

Shell Penguins – Stack Monitoring Plan

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Prepared for: Shell UK Limited

Prepared by:



26 Albyn Place, Aberdeen AB10 1YN

Tel: [REDACTED]

Fax: [REDACTED]

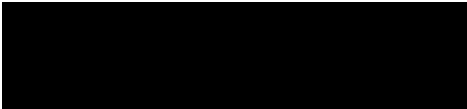
www.genesisoilandgas.com

Project Title: J75738D– Penguins Permit Application Support

Document Number: 204226C-004-RT-6200-0039-1

Date: March 2024

Rev	Date	Description	Issued by	Checked by	Approved by	Client Approval
1A	16/01/2024	Issued for internal Review	■	■		
A	19/01/2024	Issued for client comment	■	■	■	
1B	05/02/2024	Issued for internal review	■			
B	12/02/2024	Issued for client review	■	■		
0	23/02/2024	Issued for client use	■	■	■	
1	01/03/2024	Issued for client use	■	■	■	





PENGUINS STACK MONITORING PLAN

ENVIRONMENTAL PERMIT DOCUMENT

Project	Penguins PPC Permit
Originating company	Shell UK Limited
Document type	Environmental Permit Document
Security Classification	Unrestricted
Issue Date	01//03/2024

Rev #	Date of Issue	Status Description	Originator	Checker	Approver (role)
R01	28/04/2023	Issued for Use	[REDACTED]	[REDACTED]	[REDACTED]
RO2	05/02/2024	Issued for internal review	[REDACTED]		
R03	22/02/2024	Issued for client use	[REDACTED]		
R04	04/03/2024	Issued for client use	[REDACTED]		

Rev	Date	Details
R01	28/04/2023	Issued for Use
R01	05/02/2024	Issued for internal review
R03	22/02/2024	Issued for client use
R04	04/03/2024	Issued for client use



DOCUMENT DESCRIPTION

The purpose of this document is to support the Pollution Prevention and Control (PPC) Subsidiary Application Template (SAT) submission for the Penguins installation (PPC/282) and provides details of the monitoring programme as required under the Offshore Combustion Installations (Pollution Prevention and Control) (PPC) Regulations 2013 (as amended), which transpose the Industrial Emissions Directive 2010/75/EU (IED).

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ABBREVIATIONS

BS	British Standard
CEN	European Committee for Standardization
CO	Carbon Monoxide
DESNZ	Department of Energy Security and Net Zero
EEMS	Environmental Emissions Monitoring System
EA	Environment Agency
EN	European Standard
EU	European Union
FPSO	Floating, Production, Storage and Offloading
GTG	Gas Turbine Generator
ISO	International Standards Organisation
MAT	Master Application Template
MCERTS	Monitoring Certification Scheme
MW	Megawatt
MW(th)	Megawatt (thermal)
NO_x	Oxides of Nitrogen
PPC	Pollution Prevention and Control
SAT	Subsidiary Application Template
SO₂	Sulphur Dioxide
SSP	Site Specific Protocol
UHCs	Unburnt Hydrocarbons
VOC	Volatile Organic Compounds



1. INTRODUCTION

This plan supports the Pollution Prevention and Control (PPC) Subsidiary Application Template (SAT) submission for the Penguins Floating Production, Storage and Offloading (FPSO) vessel and provides details of the monitoring programme as required under the Offshore Combustion Installations (Pollution Prevention and Control) Regulation 2013 (as amended).

As part of the PPC permit conditions the permit holder must undertake a monitoring programme to achieve several goals:

- To determine the levels of the polluting substances in the emissions from the combustion equipment authorised under the permit;
- To determine the suitability of the emissions factors used to calculate the total annual emissions of the polluting substances;
- To determine the suitability of emissions projections that form the basis of the total permitted annual emissions; and
- To determine the efficiency of the monitored combustion equipment.

Proposed plans for stack monitoring are described within Section 2 of this document. The results of the monitoring programme will be used to establish relationships between load and emissions. The emissions factors derived from monitoring data will be compared to those used for annual emissions reporting.

1.1. PPC REPORTING

The standard Environmental Emissions Monitoring System (EEMS) and PPC reporting format are used for monitoring the consumption of resources and emissions to air.

2. STACK MONITORING REQUIREMENTS

2.1. POLLUTANTS

The primary emissions to air monitored from combustion plant under offshore PPC are oxides of nitrogen (NO_x), carbon monoxide (CO), sulphur dioxide (SO₂) and volatile organic compounds (VOCs, otherwise known as unburnt hydrocarbons, UHCs).

