



REPORT

Petrojarl Rosebank FPSO Environmental Assessment Justification



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Project Title: Rosebank Production Master Application Template (PRA/352)
Document / Rev No.: 218536C-001/B
Client Document No.: PJR-AIP-S-RA-0007

Rev	Date	Description	Issued by	Checked by	Approved by	Client Approval
1A	28/10/2025	Issued for internal review	█	█ █	█	
A	05/11/2025	Issued to Client for review	█	█ █	█	
1B	15/12/2025	Issued for internal review	█	█	█	
B	22/12/2025	Issued to Client	█	█	█	█



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ABBREVIATIONS

Acronym/ Abbreviation	Description
>	More Than
≥	More Than or Equal To
<	Less Than
≤	Less Than or Equal To
%	Percentage
bbl	Barrels of Oil
c.	Circa / Approximately
bbl/d	Barrels of Oil per Day
km	Kilometre
kW	Kilowatt
l	Litres
m	Metre
m/s	Metres per second
m ²	Square metre
m ³	Cubic metre
MMscf	Million standard cubic feet (of gas)
MMscf/d	Million standard cubic feet (of gas) per day
mg	Milligrams
MW	Megawatt
MWth	Megawatt thermal
nm	Nautical miles
ppm	Parts per million
te	Tonnes
AFEN	Atlantic Frontier Environmental Network
AHV	Anchor Handling Vessel
BAT	Best Available Technology
BDV	Blow Down Valves
BEIS	Department for Business, Energy and Industrial Strategy (now known as DESNZ)
BEP	Best Environmental Practice
CCA	Canonical Correspondence Analysis
CEFAS	Centre for Environment, Fisheries and Aquaculture
CFU	Compact Flotation Unit
CH ₄	Methane
CHARM	Chemical Hazard and Risk Management
CL	Consent to Locate Permit
CO	Carbon Monoxide
CO ₂	Carbon Dioxide
CO ₂ e	Carbon Dioxide Equivalent
CP	Chemical Permit
DECC	Department of Energy and Climate Change (now DESNZ)
DESNZ	Department for Energy Security and Net Zero (formerly BEIS)
DLE	Dry Low Emissions
DGPS	Differential Global Positioning System
DWT	Deadweight Tonnage

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Acronym/ Abbreviation	Description
EAJ	Environmental Assessment Justification
EEMS	Environmental and Emissions Monitoring System
EPS	European Protected Species
ES	Environmental Statement
EUNIS	European Nature Information System
FPSO	Floating Production, Storage and Offloading Unit
FSS	Foundation Satellite Structure
FTS	Foundation Template Structure
GHG	Greenhouse Gas
GTG	Gas Turbine Generators
GWP	Global Warming Potential
HP	High Pressure
HUC	Hook-up and Commissioning
ICES	International Council for the Exploration of the Sea
IPCC	Intergovernmental Panel on Climate Change
IR	Infrared
ITOPF	International Tanker Owners Pollution Federation
JNCC	Joint Nature Conservation Committee
LAT	Lowest Astronomical Tide
LDAR	Leak Detection and Repair
LP	Low Pressure
LLP	Low Low Pressure
LV	Limit Value
MAH	Major Accident Hazard
MAT	Master Application Template
MCZ	Marine Conservation Zone
MEI	Major Environmental Incident
MGC	Motion Gyro Compass
MNAW	Modified North Atlantic Water
MPA	Marine Protected Area
MSFD	Marine Strategy Framework Directive
MU	Management Unit
MW	Megawatt
NAW	North Atlantic Water
N₂O	Nitrous Oxides
NAW	North Atlantic Water
NCMPA	Nature Conservation Marine Protected Area
NNS	Northern North Sea
NMFS	National Marine Fisheries Service
NMP	National Marine Plan
NMPi	National Marine Plan interactive
NO_x	Nitrogen Oxides
NSTA	North Sea Transition Authority (formerly OGA)
OCNS	Offshore Chemical Notification Scheme
OCR	Offshore Chemicals Regulations
OESEA	Offshore Energy Strategic Environmental Assessment

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Acronym/ Abbreviation	Description
OEUK	Offshore Energies UK (formerly OGUK)
OGA	Oil and Gas Authority (now the NSTA)
OGUK	Oil and Gas UK (now OEUK)
OIW	Oil in Water
OLP	OIL Discharge Permit (Life Permit)
OPEP	Oil Pollution Emergency Plan
OPPC	Oil Pollution Prevention and Control
OSD	Offshore Safety Directive
OSPAR	The Convention for the Protection of the Marine Environment of the North-East Atlantic
OVID	Offshore Vessel Inspection Database
PCV	Pressure Control Valve
PLA	Pipelines Application (MAT)
PMF	Priority Marine Feature
PNEC	Predicted No Effects Concentration
PPC	Pollution Prevention and Control
PSV	Pressure Safety Valve
PVA	Particularly Valuable Area
ROV	Remotely Operated Vehicle
RQ	Risk Quotient
SAC	Special Area of Conservation
SAT	Subsidiary Application Template
SCANS	Small Cetacean Abundance in the North Sea and Adjacent waters
SCI	Sites of Community Importance
SEA	Strategic Environmental Assessment
SEEMP	Ship Energy Efficiency Management Plan
SERPENT	Scientific and Environmental ROV Partnership using Existing Industrial Technology
SHEFA	SHEtland-FARoes fibre optic cable
SMRU	Sea Mammal Research Unit
SNH	Scottish National Heritage (now NatureScot)
SO₂	Sulphur Dioxide
SO_x	Sulphur Oxides
SOLAS	Safety of Life at Sea
SOSI	Seabird Oil Sensitivity Index
SOPEP	Shipboard Oil Pollution Emergency Plan
SPA	Special Protection Area
SRU	Sulphate Removal Unit
TEG	Triethylene glycol
THC	Total Hydrocarbon Content
TOC	Total Organic Carbon
UK	United Kingdom
UKCS	United Kingdom Continental Shelf
UKOOA	United Kingdom Offshore Operators Association
UPS	Uninterrupted Power Supply
VAMS	Video-Assisted Multi Sampler

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Acronym/ Abbreviation	Description
VMS	Vessel Monitoring System
VOC	Volatile Organic Compounds
VRU	Vapour Recovery Unit
WFD	Water Framework Directive
WHRU	Waste Heat Recovery Unit
WOS	West of Shetland
WOSE	West of Shetland Operators Electrification Workgroup
WOSPS	West of Shetland Pipeline Systems

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1.0 INTRODUCTION

1.1 Project Overview

The Rosebank field is located in the Faroe-Shetland Channel, on the north-western edge of the United Kingdom Continental Shelf (UKCS), as shown in Figure 1-1. The location is approximately 130 km north-west of Shetland, in a water depth of around 1,100 m. The field spans UKCS Blocks 213/26b and 213/27a, Block 205/1a, and Block 205/2a.

The Rosebank Development is a project involving the drilling of subsea wells in the Rosebank field to extract oil and gas. The wells will be connected by new flowlines to a redeployed Floating Production Storage and Offloading (FPSO) vessel where the hydrocarbons will be processed. The gas will be exported from the Petrojarl Rosebank FPSO (hereafter referred to as the Rosebank FPSO) via a new gas export pipeline to the existing West of Shetland Pipeline Systems (WOSPS). The oil will be offloaded from the Rosebank FPSO using tankers. The Rosebank FPSO will be located in Block 205/2a at the co-ordinates shown in Table 2-1.

The Rosebank Development Environmental Statement (ES) (reference number ES/2022/001), submitted by Equinor U.K. Limited (Equinor) on 3rd August 2022 (Equinor, 2022a), was approved by the Department for Energy Security and Net Zero (DESNZ) on 16th June 2023. The Rosebank Field Development Consent was granted by the North Sea Transition Authority (NSTA) in September 2023.

The Rosebank field is operated by Adura Operations Limited (Adura) (previously Equinor prior to the recent integrated joint venture of Equinor and Shell) under a joint venture agreement with Ithaca Siccar Point Exploration and Production (SP E&P) under an 80/20 split. The Rosebank FPSO (from the base of the risers) will be operated by Golar-Nor (UK) Limited (part of the Altera Infrastructure Group). The Rosebank FPSO will be towed to field and hooked up in May 2026. Testing and preparing the Rosebank FPSO and pipeline for production is anticipated to take six to seven months. First production is expected in the fourth quarter of 2026.

The conceptual field layout for Phase 1 of the Rosebank Development is shown in Section 2, Figure 2-2.

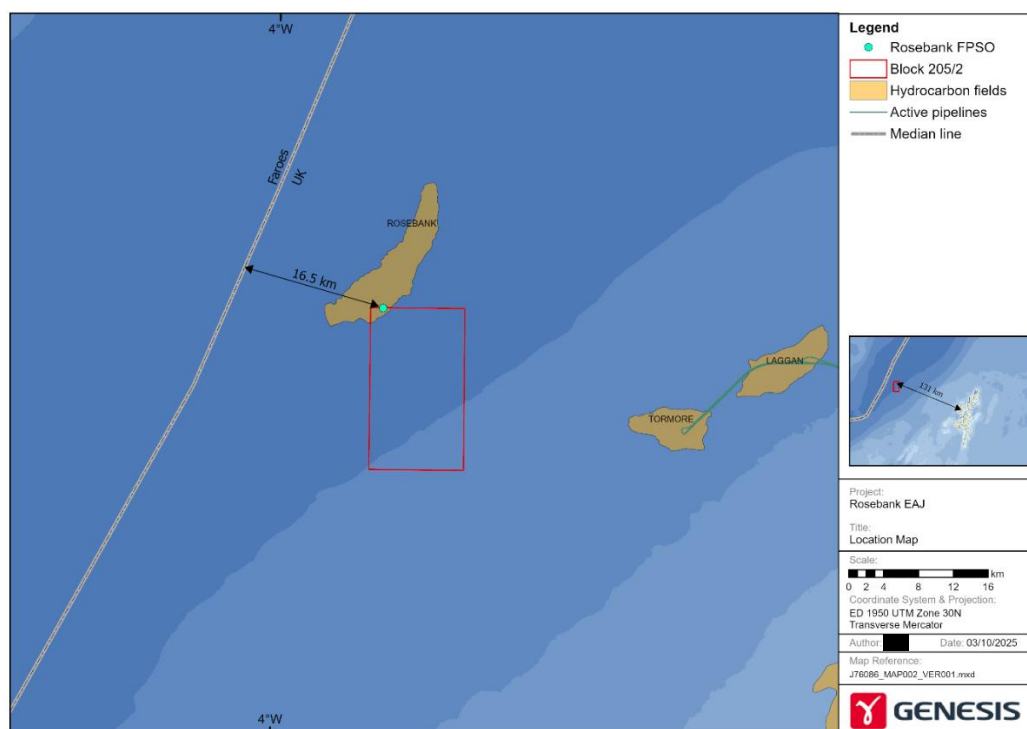


Figure 1-1 Rosebank Field Location

1.2 Purpose and Scope of the Environmental Assessment Justification

A Master Application Template (MAT) application requires the submission of an Environmental Assessment Justification (EAJ) document. The EAJ provides information on the project, the environmental sensitivities description, and any likely significant environmental effects of the project, as required by Schedule 4 of The Offshore Oil and Gas Exploration, Production, Unloading and Storage (Environmental Impact Assessment) Regulations 2020.

The EAJ also contains information required by law which includes (but is not limited to) the contents and requirements of permit applications, including information related to the carrying out an assessment of the risk of harm to the environment from the activities, as required under The Offshore Petroleum Activities (Oil Pollution Prevention and Control) 2005 (as amended) (Regulation 5); The Offshore Chemical Regulations 2002 (as amended) (Regulation 6); The Offshore Combustion Installations (PPC) Regulations 2013 (as amended) (Regulation 4); and The Energy Act 2008 (Part 4a).

This section documents previous MAT applications associated with preparatory works prior to the FPSO being brought on location, as well as outlining the scope of the current MAT application.

As agreed with DESNZ, a Production Operations MAT (PRA/325) was initially set up by Equinor (now Adura) for the work scopes involving the wet storage of the FPSO mooring lines and the installation of a number of anchors (riser suction pile anchors and mooring line suction pile anchors) and foundation structures. These work scopes are summarised below:

- A Consent to Locate under Part 4a of The Energy Act 2008 (CL/1460), submitted by Equinor (now Adura) for the following: 6 No. Hold Down Riser Suction Piles (RSP); 6

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No. Hold Back Riser Suction Piles (RSP); 3 No. Foundation Template Structures (FTS) at B, C and D; 3 No. Foundation Satellite Structures (FSS) at I, J and K. The riser suction piles and foundation satellite structures will remain *in situ* throughout field life. This Consent to Locate has been surrendered, and the infrastructure now covered by CL/1552 under PLA/1126.

- A Consent to Locate under Part 4a of The Energy Act 2008 (CL/1540) submitted by Equinor (now Adura) for the following: 12 suction pile anchors for the Rosebank FPSO mooring lines; wet storage of 12 FPSO mooring lines, and the use of sandbags for stabilisation. The mooring lines will remain in wet storage until the Rosebank FPSO arrives on location.

The Production Operations MAT has now been transferred to the operatorship of Golar-Nor (UK) Limited (now PRA/352). Table 2-2 provides a summary of which work scopes have already been completed, and which work scopes are to be completed as part of the FPSO installation under PRA/352. This EAJ supports the following Subsidiary Application Templates (SATs) for the FPSO installation and commissioning work scopes:

- A Consent to Locate under Part 4a of The Energy Act 2008 for a Permanent/Fixed Structure. This covers the 12 mooring line suction pile anchors for the Rosebank FPSO, as these are now the responsibility of Golar-Nor (UK) Limited.
- An Offshore Combustion Installation Permit under the Offshore Combustion Installations (Pollution Prevention and Control) (PPC) Regulations 2023 (as amended).

In addition, the following SATs will be applied for under PRA/352 in 2026 (in future variations):

- A Consent to Locate under Part 4a of The Energy Act 2008 for a Permanent/ Fixed Installation. This will cover the installation of the Rosebank FPSO and will be applied for prior to the FPSO arriving on station;
- A Screening Direction under the Offshore Petroleum Production and Pipelines (Assessment of Environmental Effects) Regulations 1999 (as amended) for the production of hydrocarbons;
- A Chemical Permit (CP) application for the use and discharge of chemicals under the Offshore Chemicals Regulations 2002 (as amended);
- An Oil Discharge Permit (OLP) under the Offshore Petroleum Activities (Oil Pollution Prevention and Control) Regulations 2005 (as amended).

The Production Operations MAT (PRA/352) is the production MAT for the Rosebank field throughout the lifetime of the field and will be updated to reflect future work scopes and operations.

The other field development activities such as drilling of the Rosebank wells and installation of all pipelines, flowlines and umbilical's will be covered under separate MAT applications made by Adura.

1.3 National Marine Plan

Scotland's National Marine Plan (NMP) covers the management of both Scottish inshore waters (out to 12 nautical miles) and offshore waters (12 to 200 nautical miles) (Scottish Government, 2015). The aim of the NMP is to help ensure the sustainable development of the marine area through informing and guiding regulation, management, use and protection of the NMP areas.

The NMP also sets out general policies and objectives as part of the UK's shared framework for sustainable development. In accordance with the DESNZ Guidance, the operations as described in this EAJ document have been assessed against all NMP objectives and policies, but specifically GEN 1, 4, 5, 9, 12, 13, 14 and 21:

GEN 1 - General Planning and Principle

Development and use of the marine area should be consistent with the Marine Plan, ensuring activities are undertaken in a sustainable manner that protects and enhances Scotland's natural and historic marine environment.

GEN 4 - Co-existence

Where conflict over space or resource exists or arises, marine planning should encourage Initiatives between sectors to resolve conflict and take account of agreements where this is applicable.

GEN 5 - Climate Change

Marine planners and decision makers should seek to facilitate a transition to a low carbon economy. They should consider ways to reduce emissions of carbon and other greenhouse gasses.

GEN 9 - Natural Heritage

Development and use of the marine environment must:

- Comply with legal requirements for protected areas and protected species.
- Not result in significant impact on the national status of Priority Marine Features (PMFs).
- Protect and, where appropriate, enhance the health of the marine area.

GEN 12 – Water Quality and Resource

Developments and activities should not result in a deterioration of the quality of waters to which the Water Framework Directive (WFD), Marine Strategy Framework Directive (MSFD) or other related Directives apply.

GEN 13 - Noise

Development and use in the marine environment should avoid significant adverse effects of man-made noise and vibration, especially on species sensitive to such effects.

GEN 14 – Air Quality

Development and use of the marine environment should not result in the deterioration of air quality and should not breach any statutory air quality limits.

GEN 21 – Cumulative Impacts

Cumulative impacts affecting the ecosystem of the marine plan area should be addressed in decision making and plan implementation.

Assessment of compliance against relevant policies is achieved through the impact assessment in this document (Environmental and Socio-Economic Impact Assessment). The proposed operations do not contradict any of the NMP objectives and policies.

1.4 Oil and Gas Sector Specific Policies

In addition to the above general policies, the objectives and policies for the oil and gas sector were addressed. They should be read subject to those set out in Annex B and Chapter 4 of the NMP. It is recognised that not all of the objectives can necessarily be achieved directly through the marine planning system, but they are considered important context for planning and decision making.

Oil and Gas 1 - Environmental Risks & Impacts

The Scottish Government will work with DESNZ, the NSTA and the industry to maximise and prolong oil and gas exploration and production whilst ensuring that the level of environmental risks associated with these activities are regulated. Activity should be carried out using the principles of Best Available Technology (BAT) and Best Environmental Practice (BEP). Consideration will be given to key environmental risks including the impacts of noise, oil and chemical contamination and habitat change.

Oil and Gas 2 – Decommissioning

Where re-use of oil and gas infrastructure is not practicable, either as part of oil and gas activity or by other sectors such as carbon capture and storage, decommissioning must take place in line with standard practice, and as allowed by international obligations. Re-use or removal of decommissioned assets from the seabed will be fully supported where practicable and adhering to relevant regulatory process.

Oil and Gas 3 - Other Users of the Sea

Supporting marine and coastal infrastructure for oil and gas developments, including for storage, should utilise the minimum space needed for activity and should take into account environmental and socio-economic constraints.

Oil and Gas 4 - Aeronautical Constraints

All oil and gas platforms will be subject to 9 nautical mile consultation zones in line with Civil Aviation Authority guidance.

Oil and Gas 5 - Potential Environmental Risk & Hazards

Consenting and licensing authorities should have regard to the potential risks, both now and under future climates, to oil and gas operations in Scottish waters, and be satisfied that installations are appropriately sited and designed to take account of current and future conditions.

Oil and Gas 6 - Risk Reduction Measures

Consenting and licensing authorities should be satisfied that adequate risk reduction measures are in place, and that operators should have sufficient emergency response and contingency strategies in place that are compatible with the National Contingency Plan and the Offshore Safety Directive.

2.0 PROJECT DESCRIPTION

2.1 Overview

As described in Section 1, the Rosebank FPSO will be located in Block 205/2a in the Faroe-Shetland Channel on the north-western edge of the UKCS. The location is c.130 km north-west of Shetland, 16.5 km from the UK/Faroes median line, and c.31 km from the nearest oil and gas field in the west of Shetland area. The geographical co-ordinates of the Rosebank FPSO location are shown in the table below.

Table 2-1 Rosebank FPSO Co-ordinates

	UKCS BLOCK	LATITUDE ED50	LONGITUDE ED50
Rosebank FPSO	205/2	60° 59' 58.067" N	3° 46' 25.425" W

The Rosebank FPSO, shown in Figure 2-1, will be redeployed from its previous use on the Knarr field on the Norwegian Continental Shelf to the Rosebank Development after modifications have been carried out to meet the Rosebank process requirements. Once on location, it will be designated as an installation with a 500 m safety zone on the UKCS and subject to all laws, regulations and practices required of a UK oil and gas producing facility and workplace.



Figure 2-1 The FPSO which will be redeployed at Rosebank.

The Rosebank Development will produce via subsea production well templates (three times four slot templates B, C and D shown in Figure 2-2) and flexible risers to the FPSO. The Development is divided into phases, whereby seven wells will be drilled in Phase 1 and up to

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five wells will be drilled in Phase 2. Information about the reservoir and drilling, acquired during Phase 1, will be used to optimise the plans for Phase 2. Field installation activities will commence from 2024 and continue through 2026.

Oil will be off-loaded from the Rosebank FPSO using tankers, and gas will be exported via a new offshore gas export pipeline to tie into the existing WOSPS pipeline at the Clair Tee. There is no planned routine overboard discharge of produced water and no planned routine flaring. The FPSO will connect to the SHEFA-2 (Shetland-Faroes) fibre optic cable which also provides data communications routing to other west of Shetland (WoS) operators.

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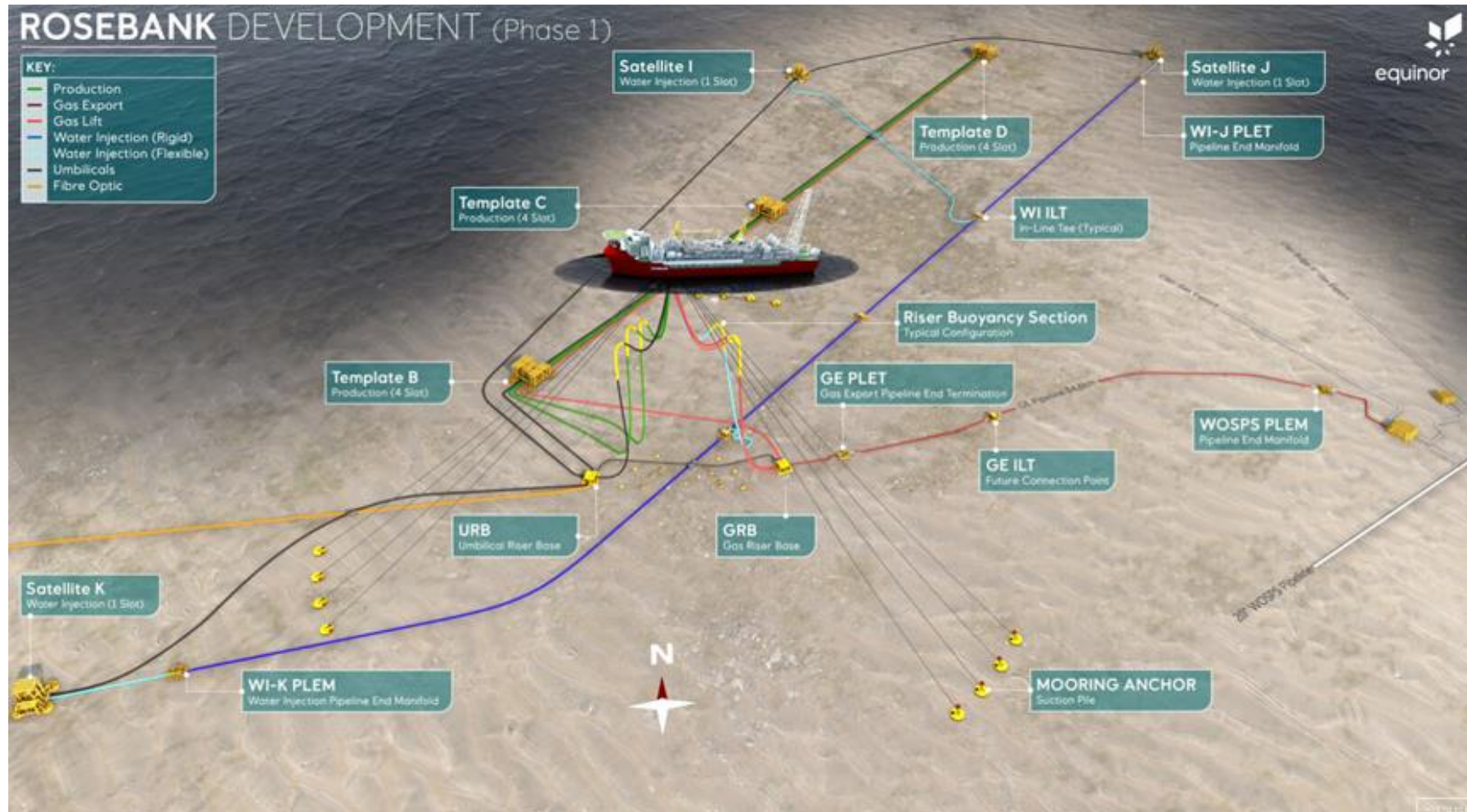


Figure 2-2 Rosebank Phase 1 Conceptual Field Layout

2.2 FPSO Installation

This section relates to the Consent to Locate under Part 4a of the Energy Act 2008 for the installation of the Rosebank FPSO (CL/1461).

