Addendum AD1 to report LSW240750, Issue 6, 6 February 2025
Europa Oil and Gas Limited, Cloughton Appraisal Wellsite

Response to a Note of request for more information
ERP/YP3623/AA001, 15 August 2025

Source release and conditions (points 9 to 11)

AD1.1 Introduction

An air quality impact assessment supporting Europa Oil and Limited's (Europa) application to undertake hydrocarbon appraisal operations on land off the A165 to the south east of Burniston, known as the Cloughton Appraisal Wellsite, was undertaken as described in SOCOTEC UK Limited report LSW240750, Issue 6 dated 6 February 2025.

Following submission for consideration the Environment Agency issued a Note of request for more information, dated 15 August 2025. Part of the request required clarification of the exhaust gas releases and conditions of all sources considered within the air quality impact assessment. The specific requirements were listed in points 9 to 11 of the request:

9) Provide:

a) Actual oxygen (O_2) and moisture (H_2O) levels for all sources.
b) Reference conditions for temperature, O2 and H_2O that were used to calculate your emission rates, for example, "273K, 101.3 kPa, dry gas and 5% O_2".
Reason: These parameters are required to demonstrate that the emissions used in the model are a valid representation of the operational scenarios being modelled in accordance with our Air Dispersion Modelling Reports guidance (linked previously, see "Explain emission parameters").

10) Provide volumetric flow rates for all sources:

a) Volumetric flow rate at actual conditions (m3/s)
b) Volumetric flow rate at reference conditions (Nm3/s)

Reason: The consultant has not provided the volumetric flow rates at actual or reference conditions for any of the sources in their AQA report. Providing these is required as per our Air Dispersion Modelling Reports guidance (linked previously, see "Explain emission parameters").

11) Provide emission concentrations (in mg/Nm3) for all modelled pollutants from all sources, and/or an explanation of how the modelled emission rates were calculated or derived.

Reasons:
We require the consultant to provide either the emission concentrations used to calculate the modelled emission rates and/or an explanation of how the modelled emission rates were calculated, in accordance with our Air Dispersion Modelling Reports guidance (linked previously, see "Explain emission parameters") – "You must explain how you have worked out the emission rates used in your model. You need to demonstrate that the emissions are appropriate to the assessment purpose".
Providing datasheets for the modelled sources may be useful in supporting the consultant's calculations or explanations.

The purpose of this addendum is to provide the information requested.

In this addendum, Section and Table references refer to report LSW240750, Issue 6 dated 6 February 2025. unless otherwise noted.

Section AD1.2 of this addendum provides the details requested for each item of equipment, together with a detailed explanation of the calculation methodology applied.

AD1.2 Methodology for determining exhaust gas conditions and discharge rates

The equipment specified for use during operations at the Cloughton Appraisal Wellsite is specified in Table G.1. This includes a reference for the equipment specification and relevant details of full load operating parameters.

AD2.1 Mobile and stationary engines

The equipment employed was largely mobile or temporary stationary engines which are diesel fuelled. These are not generally subject to specific emission limit values in the same way as a fixed installation such as an incinerator. As such, in most cases emission limit values (in mg/m^3) or corresponding exhaust gas reference conditions for temperature or pressure or oxygen and water vapour contents are not applicable. The standards generally applicable to this type of equipment are those for non-road engines, where emission limits are specified on the basis of a mass emission and net power (i.e. g/kWh).

This applies to items A to G and J and K in Table G.1.

Discharge rates for this equipment are based on the manufacturers' specification for full load net power and declaration of compliance with an appropriate standard (see Tables G.1 and 3.13).

The assumption throughout the assessment, except where specifically noted, is that all equipment runs at full load. Discharge rates are therefore a product of the net power and emission standard. For example, the Rig Engine (F), has a full load net power of 1420kW and is assumed to comply with US Tier 2 emission standards.

Substance		Carbon monoxide	Nitrogen oxides	Hydrocarbons	Particulate matter
US Tier 2 emission standards	g/kWh	3.5	6.4[a]		0.2
Mass emission	g/h	4970	9088		284
	g/s	1.380	2.337	0.187	0.079

a. Where the emission standard quotes a combined value for hydrocarbons and nitrogen oxides, it is assumed that nitrogen oxides comprise 92.6% of the total with the remainder being hydrocarbons.

The above details are provided for all stationary engines in Table 3.14.

