Determination of an Application for an Environmental Permit under the Environmental Permitting (England & Wales) Regulations 2016

Decision document recording our decision-making process

The Permit Number is:	EPR/VP3530LS
The Application reference is:	EPR/VP3530LS/V022
The Applicant / Operator is:	Drax Power Limited
The Installation is located at:	Drax Power Station, Selby, North Yorkshire, YO8 8PH
The date of issue is:	05/08/2026

What this document is about

This is a decision document, which accompanies a varied permit.

It explains how we have considered the Applicant's Application, and why we have included the specific conditions in the varied permit we are issuing to the Applicant. It is our record of our decision-making process, to show how we have taken into account all relevant factors in reaching our position. Unless the document explains otherwise, we have accepted the Applicant's proposals.

We try to explain our decision as accurately, comprehensively and plainly as possible. Achieving all three objectives is not always easy, and we would welcome any feedback as to how we might improve our decision documents in future. A lot of technical terms and acronyms are inevitable in a document of this nature: we provide a glossary of acronyms near the front of the document, for ease of reference.

Preliminary information and use of terms

We gave the Application the reference number EPR/VP3530LS/V022. We refer to the application as "the **Application**" in this document in order to be consistent.

The Permit number is EPR/VP3530LS. We refer to the variation to the Permit as "the **varied Permit**" in this document.

The Application was duly made on 18/05/2023.

The applicant is Drax Power Limited. We refer to Drax Power Limited as "the **Applicant**" in this document. Where we are talking about what would happen after the variation is issued, we call Drax Power Limited "the **Operator**".

Drax Power Limited's facility is located at Drax Power Station, Drax, Selby, Yorkshire, YO8 8PH. We refer to this as "the **Installation**" in this document.

The proposed variation

The Applicant has applied to vary the Permit as follows:

- Add a carbon capture activity in accordance with section 6.10 Part A(1)(a) of schedule 1 to the Environmental Permitting (England and Wales) Regulations 2016 ("EPR 2016") with associated solvent treatment and carbon dioxide compression and storage (referred to as Post Combustion Carbon Capture or PCC).
- Replace the existing effluent treatment plant associated with flue gas desulphurisation with a new treatment plant for treatment of effluent from the quencher tower should PCC be implemented.
- Modify the flue gas layout and abatement of units 5 and 6 should PCC be implemented.
- Remove the Ouse Renewable Energy Plant.
- Install a quencher tower to treat flue gases prior to PCC.
- Change management of Furnace Bottom Ash handling and its infrastructure.
- Add hydrogen production activity in accordance with section 4.2 Part A(1)(a)(i) of schedule 1 to EPR 2016 (hydrogen to be used in the conditioning of the captured CO_2 to remove oxygen).

How this document is structured

Contents:

Glossary of acronyms used in this document

AAD	Ambient Air Directive (2008/50/EC)
ADMLC	Atmospheric Dispersion Modelling Liaison Committee
APIS	Air Pollution Information System
AQS	Air Quality Strategy
AQTAG	Air Quality Technical Advisory Group
BAT	Best Available Technique(s)
BAT AEL	BAT Associated Emission Level
BAT AEEL	BAT Associated Energy Efficiency Level
BAT C	BAT Conclusions
BECCS	Bioenergy carbon capture and storage
BREF	Best Available Techniques (BAT) Reference Documents for Combustion
BS	British Standard
CCS	Carbon capture and storage
CEM	Continuous emissions monitor
CERC	Cambridge Environmental Research Consultants
CI	Confidence interval
CIC	Commercial or industrial confidentiality
CIRIA	Construction Industry Research and Information Association
CRM	Carcinogenic, reproductive toxicity, mutagenic
CO_2	Carbon dioxide
CROW	Countryside and rights of way Act 2000
DAA	Directly associated activity – Additional activities necessary to be carried out to allow the principal activity to be carried out
DCO	Development Consent Order
DD	Decision document
DEA	Diethanolamine
EA	Environment Agency
EAL	Environmental assessment level
EFSA	European Food Safety Authority

ELCR	Excess Life-time Cancer Risk
ELV	Emission limit value
EMS	Environmental Management System
EPR 2016	Environmental Permitting (England and Wales) Regulations 2016 (SI 2016 No. 1154) as amended
EQS	Environmental Quality Standard
ES	Environmental standard
ESP	Electrostatic precipitators
ETP	Effluent treatment plant
EU	European Directive
FEED	Front end engineering design
FGD	Flue gas desulphurisation
FSA	Food Standards Agency
GET	Guidance on emerging techniques
HRA	Human Rights Act 1998
HSE	Health and Safety Executive
IED	Industrial Emissions Directive (2010/75/EU)
KS21	Name of proprietary solvent
LCP	Large Combustion Plant
m	Metre
MEA	Monoethanolamine
MHI	Mitsubishi Heavy Industries
MWe	Mega watts of electrical power
NDEA	N-nitrosodiethylamine
NDMA	N-nitrosdimethylamine
NH_3	Ammonia
NO	Nitrogen oxide
NOx	Oxides of nitrogen (NO plus NO_2 expressed as NO_2)
NO_2	Nitrogen dioxide
OTNOC	Other than normal operating conditions
PC	Process Contribution

PCC	Post-combustion carbon capture
PEC	Predicted Environmental Concentration
PFA	Pulverised fuel ash
PM	Particulate matter
PPS	Public participation statement
RFI	Request for information
RGN	Regulatory Guidance Note
SAC	Special Area of Conservation
SCR	Selective catalytic reduction
SHPI(s)	Site(s) of High Public Interest
SNCR	Selective non-catalytic reduction
SO_2	Sulphur dioxide
SO_3	Sulphur trioxide
SPA(s)	Special Protection Area(s)
SSSI(s)	Site(s) of Special Scientific Interest
TD50	Tumourigenic Dose 50
TGN	Technical guidance note
TOC	Total Organic Carbon
UK	United Kingdom
UKCCSRC	UK Carbon Capture and Storage Research Community
WFD	Waste Framework Directive (2008/98/EC)

Links to relevant guidance

The table below provides links to the key guidance documents referred to in this document. The links were correct at the time of producing this document.

Guidance	Link
RGN 6: Determinations involving sites of high public interest	RGN6
Public Participation Statement	Environmental permits: when and how we consult - GOV.UK
Risk assessment guidance	Risk assessments for your environmental permit - GOV.UK
Air emissions risk assessment guidance	Air emissions risk assessment for your environmental permit - GOV.UK
Noise modelling guidance	Noise impact assessments involving calculations or modelling - GOV.UK
Methodology for deriving EALs	Methodology for the scientific derivation of environmental assessment levels - GOV.UK
Emissions from Storage – Bref July 2006	efs_bref_0706_0.pdf
Post- combustion carbon dioxide capture: emerging techniques guidance	Post-combustion carbon dioxide capture: emerging techniques - GOV.UK
Hydrogen production by electrolysis of water: emerging techniques guidance	Hydrogen production by electrolysis of water: emerging techniques - GOV.UK
Large Combustion Plant BAT Conclusions	LCP BAT C

1. Our decision

We have decided to issue the Variation to the Applicant. This will allow the Applicant to operate the Installation, subject to the conditions in the varied Permit.

We consider that, in reaching that decision, we have taken into account all relevant considerations and legal requirements and that the permit will ensure that a high level of protection is provided for the environment and human health.

This Application is to operate an installation which is subject principally to the Industrial Emissions Directive ("IED").

The varied Permit contains many conditions taken from our standard Environmental Permit template including the relevant Annexes. We developed these conditions in consultation with industry, having regard to the legal requirements of the Environmental Permitting (England and Wales) Regulations 2016 (EPR 2016) and other relevant legislation. This document does not therefore include an explanation for these standard conditions. Where they are included in the permit, we have considered the Application and accepted that the details provided are sufficient and satisfactory to make use of the standard condition acceptable and appropriate. This document does, however, provide an explanation of our use of "tailor-made" or installation-specific conditions, or where our Permit template provides two or more options, an explanation of the reason(s) for choosing the option that has been specified.

2. How we reached our decision

2.1 Receipt of Application

The Application was submitted as a staged application. This means that the application documents were submitted in accordance with an agreed timetable. Stage 1 of the Application was submitted on 22/08/2022 and Stages 2 and 3 were submitted on 03/04/2023. The Application was duly made on 18/05/2023. This means we considered it was in the correct form and contained sufficient information for us to begin our determination, but not that it necessarily contained all the information we would need to complete that determination: see section 2.3 below.

The Applicant claimed that certain information was commercially confidential and should be withheld from the public register. We considered this request and determined that the information is commercially confidential. Apart from the issues and information just described, we have not received any information in relation to the Application that appears to be confidential in relation to any party.

2.2 Consultation on the Application

We carried out consultation on the Application in accordance with the EPR 2016, our statutory Public Participation Statement ("PPS") and our own internal guidance Regulatory Guidance Note 6 for Determinations involving Sites of High Public Interest. RGN 6 was withdrawn as external guidance, but it is still relevant as Environment Agency internal guidance.

We consider that this process satisfies, and frequently goes beyond, the requirements of the Aarhus Convention on Access to Information, Public Participation in Decision-Making

and Access to Justice in Environmental Matters, which are directly incorporated into the IED, which applies to the Installation and the Application. We have also taken into account our obligations under the Local Democracy, Economic Development and Construction Act 2009 (particularly Section 23). This requires us, where we consider it appropriate, to take such steps as we consider appropriate to secure the involvement of representatives of interested persons in the exercise of our functions, by providing them with information, consulting them or involving them in any other way. In this case, we consider that our consultation already satisfies the requirements of the 2009 Act.

We advertised the Application by a notice placed on our website, which contained all the information required by the IED, including telling people where and when they could see a copy of the Application. We also placed an advertisement in the Yorkshire Post that contained the same information.

We made a copy of the Application and all other documents relevant to our determination available to view on our Public Register. Anyone wishing to see these documents could do so and arrange for copies to be made.

We also created an information page in relation to the Application and placed a link to the consultation on this page.

We sent copies of the Application to the following bodies, which includes those with whom we have "Working Together Agreements":

- Food Standards Agency
- Health and Safety Executive
- UK Health Security Agency
- North Yorkshire Council
- Yorkshire Wildlife Trust

These are bodies whose expertise, democratic accountability and/or local knowledge make it appropriate for us to seek their views directly. Note under our Working Together Agreement with Natural England, we only inform Natural England of the results of our assessment of the impact of the installation on designated Habitats sites.

In addition to our advertising the Application, we undertook a programme of extended public consultation. Public surgeries were held at Drax Village Hall on 06/06/2023 and online via Teams Live on 13/06/2023 and written comments were also accepted beyond the formal consultation period. Further details along with a summary of consultation comments and our response to the representations we received can be found in Annex 3. We have taken all relevant representations into consideration in reaching our determination.

2.3 Requests for Further Information

Although we were able to consider the Application duly made, we did in fact need more information in order to determine it and issued information notices and Requests For Information ("RFI") as shown in the table below. Copies of the information notices and the RFIs were placed on our public register together with the responses on receipt.

Request and response dates for information notices and requests		
Request date	**Response date**	**Summary of information**
27/07/2023 Notice No1	29/11/2024 and 27/01/2025	Revised air emissions risk assessment to include: • all components of the solvents and reaction and breakdown products as emissions • consideration of the range of reaction and breakdown products present over the lifetime of the solvent use • evidence to support the inclusion of the reaction and breakdown products • justification for not including any substances • consideration of the formation of any additional substances in the atmosphere • the ratio of NOx to NO_2 • justification that the kinetic values for Monoethanolamine ("MEA") and N-nitrosdimethylamine ("NDMA") are representative of the additional substances • contour plots for nutrient nitrogen and acid deposition Description of how uncertainties in the CO_2 venting modelling have been taken into account.
23/10/2023 Notice No2	31/03/2024	Revised site plan with proposed emission points and a list of emission points removed. Details of the revised ash handling. Confirmation of re-circulation of treated effluent into the cooling system and that there are no changes to the emissions to the River Ouse. Revised Noise Impact Assessment and further information regarding noise including: • derived specific sound levels for the new activity • cumulative impacts of existing and proposed activities • raw sound survey data • evidence of weather conditions during the sound survey • a qualitative description of the soundscape at each location • clarification of whether the measured background includes the existing operations • a description of the sound sources • duration and occurrence of non-continuous sources • clarification of site operating hours • noise files and calculations • details of noise mitigation measures Further information regarding bunding and storage of chemicals. Management of fugitive emissions such as of CO_2. The KS21 safety data sheet.

Request and response dates for information notices and requests		
Request date	**Response date**	**Summary of information**
		Assessment of changes to the solvent during its lifetime. Waste codes for waste solvent and waste waters. Details of containment for the solvent at different stages of use. Details of the Leak Detection and Repair system. Justification for use of KS21 solvent based on energy use, water use and cooling. Details of the effectiveness of the solvent recovery process. Details and revised assessments if CO_2 compression system design has changed. Confirmation of commitment to achieve 95% CO_2 capture rate, including if capture is during start up and shut down. Provision of solvent contact trial data and findings.
04/06/2024 RFI	18/06/2024	Confirmation that ash pits will be decommissioned irrespective of the operation of the carbon capture plant. Confirmation of the waste code for the acid wash. Clarification of the reported water demand per tonne of CO_2 captured. Clarification of understanding that CO_2 compression design has changed compared with notice response that says it has not.
11/07/2024 Notice No3	13/09/2024	Assessment of storage of solvent against the BREF for Emissions from storage Clarification if any below ground storage is proposed. Details of hydrogen use in CO_2 treatment prior to discharge to the pipeline, and if it is to be generated on site, a review against the guidance for emerging techniques.
15/07/2024 RFI	01/08/2024	Dates when background sound level measurements were taken.
10/10/2024 RFI	08/01/2025	Clarification of solvent storage
20/03/2025 RFI	01/04/2025	Clarification of modelling scenarios
27/05/2025 Notice No4	20/06/2025, 31/07/2025 and 12/09/2025	CO_2 venting assessment, information regarding the degradation of the solvent and update to air impact risk assessment
25/11/2025 RFI	19/12/2025	Assessment of amine hazards with use, confirmation of removal of references to SCR in the Permit
27/01/2026 Notice No5	27/02/2026	Further assessment of acid deposition at Thorne Moor SAC/SSSI

The Applicant requested extensions to the response date for the first two information notices, and we agreed to extend the response date for the first notice until 30/11/2024 and for the second notice until 31/03/2024.

The Applicant claimed that certain information in their response to the second notice received on 31/03/2024 was commercially confidential and should be withheld from the public register. We considered this request and determined that the information is commercially confidential. Apart from the issues and information just described, we have not received any other information in relation to the responses to any other notices or RFIs that appears to be confidential in relation to any party.

2.4 Consultation on the response to information notice dated 27/07/2023

We considered that the air impact assessment submitted with the Application did not take account of all the potential emissions from the carbon capture process and, therefore, the impact of emissions from the process had not been fully determined. As emissions to air are one of the main impacts from the activity, we decided to consult on this revised air impact assessment that was more representative of the potential emissions.

We sent copies of the response received on 29/11/2024 to the information notice dated 27/07/2023 regarding the air emissions impact assessment to the following body:

- UK Health Security Agency

We advertised the air impact assessment by a notice placed on our website, which contained all the information required by the IED, including telling people where and when they could see a copy of the air impact assessment.

We made a copy of the air impact assessment available to view on our Public Register. Anyone wishing to see this document could do so and arrange for copies to be made.

We also placed a link to the consultation on the information page that was created for the Application.

Further details along with a summary of consultation comments and our response to the representations we received can be found in Annex 3B. We have taken all relevant representations into consideration in reaching our determination decision.

2.5 Consultation on the CO_2 venting risk assessment

We considered that the Applicant had not fully considered the risks from the proposed venting of CO_2, so we requested a revised venting risk assessment in our notice dated 27/05/2025. A CO_2 venting risk assessment was received on 12/09/2025 and we consulted the Health and Safety Executive on this on 27/10/2025.

A summary of the consultation comments and our response to the representations we received can be found in Annex 3C. We have taken all relevant comments into consideration in reaching our determination decision.

2.6 Consultation on our draft decision

Having carefully considered the Application and all other relevant information, we put our draft decision before the public and other interested parties in the form of a draft varied

Permit, together with a draft of this explanatory document. As a result of this stage in the process, the public has been provided with all the information that is relevant to our determination, including the original Application and additional information obtained subsequently, and we have given the public two separate opportunities to comment on the Application and its determination.

We consulted on our draft decision from 27/05/2026 to 24/06/2026. A summary of the consultation responses and how we have taken into account all relevant representations is shown in Annex 3D.

3. The legal framework

The varied Permit will be issued under Regulation 20 of the EPR 2016. The Environmental Permitting regime is a legal vehicle which delivers most of the relevant legal requirements for activities falling within its scope. In particular, the regulated facility is:

- an *installation* and a Large Combustion Plant ("LCP") with Post-combustion Carbon Capture ("PCC") for geological storage and production of hydrogen as described by the IED; and
- subject to aspects of other relevant legislation which also have to be addressed.

We address some of the major legal requirements directly where relevant in the body of this document. Other requirements are covered in section 9 towards the end of this document.

We consider that, in issuing the varied Permit, it will ensure that the operation of the Installation complies with all relevant legal requirements and that a high level of protection will be delivered for the environment and human health.

We explain how we have addressed specific statutory requirements more fully in the rest of this document.

4. The Installation

4.1 Description of the Installation and the proposed activities

4.1.1 The permitted activities

The Installation is subject to the EPR 2016 because it carries out activities listed in Part 2 of Schedule 1 to the EPR 2016.

Existing activities:

- Section 1.1 Part A(1)(a) – Burning any fuel in an appliance with a rated thermal input of 50 or more megawatts
- Section 4.2 Part A(1)(a)(iv) - Producing inorganic chemicals such as – salts – Operation of Flue Gas Desulphurisation ("FGD") units
- Section 5.4 Part A(1)(a)(ii) - Disposal of non-hazardous waste with a capacity exceeding 50 tonnes per day - physico-chemical treatment (for treatment of effluent from FGD)

- Section 3.5 Part B (f) - Loading, unloading or storing pulverised fuel ash in bulk prior to further transportation in bulk
- Section 4.8 Part B (a)(iii) - The storage in tanks of anhydrous ammonia
- Section 5.4 Part A(1)(b)(iii) - Treatment of slags and ashes

New activities:

- Section 6.10 Part A(1)(a) - Capture of carbon dioxide streams from an installation for the purposes of geological storage pursuant to Directive 2009/31/EC of the European Parliament and of the Council on the geological storage of carbon dioxide
- Section 5.4 Part A(1)(a)(ii) - Disposal of non-hazardous waste with a capacity exceeding 50 tonnes per day - physico-chemical treatment (for treatment of effluent from the quencher tower which treats flue gas prior to the PCC)
- Section 4.2 A(1)(a)(i) - Producing inorganic chemicals such as - hydrogen

An installation may also comprise “directly associated activities”, which at this Installation includes:

Existing:

- Fuel storage
- Water treatment
- Use of water
- Reverse osmosis plant
- Surface water drainage

New:

- Storage and handling of solvents
- Storage of waste solvent and acid wash water
- Operation of two steam turbines
- High pressure compression and storage of CO_2
- Solvent reclaiming

Together, these listed activities and directly associated activities comprise the Installation.

4.1.2 Activities removed from the Permit

The Applicant has applied to remove activities from the Permit that have ceased or that are no longer proposed to be carried out.

The current Permit includes the proposed Ouse Renewable Energy Plant within the combustion activity. As part of the Application, the Applicant has stated that there is no intention to operate the Ouse Renewable Energy Plant and this and the associated emission points have been removed from the Permit under this Application.

4.1.3 The Site

There are no changes to the site boundary as a result of this Variation. The new PCC activity will be located within the current footprint of the permitted boundary.

4.1.4 What the Installation does

The Installation comprises four biomass fired units (1 to 4) and two coal fired units (5 and 6) although the coal fired units have ceased operating. The units together comprise a Large Combustion Plant ("LCP").

Heavy fuel oil is used for start-up and stabilisation of these units. There are also three oil-fired open cycle gas turbines which comprise a separate LCP and are used for start-up and grid support roles including black start. These units are only run for a few hundred hours per year at most.

Currently, combustion gases from the biomass and coal fired (when operated) LCP containing carbon dioxide, oxides of nitrogen, sulphur dioxide, nitrogen (from the combustion air and fuel) and water vapour together with smaller amounts of other substances including dust, are discharged from three separate flues (two boiler units per flue) rising inside a single windshield at a height of approximately 259m above ground.

A Reverse Osmosis water treatment plant is installed on the site to provide high quality water for use in the production of Selective Non-Catalytic Reduction ("SNCR") reagent. Units 1-5 have been fitted with SNCR which will be used to minimise NO_x emissions where required in order to comply with IED and the LCP Best Available Techniques Reference document ("BREF").

Ash produced is sold where possible or otherwise transported, after conditioning with water, to an adjacent ash disposal facility at Barlow (operating under a separate EPR 2016 permit). Under some conditions surface water from the Barlow site overflows to the station water system. Checks on this have been included in the process monitoring requirements of the Permit. Slurried pulverised fuel ash ("PFA") sourced from Barlow is used in the biomass fired boilers to mitigate impacts of corrosion, fouling and slagging.

The variation Application is for the addition of two carbon capture plants, one on each of Units 1 and 2. In order to provide the space for the installation of the carbon capture plant, Units 5 and 6, the associated electrostatic precipitators, the Sulphur Trioxide ("SO_3") injection system and some ash handling infrastructure will be demolished. However, the operation of the carbon capture plant is contingent on government decisions regarding funding so the Operator will maintain Units 5 and 6 and their associated infrastructure so that they can be converted to alternative fuels to coal, or to burn coal, until the funding decisions are made and it is clear that the capture of carbon dioxide can go ahead.

Flue gases from Units 1 and 2 will be diverted from discharge via the main stack to the carbon capture plant. In order to protect the performance of the solvent used in the carbon capture process and to reduce the formation of degradation products, a number of measures will be in place to ensure the flue gas influent to the carbon capture plant is appropriate.

Primary controls:

The sulphur content of the flue gases is controlled by fuel selection and the Operator's current fuel management system ensures that suppliers are provided with specifications and criteria to meet that ensures low sulphur fuel is provided.

Nitrogen oxides (“NOx”) are controlled through the use of low NOx burners and combustion zone control monitoring. Thermal NOx (formed by the combustion of nitrogen in the air) is reduced by using air staging to ensure a long cool flame and reduced air in the combustion chamber. Secondary abatement in the form of Selective Non-Catalytic Reduction (“SNCR”) is also fitted to reduce the NOx emisisons, However, this results in ‘ammonia slip’ which can also impact the performance of the solvent and generate additional degradation products. Currently, the emissions from burning biomass in Units 1 and 2 achieve the emission standards so SNCR is not routinely used, but rather it is available when additional controls are required.

Particulates are controlled by electrostatic precipitators on each unit.

Mercury is controlled through fuel selection, but biomass fuels generally contain very low levels of mercury.

Secondary measures:

A gas/gas heater will be installed which will reduce the temperature of the influent gas and also reduce the formation of SO_3 mist. The gas temperature is required to be reduced in order for the chemical reaction between the solvents and the CO_2 to occur in the absorber columns.

A quencher tower will be installed which will further reduce sulphur with the use of an alkali solution.

The quencher tower is also designed to act as a wet scrubber so this will further reduce particulate matter in the influent gas.

When SNCR is used to reduce NOx emissions, there is an increase in ammonia present in the flue gas as a result of ‘ammonia slip’. These low levels of ammonia will be reduced in the quencher tower.