Although Adura is responsible for towing the Rosebank FPSO from the second layup location in Norway to the Rosebank field location and hooking it up to the 12 pre laid mooring lines and risers once it arrives on location, Golar-Nor (UK) Limited as the Duty Holder has overall responsibility for these work scopes. The FPSO is considered storm safe when hooked up with 6 mooring lines (2 from each mooring cluster). Once the FPSO is on site, a 500 m safety zone will be applied, excluding fishing vessels from a 0.8 km² area. The safety zone around the FPSO will extend from the extremities of the centre of the turret.

2.2.1 Items on the Seabed

Table 2-2 details which work scopes involving items placed on the seabed have been completed prior to the FPSO arrival and which work scopes involving removal of items placed on the seabed will be carried out as part of the FPSO installation operations under PRA/352.

A description of the installation of the mooring line suction pile anchors and wet storage of the mooring lines and associated impacts were covered in the Adura permit PRA/325 CL/1540. The 12 mooring line suction pile anchors are part of the FPSO's mooring system and are therefore included on the PRA/352 consent to locate as these are now the responsibility of Golar-Nor (UK) Limited.

During the pre-lay of the FPSO mooring lines, turning bollards comprising 4 x 1 tonne sand bags ("salt sacks") for each mooring line (48 in total) were used during the wet storage operations to stabilise and guide the pre-installation configuration of the mooring lines. The bollards have remained in-situ during the period of wet storage and will be used in the reverse-lay hook-up procedure when the FPSO arrives at the field in 2026. During the hook up procedure, the mooring lines will be lifted and connected to the FPSO. The connected mooring lines will span over the bollard locations, and recovery of the complete bollard assembly (via crane wire and Remotely Operated Vehicle (ROV) tether management system) presents a risk of entanglement and damage to the connected moorings. To minimise these risks, it is planned to deploy an ROV to cut the sand bags and deposit the sand on the seabed before lifting the bags.

The current area impacted by the wet storage of the turning bollards is 70m² (see Table 2-2). The sand will be deposited at the bollard location and no additional impact over and above the 70m² from bollard placement is expected.

Nine on-bottom stability bollards comprising 1 tonne "salt sacks" (1.2 m x 1.2 m) containing inert sand to weigh down and stabilise each of the twelve mooring lines (108 in total) were used during the period of wet storage to prevent movement and abrasion of the lines on the seabed. These will be recovered during the hook up of the FPSO to the mooring lines under this PRA MAT.

Table 2-2 Summary of status of items on seabed associated with FPSO installation

Item	Status	Permit Ref	Seabed Footprint m ²
Riser suction pile anchors (x12)	Completed	PRA/325 CL/1460 – now transferred to PLA/1126	261
Mooring lines suction pile anchors (x12)	Completed	PRA/325 CL/1540	711
Wet store of mooring lines (x12)	Completed	PRA/325 CL/1540	7,200
Temporary placement of clump weights (x12) and blast mats (x24)	Completed – items recovered	PRA/325 CL/1540	558
Temporary placement of turning bollards (x48)	Item deposition – complete Item recovery -to be completed during FPSO hook-up	PRA/325 CL/1540 PRA/352	70
Deposition of sand during turning bollard recovery	To be undertaken during FPSO hook-up	PRA/352	70
Temporary placement of stability bollards (x108)	Item deposition – complete Item recovery - to be completed during FPSO hook-up	PRA/325 CL/1540 PRA/352	156

2.2.2 Vessel Use for FPSO hook-up

The FPSO tow and hook-up campaign will utilise multiple vessels.

The FPSO will be towed to the Rosebank location by anchor handling vessels (AHVs). Once on location at Rosebank, the AHVs will be involved in hooking up the FPSO to the mooring lines and risers. There will also be an ROV support vessel present for the hook up operations.

The estimated vessel days and fuel use associated with the tow and hook up support vessels is shown in Table 2-3. This information is a best estimate at present and will be updated in a future variation prior to the FPSO arriving on station.

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Table 2-3 Support vessel fuel use.

Vessel Type	Number of days mob/demob	Fuel use mob/demob (te/day)	Number of days in transit	Fuel Use transit (te/day)	Number of days working	Fuel Use working (te/day)	Total Fuel Use (te)
AHV 1	2	3	7	50	34	18	968
AHV 2	2	3	7	50	34	18	968
AHV 3	2	3	7	50	34	18	968
ROV Support Vessel	2	3	7	22	34	18	772
Total fuel use							3,676
<p><i>Up to three AHV will tow the FPSO to the Rosebank location and will then be involved in the mooring line hook up operations. The number of days includes a 20% contingency for waiting on weather.</i></p>							

2.2.3 Moorings

The FPSO will be installed with twelve mooring lines positioned in three groups of four suction pile anchors and anchor chains; the moorings configuration is shown in Figure 2-3. The installation of the mooring line suction pile anchors and wet storage of the mooring lines were covered in the Adura permit PRA/325 CL/1540. The moorings will be connected to the geostationary FPSO turret, and the positions will be located on charts for information of mariners.

The mooring lines are composed of a 50 m long top chain made of a 130 mm diameter studless chain, a c. 2,000 m long polyester rope and a c. 550 m long 130 mm diameter studless chain (of which c. 500 m will lie on the seabed and 50 m will be buried in the seabed). Between the polyester rope and the bottom chain there is a buoy with 20 tonnes buoyancy that prevents the polyester rope from hitting the seabed.

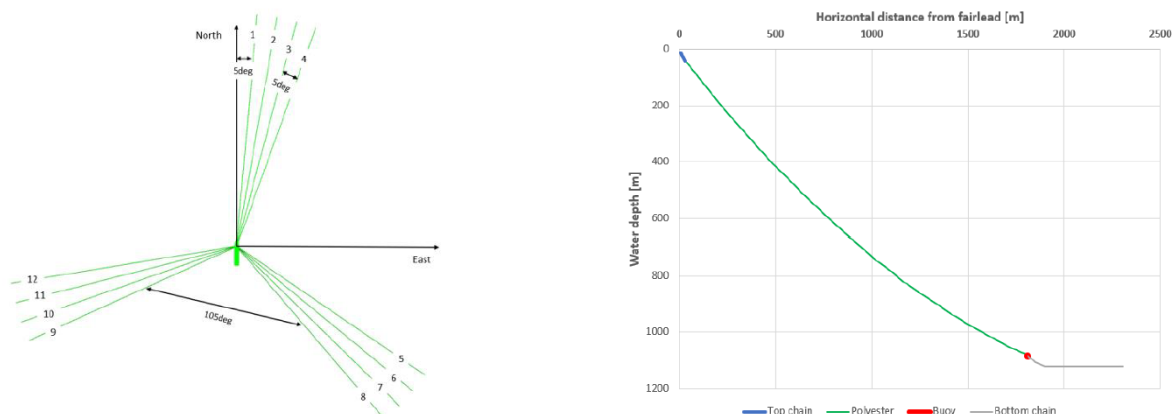


Figure 2-3 Diagram of the FPSO moorings configuration.

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2.2.4 FPSO Navigational Aids

The Rosebank FPSO is equipped with navigational aids as required by the Safety of Life at Sea (SOLAS) convention and other applicable international standards. These requirements are supplemented by systems provided to manage risks of vessel collision with the Rosebank FPSO.

The navigational aids and equipment includes:

- U-lights: Two primary white lights visible for 15 nautical miles (nm) and two secondary red lights visible for 10 nm. Each of the white lights has a reserve unit capable of operating for at least 96 hours from the uninterrupted power supply (UPS).
- Foghorn: The primary foghorn has a range of 2 nm; a secondary unit is provided with a range of 0.5 nm.
- Aircraft collision warning lights: 3 on each crane boom, 1 for each telecom mast, and 1 for the flare boom (and the flare tower is illuminated with floodlights in accordance with the CAP437 Regulations).
- Search lights x2.
- Helicopter 'Wave Off' lights at the helideck.
- Perimeter lights for the helideck. Helideck floodlights x4.
- Offloading position reference systems: Multiple and independent, both absolute and relative.
- Differential Global Positioning System (DGPS): The system is designed as a standalone wheel marked electronic position fixing system for the Rosebank FPSO that feeds into various installation systems. The DGPS has dual configuration with a back-up system in the event of failure of the primary system.
- Marine radar (x-band): with automatic radar plotting aid function.
- Motion gyro compass. (MGC).

2.3 Production Operation Activities

2.3.1 Overview

The Rosebank field measures approximately 20 km long by 5 km wide. The field was discovered in 2004 by well 213/27-1Z. The exploration and appraisal wells drilled to date have encountered high quality sandstones filled with a mix of light oil and gas. As production is planned from three reservoirs (Colsay-1, Colsay-3 and Colsay-4), the fluid properties (such as gas to oil ratio and density) will exhibit some variation across the field.

Produced water and treated seawater will be injected into the reservoir for pressure support and as enhanced oil recovery to maximise the recovery of the Rosebank field reserves. Downhole gas lift will be required for the production wells to reduce the start-up time of the well, increase the production rates, and maintain flow stability in the production flowlines. The Rosebank FPSO will be powered by dual fuel (field gas and diesel) generators from the start of production.

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2.3.2 Production Profiles

The predicted oil, gas, and water production figures are presented in Table 2-4 and the Phase 1 and Phase 2 profiles for the life of field are shown in Figure 2-4 and Figure 2-5 respectively.

The estimated start up from Phase 1 is expected to occur in Q4 2026 and therefore 2027 is the first full year of production. The production predictions are based on an ensemble of reservoir models which reflect the range of uncertainty in reservoir parameters. The oil and gas production presented represents the highest values¹ (production efficiency of 92% uptime) expected from the whole life of the Development and align with the application for development and production consent which have been submitted to the NSTA. The highest predicted hydrocarbon case represents the greatest potential for environmental impact and is therefore the most appropriate estimate on which to assess the environmental impact. The impact assessment presented in this EAJ (and all associated calculations such as air emissions calculations) have been carried out using the high oil case production values.

Table 2-4 Rosebank Phase 1 and 2 oil, gas and water production volumes based on high oil case production profile (Equinor, 2022a)

Year	Oil		Gas		Water	
	Tonnes*/day	Bbl/day	MMSm ³ /day	Mmscf/day	M ³ /day	Bbl/day
2026	2,584	19,188	0.47	16	0	0
2027	9,540	70,840	1.62	57	0	0
2028	9,540	70,840	1.67	59	23	144
2029	9,436	70,067	1.72	61	304	1,908
2030	9,090	67,490	1.72	61	577	3,629
2031	8,712	64,688	1.72	61	624	3,922
2032	9,389	69,716	1.66	58	1,823	11,461
2033	8,895	66,045	1.58	56	3,127	19,667
2034	8,231	61,122	1.47	52	4,151	26,111
2035	7,868	58,420	1.39	49	4,790	30,130
2036	7,463	55,419	1.33	47	5,354	33,678
2037	7,365	54,682	1.39	49	5,549	34,901
2038	6,622	49,169	1.35	48	6,047	38,037
2039	6,073	45,097	1.27	45	6,877	43,257
2040	5,965	44,292	1.26	45	7,328	46,095

¹ High oil case production values

Year	Oil		Gas		Water	
	Tonnes*/day	Bbl/day	MMSm ³ /day	Mmscf/day	M ³ /day	Bbl/day
2041	5,604	41,611	1.21	43	7,526	47,337
2042	5,447	40,449	1.05	37	7,305	45,947
2043	5,454	40,497	0.98	34	8,095	50,920
2044	4,635	34,414	0.84	29	8,561	53,849
2045	4,353	32,317	0.72	25	8,949	56,286
2046	3,967	29,457	0.61	21	9,414	59,216
2047	3,716	27,595	0.52	18	9,672	60,837
2048	3,289	24,422	0.48	17	10,340	65,038
2049	2,953	21,930	0.45	16	10,703	67,325
2050	2,633	19,548	0.40	14	11,107	69,864
2051	2,410	17,900	0.37	13	11,371	71,526

The total oil production is expected to peak at 9,540 tonnes/day early in field life in the first two full years of production in 2027/2028, with relatively stable plateau rate until 2033, after which there is a steady decline through the life of the field. Total gas production from the wells is expected to be 1.62 MMSm³/day in the first full year of production (2027), rising to a peak in 2029-2031 (1.72 MMSm³/day), before steadily declining over field life.

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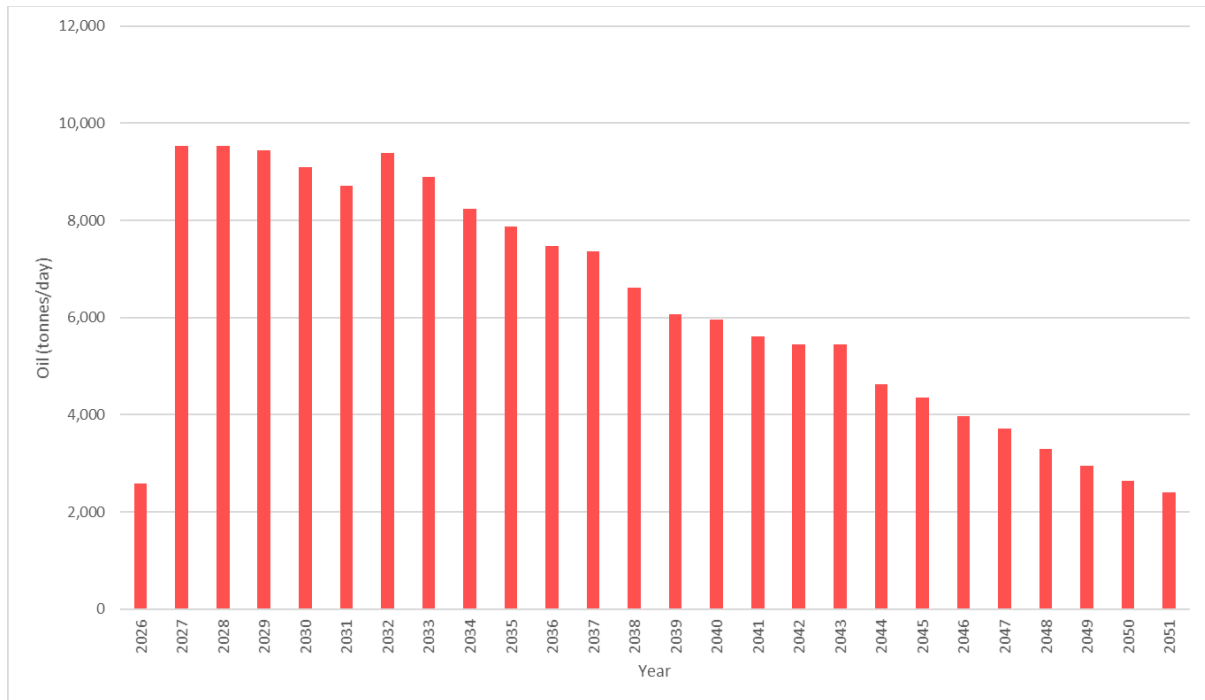


Figure 2-4 Rosebank Phase 1 and 2 Development oil production profile (Equinor, 2022a).

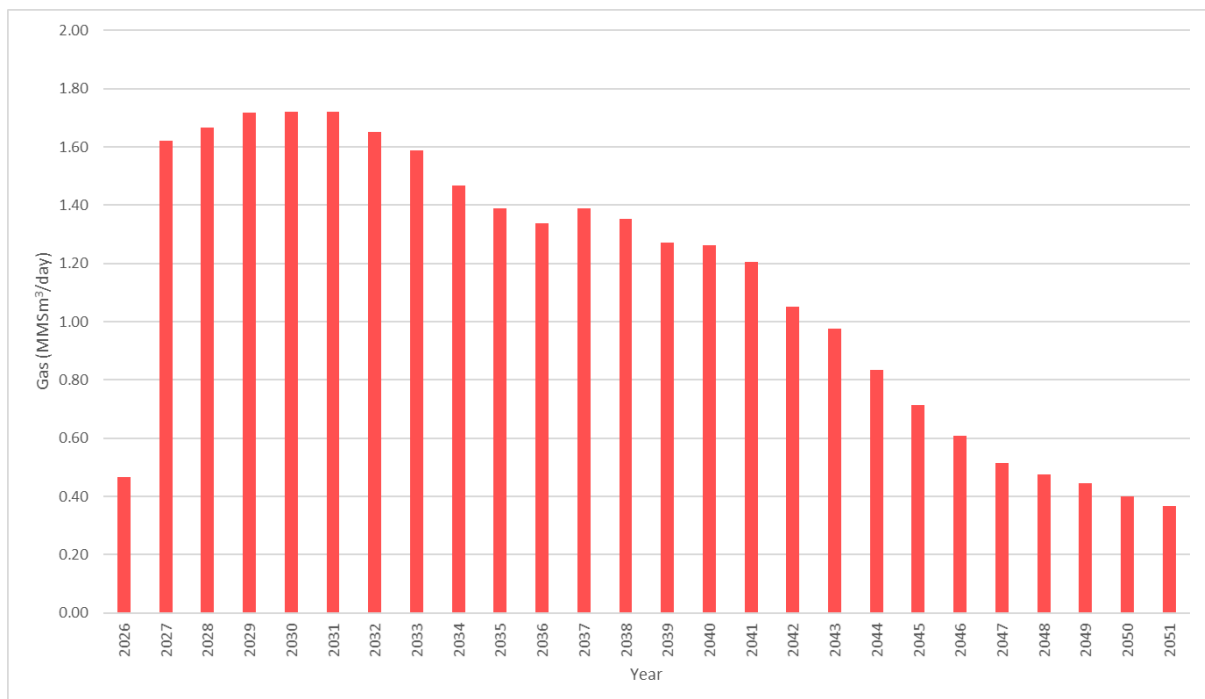


Figure 2-5 Rosebank Phase 1 and 2 Development gas production profile (Equinor, 2022a).

2.3.3 FPSO Facilities and Process Overview

The Rosebank FPSO will provide services for the reception of reservoir fluids, processing, storage and offloading of crude oil, and export of gas via pipeline.

The main characteristics of dimensions and capacities of the Rosebank FPSO are listed in Table 2-5.

Table 2-5 Rosebank FPSO main dimensions and processing capacities

PARAMETER	DIMENSIONS/ CAPACITY
Length (m) excluding helideck	256
Breadth (m)	48
Depth (m)	26.6
Total cargo storage in 12 tanks (m ³)	128,392.6
Total diesel/gas oil storage (m ³)	5006.7
Total ballast water (m ³)	60,559.7
Total methanol storage (m ³)	140.6
Processing capacities	
Oil Production	~12,500 Sm ³ /d (77 kbb/d)
Water Production	~15,000 Sm ³ /d (93 kbb/d)
Total Liquid Production	~17,500 Sm ³ /d (110 kbb/d)
Seawater treatment (SRU)	~15,000 Sm ³ /d (95 kbb/d)
Water Injection	~18,000 Sm ³ /d (115 kbb/d)
Gas lift	1.1 MSm ³ /d (39 MMscf/d)
Gas export	1.7 MSm ³ /d (60 MMscf/d)
Total Gas Handling	1.87 MSm ³ /d (66 MMscf/d)

The reservoir fluids from the wells will flow via flowlines to the risers below the FPSO. They will then be piped to the topsides for processing. This processing will separate the oil, gas, and water from the recovered fluids into three streams and condition each stream for subsequent use:

- The **oil** will be processed to produce a stabilised crude oil product suitable for storage in the Rosebank FPSO crude oil tanks and subsequent export by shuttle tanker;

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- The **gas** will be dehydrated (i.e., water will be removed) and, should hydrogen sulphide (H₂S) arise, the gas will be processed to meet the WOSPS entry specification of 2.3 ppm of H₂S. The gas will be used as fuel gas on the Rosebank FPSO, for gas lift in the wells to aid production or exported to shore. Excess gas from the storage tanks will be handled by the volatile organic compounds (VOC) flare recovery system which supports zero routine flaring. Flaring will only be for safety related reasons; and
- The **water** separated from the oil and gas (known as produced water) will be used for water injection purposes. The produced water will be treated and then combined with treated seawater to be used as the injection water to provide reservoir pressure support. In very limited circumstances, there would be a discharge to sea of the treated produced water to overboard permit specifications e.g., if water injection is unavailable for maintenance.

Stabilised crude will be stored in the 12 FPSO hull storage tanks for offloading to tankers.

The Rosebank FPSO storage capacities are presented in Table 2-5, which for production chemicals and diesel fuel shall be designed for 14 days of normal operation given the challenging weather conditions in the WoS area. The FPSO has an existing oil capacity of 10,015 Sm³/d (63,000 bbl/d) which will be modified to increase the capacity to around 11,129 Sm³/d (70,000 bbl/d) to process the Rosebank fluids. The project is carrying out debottlenecking studies to potentially increase capacity up to 12,500 Sm³/d (77,000 bbl/d). Further details of the Rosebank FPSO's processing systems are described in Section 2.3.4.

2.3.3.1 FPSO Modifications prior to deployment at the Rosebank Field

Modifications to be made to the FPSO prior to arrival at Rosebank will include:

- Demolishing of Debutanizer module M-510;
- Installation of a new process module R-510 containing:
 - New 3rd stage High Pressure (HP) Gas export compressor trains;
 - New 3rd Stage HP Gas Lift Compressor trains;
 - New inlet heaters for Test Separator;
 - New produced water hydrocyclones;
 - New produced water compact flotation units; and
 - New sand treatment package.
- New instrumentation for gas lift metering;
- Installation of variable speed drives on water injection pumps;
- Installation of LP and LLP compressors;
- Installation of 2 new Ultra filtration vessels;
- Installation of 3 new Compressor panels in the Central Electrical Equipment Room, accompanied with approx. 1,500 m of HV cable run;
- Structural reinforcements and replacement of the turret mooring table in order to accommodate increased riser and mooring loads;
- Modifications to increase the oil storage capacity;

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- Structural reinforcements to the hull to meet Rosebank environmental conditions;
- Green sea protection modifications to bulwark in bow area; and
- Preparation for electrification (as further described in Section 2.3.6.2).

2.3.3.2 Risers

Flexible pipe risers will connect all the production flowlines and umbilicals to the FPSO through the turret in a pliant lazy wave configuration as shown in Figure 2-6. The production risers go between the FPSO and the three well templates, and water injection risers go to an inline Tee on the water injection flowline. The gas risers will be connected to the gas riser base. Golar-Nor (UK) Limited are responsible for the operation of the FPSO from the riser bases upwards. The risers have been pre laid by Adura on the seabed from the in-field area towards the FPSO. All buoyancy modules, tether clamps, etc. have been attached to the risers during the laying of the risers.

Once the Rosebank FPSO is moored on location, the FPSO end of the risers will be lowered from the vessel and connected to a pre-deployed winch wire from the FPSO. The FPSO winch will then be used to pull the riser into the FPSO turret where the riser will be connected to the hang-off at the top of the I-tube (see Figure 2-6), which is a protective column through which the flexible riser passes. Both underwater cameras and ROV will be used to provide visual inspection in real-time of the installation process, which will allow correction if required and inspection of the risers and catenary after they are pulled-in to the FPSO.

The risers and base structures will be located within the FPSO 500 m safety zone.

