2017 Environmental Statement Report – Rough Offshore Facilities

2017 Environmental Statement – Rough Offshore Facilities

Contents

1 FORWARD

Since 2015, Centrica Storage Limited (CSL) have undertaken maintenance work and conducted testing and verification work on the Rough Wells. After experiencing several issues associated with the integrity of the offshore installations and Rough well stock that have substantially reduced the physical capabilities of the Rough Storage Facility, during 2017 CSL have decided that the Rough field is no longer feasible to continue has a storage facility.

In Q4 2017, CSL have submitted a Field Development Plan Addendum proposing that the Rough Storage Operations are permanently ceased and that Rough becomes a Production Facility. As part of this, CSL have decided to permanently withdraw the 47/8A platform from service.

To ensure the safety and integrity of the installations, throughout Q4 2017 and Q1 2018, CSL produced a further 34 BCF of native gas from the Rough field under its current storage licence. This was intended to reduce the risks associated with the Rough wells by reducing the Closed in Well Head Pressures (CIWHP) of the wells to below the Maximum Allowable Annulus Surface Pressure (MAASP) of 1500 psig. After the production of the 34 BCF, CSL have continued to produce gas from the Rough field under a Production Licence through the Easington Terminal.

During the summer of 2017, CSL have undertaken two major shutdown projects comprising of thousands of construction hours. One project was the combined operations jack-up campaign on the 47/3B platform and the other at the Easington Terminal. Both projects undertook essential maintenance to ensure the safety and integrity of the assets. For both activities, environmental aspects and impacts were assessed prior to commencement of the work and monitored throughout, giving consideration to the whole life cycle impacts on supplies to prevent pollution, reduce waste and ensure the efficient use of natural resources.

Throughout 2017, as per the Centrica Environmental Policy (Appendix 1) CSL have continued to place a huge importance on their environmental responsibilities and continue to be committed to understanding, managing and reducing the environmental and ecological impacts of our activities through innovation, technology and cultural change. As part of this, CSL are currently implementing all the requirements to ensure the successful transition from ISO 14001:2004 to the updated ISO 14001:2015 certification. The resubmission will take place in May/June 2018 before the CSL's current ISO 14001:2004 certificate expires in September 2018.

2 EXECUTIVE SUMMARY

Centrica Storage Limited owns and operates the Rough Gas Facilities which is located approximately 29 kilometres off the east coast of Yorkshire, and is the UK's largest facility for the storage of gas. The platforms are permitted to undertake regulated activities under a Production Licence, Consent to Vent, OPPC Permit, Chemical Permit, Greenhouse Gas Permit, PPC Permit and Consent to Locate. Under these permits and consents, CSL have the requirement to monitor, record and report emissions released to air and water. The amount and classification of waste is also required to be reported.

Throughout 2017, the Rough Offshore Facilities operated for 181 days. During this time 0 Mscm of gas was injected and 1862.14 Mscm of gas was produced. Between the 2nd July 2017 and 2nd October 2017 the 47/3 Bravo was offline, allowing an extended period of essential maintenance to be carried out to ensure the safety and integrity of the asset.

Releases to Air

Under the Greenhouse Gas Emissions Permit (UK-D-IN-13143) the Rough Gas Facilities released 17,782.9 tCO_2e during 2017. This is a 54% reduction from the amount of carbon dioxide released in 2016. The main reason for this reduction is the non-operation of the two RR Avon 1535-161 Gas Turbines throughout 2017.

Releases to Water

The 47/3 Bravo generated Produced Water on 149 days, with a total of 868.1 m^3 (257% increase from 2016) of Produced Water discharged to sea and 449.7 kg (165% increase from 2016) of associated oil

The Produced Water was analysed for radioactivity on a quarterly basis. Only Polonium-210 was detected in Quarter 2, however the levels detected were below the limits set out which determine if a substance is radioactive, therefore it is considered that the Produced Water generated in 2017 is not radioactive.

All chemicals used were within permitted limits. Throughout 2017, the Rough Gas Facilities discharged a total of 1,153 Kg of chemicals into the sea, a 155% increase in chemical discharge from 2016. The total permitted allowance for discharging chemicals to sea was 11,061 Kg.

Waste

The Rough Gas Facilities generated a total of 277.5 tonnes of waste throughout 2017, of which 99.05% (274.9 tonnes) was recovered (diverted from landfill). From the total amount of waste generated, 207.9 tonnes was categorised as non-hazardous and 69.6 tonnes as hazardous waste.

Non-Conformities

CLS exceeded the maximum concentration for Oil in Water on 145 occasions and exceeded the Monthly Average Oil in Water concentration 8 times.

CSL submitted 11 PON1's in 2017 for the non-regulated release of oil to sea.

Throughout 2017, apart from the non-conformities mentioned above, all releases to the environment have been within the permitted limits set out by the various Permits and Consents under which the Rough Gas Facilities operate.

3 INTRODUCTION

3.1 Site Location & Operation

The Rough offshore gas storage field is located approximately 29 kilometres off the east coast of Yorkshire, and is the UK's largest facility for the storage of gas. The field is designed to meet peak winter demand by injecting gas supplied from Centrica Storage Limited customers via the Easington Gas Terminal into the Rough Field Reservoir approximately 300m below the seabed. This stored gas is then available to be produced back into the National Transmission System at rates of up to 45 million cubic metres per day – equivalent to approximately 10% of the total gas supplied in the UK during the coldest winter day.

The Rough Offshore Facilities comprises of the Alpha (two bridge-linked platforms) and Bravo (three bridge-linked platforms) complexes. The complexes are approximately 2 kilometres apart and are designed to produce or inject gas via the reservoirs 30 wells.

During injection, gas taken from the national transmission system is compressed at the Easington terminal and transferred to the offshore Bravo complex via a 36-inch subsea pipeline. On the Bravo two Rolls Royce (RR) Avon Gas Turbines drive two centrifugal compressors which force the gas under pressure down the wells into the storage reservoir.

During production, the gas retrieved from the reservoir is essentially the same as that which was injected. However, the nature of the reservoir results in some contamination with water and indigenous hydrocarbons, necessitating treatment (separation and dehydration) on the offshore platforms. Gas flows through the wells to the surface under reservoir pressure. Water and condensed hydrocarbons are removed by the offshore process prior to transmission via the 36-inch sealine to shore. The small quantities of produced water are discharged offshore and the condensed hydrocarbons are re-injected into the pipeline and carried ashore with the gas.

Corrosion inhibitor is injected on both platforms to prevent corrosion of the sealine. Hydrate inhibitor is also injected into the sealine pipe to prevent the build-up of hydrates. Effluent from the wet gas operation is received at the Terminal and tankered offsite to an effluent treatment plant.

3.2 Environmental Permits

The Rough Gas Facilities operate under the following permits.

3.2.1 Production Licence

At the beginning of 2017, CSL were operating under a licence which permitted the storage and production of gas at the Rough Gas Field. In Q4 2017, CSL submitted a Field Development Plan Addendum proposing that the Rough Storage Operation be permanently ceased and that Rough become a Production Facility.

On 11th December 2017, CSL received an Increase in Production Licence (IP/1273/0 (Version 2)), allowing CSL to remove an additional 34 BCF of native gas from the Rough field under its current storage licence to ensure the safety and integrity of the installations.

On 17th January 2018, CSL obtained and are now operating under a Long Term Production Consent (PCON/4517/0 (Version 2)) which permits CSL to extract gas from the Rough Gas Field until 31st December 2020.

3.2.2 Consent to Vent

The Consent to Vent permitted CSL to dispose of unignited natural gas into the atmosphere won under the Rough Gas Field Petroleum Production Licence.

The purpose of venting under this consent is to

- facilitate the planned start-up, shut-down or maintenance of plant and equipment, or to ensure its efficient operation, or
- to protect plant, equipment or persons.

3.2.3 OPPC Permits

The Rough Offshore Facilities operated under two Offshore Petroleum Activities (Oil Pollution Prevention and Control) Regulations 2005 permits. These permits allow the discharge of oil in accordance with the arrangements described within the permit for the Rough AD platform (OLP/74/3 (Version 1)) and the Rough BD platform (OLP/72/3 (Version 2)).

3.2.4 Chemical Permits

The Rough Offshore Facilities operated under two separate Offshore Chemicals Regulations 2002 permits, one for the 47/8 Alpha and one for the 47/3 Bravo. The permits require that all chemicals used or discharged during the course of the operations are covered by the permit and when discharged to sea, appropriate measures are taken to minimise any discharge and are undertaken in accordance with the conditions detailed within the permit.