The quencher tower will also remove any metals which are generally found in the PFA as the quencher tower acts as a wet scrubber removing particulates. In addition, low levels of mercury are also removed in the tower.

Although not its primary purpose, the quencher tower will also reduce other pollutants in the gas stream which could impact the performance of the solvent or result in foaming, vapour formation or other oxidative reactions which can cause breakdown products to be emitted.

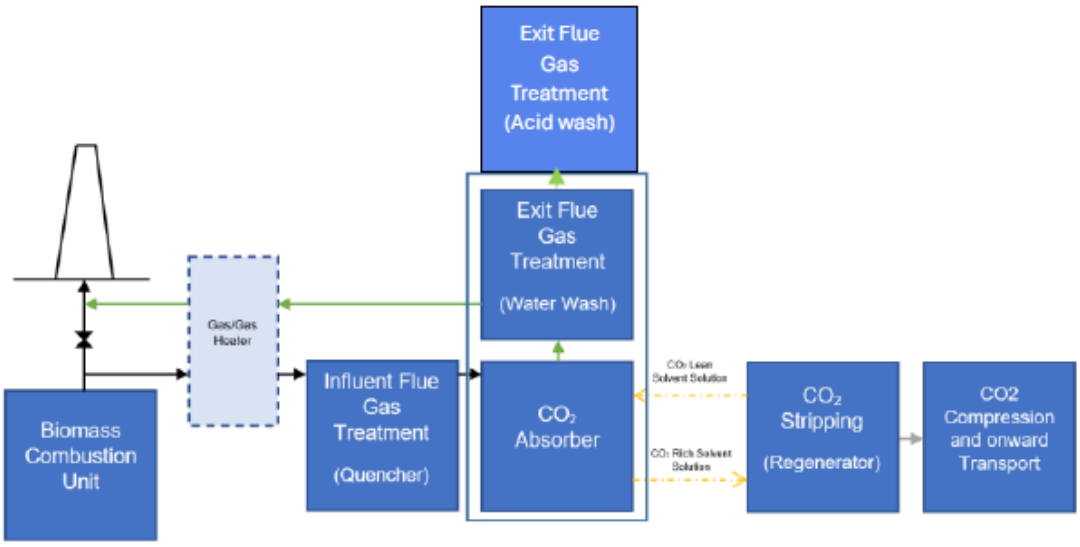
The cooled and treated flue gas is then discharged into the base of the absorber tower where it rises up the column to meet the solvent when a chemical reaction occurs removing the CO_2 from the gas stream. The CO_2 containing solvent (known as rich solvent) is then discharged to a stripper column where it is heated to break the chemical bond between the CO_2 and the solvent releasing the captured CO_2 as a separate gas stream. The now lean solvent (solvent without CO_2) passes to a regenerator where it is treated before re-use in the capture process. The captured CO_2 is compressed and stored prior to transport from the site in the pipeline network for permanent geological storage in the spent oil and gas wells in the North Sea. This transport and storage do not form part of the variation Application as it is not regulated under EPR or by the Environment Agency.

4.2 Operation of the carbon capture plant

Two PCC units are proposed to be installed, one for each of combustion Units 1 and 2. Each unit will operate in the same way. Therefore, where we refer to the operation of the PCC plant as a singular activity, the reference to the operation applies to both units.

4.2.1 Overview

A schematic of the PCC activity is shown in the drawing below.



Flue gas cooling

Due to the high temperature of the flue gas following combustion of the biomass, the gas has to be cooled in order for the chemical reaction with the solvent that captures the CO_2 to take place. The flue gas is passed through a gas/gas heater and the cooled gas passes into the quencher tower for treatment to remove pollutants that could impact the capture process by inhibiting the chemical reaction of the solvent with the CO_2 or reducing the life of the solvent.

Quencher tower

The cooled flue gas enters the quencher at the base and passes up the tower through packing and sprays. The sprays, or washes, comprise an alkali solution which reduces the sulphur in the flue gas. As the tower acts as a wet scrubber, particulates are removed from the gas stream. Other pollutants such as ammonia, arising from the use of SNCR to reduce NOx in the combustion gases, and metals, often adhering to particulate matter, chloride and hydrogen fluoride are also removed or reduced. In addition, the water wash also further cools the flue gas.

The wash water produced in the quencher tower which contains pollutants removed from the flue gas is discharged to the Effluent Treatment Plant (“ETP”). The wash water is treated in the ETP with a combination of methods including pH control, chemical coagulation, flocculation, settling and filtration in order to meet the required standards. The treated effluent is discharged to the cooling system for re-use and will finally be discharged to the River Ouse at the existing discharge point, W1.

Absorber column

The cooled and treated flue gas exits the top of the quencher tower and enters the base of the absorber tower where it rises up the column through the structure packing which maximises the time in the column and the surface area for the capture to take place. The amine solvent is added at the top of the column and trickles down to meet the flue gas and reacts with the CO_2 exothermically in the lower section of the column creating rich solvent (solvent containing CO_2).

The remaining flue gases and the gaseous products of the reaction between the solvent and the CO_2 are treated at the top of the absorber column through two three-stage water wash systems, demister system and an acid wash to remove amines and amine breakdown products, such as nitrosamines and nitramines, and ammonia from oxidation of the amines. The treated flue gases are then directed to the existing stack for discharge to atmosphere via the gas/gas heater where heat removed from the flue gas prior to treatment in the quencher tower and absorber is used to reheat the flue gases.

As the PCC process is designed as a sealed system, the water wash waters are not disposed of but rather are re-used in the system, which also reduces the amount of water required and maximises the solvent used. The acid wash is collected for off-site treatment and disposal.

The rich solvent (solvent containing the CO_2) passes to the regeneration system from the bottom of the absorber column.

CO_2 stripping

There are two systems for each PCC line to strip the CO_2 from the rich solvent, and these operate in parallel.

The rich solvent passes to the regenerators via a crossflow heat exchanger and moves down through contact packing. This is heated using steam and this heated environment enables the CO_2 to be released from the rich solvent.

Solvent reclaiming

The regeneration takes place as a batch process in a vacuum reclaim system. A specific batch of lean solvent can be diverted away from the return to the absorber for further treatment to remove unwanted substances such as soluble metals and suspended solids by heating to boil off the solvent and water vapour. The solvent and water vapour are drawn off and condensed in the reclaim condenser and then pass into the reclaimer vapour drum. Condensed water is transferred to the CO_2 absorber. The reclaimed solvent is returned to the absorber via the crossflow heat exchanger so the heat from the lean solvent further heats the rich solvent as it passes into the regenerator. Over time, the impurities in the reclaim boiler reach a concentration that requires them to be disposed of via the reclaim tank. These are then removed from the site as hazardous waste.

CO_2 conditioning

The released CO_2 and associated water vapour exit the top of the regenerator and enter the reflux column. The CO_2 comes in to contact with a series of water sprays that cool the CO_2 to the saturation temperature removing some of the moisture from, and washes

pollutants out of, the CO_2 stream. The condensate collects at the bottom and some of the condensate is returned to the absorber for use in the wash section and some is passed to the top of the regenerator to maximise solvent recovery and use.

The cooled CO_2 leaves the reflux column and enters the first compressor stage scrubber where water droplets are removed. The CO_2 is compressed under low pressure and then passes to the Oxygen reactor.

The Oxygen reactor is a pressure vessel containing a catalyst and hydrogen (generated on site) is added to the reactor where it reacts with oxygen to produce water. The level of hydrogen added depends on the amount of oxygen present and the oxygen is measured to determine the amount of hydrogen required and this is controlled automatically through a control loop.

The de-oxygenated CO_2 stream enters the dehydration unit to remove the moisture. The CO_2 is then compressed.

The water removed from the CO_2 conditioning is returned to the solvent system.

CO_2 compression and off-site transport

The design of the compression system is dependent on the requirements of the operator of the CO_2 transport pipeline. Currently the transport provider has provided an envelope of operating parameters, and this has identified Drax's CO_2 as being a dense phase transport system with CO_2 pressures required of between 90 and 135 barG. The dispatchable tonnages for the PCC process to dispatch to transport will be up to 540tph. Details of the final compression system will be provided in accordance with pre-operational condition PO37 in table S1.4 in the varied Permit.

Following compression, the CO_2 will be discharged into the CO_2 transport network and ultimately it will be stored geologically in the strata under the North Sea.

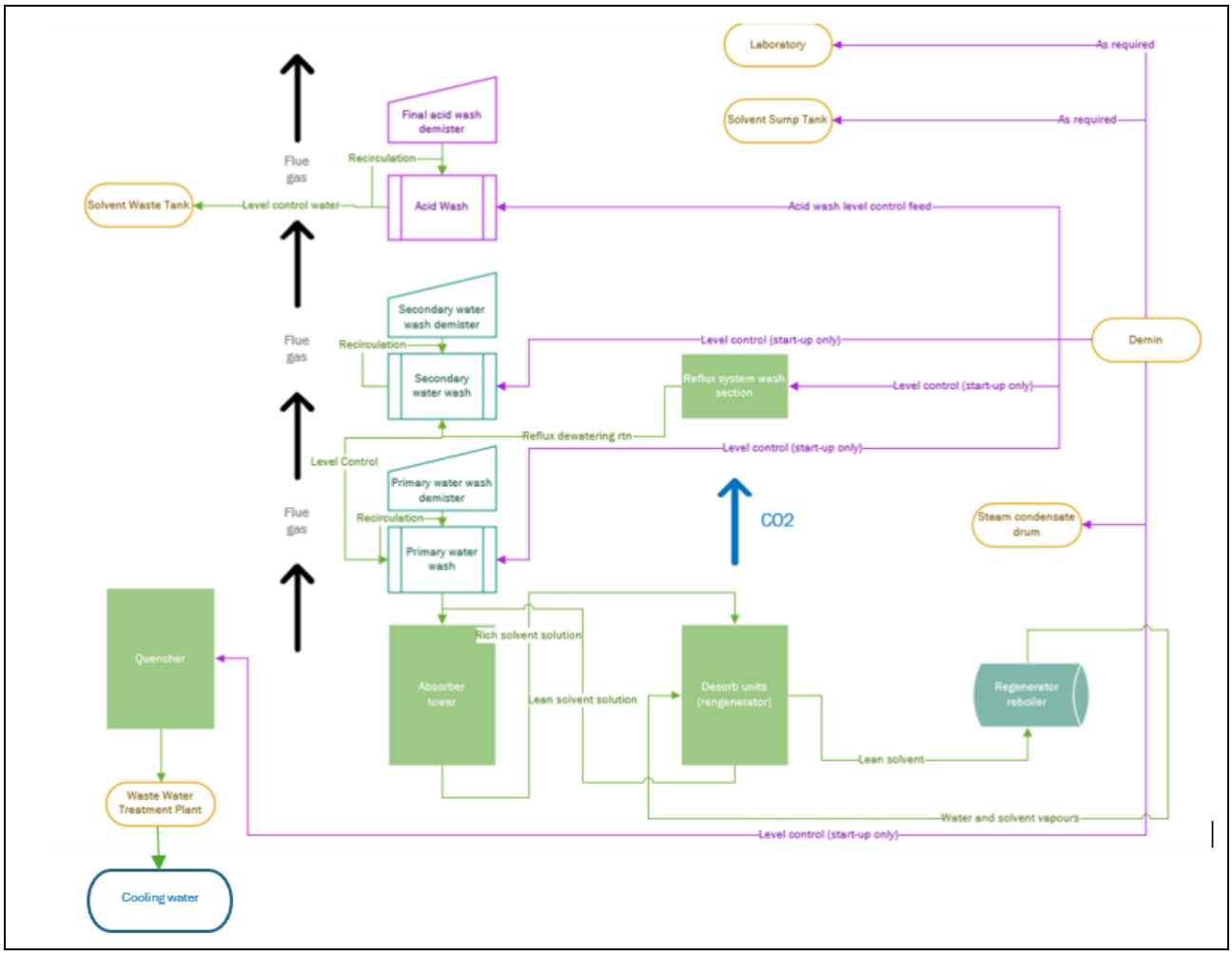
Should there be a problem with the CO_2 transport network, the Operator will need to vent the captured CO_2 to atmosphere. This will take place via a dedicated stack.

4.2.2 Water use

Water is used within the PCC process as follows:

- In the quencher column as a water wash.
- In the absorber tower as water wash, acid wash and de-misters.
- Mixed with the amine solvent for use in the absorber tower.
- For cooling.

The PCC system has been designed to recover and reuse demineralised water so optimises the use of water. The solvent system is a self-contained absorption/desorption process which maximises the retention of water through recovery, reuse and recirculation. Water is mainly used at start up and then as level control during operation to top up the water in the closed system. Below is a summary diagram showing the flow of water through the PCC process.

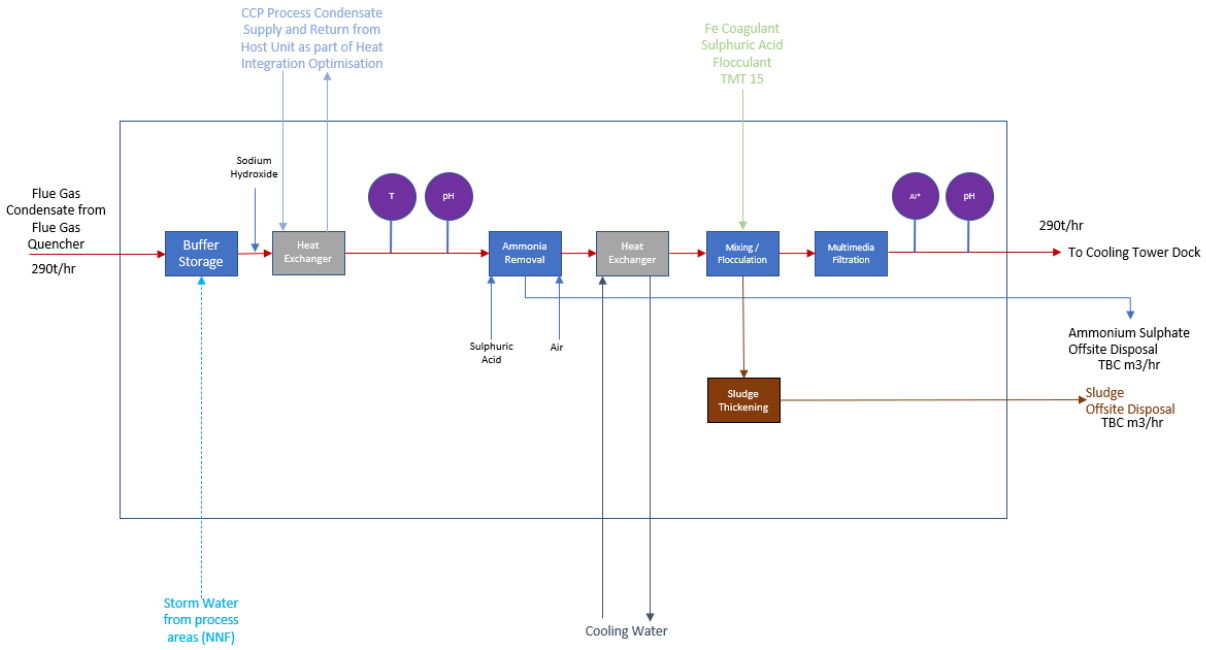


Water is recovered and utilised in four different locations within the system:

1. The first is the reflux drum which separates out the desorption steam and solvent from the captured CO_2 and returns this back to the system either directly to the process after solvent separation or the absorber tower water wash as make up.
2. The second is the solvent regeneration process, where the water and solvent are separated from the contaminates and returned to the system for recirculation.
3. The third is when the condensate from the high-pressure compression is returned via the reflux drum for reutilisation.
4. The fourth is when the associated waste solvent materials undergo a concentration process which removes as much water as possible, returning the water back to the process.

This recovered and reused water will have come in to contact with the amine solvent and the breakdown products, but the solvent is recovered from the water, as described above, and is re-used. As the water is also recirculated and re-used, there is no emission of contaminated water to the environment. The concentrated substances removed from the system are disposed of off-site as hazardous waste.

The quencher system is designed so that after the initial filling of the system, the water level is maintained from the moisture in the incoming flue gas. Periodically this water is purged to maintain a suitable level and this water is treated in the ETP. The treated water is then added to the site's cooling system to off-set water that would otherwise have to be abstracted. As this water comes from the quencher where the flue gas is treated before it enters the absorber column where it is mixed with solvent to absorb CO_2, it has not been in contact with the solvent. The diagram below shows the outline of the operation of the ETP.



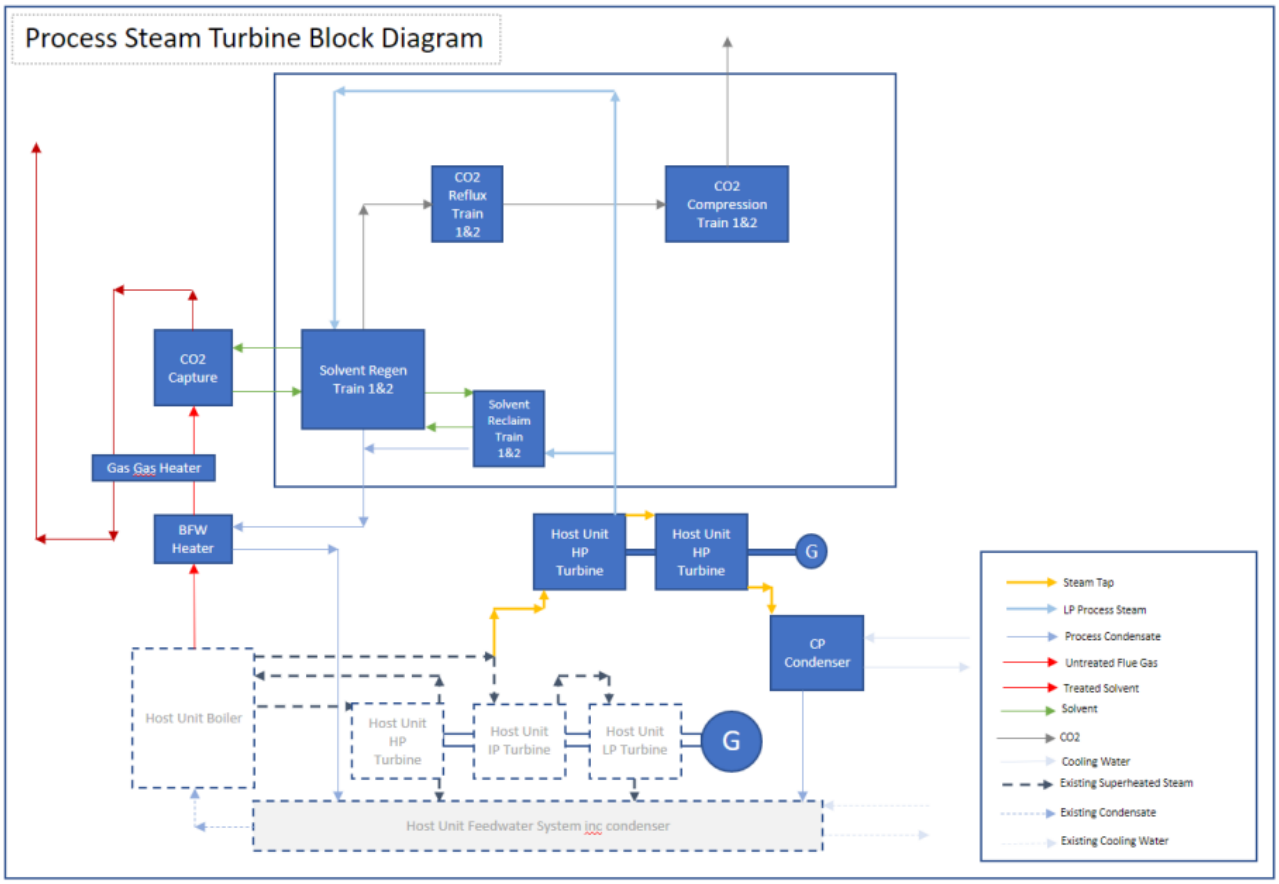
The PCC requires significant cooling and where cooling is required to cool water, this will be carried out using the existing natural draft cooling towers located to the north of the site. Cooling required for various parts of the solvent system will generally be provided by a liquid and plate cooled system designed so that there is no transfer of solvent into the cooling water.

4.2.3 Energy use

The PCC requires steam, heat and electrical power. The Applicant states that the PCC has been designed in order to maximise the use of useful heat and steam from the power station in the PCC process and to produce power for the PCC process and to minimise the demand for heat and steam from the combustion plant.

Steam

Hot reheat steam is tapped off from the turbines prior to the intermediate pressure turbine and is transported to the regeneration boiler via a small turbine that generates approximately 90 MW of electrical power (MWe) required by the PCC unit and to provide process steam at the desired temperature and pressure for the operation of the PCC units. The use of steam in the process is shown in the diagram below.



Steam is used in the regeneration boilers to provide heat for the solvent regeneration process to break the bonds between the solvent and CO_2 in the rich solvent and for heating the dedicated water supply within the solvent.

Heat

The design of the system utilises the inherent heat in the process for two different systems; solvent heat utilisation; process condensate heat utilisation. Waste heat from the CO_2 system has also been assessed to determine its suitability for use.

Solvent: The use of heat is optimised via a series of heat exchangers to transfer heat and to maximise the efficiency of the absorption/desorption cycle. Heat is transferred from the hot lean solvent to the cooler rich solvent prior to the reclaimer via a series of heat exchangers to maximise the efficiency of CO_2 removal by reducing the associated steam demand of each regenerator. This transfer of heat also reduces the cooling demand for the lean solvent as it returns to the absorber column optimising the absorption efficiency of CO_2.

Process condensate: Heat remaining in the low-pressure steam system is fed back to the boiler feed system.

Compression waste heat: The applicant has reviewed whether the low-grade heat from the compression of CO_2 could be utilised within the system and has concluded that due to the low grade nature of the heat and the lack of suitable space to install a heat exchanger, the benefit of using the heat is outweighed by the limited heat availability and the engineering complexities.

Power

The operation of the PCC units requires approximately 90MWe for each unit. This is supplied by dedicated turbines utilising the steam diverted from the main turbine to generate power for the PCC units. This does result in an energy penalty for the main turbines with output reduced by around 200MWe.

4.3 Operating techniques

We have specified that the Applicant must operate the carbon capture plant in accordance with the following documents contained in the Application:

Description	Parts Included	Justification
Application EPR/VP3530LS/V022	Second Stage Information Report: Sections: • 3.0 Additional Best Available Techniques for emission to air from PCC • 3.1 Aerosol and Droplet control • 4.0 Carbon Dioxide High Pressure Compression and Venting • 5.0 PCC Operation and Control	These documents contain key operating techniques that will ensure environmental risk is managed on site.
Application EPR/VP3530LS/V022	Supporting Information Report V2.0 Sections: • 4.0 Units 5 &6 • 5.0 Biomass Furnace Bottom Ash Handling • 7.0 BAT for Control of Emissions to Air from PCC, excluding 7.12 Proposed Air Emission Limit Values, 7.13 Mass Emission Releases, 7.14 Air Dispersion Modelling • 8.0 Monitoring • 9.1.3 Thermal integration • 9.2 Operational Control • 10.0 Carbon Dioxide Compression • 11.0 Chemical and Solvent Storage, Load and Filling Systems • 13.0 Cooling • 14.0 Discharges to water	
Response to schedule 5 notice No2 dated 23/10/2023	Schedule 5 Notice Part 2 Response version 2.0: 1. Emission points 2. Ash handling 3. Water emissions and Appendix A WWTP Block diagram 31/03/2024 4. c) confirmation that treated effluent will be re-circulated in the cooling water Appendix B Drax BECCS Cooling water balance 31/03/24 10. Bunding 13. Primary and secondary containment arrangements for the amine solvent 16. Amine solvent recovery process	
Response to schedule 5 notice	Schedule 5 notice Part 3 Response: 1. Storage and transfer of amine solvent	

Description	Parts Included	Justification
No3 dated 11/07/2024	2. Storage for raw materials 3. Treatment of carbon dioxide	
Response to schedule 5 notice No1 dated 27/07/2023	Schedule 5 Notice Part 1 Response: • Appendix B Air Emissions Risk Assessment: Section 4.2 Emission parameters • Appendix C Specification of Emissions for Control by Emission Limits: Section 3.2 Speciated emissions under Drax flue gas conditions	
Response to RFI dated 10/10/2024	Solvent storage	

The operating techniques set out in the table above are in addition to those already specified in table S1.2 of the Permit. Together they comprise the techniques that the Operator will operate to for the Installation as a whole.