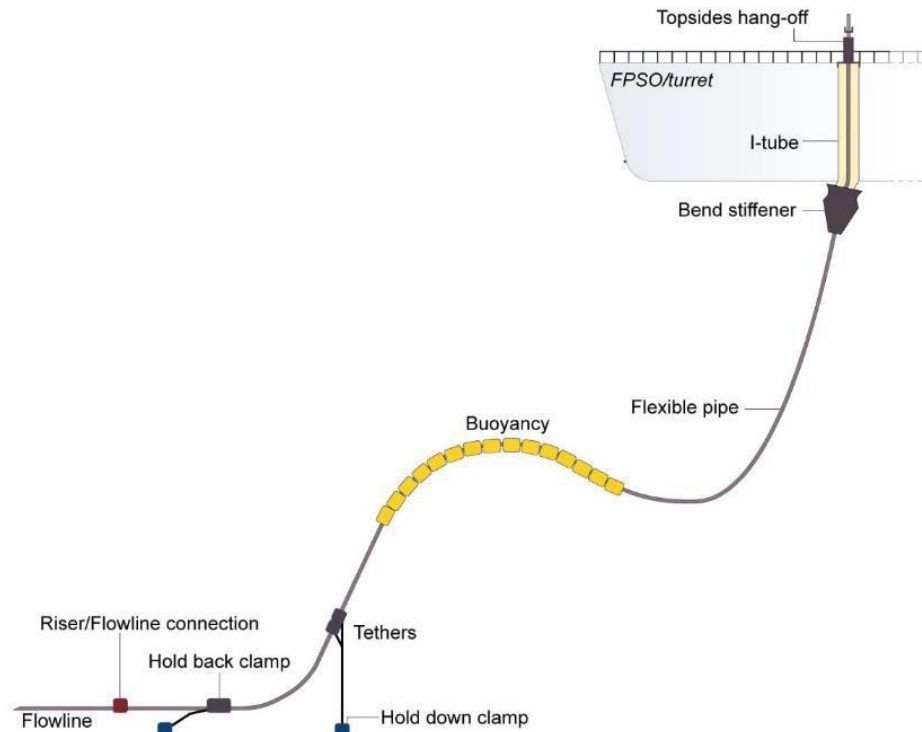


Figure 2-6 FPSO Riser Configuration.

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2.3.4 Processing System, Storage and Offloading

2.3.4.1 Oil Processing

The FPSO topside inlet arrangement tie in the production risers from the turret and transfer the well stream to the topside separation system which consists of first, second and third stage separators and a coalescer, as well as a test separator. The separation system is designed to separate the produced fluids into oil, gas, and water and to deliver oil within the required specification. The test separator is used for well clean-up operations, start-up, pigging, well testing and calibration of subsea multiphase flow meters to avoid upsetting the process which can result in corrective activities and increased oil in water levels or flaring emissions (Figure 2-7).

The well stream from the production risers will be received in the production and/or test manifold in the turret. The well stream will be separated in the first stage separator. Oil will be heated and stabilised, and water content removed in the electrostatic coalescer before oil is sent to storage for offloading. The processing of the well fluids is as follows:

- The well production fluids from the production header enter the first stage separator. The first stage separator is a 3-phase separator that separates oil, gas, and water. The first stage separator is designed for the total design rates and cater for a slug volume of 20 m³ between normal liquid level and high liquid level. The crude oil from the first stage separator is routed to the second stage crude heaters. The temperature of the heater is adjusted so that the temperature of the inlet stream to third stage separator is constant for all cases. Second stage crude heaters are designed as shell and tube exchangers;
- The second stage separator is a 3-phase separator. The separated oil from the second stage separator is then routed to the third stage separator and electrostatic coalescer. Vapour from the second stage separator is sent to the Low Pressure (LP) Gas Compression System and produced water is sent to the Produced Water Treatment System;
- The third stage separator is a 2-phase separator, operating to ensure no vapor is present downstream of the electrostatic coalescer; and
- Well test fluids from the test header enter the test separator via the test inlet heater for well testing. The test separator is a 3-phase separator that separates oil, gas, and water.

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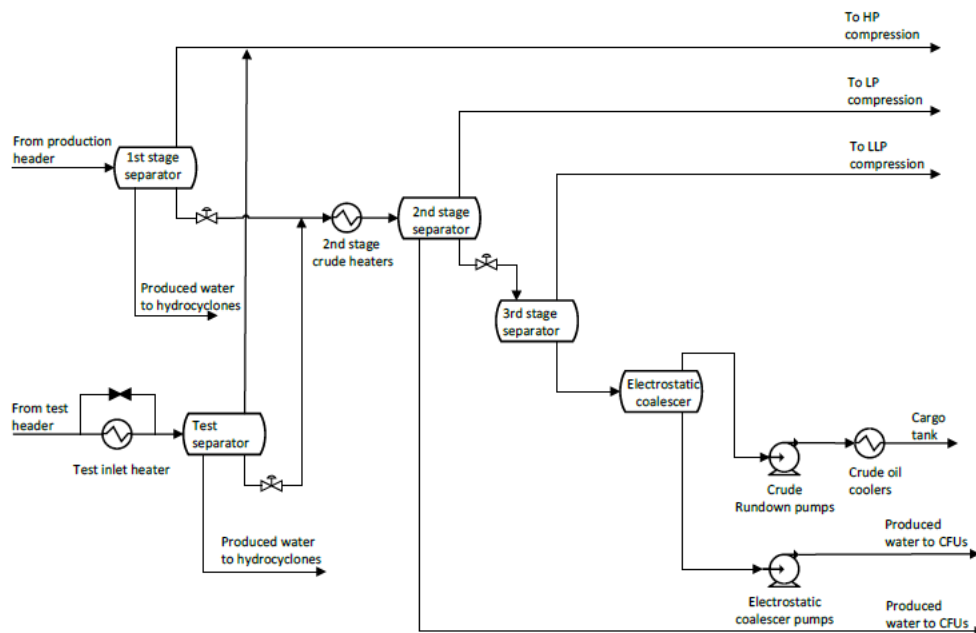


Figure 2-7 Diagram of the FPSO production separation process.

2.3.4.2 Gas Processing

Gas will be treated for H₂S and mercury (if required), dehydrated, and compressed. It will then be either exported to WOSPS or utilised as fuel gas and injected in the wells for production support. Downhole gas lift is required in the producing wells to reduce the start-up time of wells with high water cut, to increase the production rates, and to reduce slugging in the production flowlines. At the start of the field production, gas will be imported from the WOSPS to serve as the gas lift for the initial wells.

Mercury removal will be via a mercury removal unit in the form of a fixed-bed absorbent. It will be designed for a 4 year bed life, depending on inlet concentration. Physical change out of the beds would occur as required, according to that approximate timeline, with no shut down facilities required. The mercury removal unit will be installed upstream the third stage export gas compression stage to fulfil the gas export specification.

All processed gas, including export, lift and fuel gas, is dried in the gas dehydration system to the WOSPS maximum water content specification of 35 parts per million by volume (ppmV). The gas compression system on the FPSO consists of the LP and low low pressure (LLP) compressor packages with associated coolers and scrubbers. The LLP and LP compressors will be modified to accommodate the lower flow rates and the leaner Rosebank gas than that present on the field in which the FPSO currently operates (see Section 2.3.3.1). The gas from the first stage separator, the test separator and the LP compressor is compressed in three stages up to the final gas lift and/or gas export pressure (Figure 2-8).

Flash gas from the cargo storage tanks is routed to the VOC recovery unit where it is commingled with gas from the third stage separator and compressed by LLP compression. Gas from the second stage separator is mixed with the gas from LLP compression and is further compressed by LP compression before entering the HP gas compression. Gas from the first stage separator, test separator and the decompressor train is compressed in 2-stage

compression trains prior to third stage compression (consisting of a new gas lift compressor and a new gas export compressor).

Gas conditioning consists of gas cooling to reach the hydrocarbon dew point specification and water dew point reduction through a Tri-Ethylene Glycol (TEG) contactor.

The gas lift and gas export compressors will be equipped with Variable Speed Drives; discharge pressures will be controlled by varying the compressor speeds. The flow split between the gas lift and the gas export will be by a new control valve on the inlet to the gas lift system. Dry gas is compressed in a dedicated gas lift compressor and cooled before it is sent subsea and distributed to the wells. New instrumentation for gas lift metering will also be installed.

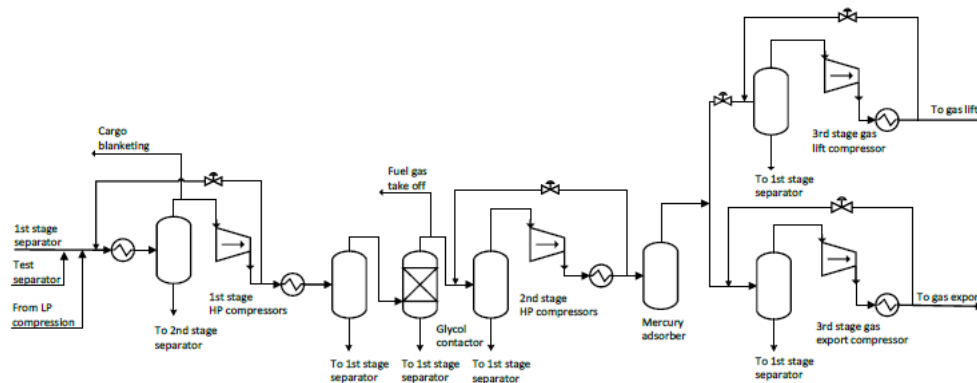


Figure 2-8 Diagram of the Process Gas Management System.

2.3.4.3 Produced Water Management System

Produced water is the result of the production of formation water from the reservoir. The produced water will be treated and reinjected into the reservoir with seawater that has been treated to produce low sulphate seawater in the Sulphate Removal Unit (SRU). Injection of non-treated seawater can introduce sulphur to the reservoir and contribute to souring by provision of a bacterial source. The resulting sour production will promote bacterial production and reservoir souring requiring further treatment before export or use as a fuel or lift gas.

Seawater will be lifted on to the FPSO, where it will be filtered, passed through the SRU, and finally de-aerated to produce the low sulphate seawater. The SRU contains sulphate removal membranes through which the majority of the seawater will pass. The remainder of the seawater, along with any ions that were retained by the membrane, will be rejected and constitutes the hypersaline water for discharge via the caisson with excess low-sulphate seawater. The amount of excess low-sulphate seawater discharged will be dependent upon how much water is required to make up the total injection water volume at any one time. As more water is produced from the reservoir in field life as it matures, then the amount of excess low-sulphate seawater required will decrease.

The combined seawater and produced water flow comprise the water injected to the reservoir required to maintain pressure and maximise production. Produced water may be discharged to sea if water injection is unavailable e.g. breakdown of a pump or the SRU, however the uptime of the combined water injection system is expected to be >95%. The produced water treatment system is required to remove oil and sand particles from the produced water stream to comply with the injection specification, and the overboard discharge permitted levels in case of injection system unavailability.

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The following activities and actions are the basis for water management at the Rosebank Development:

- Great care will be taken to ensure only the required volumes of seawater are lifted;
- All produced water shall be re-injected into the reservoir for pressure support;
- Produced water shall be treated prior to injection to allow for fracture injection and to ensure reservoir containment of injected water;
- The backup solution in case of downtime of the water injection system is to discharge the produced water to sea following treatment;
- Sea water shall be treated for sulphate and oxygen removal prior to injection. In case of downtime of the SRU plant, sea water injection shall be stopped. No untreated sea water shall be injected into the reservoir; and
- Treated sea water and produced water will be mixed and injected through common subsea pipelines.

The water injection system consists of a seawater treatment system and common injection pumps for produced water and sea water (Figure 2-9). The produced water and treated seawater are injected for reservoir voidage replacement to maintain the reservoir pressure.

The produced water system on the Rosebank FPSO will be subject to modification aiming to meet an oil in water concentration of between 15 mg/l and 30 mg/l (permitted limit) (monthly average) prior to re-injection into the reservoir or in upset situations discharged to sea for a limited period. During the modification phase (see Section 2.3.3.1), the fixed speed motors on the water injection pumps will be replaced with Variable Speed Drives. The average power saving is just over 700 kW per operating pump, therefore installation of Variable Speed Drives to the seawater injection pumps results in a reduction in electrical demand of 1,400 kW across the life of field.

The produced water source includes the first and second stage separation and electrostatic coalescer. The combined water stream enters the hydrocyclones where the pressure drops along the inner contour of the liners creating the spin, thereby allowing gravitational oil/water separation. The bulk of the incoming oil is removed by the hydrocyclones, where the removed oil is directed back to third stage separator. The treated water is directed to the compact flotation units (CFU) for mechanical separation of liquids and gas.

The gasses which are removed from the CFUs are routed to the third stage separator whilst the water is routed primarily to water injection (> 95% of the time). The 95% uptime of the water injection system is derived from the Reliability Availability and Maintainability (RAM) analysis carried out based on produced water profiles.

During production, it is a credible scenario that there may be certain process upsets or outages (e.g. slugging, loss of deoiler chemical injection, reduced hydrocyclone efficiency caused by blockages etc.) where it is clear that the monthly average oil in water specification will be jeopardised if production continues.

In addition to produced water being routed direct to an overboard dump caisson (if it is within the permitted discharge specification), there is another option available to divert produced water to the slop tanks and cargo tank 5 until these reach their capacities. The capacity utilising these two options is around 10,400 m³ and would generally allow sufficient time to carry out short duration repairs on the water injection system. Routing to these tanks could also be done if the produced water was off specification. The discharge of hydrocarbons to sea will be permitted under the Offshore Petroleum Activities (Oil Pollution Prevention and Control)

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Regulations 2005 (as amended). An OLP will be prepared in 2026 for all hydrocarbon discharges to sea.

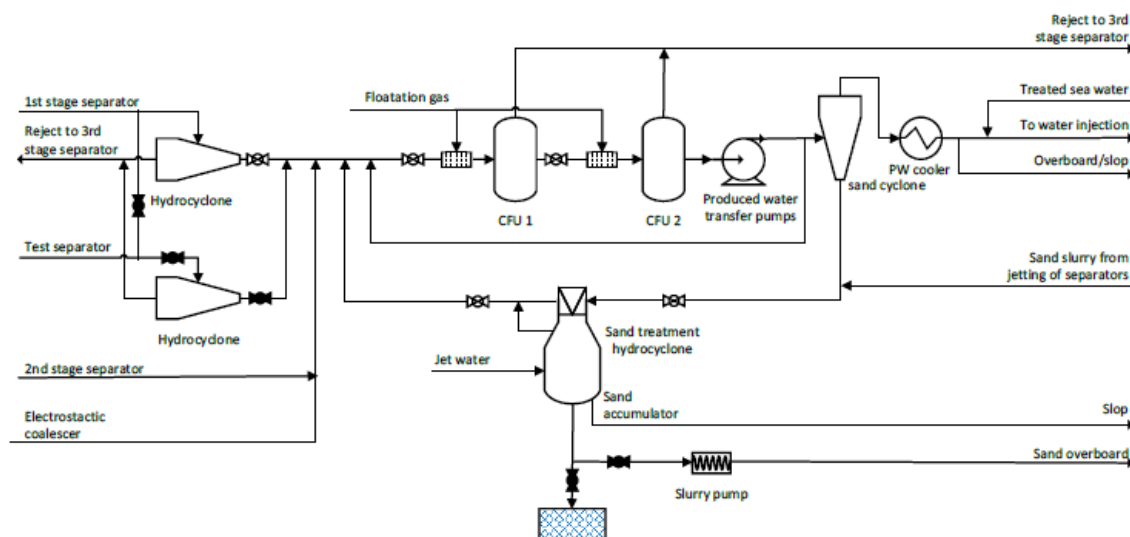


Figure 2-9 Diagram of the Rosebank FPSO produced water management system.

2.3.4.4 Sand Processing System

The Rosebank production wells will be completed with a combination of open hole gravel pack completions for the deviated wells and stand-alone screens (SAS) for the horizontal wells. Neither completion type is expected to produce solids under normal producing conditions. Production wells will be equipped with an acoustic sand detector and one CEM (Corrosion Erosion Monitoring) to control sand production. The topside production flowlines will also include one acoustic detector with sand injection point and one CEM.

During normal operations, minimum solids production is expected to be on average 9.4 te/year during production, ranging from 1 te in 2026 to 11 te in 2033. During the initial clean-up flow to the FPSO, elevated sand production is anticipated for a short period. During clean-up of the SAS, a sand production of 10 ppmw/well (weight of total fluid) could occur, and the majority of solids will be produced during the first five hours of the clean-up operation. (HOLD 07)

A sand treatment and removal system will be installed on the FPSO to manage any produced sand within the fluids produced from the Rosebank reservoir; these have been designed to handle the predicted sand quantities mentioned above. Sand removal facilities will be included in the first and second stage separators and the electrostatic heater. Sand will be removed as required as fluids pass through the vessel. The sand removed from the sources above will be transferred to a sand treatment hydrocyclone and collection chamber. As the sand enters the unit it passes through the hydrocyclone section with any oil/water rejected to the 1st stage CFU. The washed sand will pass through the hydrocyclone and collect in the base of the sand accumulator.

The options for disposal of the sand are either to skip it for return to shore or to discharge it overboard, providing the sand has been sufficiently cleaned. The final design has not been confirmed, but it is expected that the washing of sand with produced water will continue until samples show that the sand particles contain $\leq 1\%$ by weight of oil. At this point, the sand slurry could be routed overboard. The washing and overboard disposal of sand is expected to be a batch process, which operates intermittently.

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The discharge of sand to sea will be permitted under the Offshore Petroleum Activities (Oil Pollution Prevention and Control) Regulations 2005 (as amended). An OLP will be prepared in 2026 that will cover sand discharges during start up and production.

2.3.4.5 Chemicals

Specialist chemicals are to be used during production to maintain process efficiency and to maintain pipelines and ensure pipeline integrity. Chemical injection will be required for the Rosebank FPSO process and utilities facilities and for provision to the subsea production manifolds. The Rosebank FPSO has separate tanks for chemical storage, each linked to a dedicated injection pump. Injection points are installed at various locations throughout the process systems where chemical treatment may be required.

The selection of specific production chemicals will be undertaken to identify the most environmentally acceptable chemical with the required technical performance. The use and/or discharge of all production chemicals will be subject to risk assessment and permitting under the Offshore Chemicals Regulations 2002. A production CP will be prepared in 2026 for all production chemicals. Golar-Nor (UK) Limited will ensure the chemicals selected will be registered for use under the Centre for Environment, Fisheries and Aquaculture (CEFAS) definitive ranked list of products for use in the UKCS.

2.3.5 Description of Combustion Equipment

A large combustion installation, for the purposes of the Offshore Pollution Prevention and Control (PPC) Regulations 2013 (as amended), is any offshore oil or gas facility where the aggregated rated thermal input of the combustion equipment on the facility exceeds a threshold of 50 MegaWatt thermal (MW_{th}). This threshold applies to all operational combustion equipment.

The combustion equipment covered by the Rosebank PRA/352 PPC permit is provided under the 'Description of equipment' table contained within the PPC SAT, along with details such as the maximum electrical rated output, the maximum thermal rating and the thermal efficiency. The process undertaken to select the Rosebank combustion plant is described under the Best Available Techniques (BAT) Assessment (Genesis, 2025c), which is provided in the PPC SAT. In summary, the combustion equipment consists of:

- Four Solar Titan 130 Gas turbines generator for power generation (4 x 14.055 MW ISO rated);
- One Aalborg Auxilliary Boiler (8MW)
- One MAN essential Diesel generator (ESDG) (2.45 MW);
- One MTU emergency Diesel generator (EMGEN) (2.6 MW);
- Four firewater pump diesel generators (4 x 1.9 MW); and
- One Warstila Inert Gas Generator (IGG) (0.11MW).

The inert gas generator is not expected to run under normal operations, but acts as a back-up for blanketing gas when fuel gas sourced from the first stage suction scrubber for A and B compressors is not available. The IGG provides an alternative source of safe inert gas to maintain a slight positive pressure in cargo storage tanks during cargo oil offloading or during preparation for maintenance.

2.3.6 Power Generation

Power will be required for the operation of process equipment and other vessel systems, including living quarters across the full lifecycle of the Rosebank field development. The main power generation system for the FPSO comprises of four gas turbine generators (GTG's). Normal operating philosophy will be to run in a three out of four (3oo4) configuration with load shared to meet installation power demand requirements. All GTG's are capable of dual fuel operation (fuel gas and diesel), however, will be preferentially ran on fuel gas during normal operations. The FPSO has the ability to import gas from the nearby WOSPS during the commissioning phase and longer term if the field becomes depleted of gas and it is still required for power generation, although this is a contingency.

Waste Heat Recovery Units (WHRUs), which heat circulate fluid (heating medium) by cooling down hot exhaust gases, have been installed on all power generation turbines. The heating medium supplies the normal process heat duty to the FPSO topsides equipment and cargo storage systems. Each WHRU has an installed capacity of 14,3MW duty and are designed to operate in 4x33% configuration. Installation heat demand is expected to be ~25.9MW. (Altera, 2024). Combustion gases are discharged to the local environment through stand-alone discharge stacks (one per gas turbine) to ensure all components are dispersed and to enable maintenance of stand-by turbines without a facility-wide shut-down. Ports in the exhaust stacks are provided to enable sampling of effluent gases with a traversing probe.

The peak electrical power demand for the Rosebank FPSO is estimated to be 31.709 MW_e; this is the peak power during peak production and offloading operations. The normal load during peak production, when not offloading, is 28.978 MW_e. (Altera, 2025).

The emergency diesel generator will provide power to equipment such as radio and navigational equipment, emergency lighting, UPS and other life support systems and shall be automatically initiated by a loss of power to the emergency switchboard.

The essential diesel generator provides essential power to support the normal conditions of habitability and essential marine/process systems in the event of black starts. For topsides, this includes the start-up loads for a turbine generator and some essential process and utility loads.

2.3.6.1 Fuel Supply

Fuel gas

Hydrocarbon gas produced from the Rosebank wells will be treated in the FPSO topsides systems to provide de-hydrated and super-heated fuel gas to the installed combustion and utility systems:

- Primary fuel supply to GTGs;
- Blanketing gas for cargo tanks during offloading;
- Back-up purge gas for flare systems;
- Seal gas for LLP compressor dry-gas seals during start-up or pressurized shutdown (with partial blowdown); and
- Stripping gas for CFU package and glycol regeneration system.

Fuel gas consumption is accurately metered, and turbine systems can determine the fuel characteristics to achieve optimal control of combustion. Solar's SoLoNOx™ dry low-emission combustion system controls are configured to prioritise low emissions. Fuel gas composition

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(Table 2-6 Rosebank Expected Fuel Gas Composition) is expected to be stable, but some changes can be expected during the life of the development.

Table 2-6 Rosebank Expected Fuel Gas Composition

COMPONENT	EXPECTED CONCENTRATION (MOLE%)
Methane	86.729
Ethane	6.52
Propane	3.56
i-Butane	0.65
n-Butane	1.2
i-Pentane	0.32
n-Pentane	0.36
C6*	0.2
C7*	0.05
C8*	0.01
C9*	0.00
Nitrogen	0.41
Water Vapour	0.00
Hydrogen Sulphide	0.00

Diesel

Low sulphur diesel conforming to the Marine Gas Oil ISO:8217, with a maximum Sulphur concentration of 0.1%, is transferred to the Rosebank FPSO from supply boats. It is permanently stored in tanks for distribution and consumption when required. Diesel fuel is used to supply equipment that is not intended to be run continuously:

- Direct Drive Engines on all four Fire water pumps
 - FWD Fire Pump A (71-PA-551) engine 71-DD-553
 - FWD Fire Pump B (71-PA-554) engine 71-DD-558
 - AFT Fire Pump A (71-PA-557) engine 71-DD-564
 - AFT Fire Pump B (71-PA-562) engine 71-DD-571
- Essential diesel generator (ESDG) (80-DD-501)
- Emergency diesel generator (EMGEN) (84-DD-501); and,
- Inert gas generator (64-VV-501).