2.2. COMBUSTION EQUIPMENT

Emissions monitoring will be carried out for all primary combustion units (electricity generation or heat generation) in continuous use. Equipment of minor relevance to annual emissions are not required to be monitored (DESNZ,2016). For the Penguins FPSO, the combustion equipment which are anticipated to satisfy the criteria for emissions monitoring are summarised in Table 2-1 It should be noted that it is anticipated that following the commissioning period, the diesel engines associated with the firewater pumps and emergency generators will only be used in emergencies and furthermore, will normally operate for less than 500 hours per annum; therefore, stack monitoring will not be carried out for these items of combustion plant.

The design and location of sample points and appropriate measurement techniques are discussed in the Department for Energy Security and Net Zero (DESNZ,2013), formerly the Department for Business, Energy and Industrial Strategy (BEIS) Offshore PPC (Combustion Plant) Emissions Monitoring Guide (DESNZ, 2013, updated Aug 2023).



Table 2-1 Penguins FPSO Relevant Combustion Equipment to be Monitored

Emission Source Description	Tag Number	Maximum Rated Output (MW)	Maximum Thermal Rated Output (MW _{th})	Sample Point	Drawing Number
Solar Taurus 70 Gas Turbine Generators	EG8001A	8,600 ⁽⁴⁾	23.926 ⁽²⁾	41-MV-185/187	PRD-PT-TOPS-41-E-PX-2365-00003-001
Solar Taurus 70 Gas Turbine Generators	EG8001B	8,600 ⁽⁴⁾	23.926 ⁽²⁾	41-MV-189/191	PRD-PT-TOPS-41-E-PX-2365-00004-001
Solar Taurus 70 Gas Turbine Generators	EG8001C	8,600 ⁽⁴⁾	23.926 ⁽²⁾	41-MV-193/195	PRD-PT-TOPS-41-E-PX-2365-00005-001
Solar Titan 130 HP Compressor Turbine	KG-2601	15,100 ⁽⁵⁾	41.92 ⁽³⁾	26SC003	PRD-PT-TOPS-26-E-PX-2365-00008-001

(1) Based on ISO Rating as per Turbine data sheet – 4A271-API616.
(2) Based on 31% Efficiency @ 15 °C (run 1) - Turbine data sheet – 4A271-API616.
(3) Turbine data sheet - 4A271-API616
(4) PRD-PT-GEN-00-E-PX-4814-00156 – GTG and EG POPM
(5) PRD-PT-GEN-00-E-PX-4814-00003 – HP Compressoer POPM

Note - For Emergency diesel generator (A-8401), Firewater pump diesel generators (A-7101A/B/C) and Inert Gas Generator A-6402 which are operated <500 hrs per annum, stack monitoring will not be carried out.

2.3. MCERTS

The Monitoring Certification Scheme (MCERTS) provides a framework of standards in relation to environmental monitoring and covers:

- The standards of performance that monitoring equipment must meet;
- The level staff must be qualified to; and
- Accrediting laboratories and inspecting sites in line with European and International standards.

Shell will use MCERTS qualified personnel and MCERTS accredited equipment and laboratories to support the Penguins FPSO installation offshore stack monitoring programme. However, it is acknowledged that offshore execution of the monitoring in line with every aspect of the relevant standards indicted in the MCERTS performance standards may not be possible given the constraints on offshore facilities.

2.4. MEASUREMENTS STANDARDS

The following hierarchy is generally applied to measurements standards:

- European Standard (EN)
- International Standard (ISO)
- National Standard (BS)
- Other recognised method

DESNZ requires best endeavours to carry out monitoring in line with MCERTS and the use of Standard CEN/ISO measurements techniques for the main pollutants. EN 15259:2007 is one of the key standards for offshore stack monitoring. EN 15259 is the standard for “Stationary source emissions – Requirements for measurements sections and sites and for the measurement objective, plan and report” (BS EN, 2007).

Accreditation of the test organisation to EN 17025 (ISO, 2017) is commonplace, and is mandatory for organisations undertaking compliance and check monitoring of IED sites onshore.

An important aspect of exhaust stack monitoring is to obtain a representative sample from the exhaust stack. To achieve this, there are requirements around ensuring homogeneous flow at the sample location and in



relation to the number of samples required. EN 15259:2007 sets out appropriate sampling strategies i.e. number and positioning of sample points, for circular and rectangular ducts of different sizes.