4.4 Raw materials

We have specified the following limits and controls on the use of raw materials and fuels in relation to the proposed carbon capture plant:

Raw Material or Fuel	Specifications	Justification
Gas Oil or equivalent substitute approved in writing by the Environment Agency	Not exceeding 0.1% sulphur content	As required by Sulphur Content of Liquid Fuels Regulations. The added text will allow the operator to use alternative fuels that are equivalent to gas oil provided we have agreed to it in writing.
Carbon capture solvent used for activity AR8	MHI KS21, formulation consistent with the emissions profile assessed in variation application EPR/VP3530LS/V022, Appendix C of response dated 29/11/2024 to schedule 5 No1.	We have specified the solvent that can be used in the PCC to capture CO_2 as the emissions from the use of this solvent are the basis of the risk assessments provided with the Application. In addition, the parameters, limits and monitoring requirements that have been set in the varied Permit are based on the use of this solvent.

We have amended the reference to gas oil to allow equivalent substitutes to be used as agreed with us in writing.

The raw materials in the table above are in addition to those already specified in table S2.1 of the Permit and these, together with those already included in the Permit, are the raw materials and fuels that the Operator will use in the operation of the Installation as a whole.

5. The Installation's environmental impact

Regulated activities can present different types of risk to the environment, these include noise and vibration, accidents, fugitive emissions to air and water; as well as point source releases to air, discharges to ground or groundwater, global warming potential and generation of waste and other environmental impacts. Consideration may also have to be given to the effect of emissions being subsequently deposited onto land (where there are ecological receptors). The key factors relevant to this determination are discussed in this and other sections of this document.

For carbon capture using amines, the principal emissions are:

- to air,
- noise, and
- venting from CO_2 compression.

We have not considered the emissions from the existing activities as these remain unchanged.

The next sections of this document explain how we have approached the critical issue of assessing the likely impact of the emissions to air from the carbon capture activity on human health and the environment, the impacts from venting of CO_2 on human health, the impacts from other emissions such as those to water and from noise and the impacts from the other proposed changes included in the Application.

5.1 Assessment Methodology for emissions to air

5.1.1 Application of Environment Agency Web Guide for Air Emissions Risk Assessment

A methodology for risk assessment of point source emissions to air, which we use to assess the risk of applications we receive for permits, is set out in our Web Guide and has the following steps:

- Describe emissions and receptors
- Calculate process contributions
- Screen out insignificant emissions that do not warrant further investigation
- Decide if detailed air modelling is needed
- Assess emissions against relevant standards
- Summarise the effects of emissions

The methodology uses a concept of "Process Contribution" (PC"), which is the estimated concentration of emitted substances after dispersion into the receiving environmental media at the point where the magnitude of the concentration is greatest. The guidance provides a simple method of calculating PC primarily for screening purposes and for estimating process contributions where environmental consequences are relatively low. It is based on using dispersion factors. These factors assume worst case dispersion conditions with no allowance made for thermal or momentum plume rise and so the process contributions calculated are likely to be an overestimate of the actual maximum concentrations. More accurate calculation of process contributions can be achieved by mathematical dispersion models, which take into account relevant parameters of the release and surrounding conditions, including local meteorology.

5.1.2 Use of Air Dispersion Modelling

We require the Applicant to submit a full air dispersion model as part of their application, for the key pollutants from the PCC and from the LCPs. Air dispersion modelling enables the process contribution to be predicted at any environmental receptor that might be impacted by the plant.

Once short-term and long-term PCs have been calculated in this way, they are compared with Environmental Standards ("ES").

Where an EU ES exists, the relevant standard is the EU ES. Where an EU ES does not exist, our guidance sets out a National ES, also referred to as Environmental Assessment Level, ("EAL") which has been derived to provide a similar level of protection to Human Health and the Environment as the EU ES levels. In a very small number of cases, e.g. for emissions of Lead, the National ES is more stringent than the EU ES. In such cases, we use the National ES standard for our assessment.

National ESs do not have the same legal status as EU ESs, and there is no explicit requirement to impose stricter conditions than BAT in order to comply with a national ES. However, national ESs are a standard for harm and any significant contribution to a breach is likely to be unacceptable.

Where there are no published ESs for substances that are emitted from the PCC, we require applicants to derive their own ES/EALs using the methodology in accordance with our consultation from 2012, republished in March 2025, Methodology for the scientific derivation of environmental assessment levels - GOV.UK. In response to our first information notice requiring revised air dispersion modelling, the Applicant provided a document detailing how EALs for the substances modelled had been derived.

PCs are considered **Insignificant** if:

- the **long-term** process contribution is less than **1%** of the relevant EQS; and
- the **short-term** process contribution is less than **10%** of the relevant EQS.

The **long term** 1% process contribution insignificance threshold is based on the judgements that:

- It is unlikely that an emission at this level will make a significant contribution to air quality;
- The threshold provides a substantial safety margin to protect health and the environment.

The **short term** 10% process contribution insignificance threshold is based on the judgements that:

- Spatial and temporal conditions mean that short term process contributions are transient and limited in comparison with long term process contributions.
- The threshold provides a substantial safety margin to protect health and the environment.

Where an emission is screened out in this way, we would normally consider that the Applicant's proposals for the prevention and control of the emission to be BAT or BAT in accordance with the emerging techniques guidance. That is because if the impact of the

emission is already insignificant, it follows that any further reduction in this emission will also be insignificant.

However, where an emission cannot be screened out as insignificant, it does not mean it will necessarily be significant.

For those pollutants which do not screen out as insignificant, we determine whether exceedances of the relevant ES are likely. This is done through detailed audit and review of the Applicant's air dispersion modelling taking background concentrations and modelling uncertainties into account. Where an exceedance of an EU ES is identified, we may require the Applicant to go beyond what would normally be considered BAT for the Installation, or BAT in accordance with the emerging techniques guidance, or we may refuse the application if the applicant is unable to provide suitable proposals. Whether or not exceedances are considered likely, the application is subject to the requirement to operate in accordance with BAT, or BAT in accordance with the emerging techniques guidance.

This is not the end of the risk assessment, because we also take into account local factors such as particularly sensitive receptors nearby such as Sites of Special Scientific Interest (SSSIs), Special Areas of Conservation (SACs) or Special Protection Areas (SPAs). These additional factors may also lead us to include more stringent conditions than BAT, or BAT in accordance with the emerging techniques guidance.

Conservation sites are protected in law by legislation which provides the highest level of protection for SACs and SPAs, and also for protection of SSSIs. In addition, the Environment Act 1995 provides more generalised protection for flora and fauna rather than for specifically named conservation designations. We apply the same screening criteria described above to European habitat sites (SPA, SAC), and to other statutory sites including Ramsar sites and SSSIs.

It is under the Environment Act 1995 that we assess other sites (such as ancient woodlands, local wildlife sites and national and local nature reserves) which prevents us from permitting something that will result in significant pollution; and which offers levels of protection proportionate with other European and national legislation. However, it should not be assumed that because levels of protection are less stringent for these other sites, that they are not of considerable importance. Local sites link and support EU and national nature conservation sites together and hence help to maintain the UK's biodiversity resilience.

For SACs SPAs, Ramsars and SSSIs we consider the PC and the background levels in making an assessment of impact. In assessing the local nature sites under the Environment Act 1995 we look at the impact from the Installation alone to determine whether it would cause significant pollution. This is a proportionate approach, in line with the levels of protection offered by the conservation legislation to protect these other sites (which are generally more numerous than Natura 2000 or SSSIs) whilst ensuring that we do not restrict development.

Critical levels and loads are set to protect the most vulnerable habitat types. Thresholds change in accordance with the levels of protection afforded by the legislation. Therefore,

the thresholds for SAC, SPA and SSSI features are more stringent than those for local nature sites.

Therefore, we would generally conclude that the Installation is not causing significant pollution at these other sites if the PC is less than the relevant critical level or critical load, provided that the Applicant is using BAT, or BAT in accordance with the emerging techniques guidance, to control emissions.

If, as a result of reviewing of the risk assessment and taking account of any additional techniques that could be applied to limit emissions, we consider that emissions would cause significant pollution, we would refuse the Application.

5.1.3 The Applicant's air dispersion modelling

The Applicant's assessment of the impact of air quality is set out in the following:

- 'Air Emissions Risk Assessment' dated November 2024 submitted in response to our first information notice.
- 'BECCS Environmental Permit Variation Application Schedule 5 Response: Q4' dated July 2025 submitted in response to our fourth information notice. And,
- 'Drax Power Station Environmental Permit Variation V022 Schedule 5 Notice Part 5', dated 27/02/2026 submitted in response to our fifth information notice.

The assessments comprise:

- Dispersion modelling of emissions to air from the operation of the PCC alone, from the continuous operation of the PCC and the combustion plant and from the continuous operation of the PCC together with operation of the combustion plant for 4000 hours per year.
- A study of the impacts on human health receptors.
- Modelling of amine chemistry.
- A study of the impact of emissions on sensitive conservation sites within the relevant screening distances and on one within 20km.
- Additional assessment of the impact of acid deposition on the Thorne Moor SAC/SPA/SSSI based on the annual average actual SO_2 concentrations monitored in the flue gases in 2024 and 2025.

The Applicant has assessed the potential emissions to air from the PCC plant against the relevant environmental standards and derived EALs, and the potential impact upon local conservation sites and human health. As carbon capture using amines is an emerging technology, not all the pollutants emitted from the PCC plant have published environmental standards. Therefore, the Applicant has assessed the emissions against published EALs, EALs derived by the Environment Agency that were being consulted on at the time (now published) and EALs derived by the solvent manufacturer. These assessments predict the potential effects on local air quality from the Installation's stack emissions using the Atmospheric Dispersion Modelling System ("ADMS") dispersion model version 6.0.0.1, which is a commonly used computer model for regulatory dispersion modelling. The model used 5 years of meteorological data between 2019 and 2023 collected from the weather station at RAF Waddington which is 69km south of the

Installation. The impact of the terrain surrounding the site upon plume dispersion was not considered in the dispersion modelling as there are no significant features with a gradient above 1 in 10m that would affect the dispersion of pollutants.

The ADMS model developers, CERC, have generated a specific amine chemistry module for use with ADMS software for assessment of emissions of amines and their atmospheric degradation products. The ADMS amine chemistry module was the only commercially available software at the time that could be used to evaluate potential impacts on air quality from amines and amine degradation. The model calculates the rate of amine degradation taking into account the reaction of amines with other species present in the exhaust gas, such as Nitrogen Dioxide ("NO_2"), and also with hydroxyl radicals in the atmosphere. Whilst the ADMS model itself has been validated, the specific amines module has not been, and therefore the results should be regarded as indicative rather than definitive.

The air impact assessments, and the dispersion modelling upon which they were based, employed the following assumptions:

- The emission concentrations for the pollutants from the combustion plant are based on the BAT AELs and IED limits as specified in the current Permit.
- The emission concentrations for each of the speciated amines, nitrosamines and nitramines have been based on the ELV for total amines, which is a worst case for each compound since compliance with the ELV requires that no more than one compound is emitted at the ELV at any given time.
- The Core Scenario is based on the continuous operation of Units 1 and 2 with PCC and Units 3 and 4 without PCC at full load (2 x BECCS and 2 x Non-BECCS).
- The reported results are the maximum from the five years of meteorological data modelled.

The Applicant modelled a grid 15km in each direction from the stack with a resolution of 250m. In addition, PCs were determined at 45 discrete human health receptors. For ecological receptors a grid of minimum resolution 200m and at a height of 0.5m was modelled and PCs were determined at a number of ecological receptors within the 15km screening distance as well as at South Cliffe Common SSSI 20km to the northeast of the stack.

The Applicant used the values from the DEFRA background mapping system and from the Air Pollution Information System ("APIS") as background concentrations.

The Applicant provided us with modelled output showing the concentration of key pollutants at a number of specified locations within the surrounding area.

5.1.4 Our assessment of the Applicant's air dispersion modelling

The way in which the Applicant used dispersion models, its selection of input data, use of background data and the assumptions it made have been reviewed by us to establish the robustness of the Applicant's air impact assessment. The output from the model has then been used to inform further assessment of health impacts and impact on habitats and conservation sites.

We carried out our own modelling based on the Applicant's modelling files which included checking sensitivity to model input parameters, as follows:

- Use of meteorological data from a different site and for a different period.
- Use of the latest version of the ADMS model (v 6.0.2.3).
- A larger model grid of 50km by 40km and a height of 0m (ground level) at ecological receptors.
- Additional human health and ecological receptors in the wider grid.
- Use of most conservative kinetic parameters for each amine available from CERC, rather than average values and relevant proxies, and
- Alternative background concentrations.

We checked the assumptions underpinning the model and these are considered to be reasonably precautionary.

We were not in total agreement with the Applicant's approach and required the Applicant to model two other scenarios based on our own modelling which the Applicant confirmed are the more likely operating scenarios than the core scenario, as follows:

- 2 x BECCS scenario based on continuous operation of Units 1 and 2 with PCC, for impacts from methylethylamine and N-dimethylethylenediamine.
- Mid-merit scenario based on continuous operation of Units 1 and 2 with PCC and 4000 hours combined operation of Units 3 and 4 without PCC for impacts from methylethylamine and N-dimethylethylenediamine.

We required additional modelling of these two pollutants as they are the amines that are predicted to form the greatest quantity of nitrosamines and nitramines.

We also required the Applicant to model the impact of emissions on the South Cliffe Common Site of Special Scientific Interest ("SSSI") located 20km to the north-east of the stack as the Applicant's plume modelling and our checks indicated that this site could be impacted.

The additional modelling of these two scenarios and the impacts on South Cliffe Common SSSI were submitted on 31/07/2025 in response to our fourth information notice dated 27/05/2025.

We also required the Applicant to provide a quantitative justification that the impact of acid deposition at the Thorne Moors SAC/SPA/SSSI is insignificant. This was provided on 27/02/2026 in response to our fifth information notice dated 27/01/2026.

The assessment of the impact of emissions on local air quality is set out in section 5.2 of this document, and the impact on conservation sites is considered in section 5.3.

5.2 Assessment of Impact on Air Quality

Our initial review of the Applicant's assessment led us to require additional modelling of two other scenarios on the basis that these are more likely to be how the combustion plant and PCC will be operated. Our review of both the initial modelling and the revised modelling leads us to agree with the Applicant's conclusions.

The Applicant's modelling predictions are summarised in the following sections.

5.2.1 Pollutants modelled

The pollutants modelled are based on the emissions from the PCC together with the emissions from the combustion plant.

(i) Pollutants from combustion

The emission concentrations modelled are based on the BAT AELs and IED ELVs as specified in the current Permit. These will not change as a result of the operation of the PCC.

The following pollutants were modelled:

- Oxides of nitrogen ("NO_x")
- Sulphur dioxide ("SO_2")
- Ammonia ("NH_3")
- Hydrogen chloride ("HCl")
- Particulate matter at 10 microns ("PM_{10}")
- Particulate matter at 2.5 microns ("$PM_{2.5}$")

(ii) Pollutants introduced by the PCC plant

The Applicant has specified the pollutants that are likely to be emitted from the PCC plant based on information provided by the supplier of the KS21 solvent.

The following pollutants were modelled:

Pollutant	**Type**	**Pollutant**	**Type**
Acetaldehyde	Aldehyde	Ethyl diethanolamine	3º Amine
Formaldehyde	Aldehyde	N-(2-hydroxyethyl) acetamide	Amide
Ammonia	Ammonia	N-(2-hydroxyethyl) formamide	Amide
Ethylamine	1º Amine	N-Nitrosomethylethylamine	Nitrosamine
Methylamine	1º Amine	N-Ethyl-N-(2-hydroxyethyl) nitrosamine	Nitrosamine
Monoethanolamine	1º Amine	N-Nitrosodimethylamine	Nitrosamine
Diethanolamine	2º Amine	1-Nitrosopiperazine	Nitrosamine
Diethylamine	2º Amine	N-Nitrosodiethylamine	Nitrosamine

Pollutant	Type	Pollutant	Type
Dimethylamine	2º Amine	N-Nitrosodiethanolamine	Nitrosamine
Ethyl ethanolamine	2º Amine	N-Nitrosomorpholine	Nitrosamine
Ethyl methylamine	2º Amine	1,4-Dinitrosopiperazine	Nitrosamine
Piperazine	2º Amine	2-(Ethylnitroamino) ethanol	Nitramine
N-Dimethylethylenediamine	3º Amine	1-Nitropiperazine	Nitramine

Ammonia is listed as both a combustion related pollutant and one introduced by PCC. Ammonia in the flue gas from Units 1 and 2 will be reduced in the quencher tower before the flue gas enters the PCC plant. However, ammonia is also a degradation product of the amines within the PCC plant so will be emitted in the flue gas from the PCC plant.

In the additional modelling requested in our fourth information notice, assessment of the impacts from nitrosamines and nitramines formed from amines methylethylamine and N-dimethylethylenediamine was carried out for the '2 x BECCS' and the '2 x BECCS plus 2 x Non-BECCS' (mid-merit) operating for 4000 hours operating scenarios.

5.2.2 Assessment of air dispersion modelling outputs

The tables below show the maximum ground level concentrations of pollutants. Where emissions screen out as insignificant, the background pollutant levels are not considered within the assessment in accordance with our H1 screening process. Where we take the background levels into account, we combine these with the PC to determine the Predicted Environmental Concentration ("PEC") and assess the headroom between the PEC and the ES as shown below.

5.2.2.1 Emissions of combustion pollutants

The table below shows the Applicant's modelled maximum PC for each pollutant emitted as a result of combustion for the Core Scenario (continuous operation of 2 x BECCS units and 2 x Non-BECCS units at maximum load).

Table 1: Maximum ground level concentrations of pollutants from combustion

Pollutant	ES (µg/m³)	Process Contribution (PC) (µg/m³)	PC as % of ES	PEC (µg/m³) (Background + PC)	PEC as % of EQS
Nitrogen dioxide (NO_2) Annual mean	40	0.16	0.4	-	-
NO_2	200	4.82	2.4	-	-

Table 1: Maximum ground level concentrations of pollutants from combustion					
Pollutant	ES (µg/m³)	Process Contribution (PC) (µg/m³)	PC as % of ES	PEC (µg/m³) (Background + PC)	PEC as % of EQS
Hourly mean					
SO_2 Hourly mean	350	10.31	2.9	-	-
SO_2 24 hour mean	125	1.32	1.1	-	-
SO_2 15 minute mean	266	19.22	7.2	-	-
NH_3 Annual mean	180	0.01	0	-	-
NH_3 Hourly mean	2500	1.37	0.1	-	-
HCl Hourly mean	750	1.64	0.2	-	-
PM_{10} Annual	40	0.01	0	-	-
PM_{10} 24 hour mean	50	0.32	0.6	-	-
$PM_{2.5}$ Annual	20	0.01	0.1	-	-

The table above shows that the PCs for the combustion pollutants (based on the core scenario modelling) are below 1% of the long-term ES and below 10% of the short-term ES. Our check modelling determined that for all the scenarios the PCs for the above pollutants are below 1% of the long-term ES and below 10% of the short-term ES, or the PECs are below the ES and it is unlikely that the ES will be exceeded.

Therefore, we consider that the operation of the PCC plant will not affect the emissions from the combustion plant and that the Operator's current measures for preventing and minimising emissions of these substances will continue to be BAT for the Combustion Installation.

5.2.2.2 Direct emissions of pollutants introduced by the PCC plant

The following table shows the Applicant's maximum modelled PCs for aldehydes, ammonia, amines, amides, nitrosamines and nitramines emitted from the PCC plant for

the Core Scenario. These are the amines present in the solvent and the degradation products formed in the PCC plant prior to emissions to ambient air. The PCs are based on the proposed ELV for each amine.

Table 2: Maximum ground level concentrations of pollutants introduced by the CC plant

Pollutant	ES (µg/m³)	Process Contribution (PC) (µg/m³)	PC as % of ES	PEC (µg/m³) (Background + PC)	PEC as % of EQS
Formaldehyde Annual	5	0.001	0	-	-
Formaldehyde 1 hour	100	0.155	0.2	-	-
Acetaldehyde Annual	370	0.008	0	-	-
Acetaldehyde 1 hour	9200	0.894	0	-	-
NH_3 Annual mean	180	0.01	0	-	-
NH_3 Hourly mean	2500	1.37	0.1	-	-
Ethylamine Annual	22	0.00136	0	-	-
Ethylamine Hourly mean	2800	0.299	0	-	-
Methylamine Annual	15	0.00136	0	-	-
Methylamine Hourly mean	1900	0.299	0	-	-
Monoethanolamine Daily mean	100	0.0309	0	-	-
Monoethanolamine Hourly mean	400	0.299	0.1	-	-
Diethanolamine Daily mean	3	0.0185	0.6	-	-

Table 2: Maximum ground level concentrations of pollutants introduced by the CC plant					
Pollutant	ES (µg/m³)	Process Contribution (PC) (µg/m³)	PC as % of ES	PEC (µg/m³) (Background + PC)	PEC as % of EQS
Diethanolamine Hourly mean	3000	0.179	0	-	-
Diethylamine Daily mean	33	0.0185	0.1	-	-
Diethylamine Hourly mean	330	0.179	0.1	-	-
Dimethylamine Annual	22	0.000819	0	-	-
Dimethylamine Hourly mean	2800	0.179	0	-	-
Ethyl ethanolamine Annual	50	0.000819	0	-	-
Ethyl ethanolamine Hourly mean	300	0.179	0.1	-	-
Ethyl methylamine Note 1 Annual	28.6	0.000819	0	-	-
Ethyl methylamine Note 1 Hourly mean	3,640	0.0179	0		
Piperazine Daily mean	15	0.0185	0.1	-	-
N-Dimethylethylenediamine Daily mean	104	0.0185	0	-	-
N-Dimethylethylenediamine Hourly mean	417	0.179	0	-	-
Ethyl diethanolamine Annual	440	0.00136	0	-	-
N-(2-hydroxyethyl) acetamide	0.085	0.0005	0.6	-	-

Table 2: Maximum ground level concentrations of pollutants introduced by the CC plant					
Pollutant	ES (µg/m³)	Process Contribution (PC) (µg/m³)	PC as % of ES	PEC (µg/m³) (Background + PC)	PEC as % of EQS
Annual					
N-(2-hydroxyethyl) formamide Annual	86	0.0005	0	-	-
N-Nitrosomethylethylamine Annual	0.0002	0.00000164	0.8	-	-
N-Ethyl-N-(2-hydroxyethyl) nitrosamine Annual	0.0002	0.00000164	0.8	-	-
N-Nitrosodimethylamine Annual	0.0002	0.00000164	0.8	-	-
1-Nitrosopiperazine Annual	0.0002	0.00000164	0.8	-	-
N-Nitrosodiethylamine Annual	0.0002	0.00000164	0.8	-	-
N-Nitrosodiethanolamine Annual	0.0002	0.00000164	0.8	-	-
N-Nitrosomorpholine Annual	0.0002	0.00000164	0.8	-	-
N-Nitrosomorpholine Daily	0.37	0.0000371	0.1	-	-
1,4-Dinitrosopiperazine Annual	0.0002	0.00000164	0.8	-	-
2-(Ethylnitroamino) ethanol	0.0002	0.0000273	0.1	-	-
1-Nitropiperazine	0.0002	0.0000273	0.1	-	-
Note 1: Results based on response dated 20/06/2025 to schedule 5 notice No4 which amended the annual mean EAL and included an hourly mean EAL.					

