Supporting Documentation – Permit Variation V004

EPR/BJ7522IJ – BOC Hydrogen Plant

BOC Limited

BOC Hydrogen Plant
Huntsman Drive
SABIC North Tees Site
Port Clarence
Stockton-on-Tees
TS2 1TT

Prepared by:

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Revision Record

Revision	Date	Prepared By	Checked By	Authorised By
01	9 October 2024	Mark Webb		
02	5 November 2024	Mark Webb	BOC	Mark Webb
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Basis of Report

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1.0 Non-technical Summary

This application is for substantial variation of Environmental Permit (EP) number EPR/BJ7522IJ for the BOC Hydrogen Plant in Teesside.

The variation is required to incorporate a new CO_2 recovery and liquefaction plant (LIC Plant) into the EP.

The LIC plant will be used to capture CO_2 typically present in the steam methane reformer syngas produced by the existing hydrogen (H_2) plant with a corresponding reduction in the CO_2 emissions to the environment. The LIC Plant will process up to 144 tonnes per day of CO_2 which will be liquefied and then exported from site by road tanker for use in other industrial activities – including food and drink production.

There are two stages to the new LIC plant:

- The first part of the process is the capture of CO_2 from the syngas stream which is undertaken using an adsorption and desorption technology using an amine-based washing agent.
- The second part of the process is the processing and liquefaction of the recovered CO_2 with subsequent storage and loading into road vehicles for despatch from site.

The addition of the LIC plant will require extension of the existing Installation Boundary to incorporate the additional land areas required to accommodate the LIC plant and will lead to additional emissions to water which have required assessment of potential environmental impacts and hence this application is considered to represent a substantial variation to the EP.

A set of technical supporting documentation has been prepared which includes details of the proposed site changes supported by appropriate environmental risk and impact assessments as well as presenting details of the management controls that will be utilised to operate and control the LIC Plant.

The application demonstrates that the addition of the LIC plant will not lead to any significant environmental impacts and will in fact lead to the following benefits:

- Improved energy efficiency;
- Improved process efficiency; and
- Reduced CO_2 emissions.

2.0 Applicant and Site Details

2.1 Applicant

Table 1: Applicant Company Details

Aspect	Applicant Details
Company Name	BOC Limited
Company Number	00337663
Registered Office Address	Forge, 43 Church Street West, Woking, Surrey, England, GU21 6HT
Date Of Incorporation	8 March 1938
Nature of Business (SIC)	20110 - Manufacture of industrial gases

Table 2: List of Company Directors (as recorded at Companies House)

Director Name (Last Name , First Name)	Role	Date of Birth	Appointed On
KELLY, Susan Kathleen	Secretary		21 December 2007
BLAND, Julian Michael	Director	April 1967	17 May 2018
BOTELLO ALBARRAN, Armando	Director	August 1967	1 February 2024
COSSINS, Christopher James	Director	November 1966	16 May 2013
WILLIAMS, Sally Ann	Director	August 1970	14 December 2015

Table 3: Applicant Site Contact Details

Aspect	Applicant Details
Site Name	BOC Hydrogen Plant
Site Address	Huntsman Drive, SABIC North Tees Site, Port Clarence, Stockton-on-Tees, TS2 1TT
Site Contact	Mr Nigel Anderson
Role	Environment & Sustainability Manager - SHEQ
Email	Nigel.anderson@boc.com
Telephone Number	07771 815663

2.2 Existing Environmental Permit Details

The existing facility is permitted under Schedule 1, Part A1 of the Environmental Permitting (England and Wales) Regulations (EPR) 2016 (as amended). The Environmental Permit number is EPR/BJ7522IJ, Table 4 presents the details of the permitted activities as defined in Table S1.1 of the Permit.

Table 4: Permitted Activities

Activity Reference	Activity Listed in Schedule 1 of the EP Regulations	Description of Specified Activity and WFD Annex I and II Operations	Limits of Specified Activity and Waste Types
A1	S1.2 A(1)(b): Reforming of Natural Gas	Gas treatment, reformation using a catalytic steam reformer, steam raising and all associated activities	Receipt of raw materials at the battery limit to the dispatch of steam and hydrogen product from the battery limit.
A2	S4.2 A(1)(a) (i)	Production of Inorganic Chemicals, namely Hydrogen	Not currently defined in the Environmental Permit Receipt of raw materials at the battery limit to the dispatch of hydrogen product from the battery limit

The steam methane reformer at Teesside was first commissioned in 2002, to export up to 3.69 tonnes/hr of hydrogen and up to 96 tonnes/hr steam to Huntsman Polyurethanes and SABIC. In 2017, the plant underwent a reconfiguration project following closure of the SABIC Aromatics plants and therefore the loss of the steam and high-pressure hydrogen consumer.

Today the plant can operate between 30% and 100% capacity, with plant rate dictated by the low-pressure hydrogen consumer, Huntsman Polyurethanes at Wilton. Hydrogen is made by mixing steam and natural gas and reforming this over a nickel catalyst. The raw hydrogen gas or ‘syngas’ is then passed through a shift converter to convert CO to CO_2, before the gas is cooled down to ambient temperature and fed through the PSA unit, which adsorbs impurities to get the hydrogen to the required purity. Waste gases and then desorbed when the PSA beds depressurise and returned to the reformer as a fuel source. Surplus steam generated by the plant is used to warm up the combustion air through the secondary steam air preheater and is also let down to warm up the cold make up water. Any excess steam is reduced in pressure and condensed in the steam condenser unit.

2.3 Details of the Variation Request

This application for variation of the existing Environmental Permit (EP) is required to incorporate a new CO_2 recovery and liquefaction plant (LIC Plant) into the EP. The LIC plant will be used to capture CO_2 typically present in the SMR syngas produced by the existing H_2 plant with a corresponding reduction in the CO_2 emissions to the environment. The LIC Plant will process up to 144 tonnes per day of CO_2 which will be liquefied and then exported from site by road tanker for use in other industrial activities – including food and drink production.

The addition of the LIC plant will require extension of the existing Installation Boundary and will lead to additional emissions to water and hence is considered to represent a substantial variation.

The variation is to add a directly associated activity to the Environmental Permit as defined in Table 5 Below

Table 5: Proposed New Directly Associated Activity

Directly Associated Activities	Description of the DAA	Activity Capacity
CO_2 Recovery and Liquefaction	CO_2 adsorption and desorption CO_2 purification and drying CO_2 compression, cooling and liquefaction Storage of Liquid CO_2 Loading of liquid CO_2 into road vehicles for despatch from site	Recovery of CO_2 present in the PSA tail gas

2.4 Communication with the EA in Relation to the Permit Variation

This application for Permit Variation is a re-submission of the application previously submitted in September 2023.

As part of the previous submission, the following communications occurred with the Environment Agency (EA).