3.2.5 Greenhouse Gas Permit

The Greenhouse Gas Emissions Permit (UK-D-IN-13143) authorises CSL to emit Carbon Dioxide through the combustion of natural gas, diesel, and Liquefied Petroleum Gases (LPG) from regulated activities that are listed within the permit. CSL are subjected to a number of conditions, including the monitoring and reporting of such emissions, and the surrendering of allowances and notification requirements.

3.2.6 PPC Permit

The Rough BD Platform operates under the Offshore Combustion Installations (Pollution Prevention and Control) Regulations 2013 Permit. The permit authorises the use of listed combustion equipment, ensuring that appropriate measures are taken to minimise discharges, emissions and waste, and sets limits on the total annual emissions of polluting substances (Nitrogen Oxides, Sulphur Oxides, Carbon Monoxide, Methane and Non-Methane Volatile Organic Compounds) from the listed combustion equipment.

3.2.7 Consent to Locate

The Consent to Locate designates the geographic location of the platforms (47/8 Alpha and 47/3 Bravo) and the aids required to ensure navigational safety.

3.3 Environmental Management System

CSL have a certified ISO 14001 Environmental Management System which demonstrates our commitment and responsibility to understand, manage and reduce the environmental impact of our operations in a manner which protects the environment and its resources. The environmental management system is integrated within health and safety as well as the business management activities. Central to the environmental management system is strong leadership, continuous enhancement and good performance baselines. Annual environmental improvement plans are developed to measure and report improvements. The environmental management system is audited internally and externally.

4 EMISSIONS MONITORING

A condition of all the permits described in Section 2.2 is the monitoring and recording of emissions from the activities undertaken by the Rough Offshore Facilities. Throughout 2017, CSL have undertaken the required monitoring of all emission sources and ensured that all reporting requirements under these permits have being fulfilled. The following sections will discuss the monitoring of each of these activities.

4.1 Releases to Air

Releases to air are emissions of Carbon Dioxide (CO_2), Carbon Monoxide (CO), Oxides of Nitrogen NOx), and Methane (CH_4). The quantities of the above gases are calculated from the total volume of fuel gas used, diesel usage, gas vented, and an estimated release of fugitive emissions. The monitoring of emissions includes those from routine, non-routine and abnormal operations, and includes start-up, shut-down and emergency situations.

4.1.1 Fuel Gas Consumption

4.1.1.1 47/8 Alpha

There is no qualifying combustion equipment on the 47/8 Alpha platform therefore the platform is exempt from the EU Emissions Trading Scheme.

4.1.1.2 47/3 Bravo

The total fuel gas consumption and calculation factors of the 47/3 Bravo platform are metered at one fuel gas metering point. This metering point consists of two dual Micro Motion CMF300 coriolis meters and transmitters (FE562260 A & B) operating in duty/stand-by parallel configuration. Secondary pressure (PT562259) and Temperature (TT562262) are also used to calculate flow at reference conditions to provide compensation to raw mass flow rates for the ISO 6976/AGA8 flow calculations. Data from the meter is transferred to a dedicated FloBoss S600+ flow computer on a 6 minute cycle.

Gas composition is taken from continuous online gas chromatographs for AGA8 and ISO6976, NCV calculations, and a site specific emission factor which are certified annually by an ISO17025 approved organisation. Monthly manual samples of Rough Fuel Gas from Onshore are also taken and analysed by an ISO17025 certified laboratory. Uncertainty analysis of emissions factors is undertaken to ensure that the flow weighted monthly analysis is within the +/- 0.5% uncertainty threshold for EU ETS top tier monitoring of NCV and emissions factor.

The total CO_2 emissions is calculated using the ISO6976 methodology and is a product of gas combusted, a net calorific value (NCV), an emissions factor (EF) per unit of fuel used, and a standard oxidation factor (OF).

4.1.2 Diesel Consumption

Diesel is used for Power Generators and Heating Medium during routine maintenance shutdown, firewater pump and cranes and is consumed in relatively small quantities. Consumption of diesel is considered to be equal to the amount of diesel bunkered on the platforms, therefore equal to the

quantities recorded on the bunker delivery notes. The density factor (0.8540 t/m^3) used to convert litres to tonnes is obtained from the most recent Digest of UK Energy Statistics (DUKES), Annex A, Average conversion factors for petroleum found at:
https://www.gov.uk/government/collections/digest-of-uk-energy-statistics-dukes

The total CO_2 emissions is calculated using the ISO6976 methodology and is a product of diesel combusted, a net calorific value (NCV), an emissions factor (EF) per unit of fuel used, and a standard oxidation factor (OF).

The NCV factor (42.5688 GJ/t) and Emissions Factor (74.9375 tCO2/TJ) for diesel are taken from the UK GHG Latest UK inventory factors. These factors are sourced from the GOV.UK website at https://www.gov.uk/guidance/participating-in-the-eu-ets#complying-with-the-eu-ets

4.1.3 Venting

Venting of natural gas represents a loss of primary energy and the largest source of unburnt hydrocarbon emissions from the platforms. Venting of natural gas is required as a result of planned maintenance or blowdown situations. The amount of gas vented is recorded on the IMAC system.

4.1.4 Fugitive Emissions

Fugitive emissions are emissions of gas from pressurized equipment due to leaks, weeps and seeps, and other unintended or irregular releases from operating activities. These emissions cannot be measured; therefore it is considered that 48 t of fugitive emissions are released every six months from the platforms.

4.2 Releases to Water

The releases to the surrounding sea are subject to the OPPC and Chemical permits. The discharge of these substances are controlled and emitted through dedicated emission points that are specified on the above mentioned permits.

4.2.1 Produced Water

4.2.1.1 47/8 Alpha

The Alpha platform does not generate Produced Water; therefore there are no requirements to monitor and sample Produced Water.

4.2.1.2 47/3 Bravo

Produced Water is water which is generated from the reservoir and is extracted along with the extraction of the gas. The water can be contaminated with hydrocarbons and Naturally Occurring Radioactive Material (NORM). The OPPC permit requires the sampling and reporting of oil content at least monthly, an analysis for NORM quarterly, and the in-depth bi-annual analysis of the water. The 47/3 Bravo platform generates Produced Water; therefore there is equipment used to process the Produced Water before sampling and discharging to sea. The process includes:

An Inlet Separator – this is a vertical 2-phase separator which acts as a sand trap to minimise sand erosion and blockage of the downstream equipment.
An Injection Separator – this provides hold-up and separation for bulk liquids.

Test Separator – allows liquid separation. Condensate will separate from the water phase and is then routed off.
Off-Spec Condensate Vessel - a horizontal three phase separator with recently-installed baffles and inclined plate pack to assist oil-water separation.
Oily Water Separator - is an inclined plate separator that separates hydrocarbons from the produced water.
Oil Absorption Media Filter Package - removes any residual hydrocarbon from the water phase prior to discharge. The water samples for the required permitted analysis are taken from a sample point after the Oil Absorption Media Filter Package prior to discharge.

4.2.1.3 Oil in Water

For Oil in Water content, the sample is analysed on the platform and should be analysed using the OSPAR reference methodology for oil in produced water. However, this methodology requires the use of gas chromatography using a flame ionisation detector and n-pentane as an extraction solvent, which is unavailable on the platform. After approval from BEIS, CSL use a simpler analytical methodology which is correlated against the OSPAR Reference Method.

4.2.1.4 Radioactivity

There is a requirement under the Radioactive Substances Act 1993 to determine whether produced water is radioactive as defined in Schedule 1 of Radioactive Substances Act 1993. For each Quarter, while generating Produced Water, a sample is taken and sent to Public Health England to undertake the analysis and detection of Polonium-210 (Pb-210), Actinium 228 (Ac-228) and Radium 226 (Ra-226). The analysis follows the fully documented procedures contained in CRCE Glasgow Radiochemistry Group Technical Manual.

The detection of Radium 228 (Ra-228) is used to determine Actinium 228 (Ac-228), as Ac-228 is an equilibrium daughter of Ra-228.

4.2.1.5 Bi-annual Water Analysis

The bi-annual water analysis includes testing for the presence of Polycyclic Aromatic Hydrocarbons (PAH), BTEX chemicals (benzene, toluene, ethylbenzene and xyleneheavy metals), Heavy Metals, Phenols and Alkyl Phenols, Organic Acids, Oil in Water, NPD's (Naphtalenes, Phenanthrenes, Dibenzothiophenes) and Inorganic compounds.

The purposes for undertaking the bi-annual water analysis is to build-up a regulatory database of information on the amounts of various constituents of produced water discharged to sea.