The Applicant's predicted PCs for the Core Scenario for all individual pollutants from the PCC plant are insignificant as they are below 1% and 10% of the long term and short-term ES as shown in the table above.

Our check modelling showed that the PCs of amines, amides and aldehydes are insignificant. The PCs of nitrosamines and nitramines are 'not insignificant' (they are >1% or >10% of the long term or short-term ES), but they are not predicted to exceed the ES.

Therefore, we consider the Applicant's proposed measures for preventing and minimising emissions of these substances to be BAT in accordance with the guidance 'Post-combustion carbon dioxide capture: emerging techniques'.

5.2.2.3 Indirect emissions of nitrosamines and nitramines

Direct emissions of amines (from the stack) may lead to chemical transformation to stable nitrosamines and nitramines in the presence of hydroxyl (OH) and nitrate (NO_3) radicals in ambient air. These are referred to as indirect nitrosamines and nitramines which are formed in ambient air from emitted amines.

The Applicant used the ADMS 6 amines chemistry module (which scopes amine reactions with the OH radical) to estimate impacts of indirect N-amines (nitrosamines and nitramines). Reaction rate coefficients required by the module have been derived from information provided in the CERC Report on Improving Post-Combustion Carbon Capture Air Quality Risk Assessment Techniques (May 2024).

The Applicant's assessment shows that none of the indirect emissions of any of the nitrosamines or nitramines are insignificant. The maximum impact of the combined modelled PCs for direct and indirect emissions of individual nitrosamines and nitramines is just under 25% and 50.5% of the ES as shown in table 3 below, with the modelled PC value being dominated by the concentrations of indirect emissions.

Table 3: Maximum combined direct and indirect nitrosamine and nitramine concentrations (Core Scenario)

Pollutant	ES (µg/m³)	Process Contribution (PC) (µg/m³)	PC as % of ES
N-Nitrosomethylethylamine (nitrosamine)	0.0002	0.0000498	24.9
Nitramine 11 (formed from N-Dimethylethylenediamine)	0.0002	0.0000101	50.5

This assessment is based on each parent amine being emitted individually at the ELV for amines, which is a conservative assessment as in reality the amines will not be emitted at the ELV simultaneously. If the maximum likely emission concentrations are considered,

then the maximum impacts reduce significantly, with the maximum impact for direct and indirect nitrosamines and nitramines reducing to 12.5% and 4% of the ES.

Although the total nitrosamines and nitramines are not insignificant, due to the conservative assumptions included in the modelling and the PCs being considerably lower than the ES, it is considered that it is unlikely that the ES will be breached.

The results of the Applicant's additional modelling of methylethylamine and N-dimethylethylenediamine (the parent amines predicted to form the greatest quantity of nitrosamines and nitramines respectively), using the amines chemistry module, for the 2 x BECCS and Mid-merit scenarios (the most likely operating scenarios than the Core Scenario) are shown in table 4 below.

Table 4: Maximum combined indirect nitrosamine and nitramine concentrations

Pollutant	ES (µg/m³)	Process Contribution (PC) (µg/m³)	PC as % of ES
Methylethylamine 2 BECCS	0.0002 (NDMA)	0.0000965	48.2
Methylethylamine 2 BECCS & 2 Non-BECCS (4000 hrs)	0.0002 (NDMA)	0.0000794	39.7
N-dimethylethylenediamine 2 BECCS	0.0002 (NDMA)	0.000224	111.86
N-dimethylethylenediamine 2 BECCS & 2 Non-BECCS (4000 hrs)	0.0002 (NDMA)	0.000178	89.2

The results of the modelling shown in table 4 above are the predicted impacts from atmospheric formation of nitrosamines and nitramines from each parent amine if it was emitted individually at the emission limit. The Applicant states that it is not credible that either of these amines would ever be emitted at the emission limit, so the results are very conservative. The Applicant concluded that the risk of exceedance of the ES (based on NDMA) is very low, even when nitrosamines and nitramines combined are considered. This is based on:

- Maximum emissions of methylethylamine and N-dimethylethylenediamine are expected to be approximately 16% and <8% respectively of the emission limit value for total secondary & tertiary amines.

- The most prevalent secondary amine in the emissions is likely to be ethyl ethanolamine which is less reactive than these compounds (forms fewer nitrosamines and nitramines per g/s release).
- Consideration of the solvent composition, solvent degradation and amine volatility, meaning it is not plausible that emissions of methylethylamine or N-dimethylethylenediamine would occur continuously at, or even close to, the ELV with overall emissions meeting the ELV.
- The 2 x BECCS units operating scenario (with the greatest predicted impacts) is unrealistic.

5.2.3 Conclusions

In our review of the Applicant's assessment of the impacts from indirect emissions, we used the most conservative kinetic parameters and background ozone and NOx concentrations from a different monitoring station.

Based on our review of the Applicant's assessment and on our check modelling and sensitivity analysis, we consider that, although the total direct and indirect emissions of nitrosamines and nitramines are not insignificant, the emisisons are not predicted to exceed the ES.

We reviewed the Applicant's additional modelling for the more likely operating scenarios and agree with their conclusions. We agree that, although it is likely that Units 1 and 2 with the PCC plant (2 x BECCS scenario) will operate without Units 3 and 4 (Non-BECCS), it is not realistic that they would operate continuously throughout the year. Therefore, we consider that the Applicant has considered the worst-case and that the modelling is conservative.

5.3 Impact of emissions to air on ecological receptors

5.3.1 Sites Considered

The following Habitat sites - Special Areas of Conservation (SAC), Special Protection Areas (SPA), Ramsar - are located within 15km of the Installation and the following Sites of Special Scientific Interest (SSSIs) are located within 2km of the installation:

- River Derwent SAC/SSSI
- Thorne Moor SAC/SPA/SSSI
- Lower Derwent Valley SAC/SPA/Ramsar
- Skipwith Common SAC/SSSI
- Humber Estuary SAC/SPA/SSSI/Ramsar
- Breighton Meadows SSSI
- Eskamhorn Meadows SSSI
- Went Ings SSSI
- Barn Hills Meadows SSSI
- Burr Closes SSSI

In addition, the following SSSI, which is greater than 15km from the Installation, was also considered as it could be impacted:

- South Cliffe Common SSSI

The following non-statutory local wildlife and conservation sites are located within 2 km of the Installation:

- Common Plantation Ancient Woodland ("AWS")/ Local Wildlife Site ("LWS")
- Brockholes LWS
- Cobble Croft Wood AW/LWS
- Sandpit Wood and Barffs Close AW/LWS
- Barlow Common Local Nature Reserve ("LNR")

The Applicant has also included the following non-statutory sites as receptors in their assessment, although they are outside the screening distance:

- Orchard Farm Sites of Importance for Nature Conservation ("SINC")
- Barmby Pond LWS
- Hagg Green Lane SINC
- Barmby on the Marsh LWS

5.3.2 Assessment of Air Dispersion Modelling Outputs

The Applicant's modelling predicted pollutant concentrations at ecological receptors. We requested in our schedule 5 notice No4 dated 27/05/2025 that the Applicant model the impacts at an additional SSSI outside the screening distance, South Cliffe Common SSSI, as the isopleths included in the modelling report showed that the maximum point of impact for ammonia and acid and nitrogen deposition to be where this SSSI is located. We requested additional modelling in relation to acid deposition at the Thorne Moors SAC/SPA/SSSI in our fifth information notice dated 27/01/2026.

The impact of the pollutants from the PCC plant at the ecological receptors has been determined by treating the contribution from the amines as ammonia on the basis that they are all basic compounds with high solubility in water.

Table 5 below shows the concentrations based on the Core Scenario at the most impacted ecological receptors for NOx, SO_2, NH_3 and nitrogen deposition, which are:

- Lower Derwent Valley SPA/SAC
- Breighton Meadows SSSI
- Derwent Ings SSSI
- South Cliffe Common SSSI

and for acid deposition the most impacted ecological receptor is:

- Thorne Moor SAC/SPA/SSSI

Where emissions screen out as insignificant, the background pollutant levels are not considered within the assessment in accordance with our screening process.

Table 5: Predicted maximum ground level concentrations at ecological receptors						
Pollutant	EQS / EAL (µg/m³)	Back-ground (µg/m³)	Process Contribution (PC) (µg/m³)	PC as % of EQS / EAL	Predicted Environmental Concentration (PEC) (µg/m³)	PEC as % EQS / EAL
Direct Impacts[1]						
NO_x Annual	30	-	0.21	0.7	-	-
NO_x Daily Mean	75	-	4.84	6.4	-	-
SO_2 Annual	10	-	0.09	0.9	-	-
NH_3 Annual	3	1.93	0.01	0.3	-	-
NH_3 Annual	1	2.27	0.01	1	2.28	227.6
Deposition Impacts[1]						
N Deposition (kg N/ha/yr)	5	18.4	0.08	1.6	18.48	369.6
Acidification - Nitrogen Dep (Keq/ha/yr)	1.181	1.28	0.0181	1.5	1.3	121.8
Note 1: Direct impact units are µg/m³ and deposition impact units are kg N/ha/yr or Keq/ha/yr.						

The Applicant's modelling showed that the PCs for:

- Annual and daily mean NOx are <1% and <10% of the ES at all ecological receptors.
- Annual mean SO_2 are <1% of the ES at all ecological receptors.
- Annual mean ammonia are <1% of the ES at all ecological sites where the ES is 3 µg/m^3.
- Annual mean ammonia are <1% of the ES at most of the ecological receptors where the ES is 1 µg/m^3, except at Lower Derwent Valley SAC/SPA where the annual mean ammonia PCs are 1% of that ES and at South Cliffe Common SSSI where it is 1.1% of the ES.

- Nitrogen deposition are <1% at all ecological receptors, except at South Cliffe Common SSSI where the PC is 1.6% of the ES. And,
- Acid deposition are <1% at most ecological receptors except at Thorne Moor SAC/SPA/SSSI (1.08%) and South Cliffe Common SSSI (1.5%).

The Applicant's conclusions are as follows:

NOx

As the PCs are <1% and <10% of the critical loads at all ecological receptors, the Applicant concluded that emissions of NOx are insignificant.

SO_2

As the PCs are <1% of the critical loads at all ecological receptors, the Applicant concluded that emissions of SO_2 are insignificant.

Ammonia

The Applicant concluded that emissions of ammonia are insignificant at all ecological receptors except at South Cliffe Common SSSI.

The Applicant concluded that the PC is insignificant at the Lower Derwent Valley SAC/SPA (even though the PEC exceeds the critical level), on the basis of model uncertainty, the conservative critical level applied to the habitat site and the conservative assumption that all emissions will be at the emission limit of 10 mg/m^3 when the likely maximum concentration of ammonia from the PCC plant is <6 mg/m^3.

For the impacts of ammonia at South Cliffe Common SSSI, the Applicant concluded that the PEC exceeds the critical level due to the background which already exceeds the critical level. In addition, the Applicant concluded that there is no difference in the impact from the operation of the plant with PCC fitted to two units (Core Scenario – continuous operation of 2 x BECCS and 2 x Non-BECCS) and the operation without PCC (baseline scenario – continuous operation of 4 x Non-BECCS). The results of this are shown in table 6.

Table 6: Ammonia impacts at South Cliffe Common SSSI

Scenario	Pollutant	EQS / EAL ($\mu g/m^3$)	Back-ground ($\mu g/m^3$)	Process Contribution (PC) ($\mu g/m^3$)	PC as % of EQS / EAL	Predicted Environmental Concentration (PEC) ($\mu g/m^3$)	PEC as % EQS / EAL
Baseline	Ammonia	1	2.2	0.01	1.1	3.3	330
Core	Ammonia	1	2.2	0.01	1.1	3.3	330
Difference	Ammonia	-	-	0	0	0	0

Nitrogen deposition

The Applicant concluded that nitrogen deposition is insignificant at all ecological receptors, except at South Cliffe Common SSSI.

The Applicant carried out sensitivity analysis on the operating scenarios for nitrogen deposition at South Cliffe Common SSSI, including the baseline without PCC plant. The Applicant states that the Core Scenario is not a realistic operating scenario but represents the worst case as the results of the modelling for continuous operation of 2 x BECCS units only and for continuous operation of 2 x BECCS units and 4000 hours per year of 2 x Non-BECCS units (mid-merit scenario) are lower. For the more realistic mid-merit scenario the nitrogen deposition is <1% of the ES and is insignificant. The Applicant also concluded that the difference between the PC of the Core Scenario compared to the baseline without PCC is <1% of the critical load so the operation of the PCC plant is insignificant compared with the existing operation without PCC – see table 7.

Table 7: Nitrogen deposition at South Cliffe Common SSSI

Scenario	Pollutant	EQS / EAL Note 1	Back-ground Note 1	Process Contribution (PC) Note 1	PC as % of EQS / EAL	Predicted Environmental Concentration (PEC) Note 1	PEC as % EQS / EAL
Baseline	N Deposition	5	18.2	0.06	1.3	18.26	365.3
Core	N Deposition	5	18.2	0.08	1.6	18.28	369.9
Difference	N Deposition	-	-	+0.02	0.3	-	-

Note 1: Deposition impact units are kg N/ha/yr or Keq/ha/yr.

Acid deposition

The Applicant concluded that acid deposition is insignificant at all ecological receptors except at Thorne Moor SAC/SPA/SSSI and South Cliffe Common SSSI. Although the PEC for total deposition exceeds the critical loads, the Applicant concludes this is due to the background deposition rather than a contribution from the site, and the Applicant stated that the operations contribute less than 1% of the total deposition.

The Applicant carried out sensitivity analysis on various operating scenarios and compared these to the baseline, without PCC This modelling showed that the Core Scenario predicted the highest impacts at ecological receptors, with the PCs for the Core and Mid-merit Scenarios exceeding 1% of the critical loads at Thorne Moor SAC/SPA/SSSI and at South Cliffe Common SSSI.

The Applicant stated that the Core Scenario is not a realistic operating scenario (although it does represent the worst case) and that the mid-merit and 2 x BECCS only scenarios, the more likely operating scenarios, predict lower acid deposition PCs. However, the PCs are still greater than 1% for the Mid-merit Scenarios at the Thorne Moor SAC/SPA/SSSI and South Cliffe Common SSSI.

The Applicant considered that although the impacts on acid deposition at the Thorne Moor SAC/SPA/SSSI when SO_2 is reduced to the long term annual average concentration are in the range 0.9% to 1.1% (when rounded up) of the critical load for all the scenarios, these results are conservative since:

- Emissions of pollutants that contribute to acid deposition other than SO_2 are assumed to be at their ELVs at all times, which is not realistic.
- Plume depletion is ignored i.e. the deposition of pollutants is calculated in the post-processing of model results using a deposition velocity approach. This, in effect, ignores the removal of some pollutant from the plume by its deposition to the surface, both over designated sites and as the plume travels between the emission point and the designated sites. This, in turn, results in an overestimation of pollutant concentrations and deposition over designated sites. This is particularly conservative for highly reactive gases such as HCl, SO_2 and NH_3 which deposit readily to vegetated surfaces.
- Impacts are reported at the point of maximum impact over the whole site, whereas site wide average emissions are approximately 20% lower. And
- Impacts are reported as the worst annual mean across the 5 years, whereas the 5-year average is over 20% lower again.

The Applicant concluded that the installation of carbon capture will have an insignificant impact on acid deposition over Thorne Moor SAC/SPA/SSSI. In addition to the consideration that the modelling is conservative, the Applicant based their conclusion on the following:

- Emissions of SO_2 and other reactive gases will be reduced in the future due to the flue gas treatment prior to carbon capture.
- Existing operations at Drax are included within the APIS estimates of deposition.
- Assessed on a like for like basis, e.g. continuous full load operation, the future process contribution to acid deposition on Thorne Moor will be imperceptibly different from existing operations.
- The maximum Process Contribution from Drax when modelled with realistic, but conservative, estimates of SO_2 emissions is insignificant, even without discounting for existing operations.

The Applicant concluded that although the results of the modelling of acid deposition at South Cliffe Common SSSI show the PEC to have widespread exceedance of the relevant critical load, this is a function of background deposition resulting from long range transport and local sources other than Drax and occurs irrespective of the contribution of Drax. The Applicant states that this is shown by comparing the acid deposition PCs for all the scenarios with carbon capture with the baseline scenario, with no carbon capture, as the increase in impact is <1% and concludes, therefore, that the impact is insignificant.

5.3.3 Conclusions

We carried out check modelling and sensitivity analysis and agree that the Core Scenario is the worst case for impacts at ecological receptors. We agree with the Applicant's modelling that shows that at all ecological sites the long- and short-term PCs are insignificant, except at the Thorne Moor SAC/SPA/SSSI, where the acid deposition PC exceeds 1% of the critical load and at South Cliffe Common SSSI where the nitrogen and acid deposition PCs exceed 1% of the critical loads. For both nitrogen and acid deposition at these receptors the background already exceeds the critical loads.

Based on the Applicant's comparison of the impacts of emissions on Thorne Moor SAC/SPA/SSSI and South Cliffe Common SSSI with the baseline operating scenario, without PCC, it is considered that the impact from the operation of the PCC plant is insignificant. However, the PCs still exceed the insignificance criteria of 1%.

Thorne Moor SAC/SPA/SSSI
In relation to the interest features - nightjar of the Thorne Moor SPA, information on APIS states that these are not sensitive to acid deposition so the impact on the SPA is not considered further.

Based on the results of the Applicant's additional modelling of acid deposition, we agree that the modelling is conservative based on the considerations provided by the Applicant. We therefore consider that the likely impact of acid deposition on the interest features of the Thorne Moor SAC/SSSI is insignificant.

South Cliffe Common SSSI
We do not consider that emissions will have a significant impact on nitrogen deposition as the nitrogen deposition PC for the more likely operating scenario (2 x BECCS & 2 x Non-BECCS) is <1% of the critical load.

The sensitive features (invertebrate assemblage and lowland dry heath) are sensitive to acid deposition. However, the invertebrate assemblage is in favourable condition, and the lowland dry heath is recovering according to the last condition assessment in 2020, so it does not appear that the exceedance of the critical load is causing damage to the SSSI. In addition, Natural England have not listed air pollution as a pressure for this SSSI.

Therefore, given that the predicted deposition levels from the proposal are relatively small and the existing declining background load does not appear to be causing the sensitive

features to decline in condition, it can be concluded that an increase of 0.1% in the contribution of acid deposition from the proposal, core scenario, compared with the baseline would not cause any damage to the SSSI or its features.

5.3.4 Consultation with Natural England

We consulted Natural England on 15/12/2025 on the Applicant's assessment of impact from air emissions on ecological receptors and they agreed with our conclusions that:

- There could be an adverse impact on the Thorne Moor SAC from acid deposition.
- There would be no adverse impact on all other SAC, SPA and Ramsar sites from all other emissions.
- The proposal is likely to damage the Thorne Moor SSSI due to acid deposition. And
- All other emissions from the proposal are unlikely to damage all other SSSIs.

We reconsulted Natural England on 13/03/2026 on the Applicant's reassessment of the impacts of acid deposition on the Thorne Moor SAC and SSSI. In their response dated 27/03/2026 Natural England agreed with our conclusion, based on the additional information submitted by the Applicant, that there would be no adverse impact on the Thorne Moor SAC and the proposal is not likely to damage the Thorne Moor SSSI.

5.4 Impact of venting of carbon dioxide (CO_2)

Although the Applicant provided information in the Application and in response to our information notices regarding the assessment of the impact of venting of CO_2, we were not satisfied that the risks had been fully assessed. In addition, our approach to assessing the impacts of CO_2 venting changed during the determination of this Application and we no longer required applicants to submit modelling of the CO_2 venting with their applications. We now require that Applicants use modelling to inform the design of the CO_2 vent and have measures in place to manage the venting of CO_2 so that the risks to human health off-site and the environment from the venting of CO_2 is minimised.

We requested a revised CO_2 Venting Risk Assessment in our fourth information notice, and the Applicant provided a revised assessment on 12/09/2025. The Applicant considered the following in their assessment:

- An overview of the CC process and the conditioning of the CO_2 once captured.
- The potential pipeline conditions.
- The venting strategy and scenarios where CO_2 may be vented.
- The results of modelling of the different scenarios including potential locations, pressure, temperature, height, diameter of the vent stack.
- Identification of potential off-site receptors.
- Details of the software used in the modelling and the input parameters.

- An overview of the hazardous nature of CO_2 if vented with reference to HSE guidance. And
- Information regarding the assumptions made and the uncertainty in the modelling.

The Applicant concluded that the maximum potential exceedance of the standard would occur for high pressure venting from a single PCC plant, that the assessment is robust and precautionary and that the results show there is a low risk that human receptors outside the boundary of the site would experience mild but transient effects and that the general population would experience no significant health effects.

We reviewed the assessment provided by the Applicant and consider that it is reasonable and has adequately addressed the risks from venting of CO_2. However, as CO_2 venting is also a safety issue and the Applicant is relying on safety devices to control the venting, we consulted with the HSE on 27/10/2025. We did not receive a response.

The risk assessment provided in response to our fourth information notice is based on the Applicant's information to date. The Applicant acknowledged in the assessment that further assessment would be required at the final design stage. We have, therefore, included a Pre-Operational Condition ("PO38") in the varied Permit requiring a revised risk assessment and Venting Management Plan to be submitted prior to commissioning and operation of the PCC.

5.5 Other Emissions to the Environment

5.5.1 Emissions to Water

As described in section 4.2.2, water is used within the carbon capture process in a number of ways, but the use of water is minimised by the re-use and re-circulation of water in the system, thereby limiting the required discharge to surface water. Any water that has come into contact with the amine solvent and its breakdown products will not be discharged to surface water.

Currently, the Applicant discharges cooling water, rainwater, river sludge and FGD effluents to the River Ouse at discharge point W1. The PCC system has been designed on the basis that there is no deterioration of the discharge at W1. As coal is no longer burnt and should the Applicant decide to proceed with the PCC, the FGD system will be removed and there will no longer be a discharge from the ETP treating the wastewater from the FGD system. However, the Applicant is proposing to install a new ETP to treat waste waters from the quencher tower (as described in section 4.2.1) and, although most of the treated wastewater will be discharged to the cooling water system, some effluent will be discharged at W1.

The Applicant has stated that the treatment of the effluent from the quencher tower in the ETP will be carried out to the same BAT AELs as for the current ETP that treats effluent from the FGD system. This is considered to be a conservative approach as the BAT AELs for treatment of FGD effluent are tighter than the BAT AELs in the Waste Treatment BAT Conclusions, which would otherwise be applicable. This means that the impact on the River Ouse will be no different with the operation of the PCC compared to now as the

effluent will meet the current limits set out in the Permit. These limits will remain in the varied Permit.