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Diesel fuel is also used as a back-up fuel source for gas turbines for infrequent events where enough super-heated fuel gas is not available e.g., during start-up or shut-down and the auxiliary boiler in the event heat demand requirements are not met by the primary heat source from WHRU's. Diesel is also supplied to life-boat stations for re-fueling. All diesel supply to the FPSO and consumption by combustion plant (i.e. gas turbine), is accurately metered.

2.3.6.2 Electrification

Adura is working to realise the opportunity to source electric power for the Rosebank Development, and thereby reduce operating emissions and optimise oil and gas production. The ongoing transfer of the UK power grid to renewable energy sources, the development of wind power on the Shetland Islands, the establishment of a direct current (DC) link between Shetland and the UK mainland, and the development of floating wind turbines all represent opportunities to facilitate a possible future electrification of the Development. Adura is actively engaged in the West of Shetland Operator Electrification Workgroup (WoSE,) together with the operators for the Clair and Cambo fields to seek the best area solution.

The Rosebank FPSO will be deployed to the field as electrification ready. The FPSO has suitable space in the turret for the installation of an electrical swivel and necessary deck space for electrical equipment. The FPSO preparations for electrification, while it is being modified at the yard prior to deployment to the Rosebank Field, will consider the flexibility required in order to accommodate the final electrification solution when it is selected.

2.3.7 Flare System

The FPSO will be operated without routine continuous flaring. The Development philosophy is to reduce flaring wherever possible and maintain flare combustion efficiency to minimise emissions from the Development. The intention will be to start using the field gas as soon as possible and recover any gas in the separation process. Flaring will be reduced at well start up by using import gas from the WOSPS to speed up the start-up process. This method of start-up will limit the amount of gas to the flare to the well flowback and clean-up phase as far as possible.

The Rosebank FPSO is designed with closed high- and low-pressure flare systems to service different parts of the plant at different pressures and retain as much gas as possible to reduce flaring emissions. In both systems, the received flows will enter a flare knock-out drum where any liquids in the stream are recovered. Gases will go from the knock-out drum on to a flare gas recovery compressor where hydrocarbon gases are recovered and fed into the compression system joining the rest of the gas flow for export and use in gas lift or power generation. The flaring of gas as waste is therefore eliminated on a routine basis.

2.3.8 Inert Gas System

On the Rosebank FPSO, cargo tank pressure control is normally achieved using hydrocarbon fuel gas sourced from the first stage suction scrubber for A and B compressors. This is used as the primary means of supplying hydrocarbon blanketing gas for oil storage tanks, however, in the event of package or plant shutdown/blowdown, the inert gas generator (IGG) provides a large quantity of safe, inert gas to maintain positive pressure in cargo storage tanks. The IGG is not expected to run normally and provides a back-up for blanketing gas when the primary means of maintaining positive pressure in cargo storage tanks is not available. The inert gas generator can also be used to displace hydrocarbon gas from cargo tanks prior to maintenance. Any combustion gases from the inert gas generator are ultimately discharged

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to the environment via the cargo tank vent stack. Combustion gases are diverted to a blow-off line in the package during start-up and through a vent line between the inert gas generator and deck seal during a shutdown.

2.3.8.1 Venting

During normal production operations, the vent and flare systems are closed. Venting will be required for safe isolation of plant by allowing pressure release during maintenance operations. The vent system is provided for safe release of hydrocarbon / blanket gas fluids that are relieved from process equipment and/or from Pressure Safety Valves (PSVs), Blowdown Valves (BDVs), and Process Control Valves (PCVs)/PSVs during start-up and/or process upset conditions. There is also a VOC recovery unit which prevents continuous flaring and reduces emissions during normal operation as it receives vapor from cargo tanks during production operation and also receives the vapor from flare system during offloading.

Shuttle tankers will have tanks empty of crude oil when they arrive at the FPSO, but the tanks will contain inert gas or a mixture of hydrocarbon gas and inert gas. This inert gas or mixture will be displaced (i.e. vented to the atmosphere) during offshore loading of crude oil from the FPSO to the shuttle tankers; this process will be managed as per the shuttle tanker's VOC Management Plan.

2.3.8.2 Fugitive Emissions

A methane action plan will be developed for the operational phase of the Development. This will include management of fugitive emissions, which are small leaks typically originating from valves and flanges which are not completely tight. The mitigation approaches needed to deal with leaks and fugitive emissions differ from the other emission categories, with the focus being on the detection and prevention of leaks, rather than the avoidance or configuration of processes that would release methane through normal operations. While the emissions from individual fugitive leakages are typically limited in magnitude, the total amount may represent a significant source of methane emissions.

An effective way of detecting and reducing fugitive emissions (i.e. those not typically identified with stationary gas detectors and/or through regular inspection rounds) is to carry-out regular Leak Detection and Repair (LDAR) programmes, which use specialised detection equipment to identify fugitive leakages. Handheld infrared (IR) cameras, used for optical gas imaging (OGI), are becoming the standard equipment for LDAR campaigns, as camera operators can survey many more potential leak sources in far less time than traditional "sniffing" methods which require detection equipment (e.g. Flame Ionisation Detection devices) to be placed within 1-2 cm of a potential leak point. A specific remediation plan for fugitive emissions will be dependent on the findings of future surveys.

2.4 Decommissioning

The main obligations for decommissioning offshore oil and gas operations are set out in OSPAR decision 98/3 (the "Decision 98/3") which specifically prohibits the dumping or leaving in place of installations in the marine environment. OPRED (2018) guidance sets out current UK policy on decommissioning. Decommissioning will be carried out in compliance with national legislation and international agreements in place at the end of field life. Agreement to Cessation of Production will be sought from the regulator as a pre-requisite for approval of the decommissioning programme. Consideration has been made in the design and construction

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Project Title:

OFFICIAL Rosebank Production Master Application Template (PRA/352)
Document & Rev No.: 218536C-001/B
Document Title: Petrojarl Rosebank FPSO Environmental Assessment Justification



of the Rosebank development to matters that will facilitate decommissioning of the field facilities.

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3.0 ENVIRONMENTAL BASELINE

This section describes the main characteristics of the offshore environment around the Rosebank location, with particular attention being given to those aspects that may be sensitive to, or affected by, the Rosebank FPSO operations.

3.1 Supporting Studies

Since the discovery of the Rosebank field in 2004, a number of studies have been undertaken to gather information on the environmental and socio-economic sensitivities in the Rosebank Development area. These have been used in the development of the environmental baseline and are summarised below.

3.1.1 Seabed Surveys

The following surveys have been carried out in the Rosebank infield area:

- Hartley Anderson (2003) ROV investigations of the seabed environment around well 204/17-1 pre and post drilling - Report on seabed sediments and fauna observed from a ROV around well 204/17-1 during drilling in March-April 2003, including assessment of scale of impacts from cuttings discharges from top-hole sections.
- Scientific and Environmental ROV Partnership using Existing Industrial Technology (SERPENT) (2008) SERPENT Project; Rosebank visits 2007. Preliminary analysis of results - Preliminary report of investigations into extent of seabed disturbance by drill cuttings discharges on megafauna at Rosebank well 205/1-1 and 213/27-2 well locations.
- Fugro (2011) Environmental baseline survey of the Rosebank in-field area - Environmental survey in 2011 of seabed over 162 km² Rosebank field, as part of a geophysical and geotechnical programme. Station locations determined on the basis of acoustic (high resolution bathymetry and sidescan) returns. Benthic sediments at nine stations were photographed, and also sampled for sediment particle size, metals, hydrocarbons and macrofaunal analyses using a 0.25 m² box corer.
- Fugro (2014a) Habitat assessment report UKCS Quadrants 205, 206 and 213 - Environmental survey in 2014 of the seabed of the in-field area of the Rosebank field and a now-discounted gas pipeline route option from the Rosebank field to the Tormore manifold. Ten stations were sampled. The report details the results of the habitat assessment, undertaken on the basis of acoustic data interpretation for wide-scale mapping of seabed types, with ground truthing by video and still photography.
- Fugro (2014b) Environmental Baseline Survey UKCS Quadrants 205, 206 and 213 - Environmental survey in 2014 of the seabed of the in-field area of the Rosebank field around the northern and south-western water injection well and a now-discounted gas pipeline route between the Rosebank field and Tormore. Ten stations were sampled. This report details the results of the seabed sampling investigations, including sediment particle size, metals, hydrocarbons and macrofaunal analyses.
- DNV (2022a) Environmental Baseline Survey carried out predominantly along the gas export pipeline route. Samples for physico-chemical analysis and macrofaunal analysis obtained at 23 stations.

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- DNV(2022b) Habitat Assessment Report carried out predominantly along the gas export pipeline route and focussed on identifying potential red list species or OSPAR habitat.
- Akvaplan (2022a/b) Environmental Baseline Survey in the Rosebank field including seabed sampling and camera survey.

3.1.2 Other Studies

A meteorological and oceanographic data gathering study to inform the design basis for the Rosebank Development was carried out (Equinor, 2022b).

The ship routeing data in the Rosebank field and the risks of collision were assessed by Anatec in 2024 (Anatec, 2025)

Regional-scale studies that were used to inform the environmental baseline for the Rosebank Development include the following:

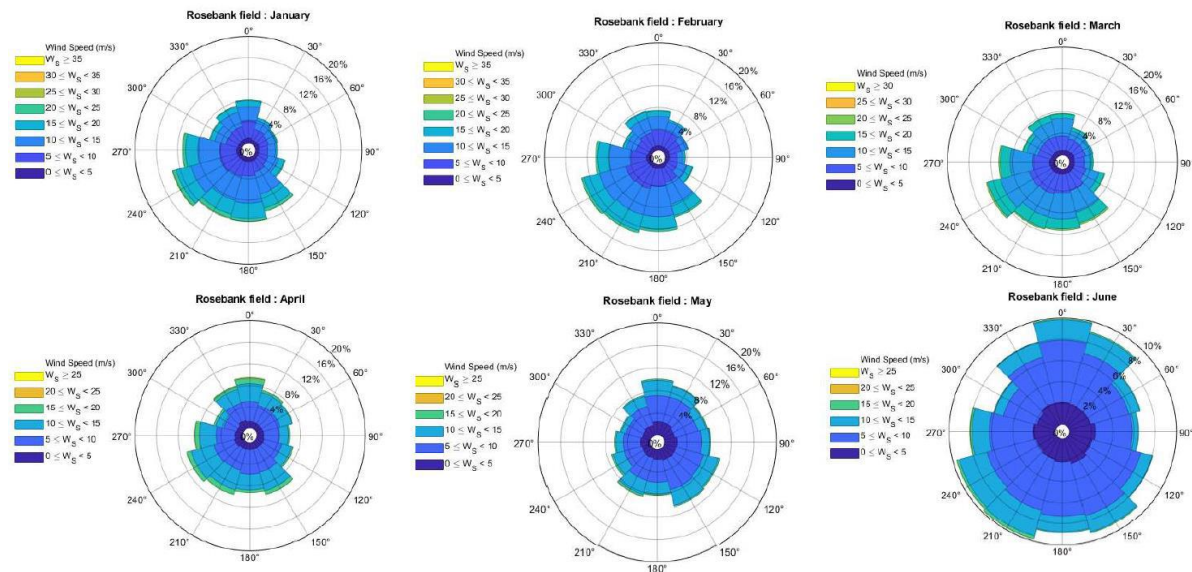
- The Atlantic Frontier Environmental Network (AFEN) was an innovative grouping of oil companies and UK Government departments set up to orchestrate sound management and regulation of oil and gas activities. Since 1995, several studies and research initiatives have been commissioned by AFEN to expand environmental knowledge of the area. Two widescale seabed surveys funded by AFEN were undertaken offshore to the north and west of Scotland (Bett, 1996; 1998). In 1996, 20,000 km² of seabed lying to the west of Shetland was mapped and sampled. The 1998 survey covered a further 10,000 km² of seabed. The results of both surveys were reported in AFEN (2000) and also summarised in AFEN (2001); and
- The United Kingdom Offshore Energy Strategic Environmental Assessment (OESEA) programme, referred to as OESEA3, builds on the work completed for the previous regional scale Strategic Environmental Assessments (SEAs) since 1999 (DECC, 2016). It aims to help inform licensing and leasing decisions by considering the environmental impacts of potential activities that could result from their implementation. Each SEA is supported by a series of specialist technical studies on issues relevant to the region being covered. As the individual SEA regions have been assessed in OESEA3, documents relating to the assessments have been made available for access by the industry and public on the internet. The Rosebank field and pipeline are located in the previous SEA region 4, which falls within the Regional Seas 8 (Scottish Continental Shelf) and 9 (Faroe-Shetland Channel), as described in OESEA3 (DECC, 2016).

3.2 Physical Environment

3.2.1 Metocean Conditions

The maritime climate of the Faroe-Shetland Channel is dominated by Atlantic weather systems, which in turn are influenced by a persistent regional pattern of high pressure over the Azores and low pressure over Iceland. This produces a sequence of secondary depressions which travel in an easterly or north-easterly direction, resulting in the passage of warm and cold fronts, changeable wind direction and frequent precipitation.

Seasonal temperature variations are reduced by the influx of relatively warm surface water from the Atlantic Continental Slope Current and the dominance of south-westerly winds. The deep oceanic water west of Shetland is almost completely open to the prevailing weather from the west and south-west, with the result that the region is exposed to significantly stronger winds and sea conditions compared to other UK offshore areas. There is a significant seasonal variation in wind speed; winds of 8 m/s or greater are reported around 70% of the time in winter and around 30% of the time in summer (DECC, 2016). Monthly wind roses for the Rosebank field are shown in Figure 3-1 (Equinor, 2022a). These correlate with the general picture for the west of Shetland region as a whole, i.e. that winds from the westerly to southerly quarters predominate and that wind strengths are highest over autumn and winter and lowest over the summer.



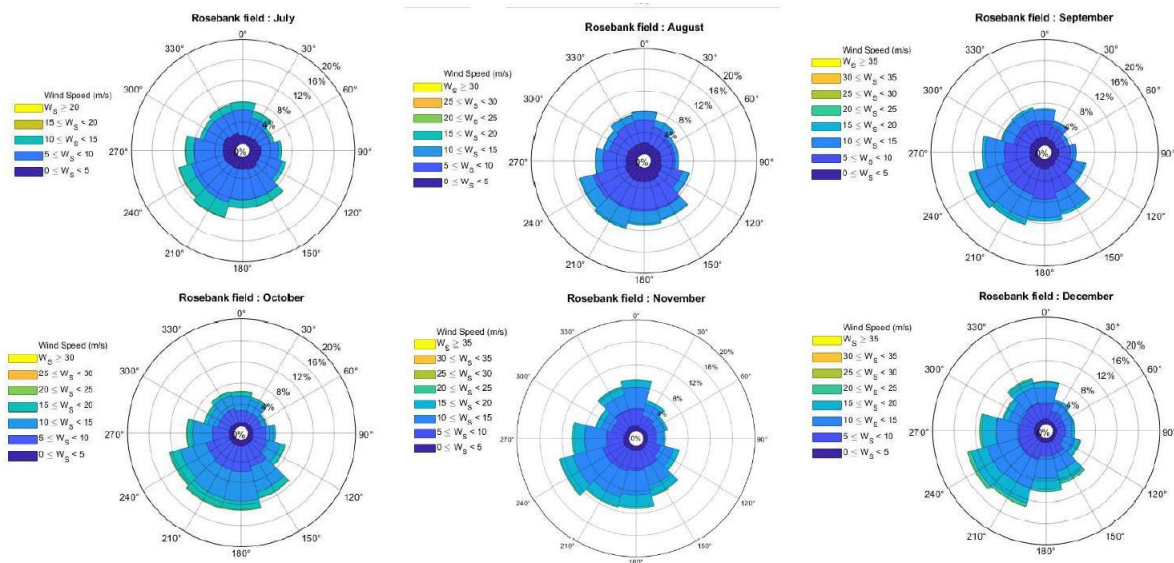


Figure 3-1 Monthly wind roses for the Rosebank field (Equinor, 2022a).

Currents are variable and distinguishable by geographical origin and vertical distribution in the water column. The surface layer is composed of North Atlantic Water (NAW) and Modified North Atlantic Water (MNAW). The circulation of water in the region is dominated by two main flows (Figure 3-2). The first of these is the northeasterly flow of relatively warm and saline NAW from the Rockall Trough, which flows north over the Wyville Thomson Ridge and into the Faroe-Shetland Channel along the shelf break. The second current occurs below this, at more than 450 m depth, and consists of cold and less saline water from the Norwegian Sea flowing in the opposite direction to the southwest along the Faroe-Shetland Channel (Ellet, 1992). The mean residual currents surrounding the Rosebank area are approximately 0.2 m/s (Wolf *et al.*, 2016).

Variations in seawater temperature in the vicinity are complex and the rate of change in temperature with depth and time is particularly high. Mean sea temperatures for May in the region range from 8°C at the surface to -1.5°C at 1,000 m. Salinity of the surface water in the vicinity varies annually but is typically approximately 35‰ (Scottish Government NMPI).

The deep water over the West Shetland continental slope is exposed to a large fetch and strong winds, particularly from the west and southwest. These conditions generate a wave regime in the area which is more severe than that experienced in the northern North Sea. Wave direction appears relatively consistent through the year, travelling predominantly from southwest to northeast or west to east. Worst-case wave conditions are typically encountered during the winter months and into early spring. Significant wave heights of mean 4.1 m and a maximum of 15.1 m occur in January, whereas in July significant the mean wave height is 1.7 m with a maximum of 6.3 m (Equinor, 2022).

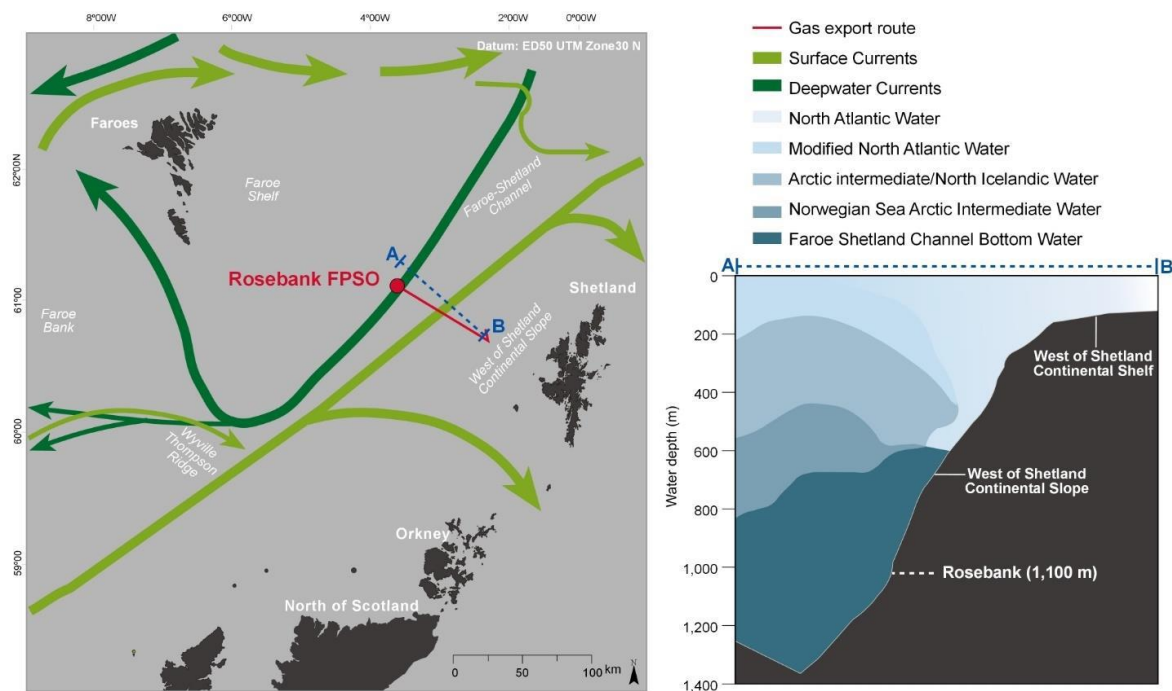


Figure 3-2 Water currents West of Shetland (DECC, 2016; Hansen and Osterhus, 2000; Turrell *et al.*, 1999 in AFEN, 2001).

3.2.2 Bathymetry and Seabed Sediments

The Faroe-Shetland Channel forms a narrow deep trough, orientated south-west to north-east, separating the Faroe Shelf from the West Shetland Continental Shelf to the east and the Wyville Thomson Ridge and several isolated banks to the south. The channel is wider and deeper to the northeast compared to the southwest, where it turns to the northwest into the Faroe Bank Channel (DECC, 2016).

The Rosebank field is located on the continental slope that forms the eastern flank of the Faroe-Shetland Channel in a water depth of approximately 1,100 m.

The combined geophysical and environmental survey conducted by Fugro (2011) found that the regional gradient of the seabed in the infield area to be typically less than 2°, although localised gradients of up to 22° were recorded associated with the flanks of sediment mounds and seabed depressions. Measured water depths at the sampling stations during the recent Rosebank field environmental survey ranged between 1,211 and 1,123 m (Akvaplan, 2022a).

UKSeaMap 2021 provides a 100 m resolution habitat map which includes the Rosebank Development area (JNCC, 2021a). This describes the seabed within the Rosebank field and deeper parts of the gas pipeline route as deep sea mud and deep sea mixed substrata, with sediments becoming coarser further up the continental slope (see Figure 3-3).

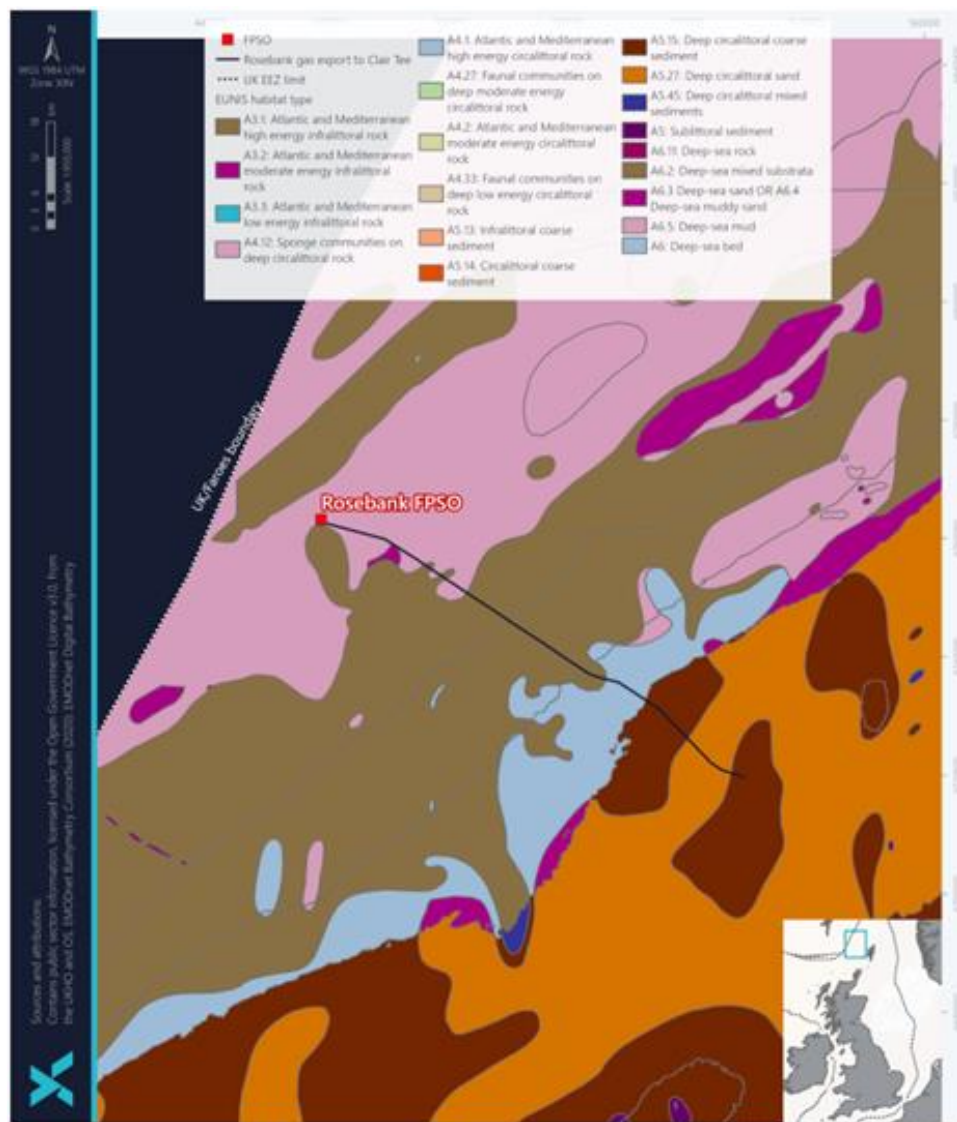


Figure 3-3 EUNIS seabed habitat classification around Rosebank (UK SeaMap 2021).