Table 6: Details of Communications and Previous Submissions to the EA in Relation to this Application for Variation

Date	Communication Type	Topic	Who was Involved
07/10/2020	Teams meeting	BOC environmental permit variation application	Simon Crossley BOC Leading Project Engineer
			Paul Saunders - Regulatory Officer - EPR Process Industry Regulation
			Jonathan Holman BOC Regional SHEQ Advisor
22/04/2021	Telephone conversation	Clarification of issues to consider in relation to permit variation	Paul Saunders - Regulatory Officer - EPR Process Industry Regulation
			Jonathan Holman BOC Regional SHEQ Advisor
06/07/2021	On site meeting	To review variation application	Victoria Oleksik BOC TH2 Plant Manager
			Paul Saunders - Regulatory Officer - EPR Process Industry Regulation
			Jonathan Holman BOC Regional SHEQ Advisor
15/09/2023	Email	Submission of original application for variation	Nigel Anderson BOC Health & Environment Manager - SHEQ
23/10/2023	Email	EA request for further information (RFI)	Francesco Di Stefano – EA Principal Permitting Officer, Installations, National Permitting Service

Date	Communication Type	Topic	Who was Involved
Various	Email and telephone	Discussions in relation to RFI delivery	Nigel Anderson BOC Health & Environment Manager - SHEQ Catherine Harvey – EA - Permitting Officer – National Permitting Service
01/02/2024	Email	Response to RFI part 1	Nigel Anderson BOC Health & Environment Manager - SHEQ Catherine Harvey – EA - Permitting Officer – National Permitting Service Mark Webb – SLR Consulting Ltd
16/02/2024	Email	Response to RFI part 2	Nigel Anderson BOC Health & Environment Manager - SHEQ Catherine Harvey – EA - Permitting Officer – National Permitting Service Mark Webb – SLR Consulting Ltd
19/02/2024	Telephone / email	Application returned by EA due to missing information	Nigel Anderson BOC Health & Environment Manager - SHEQ Catherine Harvey – EA - Permitting Officer – National Permitting Service

This revised application has been prepared to include and update the data provided in the original submission and to address all items previously requested in the EA request for further information.

As this is a re-submission of an application for variation of the site environmental permit and has previously been through the EA application queue delays, we formally request that this application for variation be prioritised to facilitate prompt determination.

The LIC plant is under construction and is proposed to commence commercial operation in Q4 2025, it is therefore requested that the EA bears this in mind when processing the application and determining the application so that a valid Environmental Permit is in place prior to commencement of operation.

2.5 Supporting Documentation

The application package comprises the documents detailed in Table 7.

Table 7: Details of the Documents Comprising the Application Package

Document Reference	Content	Location
Form A	EA Application Form A - Application for an environmental permit - Part A – About you	Application Forms Folder
Form C2	EA Application Form C2 – general – Varying a bespoke permit	Application Forms Folder
Form C3	EA Application Form C3 – Variation to a bespoke installation permit	Application Forms Folder
Form F1	EA Application Form F1 – Charges and Declarations	Application Forms Folder
416.065113.00001	Technical Supporting Document	This Document

Document Reference	Content	Location
Appendix A	Figures	Appendix A
Appendix B	Site Condition Report	Appendix B
Appendix C	Process Information	Appendix C
Appendix D	BAT Assessment	Appendix D
Appendix E	Air Emissions Risk Assessment	Appendix E
Appendix F	Water Emissions Risk Assessment	Appendix F
Appendix G	Noise Impact Assessment	Appendix G
Appendix H	CO_2 Venting Risk Assessment	Appendix H
Appendix I	Management System Overview	Appendix A
Appendix J	Climate Change Agreement	Appendix A

3.0 Site Setting

The Installation site is roughly 1.26 hectares of leased land forming part of a larger industrial area of the SABIC North Tees Complex.

The Installation site comprises the existing Teesside Hydrogen Plant to the south with the proposed location of the LIC plant to the north of the overall site.

The Site is situated approximately 5km northeast of Middlesbrough city centre within a tract of reclaimed land utilised for industrial development along the Tees Estuary. Access and egress to the Site is through a manned security barrier leading from Huntsman Drive, which connects to the A178 (Seaton Carew Road) further to the west.

The location of the site is shown in Appendix A – Figure 1.

3.1 Site Condition Report

The new LIC plant will be located on the plot immediately to the north of the existing H_2 plant on the North Tees Complex in the location which was previously occupied by the SABIC Cumene plant.

The revised installation boundary is presented in Appendix A – Figure 2 and the LIC plant layout is presented in Appendix A – Figure 3.

The site condition assessment for the additional land to be added into the Installation boundary to accommodate the LIC Plant is presented in Appendix B and has been prepared in 2 parts:

- Appendix B1 – Land Quality Risk Assessment (Desktop Assessment); and
- Appendix B2 – Phase 2 Site Investigation (Intrusive Site Condition Assessment).

The soil and ground condition data presented within the Phase 2 Site investigation is considered to represent the baseline site condition for the LIC plant area.

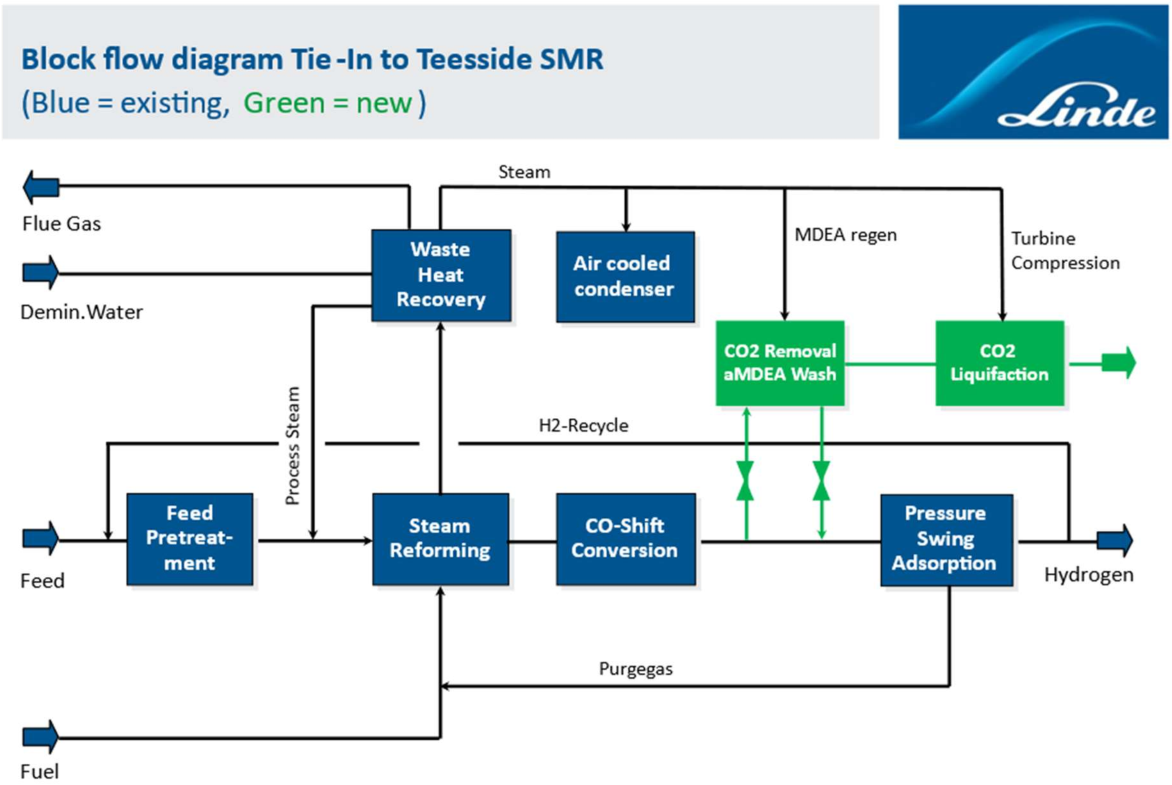
It is proposed that this will be supplemented by periodic groundwater monitoring at the site with baseline groundwater condition being established by the results of the first round of monitoring.