4.2.2 Chemical Permits

Under the Chemical Permits all chemicals used are to be monitored and usage recorded. The chemicals used are essential to the operation and are used sparingly and responsibly to ensure limited impact on the environment.

Apart from ZOK MX GS, Offshore Degreaser EF, SOBO S GOLD and SOBO, which are discharged to sea, all other chemicals permitted and used on the Rough Offshore Facilities are returned through the 36-inch subsea pipeline to Easington, to be treated ashore.

4.3 Waste

CSL have a Duty of Care and takes measures to ensure that all controlled waste generated on the Rough Offshore Facilities are treated, segregated, stored, and disposed in an appropriate manner to prevent the likelihood of pollution or harm to health. The Offshore 47/8 Alpha Garbage Management Plan (DOC-CSL-HSE-ENV-006a) and the Offshore 47/3 Bravo Garbage Management Plan (DOC-CSL-HSE-ENV-006b) provides a detailed description of how waste is managed on the platforms.

The waste generated on the platforms are separated into various waste streams but can be categorised into General/Industrial waste and Hazardous waste. The waste is transferred to the support vessel before been sent to shore to a treatment or disposal facilities. The transfer of waste is accompanied with appropriate transfer documentation.

5 EMISSIONS REPORTING

A condition of the Permits is the reporting of emissions from the regulated activities undertaken at the Rough Offshore Facilities. CSL have fulfilled its responsibility to report the 2017 emissions and below is a discussion of the Rough Offshore Facilities performance against the permit conditions. Trends, using historical data, have also being discussed.

5.1 Performance

Throughout 2017, the Rough Offshore Facilities operated for 181 days. During this time 0 Mscm of gas was injected and 1862.14 Mscm of gas was produced. Between the 2nd July 2017 and 2nd October 2017 the 47/3 Bravo was offline, allowing an extended period of essential maintenance to be carried out to ensure the safety and integrity of the asset.

5.1.1 Environmental Observations

CSL run an HSE Observation system which allows all employees and contractors to report activities which they may consider being unsafe or may cause an incident which is harmful to personnel, the environment or plant. The observations are reviewed in a daily meeting by the OIMs, Supervisors, and HSE advisors. These meetings allow opportunity for discussions on safety and environmental themes and include any significant learning from monitoring activities, accidents and near misses. During 2017 there were 6,878 observations raised on the platforms, of which 945 (229 Environmental, 651 Housekeeping, 65 Working Environmental Factors) were directly related to environmental concerns. CSL consider that the number of observations raised in 2017 as had a direct contribution to the prevention of potential incidents, which can be seen by the decrease in the number of HSE incidents during 2017.

5.2 Releases to Air

5.2.1 EU ETS Emissions

Through the combustion of fuel gas, diesel and LPG, Rough Gas Facilities released 17,782.9 tCO_2e during 2017.

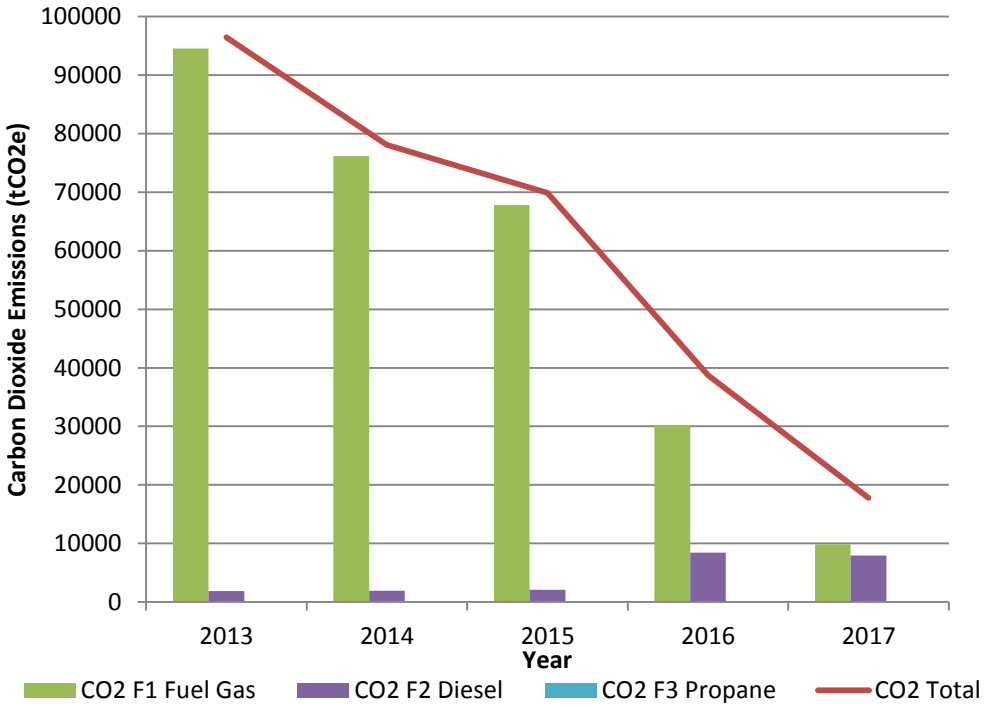

Figure 1: Annual CO_2 emissions from Rough Offshore Facilities.

The amount of CO_2 release throughout 2017 has decreased further from the previous year's release, with a continued downward trend in CO_2 release since 2013. There has been 82% reduction in the amount of CO_2 released since 2013 and a 75% reduction since 2015. As shown in Figure 2, this reduction is reflective of the amount of gas being injected from the NTS to the Rough Storage Facility, with both CO_2 emissions and gas injected following the same trend. In 2015 there was 2232.35 Mscm of gas injected, 879.05 Mscm in 2016 and zero gas injected in 2017. This relationship is due to the operational time of the two RR Avon 1535-161 Gas Turbines.

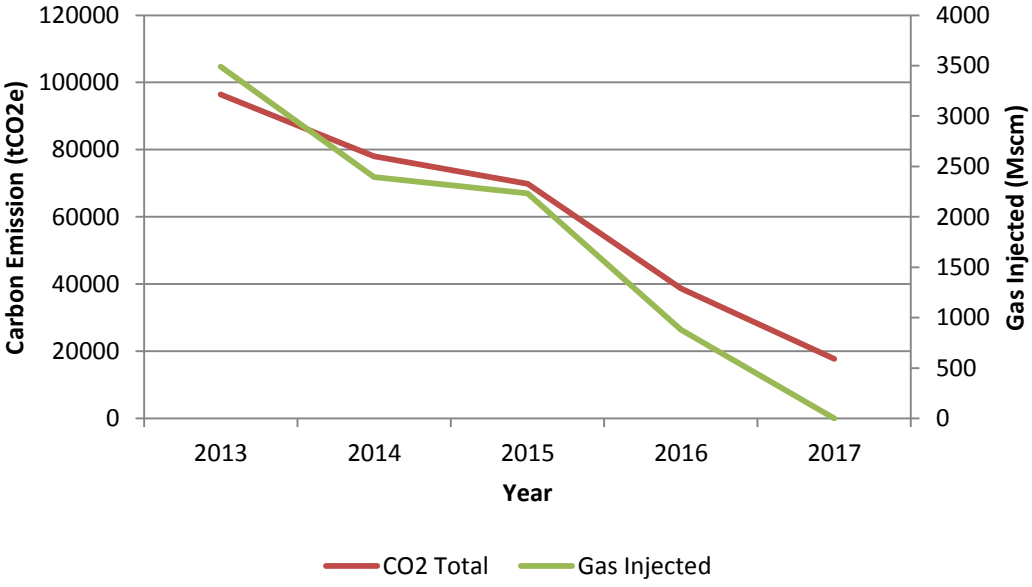

Figure 2. Relationship between CO_2 emissions and the amount of Gas Produced/Injected at the Easington terminal.

The injection of gas requires the use of the two RR Avon 1535-161 Gas Turbines. In 2015, gas from the NTS was injected on 146 days. In 2016, this was reduced to 42 days and in 2017 no gas was injected. This reflects the large reduction in CO_2 emissions since 2015. With the change in business direction, from storage to production, there is no requirement to use the two RR Avon 1535-161 Gas Turbines to inject gas, therefore during 2018 the two RR Avon 1535-161 Gas Turbines are planned to be removed from the platform and sold. On the completion of their removal, the gas turbines will then be removed from the PPC and Greenhouse Gas permits.

With major reductions in CO_2 emissions for both 2016 and 2017, a partial cessation was submitted to EU ETS. With the removal of the RR Avon 1535-161 Gas Turbines, it is estimated that future Carbon emissions from the Rough Gas Field will remain at approximately the same levels as 2017.