Side scan sonar data acquired in the Rosebank in-field area in 2011 showed seabed sediments to comprise very soft, sandy clay (Fugro, 2011a). In the additional locations surveyed in 2014, the seabed was interpreted as silty gravelly fine sand (Fugro, 2014a). In both surveys undertaken within the in-field area, numerous sonar contacts were observed and identified as boulders or glacial drop stones deposited from the base of ice sheets. Many of these sonar contacts had some degree of scour associated with them, to the extent that a considerable number of the contacts lay within well-defined small depressions (Fugro, 2011, 2014a). Mounds were also observed, with diameters of up to 25 m and heights of 1 m. These are thought to have been formed by near seabed currents and are not considered biogenic in origin. These results correlate with the findings of earlier surveys and observations (Hartley Anderson, 2003).

The 2021 in-field survey consisted of samples collected at 19 stations using a video-assisted multi sampler (VAMS) equipped with four 0.15 m² combi grabs and one 0.1 m² grab. Sediments were classified as fine sand and silt with the fine sand proportion varying from

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25.2% to 46.5% and the silt proportion ranging from 28.7% to 59.1% (Akvaplan, 2022a). The stations across the Rosebank location had a relatively homogeneous substrate that was mainly dominated by soft sediment with some gravel and boulders. Since there was high homogeneity between the stations at Rosebank, all the stations were classified into the same European Nature Information System (EUNIS) category: 'deep sea muddy sand'. The 2021 infield survey data confirmed the regional-scale information for west of Shetland, where the broad habitat type is categorised as deep sea mud and deep sea mixed substrata. These results were consistent with the sediment type observed during earlier surveys at the Rosebank field as described above.

3.3 Biological Environment

3.3.1 Plankton

Plankton are drifting organisms that inhabit the pelagic zone of a body of water and include single celled organisms such as bacteria as well as plants (phytoplankton) and animals (zooplankton). Phytoplankton are the primary producers of organic matter in the marine environment and form the basis of marine ecosystem food chains. They are grazed on by zooplankton and fish, which in turn are eaten by larger species such as other fish, birds and cetaceans. Therefore, the distribution of plankton directly influences the movement and distribution of other marine species. Zooplankton include all life stages of planktonic organisms (holoplankton) and includes the eggs, larvae and spores of non-planktonic species such as fish, benthic invertebrates and algae (meroplankton).

The composition and abundance of plankton communities varies throughout the year; influenced by several factors including depth, tidal mixing, temperature stratification, nutrient availability and the location of oceanographic fronts. Species distribution is directly influenced by temperature, salinity, water inflow and the presence of local benthic communities (Colebrook, 1982). The meroplankton population may have a very different seasonal cycle depending on the life cycle strategy of the fish species and benthic organisms which inhabit the area.

The Rosebank Field is located within Regional Sea 9; Faroe-Shetland Channel. Regional Sea 9 is a deep, oceanic region, following the contours of the Faroe-Shetland Channel. The region is characterised by cold water inflowing from the Arctic and Norwegian Sea at depths below 600 m (JNCC, 2004). The Faroe Shetland Channel typically has lower phytoplankton biomass and a shorter productive season than waters more influenced by coastal processes (Johns & Wootton 2003). The phytoplankton community in the region is dominated by the dinoflagellate genus *Tripos* (mainly *T. fusus*, *T. furca* and *T. muelleri*), with diatoms such as *Thalassiosira* spp. and *Chaetoceros* spp. also abundant.

The zooplankton communities of the Faroe-Shetland Channel are dominated in terms of biomass and productivity by oceanic calanoid copepods, particularly *Calanus* spp. (*C. finmarchicus* and *C. helgolandicus*), *Pseudocalanus elongatus*, *Metridia lucens* and *Acartia clausii*. The Faroe-Shetland Channel is a particularly important site for *Calanus finmarchicus* as the species over-winters in dense aggregations in cold waters below the warm North Atlantic Current (Heath 1999).

3.3.2 Benthos

The biota living near, on or in the seabed is collectively termed benthos. The diversity and biomass of the benthos is dependent on a number of factors including substrata (e.g. sediment, rock), water depth, salinity, the local hydrodynamics and degree of organic

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enrichment (DECC, 2016). The species composition and diversity of the benthos or macrofauna found within sediments is commonly used as a biological indicator of sediment disturbance or contamination.

Environmental survey work within the Rosebank field (Fugro, 2011, 2014a) found a similar range of epifaunal forms to that seen during the AFEN survey (AFEN, 2000) of the eastern flank of the Faroe-Shetland Channel. On the channel floor, Bett (2000) and Texaco (2000) found a muddy seabed with sparsely distributed stones with attached stalked sea squirts, sponges, and soft corals, while the lower slope (>600 m) supported large polychaetes, brittlestars and sea spiders.

Species similar to those found by the AFEN and Fugro survey work had also been observed and photographed by ROVs operating in the Rosebank field as part of the SERPENT programme in 2007, and some of these images are shown in Figure 3-4. The AFEN survey work identified an area of sandy sediments at depths of 900 m or more, supporting an abundant population of surface-dwelling acorn worms (*Enteropneusts*).

The macrofauna at the Rosebank field sampled in 2011 (Fugro, 2011) was abundant and diverse, and dominated numerically by polychaetes. The most abundant species were the polychaetes *Paramphinome jeffreysii*, *Notoproctus sp.*, *Notomastus sp.*, *Proclea graffii*, *Glycera lapidum agg.*, *Myriochele heeri* and *Samythella elongata*, together with the sipunculan worm *Nephasoma sp.*, the sea cucumber *Myriotrochus sp.* and the tube-dwelling amphipod *Haploops vallifera*.

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Sabellid polychaete in tube on a boulder; feeding fan just being withdrawn into the tube.



Ophiuroid brittlestar on sediment (central disc approximately 25 mm diameter).



Sea spider *Colossendeis proboscidea* (leg span up to 400 mm).



Club sponge *Chondrocladia gigantea*.



Soft coral and tube-dwelling sabellid polychaetes on silty cobbles



Cerianthid burrowing anemone in sandy sediment.

Figure 3-4 Examples of megafauna or visible epifauna at approx. 1,100m depth, Faroe Shetland Channel 2007 (SERPENT, 2008).

The 2021 infield survey conducted at Rosebank by Akvaplan (2022a) recorded polychaetes dominating the fauna, representing 65% of the total number of individuals and 42% of the number of taxa recorded. The most dominant taxa were the polychaetes *Notoproctus sp.*,

Galathowenia oculata, *Paramphinome jeffreysii* and *Galathowenia fragilis* and the sipunculid *Nephasoma sp.*

A canonical correspondence analysis (CCA) was conducted on data from the 19 stations to assess associations between biological data (species abundances) and selected environmental covariates. The CCA results indicate that 87% of the total variation in the benthos data can be explained by the environmental data. Among the environmental covariates, fines (silt/clay), gravel and TOC were statistically significant. Numerous traces of animal life in the sediment were observed, showing that there was a rich biological activity which is reflected in the results from the infaunal analyses conducted (Akvaplan, 2022b). None of the species recorded form habitat types that are listed as threatened and/or declining according to OSPAR (Akvaplan, 2022b).

The 2022 environmental baseline survey carried out along the Rosebank gas export pipeline route (DNV, 2022b) exhibited marked depth related trends in macrofaunal communities, with the lowest number of individuals recorded at the stations located on the continental shelf i.e. a shallower depth. In general, the number of species increased with water depth (maximum 60 species at station ENV11 at 1,095 m depth), Figure 3-5.

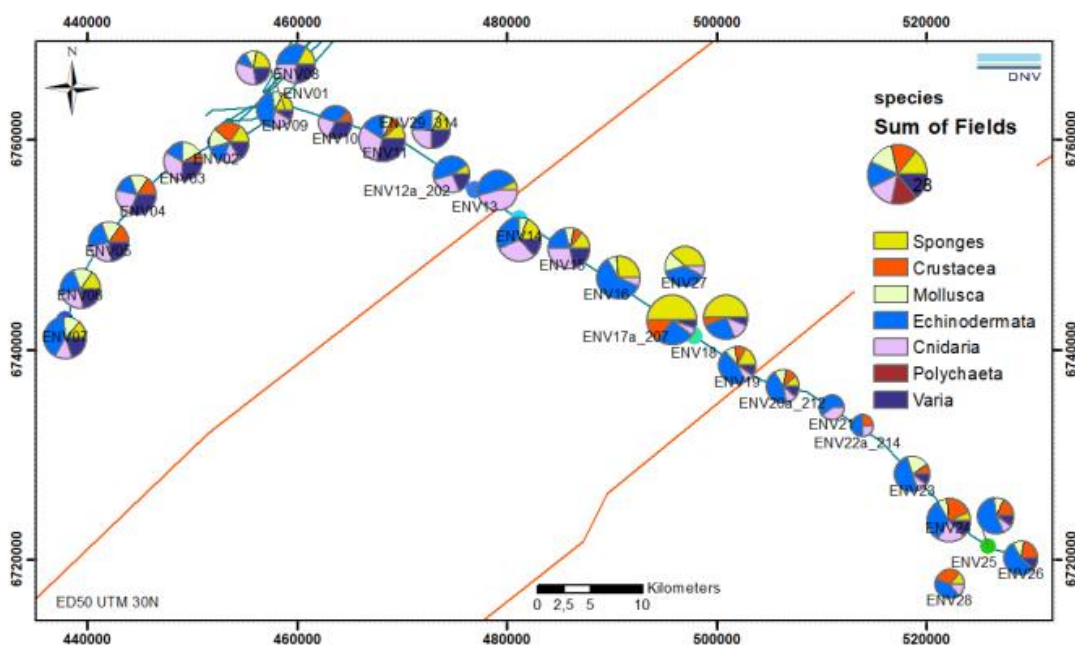


Figure 3-5 Composition of faunal types per sample station (DNV, 2022b)

The deeper stations (>900 m) were dominated by the sipunculids *Golfingiidae* and *Nephasoma* and polychaetes *Paramphinome jeffreysii*, *Galathowenia oculata* and *Notoproctus spp.* Stations at depths of 700-550 m were dominated by polychaetes *Spiophanes kroeyerii* and *S. wigleyi*.

The ocean quahog *Arctica islandica*, a large marine bivalve mollusc, has been observed in the vicinity of the Development area, off the south-west coast of Shetland (Scottish Government NMPi). These species are considered of conservation importance in Scotland and designated as Scottish PMFs (Tyler-Walters, 2016). No specimens of ocean quahog (*Arctica islandica*) were identified in the sampled material during the pipeline route survey (DNV, 2022b).

Deep-sea sponge occurrences were noted in the AFEN survey work. As outlined in OSPAR (2010), deep-sea sponge aggregations (also known as 'ostebund' or 'cheese bottoms' by Faroese fishermen) are known to occur in water depths of 250 to 1,300 m, typically where the water temperature is higher than 4°C and where there is moderate current velocity. These aggregations may occur on soft or hard substrata, i.e. on both sediments and on boulders/cobbles. Deep-sea sponge aggregations are features of conservation importance in Scotland and have been designated as Scottish PMFs (SNH, 2014). Surveys undertaken in 2007 confirmed a patchy presence of a structural sponge habitat (i.e. deep-sea sponge aggregations) between 400 and 600 m depth (Howell *et al.*, 2007).

The Faroe-Shetland Sponge Belt Nature Conservation Marine Protected Area (NCMPA) has been designated to protect these deep-sea sponge aggregations. Joint Nature Conservation Committee (JNCC) interpretation of sponge distribution in the Faroe-Shetland Channel area (JNCC, 2014) shows aggregations centred around the 500 m isobaths, with records becoming scarcer as water depth becomes deeper and shallower. Henry & Roberts (2014) state that sponge grounds occur in a particularly narrow 'sponge belt' centred around the 500 m isobath.

3.3.3 Fish and Shellfish

A number of fish species may be found in the vicinity of the in-field area. These populations may be vulnerable to discharges emitted from offshore installations especially during the egg and juvenile stages of their lifecycles (Bakke *et al.*, 2013).

The Rosebank in-field area is located in International Council for the Exploration of the Sea (ICES) rectangle 50E6 in an area of spawning and nursery grounds for several species (

Table 3-1). Norway pout (*Trisopterus esmarkii*) spawn to the west of Shetland, using deep waters between March and May and shelf waters between January and April (Coull *et al.*, 1998). There are no predicted spawning areas of high intensity which directly overlap with the in-field area.

Blue whiting (*Micromesistius poutassou*) spawn in deep water areas to the west of Shetland from April through to June and may use the area around the Rosebank field as high intensity spawning ground in April and May (Ellis *et al.*, 2012). Blue whiting are widely distributed in the north-east Atlantic, moving in shoals between 150 - 3,000 m water depths. They may pass through the Faroe Shetland Channel when migrating south to reach spawning grounds (DECC, 2016).

Information on spawning and nursery periods for different species, including peak spawning times (where applicable) are detailed in the MAT. There are no benthic spawners such as sandeels and shellfish that are likely to spawn in the vicinity of ICES rectangles 51E6 and 50E6 (relevant to the Faroe-Shetland channel). All species are also listed as Scottish PMFs (SNH, 2014).

Table 3-1 Spawning and nursery periods for fish species in the Faroe-Shetland Channel in the vicinity of the Rosebank in-field area

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Blue whiting	N	N	N	N	N	N	N	N	N	N	N	N
Ling	N	N	N	N	N	N	N	N	N	N	N	N
Mackerel (North Sea)	N	N	N	N	N	N	N	N	N	N	N	N
Norway Pout (Deep)	N	N	SN	SN	SN	N	N	N	N	N	N	N
Norway Pout (Shelf)	SN	S*N	S*N	SN	N	N	N	N	N	N	N	N

Key: S = Spawning; S* = Peak Spawning; N = Nursery; J = Juveniles (i.e., 0 group fish)
 Orange highlight indicates high intensity spawning grounds.
 Source : Coull *et al.* (1998); Ellis *et al.* (2012); Aires *et al.* (2014).

A review of juvenile fish data was undertaken by Aires *et al.* (2014) taking into account the findings of Ellis *et al.* (2012) and Coull *et al.* (1998), together with findings from the National and International Bottom Trawl Surveys, the Beam Trawl Survey, International Herring Larval Surveys and other standalone surveys. The findings summarise the probability of aggregations of juvenile (group 0) fish being present around the UKCS. Within the offshore Development area, there is a low probability of aggregations of juvenile fish (<1 year old) amongst the species that are known to spawn and/or to use the area as nursery (Aires *et al.* 2014).

3.3.4 Seabirds

The Faroe Islands, Norway, Shetland and Orkney and their surrounding waters are of national and international importance for their breeding colonies of seabirds. Seabirds from these breeding colonies are likely to be the main source of seabirds found in offshore waters to the west of Shetland. The WoS area is also visited by over-wintering and migratory birds from Norway, Iceland and the UK mainland.

Seabird abundance decreases in offshore waters following the winter period (December to February) when large numbers of seabirds start to return to their coastal colonies for the breeding season (April to June). During this breeding period, high numbers of breeding seabirds are linked to their colonies and adjacent coastal waters for feeding. Generally, vulnerability is lowest during the pre-breeding and breeding months, increasing as the breeding season ends and birds disperse into offshore waters.

The JNCC has released the latest analysed trends in abundance, productivity, demographic parameters and diet of breeding seabirds, from the Seabird Monitoring Programme (JNCC, 2021b). From the years 1998-2015, the following population trends for species known to use the field area have been recorded: northern fulmars (*Fulmarus glacialis*) (-31%), black legged kittiwakes (*Rissa tridactyla*) (-44%) and common guillemots (*Uria aalge*) (+5%). Breeding seabird numbers of some species have shown a long-term decline, thought to be as a result of a shortage of key prey species such as sandeels associated with changes in oceanographic conditions (Baxter *et al.*, 2011; DECC, 2016).

According to the density maps provided in Kober *et al.* (2010), the following species have been recorded within the Rosebank area; northern fulmar (*Fulmarus glacialis*), sooty shearwater (*Puffinus griseus*), manx shearwater (*Puffinus puffinus*), European storm-petrel (*Hydrobates pelagicus*), northern gannet (*Morus bassanus*), Arctic skua (*Stercorarius parasiticus*), long-tailed skua (*Stercorarius longicaudus*), great skua (*Stercorarius skua*), black-legged kittiwake (*Rissa tridactyla*), great black-backed gull (*Larus marinus*), common gull (*Larus canus*), lesser black-backed gull (*Larus fuscus*), herring gull (*Larus argentatus*), glaucous gull (*Larus hyperboreus*), Arctic tern (*Sterna paradisaea*), common guillemot (*Uria aalge*), razorbill (*Alca*

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torda), little auk (*Alle alle*), and Atlantic puffin (*Fratercula arctica*). The European storm petrel is a summer visitor to the area and occurs in internationally important numbers (>1% of biogeographic population).

The Seabird Oil Sensitivity Index (SOSI) (Webb *et al.*, 2016) identifies sea areas where seabirds are likely to be most sensitive to oil pollution. The survey area covers the UKCS and beyond. Seabird data was collected using boat-based, visual aerial, and digital video aerial survey techniques. This data was combined with individual species sensitivity index values and summed at each location to create a single measure of seabird sensitivity to oil pollution. Block/month combinations that were not provided with data have been populated with the SOSI using an indirect assessment method. Seabird sensitivity is provided in Table 3-2. Seabird sensitivity in Block 205/2 is low all year except for May, where sensitivity is medium. Nearby blocks where sensitivity is high / very high are Blocks 204/5 and 204/10 in September, and Blocks 205/3 and 205/4 in October.

The field is located approximately 130 km from the nearest UK coast and remote from sensitive seabird breeding areas on the coast, including Special Protection Areas (SPAs) designated under the European Union (EU) Birds Directive (79/409/EEC as amended by 2009/147/EC).

Table 3-2 Seabird Sensitivity to Oil Pollution in Block 205/2 and surrounding area (Webb *et al.*, 2016)

Block	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
205/2	5	5*	5*	5	4	5	5	5	5	5*	5	5
205/1	5	5*	4*	4	3	5	5	5	3	5	5	5
205/3	5	5*	5*	5	4	5	5	5	5	1	5	5
205/6	5	5*	5	4	4	5	5	5	3	5	5	5
205/7	5	3*	3	4	3	5	5	5	5	4	5	5
205/8	5	3*	3	5	3	5	5	5	5	3	5	5
213/26	5	3*	3	4	5	5	4	5	2	2*	5	5
213/27	5	3*	3	5	5	5	5	5	4	4*	5	5
213/28	5	5*	5	5	5	5	5	5	5	5*	5	5
Key	1=Extremely high		2=Very high		3=High		4=Medium		5=Low			
* in light of coverage gaps, an indirect assessment of SOSI has been made												

3.3.5 Marine Mammals

3.3.5.1 Cetaceans

Of the 27 species of cetacean recorded in UK waters, 23 are known to be present in the west of Shetland area (Reid, *et al.*, 2003). The Faroe-Shetland Channel and adjacent waters are regarded as important areas for cetaceans in a national and international context.

The regularly sighted whales in the region include blue whale (*Balaenoptera musculus*), fin whale (*Balaenoptera physalus*), sei whale (*Balaenoptera borealis*), minke whale (*Balaenoptera acutorostrata*), humpback whale (*Megaptera novaeangliae*), sperm whale (*Physeter macrocephalus*), northern bottlenose whale (*Hyperoodon ampullatus*), long-finned pilot whale (*Globicephala melas*) and the killer whale (*Orcinus orca*). In addition, Risso's dolphin (*Grampus griseus*), bottlenose dolphin (*Tursiops truncatus*), white-beaked dolphin (*Lagenorhynchus albirostris*), Atlantic white-sided dolphin (*Lagenorhynchus acutus*) and harbour porpoise (*Phocoena Phocoena*) have all been regularly sighted in the waters to the west of Shetland and are therefore considered to be 'within their natural range'. There is increasing evidence that many of the species present in the WoS region are breeding and rearing young (including white-beaked and Atlantic white-sided dolphins, common dolphins, humpback whales and probably blue and fin whales). It is also likely that many of those species reported regularly in this area are feeding. In addition, several species make migrations through these waters (humpback whales and possibly blue and fin whales) (Reid *et al.*, 2003, NMPI, 2023).

Atlantic white-sided dolphin, harbour porpoise, killer whale, long-finned pilot whale, minke whale, Risso's dolphin and white-beaked dolphin have been recorded in the vicinity of the Rosebank area (Reid *et al.*, 2003 and NMPI, 2023) (see Table 3-3 and the MAT). Killer whale, white-beaked dolphin and harbour porpoise are the most frequently recorded species within the Rosebank area, with recorded sightings all year round ranging from low to high densities.

All species that have been sighted in the vicinity of the Rosebank area are listed EPS under the Habitats Directive and as Scottish PMFs. In addition to this, harbour porpoise is also listed as an Annex II species under the Habitats Directive.

Table 3-3 Seasonal sightings of the most frequently sighted cetaceans around the field (Reid *et al.*, 2003 and Scottish Government NMPI)

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Atlantic white-sided dolphin					2	2	2	1				
Harbour porpoise		2	2	2	2	1	1	1	1	2		
Killer whale					1	1	1					
Long-finned pilot whale	2											2
Minke whale					2	2	1					
Risso's dolphin				1		1			3			
White-beaked dolphin							1	1	1	1		

Key: 1 = High Density, 2 = Moderate Density, 3 = Low Density, Blank = No Data,

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3.3.5.2 Seals

Two seal species are resident in British waters; the grey seal (*Halichoerus grypus*) and the harbour seal (*Phoca vitulina*). Under the Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019, grey and harbour seals are considered species whose conservation requires the designation of SACs². These seal species are not considered EPS under the Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019³. However, in UK waters they are protected under the Conservation of Seals Act 1970 such that it is illegal to intentionally or recklessly kill, injure, or take seals. In Scottish waters, both species are considered Scottish PMFs.

Both grey seals and harbour (also called common) seals tend to frequent inshore waters but have been seen offshore from a number of platforms in the North Sea (Cosgrove, 1996).

During a study by Carter *et al* (2022) grey (n = 114: 45 male, 69 female) and harbour seals (n = 239: 107 male, 132 female) were tagged at 26 sites in the UK and Ireland between (2005 – 2019). Haulout counts were scaled to total population size for UK and Ireland using the mean estimated proportion of the population hauled-out during the survey window (and thus available to count). Total population size was then scaled to at-sea population size using the mean estimated proportion of time seals spend at-sea based off the telemetry data gathered during the study period.

Telemetry data were analysed at a 5 km² cell resolution, enabling the percentage of the at-sea population for the UK and Ireland (i.e. excluding hauled-out animals) present in each cell at any one time to be estimated. The resulting distribution maps indicate harbour seals and grey seals are not likely to be present in the Rosebank field area (Carter *et al.*, 2022; Figure 3-6).

