of heat to the system based on demand. The Hot Oil Heaters are kept online under pilots & single burner operation to keep warm and maintain plant operations in the event of losing the Turbine.
Turn off the stand-by heater to reduce fuel consumption.	To ensure continued supply of hot oil to the process, turning off the stand-by heaters would mean that the Terminal would need to be switched to recycling mode, and loss of revenue would occur if the supply of hot oil was disrupted for more than half an hour. Confidence in the reliability of the gas turbine to supply this heat is moderate. The cold start sequence for the heaters is approximately 2 hours whereas confidence in unproblematic start-up is u low. Hence a standby heater is maintained.
3. TURBINE LOAD	**POA Improvement Summary**
Optimise the turbine load; optimum load would be achieved at maximum income at minimum costs.	The turbine is run at maximum fuel efficiency /WHRU efficiency, supplying enough heat to satisfy the majority of process heat requirements (see opportunity 2 regarding hot oil heaters) and generating approximately 5 MW of electricity.
4. TOX OPTIMISATION	**POA Improvement Summary**
Consider options for optimisation of the TOX and reduction of energy consumption.	A review of actions relating to optimisation of the TOX and the possible reduction of greenhouse gases is on-going in parallel with NRW. The discharge pipework from the effluent cooler has now been lagged. Caustic usage has reduced.
5. RAISE ENERGY AWARENESS	**POA Improvement Summary**
Develop, adopt and implement a formal energy policy for POA	Commitment is included in eni LBOC HSE and Integrity Policy.
Environmental awareness of staff.	These issues are covered during the PoA TM14 monthly safety meetings.
Disseminate energy use information to staff.	
Awareness of company policy.	
6. SINGLE TRAIN OPERATION	**POA Improvement Summary**
Only one train is now operated; the second train being on standby (mothballed).	
FURTHER REDUCTION OPPORTUNITY 1	**POA Improvement Summary**
MINIMISE EQUIPMENT DEPRESSURISATION	Due to single train operation, plant depressurisation only occurs during a shutdown or for specific, limited

	operations such as pigging receipt.
FURTHER REDUCTION OPPORTUNITY 2	
SWITCHING OFF STEAM BOILER. Under normal operating conditions, sufficient steam is generated by the waste heat boiler and effluent cooler in the sulphur plant ; therefore the steam boiler is switched off or standby	The boiler is on standby ensuring that it is ready to supply the heat required to keep recovered sulphur from solidifying in process vessels and pipe-work.
FURTHER REDUCTION OPPORTUNITY 3	
OPTIMISE EFFICIENCY OF BURNERS IN HOT OIL HEATERS. The efficiency of the burners in the fired heaters	The burners of the hot oil heaters are the subject to regular maintenance and are monitored on a routine basis.
The feed gas analyser fitted to control the air-gas ratio upon fluctuating gas composition	There is no composition analyser at the front end of the plant. The benefit is minimal with high costs to implement.
FURTHER REDUCTION OPPORTUNITY 4	
REDUCE THE FLOW THROUGH THE HOT OIL SYSTEM. To reduce the flow through the hot oil system of the waste heat recovery unit (WHRU)	Reducing flow of Hot Oil through the WHRU will be considered as part of the plant optimisation accompanying change to single process train operation, rather than as a stand-alone improvement. This work is still on-going and the operator is further investigating.
FURTHER REDUCTION OPPORTUNITY 5	
REFRIGERATION PROCESS. The gas refrigeration process is driven by two 300 kW electric motors	Currently at POA only one motor is online.
FURTHER REDUCTION OPPORTUNITY 6	
PROCESS OPTIMISATION. Pressure drops across valves and process equipment	The pressure drops across valves and process equipment is based on controllability. There is no significant opportunity.
Efficiency of combustion equipment and of the process in which they are used.	The work is still on-going and the operator is still looking into this opportunity.
Heat balance through the sweetening and dewpoint control systems	
FURTHER REDUCTION OPPORTUNITY 7	
OPTIMISE TERMINAL LIGHTING. Office lighting	Automatically controlled with passive infra-red detectors so that they switch off after a period of no occupancy.
Plant lighting	Plant lighting is zoned in high level and low level lighting and high level lighting is divided into smaller zones which are switched manually on a need by need basis.
Low level plant lighting	Low level plant lighting is managed with light sensors so that they can't operate accidentally during daylight hours.
Cleaning Lighting emitters at regular intervals	Contamination of the light emitter, reflector, and any diffuser can reduce output by up to 50%.
FURTHER REDUCTION OPPORTUNITY 8	
SWITCH TO BIODIESEL. To replace the diesel used at the terminal with biodiesel	Switching to biodiesel is not recommended.

5 CONCLUSIONS AND RECOMMENDATIONS

Flaring currently constitutes around 1.5% of PoA annual CO_2 emissions. A large percentage of this consists of pilot gas (>90%) and reducing this could significantly reduce flaring. The amount of pilot gas 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 s upport 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.

The PoA turbine is run at maximum fuel efficiency/WHRU efficiency, supplying sufficient heat to satisfy process requirements.

TOX optimisation work is still on-going.