4.0 Process Details

4.1 Process Overview

There are two elements to the new LIC plant. The first part of the process is the capture of CO_2 from the syngas stream and the second is the liquification of the CO_2.

Figure A: LIC Tie-in to the Existing H2 Plant



4.2 CO_2 Adsorption and Desorption

Syngas from the existing hydrogen reformer is fed to the Absorber Column which is operated with an amine-based washing agent for CO_2 adsorption. Syngas, will be taken from the H_2 plant via a tie-in located between the high temp shift reactor (HTS) and the pressure swing absorber (PSA) (see Figure A). The CO_2 lean syngas is sent back to the H_2 plant (fed upstream of the PSA unit), the returned Syngas will be CO_2 depleted and have a lower mass flow which will lead to a change in the PSA cycle time and off gas composition (see Section 8.1.1 for assessment of the potential impacts this may have on the emissions to air from the SMR).

The CO_2-rich absorbent solution is withdrawn at the bottom of the column. Impurities in the CO_2 rich solution are removed in the HP Flash Drum and fed to the reformer tail gas stream.

Regeneration of the amine solution is carried out in the Stripper Column by releasing the absorbed CO_2. The hot Rich Solution enters the stripper column and passes counter-current to the ascending vapor, generated in the Reboiler. Regenerated amine solution leaves the bottom of the Stripper Column.

Process condensate will be collected in a separator pit and pumped to the existing effluent tank on the H_2 plant where it can be monitored, pH corrected and then discharged into the

North Tees Site (SABIC) drainage system for subsequent discharge to the Tees Estuary – See Section 7.2.

Details of the CO_2 adsorption and desorption systems are presented in the process flow diagram presented in Appendix C1.

4.3 CO_2 Processing and Liquefaction

The CO_2 gas coming from the Stripper Column enters the LP Scrubber, where water-soluble components like amines and ammonia are removed. The raw CO_2 gas coming from the LP Scrubber will be sent to the CO_2 Compressor Unit and compressed to approx. 20 barg. Any remaining water in the feed gas is removed in interchangeable dryers. The dry raw gas then passes through the CO_2 Reboiler and cooled down. From the Reboiler, the gas is sent to the CO_2 Condenser where liquefaction of the CO_2 takes place. The liquid CO_2 product is drawn-off the bottom of the CO_2 Column and sent to storage.

Details of the CO_2 processing and liquefaction systems are presented in the process flow diagram presented Appendix C2.

4.4 CO_2 Storage and Road Tanker Loading Station

The CO_2 storage and loading station will have three identical CO_2 horizontal storage tanks (each with 400 tonnes storage capacity). During normal operation the storage tank pressure will be kept around 15 barg. The pressure and temperature in the tanks can be maintained by removing excess gas from the tanks. Any excess gas is sent to either the CO_2 compressor unit, the dryer or under certain circumstances may be vented to atmosphere via a silencer. It is envisaged that up to 8 road tankers per day will be filled and exported from site.

4.5 CO_2 Refrigeration Unit

The required refrigeration duty for the CO_2 liquefaction is provided by the refrigeration unit using ammonia as the refrigerant. The compressor will be driven by HP-Steam from the existing H_2 plant.

4.6 Raw Materials

The CO_2 recovery and liquefaction plant will process the gases produced by the existing hydrogen plant steam methane reformer (SMR) to recover CO_2 present.

As such there are no raw materials fed into the process other than the gases generated by the SMR.

The CO_2 plant will use water for topping up the cooling systems and is expected to require periodic / infrequent replacement of the amine solution used within the adsorption column. The use of both water and amine will be minimised through effective control and operation of the process.

The cooling towers will also require cooling water dosing chemicals which are detailed in Section 4.9.

4.7 Chemical Storage and Secondary Containment

The plant is equipped with a bulk storage tank to store the entire inventory of the amine plant (up to 30m³), this tank will be provided with suitable secondary containment of approximately 60 m³ capacity.

The amine plant area will also be bunded (impermeable concrete bund) with rainwater draining into a blind collection pit. This water will be checked for amine content, and if no amine is present, then it will be pumped into the existing H_2 plant effluent tank. If amine is found to be present, then this water would be collected for appropriate offsite disposal and an investigation initiated to identify and rectify the source of amine loss.

The compressor area will include a compressor oil storage tank of around 650 litres capacity which will be provided with its own impermeable bund of approximately 5m³ capacity. The compressor area will also be located over an impermeable concrete bund with rainwater draining into a blind collection pit, any losses within this area would be collected for appropriate offsite disposal.

The new cooling water system will also have dedicated storage tanks for the storage of water treatment dosing chemicals. These tanks are anticipated to be of between 750 litre and 1,500 litre capacity and will be integrally bunded plastic tanks located over an impermeable concrete hardstanding.

The chemicals storage arrangements at the site are considered to be appropriate for the materials and volumes being stored, and compliant with the requirements of the CIRIA C736 guidance.

4.8 Utilities and Site Facilities

Although the LIC will be a new build plant, the utilities and services will be supplied via the existing H_2 Plant as an umbilical with shared control room, communications systems and welfare facilities.

Utilities provided by the H_2 plant will include: low pressure steam, receipt of condensate return, electricity, demineralised water etc.

4.9 Cooling Water

The cooling water for the plant will be provided by a recirculating cooling water system with an associated cooling tower. There will be a continuous purge and make-up of the cooling water recirculated within the system to maintain suitable water quality. Purge / blow down water will be discharged directly into the North Tees Site (SABIC) drainage system for subsequent release into the Tees Estuary.

The cooling water will be dosed with appropriate proprietary chemicals to maintain the desired cooling water quality and to minimise potential for biofouling and corrosion etc.

The LIC plant cooling water system operated and managed in a similar manner to the existing H_2 plant cooling water system and is expected to utilise the same dosing chemicals and to have periodic water quality monitoring undertaken to ensure that the desired composition is maintained.

The cooling water dosing chemicals anticipated to be used on the LIC site are:

- Biofouling control e.g. Purechlor 15;
- pH control e.g. Sulphuric acid;
- Corrosion Inhibitor e.g. Performax PM3610;
- Antifoam e.g. Antispumin WF7200.

4.10 Steam Supply

HP-Steam from the existing H_2 plant will be used to run the Steam Turbine CO_2 Compressor and the Steam Turbine Refrigerant (Ammonia) Compressor. LP steam will also be available for process heating duties. Some venting of excess steam from the H_2 Plant may be required during start-up / shut down of the LIC plant, this would be via the existing steam venting systems on the H_2 plant.

Steam condensate will be recovered and pumped back to the deaerator on the H_2 plant, this will minimise the need for demineralised water make up.

4.11 Site Drainage

The LIC plant plot will be installed with surface water drainage systems to collect rainwater. These drainage systems will be routed to the LIC plant collection pit, where they will be contained and checked for potential contamination. If no contamination is present, then the rainwater will be pumped out into the North Tees Site (SABIC) drainage system for subsequent discharge to the Tees Estuary – See Section 7.2.

The site drainage system is illustrated in Appendix A – Figure 4.

5.0 Best Available Techniques

BAT assessment has been undertaken to review the proposed site changes and in particular the addition of the CO_2 recovery and liquefaction plant against the requirements defined within published BAT.