² In UK waters, species previously referred to as Annex II under the EU Habitats Directive are now referred to as species of community interest requiring Special Areas of Conservation (SACs).

³ In UK waters species previously referred to as Annex IV under the EU Habitats Directive are now referred to as European Protected Species (EPS). EPS are under strict protection regardless of where they occur within the EU member states. This means it is prohibited to kill, disturb, capture, or trade these species.

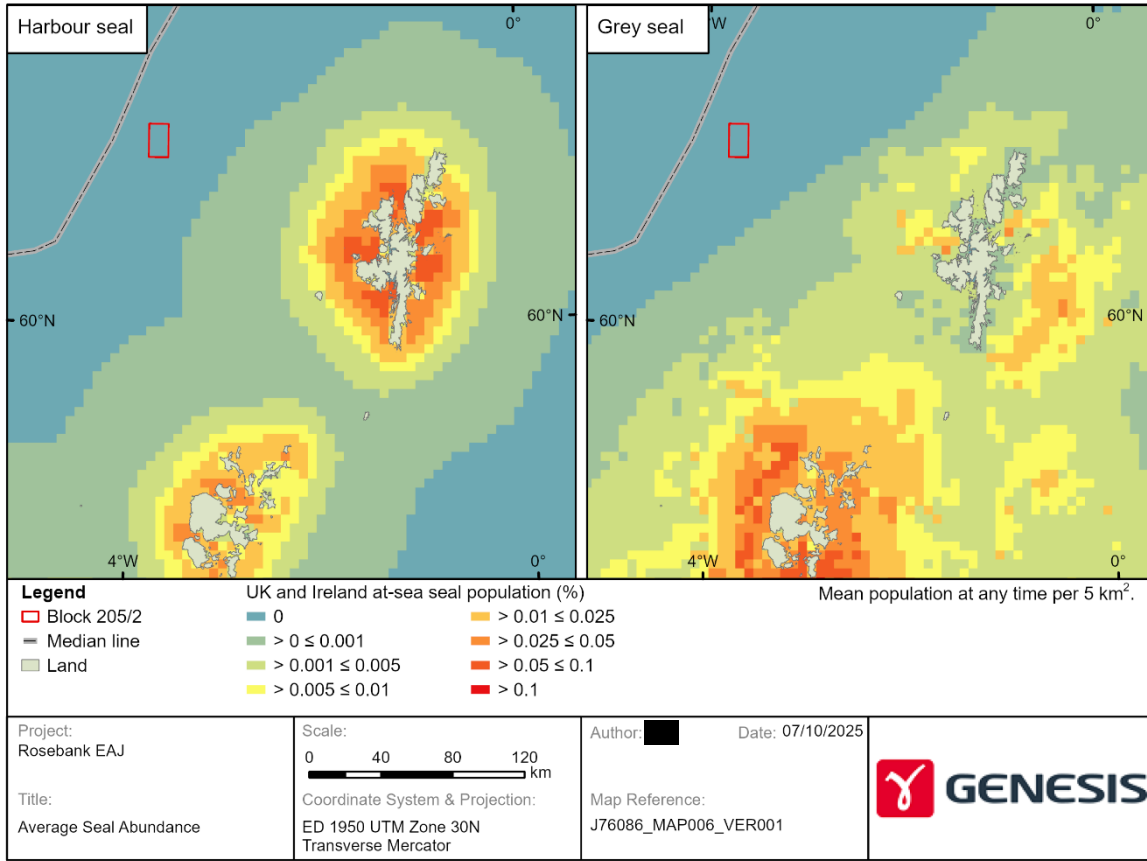


Figure 3-6 Seals abundance in the vicinity of Rosebank.

3.4 Conservation

3.4.1 Protected Areas

A network of Marine Protected Areas (MPAs) is in place to aid the protection of vulnerable and endangered species and habitats through structured legislation and policies. These sites include Special Areas of Conservation (SAC) and Special Protection Areas (SPA), which were designated in the UK under the EU Nature Directives (prior to January 2021) and are now maintained and designated under the Habitats Regulations for England and Wales, Scotland and Northern Ireland. Amendments to the Habitats Regulations mean that the requirements of the EU Nature Directives continue to apply to how European sites (SACs and SPAs) are designated and protected. The Habitats Regulations also provide a legal framework for species requiring strict protection, e.g. EPS.

Nature Conservation Marine Protected Areas (NCMPAs) designated under the Marine (Scotland) Act 2010 or the Marine and Coastal Access Act 2009. The Marine and Coastal Access Act 2009 also allows for the creation of Marine Conservation Zones (MCZs) in English, Welsh and Northern Irish waters. In addition, NatureScot (previously SNH) and JNCC list 81 species and habitats considered PMFs of conservation importance in Scotland's seas (Tyler-Walter *et al.*, 2016). The protected areas within the vicinity of the Rosebank field are shown in Figure 3-7.

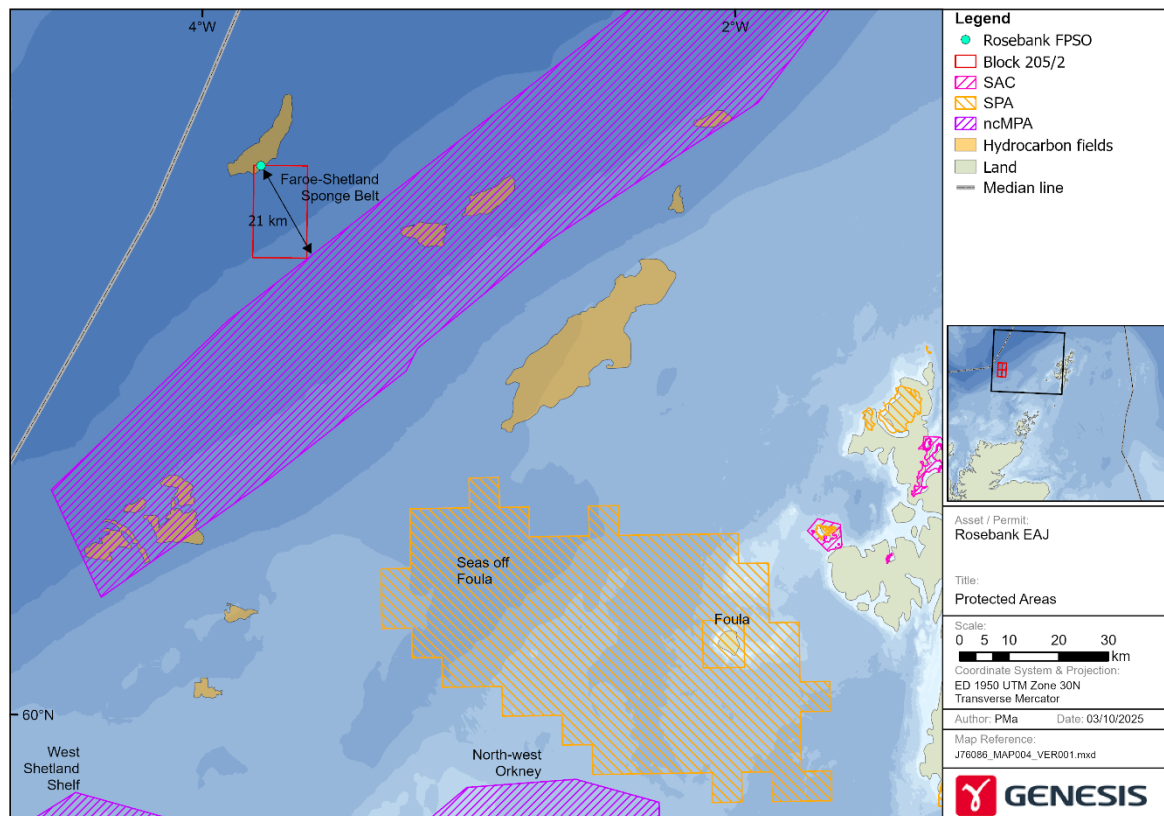


Figure 3-7 Protected Areas in the Vicinity of the Rosebank Field.

3.4.1.1 NCMPA (Nature Conservation Marine Protected Areas)

The closest protected site within 40 km of the field is the Faroe-Shetland Sponge Belt Nature Conservation Marine Protected Area (NCMPA), which is located 21 km away. This has been designated for aggregations of the OSPAR threatened and/or declining habitat of deep sea sponges. It is also designated for offshore subtidal sands and gravels, presence of ocean quahog, large scale continental slope features, and features representative of the West Shetland Margin Paleo-depositional system Key Geodiversity area, including continental slope channels, iceberg plough marks, prograding wedges, slide deposits, sand wave fields, and sediment wave fields (JNCC, 2014). As discussed in Section 3.3.2, the JNCC interpretation of sponge distribution in the Faroe-Shetland Channel area (JNCC, 2014) shows aggregations centred around the 500 m isobaths, with records becoming scarcer as water depth becomes deeper and shallower. Henry & Roberts (2014) state that sponge grounds occur in a particularly narrow 'sponge belt' centred around the 500 m isobath.

3.4.1.2 SPAs (Special Protection Areas)

There is one SPA, the Seas off Foula SPA that is within 100 km of the Rosebank Development. This SPA covers a large area of approximately 3,412 km² and is designated as it provides a foraging area for the following seabird populations of European importance during the breeding season: great skuas, fulmars, gulls and auk.

3.4.1.3 SAC (Special Areas of Conservation)

There are no SACs within 100 km. The nearest Annex I designated offshore conservation site to the proposed operations is the Papa Stour SAC, located approximately 129 km to the southeast.

3.5 Socio-economic Environment

3.5.1 Commercial Fisheries

Vessel activity associated with the installation operation has the potential to interfere with fishing activities. The ICES collates fisheries information for area units termed ICES rectangles measuring 30 nm by 30 nm. The importance of an area to the fishing industry is assessed by measuring the fishing effort, which is defined as the number of days (time) multiplied by the fleet capacity (tonnage and engine power). Due to the requirement by UK fishermen to report catch information such as total landings (includes species type and tonnage of each), and location of hauls and catch method (type of gear / duration of fishing), it is possible to get an indication of the value of an area (ICES rectangle) to the UK fishing industry. It should be noted, however, that fishing activity may not be uniformly distributed over the whole area of the ICES rectangle.

3.5.1.1 Fishing Effort

The Rosebank FPSO is located within ICES statistical rectangle 50E6. Fishing effort statistical data for 2019 to 2023 for ICES rectangle 50E6 (Table 3-4) shows that fishing effort in ICES 50E6 is low (with a mean total fishing effort of 118 days), with data recorded as disclosive (very low) for 6 months of the year (SGMD, 2024).

Table 3-4 Fishing effort (days) taken from ICES rectangle 50E6 2019 – 2023

ICES rectangle 50E6															
Year	Monthly Fishing Effort ¹												Total ²	UK Total	50E6 as % of UK
	J	F	M	A	M	J	J	A	S	O	N	D			
2019	14	D	D	D	D	D	D	D	25	31	D	D	106	126,245	0.1
2020	18	D	D	D	D	D	D	22	17	D	10	5	100	104,027	0.1
2021	D	8	D	D	D	D	D	5	D	D	D	14	63	105,793	0.1
2022	5	3	D	5	17	16	7	D	23	49	D	44	181	95,211	0.2
2023	D	D	10	D	D	15	D	13	10	D	42	26	140	95,358	0.2
Mean													118	105,355	0.1
Notes:															
¹ Monthly effort data are shown where five or more UK vessels over 10 m undertook fishing activity in a given year. Where less than five such vessels undertook fishing activity in a given month, the data are "disclosive" (D) and not shown. ND = No Data. Fishing effort is defined as a measure of the fishing activity of vessels, which includes the time spent travelling to fishing grounds as well as the time spent fishing.															
² Includes disclosive days.															

Vessel Monitoring System (VMS) amalgamated data from 2015-2019 show that demersal fishing intensity in ICES rectangle 50E6 is low in comparison with other areas of the North Sea and in comparison with the adjacent ICES rectangle 50E7 covering shallower waters (Scottish Government NMPi).

3.5.1.2 Fishing Landings

Marine Scotland landings data (2019-2023) have been analysed, which includes landings data for ICES rectangle 50E6 (SGMD, 2024). Based on the SGMD landings and values data, the catch in ICES 50E6 is mainly demersal fishing catch as shown in Table 3-5.

Table 3-5 Live weight and value of landings from ICES Rectangle 50E6, 2019 – 2023 (SGMD data, 2024)

50E6 Species Type	2019		2020		2021		2022		2023	
	Value (£)	Live weight (tonnes)	Value (£)	Live weight (tonnes)	Value (£)	Live weight (tonnes)	Value (£)	Live weight (tonnes)	Value (£)	Live weight (tonnes)
Demersal	720,649	417	578,408	687	287,186	182	1,412,016	695	604,173	393
Pelagic	18	0	111	0.2	-	-	-	-	-	-
Shellfish	2,246	0.7	2,140	1	3,968	2.2	4,264	0.9	7,910	2.2

Trawls and hooks and lines were the most utilised gear type in ICES rectangle 50E6 between 2019 and 2023. Trawl gear was utilised for 55 days and hooks and lines for 93 days in 2023 (SGMD, 2024).

Under the Offshore Fishing (Prohibition of Fishing Methods) (Scotland) Order 2025, demersal mobile gear (bottom trawls, beam trawls, seines and dredges) and demersal static gear (pots, traps, creels, demersal longlines and static nets) is prohibited from zoned areas within the Faroe Shetland Sponge Belt NCMFA. As shown in Figure 3-8, demersal mobile gear and demersal static gear will be prohibited from the southern hatched area, demersal mobile gear will be prohibited from the northern hatched area.

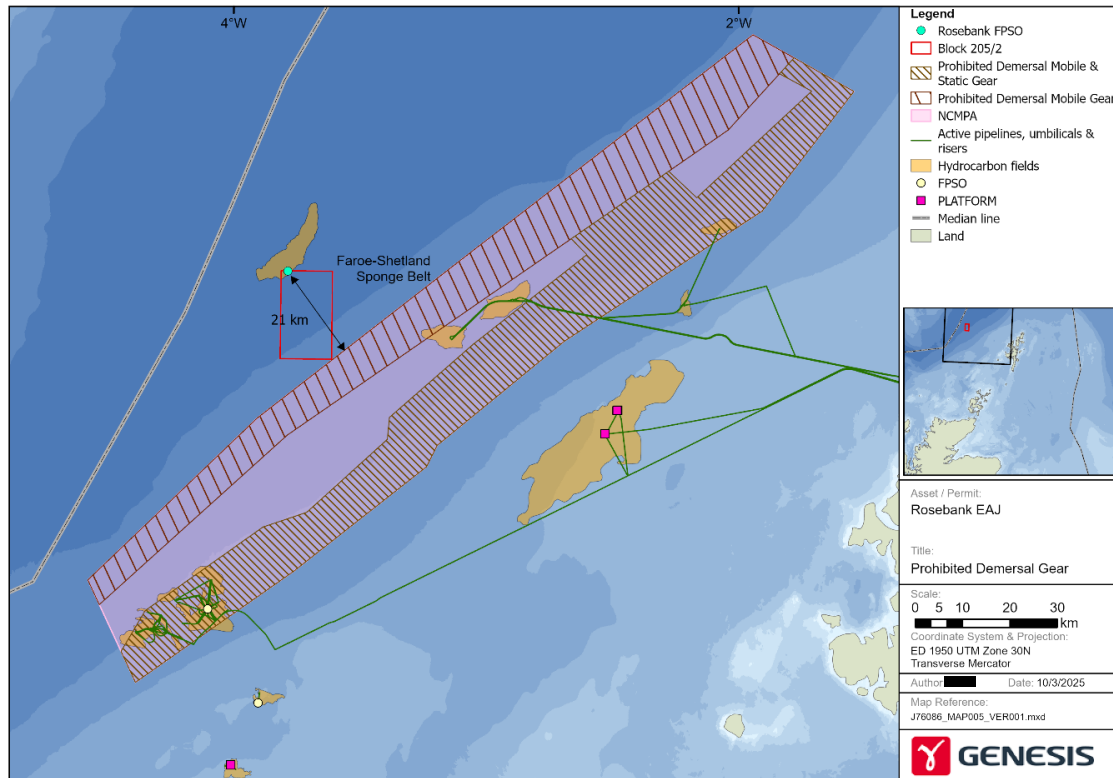


Figure 3-8 Faroe Shetland Sponge Belt MPA showing demersal fishing prohibitions (Scottish Government, 2025).

3.5.2 Shipping

Shipping activities in north west Shetland are low compared with the North Sea and English Channel. Shipping activity around the Rosebank area is negligible to low (OGA, 2017). Commercial vessels in the area include those en route to/from Sullom Voe and cruise liners and ferries between the Faroe Islands and Shetland or Denmark.

A vessel traffic survey was carried out by Anatec Ltd. in December 2024 covering all shipping routes passing within 10 nautical miles of the Rosebank field (Anatec, 2025). The co-ordinates of the well templates and satellite well structures were used as reference guides for the field location. The study indicated that there are thirteen shipping routes trafficked by an estimated 143 vessels per year within 10 nm of the stated locations, corresponding to approximately 2 to 3 vessels per week. The main vessel type is cargo (67%), followed by passenger (25%) and tanker (13%). The closest points of approach to the Rosebank field is 0.6nm N of the Satellite K location used by an estimated 7 vessels per year and 0.7nm to the SW of the Satellite K location used by an estimate of 6 vessels per year.

Using data from AIS, the Anatec survey noted that there was fishing vessel activity in the area of the Rosebank field, with fishing vessels typically recorded as on passage through this area.

A passing vessel density “heat map” illustrates the variation in relative shipping density (Figure 3-9). The diagram shows that the areas surrounding the Rosebank locations have relatively low density, with moderate density levels to the north. The highest density levels were noted within the SW of the 10nm buffer, associated with traffic routing in a NW/SE direction.

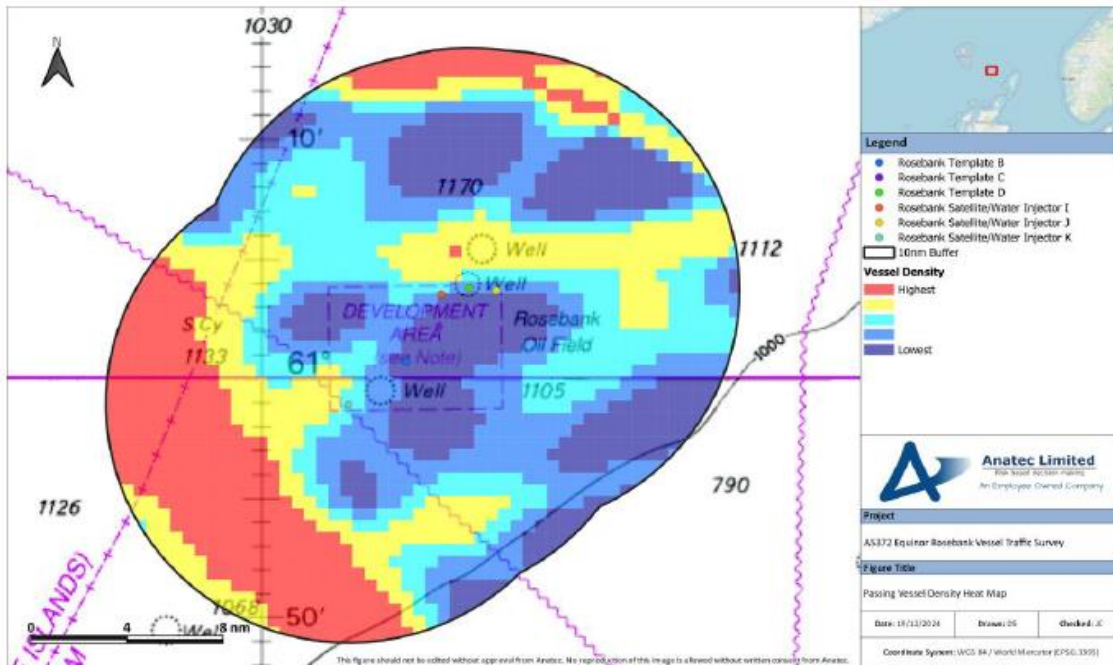


Figure 3-9 Vessel Density "heat map" infield (Anatec, 2025).

AIS data from EMODnet supports this conclusion that areas of shipping activity correlate to the location of offshore facilities, with fishing vessels transiting northeast/southwest in the Faroe-Shetland Channel (EMODnet, 2023).

3.5.3 Oil and Gas Activities

The WoS area is not extensively developed for offshore oil and gas activities. The nearest oil and gas field is the Tormore field c.31 km from the Rosebank field, as shown in Figure 3-10.

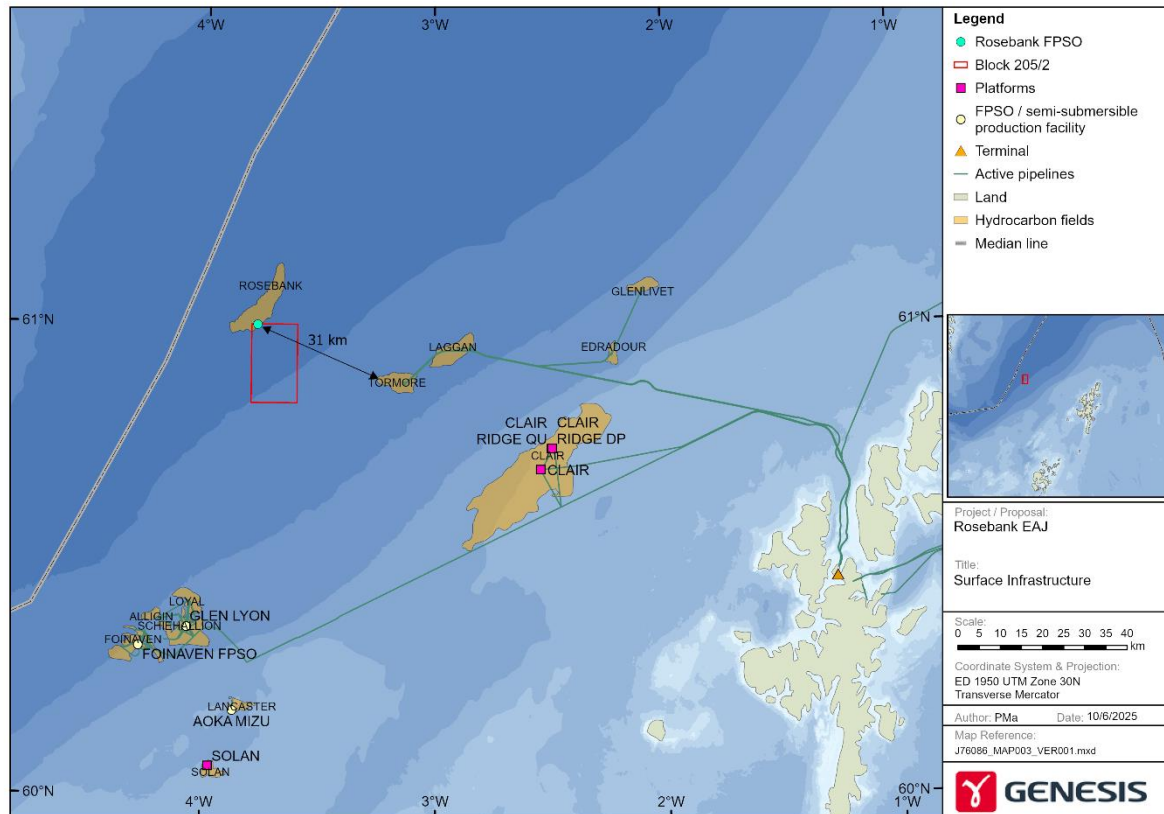


Figure 3-10 Location of Rosebank FPSO in relation to surrounding oil and gas infrastructure.