Currently rainwater collected at the site is a pumped operation to the 'purge' and the drainage is discharged at point W1. With the installation of the PCC units, some of the rainwater gullies will need to be diverted. It is proposed that collected rainwater is discharged to the cooling water system in order to reduce the amount of abstracted water required, albeit by a very small amount. In the event that the cooling system is not operational, the rainwater system will still allow the collected rainwater to be discharged to the River Ouse at point W1 as currently happens. The quality of the collected rainwater run-off will be no different to that collected now as areas of storage of solvent and other chemicals have their own sealed drainage systems which are isolated from the rainwater system, see section 5.5.3. Therefore, there is no change to the quality of the discharge at point W1.

Based on the information in the Application and in the responses to our requests for further information, we are satisfied that emissions to water from the operation of the PCC units are no different to those allowed under the current Permit and, therefore, there will not be a change to the impact on the River Ouse.

5.5.2 Noise Impacts

The Applicant provided a noise impact assessment in the Application which identified local noise-sensitive receptors, potential sources of noise from the proposed carbon capture plant and noise attenuation measures. Measurements were taken of the prevailing ambient noise levels to produce a baseline noise survey, but these were taken whilst the power station was in operation, so the background level was taken to be that at one receptor where the noise from the existing power station was not audible. A number of mitigation measures are anticipated to be required to control sound emissions, including enclosures, silencers and attenuators and the specifications for these are included in the assessment. However, the final design of the carbon capture plant is not completed so these measures could change.

The Applicant carried out an assessment in accordance with BS4142:2014 to compare the predicted plant rating noise levels with the established background levels.

The Applicant's assessment concluded that the carbon capture plant is unlikely to increase the level of impact from noise at any of the nearby residential receptors. It was also concluded that there are numerical impacts from the operation of the existing power station at some receptors equivalent to significant adverse impacts.

We audited the Applicant's assessment and agreed with the conclusion that the operation of the carbon capture plant will not change the overall impact of noise from the existing operations. We also agreed with the conclusion that the current numerical noise levels show a significant adverse impact. We agreed with the conclusions on the basis of the Applicant achieving the assumed design targets for sound levels of equipment and installation of appropriate mitigation measures. However, as carbon capture is an emerging technology, we have not been able to verify the sound power levels of the equipment used in the assessment.

Although the predicted sound levels from the existing operation of the power station show a significant adverse impact at residential receptors, we have not received any complaints about noise form the site since its operation commenced in the 1970s. The Permit already has a condition, 3.4.2, that requires the Operator to produce a noise management plan if requested by us due to noise pollution being detected outside the site. This condition will be retained in the varied Permit.

As carbon capture is a novel technology and the design of the equipment has not been finalised, we have included a pre-operational condition in the varied Permit (table S1.4, PO35) that requires the Operator to submit to us for approval a new Noise Impact Assessment based on the final design of the carbon capture plant. At this point we can review the noise impacts from the Operator's final plant design, and we will not approve the proposals unless we are satisfied that noise impacts from the carbon capture plant will not change the current impacts.

5.5.3 Fugitive emissions

The Applicant has provided information regarding the storage and bunding of the raw materials that will be required for the operation of the PCC units. Tanks with the same substances will be co-located within a single bunded area. Tanks containing incompatible substances will have their own individual bunds. Bunds will be designed in accordance with our guidance and CIRIA guidance for storage of solvents and other materials and will meet the required capacity. The bunds will contain a sump for collection of rainwater and spills and effluent from these sumps will be tested prior to being pumped either to the water system where it is uncontaminated or into a collection tank prior to off-site disposal where it is contaminated.

The Applicant has confirmed that the solvent to be used in the carbon capture process is a substance that has Carcinogenic, Mutagenic or Reproductive toxic ("CMR") properties. The Applicant has reviewed the proposals for the storage and handling of the CRM solvent against the requirements in the Emissions from Storage BRef and, although they have not provided the final details of the measures to be taken for the storage and handling of the CRM solvent, they have confirmed that they will store and handle the CRM solvent in accordance with the BRef requirements. We have included a pre-operational condition in the varied Permit (PO34) that requires the Operator to provide the details of measures they will take to store and handle the solvent before commencement of operations.

We are satisfied that the Applicant will design the storage and bunding of, and handle, raw materials so as to prevent and contain emissions of potentially polluting substances.

5.6 Impact of other proposed changes

In addition to the proposal to add PCC to Units 1 and 2, the Applicant has proposed some other changes to the operation of, and the infrastructure at, the site, some of which are related to the installation of the PCC. These are discussed below.

5.6.1 Removal of Ouse Renewable Energy Plant

The Permit currently includes the Ouse Renewable Energy Plant LCP as part of the permitted combustion activity. The Applicant has stated that there is now no intention to

construct and operate this LCP and has applied to remove it from the Permit as part of this Application.

We are satisfied that it can be removed from the Permit as no construction has commenced. Therefore, all references to this LCP and associated monitoring requirements and improvement and pre-operational conditions have been removed in the varied Permit.

5.6.2 Infrastructure changes to allow operation of the PCC

The current Permit allows Units 5 and 6 to burn coal. This has now ceased, but could restart under certain conditions, such as instruction from the government. If the Applicant does decide to fit PCC to Units 1 and 2 as proposed in this Application, then some of the space currently utilised by Units 5 and 6 and their associated infrastructure will be required to allow construction of the PCC. Units 5 and 6 will be permanently closed and the Sulphur Trioxide (SO_3) injection and electrostatic precipitators systems for Units 5 and 6 will be removed as will the FGD plant.

The wastewater treatment plant for the treatment of effluent from the quencher (treating flue gases prior to entry to the PCC) will be installed to replace the existing treatment plant that treats effluent from the FGD plant should the Applicant proceed with installation of PCC to Units 1 and 2. In order to allow flexibility for the Operator, we have amended table S1.1 of the varied Permit to say that either the existing treatment plant can operate or the proposed treatment plant for the PCC, and not both at the same time. This allows the Operator to replace the existing wastewater treatment plant with the new one related to the PCC should they decide to progress the installation of the PCC but also allows the existing treatment plant to be retained in the event that PCC is not installed.

As the installation of the PCC units is dependent on a number of factors including development of a business model by the UK government to support the economics of these projects, Units 5 and 6 will be maintained with associated systems and controls so that they can be utilised for combustion with an alternative fuel to coal, or with coal, in the event PCC does not progress to construction.

To allow the flexibility within the Permit required by the Applicant regarding Units 5 and 6, we have not removed coal as a permitted fuel or the associated emission limits and monitoring requirements in the varied Permit. We have, however, stated that Units 5 and 6 are not operational in table S1.1 of the varied Permit.

We are satisfied that the changes described above to the varied Permit will allow the installation of the PCC and, if the Operator decides to not install PCC, will allow the Operator to burn coal or, following a variation to the Permit, an alternative fuel.

5.6.3 Changes to bottom ash handling

Currently there is one ash pit per combustion unit (six in total). Coal is no longer burnt in Units 5 and 6 and the amount of ash generated by the burning of biomass is less than that produced from burning coal, so the space required to store ash is reduced. The installation of the PCC units will require some of the ash pits to be demolished to make space for the PCC system. Therefore, should PCC go ahead, ash pits 3, 4, 5 and 6 will be demolished and changes will be made to the ash delivery system so that ash from Units 1 to 4 will all

be delivered to ash pits 1 and 2. However, if PCC does not go ahead, there will be no need to demolish pits 3 to 6 and they will remain.

The Applicant provided an assessment of the risk from the changes to ash handling, and we are satisfied that should the PCC go ahead, ash handling will be carried out without causing an impact to receptors outside the site boundary. In addition, we have included a pre-operational measure PO43 in table S1.4 of the varied Permit that requires the Operator to provide a decommissioning plan for the removal of the ash pits should PCC go ahead.

5.7 Summary of assessment of environmental impact

Based on our review of the environmental impact assessments submitted with the Application, we are satisfied that the PCC plant will be operated without causing an impact on human health and the environment and that the proposals are BAT in accordance with our emerging techniques guidance.

As this is emerging technology, we have included various improvement and pre-operational conditions in the varied Permit (see Annex 2 of this document) requiring the Operator to review the final design of the PCC plant and use monitoring data recorded during the actual operation of the site to confirm the assumptions made in the risk assessments submitted with the Application. In the unlikely event that these reviews do not confirm that there is no risk of significant impact, we will take further action to address this.

6. Application of Best Available and Emerging Techniques

6.1 Scope of Consideration

In this section, we explain how we have determined whether the Applicant's proposals:

- Are in accordance with our guidance on the emerging techniques, or equivalent, for the carbon capture sector.
- For the generation of hydrogen to be used to refine the CO_2 prior to discharge to the pipeline are in accordance with our guidance on the emerging techniques for that activity, And
- Will ensure the combustion plant continue to meet BAT for the combustion sector.

6.2 Post- combustion Carbon Dioxide Capture Emerging Techniques

We have reviewed the Application against the Post-combustion carbon dioxide capture emerging techniques guidance Post-combustion carbon dioxide capture: emerging techniques - GOV.UK (www.gov.uk).

The Applicant's response to each technique is set out in Annex 1A of this decision document together with our assessment of whether the Applicant is compliant with the relevant emerging techniques.

6.3 Hydrogen Production by Electrolysis Emerging Techniques

We have reviewed the Application against the Hydrogen production from electrolysis of water emerging techniques guidance Hydrogen production by electrolysis of water: emerging techniques - GOV.UK (www.gov.uk).

The Applicant's response to each technique is set out in Annex 1B of this decision document together with our assessment of whether the Applicant is compliant with the relevant emerging techniques.

6.4 Consideration of Combustion Plant BAT

The fitting of plant to capture the CO_2 from the flue gases from the combustion plant can affect the operation of the combustion plant. However, the Operator is still required to meet the BAT requirements as set out in the LCP BAT C. In this section we consider the issues that could change as a result of the deployment of PCC on Units 1 and 2 and whether the Operator will still be compliant with the LCP BAT C. For all other aspects of the operation of the combustion plant, we consider that there will be no change as a result of PCC on Units 1 and 2 and the Operator will remain compliant, so these are not considered further.

6.4.1 Energy Efficiency

An energy efficiency level associated with the best available techniques (BAT-AEEL) refers to the ratio between the combustion unit's net energy output(s) and the combustion unit's fuel/feedstock energy input at actual unit design. The net energy output(s) is determined at the combustion unit boundaries, including auxiliary systems (e.g. flue-gas treatment systems), and for the unit operated at full load.

We have not re-visited the use of energy within the combustion system, the applicability of the combined heat and power guidance or the extent to which the Installation meets the requirement of Article 14(5) of the Energy Efficiency Directive as these were determined when the Permit was issued and are not material to the determination of this Application. However, we have reviewed the energy efficiency of the Installation as a whole as the deployment of PCC on Units 1 and 2 can affect the efficiency.

The Applicant has stated that it is well understood that the deployment of PCC systems will require energy so there will be an energy penalty. The Applicant states that they have used substantial resources to develop a heat integration system that will minimise the electrical output penalty from the deployment of the PCC.

The Applicant estimates the current and proposed energy performance and electrical efficiency with the deployment of PCC on Units 1 and 2 to be as follows:

Estimated Plant Performance		**Unit**
Gross Net output for LCP BREF	645	MW
CO2 capture per hour (full load, stable conditions, design basis)	550	t/hr
Electrical output penalty for heat supply and power	192	MW_e
Gross Net output with PCC	453	MW_e
Efficiency with PCC and Compression	27.8	%

The BAT AEELs for electrical efficiency for plant burning solid biomass or peat as set out in the LCP BAT C are in the range 28-38% for existing plant, although currently there is no

specific BAT AEEL for combustion plant with PCC. The stated electrical efficiency just meets the lower limit in the range (taking account of uncertainty and decimal points).

Therefore, we are satisfied that the operation of Units 1-4 with two PCC units fitted will still meet the BAT AEELs for LCPs burning solid biomass.

The Operator is required to report energy usage and energy generated under condition 4.2 and table S4.2 in Schedule 4 of the current Permit. This requirement will not change as a result of this variation Application.

6.4.2 Emission limits

The Operator is still required to comply with BAT AELs and Emission Limit Values (ELV) set out in the Permit for all combustion units following the deployment of PCC on Units 1 and 2 and abatement measures used to meet these limits will still be in place. Therefore, the limits already specified in table S3.1 of the current Permit will remain and are set in tables S3.1a and S3.1b of the varied Permit.

The Applicant has provided information regarding where monitoring will take place to demonstrate compliance with the ELVs and BAT AELs from the combustion plant both with and without CO_2 capture (see section 8) and we are satisfied that the Operator will have measures in place to comply with the BAT AELs and ELVs in the flue gases from the combustion of biomass.

7. Emission limits

7.1 Emission limits to air in abated mode

We have set emission limits to air for when Units 1 and 2 are operating in CO_2 abated mode in table S3.1a of the varied Permit. The limits will apply to the treated exhaust gases arising from Units 1 and 2 emitted from the PCC plant via the main stack and arising from Units 3 and 4 emitted through the main stack.

The emission limits are based on the Applicant's concentrations used in the air dispersion modelling. The emission limits for the parameters released from combustion remain unchanged from the existing Permit.

We have included the following emission limits for the parameters released from the PCC in the varied Permit:

Parameter	Reference Period	Permit limit
Ammonia	Average over the sampling period	10 mg/m^3
Total Amines	Average over the sampling period	4 mg/m^3
Total Amides	Average over the sampling period	1 mg/m^3
Total nitrosamines	Average over the sampling period	0.003 mg/m^3
Total nitramines	Average over the sampling period	0.0005 mg/m^3
Acetaldehyde	Average over the sampling period	15 mg/m^3
Formaldehyde	Average over the sampling period	2 mg/m^3

7.2 Emission limits to air in unabated mode

There is no change to the BAT AELs and ELVs for the parameters produced as a result of the combustion of biomass and coal. These are specified in table S3.1b of the varied Permit for Units 1 to 6.

7.3 Emission limits to air for other combustion plant

There is no change to the BAT AELs and ELVs for the parameters emitted from LCP 454 (gas turbine fired on gas oil) at emission point A2 or for the auxiliary boilers 4 and 5 at emission points A4 and A5. These limits are specified in table S3.1c of the varied Permit.

7.4 Emission limits to water

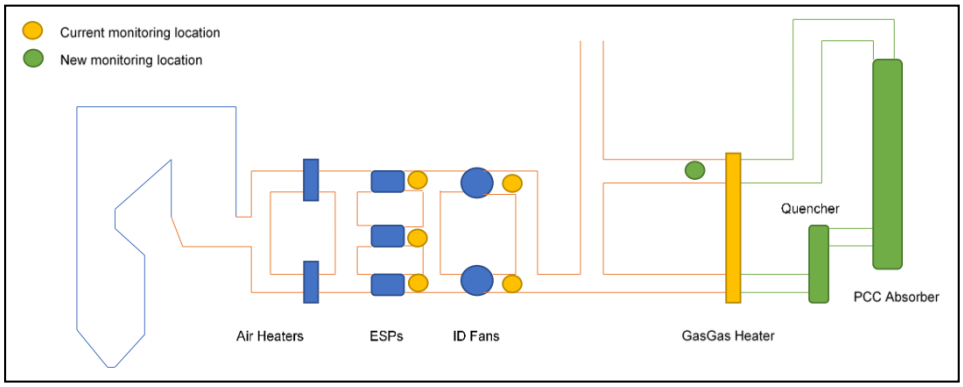
There is no change to the emission limits for emissions to water as a result of the Application. These are specified in table S3.2 of the varied Permit.

8. Monitoring and Reporting

8.1 Emissions to air

The Operator is still required to meet the emission limits and BAT AELs for emissions to air following the fitting of PCC units. Post-absorber gases (combustion flue gases with the CO_2 removed) will be directed to the existing stack for discharge to air. Currently the flue gases are monitored at locations prior to entry into the PCC system so, should the flue gases from Units 1 and 2 by-pass the PCC units and be discharged via the main stack (as currently occurs), the Operator can demonstrate compliance with the ELVs and BAT AELs specified in the Permit.

A new monitoring location and a Continuous Emissions Monitoring system ("CEM") will be located in the flue between the PCC absorber column and the main stack for each unit so the Operator can monitor compliance post-PCC and prior to discharge via the main stack. However, as monitoring for the LCP BAT AELs and ELVs will take place prior to the flue gases entering the PCC system the Operator can demonstrate that flue gases compliant with the BAT AELs and combustion ELVs will enter the PCC system. The locations of the proposed emission points are shown in the following schematic:



As described in section 7.1 above, we have set emission limits for total amines, total amides, total nitrosamines and total nitramines in table S3.1a of the varied Permit. We

have specified monitoring in table S3.1a of the varied Permit for a range of pollutants based on the KS21 solvent and the degradation products that may be formed following chemical reactions resulting from the CO_2 abatement of the flue gas within the PCC. The Operator is required to monitor these pollutants in order to determine the total concentrations, as follows:

Parameter		**Reference Period**
Total Amines	Ethylamine (CAS No. 75-04-7)	Average over the sampling period
	Methylamine (CAS No. 74-89-5)	
	Monoethanolamine (CAS No.141-43-5)	
	Diethanolamine (CAS No.111-42-2)	
	Diethylamine (CAS No.109-89-7)	
	Dimethylamine (CAS No.124-40-3)	
	Ethyl ethanolamine (CAS No.110-73-6)	
	Ethyl methylamine (CAS No.624-78-2)	
	Piperazine (CAS No.110-85-0)	
	N-Dimethylethylenediamine (CAS No.108-00-9)	
	Ethyl diethanolamine (CAS No.139-87-7)	
Total Amides	N-(2-hydroxyethyl) acetamide (CAS No.142-26-7)	Average over the sampling period
	N-(2-hydroxyethyl) formamide (CAS No.693-06-1)	
Total nitrosamines	N-Nitrosomethylethylamine (CAS No.10595-95-6)	Average over the sampling period
	N-Ethyl-N-(2-hydroxyethyl) nitrosamine (CAS No.13147-25-6)	
	N-Nitrosodimethylamine (CAS No.62-75-9)	
	1-Nitrosopiperazine (CAS No.5632-47-3)	
	N-Nitrosodiethylamine	

Parameter		Reference Period
	(CAS No.55-18-5)	
	N-Nitrosodiethanolamine (CAS No.1116-54-7)	
	N-Nitrosomorpholine (CAS No.59-89-2)	
	1,4-Dinitrosopiperazine (CAS No.140-79-4)	
Total nitramines	2-(Ethylnitroamino) ethanol (CAS No. 217089-38-8)	Average over the sampling period
	1-Nitropiperazine (CAS No.42499-41-2)	

Monitoring in relation to emissions to air from the unabated flue gases (those still containing CO_2) remain unchanged.

We are satisfied that the Applicant has considered the requirement to continue to monitor emissions to air from the combustion plant with and without the PCC system in order to demonstrate compliance with LCP BAT AELs and ELVs specified in the Permit. As the final design has not yet been confirmed, we have included a pre-operational condition PO32 in table S1.4 of the varied Permit, which requires the Operator to submit the final design and location of the monitoring points and to confirm that the monitoring system is in accordance with our relevant guidance. In addition, we have set improvement condition IC52D in table S1.3 of the varied Permit that requires the Operator to assess whether the monitoring locations are in accordance with our guidance during the commissioning of the PCC plant.

Reporting of monitoring of emissions to air is specified in the varied Permit in table S4.1. Reporting for the unabated flue gases remains unchanged. We have required reporting of monitoring of emissions from the PCC every three months.

8.2 Emissions to water

There is no discharge to water directly from the PCC and as the ETP that treats water from the quencher tower has been designed to treat water to a standard to meet the limits specified in the current Permit, we have not changed the monitoring or reporting requirements in the varied Permit.

8.3 Carbon capture plant performance

We have included process monitoring requirements in the varied Permit covering the operation of the PCC plant. The monitoring concentrates on ensuring that solvent quality is monitored and maintained to ensure that CO_2 capture rates are optimised and degradation products (e.g. amines, nitrosamines and nitramines) are minimised. Iron and stable salt build up in the solvent can give an indication of plant corrosion and can lead to amine solvent degradation which may affect carbon capture performance. We have, therefore, required the Operator to routinely monitor the solvent quality for iron content, heat stable salts, colour changes in the amine solvent and degradation products including, but not

limited to, amines, nitrosamines, nitramines (in absorber amine prior to reclaiming and after reclaiming). There is evidence of yellowing of amine solvents as iron levels build up and as the solvent ages.

With regards to carbon capture efficiency, the purpose of a post combustion carbon capture plant is to maximise the capture of CO_2 emissions it receives. Operators should aim to achieve a design CO_2 capture rate of at least 95%, although operationally this can vary, up or down. The Applicant has stated in the Application that the PCC plant has been designed to capture 95% of the CO_2 in the flue gas from Units 1 and 2 during steady state 'normal' operation. In order to assess whether CO_2 capture is maximised, monitoring and reporting requirements have been included in the varied Permit. Pre-operational condition PO33 in table S1.4 includes a requirement for the Operator to provide a methodology for approval to demonstrate the carbon capture efficiency of the plant. This approved methodology will then be used to measure carbon capture efficiency as required in table S3.4 of the varied Permit.

We have also included improvement condition IC54D, requiring the Operator to provide a report on carbon capture efficiency under normal operations after the first 12 months of operation.

9. Other legal requirements

In this section we explain how we have addressed other relevant legal requirements, to the extent that we have not addressed them elsewhere in this document.

9.1 The EPR 2016 and related Directives

The EPR delivers the requirements of a number of assimilated and national laws.

9.1.1 Schedules 1 and 7 to the EPR 2016 – IED Directive

We address the requirements of the IED in the body of this document.

There is one requirement not addressed above, which is that contained in Article 5(3) IED. Article 5(3) requires that "In the case of a new installation or a substantial change where Article 4 of Directive 85/337/EC (now Directive 2011/92/EU) (the EIA Directive) applies, any relevant information obtained or conclusion arrived at pursuant to articles 5, 6 and 7 of that Directive shall be examined and used for the purposes of granting the permit."

- Article 5 of EIA Directive relates to the obligation on developers to supply the information set out in Annex IV of the Directive when making an application for development consent.
- Article 6(1) requires Member States to ensure that the authorities likely to be concerned by a development by reason of their specific environmental responsibilities are consulted on the Environmental Statement and the request for development consent.
- Article 6(2)-6(6) makes provision for public consultation on applications for development consent.

- Article 7 relates to projects with transboundary effects and consequential obligations to consult with affected Member States.

The grant or refusal of development consent is a matter for the relevant local planning authority. The Environment Agency's obligation is therefore to examine and use any relevant information obtained or conclusion arrived at by the local planning authorities pursuant to those EIA Directive articles.

In determining the Application, we have considered the following documents:

- The Environmental Statement submitted with the development consent order application (which also formed part of the Environmental Permit variation Application).
- The decision of the Secretary of State to grant development consent on 16/01/2024.
- The report and decision notice of the Secretary of State accompanying the grant of the development consent.
- The response of the Environment Agency to the Planning Inspectorate in its role as consultee to the development consent order process.

From consideration of all the documents above, the Environment Agency considers that no additional or different conditions are necessary.

The Environment Agency has also carried out its own consultation on the Environmental Permit variation Application which includes the Environmental Statement submitted to the Planning Inspectorate. The results of our consultation are described elsewhere in this decision document.

9.1.2 Schedule 22 to the EPR 2016 – Water Framework and Groundwater Directives

To the extent that it might lead to a discharge of pollutants to groundwater (a "groundwater activity" under the EPR 2016), the varied Permit is subject to the requirements of Schedule 22, which delivers the requirements of EU Directives relating to pollution of groundwater. The varied Permit will require the taking of all necessary measures to prevent the input of any hazardous substances to groundwater, and to limit the input of non-hazardous pollutants into groundwater so as to ensure such pollutants do not cause pollution and satisfies the requirements of Schedule 22.