The assessment includes a review against the requirements of:

- Environment Agency - Sector Guidance Note IPPC S4.03 - Guidance for the Inorganic Chemicals Sector.
- EU BAT Conclusions on Common Wastewater and Waste Gas Treatment / Management in the Chemical Sector (May 2016).
- EU BAT Conclusions on Common Waste Gas Management and Treatment Systems in the Chemical Sector (December 2022).
- Environment Agency – Draft Guidance - Emerging Techniques for Hydrogen Production with Carbon Capture (2023).

The BAT assessment is presented in Appendix D.

6.0 Process Efficiency

The LIC plant has been designed specifically to capture CO_2 typically present in the SMR syngas produced by the existing H_2 plant.

The amine based CO_2 adsorption and desorption technology and the subsequent CO_2 liquefaction technology selected to achieve this duty has been chosen as it is considered to achieve optimum process efficiency balanced against a number of other considerations including:

- Optimised energy efficiency (See Section 9);
- Selection of a process solvent (amine) which presents minimal degradation risks;
- Flexibility in operation to align with the loading on the H_2 plant;
- Minimisation of overall environmental impacts in line with BAT.

7.0 Emissions

7.1 Emissions to Air

During normal operation of the LIC plant, emissions to air will solely comprise of venting of nitrogen used for inertisation of process vessels.

Under certain operational scenarios e.g. the unavailability of the CO_2 liquefaction plant, it may be necessary to vent CO_2 to atmosphere.

7.1.1 CO_2 Venting

7.1.1.1 Vent Gas from LP-Scrubber– Infrequent Emission

In the event that the CO_2 liquefaction plant is not in operation, the hydrogen production process would need to continue to operate to meet its production obligations. This could occur as a result of a number of credible scenarios including: an unplanned maintenance shutdown, the CO_2 storage units being full, or there being no market demand for the liquefied CO_2 generated.

Under such circumstances the site would need to continue to operate the CO_2 absorber unit, however, all the CO_2 from the top of Stripper Column would be sent to the LP-Scrubber and from there it would need to be vented to atmosphere. When this occurs, the overall emissions of CO_2 to air from the installation would be equivalent to those that currently occur from the operation of the hydrogen production plant without the CO_2 recovery and liquefaction plant being present.

BOC envisages that this mode of operation would be an infrequent event, but when it occurs, it could potentially last for periods of several days.

The maximum predicted CO_2 venting rate is 3,242 Nm^3/h, and the predicted composition of the vented gas is presented in Table 8.

Table 8: LP Scrubber - Vent Gas Characteristics

Parameter	Quantity	Concentration (mg/Nm^3)
CO_2	99.33 Vol %	1,787,940
H_2O	0.53 Vol%	N/A
H_2	0.13 Vol %	106.34
CH_4	98 ppmv	64.29
N_2	5 ppmv	5.73
Ethane	1 ppmv	1.23
Ammonia	4 ppmv	2.786
Acetaldehyde	5 ppmv	9.01

7.1.1.2 Vent Gas from CO_2 Loading Station

In case a pressurised CO_2 Truck is connected to the CO_2 Loading Station 2-Y6311 the pressure of the truck has to be reduced first to the pressure of the Storage Tanks 2-D6111A-C. In case the purity of the gas in the truck does not comply with required purity the gas has to be sent to atmosphere. The depressurisation time is expected to be approx. 10 minutes.

The maximum predicted CO_2 venting rate is 1,670 Nm^3/h

7.1.1.3 Boil-off gas from Storage Tanks 2-D6111A-C

Boil-off gas from the Storage Tanks is normally sent to the Regeneration Gas Heater or back to the CO_2-Compressor. In the event that the CO_2 liquefaction plant is not running then the boil-off gas would need to be sent to atmosphere.

The maximum predicted CO_2 venting rate is 97 Nm³/h, and the predicted composition of the vented gas is presented in Table 9.

Table 9: Boil-off gas from Storage Tanks - Vent Gas Characteristics

Parameter	Quantity	Concentration (mg/Nm³)
CO_2	99.99 Vol %	1,799,820
CH_4	72 ppmv	47.23
CO	1 ppmv	1.15
Ethane	3 ppmv	3.69

7.1.2 Nitrogen Venting

The following vent points will be present to vent excess nitrogen used for inertising process plant:

7.1.2.1 Vent Gas from Make-up Water Break Tank

Nitrogen is used for blanketing the Make-up Water Break Tank. Surplus Nitrogen is sent to atmosphere. The maximum predicted N_2 venting rate is 4 Nm³/h.

7.1.2.2 Vent Gas from Solution Storage Tank

Nitrogen is used for blanketing the Solution Storage Tank. Surplus Nitrogen is sent to atmosphere. The maximum predicted N_2 venting rate is 4 Nm³/h.

In case the amine inventory of the wash unit has to be discharged to the Solution Storage Tank (due to maintenance work), nitrogen displaced from the Solution Storage Tank would need to be vented to atmosphere. The maximum predicted N_2 venting rate under this displacement scenario is 18 Nm³/h. This would be an infrequent occurrence and would be expected to occur at most a few times per year.

Details of the predicted emissions to air from the LIC Plant under these scenarios are presented in Table 10.

Table 10: Details of Potential Emissions to Air

Emission Source	Composition	Volumetric Flowrate	Frequency of Occurrence
Vent Gas from Make-up Water Break Tank 1-D2090 – from use of Nitrogen for inerting purposes	Nitrogen (100%)	4Nm³/h	Continuous
Vent gas from Solution Storage Tank 1-D7210– from use of Nitrogen for inerting purposes	Nitrogen (100%)	4Nm³/h	Continuous

Emission Source	Composition	Volumetric Flowrate	Frequency of Occurrence
Vent gas from LP-Scrubber 2-T1210	Carbon Dioxide (99.33%) Hydrogen (0.13%) Traces of: Carbon monoxide (<56ppm) Methane (<98ppm) Nitrogen (<5ppm) Ethane (<1ppm) Ammonia (<4ppm) Acetaldehyde (<5ppm)	3,242 Nm³/h	Only in the event that the CO_2 liquefaction plant is offline or unavailable, Or if the H_2 plant is operating at significantly reduced load leading to insufficient steam heat generation to operate the LIC plant – in which case the emission rate of CO_2 vented would be substantially reduced.
Vent Gas from CO_2 Loading Station 2-Y6311 In the event that a pressurised CO_2 Truck is connected to the CO_2 Loading Station, the pressure of the truck has to be reduced to the pressure of the Storage Tanks. In case the purity of the gas in the truck does not comply with required purity of the site CO_2 the gas has to be vented to atmosphere.	Carbon Dioxide (100%)	1,670 Nm³/h	Only in the event that a pressurised CO_2 Truck is connected to the CO_2 Loading Station. The depressurisation time is expected to be approx. 10 minutes.
Boil-off gas from Storage Tanks 2-D6111A-C Boil-off gas from the CO_2 Storage Tanks is normally sent to the Regeneration Gas Heater or back to the CO_2-Compressor.	Carbon Dioxide (99.99%) Methane (<72ppm) Carbin Monoxide (<1ppm) Ethane (<3ppm)	97 Nm³/h	Only In the event that the CO_2 liquefaction plant is not running, or unavailable then the boil-off gas is vented to atmosphere.