3.5.4 Military Activities

The Ministry of Defence has been consulted during the planning phase for the operations and have confirmed that there is no objection to licenced activity for the Rosebank Development. There are no military restrictions on activity in Block 205/2 (Scottish Government NMPi).

3.5.5 Submarine Cables

The SHEFA-2 telecommunications cable is laid at a south-east / north-west orientation approximately 5 km at the nearest point from the proposed Rosebank FPSO location. There are two un-named (MoD) cables in the vicinity oriented in a south-west / north-east direction: cable #1 is approximately 1 km north west from the proposed Rosebank FPSO location; cable #2 is approximately 7 km to the south east.

3.5.6 Wrecks

There are no wrecks designated under the Protection of Military Remains Act 1986 located within the proposed Rosebank field area (Scottish Government NMPi). The wreck of the Bourbon Dolphin lies to the north of the Rosebank field area outside the zone of operations.

4.0 ENVIRONMENTAL AND SOCIO-ECONOMIC IMPACT ASSESSMENT

4.1 Physical Presence

This section assesses the physical presence of vessels present during FPSO hook up operations that could cause temporary interference to other marine activities within the area of activities, and the permanent presence of the Rosebank FPSO and mooring lines. The installation of the FPSO has the potential to disrupt the activities of other marine users in the short, medium, and long term, depending on field life.

4.1.1 Vessels

The presence of the vessels used for the FPSO tow and hook up may cause interference to other users of the sea including shipping traffic and fishing vessels. In addition, once the Rosebank FPSO arrives on site, a 500 m safety zone will be applied for the life of the field, excluding fishing vessels from a 0.8 km² area.

The annual fishing effort and shipping within the area can be considered to be low (SGMD, 2024; OGA, 2017). This corresponds to the latest information supplied by a vessel traffic survey carried out in 2024 where it is reported an average of 2 to 3 vessels per week pass within 10 nm the Rosebank vicinity (Anatec, 2025). Golar-Nor (UK) Limited will have in place a robust system for ensuring that the appropriate authorities are informed prior to the commencement of the Rosebank FPSO arrival and commissioning operations. This includes:

- Notification to the UK Hydrographic Office;
- Notification and regular updates to the fortnightly Kingfisher Bulletin/ Fishsafe;
- Notification to Navigational Warnings; and
- Regular meetings are held with the Scottish Fishermen's Federation (SFF) to ensure they are aware of upcoming operations.

A guard vessel is already engaged to patrol the Rosebank field and will cover the installation operations. All vessels undertaking the work scopes discussed in this EAJ operate standard marine operating procedures regarding navigational practice and preventing collisions at sea as in accordance with UK maritime regulations and guidance issued by the Maritime and Coastguard Agency. Due to the temporary nature of vessel operations, and the low fishing and shipping effort within the area, the increase in vessel activity is not expected to have a significant impact on other sea users.

4.1.2 Structures on the Seabed

Following hook-up of the FPSO, the mooring lines will extend beyond the 500 m exclusion zone. Golar-Nor (UK) Limited will inform the fishing community of the presence of the mooring lines, using the measures outlined in Section 4.1.1 above. The mooring lines and their anchors are located in a water depth of approximately 1,100 m. There is a ban on demersal trawl in water depths greater than 800 m and although pelagic trawling may occur in this area, the risk of fishing gear snagging on the structures is considered to be very low given the depths of the mooring lines, the low fishing effort in the area and the mitigation measures in place.

4.1.3 Conclusion

Vessel exclusion zones and the presence of the Rosebank FPSO are expected to have a small magnitude of impact to other sea users due to the small area affected and wider availability of space in the marine environment. Other marine users are considered of medium importance and sensitivity. The area is of low importance to the commercial fishing industry and shipping industry.

Given the mitigation measures in place, the potential impact of physical presence from the operations on other sea users is considered to be minor and therefore impacts may be detectable but not significant. The proposed operations do not contradict the NMP objectives GEN 1 (General Planning and Principle); GEN 4 (Co-existence); GEN 21 (Cumulative Impacts); Oil and Gas 1 (Environmental Risks & Impacts); Oil and Gas 3 (Other Users of the Sea); Oil and Gas 5 (Potential Environmental Risks & Hazards) and Oil and Gas 6 (Risk Reduction Measures).

4.2 Seabed Disturbance

This section relates to the Consent to Locate under Part 4a of the Energy Act 2008 for the 12 mooring line suction pile anchors for the Rosebank FPSO (permanent/fixed structure) and the Consent to Locate under Part 4a of the Energy Act 2008 for the installation of the Rosebank FPSO including the 12 mooring lines (permanent installation). This section provides an assessment of the potential effects relating to seabed disturbance from the Rosebank FPSO installation and discusses the measures implemented to mitigate those effects on the physical environment and associated resources and receptors.

4.2.1 Quantification of Impact

Seabed disturbance will occur on a temporary (short term) and long-term ('permanent') basis. Temporary disturbance will occur during the installation phase and permanent disturbance will occur due to the long-term presence of the mooring line bottom chains on the seabed following hook-up to the FPSO and presence of sand from the sand bags that will be deposited on the seabed.

- Temporary seabed disturbance
 - Lifting of the pre-laid mooring lines during hook up operations
 - Removal of the turning and stability bollards from the seabed
- Permanent seabed disturbance:
 - Presence of 12 suction pile anchors in the seabed
 - Deposit of sand from the turning bollard sandbags
 - Presence of mooring line ground chains following hook-up to the FPSO

There will be a small area of seabed temporarily impacted by the lifting of the pre laid mooring lines and risers, and the removal of the turning and stability bollards.

Permanent seabed disturbance will occur due to the long-term presence of the mooring line suction pile anchors in the seabed. The quantification of impact and assessment of impact of these were assessed in the Adura permit PRA/325.

There will be a small area of permanent disturbance from the deposit of sand from the sandbags that make up the turning bollard 'salt stacks' (refer to Section 2.2.1) The sand will

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be deposited at the bollard location and no additional impact over and above the 70m² from bollard placement is expected.

There will be also be an area of permanent disturbance from the section of mooring line ground chain in contact with the seabed based on 12 lines, each with 500 m of chain in contact with the seabed with an assumed swathe of lateral disturbance of 50 m.

The overall area of seabed anticipated to be permanently impacted is 0.3 km²

4.2.2 Impact Assessment

The hook up operations will cause some sediment to be re-suspended when the mooring lines/ risers are lifted and connected, with resulting turbidity. Exposure to higher-than-normal loads of suspended sediment can have the potential for negative impacts on adjacent habitats and species. The particles can affect the breathing functions (gills and membranes) and feeding functions of organisms in the vicinity, but effects will be localised and short term and are not deemed significant. The benthic species in this area have already been impacted by the temporary placement of the mooring lines, risers and bollards.

The overall area of seabed anticipated to be permanently impacted from the deposit of the sand is 70m² which is a very small area of seabed compared to the extent of similar sediment types in the deep waters west of Shetland. The sand will be deposited in the footprint of the turning bollards which has already been impacted. The inert sand deposits from the bollards do not present a pollution risk and the sand will be assimilated over time into the seabed sediments. It is expected that flora and fauna will begin to recover quickly. The environmental effects from deposition of the sand are considered to be negligible and therefore not significant.

There will be an area of seabed that is abraded by the repetitive dragging of the FPSO mooring lines throughout the Development life. This abrasion is likely to change and/or influence the nature of the seabed and the species present. However, this impact is localised and the total area is small (0.3 km²) within the Rosebank field. There is no evidence of sensitive habitats within the vicinity of proposed operations, such as those described under Annex I of the Habitats Directive; listed on the OSPAR (2008) list of threatened and/or declining species and habitats; listed on the Scottish Biodiversity List (2013); and species/habitats selected as PMF in Scottish offshore waters (SNH, 2014).

4.2.3 Conclusions

The seabed surrounding the Development is typical of the Faroe-Shetland Channel and consists of deep sea mud and deep sea mixed substrata. Surveys have shown no evidence of protected species or habitats in the in-field area, therefore the sensitivity of these receptors is low. When taking into account the localised nature of the seabed impacts associated with the FPSO hook up operations and the presence of the FPSO and mooring lines over the field life, and the low sensitivity of receptors, the environmental effects from seabed disturbance are considered to be negligible and therefore not significant. The proposed operations do not contradict the NMP objectives GEN 1 (General Planning and Principle); GEN 4 (Co-existence); GEN 12 (Water Quality and Resource); GEN 21 (Cumulative Impacts); Oil & Gas 1 (Environmental Risks & Impacts); Oil & Gas 5 (Potential Environmental Risks & Hazards); and Oil & Gas 6 (Risk Reduction Measures).

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4.3 Atmospheric Emissions

This section provides an assessment of the potential effects from the atmospheric emissions during the installation of and production from the Rosebank FPSO and discusses the measures implemented to mitigate those effects on the environment and associated resources and receptors.

4.3.1 Emissions during FPSO Hook Up

This section relates to the Consent to Locate under Part 4a of the Energy Act 2008 for the installation of the Rosebank FPSO.

It is expected that vessel emissions during the FPSO installation activities at Rosebank will result in emissions of carbon dioxide (CO₂), methane (CH₄) and nitrous oxides (N₂O), which are all GHGs. There will also be emissions of sulphur oxides (SO_x), oxides of nitrogen (NO_x), carbon monoxide (CO) and volatile organic compounds (VOCs). Atmospheric emissions may cause effects at local, regional and global scales, the effects of which may include respiratory illness, ground-level ozone, acid rain, and contributing to global climate change.

Greenhouse gases differ in their abilities to trap heat. Global Warming Potential (GWP) is a relative measure of how much heat a greenhouse gas traps in the atmosphere; usually expressed as CO₂ equivalent (CO₂e). Overall, CO₂e emissions from UK upstream oil and gas operations in 2018 contributed three percent (14.63 million tonnes) of total domestic CO₂e emissions. Of this, around 3.5 million tonnes of CO₂e was generated from flaring gas offshore (OGUK, 2019).

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Table 4-1 shows the expected vessel emissions based on predicted vessel requirements in Section 2.2.2. This information will be updated in a future variation once the exact vessels to be used in the tow and hook up operations are known.

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Table 4-1 Predicted atmospheric emissions associated with the hook up of the Rosebank FPSO

Source		Atmospheric emissions (te)							CO ₂ e ²
		CO ₂	NO _x	N ₂ O	SO ₂	CO	CH ₄	VOC	
EEMS Emissions Factor ¹		3.2	0.0594	0.00022	0.002	0.0157	0.00018	0.002	-
GWP		1	-	265	-	-	28	-	-
Source	Total fuel use (te)								
Vessels	3,676 (see Table 2-3)	11,763.2	218.35	0.81	7.35	57.71	0.66	7.35	12,001.85
2018 total upstream UKCS emissions ³									18,100,000
Total emissions from proposed operations as a % of UKCS emissions in 2018									0.066
2024 total upstream UKCS emissions ³									11,800,00
Total emissions from proposed operations as a % of UKCS emissions in 2024									0.102
¹ Emissions calculated using EEMS emission factors (EEMS, 2008).									
² CO ₂ e figure is calculated by multiplying CO ₂ , N ₂ O and CH ₄ by their relevant GWP value (IPCC, 2014).									
³ NSTA, 2025.									

The emissions associated with these operations may result in short-term deterioration of local air quality within the vicinity of the development, however, in the exposed conditions that prevail offshore, these emissions are expected to disperse rapidly such that emissions from vessels are not considered to have a significant impact. The emissions from the anticipated vessel use will amount to c. 0.102 % of the total upstream UKCS emissions in 2024 (Table 4-1) and therefore represents a relatively small contribution to total UKCS emissions

These estimated emissions represent a worst-case scenario, including extra time to account for project delays, waiting on weather, and energy consuming activities such as maximum transit speed. The Rosebank ES (Equinor, 2022a) assessed the impact of vessel emissions at the development site for all installation operations. This has been developed and refined during project planning and Technip FMC have prepared a project specific energy efficiency plan related to vessel operations, building on the existing SEEMPs (Ship Energy Efficiency Management Plan) and including fuel consumption both during installation operations and during transit to and from field location. The SEEMP is developed and implemented by vessel owners to reduce operational costs and increase energy efficiency. It includes a vessel operating strategy describing how the vessel operates and associated energy use from the use of generators, thrusters and other equipment. Energy efficiency measures including optimising transit speeds and utilising “reduced” dynamic positioning mode during weather wait. Vessel fuel consumption and associated emissions will be recorded in an automated cloud based digital system and reported to the project at least monthly. Opportunities to reduce fuel consumption are integral to the implementation of the SEEMP and operational best practice will be shared where possible.

Due to the high dispersion rates and minimal nature of the emissions in relation to total UKCS emissions, no further mitigation measures are proposed.

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4.3.2 Emissions During Commissioning

This section relates to the Offshore Combustion Installation Permit under the Offshore Combustion Installations (Pollution Prevention and Control) (PPC) Regulations 2013 (as amended).

The main sources of emissions to air from the Rosebank FPSO during commissioning operations result from the use of diesel for power generation using the combustion equipment discussed in 2.3.5 and from non-routine gas flaring. Emission Loads forecasts are discussed in Section 4.3.5. and the PPC SAT.

The most likely impact on air quality from the use of combustion plant would be that from the discharge of exhaust gas mainly comprising carbon dioxide (CO₂), nitrogen and water with small quantities of carbon monoxide (CO), oxides of nitrogen (NO_x) and sulphur dioxide (SO₂) and volatile organic compounds (VOCs). The impacts on the environment from the release of these gases can be local, regional or global.

Local impacts from emissions tend to be on air quality and are associated with potential health problems caused by increased concentrations of certain pollutants: NO_x, SO₂, VOCs, particulates and CO. The importance of air quality is reflected in the adoption, Europe-wide, of a series of air quality standards and objectives. In addition to local impacts, emissions to air also contribute to regional impacts (for instance, eutrophication and ground level ozone formation) and global impacts (global warming).

4.3.3 Emissions during Production

This section relates to the Offshore Combustion Installation Permit under the Offshore Combustion Installations (Pollution Prevention and Control) (PPC) Regulations 2013 (as amended).

The “Emission Profiles” table as presented in the PPC SAT shows the pollutant signatures for the main items of combustion plant on the Rosebank FPSO. Profiles have not been provided for equipment that is not material, for example:

- The equipment has a thermal capacity of < 1 MW(th); or
- The equipment is run for less than 500 hours per annum.

4.3.3.1 Sources

4.3.3.1.1 Flaring

Releases to the flare system are primarily governed by:

- Category A : Streams for the safe operation of the asset based on its current design and operating at optimum efficiency (excluding Category C)
- Category B: Flaring and venting occurring during normal operations beyond levels optimum for the installation.
- Category C: Emergency disposal and gas streams required specifically for the operation of safety critical equipment/elements

During normal steady state operation very little gas is expected to be flared due to the recovery and recompression of waste gas back into the process via the VRU. There may be flaring during the following operational scenarios:

- Start-up (prior to starting the low-pressure (LLP) and high pressure (HP) compressors

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- Shut down
- Slugging events
- Equipment depressurisation for maintenance purposes
- Emergency depressurisation (EDP) in the event of a fire and gas initiated shutdown
- Equipment failure (compressors, passing valves)

4.3.3.1.2 Combustion Power

Atmospheric emissions from power generation during production will be permitted under the installations PPC permit and UKETS permit.

The combustion equipment on the Rosebank FPSO is summarised in Section 2.3.5.

4.3.3.1.3 Venting

Cold venting occurs infrequently on Rosebank only during process restart and to relieve pressure for maintenance events.

4.3.4 Emission Factors

Emissions are calculated based on the fuel forecasts and the relevant emission factors. CO₂ Emissions factors for the GTGs have been estimated using the expected gas composition in Table 2-6 and NO_x Emission Factors derived from the warranted emissions load when operating in SoLoNO_xTM DLE mode (when operating above 50% load) and using the default factor from the EEMS guidance (DECC, 2008) when outside of this operating envelope. A site specific NO_x factor will be derived once Stack Monitoring Testing has been undertaken within 12 months of production operations starting. All other Emissions factors are taken from the EEMS database. The emissions factors used for the calculation of emissions from combustion equipment on the Rosebank FPSO are presented in Table 4-2.

Table 4-2: Emission Factors (Genesis, 2025a)

FUEL	EQUIPMENT	CO ₂	NO _x	SO ₂	CO	CH ₄	VOC
Diesel	GTGs	3.2	0.0135	0.002	0.00092	0.0000328	0.000295
	Other Diesel Engines	3.2	0.0594	0.002	0.0157	0.00018	0.002
	Boiler	3.2	0.0028	0.002	0.00071	0.00000705	0.0000282
Fuel Gas	GTGs	2.8045	0.0061 ^[1] 0.001995 ^[2]	0.0000128	0.006	0.00092	0.000036
	Boiler	2.86	0.0024	0.0000128	0.006	0.000089	0.0000000099

[1] Default NO_x Emissions factor used during periods of non-DLE operation (i.e. turbine is operating below 50% load where SoLoNO_xTM will not be in operation), taken from the EEMS guidance (DECC, 2008). Suitable site specific factors will be determined following Stack Monitoring Testing within first 12 months of production.

[2] NO_x Emissions factor derived from the OEM warranted emissions load on turbines operating in SoLoNO_xTM mode (In region of 50-100% operating load)

4.3.5 Emissions Loads

Emission loads forecasts for the equipment falling under PPC are presented in the PPC SAT and in Table 4-3 for CO₂, NO_x, SO₂, CO, CH₄ and VOC emissions. The emission loads are dependent mainly on the power requirement of the FPSO. This power requirement is summarised in Section 2.3.6. Energy efficiency measures and emission control technologies are discussed in the BAT Assessment (Genesis, 2025c). During the hook up and commissioning phase, power generation will use diesel fuel till the commissioning of fuel gas systems are completed and import gas available from the WOSPS pipeline prior to production start-up.

These emission loads are based on:

- Generator Turbines have been designed with a dry low emission (DLE) burners, so overall NO_x and SO_x emissions should be less than reported;
- Normal operating philosophy is three Generator Turbines online around 70% load to satisfy heat demand in early production;
- Three Fire Pumps online where required.

Table 4-3: Predicted maximum emission loads (tonnes/year) (Genesis, 2025a).

YEAR ¹	EMISSIONS (TE)						
	CO ₂	NO _x	SO _x	CO	CH ₄	VOC	Dust (PM)
2026	183,006	349.51	34.98	291.23	42.97	6.95	N/A
2027	183,090	190.84	3.57	388.25	59.09	3.30	N/A
2028	183,090	190.84	3.57	388.25	59.09	3.30	N/A

4.3.6 Air Dispersion Modeling and Transboundary Impacts

The production emissions from the Rosebank FPSO on sensitive receptors, offshore and onshore, has been assessed using air dispersion modelling. The results have been compared to the UK short-term and long-term ambient air quality objectives. Detailed technical information of the air quality assessment is presented in the Petrojarl Rosebank FPSO Air Quality Assessment (Genesis, 2025d).

The power demand of the main combustion equipment for the Rosebank FPSO is anticipated to be up to 70% load of the gas turbines. To ensure the air quality assessment is conservative with respect to planned operation, the Rosebank FPSO gas turbine emissions were modelled at higher power demand loads. Details of the modelled scenarios are listed below:

- Scenario 1: Normal Operations. 3 x Solar Titan 130 running on fuel gas at 84% load;
- Scenario 1b: Sensitivity Test. 2 x Solar Titan 130 running on fuel gas at 84% load plus 2x Solar Titan 130 running on fuel gas at <50% load (No DLE NO_x Technology in operation);
- Scenario 2: Non-Routine Operations. 3 x Solar Titan 130 operation running on diesel at 89% load;

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- Scenario 3: Non-Routine Operations with flaring. 2 x Solar Titan 130 Operation on diesel running on diesel at 89% load with flaring. As demand is reduced, fewer turbines are required to be running.

The results of the air quality assessment showed that overall, the short-term and long-term NO₂, SO₂ and CO Process Contributions (PCs) have been screened out as insignificant (1% of the Air Quality Standards), except for the short-term NO₂ PCs during non-routine operations, Scenarios 2 and 3, (>10% of the Air Quality Standard). The NO₂ Predicted Environmental Concentrations (PECs) for these two scenarios ranged between 13.6% and 24.9% of the short-term air quality standard (200 µg/m³) and therefore considered to be insignificant.

The changes in NO₂, SO₂ and CO concentrations at all identified sensitive human receptors, including neighbouring platforms, FPSOs, the UKCS median line, and the nearest onshore receptor, Shetland, were insignificant.

4.3.7 Conclusions

The primary sources of emissions during the installation phase are associated with the vessels required for the installation activities and power generation/flaring during commissioning. The primary sources of emissions during production are from power generation. The emissions are considered to be of small magnitude and as having a short term impact that is localised at the point of discharge. The sensitivity of the local air quality to atmospheric emissions is considered low due to the absence of existing pollution sources and absence of sensitive receptors in the area. The residual effects are therefore assessed as negligible significance.

Given the distance to the nearest landfall and other oil and gas infrastructure, and the strong prevailing winds west of Shetland, the potential for any cumulative effects will be negligible. No significant transboundary air quality effects are predicted from the Rosebank FPSO during installation and commissioning on either UK receptors or receptors of other member states

Overall, the atmospheric emissions associated with the proposed installation and production activities are not considered to be significant. The proposed operations do not contradict the NMP objectives GEN 1 (General Planning and Principle); GEN 5 (Climate Change); GEN 14 (Air Quality); GEN 21 (Cumulative Impacts); Oil & Gas 1 (Environmental Risks & Impacts); Oil & Gas 5 (Potential Environmental Risks & Hazards); and Oil & Gas 6 (Risk Reduction measures).

4.4 Underwater Noise

The primary noise source during FPSO hook and up and production will be vessel noise. The noise impacts from piling during the installation of the anchor suction piles was assessed in the Adura MAT PRA/325. This section provides an assessment of the potential effects from underwater noise from vessels during the hook up and commissioning and production operations of the Rosebank FPSO.

Marine mammals use sound for navigation, communication and prey detection (see reviews in Southall *et al.*, 2007). As such, the introduction of anthropogenic underwater sound has the potential to impact marine animals if it interferes with the animal's ability to use and receive sound. Human activities at sea generate underwater sound. The characteristics of the sound produced, in terms of the amplitude, range of frequencies and temporal characteristics, vary with the type of activity and vessel type. For example, piling and blasting creates sudden, powerful and repetitive sounds which, without mitigation, can produce noise levels capable of

causing injury. Sound levels in the marine environment diminish with distance from the source. Underwater noise can also cause injury and behavioural disturbance in fish.

Vessel noise, occurring during FPSO hook up and tanker offloading, and from the FPSO propellers, propulsion and other machinery, is considered to be below the levels which would present a significant risk to marine mammals as identified by Southall *et al.*, (2019) and the NOAA thresholds (NMFS, 2018). As vessel noise is considered to be a low-risk source of underwater noise and is extremely unlikely to cause injury in marine mammals and fish. It is therefore considered that impacts to marine mammals from underwater noise will not be significant and no mitigation measures are proposed.

4.4.1 Conclusions

Underwater sound generated during the proposed operations is considered to have a slight magnitude of impact and receptor sensitivity is considered to be low. Therefore, the impact from underwater noise is deemed to have negligible significance and will not contradict the NMP objectives: GEN 1 (General Planning and Principle); GEN 9 (Natural Heritage); GEN 13 (Noise); GEN 21 (Cumulative Impacts); Oil & Gas 1 (Environmental Risks & Impacts); Oil & Gas 5 (Potential Environmental Risks & Hazards); and Oil & Gas 6 (Risk Reduction Measures).

4.5 Discharges to Sea

Under normal operations produced water will be treated and reinjected into the reservoir, as a result there will be no routine discharge of produced water. In upset conditions, produced water will be routed direct to an overboard dump caisson if it is within the permitted discharge specification. There is an option to divert produced water to the slop tanks and cargo tank 5 if the produced water is off spec, or maintenance to the produced water reinjection system is required.