5.2.2 Non-Greenhouse Gas Emissions

Through the operations on the Rough Gas Facilities the following releases were calculated.

5.2.2.1 Nitrogen Oxides (NOx)

There was a total of 55.38 tonnes of Nitrogen Oxides (NOx) released during 2017. The amount of NOx being released from the Rough Gas Facilities has declined since 2013. This is in line with the reduced use of the RR Avon 1535-161 Gas Turbines.

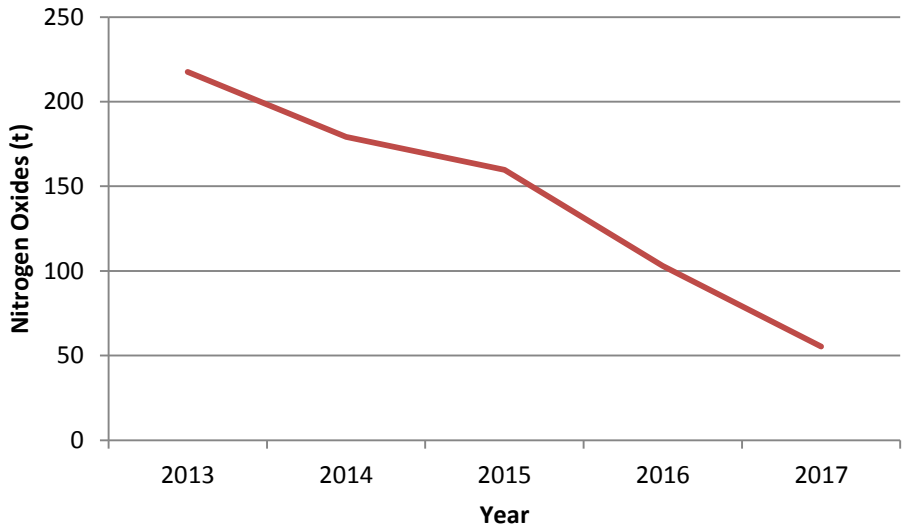

Figure 3. Nitrogen Oxides (NOx) released to the atmosphere in 2017.

5.2.2.2 Sulphur Dioxide (SO_2)

There was a total of 9.95 tonnes of Sulphur Dioxides (SO_2) released during 2017. Although 2017 emissions were lower than 2016 emissions, it is considerably higher than the emissions in 2013-2015. This is due to the increased diesel usage during the extended shutdown periods throughout 2016 and 2017 when the platforms were gas free and diesel was the main fuel source.

This trend can be seen in Figure 4, which shows the comparison of SO_2 emissions and diesel usage.

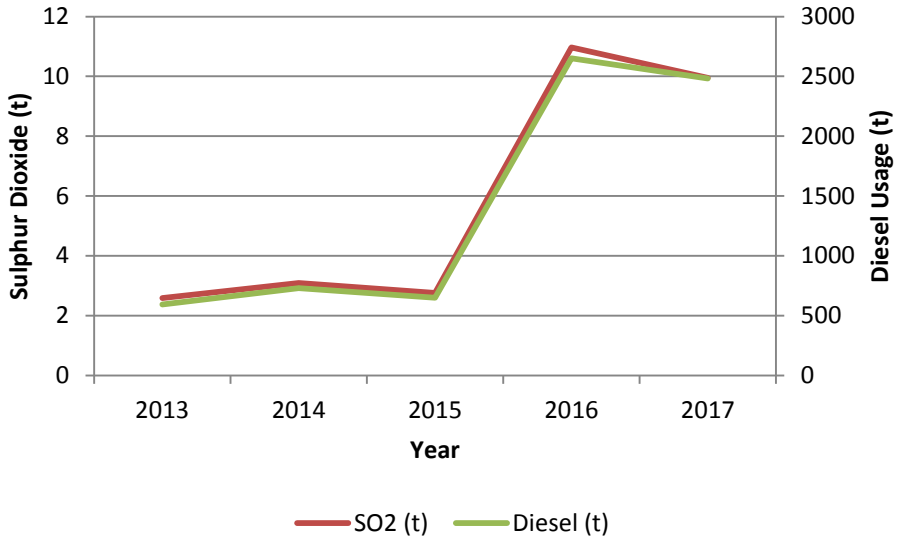

Figure 4. Sulphur Dioxide (SO_2) released to the atmosphere in 2017

5.2.2.3 Carbon Monoxide (CO)

There was a total of 23.83 tonnes of Carbon Monoxide (CO) released during 2017. The CO emissions continue to follow a downward trend since 2013, even after a spike in CO emissions in 2015.

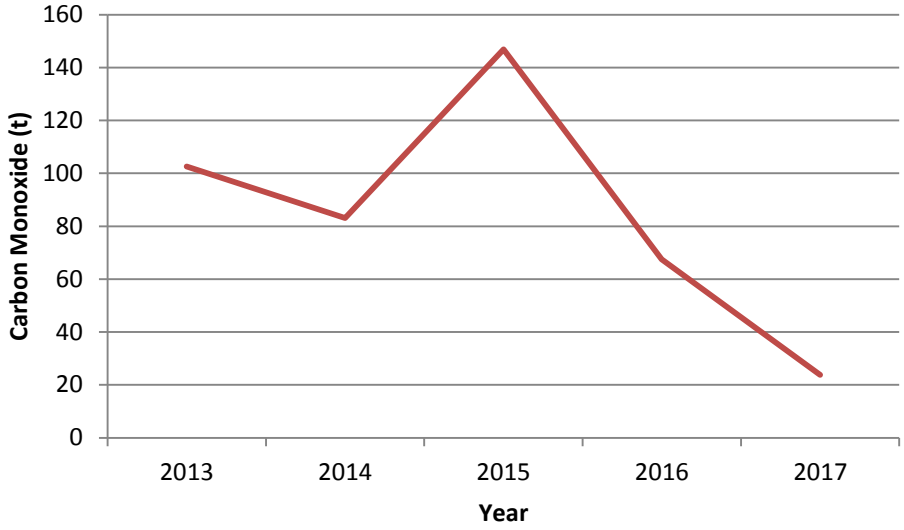

Figure 5. Carbon Monoxide (CO) released to the atmosphere in 2017

5.2.2.4 Volatile Organic Compounds (VOCs)

There was a total of 0.86 tonnes of Volatile Organic Compounds (VOCs) released during 2017. There has been a downward trend in VOC emissions since 2013, which is in line with overall reduction in fuel usage since 2013.

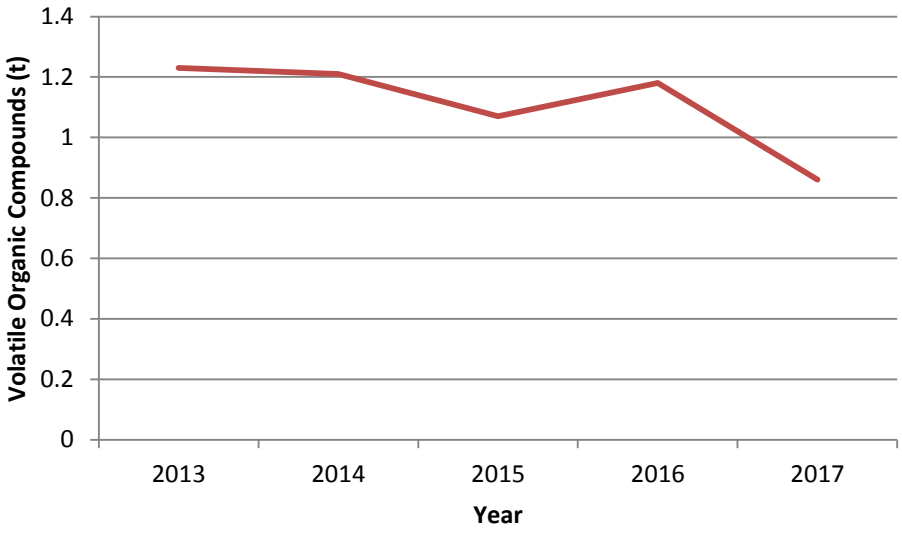

Figure 6. Volatile Organic Compounds (VOCs) released to the atmosphere in 2017

5.2.3 Methane Releases

Methane released is calculated by the amount of gas vented and the estimated amount of fugitive gas. During 2017 it was calculated that 263.12 t of methane was released into the atmosphere.