7.2 Emissions to Water

The discharges from the BOC site include the following existing sources:

- H_2 plant boiler blowdown;
- H_2 plant cooling water purge;
- H_2 plant scrubber / sump discharge;

All of which are discharged via the H_2 plant effluent tank, and

- H_2 plant demineralised water plant effluent;
- H_2 plant cooling water blowdown.

These discharge to the SABIC North Tees Site drainage system and then into the Tees Estuary are existing discharges which have been ongoing since the commencement of operation of the H_2 plant.

The discharge into the SABIC North Tees Site drainage system is under a discharge agreement between BOC and SABIC i.e. the discharge from the BOC site is into a private drainage system operated by SABIC.

The discharge from the SABIC North Tees Site drainage system into the Tees Estuary is currently regulated as emission point W1 under Environmental Permit Number EPR/BU4503IW which is held by SABIC.

The addition of the LIC plant will add the following sources to the discharge from the BOC Installation:

- LIC process condensate - which will be discharged via the H_2 plant effluent tank; and
- LIC plant cooling water blowdown.

Figure B presents an overview of the water emission sources on the BOC site and how they link into the North Tees Site drainage system.

Table 11 Presents a summary of the emission sources to water from the entire installation.

Table 11: Details of Potential Emissions to Water from the LIC Plant

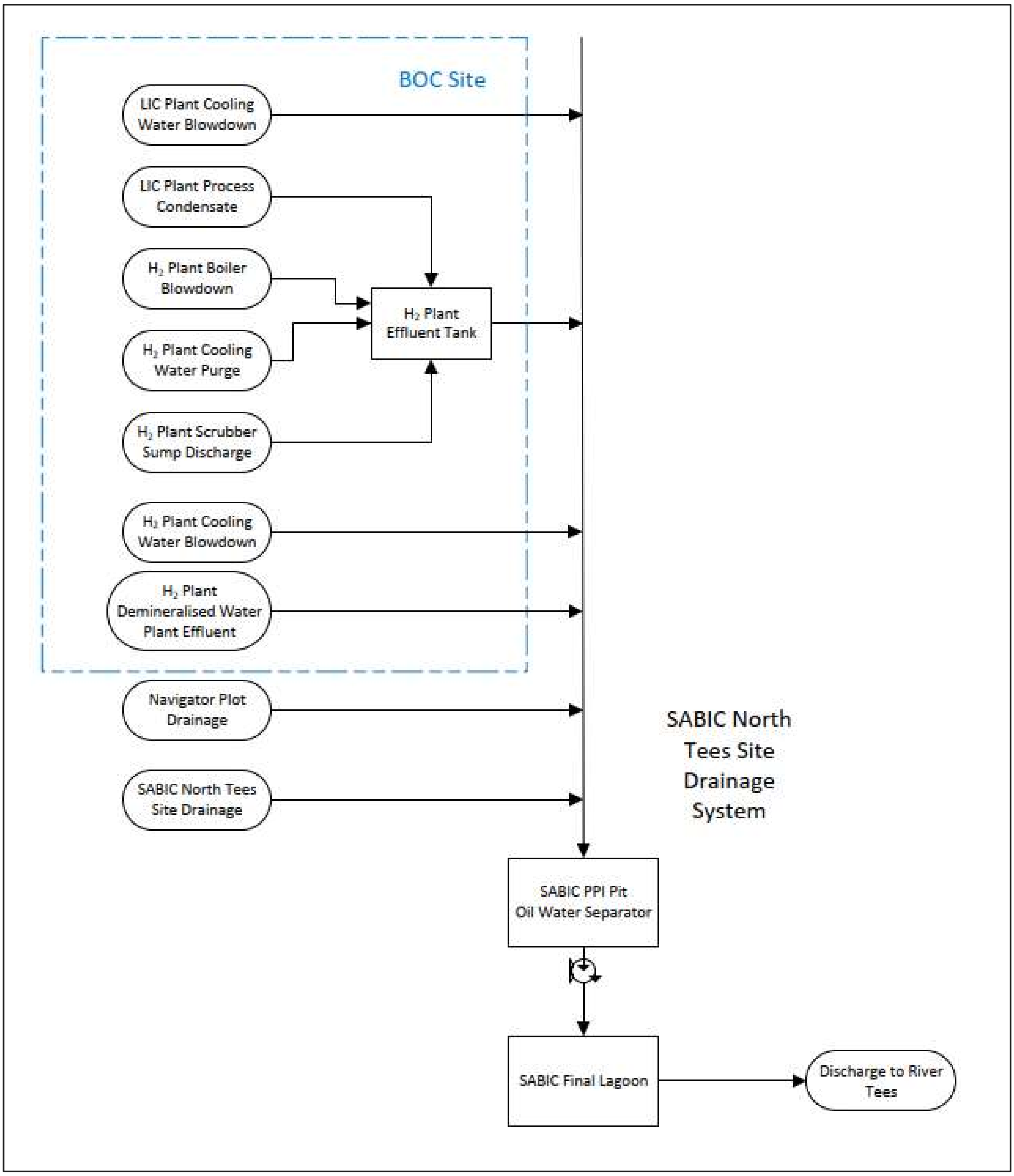
Emission Point Reference	Emission Source
E1	Combined process effluent from the H_2 and LIC plants Discharged via existing H_2 plant effluent tank
E2	Reject water from the H_2 plant demineralised water plant
E3	H_2 plant cooling water purge / blowdown
E4	LIC plant cooling water purge / blowdown
E5	Storm water from the LIC plant collection pit

The anticipated flows and loads within the water discharged are presented in the spreadsheet that forms Appendix A of the Water Emissions Risk Assessment report provided in Appendix F and summarised in Table 12.

Table 12: Details of Potential Emissions to Water from the LIC Plant

Emission Source	Composition	Volumetric Flowrate	Frequency of Occurrence
LIC process condensate Discharged via existing H2 plant effluent tank	Water With potential traces of: Ammonia solution <50ppm Acetaldehyde <60ppm	2.256 m^3/day	Continuous
LIC plant cooling water blowdown	Water With slight traces of cooling water dosing chemicals e.g. residual chlorine <1 mg/l, orthophosphate <14 mg/l	60 m^3/day	Continuous
Storm Water from the LIC plant collection pit	Uncontaminated rainwater Sampled to confirm no contamination prior to discharge.	10 m^3/h (pump rating) Daily volume discharged will be rainfall dependant.	Rainfall Dependant

Figure B: BOC Site Process Drainage



7.3 Emissions to Land

There will be no emissions to land from the LIC process.

7.4 Waste Handling and Disposal

Waste arisings from the operation of the LIC plant will primarily be related to wastes generated as part of periodic inspection and maintenance activities.

The handling, storge and disposal of waste materials generated by the LIC plant will be managed in accordance with the existing site waste handling and management protocols using existing segregated waste collection skips and containers within existing site waste storage areas.

Recycling and recovery of wastes will be prioritised where possible in line with the principals of the waste hierarchy.

Assessment and reporting of waste arisings is carried out at the site as part of both the EA annual Pollution Inventory Reporting requirements and the BOC annual environmental corporate responsibility reporting, these reporting protocols will be extended to include the LIC plant.

The site maintains a waste minimisation plan as part of the IMS and sets and reviews performance against target KPI's.

Inspection and condition-based monitoring routines are in place which include assessment of the condition of site areas used for waste storage.

