REPORT

Petrojarl Rosebank FPSO - Non-Technical Summary (NTS)

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NON-TECHNICAL SUMMARY

The Rosebank Field is located approximately 130 km north-west of Shetland, in the Faroe-Shetland Channel on the north-west edge of the UK Continental Shelf (UKCS). It spans blocks 213/26b & 213/27a (license P1026), block 205/1a (license P1191) and block 205/2a (license P1272), at a water depth of approximately 1,100 m.

The Rosebank Field subsea wells will be tied back to the Petrojarl Rosebank Floating Production Storage and Offloading (FPSO) facility. The FPSO was previously deployed on the Knarr Field in the Norwegian Sector of the North Sea and has undergone modifications prior to operations on the Rosebank Field. The FPSO serves as both the production platform and storage unit and is permanently moored on the Rosebank Field (Latitude: 60°59'58,067"N, Longitude: 3°46'25,425"W, ED50). Facilities include oil, gas and water separation. Produced gas is compressed, dehydrated and exported through the gas export pipeline tied into the existing West of Shetland Pipeline Systems (WoSPS). Gas will also be used as fuel gas and gas lift. When the FPSO becomes gas deficient or is shutdown, gas can be imported from the WoSPS system. Produced oil will be stored on the FPSO to await shuttle tanker offtake. Produced water will be treated and reinjected into the field with seawater that has been treated to produce low sulphate seawater in the Sulphate Removal Unit (SRU), providing reservoir pressure support.

The main power supply is obtained by four, dual fuel Solar Titan 130 Turbine Generators, each capable of producing a maximum rated output of 14.372 MW_e (at the expected average annual site ambient temperature of 10 °C), operated in a three out of four (3oo4) configuration with the load shared and preferentially operated on fuel gas. The power generation turbines selected are fitted with Solar's SoLoNO$_x$^{TM} Dry Low-Emission (DLE) combustion technology, which is optimised to reduce emissions by tightly controlling the combustion temperature inside the turbine. The maximum estimated electrical load requirement is 28.978 MW_e during normal operations. Upon failure of main power, the diesel engine driven essential and emergency generator will support normal conditions of habitability and essential marine/process systems. There are no routine users of diesel.

To reduce emissions from the installation, a vapour and flare gas recovery unit (VRU), which recycles waste streams that would otherwise be routed to flare has been installed. This system recovers volatile organic compounds (VOCs) from multiple sources including crude oil storage, the tri-ethylene glycol system, and the produced water treatment system. In addition, the FPSO has been designed with provisions for future electrification, enabling the use of power from shore to further reduce on-site emissions. All modifications will be completed prior to the arrival of the FPSO at the field location. As a result, Rosebank could become one of the first oil and gas developments west of Shetland to be powered by electricity, reducing the emissions and supporting the North Sea Transition deal supply decarbonisation target of achieving a net-zero basin in the UK by 2050.

The efficiency of the Titan 130 gas turbines themselves is only one of the factors of the total energy efficiency of the offshore installation. The Titan 130 gas turbines are also fitted with Waste Heat Recovery Units (WHRUs) which provide the installations primary source of heat

and satisfy the process heat demand under normal operations expected to be ~25.953 MW_{th} for heating crude oil and process equipment. A dual fuel, direct fired auxiliary boiler with rated output of 8MW_{th} is provided as an alternative source of heat should the WHRU's be unavailable.

As the combined thermal input of the main combustion plant (four Gas Turbine Generators (GTG) each with maximum thermal input of 42.106 MW_{th}, one Auxilliary Boiler (9.061MW_{th}), Emergency Generator (6.06MW_{th}) and Essential Generator (5.91MW_{th})) aggregate to provide a total thermal capacity of the main combustion plant being 189.452 MW_{th}, which exceeds 50 MW_{th}, the FPSO is considered a Large Combustion Installation (LCI).

The power requirements for the Rosebank FPSO have been strategically evaluated during the project lifecycle. Gas turbine generators with dual fuel capability provide main electrical power to the facility. All turbines are provided with state-of-the art (DLE) dry low-emission control systems to reduce environmental discharges of NOx, SOx, CO, and unburned hydrocarbons, and waste heat is recovered from hot exhaust gases to meet the heat duty requirements of process equipment.

The equipment configuration has been selected to balance emissions, efficiency, availability, reliability, and capital cost and as such, represent the Best Available Technique (BAT) to provide the Rosebank FPSO with power.

Reciprocating diesel engines are provided for equipment ran during emergency conditions such as fire pump direct drive engines, emergency generators and an inert gas generator which supplies safe combustion gases to cargo oil storage tanks to maintain a low-oxygen atmosphere during periods the primary source (fuel gas from the First Stage suction scrubber for A and B compressors) is unavailable and facilitate maintenance activities. The Rosebank BAT Assessment demonstrates that BAT has been implemented and reviews the combustion operations and assesses what measures could reasonably be implemented to minimise emissions and discharges, see BAT Assessment 217505C-003-RT-6200-0001.

Small volumes of waste are generated in relation to the combustion plant and are managed in compliance with all current legislation. Drainage systems around the combustion equipment collect oil-contaminated water and free oil is separated and recovered before discharging of treated water to sea. The GTG's are periodically washed with a detergent solution, and the wash-water is discharged to the hazardous drainage system on the platform.

Emissions from all combustion plant will be monitored and stack sampling will be carried out for all primary combustion units (four x Solar Titan 130 Gas Turbine Generators), as per the Emissions Monitoring Plan (217505C-003-RT-6200-0003). Stack sampling will be undertaken at steady state conditions to map and verify emission profiles.

Emissions of oxides of sulphur from the combustion equipment at the installation are a function of the Sulphur content of the fuels burnt. All of the main power generating gas turbines will be preferentially operated on associated fuel gas which is inherently low in sulphur minimising the emissions of SO_2 from combustion equipment. In the event of downtime of the SRU plant, sea water injection shall be stopped to prevent souring of the production fluids and potential for increased sulphur content of the associated fuel gas. Low Sulphur diesel (< 0.1 wt.%) is

also used as a back-up fuel source for gas turbines for infrequent events where enough fuel gas is not available.

Altera Infrastructure (AIP) is committed to preventing pollution, complying with legislation and improving the environmental performance. Energy efficiency is embedded in the design and operation and will be maintained through ongoing reviews of energy demand and generation efficiency, in line with the Environmental Management System (EMS). Emission reduction opportunities will be regularly identified, reviewed, and implemented where practicable as part of the emissions management and reduction plans, supporting continuous improvement over the life of the installation.

Energy consumption has been minimised through process design and equipment selection, including the use of heat conservation insulation on hot process equipment and winterisation on cold-sensitive units to reduce heating requirements and fuel consumption. All equipment will be operated by technically competent personnel and maintained to ensure safe, reliable, and efficient operation.

Air dispersion modelling has been undertaken to assess the changes in air quality of emissions from the Rosebank FPSO. Overall, there were no predicted exceedances of any of the relevant Air Quality Standards for the pollutants of concern, for any of the modelled scenarios at any location. For pollutant concentrations that were not screened out based on their Process Contribution (PC) values, all were deemed insignificant as Predicted Environmental Concentration (PEC) is less than 70% of the relevant long term environmental standard. Changes in terms of air quality associated with NO_2, CO and SO_2 concentrations at Shetland, transboundary impacts at the median line, neighboring platforms and FPSO predicted from conservative modelling scenarios were insignificant.