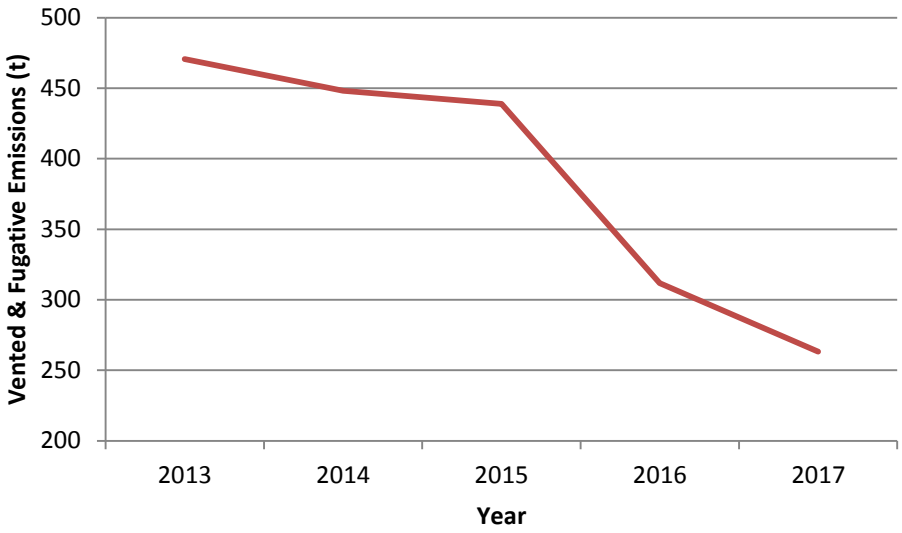

Figure 7. Methane released to the atmosphere in 2017

Vented Gas and Fugitive Emissions have reduced since 2013. Again, reflecting the changes in the operation, especially the reduction in the amount of gas injected throughout this time.

5.3 Releases to Water

5.3.1 Oil in Water Content

During 2017 the 47/3 Bravo produced gas on 181 days, of which, produced water was generated on 149 days. Throughout 2017, 868.1 m^3 of produced water was discharged with 449.7 kg of associated oil. This is an increase from 2016, were 337.6 m^3 of produced water and 271.2 kg of associated oil were discharged.

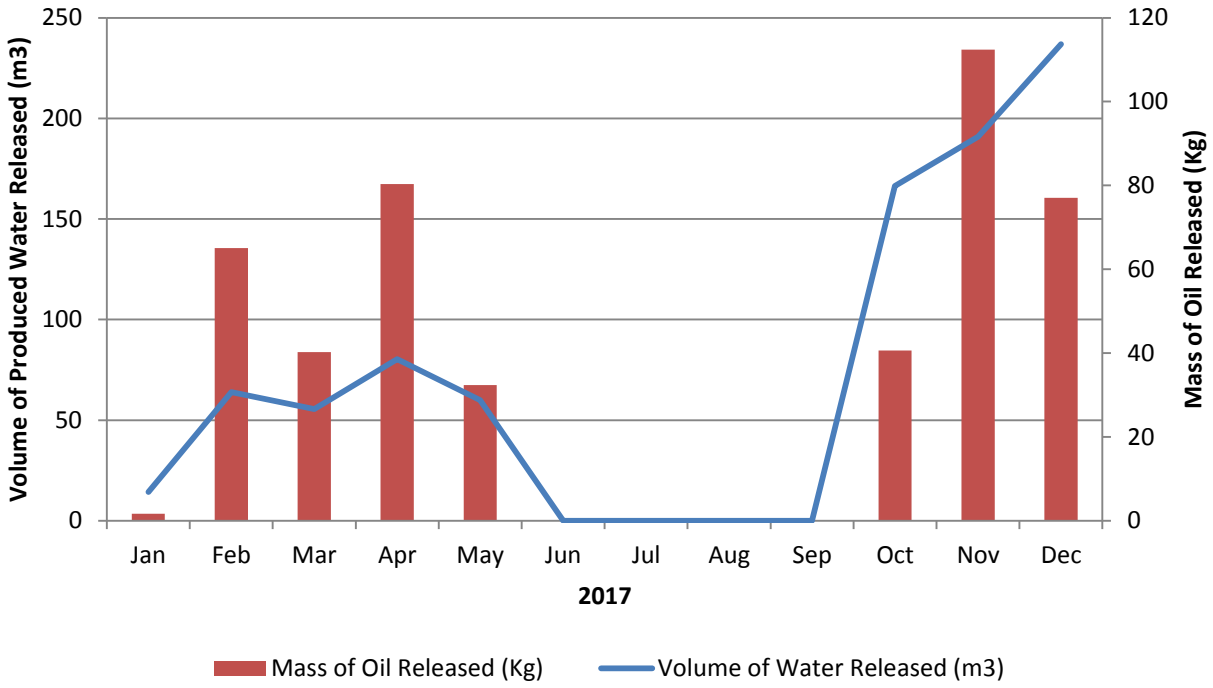

Figure 8. Monthly breakdown of Produced Water discharge and associated oil release.

When produced water was generated, samples were taken and analysed on the platform at least once per day by qualified production chemist. Throughout 2017, oil concentrations in produced water have exceeded the maximum concentration limit of 100mg/L and monthly concentration limit of 30mg/l. For each exceedence an OPPC non-conformance report has been submitted to BEIS (see Section 6.1 for more details of the non-conformance).

5.3.2 Radioactivity

Samples of Produced Water were taken for each quarter (except Q3, no produced water generated) and sent to Public Health England to undertaken analysis. Where radioactivity had been detected, the activity concentration was recorded. Where no radioactivity was detected, the laboratory limit of detection (LOD) was provided.

From the analytical results, it can be seen that the LOD was exceeded for only Polonium-210 in Quarter 2; however this was below the limits set out in Schedule 1 of the Radioactive Substances Act 1993; therefore produced water extracted from the Rough gas field in 2017 would not be considered to be radioactive.

Table 1. Summary of Radiation Analysis of Produced Water.

Quarter	Sample Date	Activity of				
		Pb-210 (Bq/g)	Ra-226 in particulate (Bq/g)	Ra-226 in soluble (Bq/g)	Ra-228 in particulate (Bq/g)	Ra-228 in soluble (Bq/g)
Q1	29/01/2017	0.000005*	1.000000*	0.000400*	1.000000*	0.000040*
Q2	24/04/2017	0.000006	1.000000*	0.000400*	1.000000*	0.000040*
Q3	N/A	N/A	N/A	N/A	N/A	N/A
Q4	30/10/2017	0.000005*	1.000000*	0.000400*	1.000000*	0.000040*
*Laboratory Limit of Detection (LOD)						

5.3.3 Bi-Annual Analysis of Produced Water

For the purposes of building up a regulatory database of information on the amounts of various constituents of produced water discharged to sea, for both halves of 2017, an accredited laboratory, on behave of CSL, have undertaken a detailed analysis of Produced Water. The results of these analyse was reported on the UK Energy Portal.

5.3.4 Chemical Permits

5.3.4.1 47/8 Alpha

With the suspension of gas extraction on the 47/8 Alpha platform the only chemical used throughout 2017 was 315.2 Kg (permit limit – 9,092 Kg) of Ethylene Glycol. The Ethylene Glycol was returned to shore for treatment.

5.3.4.2 47/3 Bravo

Figure 9 shows the usage of Corrosion and Hydrate Inhibitors on the 47/3 Bravo platform. All these chemicals were within the permit limit and were sent back to shore in the 36-inch subsea pipeline. These are used to pervert the build-up of hydrates and corrosion in the pipeline.

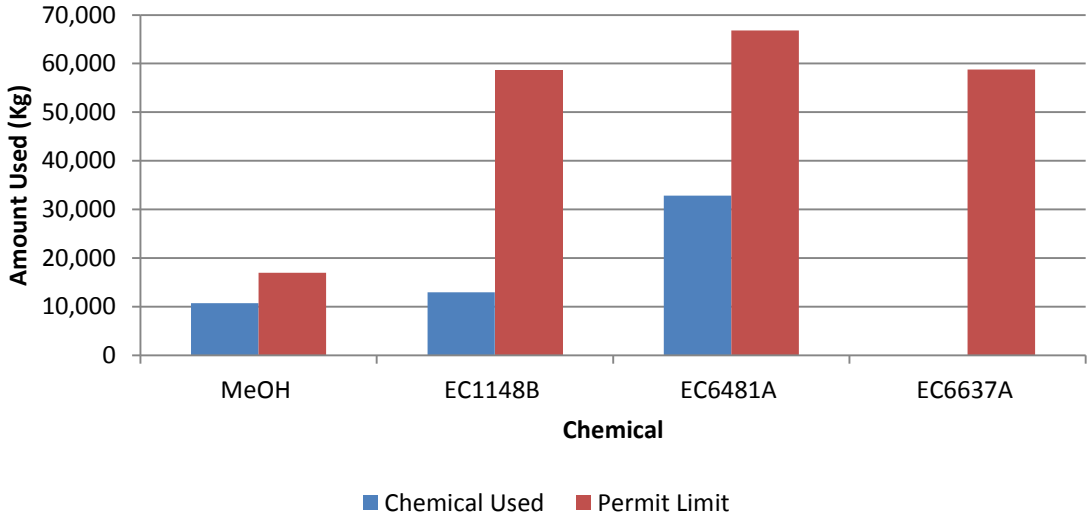

Figure 9. Corrosion and Hydrate Inhibitor usage on 47/3 Bravo.