8.0 Environmental Impact Assessment

8.1 Air Emissions Risk Assessment

8.1.1 Assessment of Potential Impacts on Emissions from the H_2 Plant Steam Methane Reformer

The introduction of the LIC plant will lead to a reduction in the CO_2 content within the PSA tail gas which is used to fire the Steam Methane Reformer furnace which in turn may alter the emissions from the combustion process via emission point A1.

The permitted Emissions Limit Value from Emission Point A1 ‘Heater Flue gas Reformer’ (see Table 6.1.2 of EPR) is 200 mg/Nm³ for total oxides of nitrogen (as NO_2).

The original PPC permit application in 2001 was supported by an Air Quality Report (AQR) ‘BOC Hydrogen Plant North Tees Site Air Quality Report’, 1-15-7921 (Foster Wheeler Energy Ltd,2001) – this is presented as Appendix E1. The AQR states that the reformer firing tail gas from the hydrogen production process, supplemented with natural gas; have been designed to achieve a release of 150 mg/Nm³. The modelled emission parameters for the reformer stack emissions are provided in Table 2.1 of the AQR. The AQR also provides detailed dispersion modelling using ‘ADMS’ software with meteorological data from 1997. It is acknowledged that although the AQR is some 20 years old the fundamentals of the algorithms used for modelling have changed little since this time and thus the modelling conclusions should still be considered valid. The modelling determined that ground level impacts were 9.2% of the air quality standard (expressed as 1 hr 99.9th percentile).

The change in syngas feeding the boilers has been tested, as presented in the accompanying Burner Test Report (WOOD Foster Wheeler Energy Ltd, 2020) - this is presented as Appendix E2. The purpose of this project was to demonstrate the effects on emissions using a fuel with less inert CO_2 in the PSA fuel than was used in the original performance test. The report states that no changes to the burner design were made to affect performance and NOx content was measured using chemiluminescence detection. Test point 2 of the burner report reflects the gas composition of the proposed syngas (i.e. with reduced CO_2 content).

The measured NOx concentration from test point 2 was 44.22 mg/Nm³. Which is noted as being a slight, but not significant, increase over that achievable with the current PSA gas composition.

The monitored NOx emission value of 44.22 mg/Nm³ is well below the currently permitted emission level of 200 mg/Nm³ and below the burner design guarantee emission level of 150 mg/Nm³ which was used in the dispersion modelling assessment submitted in support of the original PPC Permit application. No remodelling of the emissions to air from the SMR is therefore proposed.

It is therefore considered that the predicted partial reduction of the CO_2 content within the PSA tail gas will only lead to a slight increase in the NOx emissions from the SMR burners. These revised emission levels are not predicted to lead to any significant air quality impacts as they are well below that has been demonstrated through detailing modelling to have insignificant air quality impacts and is already authorised under the extant Environmental Permit for the facility.

8.1.2 CO_2 Venting

As part of the detailed design of the CO_2 recovery and liquefaction plant, BOC has undertaken a range of assessments so as to identify credible operational scenarios under which CO_2 would need to be vented from the plant including those identified in Tables 8, 9 and 10.

The design process includes:

- Identification of credible maximum venting scenarios;
- Design and sizing of vent systems to ensure that they can safely handle the maximum venting case;
- Modelling assessment to demonstrate that both onsite and offsite CO_2 exposure risks are controlled to acceptable levels.

The approach to designing such systems has been to ensure that onsite workforce exposure risk is minimised through appropriate design of the venting system to achieve good dispersion and hence reduce potential CO_2 concentrations experienced both at ground level and in key site areas where the workforce may be present. By undertaking this approach, this minimises risks to both the site staff and the general public offsite.

It should also be noted that the nearest residential receptors are located at 2.4km (King Georges Terrace - Middlesbrough) and 2.8km (Samphire Street – Port Clarence) respectively, and hence it is considered unlikely that the vented CO_2 would have any significant health impacts at these receptors.

However, in order to confirm that the potential CO_2 venting scenarios will not lead to any significant on or offsite impacts on human health, detailed dispersion modelling and impact assessment has been undertaken and is presented in the following reports:

- Appendix H1 presents the main CO_2 dispersion modelling assessments for the range of venting scenarios identified.
- Appendix H2 presents an assessment of an unlikely, but credible, scenario in which CO_2 could be emitted via the vent on the H_2 plant effluent tank.

Both reports demonstrate that the emissions of CO_2 under the defined event scenarios pose no significant risk to human health.

The assessments have solely focussed on assessing the potential impacts associated with the CO_2 component of the gas vented as in all cases the CO_2 will represent 99 -100% of the gas vented other gases present will be in trace quantities and as such will not pose any credible risk to the environment.

8.2 Water Emissions Risk Assessment

A water emissions risk assessment has been undertaken and is presented in Appendix F.

This assessment has considered the potential water quality impacts of the combined effluent from the BOC site including both the existing H_2 plant and the new LIC plant at the point that they are discharged from the North Tees Site drainage system into the estuary of the River Tees. Uncontaminated rainwater discharged via the same route has been excluded from this assessment to provide a worst-case assessment of potential impacts under dry weather flow conditions.

The assessment has demonstrated that no significant deterioration of the water quality in the River Tees will arise as a result of the proposed discharges to water.

8.3 Noise Impact Assessment

A qualitative noise risk assessment has been undertaken and is presented in Appendix G1. This assessment demonstrates that the proposed CO_2 recovery and liquefaction plant will have a low noise impact which is not anticipated to lead to any increase in noise impacts when considering the existing noise profiles in the local area, and specifically the operation of the existing BOC hydrogen plant.

This assessment has been based on the sound levels for the new plant as defined in the BOC noise control concept document which is included as Appendix G2.

As part of the development of the application for Planning consent for the CO_2 recovery and liquefaction plant, the following documents were prepared:

- Ecological Assessment Report – Avian Ecology – which was used to identify potentially sensitive ecological and Habitats sites in the local area – this is presented as Appendix G3.
- Screening Noise Assessment for Effects on Birds on the Dorman’s Pool and Reclamation Pond from the Construction and Operation of the Proposed Plant – Evans Acoustics – which was used to assess potential noise impacts on local ecology and Habitats sites – this is presented as Appendix G4.

The above assessments demonstrate that the CO_2 recovery and liquefaction plant will have a low noise impact which is not anticipated to lead to any increase in noise impacts at nearby sensitive receptors. Hence detailed quantitative noise assessment is not considered to be warranted, and there is no requirement for the site to have a Noise Management Plan.

8.4 Odour

The proposed LIC plant is not anticipated to lead to any emission of potentially odourous compounds. Hence no offsite odour impacts are anticipated.

8.5 Qualitative Risk Assessment

This section is provided to present an overview of potential environmental hazards, other than those assessed in Sections 8.1 – 8.4, and how such hazards will be managed to minimise potential risk.

8.5.1 Other than Normal Operating Conditions (OTNOC)

The plant incorporates a plc-based control system which is linked to an integrated control system which allows control of the plant from the on-site control room and also from the offsite remote main control room.

The plant includes monitoring of key process parameters to ensure that it operates to within its design parameters with data trending and system alarms set up to give warning of the potential for potential OTNOC scenarios such that appropriate actions can be taken to correct the plant operations.

Under other than normal operating conditions (OTNOC), there are a number of venting systems on the LIC plant that could be used to ensure safe operation / shutdown of the plant – these would vent CO_2 to atmosphere and would operate very infrequently – no emission benchmark values would be applied to such venting.