The full load fuel consumption for each stationary engine is generally provided within the manufacturer's specification. Where this is not available, the full load fuel consumption is based on the industry standard brake specific fuel consumption of 0.21 kg/kWh. In the case of the rig engine (F), the manufacturer's specification indicated a full load fuel consumption of 273 kg/h, which has been used in further calculations. The use of the brake specific fuel consumption gives a slightly higher estimate of 298 kg/h.

The fuel consumption is used to calculate the volumetric exhaust gas flow and hence exhaust gas velocity. It is also used to estimate the discharge of sulphur dioxide based on an assumed sulphur content for ultra-low sulphur diesel of 10 mg/kg.

The diesel fuel is assumed to comprise 87.3% (w/w) carbon and 12.6% (w/w) hydrogen, with trace contents of oxygen, nitrogen and sulphur. The density is assumed to be 0.874g/ml. Based on combustion calculation, a stoichiometric exhaust gas volume of 11.83 m^3 (wet)/kg (10.42 m^3 (dry)/kg) is determined.

The oxygen content of the exhaust gases is either consistent with the manufacturer's declared full load exhaust gas volume or assumed to be 10%, dry. A value of around 10% is considered typical of general operation of large engines based on field experience.

The temperature of the exhaust gas is generally taken from the manufacturer's specification or where not available assumed based on experience of similar engines.

The area of the exhaust flue is either taken from the manufacturer's specification or based on experience of similar equipment.

With the above, it is possible to determine the actual exhaust gas conditions. For example for the Rig Engine (F):

Full load fuel consumption	kg/h	273
	kg/s	0.076
Stoichiometric exhaust gas flowrate (wet)	Nm^3/s	0.896
Stoichiometric exhaust gas flowrate (dry)	Nm^3/s	0.792
Exhaust gas temperature	^oC	430
Exhaust gas oxygen content	%,dry	9.5
Exhaust gas flowrate (STP)	Nm^3/s	1.554
Exhaust gas flowrate (actual)	m^3/s	4.002
Flue diameter	m	0.4
Exhaust gas velocity	m/s	31.8

Table 3.15 provides the above information, although it does not include the exhaust gas volume flowrate at actual conditions. This table is updated in Table AD1.1 to include the exhaust gas volume, oxygen content and calculated water vapour content for each engine.

Table AD1.1 Exhaust gas conditions for stationary engines

Equipment	Oxygen content (%,dry)	Water vapour content (%)	Temperature (^oC)	Actual volume flowrate (m^3/s)	Velocity (m/s)
Lighting	10.0	6.6	150	0.012	0.7
Welfare unit	10.0	6.6	150	0.024	3.0
Surface conductor rig	10.0	6.6	550	0.672	21.4
Generator	10.0	6.6	550	1.315	18.6
Rig engine (3 units)	9.5	6.9	430	4.002	31.8
Rig ancillaries	10.0	6.6	150	0.349	11.1
Workover rig	10.0	6.6	550	1.329	18.8
Oil heater	8.6	7.4	150	0.500	5.2
Crane	10.0	6.6	150	0.691	22.0

For the lighting units (A) which comprise 4 small generators, the release is combined into a single point source with an assumed flue diameter of 0.15m.

The oil heater (I) is not an engine, but is diesel fuelled. The same principles as above have been applied for the determination of volumetric flowrates, although discharge rates are determined using emission factors for diesel combustion on the basis of mass per mass of diesel (US EPA AP42, 1.3).

AD1.2.2 Construction vehicles

The fleet of vehicles for construction and restoration operations are described in Table G.1. All vehicles are diesel fuelled.

Releases from these are based on the non-road vehicle emissions standards claimed within the manufacturer's specifications. Similar to the stationary engines, these are based on the net power of the

engine, As an example consider the 14 t excavator (A1 in Table G.1) with a declared net power of 78.5 g/kWh and compliance with EU Stage 4 emission standards:

Substance		Carbon monoxide	Nitrogen oxides	Hydrocarbons	Particulate matter
EU Stage 4 standards (56-130 kW)	g/kWh	5	0.4	0.19	0.025
Mass emission	g/h	393	31.4	14.9	2.0
	g/s	0.109	0.0087	0.0041	0.0005

The above details are provided for all construction vehicles in Tables 3.16 and 3.17.

The full load fuel consumption for each vehicle is based on the industry standard brake specific fuel consumption of 0.21 kg/kWh. In the case of the 14t excavator (A1), the fuel consumption is determined to be 16.5 kg/h.

The fuel consumption is used to determine the volumetric exhaust gas flow. It is also used to estimate the discharge of sulphur dioxide based on an assumed sulphur content for ultra-low sulphur diesel of 10 mg/kg.