Figure 10 shows the usage of wells chemicals and deck cleaning fluids. All chemicals were within the permit limits. A total of 838 Kg of chemicals (ZOK MX GS, Offshore Degreaser EF, SOBO S GOLD and SOBO) were discharge to sea throughout 2017. Under the permit, a maximum of 1969 Kg of chemicals were permitted to be discharged to sea. SOBO was used by Seajack Zaratan during the combined operation in 2017.

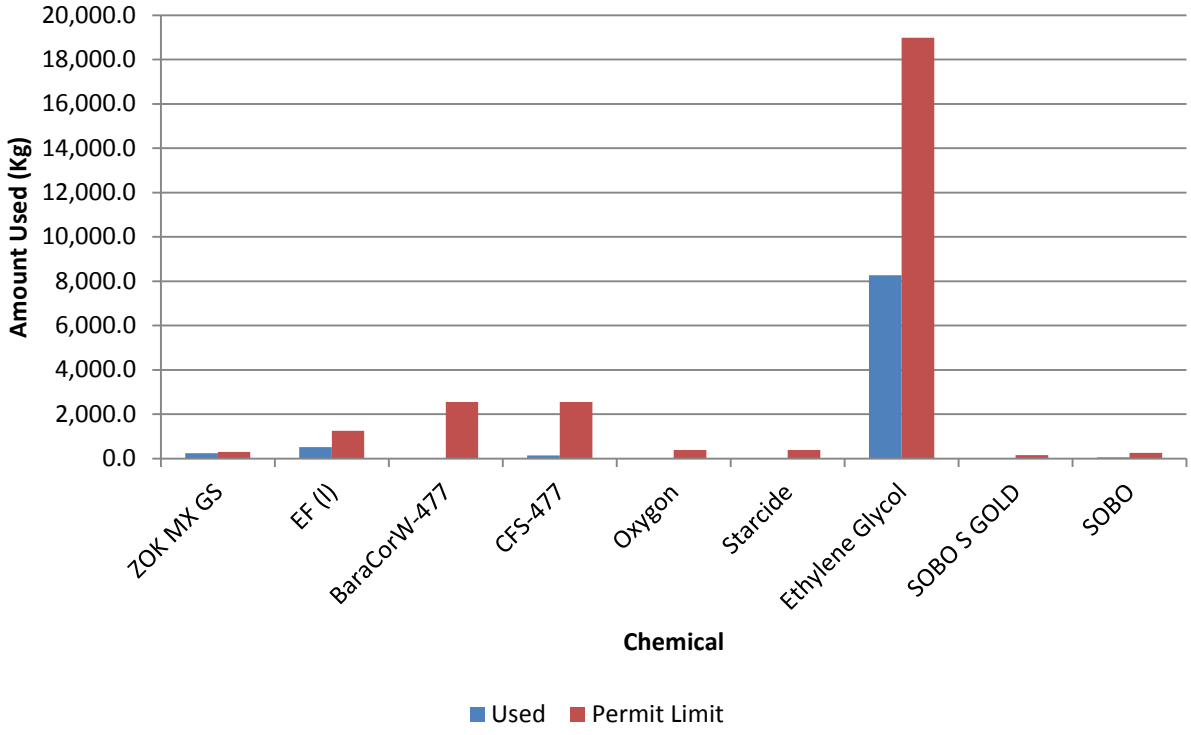

Figure 10. Wells and Deck Cleaning Fluids chemical usage on 47/3 Bravo.

5.4 Waste

5.4.1 Total Waste Generated

The total amount of waste generated throughout 2017 was 277.5 tonnes. Even with a major shutdown maintenance project in 2017, the Rough Offshore Facilities continued the downward trend of reducing the amount of waste generated on the platforms.

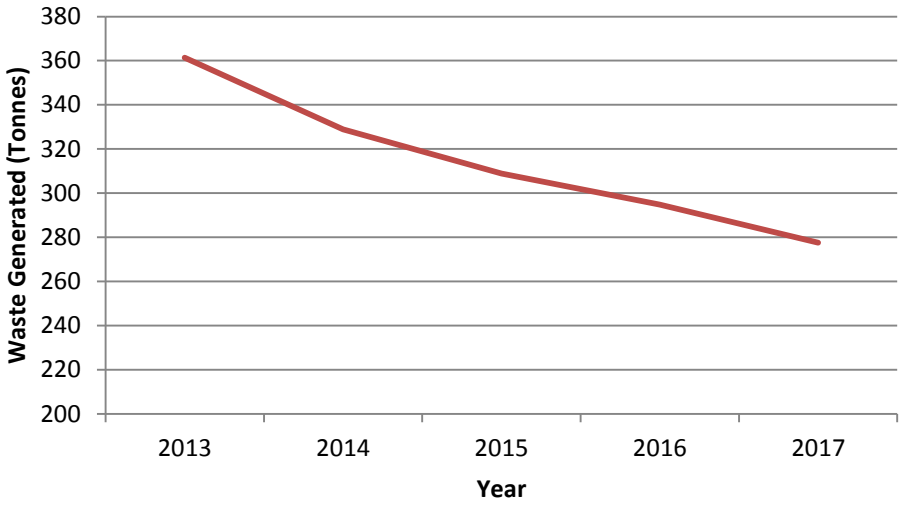

Figure 11: Total waste generated from the Rough Offshore Facilities (2013-2017)

5.4.2 Final Disposal/Recycling

Waste generated on the platforms are transferred to the support vessel to be offloaded ashore where it then goes to appropriate waste facilities. This waste is separated into either final disposal or recycled. Of the total amount of waste generated, 274.9 tonnes was recycled (99.05%) in 2017.

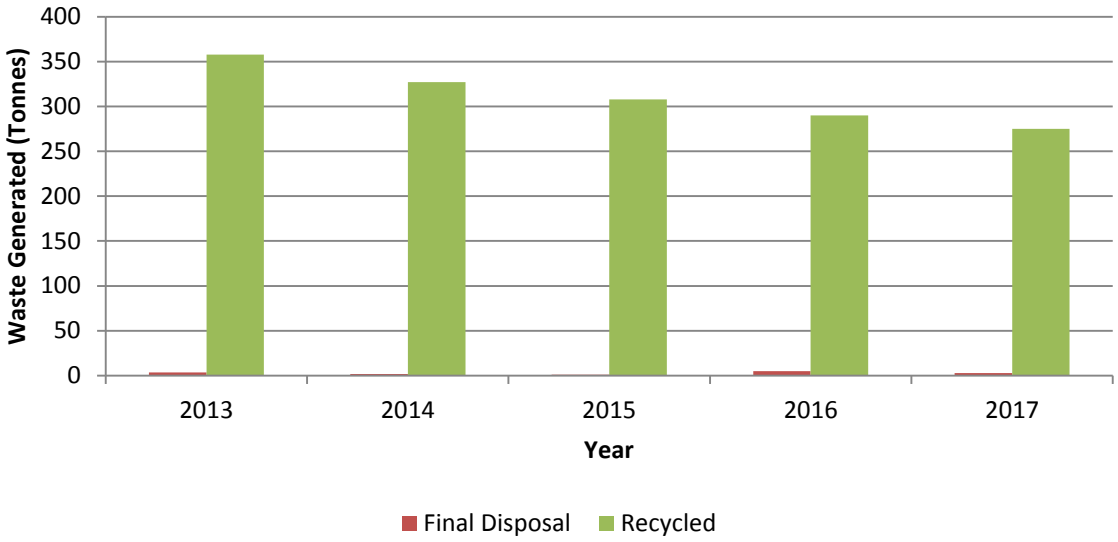

Figure 12: Breakdown of the final destination of generated waste from the Rough Offshore Facilities.