Details of these venting activities and an assessment of their potential impacts are presented in Sections 7.1, 8.1.2 and Appendix H of the main technical supporting document.

8.5.2 Incidents and Accidents

The design of the LIC plant has included detailed safety and risk assessments including: HAZID, HAZOP, LOPA etc. to minimise the risk of incidents occurring through design, and the implementation of suitable and sufficient control measures.

The plant incorporates a plc-based control system which is linked to an integrated control system which allows control of the plant from the on-site control room and also from the offsite remote main control room.

The plant includes monitoring of key process parameters to ensure that it operates to within its design parameters with data trending and system alarms set up to give warning of the potential for potential OTNOC scenarios such that appropriate actions can be taken to correct the plant operations and minimise the risk of incidents or accidents occurring.

The site IMS includes appropriate incident and accident response protocols to minimise the potential for offsite impacts arising as a result of an on-site incident.

The IMAS also includes procedures for logging and reporting of incidents and near misses, as well as procedures for investigating incidents (and near misses), including identifying suitable corrective action and follow up.

8.5.3 Loss of Containment

Details of the potentially hazardous pollutants stored at the site and their primary and secondary containment provisions for these chemicals are provided in Section 4.7. A risk assessment to assess the potential risk to soil and groundwater from the site activities has been undertaken as part of the Land Quality Risk Assessment presented in Appendix B1, which concluded that the proposed LIC site activities pose no significant risk of pollution to underlying soil or groundwater.

8.5.4 Vandalism

The site is located within the North Tees Complex which is a secure industrial site with 24h security and associated secure fencing.

Vandalism is not considered to present a significant risk to the proposed LIC plant activities.

9.0 Energy Efficiency

The site has entered into a Climate Change Levy Agreement see Appendix J.

Full energy requirement calculations are being prepared as part of the process design for the LIC plant.

Electricity is supplied from the Northern Power Grid, and the plant will have a peak load of 515KVA. The existing H_2 plant has a connection peak load of 1,650KVA.

The LIC plant will not have any direct usage of natural gas with all steam required by the plant being provided from the existing H_2 plant.

The addition of the CO_2 recovery and liquefaction plant will lead to a reduction in the energy use at the Installation, and an overall improvement in the energy efficiency of the installation. It has been designed to incorporate energy efficiency measures where appropriate which include:

- Currently, with the stand alone H_2 plant operating, approximately 10 tonnes per hour of low pressure (LP) (3.5barg) pass out steam are sent to be condensed to allow re-use of the water and some of the heat. Once the LIC plant is in steady state operation the amine column and reboiler within the LIC plant will transition to run on approximately 8 t/hr of this LP steam from the hydrogen plant.
- The use of 80% of the LP steam in the LIC plant will therefore reduce the operating load on the LP steam condensers within the hydrogen plant. This will allow the hydrogen plant steam condenser fans to shut down saving approximately 132 MWh per year (15kw on continual duty).
- The CO_2 compressors and also the ammonia compressors on the refrigeration circuits will be powered using HP steam from the process, which in turn removes the need for electrical drives which would consume a further 1.5MW.
- The reduction of the quantity of CO_2 within the PSA tail gas returned to the SMR for combustion will mean that less heat input to the SMR is required, as there is less gas (CO_2) to heat to the operating temperature. This will lead to a reduction in natural gas usage within the reformer of approximately 145kg/hr (1,200t / year).

The existing H_2 plant has a target Specific Energy Consumption which is assessed as an overall thermal efficiency target which is currently set at around 69% and is linked to the quantity of H_2 produced.

The H_2 plant has continuous monitoring of natural gas usage (which is the primary thermal input) and uses this to provide continuous online feedback on the energy efficiency of the plant. Frequent monitoring of electrical usage is also undertaken and fed into the calculation of overall plant efficiency.

This SEC target setting and monitoring approach will be expanded to incorporate the LIC plant.

10.0 Management Systems

BOC operates an Integrated Management System (IMS) which is certified to ISO 9001 and ISO 14001.

The IMS contains a comprehensive set of standards covering all aspect of plant operations and the system is both audited internally and externally to ensure compliance with requirements. The site also maintains an environmental aspect and impacts register covering site operations which is updated on an annual basis.

An overview of the IMS and copies of the ISO 9001 and 14001 certificates are presented in Appendix I.

11.0 Monitoring

11.1 Monitoring of Emissions to Air

No monitoring of emissions to air from the LIC plant is proposed.

11.2 Monitoring – Emissions to Water

Table 13 presents an overview of the initial proposals for monitoring of the emissions to water from the LIC plant.

Table 13: Details of Proposed Monitoring of Emissions to Water from the LIC Plant

Emission Point Reference	Emission Source	Composition	Frequency of Monitoring Proposed	Analytical Determinands	Proposed Reporting for Permit Compliance Purposes
E1	Combined process effluent from the H_2 and LIC plants Discharged via existing H_2 plant effluent tank	Water with potential traces of: ammonia solution and acetaldehyde	Periodic Monthly	pH COD Nitrate Orthophosphate Total Phosphorous Total Suspended Solids Amine Ammonia Acetaldehyde	6 monthly reporting of monthly average and maximum results
E2	Reject Water from the H_2 Plant Demineralised Water Plant	Water with slightly increased mineral and salt content	Periodic Monthly	pH COD Nitrate Orthophosphate Total Phosphorous Total Suspended Solids	6 monthly reporting of monthly average and maximum results
E3	H_2 plant cooling water purge / blowdown	Water With slight traces of cooling water dosing chemicals	Periodic Monthly	pH Free chlorine Orthophosphate Temperature	6 monthly reporting of monthly average and maximum results
E4	LIC plant cooling water purge / blowdown	Water With slight traces of cooling water dosing chemicals	Periodic Monthly	pH Free chlorine Orthophosphate Temperature	6 monthly reporting of monthly average and maximum results

Emission Point Reference	Emission Source	Composition	Frequency of Monitoring Proposed	Analytical Determinands	Proposed Reporting for Permit Compliance Purposes
E5	Storm Water from the LIC plant collection pit	Uncontaminated rainwater Sampled to confirm no contamination prior to discharge.	Upon Discharge pH Visible Oil and Grease	pH Visible Oil and Grease	None

BOC proposes to undertake periodic spot sample monitoring of each of the emission points E1 – E4. It is initially proposed that monitoring be undertaken on a monthly basis for the first 12 months following commencement of operation of the LIC plant to collate a suitable baseline of data. If this data shows relatively stable emission levels it is then proposed that the monitoring for compliance purposes then be undertaken on a quarterly basis.

Spot a sampling is proposed as:

- The cooling tower purge and effluent from the demineralised water plant are of relatively consistent flow and composition; and
- The effluents discharged from the H_2 plant effluent tank are not discharged continuously, the effluents sent to the effluent tank are then held within this tank, mixed and neutralised (if required) with periodic pumped discharge to the North Tees Site drainage system once sufficient level is present in the tank, and the required parameter conditions e.g. pH are met. Spot sampling from the effluent tank should therefore provide representative assessment of the effluent composition.

All monitoring of emissions to water will comply with the Environment Agency guidance on 'Monitoring discharges to water: environmental permits' and in line with the MCERTS requirements where appropriate.

Laboratories used for analysis of the water samples taken will be accredited to EN ISO/IEC 17025.