No releases to groundwater from the Installation are permitted. The varied Permit also requires material storage areas to be designed and maintained to a high standard to prevent accidental releases.

9.1.3 Directive 2003/35/EC – The Public Participation Directive

Regulation 60 of the EPR 2016 requires the Environment Agency to prepare and publish a statement of its policies for complying with its public participation duties. We have published our public participation statement.

This Application was consulted upon in line with this statement, as well as with our guidance RGN6 on Sites of High Public Interest, which addresses specifically extended consultation arrangements for determinations where public interest is particularly high. This satisfies the requirements of the Public Participation Directive.

Our decision in this case has been reached following a programme of extended public consultation, both on the original Application and the response to the first schedule 5 notice and later, separately, on the draft varied Permit and a draft decision document. The way in which this has been done is set out in Sections 2.2, 2.4 and 2.5 of this document. A summary of the responses received to our consultations and our consideration of them is set out in Annex 3.

9.2 National primary legislation

9.2.1 Environment Act 1995

(i) Section 4 (Pursuit of Sustainable Development)

We are required to contribute towards achieving sustainable development, as considered appropriate by Ministers and set out in guidance issued to us. The Secretary of State for Environment, Food and Rural Affairs has issued *The Environment Agency's Objectives and Contribution to Sustainable Development: Statutory Guidance (December 2002)*. This document:

> "*provides guidance to the Agency on such matters as the formulation of approaches that the Agency should take to its work, decisions about priorities for the Agency and the allocation of resources. It is not directly applicable to individual regulatory decisions of the Agency*".

In respect of regulation of industrial pollution through the EPR, the Guidance refers in particular to the objective of setting permit conditions "*in a consistent and proportionate fashion based on Best Available Techniques and taking into account all relevant matters…*". The Environment Agency considers that it has pursued the objectives set out in the Government's guidance, where relevant, and that there are no additional conditions that should be included in this varied Permit to take account of the Section 4 duty.

(ii) Section 5 (Preventing or Minimising Effects of Pollution of the Environment)

We are satisfied that our pollution control powers have been exercised for the purpose of preventing or minimising, remedying or mitigating the effects of pollution.

(iii) Section 6(1) (Conservation Duties with Regard to Water)

We have a duty to the extent we consider it desirable generally to promote the conservation and enhancement of the natural beauty and amenity of inland and coastal waters and the land associated with such waters, and the conservation of flora and fauna which are dependent on an aquatic environment.

We consider that no additional or different conditions are appropriate for this varied Permit as there are no changes to the discharge to surface water as a result of this Application.

(v) Section 7 (General Environmental Duties)

This places a duty on us, when considering any proposal relating to our functions, to have regard amongst other things to any effect which the proposals would have on sites of archaeological, architectural, or historic interest; the economic and social well-being of local communities in rural areas; and to take into account any effect which the proposals

would have on the beauty or amenity of any rural or urban area or on any such flora, fauna, features, buildings, sites or objects.

We considered whether we should impose any additional or different requirements in terms of our duty to have regard to the various conservation objectives set out in Section 7 but concluded that we should not.

(vi) Section 39 (Costs and Benefits)

We have a duty to take into account the likely costs and benefits of our decisions on the applications ('costs' being defined as including costs to the environment as well as any person). This duty, however, does not affect our obligation to discharge any duties imposed upon us in other legislative provisions.

In so far as relevant we consider that the costs that the permit may impose on the applicant are reasonable and proportionate in terms of the benefits it provides.

(viii) Section 81 (National Air Quality Strategy)

We have had regard to the National Air Quality Strategy and consider that our decision complies with the Strategy, and that no additional or different conditions are appropriate for this varied Permit.

We have also had regard to the clean air strategy 2019 and consider that our decision complies with the Strategy, and that no additional or different conditions are appropriate for this varied Permit.

We have had regard to the National Air Pollution Control Programme (set under the National Emissions Ceiling Regulations 2018) and consider that our decision complies with the Strategy, and that no additional or different conditions are appropriate for this varied Permit.

9.2.2 Section 108 Deregulation Act 2015 – Growth duty

We considered our duty to have regard to the desirability of promoting economic growth set out in section 108(1) of the Deregulation Act 2015 and the guidance issued under section 110 of that Act in deciding whether to grant this permit.

Paragraph 1.3 of the statutory guidance issued by the Department of Business, Energy and Industrial Strategy in March 2017 says:

> "The primary role of regulators, in delivering regulation, is to achieve the regulatory outcomes for which they are responsible. For a number of regulators, these regulatory outcomes include an explicit reference to development or growth. The growth duty establishes economic growth as a factor that all specified regulators should have regard to, alongside the delivery of the protections set out in the relevant legislation."

We have addressed the legislative requirements and environmental standards to be set for this operation in the body of the decision document above. The guidance is clear at paragraph 1.5 that the growth duty does not legitimise non-compliance, and its purpose is not to achieve or pursue economic growth at the expense of necessary protections.

We consider the requirements and standards we have set in this permit are reasonable and necessary to avoid a risk of an unacceptable level of pollution. This promotes growth amongst legitimate operators because the standards applied to the operator are consistent across businesses in this sector and have been set to achieve the required legislative standards. It also ensures that any pollution that may arise from the regulated facility does not adversely affect local businesses.

9.2.3 Legislative and Regulatory Reform Act 2006

In accordance with section 21 of this Act, when making this decision we have had regard to the need to be transparent, accountable, proportionate and consistent, and the need to target action where it is needed.

In accordance with section 22 of the Act, we have had regard to the Regulators' Code; in particular the need to base our decision on environmental risk, and to support the applicant to comply and grow, so that burdens have only been imposed where they are necessary and proportionate.

9.2.4 Human Rights Act 1998

We have considered potential interference with rights addressed by the European Convention on Human Rights in reaching our decision and consider that our decision is compatible with our duties under the Human Rights Act 1998. In particular, we have considered the right to life (Article 2), the right to a fair trial (Article 6), the right to respect for private and family life (Article 8) and the right to protection of property (Article 1, First Protocol). We do not believe that Convention rights are engaged in relation to this determination.

9.2.5 Countryside and Rights of Way Act 2000 (CROW 2000)

Section 85 of this Act imposes a duty on Environment Agency to have regard to the purpose of conserving and enhancing the natural beauty of the area of Outstanding Natural Beauty (*"*AONB*"*). There is no AONB which could be affected by the proposed new activities at the Installation.

9.2.6 Wildlife and Countryside Act 1981

Under section 28G of the Wildlife and Countryside Act 1981 the Environment Agency has a duty to take reasonable steps to further the conservation and enhancement of the flora, fauna or geological or physiographical features by reason of which a site is of special scientific interest. Under section 28I the Environment Agency has a duty to consult Natural England in relation to any permit that is likely to damage SSSIs.

We assessed the Application and concluded that the change to the Installation will not damage the special features of any SSSI. This was recorded on a CROW Appendix 4 form.

The Wildlife and Countryside Act (CRoW) assessment is summarised in greater detail in section 5.3 of this document. A copy of the full Appendix 4 Assessment can be found on the public register.

9.2.7 Natural Environment and Rural Communities Act 2006

Section 40 of the Natural Environment and Rural Communities Act 2006 has been amended with effect from 1 January 2023 to require consideration as to what action we can properly take, consistently with the proper exercise of our functions, to further the general biodiversity objective, which is to further the conservation and enhancement of biodiversity and having considered, determined such policies and specific objectives as we consider appropriate for taking action to further the general biodiversity objective, and take such action as we consider appropriate, in the light of those policies and objectives, to further that objective.

Section 40(2A) states that in complying with the duty in section 40(1) and (1A) we must have particular regard to any relevant local nature recovery strategy and species protection strategy or protected sites strategy. We have also considered the general biodiversity objective when carrying out our variation Application determination and consider that no different or additional conditions are required in the permit.

9.2.8 Countryside Act 1968

Section 11 imposes a duty on the Environment Agency to exercise its functions relating to any land, having regard to the desirability of conserving the natural beauty and amenity of the countryside including wildlife. We have done so and consider that no different or additional conditions in the varied Permit are required.

9.2.9 National Parks and Access to the Countryside Act 1949

Section 11A and section 5(1) imposes a duty on the Environment Agency when exercising its functions in relation to land in a National Park, to have regard to the purposes of conserving and enhancing the natural beauty, wildlife and cultural heritage of the areas, and of promoting opportunities for the understanding and enjoyment of National Parks by the public. There is no National Park which could be affected by the proposed activities at the Installation.

9.2.10 Environment Act 2021

Section 110(10) requires that we must have regard to a protected sites strategy, which Natural England has prepared and published in relation to improving the conservation and management of a protected site and managing the impact of plans, projects or other activities (wherever undertaken) on the conservation and management of the protected site, where relevant to exercise of our duties under Conservation of Habitats and Species Regulations 2017, sections 28G to 28I Wildlife and Countryside Act 1981 or Marine and Coastal Access Act 2009.

We have had regard to this in our assessments.

9.3 National secondary legislation

9.3.1 Conservation of Habitats and Species Regulations 2017

We assessed the Application in accordance with our guidance and originally concluded that for the purposes of the Habitats Regulations there will be likely significant effects on any European site and undertook an Appropriate Assessment (Habitats Regulations Assessment Stage 2) of those effects. Following receipt of additional information from the

Applicant, our assessment concluded that there will not be a likely significant effect on any European site.

We consulted Natural England on the original appropriate assessment and again following receipt of additional information from the Applicant. In both cases they agreed with our conclusions and consider that the operation of the PCC will not have adverse effects on the interest features of European sites.

The Habitats Regulations Assessment is summarised in greater detail in section 5.3 of this document. A copy of the Habitats Regulations Assessments can be found on the Public Register.

We have also considered our general duties under Regulation 9(3) to have regard to the requirements of the Habitats Directive in the exercise of our powers and under Regulation 10 in relation to wild bird habitat to take such steps in the exercise of their functions as they consider appropriate so far as lies within our powers to secure preservation, maintenance and re-establishment of a sufficient diversity and area of habitat for wild birds.

We considered whether we should impose any additional or different requirements in the varied Permit in terms of these duties but concluded that we should not.

9.3.2 Water Environment (Water Framework Directive) Regulations 2017

Consideration has been given to whether any additional requirements should be imposed in terms of the Environment Agency's duty under regulation 3 to secure compliance with the requirements of the Water Framework Directive, Groundwater Directive and the EQS Directive through, amongst other things, environmental permits, and its obligation in regulation 33 to have regard to the River Basin Management Plan ("RBMP") approved under regulation 31 and any supplementary plans prepared under regulation 32. However, it is felt that existing conditions in the varied Permit are sufficient in this regard and no other appropriate requirements have been identified.

We are satisfied that the activity proposed would not cause the current status of the water body to deteriorate as there are no changes proposed to the quality of effluent discharged to the River Ouse and the current limits on the discharge will remain in the varied Permit.

9.4 Other relevant legal requirements

9.4.1 Duty to Involve

Section 23 of the Local Democracy, Economic Development and Construction Act 2009 require us where we consider it appropriate to take such steps as we consider appropriate to secure the involvement of interested persons in the exercise of our functions by providing them with information, consulting them or involving them in any other way. Section 24 requires us to have regard to any Secretary of State guidance as to how we should do that.

The way in which the Environment Agency has consulted with the public and other interested parties is set out in sections 2.2, 2.4, 2.5 and 2.6 of this document. The way in which we have taken account of the representations we have received is set out in Annex 3. Our public consultation duties are also set out in ~~the~~ EPR 2016, and our statutory Public

Participation Statement, which implement the requirements of the Public Participation Directive. In addition to meeting our consultation responsibilities, we have also taken account of our guidance in Environment Agency Guidance Note RGN6.

10. Pre-operational and Improvement Conditions

10.1 Pre-operational conditions

Based on the information in the Application, we consider that we need to include Pre-Operational Conditions (*"PO"*). The conditions we have added as a result of this Application are specified in table S1.4 of the varied Permit and are referred to, where applicable, in the text of the decision document. We are using these conditions to require the Operator to confirm that the details and measures proposed in the Application have been adopted or implemented prior to the operation of the PCC plant.

The pre-operational conditions we have set are detailed in Annex 2A.

We have also updated table S1.4 in the varied Permit to remove POs that are no longer required as the Ouse Renewable Energy is no longer going ahead and to mark others as complete where this is the case.

10.2 Improvement Conditions

Based on the information in the Application, we consider that we need to include an Improvement Condition (*"*IC") programme. These improvements are specified in table S1.3 of the varied Permit. The ICs that have been added as a result of this Application are set out in Annex 2B and justifications for these are provided at the relevant section of the decision document as well as in Annex 2B. These conditions require the Operator to provide us with necessary details that are to be established or confirmed after the varied Permit is issued.

We have also updated table S1.3 to remove any ICs that are no longer required or have been completed.

Annex 1: Review of proposals against the emerging techniques

A) Post-combustion carbon capture emerging techniques

Reference*	Guidance	Applicant's Proposals	Compliant Y/N	Delivered by
2. Power Plant selection and integration with the PCC plant				
2.1 Energy efficiency in plants with PCC	You must maximise the thermal energy efficiency of the power plant and of the supply of heat for the associated PCC plant. For natural gas power plants, lower heating value efficiencies of 60% or above without CO_2 capture are reported in the LCP BREF to be achievable for large-scale new combined cycle gas turbine installations. New biomass power plant efficiencies will depend on: • the size and type of boiler • whether you use sub- or super-critical steam conditions You can reduce the impact of adding PCC by using power plant technologies that have the highest thermal efficiencies, since these have low specific CO_2 emissions (tonnes CO_2 per megawatt hour). If you expect to use more fuel to meet the heat or power needs of PCC, you should select the most efficient power plant technologies for that fuel and capture any additional CO_2 from that process. You should apply fuel input, electricity output and CO_2 emission metrics in the same way as you would to a power plant with fully integrated PCC (see	The PCC is being retrofitted to an existing biomass power plant, therefore, the Applicant has not been able to select the power plant in accordance with the criteria set out. However, the Applicant has considered the energy efficiency, heat utilisation and electrical output penalty for the combustion plant in the selection of the PCC system. The system is designed with an integrated heat utilisation system to minimise the electrical output penalty. The Applicant has stated that the gross net electrical output reduces by 192MWe with the operation of the PCC which results in an efficiency of 27.8%. This is at the lower end of the BAT AEELs for large combustion plant biomass boilers as set out in the LCP BAT Conclusions, although there is no BAT AEEL specified for combustion plant fitted with PCC.	Y	Condition 2.3.1 and table S1.2

Reference*	Guidance	Applicant's Proposals	Compliant Y/N	Delivered by
	section 2.3 on supplying heat and power for PCC operation).			
2.2 Dispatchable Operation	In line with the needs of a UK electricity system with a large amount of intermittent renewable generation, all thermal power plants, including those with CO_2 capture, are likely to be dispatchable. This means that the power plant operator can, within technical limits on rates of change in output and on minimum stable generation levels, operate the plant at any required output, up to its full load, at any time, and sustain this output indefinitely.	The Applicant states that the project is designed with the expectation that it will generally aim to operate baseload to maximise negative carbon emissions (capturing the CO_2 from the combustion of biomass). Due to there being no current subsidy scheme for the development of power BECCS meaning that that any turn down of operation of the units in the balancing market would need to take account of revenue opportunity from the captured CO_2. However, it is expected that the units would flex generation less frequently than other assets. Therefore, it was considered that any additional capital, environmental impact and operational costs to develop a more flexible and dispatchable system were not appropriate.	Y	Condition 2.3.1 and table S1.2

Reference*	Guidance	Applicant's Proposals	Compliant Y/N	Delivered by
2.3 Supplying heat and power for PCC operation	You will need to use low grade (for example 130°C) heat and electrical power to operate the PCC plant. You should work out the amounts needed based on factors that include the: • selected solvent • PCC plant configuration • CO_2 capture level • CO_2 delivery pressure You should supply this heat and electricity from the main power plant. Where not possible, this will need to be by fuel combustion in ancillary plants (with CO_2 capture) that are then also treated as a power plant system for performance calculations. The ratio between heat supplied as steam (or otherwise) and electricity output lost will depend on the: • temperature at which you need to supply heat • steam condenser cooling water temperature You should consider using a back-pressure turbine if it is not possible to supply enough steam to the PCC plant by extracting steam from a condensing turbine. If the plant needs to supply heat for district heating, and extracting steam to supply the PCC plant will mean there is insufficient steam to do this, you should consider using heat pumps or other plant to reduce the amount of steam required to meet that heat demand.	The Applicant states that they have worked with the PCC provider to identify and develop a proposal that minimises heat demand and maximises the use of heat within the PCC process. How the PCC system will use heat, steam and power is described in section 4.2.3 of this document above, but these come from the existing biomass boilers with a bleed of steam from the turbine. As stated in the Application, the amount of power required for the PCC is 190MWe. The power station does not currently supply heat for district heating, so this has not been considered further.	Y	Condition 2.3.1 and table S1.2

Reference*	Guidance	Applicant's Proposals	Compliant Y/N	Delivered by
3. PCC plant design and operation				
3.1 Purpose	The purpose of the PCC plant is to maximise the capture of CO_2 emissions for either use or secure geological storage. You should aim to design your plant to achieve a CO_2 capture rate of at least 95% during normal operating conditions, although operationally this can vary, up or down. You will need to justify proposing a design CO_2 capture rate of less than 95% as an annual average of all normal operating conditions. You can submit a cost benefit analysis as part of your application.	The Applicant has stated that the design capacity of the PCC is to capture at least 95% of CO_2 from operations at stable conditions and that this is a design guarantee from the technology supplier.	Y	Conditions 2.3.1, 2.4.1, 2.5.1, 3.5.1 and tables S1.2, S3.4 and IC54D and PO33 in tables S1.3 and S1.4
	You will need to deliver CO_2: • at local transport system pressures (gas phase such as 35 bar or dense phase such as 100 bar) • with levels of water, oxygen and other impurities as required for transport and storage such as that for the system operator National Grid (NGC/SP/PIP/25 Dec.2019)	The Applicant has stated that CO_2 will be compressed so that it can be delivered at the parameters required by the CO_2 transport network provider. An envelope of operating parameters has been provided to the Applicant and the pipeline has been identified as a dense phase system with pressures between 90 and 135 barG. The Applicant states that in the solvent regeneration process CO_2 captured in the solvent is released and the CO_2 passes into the regenerator reflux system where it is cooled and water is condensed from the CO_2. The CO_2 then passes through a gas wash section where it is cleaned to meet the required specification for transport.	Y	Conditions 2.3.1 and 2.5.1 and tables S1.2 and PO37 and PO39 in table S1.4
	The PCC plant must also have acceptable environmental risks through preventing or minimising emissions or render them harmless. You must achieve environmental quality standards for air emissions from the PCC plant and their subsequent atmospheric degradation products (including, for example, nitrosamines and nitramines). You should	The Applicant has provided an air impact assessment and an environmental risk assessment. We have reviewed these and we are satisfied that no environmental standards will be exceeded. See section 5 of this document. Relevant ELVs are set in the varied Permit.	Y	Conditions 2.3.1 and 2.4.1 and tables S1.2 and IC56D of table S1.3

Reference*	Guidance	Applicant's Proposals	Compliant Y/N	Delivered by
	confirm this using: • atmospheric dispersion and reaction modelling tools • specific site parameters which will define plant-specific ELVs			
3.2 Solvent selection	While the process design for the PCC plant is likely to be generally similar for all solvents, the amine solvent you select will determine details of the design and performance. Solvent types and published performance figures are described in the PCC evidence review. There is particular concern about impacts on the environment from nitrosamines and other potentially harmful compounds formed by reaction of the amines and their degradation products with nitrogen oxides (NOx) in the flue gases. Check the environmental standards for air emissions for the protective environmental assessment levels. You have a choice between: • solvents using primary amines that may require more heat for regeneration but will not readily form stable nitrosamines in the PCC plant, especially if a high level of reclaiming is used to remove degradation products • solvent formulations including secondary amines or other species that may have lower regeneration heat requirements but may readily form nitrosamines with NOx in the flue gases in the PCC plant – for controls, see section 3.3 on features to control and minimise atmospheric and other emissions	The Applicant states that the solvent has been selected on the basis of commercial, technical and environmental considerations. A review of available solvents has been carried out that included consideration of the maturity of the system and associated real-world operation, the energy demand, the lifecycle of the solvent and the environmental impact. The comparison was benchmarked against the performance of MEA solvent. The Applicant has provided comparison of the performance of a variety of single and proprietary solvents to identify two solvents from which to carry out pre-front end engineering design (FEED) studies. The KS21 solvent was chosen as it requires less solvent to make up per tonne of CO_2 captured, less process steam and less energy requirement than the other technologies assessed, although cooling water requirements was similar for all. In addition, it is expected to result in reduced degradation of the solvent and lower solvent emission levels due to reduced steam demand.	Y	Conditions 2.3.1, 2.5.1 and 3.5.1 and tables S1.2 and S3.4 and PO33 in table S1.4

Reference*	Guidance	Applicant's Proposals	Compliant Y/N	Delivered by
	The potential absorber stack emissions and resulting environmental impacts will depend on the selected solvent. Your air emissions risk assessment should assess your plant design and operation, taking into account local environmental factors. It should include: • direct emissions of solvent components • formation of additional substances in the PCC system and emissions of those substances • formation of further additional substances in the atmosphere from emissions from the PCC system	The air emissions risk assessment includes impacts from direct emissions of the solvent components, from substances formed from the solvent components and from substances formed due to degradation of the solvents in the atmosphere.	Y	Conditions 2.4.1 and 3.1.1 and IC56D in table S1.3 and table S3.1a
	The potential for solvent reclaiming and other cleaning methods is also an important factor in solvent selection. You should make sure it is practicable to remove all non-solvent constituents from the solvent inventory as fast as they are added during operation, to avoid accumulation. Your assessment should demonstrate that you will: • recover a high fraction of the solvent in the feed to the reclaimer during reclaiming • minimise reclaimer wastes and that they can easily be disposed of	The Applicant provided information regarding the effectiveness of the chosen solvent against a previous iteration of the proprietary solvent chosen. This showed that the addition of an additional substance decreased heat stable solids and iron concentrations, but the concentration of the solvent reclaimed had not reduced. Pilot studies show that there was no deterioration of plant performance with solvent reclamation or with aging solvent. As described in section 4.2.1 above, measures are in place to reclaim as much solvent as possible as any liquids or gases in any part of the system that have come into contact with the solvent are returned to the reclaimer. Reclaimer waste is minimised as the system operates as a 'closed loop' system, where as much solvent is reclaimed as possible.	Y	Conditions 2.3.1, 2.4.1, and 3.5.1 and tables S1.2, S3.4 and IC55D in table S1.3
	You must work out the performance of your solvent, including reclaiming requirements and modelling emissions to atmosphere. Determine this through realistic pilot (or full scale) tests using fully	The Applicant states that the supplier of the solvent has carried out extensive pilot trials and comparison of performance of the solvent against previous iterations. Details of the pilot studies were supplied.	Y	Conditions 2.4.1, and 3.5.1 and table S3.4 and IC55D in