5.4.3 Non-Hazardous/Hazardous Waste

The waste which leaves the platforms can also be categorised as non-hazardous or hazardous waste. Out of the total waste generated, 207.93 tonnes was categorised as non-hazardous and 69.62 tonnes as hazardous waste. Since 2013, the amount of hazardous waste generated on the platforms has continued to decrease.

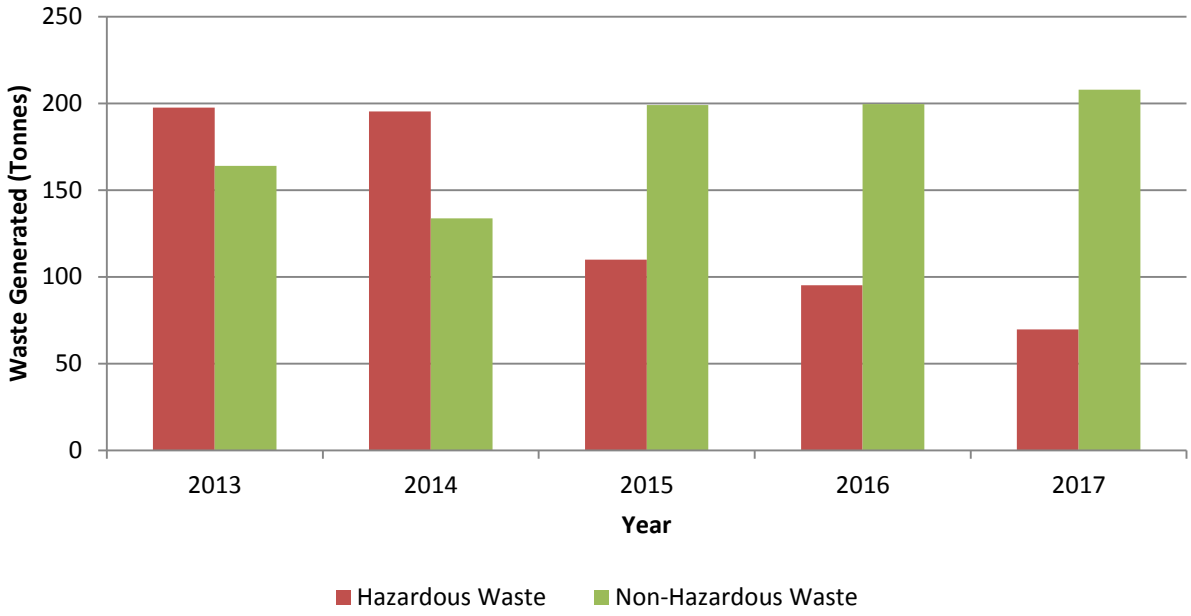

Figure 13: Historical Non-Hazardous and Hazardous Waste generated from the Rough Offshore Facilities.

6 Non-Conformities

Throughout 2017, CSL have had a number of non-conformities. All non-conformities have been reported to the appropriate Regulator and are discussed below.

6.1 Oil in Water

During 2017 the 47/3B platform produced gas on 181 days, of which, produced water was generated on 149 days. Out of the 149 days that produced water was generated, CSL exceeded the maximum concentration limit of 100mg/L on 145 days and monthly concentration limit of 30mg/l on eight occasions. For each exceedance an OPPC non-conformance report has been submitted to BEIS.

Table 2 shows the monthly breakdown of the number of days produced water was generated, the number of maximum concentration non-conformities and the monthly oil in water average.

Table 2. Summary of Oil in Water non-conformities.

	No. of Days Online	No. of Days Produced Water Generated	No. of Days of Maximum Concentration Non-Conformities	Oil in Water	
				Monthly Average (mg/L)	Mass of Oil Released (Kg)
Jan	27	4	2	117.43	1.67
Feb	17	15	14	1016.96	65.02
Mar	17	16	16	725.67	40.24
Apr	24	20	20	1000.68	80.35
May	10	10	10	539.41	32.36
Jun	0	0	0	0.00	0.00
Jul	0	0	0	0.00	0.00
Aug	0	0	0	0.00	0.00
Sep	0	0	0	0.00	0.00
Oct	29	27	26	244.00	40.59
Nov	28	28	28	588.98	112.43
Dec	29	29	29	325.14	77.04
Annual Total	**181**	**149**	**145**	**518.03**	**449.70**

Figure 14 shows the monthly average against the permit limit (30 mg/L).

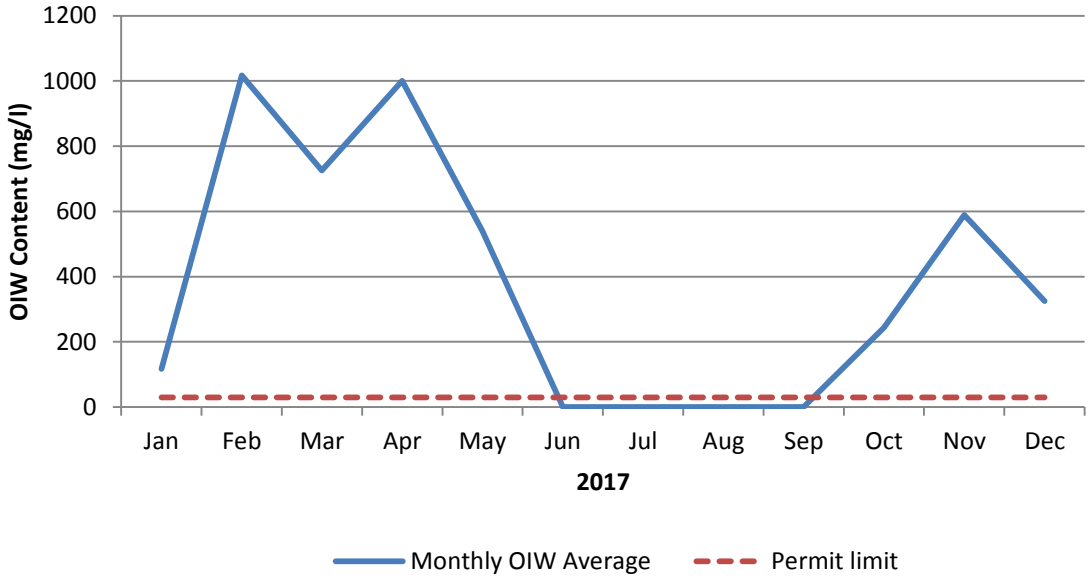

Figure 14. Monthly Average Oil in Water Concentration against OPPC Permit Limit.

During a platform shutdown period between June and September 2017, in order to reduce the oil concentration in the produced water seen during the first half of the year, CSL cleaned all the liquid handling vessels and installed new separation equipment to the interior of the Off-Spec Condensate Vessel. In addition to these improvements the use of polishing filters was re-introduced prior to overboard discharge. Although these improvements had been made, the desired improvement in oil in water content was not seen for the rest of the year.

In 2018, CSL have engaged two specialists (CETCO and Ingen) to continue to investigate and make recommendations to ensure the necessary improvements required to meet the OPPC Permit conditions.

During February 2018 CETCO undertook a characterisation and treatability study of the produced water on the 47/3 Bravo. The characterisation study was undertaken to determine oil droplet sizes, solid particle size and solid concentrations. The study allowed for an investigation to determine which CETCO treatment technologies would be plausible and effective at treating the produced water to obtain and maintain compliance.

The analysis showed that the particles sizes within the water were observed to be very small. The fluid was very turbid with fine white solids suspended throughout the water. The solid particles were analysed and 90% of the total volume of all solids particles were smaller than 11.40µm. For oil droplets, 90% of the droplets were smaller than 10.18µm.

From the characterisation study and while on the Platform, CETCO trialled and have recommended the use of Dissolved Gas Flotation (DFG) technology to reduce the oil in water concentration to within limits of the OPPC permit.

This technology uses multi-stage internals and dissolved gas technology. The introduction of a myriad of fine bubbles, with a diameter of 15-30µm, accelerates and enhances the removal of finely dispersed oil and fine solids from the fluid to be treated. The addition of dithiocarbamate (DTC) paired with a coagulant polymer prior to the introduction of gas enriched water helps to stabilise the created flocs. Using a concentration of 500ppm DTC and 25ppm polymer, a 98.8% oil removal efficiency was observed. From the results obtained, CETCO recommend that CSL should use the DGF technology to obtain compliance.

CSL are concerned that the recommended DTC (NALCO FX3060) is very toxic to aquatic life with long lasting effects to the environment and the recommended process requires the use of 5 litres/day.