Table 14 presents an overview of the test methods proposed for use when analysing water samples. Should BOC propose to use alternative test methods these would be agreed in writing with the EA in advance.

The selection of the determinands required for testing has been made following review of the upstream processes and the materials that could credibly be present in the effluents discharged.

Table 14: Analytical Test Methods

Substance / Parameter	Standard	Details
Acetaldehyde	To be Agreed with the EA	
Amine	To be Agreed with the EA	

Substance / Parameter	Standard	Details
Ammonia	BS EN ISO 11732 or BS 6068-2.11 ISO 7150-1 or BS 6068-2.7 ISO 5664 or BS 6068-2.10 ISO 6778 or SCA blue book 48	Determination of ammonium nitrogen: Flow analysis (CFA and FIA) and spectrometric detection. Manual spectrometric method. Distillation and titration method. Potentiometric method.
COD	BS 6068-2.34 (same as ISO 6060)	Physical, chemical and biochemical methods. Method for the determination of the chemical oxygen demand.
Free Chlorine	BS EN ISO 7393-1 Or BS EN ISO 7393-2 Or BS EN ISO 7393-3 Or SCA blue book 218	Determination of free chlorine and total chlorine. Titrimetric method using N, N-diethyl-1, 4-phenylenediamine. Colorimetric method using N, N-diethyl-1, 4-phenylenediamine for routine control purposes. Iodometric titration method for the determination of total chlorine. Chemical disinfecting agents in waters and effluents (2008).
Nitrate	BS EN ISO 13395 Or BS EN 26777 (same as ISO 6777) Or SCA blue book 40	Determination of nitrite, nitrogen and nitrate nitrogen, and the sum of both by flow analysis (CFA and FIA) and spectrometric detection. Determination of nitrite: molecular absorption spectrometric method. Oxidised Nitrogen in Waters (1981)
Orthophosphate	BS EN ISO 15681-1 Or BS EN ISO 15681-2	Determination of orthophosphate and total phosphorus contents by flow analysis (FIA and CFA) – part 1: Method by flow injection analysis (FIA). Determination of orthophosphate and total phosphorus contents by flow analysis (FIA and CFA) – part 2: Method by continuous flow analysis (CFA).
Total Phosphorous	As above or BS EN ISO 6878	As above or Determination of phosphorus. Ammonium molybdate spectrometric method.

Substance / Parameter	Standard	Details
Total Suspended Solids	BS EN 872 Or SCA blue book 105	Determination of suspended solids. Method by filtration through glass fibre filters. Suspended, settleable and total dissolved solids in waters and effluents (1980)
pH	BS ISO 10523 Or SCA blue book 14	Physical, chemical and biochemical methods. Determination of pH. The measurement of electrical conductivity and the laboratory determination of the pH value of natural, treated and waste waters (1978) ISBN 0117514284.
Temperature	To be confirmed	
Inorganic parameters by discrete analyser	BS ISO 15923-1	Determination of selected parameters by discrete analysis systems – part 1: Ammonium, nitrate, nitrite, chloride, orthophosphate, sulfate and silicate with photometric detection. May be used as an alternative method for analysis of Ammonium, Nitrate and Orthophosphate

Table 15 presents proposals for monitoring of flow from each of the emission points to water.

Table 15: Flow Monitoring

Emission Point	Flow Monitoring Proposed	Explanation
E1	None	Pumped discharge under level control. Flowrate is determined by the pump rating. Volumetric discharge can be calculated from pump rating and running time.
E2	None	Water softener plant discharge – can be calculated based on flow through the plant and reject rate.
E3	None	Cooling water purge – discharge continuous at a pre-determined rate and therefore no monitoring of flow is required, and flow and volume of discharge can easily be calculated.
E4	None	Cooling water purge – discharge continuous at a pre-determined rate and therefore no monitoring of flow is required, and flow and volume of discharge can easily be calculated.
E5	None	Rainwater discharge – pumped discharge. Flowrate is determined by the pump rating. Volumetric discharge can be calculated from pump rating and running time.

12.0 Site Closure

A site closure plan to cover the cessation of operations and decommissioning of the site activities and removal of pollution risk to allow permit surrender will be maintained at the site and will be expanded to cover the existing H_2 plant and the new LIC plant activities.

Appendix A Figures

Supporting Documentation – Permit Variation V004

EPR/BJ7522IJ – BOC Hydrogen Plant

BOC Limited

SLR Project No.: 416.065113.00001

5 November 2024

Figure 1 – Site Location

Figure 2 – Site Layout Plan and Installation Boundary

Figure 3 – LIC Plant Layout

Figure 4 – LIC Plant Drainage Layout

Appendix B Site Condition Report

Supporting Documentation – Permit Variation V004

EPR/BJ7522IJ – BOC Hydrogen Plant

BOC Limited

SLR Project No.: 416.065113.00001

5 November 2024

Appendix B1 – Land Quality Risk Assessment

Appendix B2 – Phase 2 Site Investigation

Appendix C Process Information

Supporting Documentation – Permit Variation V004

EPR/BJ7522IJ – BOC Hydrogen Plant

BOC Limited

SLR Project No.: 416.065113.00001

5 November 2024

Appendix C1 - Appendix C1 - Process Flow Diagram 1 - Amine Unit

Appendix C2 - Process Flow Diagram 2 - CO_2 Liquefaction

Appendix D BAT Conclusion Compliance Assessment

Supporting Documentation – Permit Variation V004

EPR/BJ7522IJ – BOC Hydrogen Plant

BOC Limited

SLR Project No.: 416.065113.00001

5 November 2024

SLR

Appendix E Air Emissions Risk Assessment

Supporting Documentation – Permit Variation V004

EPR/BJ7522IJ – BOC Hydrogen Plant

BOC Limited

SLR Project No.: 416.065113.00001

5 November 2024

Appendix E1 – Air Quality Report May 2001

Appendix E2 – Burner Test Report

Appendix F Water Emissions Risk Assessment

Supporting Documentation – Permit Variation V004

EPR/BJ7522IJ – BOC Hydrogen Plant

BOC Limited

SLR Project No.: 416.065113.00001

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Appendix G Noise Impact Assessment

Supporting Documentation – Permit Variation V004

EPR/BJ7522IJ – BOC Hydrogen Plant

BOC Limited

SLR Project No.: 416.065113.00001

5 November 2024

Appendix G1 - BOC Hydrogen - Noise Impact Assessment

Appendix G2 - Noise Control Concept

Appendix G3 - Ecological Assessment Report

Appendix G4 - Evans Acoustics Screening Noise Assessment

Appendix H CO_2 Venting Risk Assessment

Supporting Documentation – Permit Variation V004

EPR/BJ7522IJ – BOC Hydrogen Plant

BOC Limited

SLR Project No.: 416.065113.00001

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Appendix H1 - CO_2 Venting Modelling Assessment

Appendix H2 - CO_2 Venting Assessment - Effluent Tank Scenario

Appendix I Management System Overview

Supporting Documentation – Permit Variation V004

EPR/BJ7522IJ – BOC Hydrogen Plant

BOC Limited

SLR Project No.: 416.065113.00001

5 November 2024

Appendix I1 – Overview of IMS

Appendix I2 – ISO 9001 Certificate

Appendix I3 – ISO 14001 Certificate

Appendix J Climate Change Agreement

Supporting Documentation – Permit Variation V004

EPR/BJ7522IJ – BOC Hydrogen Plant

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5 November 2024

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