The MCERTS specification for portable monitoring equipment sets the criteria for two equipment “types”. The portable stack gas analysers will meet the Type II equipment accuracy and repeatability standards given in the Environment Agency (EA) Performance Standard (MCERTS) (EA, 2005) as far as is practicable offshore, considering structural, access, cost and safety restrictions on the platform. A Type I system would require calibration gases and is considered only semi-portable for offshore use but will obtain more accurate results.

According to MCERTS standards, monitoring should incorporate the use of on-site calibration gases to verify measurement data before and after a test run, using competent personnel & suitable test procedures.

2.5. METHODOLOGY APPROACH

The methodology for the monitoring programme will comply with all relevant internal HSE standards and procedures. Shell will ensure that MCERTS qualified personnel will be appointed to conduct the stack monitoring testing. Prior to conducting the testing, a site review, followed by a site-specific protocol (SSP) shall be produced to detail the application of the techniques and methods in the standards to the specific requirements of the Penguins FPSO.

The SSP needs to convert the scope of the monitoring being conducted (e.g. baseline survey) into a practical measurement programme reflecting issues such as access, safety requirements and the duration of the tests. The SSP shall be submitted to DESNZ for review prior to carrying out any stack monitoring testing.

During the stack monitoring, emission analyses will be undertaken over a range of operating loads. The results will be used to establish relationships between load and emissions. The emission factors derived from the monitoring data will be compared to those used for annual emissions reporting.

The monitoring programme will be used to achieve the objectives highlighted in the introduction and to carry out adequate compliance monitoring, which are the conditions of the PPC permit set out by DESNZ. The monitoring programme will outline the approach to measure prescribed emission releases from individual release points for the main items of combustion equipment.

2.5.1. Sampling Facilities

For the sampling facilities, the key requirements (DESNZ) include; a sampling position as far away from flow disturbances (for example, bends and dampers) and joining ducts as possible to ensure homogenous flow. Grid sampling at multiple points on a grid across the stack measurement plane is used to determine if flow is homogenous.

Generally homogenous flow is generally achieved with at least 5 hydraulic diameters of straight duct upstream of the sampling plane and 2 hydraulic diameters downstream (5 hydraulic diameters from the top of a stack to avoid air entrainment). However, it is recognised that in the offshore context the selected locations will often be a compromise position between the ‘ideal’ and ‘readily accessible’ locations.

Sampling ports are required to access the exhaust gases and, where practicable, should be located to allow a traverse of the ducts across two diameters (to assess mixing at the sampling position). If only gaseous concentration measurements are required, then a minimum 1 inch BSP (British Standard Pipe) or NPT (National Pipe Thread, US Standard) socket and safe working access are all that are required. However, it should be noted that some test houses prefer a minimum 2 inch sockets to accommodate adequate tip prefilters when undertaking testing for diesel fuel. For gas turbines without heat recovery, a flange connection is recommended (flanges appear to be less prone to seizing). To avoid discharge of hot gases at the sampling position, an isolating valve is recommended for exhaust ducts which are at higher than ambient pressure.

The sample ports are available on the exhaust stacks of the waste heat units for the 3 x Solar Taurus 70 and the 1x Solar Titan 130 HP compressor power turbine as detailed in Table 2-1. It is recommended that suitability is confirmed during site review by MCERTS qualified personnel appointed to conduct the monitoring programme.



2.5.2. Frequency

The timing of implementing the monitoring programme will be agreed with DESNZ prior to undertaking any stack monitoring testing and within the timeframe specified in the PPC permit conditions. The programme must also be submitted to DESNZ for approval prior to undertake emission baseline testing.

A detailed baseline survey could result in a reduced requirement for subsequent monitoring depending on the quality of the survey itself (DESNZ, 2016).

The frequency and scope of the monitoring programme can be reviewed once an assessment of the results obtained is conducted and as per engagement / agreement with DESNZ.



3. REFERENCES

DESNZ (2016). Guidance Notes on The Offshore Combustion Installations (Pollution Prevention and Control) Regulations 2013 – Offshore Emissions Monitoring Guidance (Nov 2016).

BS EN (2007). British Standard BS EN 15259, Air Quality – Measurement of Stationary Source Emissions – Requirements for measurement sections and sites and for the measurement objective, plan and report.

ISO (2017). European Standard EN ISO/IEC 17025 General requirements for the competence of testing and calibration laboratories.

EA (2005). Environmental Agency “Performance Standards for Portable Systems for Emission Monitoring”, (MCERTS), Version 1.

PRD-PT-GEN-00-E-PX-4814-00003 – HP Compressoer POPM

PRD-PT-GEN-00-E-PX-4814-00156 – GTG and EG POPM