Reference*	Guidance	Applicant's Proposals	Compliant Y/N	Delivered by
	representative (or actual) flue gases and power plant operating patterns over a period of at least 12 months. You do not need to do this for your plant if information on the solvent performance is already available from pilots, tests, or regular operation at a similar plant.			table S1.3
3.3 Features to control and minimise atmospheric and other emissions				
3.3.1 Flue gas cleaning	SOx in the flue gas will readily react with amines to produce heat stable salts. These products are typically stable under reclaimer conditions, but the heat stable salt formation with SOx can be, at least partly, reversed by alkali addition in the solvent reclaiming process. SOx levels will affect solvent consumption but are expected to have a limited effect on emissions. For most gas, biomass and waste fuels that have intrinsically low S levels, adding more upstream SOx removal (and HCl removal for EfW) is likely to be primarily an economic decision. SOx removal can be in the power plant flue gas desulphurisation unit, flue gas treatment system or in the PCC direct contact cooler. SOx levels in the existing flue gases from an amine PCC plant will be expected to be at extremely low levels.	As described in section 4.2.1 above, the flue gases from the combustion plant will pass into a quencher tower for treatment prior to passing into the absorber tower where the CO_2 is absorbed in the solvent. Selection of the fuel ensures there is a low sulphur content in the fuel and consequently a low concentration of sulphur oxides in the flue gas. The additive used to control corrosion in the combustion zone can also result in sulphur oxides in the flue gas, but the sulphur content of the additive is monitored and controlled. A gas/gas heater is used primarily to reduce the temperature of the flue gas from the combustion plant whilst also heating the gas stream exiting the PCC process prior to release. A secondary consequence of the heater is to mitigate sulphur trioxide mist formation. An alkali solution is used in the quencher tower with a variable dosing system which can be adjusted to account for the levels of sulphur in the flue gas. This reduces the levels of sulphur dioxide	Y	Condition 2.3.1 and table S1.2
	The impact of NOx in the flue gas will vary significantly with the solvent composition. If the amine blend will form significant amounts of stable nitrosamines with NOx in the flue gas, then you must reduce NOx to as low a level as practicably possible (see LCP BREF) using selective catalytic reduction (SCR). EfW plants may be fitted with selective non catalytic	Primary techniques based on controlling the fuel combustion are used to limit the amount nitrogen oxides in the flue gas. These include low NOx burners and air staging. SNCR is available to reduce NOx emissions further if required. These measures ensure that the NOx concentrations are in accordance with the LCP BAT Conclusions limits and	Y	Conditions 2.3.1, 3.1.2 and 3.5.1 tables S1.2 and S3.1a

Reference*	Guidance	Applicant's Proposals	Compliant Y/N	Delivered by
	reduction (SNCR) which does not reduce NOx in flue gas as much as SCR. If you are retrofitting PCC plant to an EfW plant which has SNCR NOx abatement, you should make sure the selected solvent is compatible with the abated flue gas. Both SCR and SNCR can result in ammonia (NH_3) slip. If necessary, it is expected that (NH_3) slip could be addressed in a suitably designed PCC unit. In all cases, you must assess the effects of NOx in the flue gas on atmospheric degradation reactions and this may also affect the need for SCR. If SCR is not fitted to a new build power plant, it is generally considered BAT to maintain space so it could be retrofitted, should this be considered necessary to meet ELVs in the future.	are therefore within the design parameters of the PCC.		
	Sulphur trioxide (SO_3) droplets and fine particulates should not be present in the flue gas. If they arise in the PCC process they can cause significant amine emissions. The level of emissions (mainly solvent amines) are not directly related to aerosol measurements. Monitoring aerosols is difficult and aerosol quantities may also vary significantly over time. Aerosols might be present, for example, because of significant SOx in the flue gas. Where this is the case, you should carry out long-term testing on a pilot plant or the actual plant, with all planned countermeasures in place, to show satisfactory operation. You should also carry out regular isokinetic sampling in the operational plant to assess total vapour and droplet emission levels. Other amine aerosol emission abatement techniques include: • cooling the flue gas gradually through the acid	The gas/gas heater used to cool flue gas entering the PCC and heating it as it exits will also mitigate the formation of SO_3 droplets. Other pollutants in the flue gas are controlled as follows: Particulates – there are ESPs which control particulates in the combustion flue gas. In addition, as the quencher tower used to treat the flue gas is a wet process this reduces particulates further before the flue gas enters the PCC. Ammonia – this will only be present in the flue gas if SNCR is required. The quencher tower will remove the majority of the ammonia. Mercury – there are very low levels of mercury in the fuel and any present in the flue gas as a vapour will be removed in the quencher tower. Other metals – these will be removed with the	Y	Condition 2.3.1 and table S1.2

Reference*	Guidance	Applicant's Proposals	Compliant Y/N	Delivered by
	dewpoint • Brownian Demister Units • wet electrostatic precipitators • high lean solvent temperatures These techniques can reduce aerosol emission by enhancing aerosol growth in the top of the column, and the water wash. You may need to use a combination of these or other techniques.	particulates in the ESPs and in the quencher tower. Aerosol emissions from the absorber tower are minimised by the use of multi-level water wash systems together with a proprietary de-mister system. An acid wash system will also be used to further capture any amine-based substances.		
	You may need to remove materials in the flue gas that would accumulate as impurities in the solvent (such as metals, chlorine and fly ash) to lower concentrations than is required under the LCP BREF. This is to ensure satisfactory PCC plant operation. Whether you need to do this will depend on the specific solvent properties and the effectiveness of the solvent management equipment (such as filtering and reclaiming). You should assess the effects of flue gas impurities through realistic, long term pilot testing. In general, your PCC plant must abate these types of flue gas impurities before the residual flue gases are finally released to atmosphere.		Y	Condition 2.3.1 and table S1.2
3.3.2 PCC system operation				
Operating temperatures	You must establish and maintain optimum temperature and appropriate limits in the solvent stripping process. Elevated temperatures can cause some thermal degradation of the solvent. But higher peak average temperatures during regeneration will also likely promote reduced energy requirements and higher CO_2 capture levels. You must balance both to ensure the right environmental outcome. Where feasible, you should avoid locally higher metal skin temperatures, such as from the use of superheated steam in heaters, as this provides no benefit and can	The design of the absorber tower is such that the absorber section is split into a lower and upper section, the design of which is to enable the management of the lean solvent temperature within the absorber. As the absorption process is exothermic, proprietary coolers are used to overcome this inherent temperature increase and to optimise the solvent interactions. Heat is exchanged between the rich solvent heading to the regenerator and lean solvent returning to the absorber. This together with lean solvent cooling ensures the lean solvent is at the optimum temperature prior to	Y	Condition 2.3.1 and table S1.2

Reference*	Guidance	Applicant's Proposals	Compliant Y/N	Delivered by
	result in degradation.	introduction to the absorber. This process optimises the heat utilisation across the system using the process heat difference between the rich and lean solvents. This includes proprietary heat exchangers to utilise heat to the best effect, reducing the overall steam and cooling demand of the system.		
Solvent degradation	You should minimise oxidative degradation of the solvent by reduced solvent residence times in the absorber sump and other hold-up areas. Direct O_2 removal from rich solvent may be developed in the future but has not yet been proven at scale.	The chosen solvent has been designed to be resistant to oxidation through the choice of the amines. Control of the incoming gas by treatment in the quencher tower also reduces the potential of oxidation by the removal of particulates and the associated metals that can support oxidation, including mercury vapour.	Y	Conditions 2.4.1 and 3.5.1 and table S3.4 and IC55D in table S1.3
3.3.3 Absorber emissions abatement				
Water wash	You must use one or two water washes or a scrubber to return amine and other species to the solvent inventory. Capture levels are limited by vapour or liquid equilibria, with volatile amines captured less effectively. Any aerosols present will also not be captured effectively. Water washes alone are ineffective in preventing NH_3 emissions, as concentrations will increase until the rate of release balances the rate of formation (and possibly addition from SCR or SNCR slip).	Multi-level water washes and a proprietary de-mister system are proposed to be used in the absorber column to return amine and other products to the inventory and minimise the emissions and aerosols.	Y	Condition 2.3.1 and table S1.2
Acid wash	An acid or other chemically active wash or scrubber after the water wash will react with amines, NH_3 and other basic species and reduce them to very low levels (for example, 0.5 to 5mg per m3 per species or lower). You should implement an acid wash as it is considered to be BAT, unless: • emission levels are already at acid wash levels with a water wash • you can show that the need to dispose of	An acid wash is proposed to be used.	Y	Conditions 2.3.1 and 3.5.1 and tables S1.2 and S3.1a

Reference*	Guidance	Applicant's Proposals	Compliant Y/N	Delivered by
	the acid wash waste outweighs the benefits of the additional reduction in emissions to atmosphere Depending on PCC system configuration, an absorber acid wash can also counteract NH3 slip from an SCR system. If an acid wash is not fitted, you should consider a second water wash as an acid wash if: • emissions performance is worse than expected • you wish to change to a more volatile solvent An acid wash is not likely to trap aerosols.			
Droplet removal	You must prevent emissions of aerosols. To do this you could use standard droplet removal sections after washes. These will prevent droplet carryover from the wash. However, they are not effective against very fine aerosols arising from SO_3 or other aerosol mists.	Aerosol emissions from the absorber tower are minimised by the use of multi-level water wash systems together with a proprietary de-mister system.	Y	Condition 2.3.1 and table S1.2
Stack Height	Where modelling predicts that you may need to raise the temperature at the point of release to aid dispersion, you can: • increase the design stack height • add flue gas reheating Flue gas reheating can also reduce the plume visibility. Heat from cooling the flue gas before the PCC plant or waste heat from the PCC process should be used for flue gas reheating (see section 4 on cooling)	The flue gases post-absorber will be released through the existing stack which is 259 m high. The flue gas will be re-heated to increase dispersion.	Y	Condition 2.3.1 and table S1.2
3.4 Process and emissions monitoring				

Reference*	Guidance	Applicant's Proposals	Compliant Y/N	Delivered by
3.4.1 Role of monitoring	The main purpose of monitoring the PCC process is to show that the emissions from the process, primarily to air, are not causing harm to the environment. You must also carry out monitoring to show that resources are being used efficiently. This includes: • energy and resource efficiency • CO_2 capture rate • verification that the CO_2 product is suitable for safe transport and storage You will need to develop a monitoring plan for both a commissioning phase and routine operation. During the commissioning phase you will need to optimise the operating envelope for the process. When you have achieved this the process operation will then become routine, along with the monitoring.	Continuous monitoring systems for emissions from the absorber tower will be installed and, where these are not available, periodic monitoring will be carried out. Monitoring of CO_2 will be carried out, but the location of the instruments has not yet been finalised. This monitoring will be used to determine the capture efficiency. Monitoring of the CO_2 quality prior to storage and transport will be carried out based on the requirements of the pipeline operator. As there is no confirmed pipeline operator, the details have the monitoring have not yet been finalised. A pre-operational condition has been included in the varied Permit requiring the Operator to confirm this monitoring once a pipeline operator is known. We have included a pre-operational condition for a commissioning plan to be submitted which includes monitoring during commissioning.	Y	Conditions 2.3.1, 2.4.1, 2.5.1 and 3.5.1 and tables S1.2, S3.1a and S3.4 and IC54D in table S1.3 and PO29 and PO30 in table S1.4
	It's likely you'll need to do more extensive monitoring during commissioning than during routine operation. As PCC is an emerging technique, you will need to develop monitoring methods and standards. You should include proposals for this in your permit application.	Continuous monitoring is proposed where it is available for those pollutants, and periodic monitoring will be carried out where continuous monitors are not available. We have included a pre-operational condition for a commissioning plan to be submitted which includes monitoring during commissioning.	Y	Conditions 2.3.1, 2.4.1, 2.5.1 and 3.5.1 and tables S1.2, S3.1a and S3.4 and IC53D in table S1.3 and PO29 and PO30 in table S1.4
	You must demonstrate compliance with ELVs in the permit by monitoring emissions at authorised release points. You must also show that you are managing the process to prevent (or minimise) the formation of solvent degradation products.	Monitoring will be carried out as currently set in the Permit to demonstrate compliance with the ELVs and BAT AELs already set for the combustion activity. Monitoring will be carried out for the requirements set out in the varied Permit for emissions from the absorber.	Y	Condition 3.5.1 and table S3.1a

Reference*	Guidance	Applicant's Proposals	Compliant Y/N	Delivered by
	Where monitoring shows that degradation products are being formed (and may be released), you must reduce these and any solvent emissions to the permitted level. This process control monitoring will also be part of the permit conditions.	The Applicant is working with the supplier of the PCC equipment to finalise the process control systems within the process including identifying the parameters, monitors, monitoring locations, operational alarms and actions required. We have set a pre-operational condition requiring the Operator to have this programme in place prior to operations commencing.	Y	Conditions 2.3.1, 2.4.1, 2.5.1 and 3.5.1 and tables S1.2, S3.1a and S3.4 and IC55D in table S1.3 and PO30 in table S1.4
3.4.2 Point source emissions to air	You must include monitoring to demonstrate compliance with: • IED Chapter III ELVs and Chapter IV • LCP BREF BAT AELs • WI BREF BAT AELs at normalised conditions You must also monitor for: • ammonia • volatile components of the capture solvent • likely degradation products such as nitrosamines and nitramines Your monitoring may be by either: • continuous emissions monitoring ('on line') • periodic extractive sampling ('off line') – where aerosol formation is expected, this must be isokinetic	Monitoring is already set in the Permit for the LCP emissions and these will not change. Monitoring for emissions from the PCC are also set in the varied Permit. The Applicant has stated that where continuous monitors are available, these will be installed, and where they are not available, periodic extractive monitoring will take place.	Y	Condition 3.5.1 and tables S3.1a, S3.1b and S3.1c
	Emission sampling point must also comply with M1 sampling requirements for stack emission monitoring.	The Applicant has stated that any sampling points will be compliant.	Y	Conditions 2.4.1 and 2.5.1 and IC52D in table S1.3 and PO32 in table S1.4.
3.4.3 Process control monitoring	You should use process control monitoring or periodic sampling with off-line analysis to control the CO_2 capture and the solvent reclaiming performance. Parameters you should consider	The Applicant has stated that process control monitoring will be in place, but the details have not yet been finalised. We have included a pre-operational condition requiring a process control and monitoring plan to be in	Y	Conditions 2.4.1, 2.5.1 and 3.5.1 and table S3.4 and

Reference*	Guidance	Applicant's Proposals	Compliant Y/N	Delivered by
	monitoring include: • absorber solvent quality – percentage active solvent • CO_2 loading both rich and lean solvent • maximum solvent temperature • heat stable solvent content • solvent colour or opacity • soluble iron and other metals and degradation products • in water or acid washes and scrubbers – pH, conductivity, loading of abated substances, flow rate	place for the capture of CO_2 and the reclaiming of the solvent.		IC55D in table S1.3 and PO30 in table S1.4
3.4.4 Monitoring of CO2	You should also include: • CO_2 mass balance • CO_2 in fuel combusted • CO_2 capture rate (as a percentage) • CO_2 released to the environment • CO_2 quality	The Applicant has stated that CO_2 will be monitored continuously using a CEM in the flue gases at the inlet and outlet of the absorber tower. The precise locations of these are not yet decided upon, but the data will be used to determine capture efficiency. The quality of the CO_2 will be monitored based on the requirements of the pipeline operator. The Applicant states that the UK emission trading scheme (UK-ETS) will cover the fuel and CO_2 release monitoring.	Y	Conditions 2.4.1, 2.5.1 and 3.5.1 and table S3.4 and IC54D in table S1.3 and PO33 and PO40 in table S1.4
3.4.5 Monitoring Standards	The person who carries out your monitoring must be competent and work to recognised standards such as the Environment Agency's monitoring certification scheme (MCERTS). MCERTS sets the monitoring standards you should meet. The Environment Agency recommends that you use the MCERTS scheme where applicable. You can use another certified monitoring standard, but you must provide evidence that it is equivalent to	The Applicant has stated that monitoring will be carried out in accordance with MCERTS where available and in accordance with relevant British Standards.	Y	Condition 3.5.3

Reference*	Guidance	Applicant's Proposals	Compliant Y/N	Delivered by
	the MCERTS standards. There are no prescriptive BAT requirements for how to carry out monitoring. Monitoring methods need to be flexible to meet specific site or operational conditions. You must use a laboratory accredited by the United Kingdom Accreditation Service (UKAS) to carry out analysis for your monitoring.			
3.5 Unplanned emissions to the environment	You should propose a leak detection and repair programme that is appropriate to the solvent composition. This should use industry best practice to manage releases, including from joints, flanges, seals and glands. Your hazard assessment and mitigation for the plant must consider the risks of accidental releases to environment. This should also consider the actual composition of the fluids, gases and vapours that could be released from the plant after an extended period of operation. (Not only fresh solvent as initially charged.)	The PCC system will be developed with specific bunding and drainage zones for the various substances to be stored. Each zone will have its own disposal routes related to the substance. In addition, there will be a leak detection and repair system that will include a number of monitoring and supervisory methods to minimise the potential for leaks. These would include: • A planned preventative maintenance programme • Physical inspections (daily site checks, periodic physical inspections of pipework condition/sumps, occasional non-destructive testing on tanks and pipework) • Supervisory monitoring through high, high-high level alarms and pressure monitors where appropriate • Process control via SCADA The Plate Heat Exchangers (PHE) are designed to mitigate the potential risk of cross contamination. The PHE selected will utilise a dual gasket solution where the volume between the gaskets is designed to quickly move any liquid away, coupled with a leak detection system to raise an alarm of the leak. The Applicant has provided information regarding the hazardous properties of the solvent at the different stages of its use.	Y	Conditions 1.1.1, 2.3.1, 3.2.3 and 2.5.1 and table S1.2 and PO36 in table S1.4

Reference*	Guidance	Applicant's Proposals	Compliant Y/N	Delivered by
3.6 Capture level, including during flexible operation	Capturing at least 95% of the CO_2 in the flue gas is considered BAT. You can base this on average performance over an extended period (for example, a year). To achieve this, you should make sure the design capture level for flue gas passing through the absorber equates to at least 95% of the CO_2 in the total flue gas from the power plant. If you process less than the full flue gas flow, your capture rate will have to be correspondingly higher. Over the averaging period, your capture level may vary up or down.	The Applicant has committed to capturing 95% of the CO_2 emissions from Units 1 and 2 when in safe and stable operating conditions, as an annual average of all operational hours above the stable operating threshold.	Y	Conditions 2.4.1, 2.5.1 and 3.5.1 and table S3.4 and IC54D in table S1.3 and PO33 in table S1.4
	As the fraction of intermittent renewable generation in the UK rises, CCS power plants will need to start and stop more often, and possibly also operate at variable loads. It is therefore important that CO_2 can also be captured at high levels during these periods, including during start-up and shutdown, to maintain high average capture levels. A method to maintain capture at normal rates or higher at all times using solvent storage has been identified in the BAT review. This, or alternatives that can achieve equivalent results, is considered BAT. If your PCC plant is not initially constructed with this capability, your permit application should show how you may retrofit it.	The Applicant is not proposing to capture CO_2 during start up and shutdown and has provided the following justification: • The units are expected to operate as base load as incentivised by the government for BECCS plants to maximise negative emissions. Therefore, it is expected that the units will operate with minimal start-up and shut down periods. • If CO_2 is captured during start up and shut down, an additional source of power and steam would be required for the PCC which would off-set the carbon savings before stable operation is reached. • Each start up from cold takes approximately 12 hours to reach the correct temperature for the safe start-up of the combustion unit and the PCC. Shut down takes approximately 1 to 2 hours. Start-up is undertaken using heavy fuel oil and capturing CO_2 from the flue gases from burning this fuel would not be beneficial to the PCC system as it is designed to capture CO_2 from the combustion of biomass. • The measures for CO_2 capture rate that are considered to be BAT are based on combined cycle gas turbines.		N/A

Reference*	Guidance	Applicant's Proposals	Compliant Y/N	Delivered by
3.7 Compression	You should select CO_2 compressors based on the expected duty. You should consider how any waste heat arising may be used. For base load operation, you should use integrally geared units because they give the: • maximum full-load efficiency • minimum number of compression trains For flexible and part-load operation, smaller compression trains (for example 2 at 50% compared to 1 at 100%) may be preferable. The use of different types of compressor or pump in series may also be preferable, to give greater flexibility at the expense of slightly lower full-load efficiencies.	The Applicant states that, as the design of the compressors is dependent on the specifications required by the pipeline operator as well as on the design of the PCC, the final design will be based on the requirements of these. Currently the pipeline operator is unknown. A pre-operational condition has been included in the varied Permit requiring the Operator to provide the final design of the compression system which should be in accordance with the GET guidance.	Y	Condition 2.5.1 and PO37 in table S1.4
3.8 Noise and odour	The LCP BREF and EfW BREF already cover noise impacts for the main power plant. You only need to consider additional process steps in PCC technology that have high potential for noise and vibration. In particular, CO_2 compression could be an area of concern. Once you've identified the main sources and transmission pathways, you should consider the use of common noise and vibration abatement techniques and mitigation at source wherever possible. For example: • use of embankments to screen the source of noise • enclosure of noisy plant or components in sound-absorbing structures • use of anti-vibration supports and	A noise impact assessment was carried out, and this is detailed in section 5.5.2 above. As the details of the final design are not yet complete, we have included a pre-operational condition requiring the Operator to revise the noise impact assessment based on the final design to verify the assessment submitted with the Application. Odour is not considered to be an issue and no specific odour impact assessment has been required.	Y	Conditions 2.5.1 and, 3.3.1 and 3.4.1 and PO35 in table S1.4

Reference*	Guidance	Applicant's Proposals	Compliant Y/N	Delivered by
	interconnections for equipment • orientation and location of noise-emitting machinery • change of the frequency of the sound			
	The handling, storage and use of some amines may result in odour emissions, so you should always use best practice containment methods. Where there is increased risk that odour from activities will cause pollution beyond the site boundary, you will need to send an odour management plan with your permit application	The Applicant provided a risk assessment for odour and stated that the KS21 solvent is not inherently odorous so storage of the solvent should cause minimal odour. The Applicant has identified the main potential odour sources as being the emissions of amines and breakdown products from the PCC units via the main stack and from the ETP. However, the Applicant considers that as the PCC will be operated in accordance with the manufacturer's recommendations, the system will be controlled and emissions from the stack are dispersed the risk of odour nuisance is low. Similarly, the operation of the ETP will be in accordance with the site's operating procedures so will be controlled and the wastewater being treated is not inherently odorous so odour risk from this process is low.	Y	Conditions 3.3.1 and 3.3.2
3.9 Hot potassium carbonate post combustion capture plant	Using electrically powered hot potassium carbonate as an alternative solvent to amines for capturing CO_2 is an emerging technique that may have some advantages where the on-site availability of steam supply is insufficient for amine regeneration. The configuration of the plant is similar with flue gas clean up, absorber and desorber columns and solvent reclamation. The process is carried out at pressures between 10 and 100 pounds per square inch (PSI) and so requires a flue gas compressor – see the PCC evidence review. Advantages include: • potentially less hazardous than other solvents • can be driven by electricity – no need to extract steam	The Applicant is not using this capture technology.	NA	NA

Reference*	Guidance	Applicant's Proposals	Compliant Y/N	Delivered by
	• pressurised capture process – smaller volumes of gases • higher tolerance to oxygen Disadvantages include: • requires a complex large compressor, expander, heat recovery or exchanger which is expensive and high maintenance • use of electricity is less efficient than steam • not as effective on flue gas with low CO_2 concentration – for example, combined cycle gas turbine (CCGT) • some CO_2 slip so achievable capture efficiency is likely to be 90% not 95% Where you choose to use this carbon capture technique you should justify why in your permit application.			
4. Cooling	You will be able to achieve the best power and CO_2 capture plant performance by using the lowest temperature cooling available. You should use the hierarchy of cooling methods as follows: • direct water cooling (such as seawater) • wet cooling towers • hybrid cooling towers • dry cooling – direct air-cooled condensers and dry cooling towers	There is no change to the cooling system in place and natural draft cooling is used. The Applicant states that the PCC system is designed to optimise water use and treated water from the ETP (which treats the waste water from the quencher tower where flue gases are treated prior to entry to the PCC) enters the cooling system for use.	Y	Condition 2.3.1 and table S1.2