In parallel with the CETCO trial, CSL have engaged Ingen to undertake a wider review of treatment and disposal options by revisiting a previous 'Pre-Feed and BAT Assessment Study' carried out in August 2016. This is in light of the change in business direction from Gas Storage to Production. The same methodology has been implemented for this study as was used during the 2016 study, with the intent to identify multiple alternative options that are potentially now available to CSL.

The study identified 37 options, but was reduced to 13 after Stage 1 Screening. Stage 1 Screening was effectively an immediate rejection of options that warrant no further review or evaluation. The basis for rejection of ideas was either engineering experience, technical blockers that are unlikely to be easily overcome, cost, or operational experience that suggests that the option was unlikely to be of benefit.

The study was completed and received by CSL on 25 May 2018, identifying 8 possible options to reduce Oil in Water concentrations to be with in the OPPC permit limit. These options will be under consideration by CSL.

6.2 PON1's

In 2017, CSL submitted 11 PON1's to BEIS with regards to non-regulated oil releases to sea. A review of these submissions are below.

Table 3. Summary of submitted PON1's during 2017.

Date	PON1 Ref	Category	Description	Min Quantity Released	Max Quantity Released	BEIS Status
30-Mar-17	PON1/6177	Diesel Release	During topping up of the BP crane with diesel, a small number of droplets/sheens observed overboard (total area no greater than 1m2).	0.000001 tonnes	0.000008 tonnes	No Further Action Required
22-May-17	PON1/6338	Hydraulic Oil Release	Sheen seen forming on sea approx. 10m west of the AD platform, each sheen appears approx. every 10 seconds and is approx. 1m square with an 80% sheen 20% rainbow effect. The sheen then quickly dissipates.	0.000141 tonnes	0.001897 tonnes	No Further Action Required
10-Jun-17	PON1/6389	Oil Release	When attempting to vent an airline connected to a test pump, the air line was found to be connected to the fluid inlet on the pump in error. An attempt was made to vent the air through the fluid inlet to make the work site safe, at which point the air pressure entered the oil tank causing an oil release from the fill spout on top of the tank. A sheen was then observed by a nearby work party.	0.000100 tonnes	0.000200 tonnes	No Further Action Required
20-Jul-17	PON1/6535	Hydraulic Oil Release	Sheen identified in the sea at the north edge of the CD jacket.	0.000056 tonnes	0.000654 tonnes	No Further Action Required
17-Aug-17	PON1/6625	Diesel Release	Small loss of diesel observed (approx. 5-10 drips direct to sea) from the inboard swivel joint fitting during diesel bunkering activities on CD.	0.000002 tonnes	0.000019 tonnes	No Further Action Required

08-Sep-17	PON1/6701	Annulus fluid Release	Oil sheen seen on the north east side of the BD jacket.	0.000016 tonnes	0.000211 tonnes	In-Review
21-Sep-17	PON1/6739	Annulus fluid Release	Loss of small volume of annulus fluid (observed at 1 drip every 10-15 seconds) through annulus vent line on C11 directly to sea creating a small sheen off the north west corner of the CD jacket.	0.000026 tonnes	0.000259 tonnes	No Further Action Required
28-Sep-17	PON1/6754	Diesel Release	A sheen was observed on the sea on the east side of the CD platform, upon investigation a leak of diesel was identified coming from a nitrogen pumping unit situated on the main deck.	0.0431 tonnes	0.0531 tonnes	In-Review
20-Oct-17	PON1/6816	Hydrocarbon Runoff	Oil sheen on the south east of the BD jacket.	0.000071 tonnes	0.001003 tonnes	In-Review
30-Oct-17	PON1/6849	Hydrocarbon Runoff	Sheen observed on the east side of the platform, south side of the Zaratan Jack-up	0.000299 tonnes	0.000631 tonnes	No Further Action Required.
29-Dec-17	PON1/6849	Hydraulic Oil Release	Failure of pipework sealing O ring incorporated within a pipework joint, located on Hydraulic oil cooler drain line	0.01 tonnes	0.1 tonnes	No Further Action Required.

7 2017 AUDITS

During 2017, a number of audits were undertaken with regards to the environmental aspects of the Rough Gas Facilities. An internal ISO 14001 audit was undertaken in March 2017. There were a number of observations found throughout the audit, mainly focusing on procedural improvements. Corrective actions have been identified and implemented to close out these findings.

An external ISO14001 audit to determined continued ISO 14001 Certification was completed in July 2017. From this audit there were two minor non-conformities observed, one observation and two opportunities for improvements were documented. The minor findings were based upon an error within a procedure and the Environmental Annual Review, at that time, had not taken place. Corrective actions to address all findings and observations have been identified and completed.

Both internal and external EU ETS verification audits were undertaken in November 2017 and January 2018 respectively. From the audits, it was observed that that were requirements to update the permits, submit partial cessations and make necessary procedural updates. The necessary corrective actions were identified for all findings and were implemented prior to the data submission.

8 FUTURE ACTIVITIES

Since 2015, CSL have undertaken maintenance work and conducted testing and verification work on the Rough Wells. After experiencing several issues associated with the integrity of the offshore installations and Rough well stock that have substantially reduced the physical capabilities of the Rough Storage Facility, during 2017 CSL have decided that it is no longer feasible to continue has a storage facility.

In Q4 2017, CSL have submitted a Field Development Plan Addendum proposing that the Rough Storage Operations are permanently ceased and that Rough becomes a Production Facility. A Production Licence (PCON/4517/0) has being approved by the Oil and Gas Authority, and as of 17 January 2018, CSL will operate the Rough field as production only. Under this licence, during 2018 CSL is allowed to produce an annual average offtake between 2,967,000 to 5,785,000 scm/day of gas from the Rough Gas Field. This gas will be produced through free flow high pressure mode. When pressure drops, CSL will go into a medium pressure mode (predicted to be November 2018), were the removal of gas will be supported by the use of the Rough Compressor at the Easington terminal.

9 SUMMARY

During 2017, CSL produced 1862.14 Mscm of gas from the Rough Gas Facilities in accordance with the regulated activities described within the Permits and Consents under which it operates. However, there have been a number of occasions within 2017 when CSL have exceeded the OPPC permit limits.

During the 2017 shutdown period, the cleaning of pipework and the installation of new separation equipment in the interior of the Off-Spec Condensate Vessel was undertaken with the intent to reduce the Oil in Water concentration to within OPPC Permit limits. Unfortunately, although making an improvement in Oil and Water concentration, these improvements did not succeed in lowering the Oil in Water concentration to below the permitted limit.

As part of the continuous investigation into the causes of the exceedences and exploring various options to resolve the issues and become compliant to the OPPC permit conditions, at the start of 2018, CSL have engaged specialists (CETCO and Ingen) to identify improvement opportunities.

CETCO have undertaken a characterisation and treatability study and have recommended CSL undertake a pilot trial using a Dissolved Gas Flotation Technology to reduce the Oil in Water concentration.

With the change from a Storage Facility to a Production Facility, CSL have engaged Ingen to revisit the 2016 Pre-Feed and BAT Assessment Study. To make the necessary Oil in Water improvements, Ingen have recommended 8 options for CSL to consider.

CSL are currently investigating the most viable options and are undertaking the necessary Management of Change process to ensure that any recommended changes will not affect the safety, integrity and production processes of the Rough Gas Facility.

In 2018, CSL will continue to endeavour to operate within permitted limits and look for opportunities to improve their environmental performance and reduce their environmental impacts.

APPENDIX 1 – Centrica Environmental Policy

Group Environment Policy

At Centrica we are committed to understanding, managing and reducing the environmental and ecological impacts of our activities through innovation, technology and cultural change.

We are committed to:

- **Assessing**, understanding and managing our environmental risks and impacts, placing special emphasis on minimising major accident risks
- **Enabling** and encouraging our employees to help us achieve our environmental goals
- **Proactively** seeking ways to reduce our carbon emissions
- **Reducing** waste and using resources efficiently
- **Developing** renewable and low-carbon energy sources, products and services
- **Encouraging** our customers to move towards a low carbon future by helping them make informed decisions about the use of our products and services
- **Working** with our suppliers and business partners to pursue responsible environmental practices
- **Publishing** regular performance reports and openly discussing our environmental performance with internal and external stakeholders
- **Continually** improving and setting measurable objectives and targets to prevent pollution and reduce our environmental impacts
- **Complying** with environmental legislation, regulations and other applicable requirements

We will implement comprehensive environmental management systems that are routinely audited in all our businesses and attain certification to ISO14001 or equivalent in our exploration and production, power generation and servicing and installation operations. Our performance is reviewed regularly by the Centrica Executive Committee.

Iain Conn
Chief Executive
January 2015

centrica