The discharge of hydrocarbons to sea will be permitted under the Offshore Petroleum Activities (Oil Pollution Prevention and Control) Regulations 2005 (as amended). An OLP will be prepared in 2026 for all hydrocarbon and sand discharges to sea.

As discussed in Section 2.3.4.5, specialist chemicals will be used during commissioning and production to maintain process efficiency and to maintain pipelines and ensure pipeline integrity. The use and/or discharge of all production chemicals will be subject to risk assessment and permitting under the Offshore Chemicals Regulations 2002. A production Chemical Permit will be prepared in 2026 for all production chemicals. The impact of any chemicals discharged to sea will be assessed at the time of preparing the Chemical Permit.

4.6 Cumulative and Transboundary Impacts

Due to the localised nature of the installation activities and production operations, none of the nearby oil and gas fields and installations, or other sea users, are likely to be impacted by the operations. The works will result in disturbance to the seabed, atmospheric emissions and underwater noise but these are not considered to significantly increase cumulative impacts from surrounding oil and gas assets.

The Rosebank field is c.16.5 km from the UK/ Faroes median line. Due to the localised nature of the disturbance to the seabed, underwater noise, emissions and discharges, it is not thought that there will be any transboundary impacts. Atmospheric impacts associated with the FPSO

installation and commissioning activities are expected to be localised and rapidly dispersed by the strong prevailing winds in this area.

4.7 Accidental Hydrocarbon Spills

In accordance with the Merchant Shipping (Oil Pollution Preparedness, Response and Co-operation Convention) Regulations 1998 and the Offshore Installations (Emergency Pollution Control) Regulations 2002, the Rosebank FPSO Offshore Oil Pollution Emergency Plan (OPEP) has been prepared by Golar-Nor (UK) Limited as the appointed Installation Operator and covers the Rosebank FPSO Tier 1 response (Altera, 2025).

Adura, as field operator, will take Primacy for the Tier 2/3 response for any spill originating from the FPSO and associated infrastructure. Adura have an approved OPEP in place that covers this response, which has been developed in accordance with the Merchant Shipping (Oil Pollution Preparedness, Response and Co-operation Convention) Regulations 1998 and the Offshore Installations (Emergency Pollution Control) Regulations 2002 (Adura, 2025).

The following potential hydrocarbon spill scenarios for the FPSO have been assessed as part of the modelling in the Rosebank Offshore OPEP:

- Stochastic modelling for the instantaneous release of 128,392.6 m³ of crude as a result of failure of the 12 FPSO crude inventory tanks.

The modelling results and conclusions are discussed below.

4.7.1 Spills During Operation

Stochastic modelling has been undertaken by Petrofac using the SINTEF Oil Spill Contingency and Response (OSCAR) model to evaluate the loss of the full inventory from the Rosebank FPSO cargo oil tanks (Petrofac, 2024).

The stochastic approach models a spill scenario multiple times over different weather conditions and aggregates results from all the runs. The stochastic modelling indicates the probability of exceeding the pre-defined assessment thresholds. This approach allows a sufficient number of simulations to adequately model the variability in the wind speed and direction in the area identified within the simulation.

Running multiple release simulations during a single season is considered to provide a reliable prediction of the oil pathways and oiling probabilities for a release starting during that season and extending into subsequent seasons.

The worst-case risk of an accidental hydrocarbon spill during operations would be from the loss of inventory from all 12 of the Rosebank FPSO cargo oil tanks⁴ (128,392.6 m³). This scenario has been modelled as an instantaneous release (full volume released in one hour) with a total simulation time of 20 days (see Table 4-4).

Table 4-4 Key scenario parameters

⁴ The total volume modelled did not include the two cargo slop tanks that have a capacity of 4,430.9 m³ (< 3.5% of the total volume). The inclusion of these tanks would not be expected to alter the outcome of the MEI assessment for the full inventory loss.

Release location*: Rosebank FPSO	Oil group	Release depth	Release duration (hours)	Simulation time (days)	Total release volume (m ³)
61° 0' 3.24" N 003° 46' 25.69" W	Crude	Sea surface	1	20	128,392.6
*WGS84: World Geodetic System 1984					

The fate and effect of a spill is dependent on the chemical and physical properties of the hydrocarbons. OSCAR includes a database that contains various oil types. In the model the Rosebank crude has been represented by Elli South based on their similar properties (Table 4-5).

Table 4-5 Hydrocarbon properties

Name	I TOPF Group ¹	Specific gravity	Viscosity (cP), (temp.)	Pour Point (°C)	Wax Content (%)	Asphaltene Content (%)
Rosebank Crude	2	0.841	-	20	15.8	0.83
Elli South	2	0.838	102, (13°C)	12	8.3	0.09
¹ Oils are categorised into I TOPF Groups based on their API (or specific gravity). I TOPF Group 2 oils tend to be light crude oils with a specific gravity of 0.8-0.85 (I TOPF, 2011).						

In alignment with the OPEP Guidance, the results were analysed to determine:

- The probability of a visible surface oil with a minimum thickness threshold of 0.3 µm displayed to >10%;
- Time of arrival, and probability >1% of crossing UKCS median line; and,
- Time of arrival, and probability >1% of shoreline contamination along UK and Member States coastlines respectively.

A detailed breakdown of surface oiling and beaching probabilities is provided in the stochastic modelling outputs shown in Figure 4-1 and Figure 4-2, and Table 4-6.

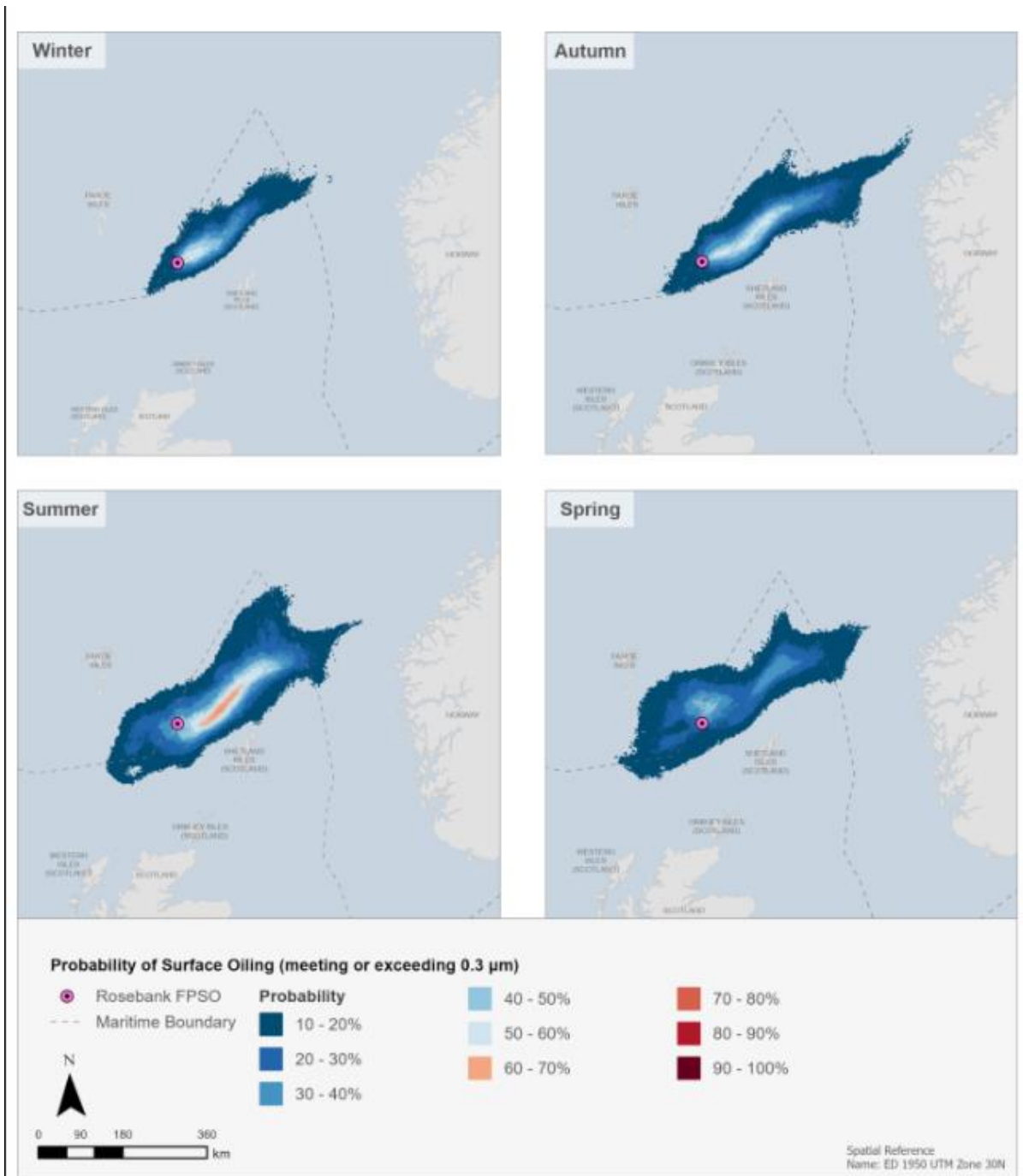


Figure 4-1 Probability of surface oiling (Petrofac, 2024)

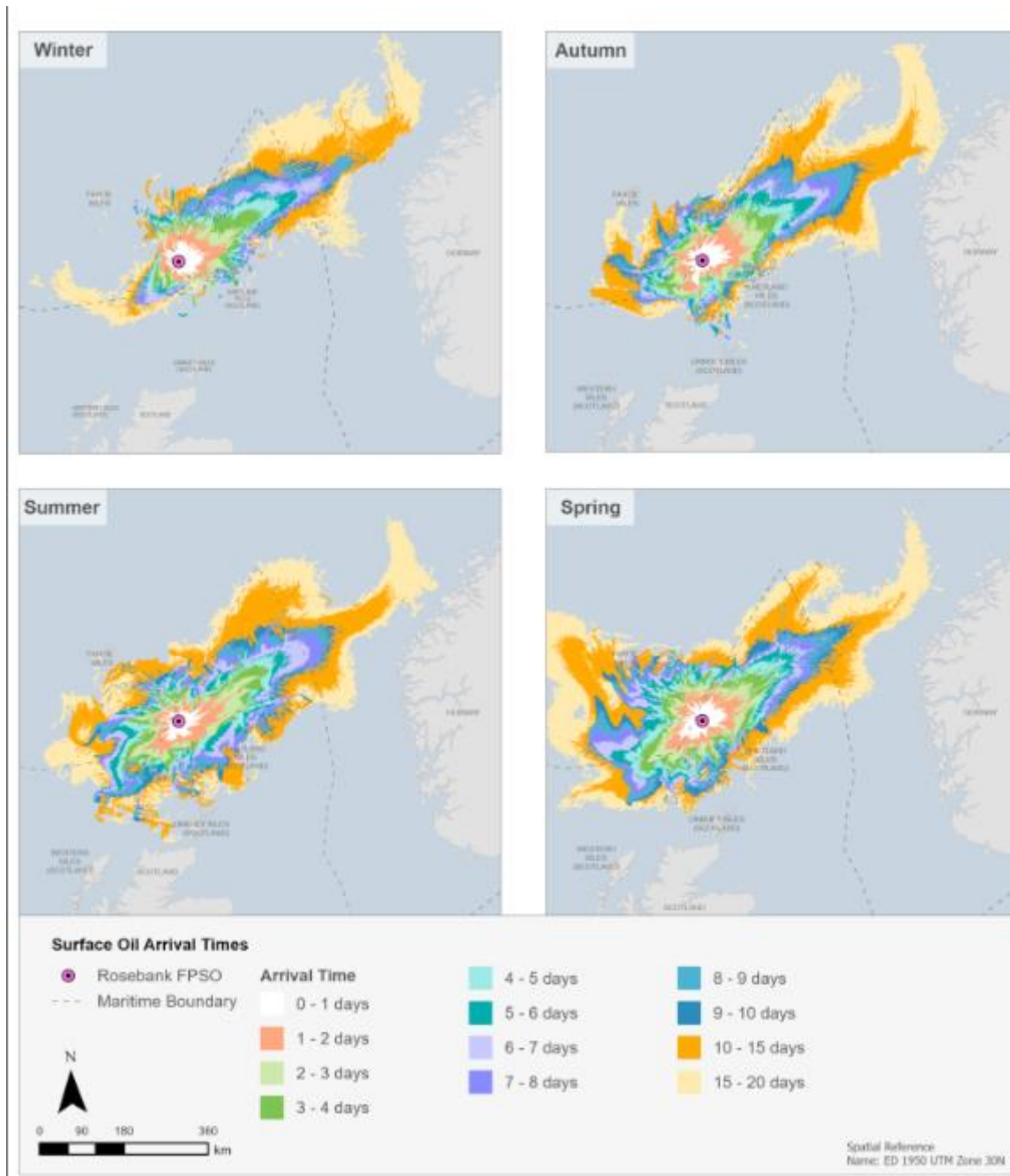


Figure 4-2 Arrival time of surface oil (Petrofac, 2024)

Table 4-6 Summary of Modelling Output for Worst Case Release

Shortest time to reach and probability ($\geq 1\%$) of surface oil ($\geq 0.3 \mu\text{m}$) crossing median line				
Coastal States	Dec-Feb	Mar-May	Jun-Aug	Sep-Nov
Norwegian Waters	5 days	6 days	6 days	6 days
	10 – 20%	20 – 30%	20 – 30%	30 – 40%
Faroese Waters	6 hours	7 hours	11 hours	8 hours
	30 – 40%	40 – 50%	30 – 40%	20 – 30%
Shortest time and probability ($\geq 1\%$) of shoreline oiling after 20 days				
Shoreline	Dec-Feb	Mar-May	Jun-Aug	Sep-Nov
United Kingdom				
Shetland	No shoreline oiling predicted above 1% probability	10 days	7 days	No shoreline oiling predicted above 1% probability
		1-5%	5-10%	
Coastal States				
Faroes	No shoreline oiling predicted above 1% probability	6 days	10 days	No shoreline oiling predicted above 1% probability
		1-5 %	1-5 %	
Maximum mass accumulated onshore				
After 20 days	148 m ³	5,631 m ³	5,092 m ³	53 m ³

A crude oil total inventory loss at Rosebank FPSO is predicted to affect a large volume of water (6,420 km³) although this volume of water would start recovering after the hydrocarbon release has stopped (Genesis, 2025). There is a low probability of oil spreading into nearshore areas. The modelling indicates that the highest probability of beaching along the UK coastline is 5-10% along the coastline of Shetland between June and August. The modelling shows an even lower probability of shoreline impact in the Faroes, 1-5% between June and August. The total worst-case of crude oil to beach is predicted to be 5,631 m³ (4,736 tonnes).

The volume of oil beaching on coastlines is dependent on a number of factors such as the properties of the oil, and weather and sea conditions; where rougher seas are expected to break up and disperse surface oil more readily. The oil modelled for the loss of crude inventory from the Rosebank FPSO is a Type II hydrocarbon, which ITOPF (2014) suggests feature low asphaltene content (<0.5%); these are less likely to form emulsions and are therefore more able to readily disperse. However, it is worth noting that the Rosebank crude has an asphaltene content of 0.83% which would tend to emulsify in moderate to rough seas (ITOPF, 2014).

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It should be noted that the modelling detailed assumes no intervention/response methods in order to determine the environmentally worst case. In reality, the OPEP would be implemented to respond to the spill. The probability of an accidental hydrocarbon release occurring is very low and with mitigation measures in place, the likelihood of a spill occurring is further reduced.

4.7.2 Spill Response Strategy

There are three tiers of hydrocarbon spill incident:

- Tier 1 – Level of response that is locally available;
- Tier 2 – Larger releases that cannot be managed by the resources on-site and will require support from a regional location; and
- Tier 3 – A major or significant release that is likely to require national and international resources.

The Rosebank FPSO Offshore OPEP (Altera, 2025) details specific response strategies for Tier 1 responses, and the process for elevating the tier response to levels 2 and 3, at which point Adura's Onshore OPEP would take over (see below for more information). Should an incident require a Tier 2 or Tier 3 response, the Adura Onshore Incident Management Team (IMT), in conjunction with Technical Specialists, would determine the appropriate response strategy, taking account of current weather conditions, spill size and sea state, along with any safety considerations

In the event of a spill, Golar-Nor (UK) Limited will follow the response measures detailed in the Rosebank FPSO Offshore OPEP, which include monitoring and surveillance (using the ERRV and crew change helicopters if required), and dispersant application from the ERRV if deemed appropriate.

If the release requires resources beyond the capability of offshore, the Tier 2/3 response will be initiated and the response measures detailed in the Adura Onshore OPEP will be followed which include:

- Offshore Containment and Recovery;
- Relief well drilling in parallel with deployment of a capping device; and
- Shoreline protection and clean-up.

The availability of some, or all, of these responses will be weather dependant and any mitigation measures will be modified accordingly throughout any response and based on the Tier of response required.

4.8 Major Environmental Incident

The Offshore Installations (Safety Case etc.) Regulations 2015 (SCR, 2015) extends the evaluation of Major Accidental Hazard (MAH) to include their potential consequences on the safety of personnel and the environment, referred to as a Major Environmental Incident (MEI).

An MEI is defined in the SCR (2015) as an "incident which results, or is likely to result, in significant adverse effects on the environment in accordance with Directive 2004/35/EC of the European Parliament and of the Council on environmental liability with regard to the prevention and remedying of environmental damage". "Environmental damage" is defined in Directive 2004/35/EC as:

- "Damage to protected species and natural habitats, which is any damage that has significant adverse effects on reaching or maintaining the favourable conservation

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status of such habitats or species. The significance of such effects is to be assessed with reference to the baseline condition, taking account of the criteria set out in Annex I”;

- “Water damage, which is any damage that significantly adversely affects the ecological, chemical and/or quantitative status and/or ecological potential, as defined in Directive 2000/60/EC, of the waters concerned, with the exception of adverse effects where Article 4(7) of that Directive applies”;
- “Land damage, which is any land contamination that creates a significant risk of human health being adversely affected as a result of the direct or indirect introduction, in, on or under land, of substances, preparations, organisms or micro-organisms”.

4.8.1 MEI Assessment

An MEI assessment has been carried out to cover a total loss of the Rosebank FPSO cargo oil tank inventories i.e., 128,392.6 m³. The approach applied considered the predicted modelling results of a loss of inventory in relation to the environmental receptors that could be impacted and then assessed the environmental significance (to a methodology described in the MEI Assessment Report (Genesis, 2025b)).

The MEI assessment concluded that a total loss of the Rosebank FPSO cargo oil tank inventory could result in significant adverse effects to offshore and nearshore protected areas, and protected species of birds and/or marine mammals. Therefore, a total loss of the Rosebank FPSO cargo oil tank inventories qualifies as a MEI under the Safety Case Regulation SCR 2015. The probability of such an event is, however, remote.

Smaller scale release scenarios such as the loss of a single cargo oil tank (11,669.3 m³) and the entire loss of the FPSO diesel inventory (5,006.7 m³) have also been considered. Release modelling has not been carried out for these two smaller scenarios, however, it was possible to use the results from the larger release scenario and the understanding of the behaviour of hydrocarbons when they are released at sea to infer if these releases would result in an MEI or not.

The loss of a single cargo oil tank and the entire loss of the FPSO diesel inventory are less than 10% and 4%, respectively, of the full cargo oil tank inventory that was modelled and assessed. As such, the magnitude of effect on the environmental receptors is predicted to be lesser. Taking this into consideration, it is unlikely that either the loss of a single cargo oil tank, or the loss of the entire FPSO diesel inventory, would result in an MEI. The probability of the loss of a single cargo oil tank is remote, and a diesel inventory loss is very remote as a result of the internal location of the diesel tanks in the double-lined hull of the FPSO.

The MEI outcomes of the three release scenarios are summarised in Table 4-7.

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Table 4-7 Summary of MEI assessment

Scenario	Is impact considered to be representative of an MEI?	Environmental receptors exposed to significantly adverse effects.
Loss of whole FPSO inventory (128,392.6 m ³)	YES	Offshore and nearshore protected areas, and protected species of birds and/or marine mammals.
Loss of single cargo oil tank (11,669.3 m ³)	No	-
Loss of whole FPSO diesel inventory (5,006.7 m ³)	No	-

An MEI assessment has already been conducted for a well blow out scenario at the Rosebank field and this was presented in the Rosebank ES (Equinor, 2022a). In the case of a well blow out, this would be managed by the Well Operator.

4.9 Environmental Management

Altera Infrastructure have a Management System (MS) which has been verified as aligned with the requirements of ISO 14001:2015. The MS includes systems and procedures to ensure environmental risks are identified and minimised. The system also includes processes to identify and assess operational risks to the environment and ensure appropriate measures are in place to ensure their control. Furthermore, the MS ensures the inspection and maintenance of equipment and assures the training and competence of all relevant personnel.

5.0 CONCLUSIONS

The proposed operations covered by this EAJ are the hook-up of the Rosebank FPSO, physical presence of the FPSO and atmospheric emissions from commissioning and production.

The potential environmental sensitivities and impacts to the marine environment have been identified and assessed. Environmental sensitivities comprise benthos, plankton, fish, marine mammals, seabirds, protected sites and species, and other users of the sea. The potential impacts arise from physical presence, seabed disturbance, emissions to air, underwater noise and accidental hydrocarbon spill.

The assessment took into account the magnitude of impact, mitigation measures, and the sensitivity of the receptor to determine the overall the impact significance.

- The physical presence of the vessels during hook up and the new Rosebank FPSO are not expected to have a significant impact on other sea users.
- Seabed disturbance will result from the hook up operations (lifting of mooring lines and risers and the deposition of sand on the seabed during removal of sandbags) and from the permanent presence of the mooring line bottom chains over Development life. The hook up operations may cause localised smothering, but the predicted area of impact is very small, with 70m² of permanent seabed disturbance. It is expected that flora and fauna will begin to recover quickly. There will be an area of seabed that is abraded by the repetitive dragging of the FPSO mooring lines throughout the Development life. This abrasion is likely to change and/or influence the nature of the seabed and the species present. However, this impact is localised and the total area is small (0.3 km²) within the Rosebank field. There are no designated protected sites within close proximity to the area of activity and no evidence of sensitive habitats and species such as those described under Annex I of the Habitats Directive; listed on the OSPAR (2008) list of threatened and/or declining species and habitats; listed on the Scottish Biodiversity List (2013); and species/habitats selected as PMF in Scottish offshore waters (SNH, 2014).
- Sources of atmospheric emissions will arise from the use of vessels during FPSO hook up and from non-routine flaring and from power generation during commissioning and production. Given the remote geographic location and prevailing winds within the offshore environment, the atmospheric emissions would be rapidly dispersed and are not likely to be detectable within a short distance from the source. Therefore, atmospheric emissions are not considered to present a significant environmental impact.
- Underwater noise associated with vessels is not expected to have a significant impact on any marine mammal or fish populations.
- Spill prevention measures will be implemented on all vessels. In the event of a diesel spill, procedures are in place, including the SOPEPs, to ensure effective management of any spill. The risk of an accidental hydrocarbon spill from the FPSO during production operations is considered to be low and effectively managed.
- No significant long term cumulative or transboundary effects are expected as a result of the installation and commissioning of the Rosebank FPSO.
- The operations are not considered to contradict the objectives of Scotland's NMP.

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Project Title:

OFFICIAL Rosebank Production Master Application Template (PRA/352)
Document & Rev No.: 218536C-001/B
Document Title: Petrojarl Rosebank FPSO Environmental Assessment Justification



All activities are to be managed according to Golar-Nor (UK) Limited's Environmental Management System requirements to eliminate or minimise potential impacts on the environment. Golar-Nor (UK) Limited therefore concludes that the proposed operations do not present a significant impact to the surrounding environment, including ecological receptors, protected sites and species, and other users of the sea.

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