Based on the same diesel specification as in AD1.2.1, an assumed oxygen content in the flue gas of 10% (dry) and an exhaust temperature of 150°C, the exhaust gas volume at actual conditions are determined.

14t Excavator (A1)

Full load fuel consumption	kg/h	16.5
	kg/s	0.0046
Exhaust gas temperature	°C	150
Exhaust gas oxygen content	%,dry	10
Exhaust gas flowrate (actual)	m^3/s	0.136

The above calculation methodology is applied to all construction vehicles. Table AD1.2 summarises this for vehicle fleet.

Table AD1.2 Exhaust gas conditions for construction vehicles

Vehicle	Gross power (kWh)	Oxygen content (%,dry)	Water vapour content (%)	Temperature (°C)	Actual volume flowrate (m^3/s)	Velocity (m/s)
14 t excavator (Hitachi)	78.5	10.0	6.6	150	0.136	-
14 t excavator (Cat)	122	10.0	6.6	150	0.211	
Dozer	120	10.0	6.6	150	0.208	
9t dumper	55.4	10.0	6.6	150	0.192	
13t sheeps roller	115	10.0	6.6	150	0.398	
Roller	24.6	10.0	6.6	150	0.085	
Concrete pump truck	240	10.0	6.6	150	0.415	
Total construction phase	-	-	-	-	1.644	23.3
Total restoration phase					0.554	17.6

The construction and restoration vehicles fleets are considered as combined single point sources with flue diameters of 0.3m and 0.2m respectively.

AD1.2.3 Heavy duty vehicles

Heavy duty vehicles (HDV) entering and leaving site are assumed to idle on site for a period of one hour during each visit. Table 3.18 sets out in detail the derivation of emission factors (kg/h) and fuel consumption (l/h) for vehicle idling. This and the vehicles' movement inventory in Table 3.19 are the basis for the determined pollutant discharge rates in Table 3.20.

The assessment makes a simplifying assumption using a constant HDV idling rate based on around double the maximum hourly idling rate in any of the phases of the operation. This is applied to all phases on a continuous 24 hour per day basis for the duration of the proposed development. In this case a continuous idling rate for HDVs of 2.5 vehicles per hour is assumed, giving a diesel fuel consumption of 4.8 l/h.

The HDV release is treated as a combined point source release with a flue diameter of 0.1m. Based same diesel specification as in AD1.2.1, an assumed oxygen content in the flue gas of 10% (dry) and an exhaust temperature of 150°C, the exhaust gas volume at actual conditions is determined in Table AD1.3

Table AD1.3 Exhaust gas conditions for heavy duty vehicles

Property		Value
Idling rate	vehicles/h	2.5
Fuel consumption during idling	l/h	4.8
	kg/s	0.00116
Exhaust gas temperature	°C	150
Exhaust gas oxygen content	%,dry	10
Exhaust gas water vapour content	%	6.6
Exhaust gas flowrate (actual)	m^3/s	0.038
Combined exhaust diameter	m	0.1
Combined exhaust gas velocity	m/s	4.9

AD1.2.4 Flare

Pollutant releases from the operation of the flare (H in Table G.1) are based on standard emission factors and the produced natural gas consumption as shown in Tables 3.10 and 3.11. The gas consumption is based on Europa's declared maximum disposal rate and is applied as a continuous release over the period designated for well testing.

The corresponding exhaust gas conditions are based on this maximum disposal rate and the gas composition declared by Europa in Table 3.9, and determined by combustion calculation. Table AD1.4 provides more comprehensive details of the calculation.

The exhaust gas temperature (1000°C) is the minimum specified by the manufacturer and the diameter of the flare stack (2.0m) is based on the manufacturer's specification. An exhaust gas oxygen content of 10% is consistent with previous measurements on this equipment.

Table AD1.4 Exhaust gas conditions for the flare

Property		Value
Disposal rate	MMscfd	4.0
	Nm^3/s	1.24
Stoichiometric flue gas volume (dry)	m^3/m^3 gas	8.78
Stoichiometric flue gas volume (wet)	m^3/m^3 gas	10.82
Exhaust gas oxygen content	%, dry	10.0
Exhaust gas water vapour content	%	10.8
Exhaust gas temperature	°C	1000
Exhaust gas flow (STP)	Nm^3/s	23.4
Exhaust gas flow (actual)	m^3/s	109.1
Exhaust diameter	m	2.0
Velocity	m/s	34.7

N Ford
20 August 2025

END