Reference*	Guidance	Applicant's Proposals	Compliant Y/N	Delivered by
	Power plants that are retrofitted with PCC using steam extraction, or are intended to be able to operate without capture, can share water cooling between the power plant and the PCC system. This is because the cooling load on the main steam condensers falls with increased steam extraction rate. This shift away from condenser cooling will not apply for systems with direct air-cooled condensers. It may also be possible to reuse cooling water after the main condensers for higher-temperature cooling applications in the PCC plant. However, site specific water discharge temperature limits may be an issue for direct cooling.	The treated wastewater from the treatment of the flue gases prior to input to the absorber will be re-used within the existing cooling system.	Y	Condition 2.3.1 and table S1.2
	A feature of PCC is that you have to remove heat from a flue gas stream that was originally not cooled. You can still achieve rejection of heat to atmosphere by heating the flue gas leaving the absorber, using heat from the incoming flue gas. You can do this either: • directly – such as using a rotary gas-gas heater • indirectly – such as using a heat transfer fluid or low-pressure steam	The use of additional water for cooling of the PCC is minimised by the use of a gas/gas heater to reduce the temperature of the flue gas entering the absorber column and various crossflow heat exchangers to use the heat from the lean solvent as it exits the reclaimer (and thus cools it) to heat the rich solvent as it exits the absorber tower and enters the reclaimer. The heat is used to heat the flue gas from the absorber as it is discharged via the stack.	Y	Condition 2.3.1 and table S1.2
	Lean and rich solvent storage may also help you achieve satisfactory PCC performance during periods of high cooling demand.	The Applicant is not proposing to use lean/rich solvent storage.	NA	NA
	You should refer to the Environment Agency's evidence on cooling water options for the new generation of nuclear power stations in the UK when considering options for cooling. This gives an overview of UK power station cooling water systems in use in the UK and abroad.	This guidance was considered in previous variations to the Permit.	Y	Condition 2.3.1 and table S1.2
5. Discharge	For discharges to water, you should refer to the	Water from the treatment plant, which treats the wash	Y	Conditions

Reference*	Guidance	Applicant's Proposals	Compliant Y/N	Delivered by
to water	guidance on surface water pollution risk assessment for your environmental permit. For best practice in plume dispersal modelling, see the Joint Environmental Program report 'A protocol on projects modelling cooling water discharges into TrAC waters within power station developments'.	water from the quencher column where flue gas is treated prior to entry to the absorber column, is used in the power station cooling system and is then discharged to the River Ouse together with the cooling water from the power station. There are no discharges of any waste waters contaminated with amines or breakdown products. The quality of the wastewater discharged to the cooling system and subsequently to the River Ouse is no different to that which was discharged from the treatment of the wastewater from the FGD process. Therefore, the emissions to the River Ouse will be within the limits and volumes already specified in the Permit. The only change to the limits and monitoring requirements in the varied Permit will be the source of the discharge. There is no change to the surface water collection system and only uncontaminated surface water will be discharged. Areas where solvents and liquid wastes associated with PCC will have their own sealed drainage system and any collected water will be disposed of off-site as waste and not discharged into the surface water drainage system.		2.3.1, 3.1.1 and 3.5.1 and tables S1.2 and S3.2
* The reference number corresponds with the numbering as set out in the Post-combustion carbon dioxide capture: emerging techniques - GOV.UK (www.gov.uk)				

B) Hydrogen production from electrolysis of water emerging techniques

Reference*	Guidance	Applicant's Proposals	Compliant Y/N/FC/NA**
2 Technique selection	When designing a hydrogen production plant and its associated activities, you should consider its overall environmental performance. You should justify your choice of technology at each stage using the principles of 'best available techniques' throughout your permit application including: • energy demand and efficiency • water demand, efficiency, and evaluation for re-use • emissions to the environment.	The chosen technology for hydrogen production will be electrolysis. Steam methane reforming is deemed too large scale for the duty being proposed and would also be more carbon intensive and contrary to the low carbon philosophy and approach of Drax and the purpose of the CCS project. Furthermore, gasification would use fossil fuel and produce too much hydrogen for the duty required. Given that the electrolysis unit would be provided with all utilities, including electricity from the main power station, it would have considerably less carbon releases than the other fossil-based technologies. The electrolysis method has a higher water demand than steam methane reforming as water is the primary raw material for the process, however this demand is considered to be low due to the size of the hydrogen generation units. Water usage will be monitored to ensure its efficient use within the hydrogen generation system.	Y
	Other associated activities may include: • feed water treatment • hydrogen purification and compression • storage of hydrogen • electrolyte treatment and recovery (where ALK technology employed) • effluent treatment	All utilities would be provided from the main power station which would include the electrical supply as well as demineralised water. The produced hydrogen does not require compression. The only storage of hydrogen will be in a buffer drum for each unit which has a capacity of 0.23m^3 and allows for 2 minutes of buffer. The purity of the hydrogen will be 99.99% but it is not known how the purification will be undertaken until detailed design and vendor selection processes have been completed.	FC Conditions 2.5.1 and PO41 in table S1.4

Reference*	Guidance	Applicant's Proposals	Compliant Y/N/FC/NA**
	• flaring and venting • cooling and heat recovery • steam systems (where SOEC technology employed)	There will be no electrolyte treatment. As the water being used is demineralised water from the station supply, the expectation is that no effluent should be produced and therefore no wastewater treatment. The philosophy is to vent as little as possible during normal operation and would only occur in the event of over pressure on the drum. Venting scenarios will be assessed during detailed design stage, upon technology vendor selection. No steam systems will be required for the hydrogen production plant. The cooling requirement of the hydrogen generation plant is not currently known and will be undertaken at detailed design and vendor selection process. It is not expected to require significant cooling demand given the small size of the electrolysers, and air cooling may be sufficient.	
3. Plant design and operation			
3.1 Operation	You must consider whether your hydrogen production plant may need to operate in steady state or on a flexible basis to balance variations in, for example: • supply of power to the plant • demand from hydrogen users You should consider whether this need for flexibility will affect the design, operation, and maintenance of the plant.	The hydrogen production plant is used in conjunction with the carbon capture system which is designed for baseload usage. Therefore, there will be little need for different operational profiles. Each unit would have 2 minutes of buffering capacity with the buffer drums. Hydrogen generation is flexible, based on the demand from the buffer drum. There will be 4 hydrogen generation units, one per train, with 2 trains per CCS unit.	Y
	You should identify all operating scenarios. Include those due to providing flexible operations where environmental performance could be affected, or where additional emissions are expected. For example, these could be because of changes in demand, or start-up and	The hydrogen production plant is to be used in conjunction with the carbon capture system which is designed for baseload usage. Therefore, there will be no need for different operational profiles, and the number of start-up and shutdowns will be limited.	Y

Reference*	Guidance	Applicant's Proposals	Compliant Y/N/FC/NA**
	shutdown.		
	You should describe measures you would take to minimise the environmental impact of these scenarios. These could result in, for example: • reduced energy efficiency • reduced water efficiency • increased emissions to air, including venting and flaring • increased effluent or wastes produced • increased risk of accidents in non-steady state conditions	The hydrogen production plant is to be used in conjunction with the carbon capture system which is designed for baseload usage. Therefore, there will be no need for different operational profiles, and the number of start-up and shutdowns will be limited.	NA
3.2 **Reliability and availability**	You will need to identify the equipment and systems, and their associated operating and maintenance techniques, that are critical in avoiding emissions or minimising environmental impact. You will need to design, operate, and maintain these to make sure they are reliable and available. This should include providing installed back-up equipment, where necessary.	There will be 4 hydrogen generation units, one per train, with 2 trains per CCS unit. All utilities such as electrical supply and water demand will be provided from the main power station. All plant and equipment will be maintained in accordance with the manufacturer's recommendations and be included within the planned preventative maintenance programme.	Y
	You should implement a risk-based other than normal operating conditions (OTNOC) management plan. This should identify potential scenarios, mitigation measures, monitoring and periodic assessment of the OTNOC management plan. This should be part of your environmental management system.	When fully designed an OTNOC management plan will be developed for the hydrogen generation units.	FC
3.3	You should design, operate and maintain your hydrogen	Operating at baseload helps maximise the hydrogen generation plant's efficiency. Other features will be detailed after vendor	Y

Reference*	Guidance	Applicant's Proposals	Compliant Y/N/FC/NA**
Energy efficiency, process efficiency, cooling	production plant to maximise: • energy efficiency (minimise the energy needed to produce each tonne of hydrogen) • process efficiency (minimise the raw materials needed to produce each tonne of hydrogen)	selection. Water and electricity use are the two main parameters which would be monitored to ensure efficiency is maintained. These will be monitored in terms of raw use and overall, as a KPI per tonne of hydrogen produced.	
	You should consider the use or recovery of oxygen by-product when this is commercially and technically viable.	Re-use or recovery of oxygen will be assessed during detailed design stage, upon technology vendor selection.	FC
	To decide on best available techniques for your plant, you will have to balance how you achieve these efficiencies to optimise the environmental and economic requirements. You must explain how you have done this and what your considerations were. Main energy users will include: • electrolysers • hydrogen compressors • hydrogen purification • pumping or fan systems	The hydrogen generation plant will not require compression as it is put straight into use. Pumping will be limited to the conditioning unit and for the demineralised water from the main power station. The purification of the hydrogen is not currently known and will be undertaken at detailed design and vendor selection process. The hydrogen generation plant will monitor water in hydrogen out and electricity usage in order to identify any unusual usages and maintain efficiency. Maintenance will be in accordance with the manufacturer's recommendations. This will include replacement of electrodes and membranes periodically.	FC
	You should consider: • electrical power needs and whether you will import or generate on site • high pressure steam need and availability (SOEC) • maximising any residual waste heat recovery	All utilities including demineralised water and electricity are provided by the main power station. There is no steam requirement as part of the hydrogen generation plant. There are no opportunities for heat recovery as the electrical demand for each electrolyser is low.	Y

Reference*	Guidance	Applicant's Proposals	Compliant Y/N/FC/NA**
	• cooling needs • cooling type and medium • energy recovery devices on high pressure fluids, for example, reverse osmosis effluent, where applicable	The cooling requirement of the hydrogen generation plant is not currently known and will be undertaken at detailed design and vendor selection process. It is not expected to require significant cooling demand given the small size of the electrolysers and air cooling may be sufficient. There are no high-pressure fluids as part of the hydrogen generation process due to demineralised water being produced by the main power station.	
	You should also consider heat integration optimisation. For example, heat recovery at higher temperatures from hydrogen compression systems for power generation or drives, where this is feasible.	There is no compression of the hydrogen undertaken. There is no opportunity for heat recovery due to hydrogen being produced through electrolysis, with no requirement from compression.	NA
	You should reference the BREF documents, where appropriate: • Industrial Cooling Systems • Energy Efficiency	The cooling requirement of the hydrogen generation plant is not currently known and will be undertaken at detailed design and vendor selection process. It is not expected to require significant cooling demand given the small size of the electrolysers and air cooling may be sufficient. The electrical demand is very small at 175 kW per electrolyser and energy efficiency will be adopted in the design where practicable.	FC
3.4 Water supply and use	Water supply and its efficient use is a fundamental aspect of hydrogen production by electrolysis of water. The quality of the water supply will determine the treatment needed before it can be used as a: • raw material in hydrogen production by electrolysis • heating medium (such as steam)	The water will be supplied from the demineralised water supply from the main power station. The water demand is expected to be low. Gaseous emissions of oxygen and hydrogen will be assessed in detailed design upon technology vendor selection. Water recovery or purge streams will be assessed in detailed design upon technology vendor selection. The cooling requirement of the hydrogen generation plant is not	FC

Reference*	Guidance	Applicant's Proposals	Compliant Y/N/FC/NA**
	• cooling medium Water is consumed in the process to make hydrogen in a minimum ratio of 9kg of pure water per 1kg of hydrogen gas produced. The remaining 8kg is oxygen as a gas. However, the gross quantity of water you bring into the installation needed per kg of hydrogen will be dependent on: • your choice of electrolysis method • the quality of the water which you use as your supply for the electrolysis process • the quantity of water you recover, recycle and re-use • the quantity of water which is discharged as a liquid effluent or gaseous emission to atmosphere • the cooling technique you use You should: • minimise the quantity of water you use • segregate, treat and re-use water where possible • identify how much contaminant needs to be removed to maintain the water quality necessary for effective operation • determine the quantity of water to be purged, the characteristics of that purged water, and design the treatment process accordingly • eliminate, minimise or treat any emissions to air or wastes that may result from the water	currently known and will be undertaken at detailed design and vendor selection process. It is not expected to require significant cooling demand given the small size of the electrolysers and air cooling may be sufficient.	

Reference*	Guidance	Applicant's Proposals	Compliant Y/N/FC/NA**
	treatment process • choose a cooling method that takes account of the impact of temperature on process performance, energy efficiency and environmental impact on the receiving medium		
3.5 **Electricity supply**	The source of power supply is not within the scope of this guidance. However, supply issues can affect the environmental performance of the hydrogen production process, such as through availability and variability. You should take this into account when you design and operate the hydrogen plant to eliminate or mitigate any environmental impact. It is likely that transformers and rectifiers, where needed as associated activities, would be considered part of the installation.	The electrical supply will be from the main power station electrical distribution system which will guarantee uninterrupted supply.	Y
3.6 **Hydrogen purification**	Your hydrogen purification requirements will depend on: • the hydrogen product quality specification • the production technique chosen • residual impurities in the hydrogen The impurities may include: • oxygen • water • other trace gases You should consider which other purification processes are appropriate, depending on the specification of	The purity of the hydrogen will be 99.99% but it is not known how the purification will be undertaken until detailed design and vendor selection processes have been completed.	FC

Reference*	Guidance	Applicant's Proposals	Compliant Y/N/FC/NA**
	hydrogen required. These may include: • deoxidiser system • dehydration system • other purification processes You should describe and justify your choice of techniques and the relevant aspects which will affect environmental criteria. For example: • consequential wastes and emissions • any recovery or treatment required		
4. Emissions to air			
	You should identify, eliminate, minimise or reduce any emissions to air that could cause pollution. You should carry out a risk assessment, including detailed air quality modelling where appropriate, to assess the impact of these emissions.	Emission to air will be assessed during detailed design stage, upon technology vendor selection and designed in line with BAT.	FC
4.1 Emissions of hydrogen	Hydrogen has been identified as an indirect greenhouse gas and so is considered a pollutant. You should design and operate your plant to achieve the following, which are listed in priority order. (Where technically and economically viable, and ensuring safety is not compromised.) • Prevent or avoid emissions of hydrogen. • Recover or recycle hydrogen. • Avoid or minimise continuous or intermittent	Emissions of hydrogen are prevented as far as practicable as the design of the plant is to use the hydrogen in the conditioning of the CO_2 which is to be captured as part of baseload operation. Venting scenarios will be assessed during detailed design stage, upon technology vendor selection and designed in line with BAT. Hydrogen from the Hydrogen Generation Unit will not be flared.	FC

Reference*	Guidance	Applicant's Proposals	Compliant Y/N/FC/NA**
	flaring of hydrogen. • Avoid or minimise continuous or intermittent venting of hydrogen, whether for operational or safety reasons.		
	You should consider using these techniques to achieve this: • designing and operating your plant to maximise equipment availability and reliability • designing and operating your plant to minimise the frequency of and amount of hydrogen purged, including during change of production rate, start-up and shutdown, abnormal operations and preparation for maintenance • use of buffer storage of out of specification hydrogen or hydrogen product during start-up and shutdown to minimise intermittent operation • recovery of hydrogen • treatment of hydrogen, for example, by recombination with oxygen or storage and purification of purged hydrogen • flaring rather than venting of hydrogen, where emissions cannot be eliminated and where practicable • designing flaring devices to ensure efficient combustion of hydrogen • venting hydrogen safely, where the above techniques are not practicable	The hydrogen production plant is to be used in conjunction with the carbon capture system which is designed for baseload usage. Therefore, there will be no need for different operational profiles and the number of start-up and shutdowns will be limited. There is a hydrogen buffer drum for each unit which can be used to buffer hydrogen availability to minimise impacts from start-up and shutdown. The site will not flare any hydrogen which may be released. Treatment and/or recovery of hydrogen will be assessed during detailed design upon technology vendor selection and designed in line with BAT. The venting of the hydrogen has been considered with regards to ATEX/DSEAR.	FC

Reference*	Guidance	Applicant's Proposals	Compliant Y/N/FC/NA**
	You should explain your design and operational considerations behind your proposed techniques, including how you have considered overall environmental impact of their use.		
4.2 Other emissions from venting or purging	You should quantify and assess other venting and purging requirements, identifying any pollutants that are expected to be present. Requirements for other continuous venting during normal operations may include, for example: • waste oxygen (which may contain hydrogen) • water vapour • deaeration of steam condensate • gases from processing wastewater streams • purge of tanks, vent or flare headers Requirements for intermittent venting may include, for example, venting needed as part of the process of purging equipment for maintenance activities. Such as nitrogen purges which may contain hydrogen.	Venting scenarios will be assessed during detailed design stage, upon technology vendor selection and designed in line with BAT.	FC
4.3 Other pollutants	You should identify, quantify and assess other pollutants. These may include, for example, nitrogen oxides (NOx) and hydrogen from flaring of hydrogen.	The hydrogen will not be flared and would therefore not generate any thermal NOx.	NA
5. Emissions to water			
	You must identify and eliminate, minimise, recycle or treat any emissions to water that could cause pollution.	There will be no emissions to water from the hydrogen generation plant.	NA

Reference*	Guidance	Applicant's Proposals	Compliant Y/N/FC/NA**
	You should carry out a risk assessment, including detailed modelling where appropriate, to assess the impact of these emissions.		
5.1 Wastewater treatment	You should identify continuous and periodic effluent streams from the process and determine whether effluent treatment is required. These streams may include waste streams from water pre-treatment processes, cooling and steam systems, including: • effluent from reverse osmosis containing ions from the feed water • effluent from continuous deionisation • effluent from desalination • purges from cooling water systems • purges from condensed water from steam systems These will contain contaminants, which may need treatment or removal before discharge, for example: • high salinity effluents • metal ions You should decide how much water to treat and how to treat it before it is: • re-used • discharged to surface water or sewage undertaker • disposed of	There will be no wastewater treatment as part of the hydrogen generation plant.	NA

Reference*	Guidance	Applicant's Proposals	Compliant Y/N/FC/NA**
	You should identify how much contaminant can be removed to comply with discharge requirements and design the treatment process accordingly. You should identify any unavoidable emissions to air or wastes that may result from the water treatment process. Ensure they are minimised or treated appropriately. You should treat water for re-use, where practicable. You should refer to the appropriate BREF, BATC and guidance: • BREF and BATC for common wastewater and waste gas treatment/management systems in the chemical sector • UK cross-cutting interpretation guidance and permitting advice on the best available techniques (BAT) conclusions published under the Industrial Emissions Directive (IED) • UK interpretation guidance and permitting advice on the best available techniques (BAT) conclusions for common waste water/waste gas treatment/management in the chemical sector (CWW) – available on request from your regulator		
6. Emissions to ground and groundwater			
	You must design your process to avoid emissions to ground and groundwater.	The hydrogen generation process will take place on hardstanding and prevent any release to ground or groundwater.	Y
7. Waste			
	You should consider how to deal with the following		

Reference*	Guidance	Applicant's Proposals	Compliant Y/N/FC/NA**
	wastes that may be generated and justify your choice following this waste hierarchy.		
7.1 Liquid wastes	Liquid wastes such as: • waste alkaline solutions, for example, potassium hydroxide • any residual liquid wastes from the water treatment processes	The only wastes to be generated are solid wastes	NA
7.2 Solid wastes	Solid wastes such as: • spent adsorbent materials from gas treatment, dehydration, hydrogen purification • spent or damaged membranes • catalyst materials • other solid consumables, for example, electrolyser components such as seals	The only wastes to be generated are solid wastes which comprise: • Membrane/cell • Anodes and cathodes These would be in small volumes and would be disposed of by approved waste contractors to an appropriate disposal/recovery facility.	Y
8. Monitoring and reporting			
	The main purpose of monitoring is to: • appropriately control the process to ensure compliance with the permit • show that emissions to air, water or land from the process are not causing harm to the environment You must also carry out process monitoring to show that resources are being used efficiently. This may include: • energy efficiency • water efficiency	Monitoring would be built into the hydrogen generation process and would include energy use, water use, hydrogen production along with a consideration of efficiency in how much is used per tonne of hydrogen. All monitoring will be undertaken in accordance with low carbon hydrogen standards where applicable.	Y

Reference*	Guidance	Applicant's Proposals	Compliant Y/N/FC/NA**
	• resource efficiency, for example, electrolyser consumables • verifying (when applicable) compliance with low carbon hydrogen standards, including any requirements relating to emissions of hydrogen		
	Your permit application should include a monitoring plan for: • routine operation • commissioning, where appropriate	A monitoring plan will be developed for routine operation and commissioning during the detailed design stage in line with BAT.	FC
	You may need to do more extensive monitoring during the commissioning phase than during routine operation. As these production techniques for hydrogen by electrolysis of water are emerging techniques, you may need to develop monitoring methods and standards.	No hydrogen MCERTS are currently available. Drax during the vendor selection phase will enter into discussion with vendors/EPC contractors as to the monitoring to be undertaken during the commissioning process.	FC
	Where relevant, during the commissioning phase, you will need to assess any monitoring results and optimise the operation of the process. You may need to report on: • your commissioning phase monitoring results • your assessment of the results • any changes you want to make to the operation You must report on emissions and process monitoring as stated in your permit.	The intent of any commissioning process is to optimise the equipment to ensure maximum efficiency/output during normal operation. The EA will be presented with a commissioning report at the end of this phase which would include all monitored results.	Y
8.1 Monitoring point source	You should eliminate or minimise emissions of hydrogen due to their global warming potential. You should provide a monitoring plan for monitoring	The intention of the process is to capture hydrogen for use in the conditioning of the CO_2. Emissions of hydrogen will be assessed during detailed design stage,	FC

Reference*	Guidance	Applicant's Proposals	Compliant Y/N/FC/NA**
emissions to air	emissions to air, based on expected pollutants such as hydrogen. You should do this using appropriate methods and measuring techniques. Your monitoring should consider, for example, any other sources of hydrogen emissions, such as venting and fugitive emissions, including vented oxygen.	upon technology vendor selection and designed in line with BAT. These release points would be subject to periodic monitoring. A monitoring plan will be developed for routine operation and commissioning during the detailed design stage.	
8.2 **Monitoring emissions to water**	You must monitor emissions to water based on expected impurities using appropriate methods and measuring techniques. You should use monitoring standards for discharges to water following BATC for common waste water and waste gas treatment/management system in the chemical sector.	There will be no emissions to water.	NA
8.3 Monitoring emissions to ground and groundwater	Through the life of the permit, your regulator may require a: • site condition and baseline report • soil and groundwater monitoring plan	The main power station site has in place a site condition and soil and groundwater reports. The hydrogen generation process will take place on hardstanding which will prevent any release to ground or groundwater.	Y
8.4 **Monitoring standards**	The person who carries out your monitoring must be competent and work to recognised standards, such as the monitoring certification scheme (MCERTS). MCERTS sets the monitoring standards you should meet. You can use another certified monitoring standard, but you must provide evidence that it is equivalent to the MCERTS standards.	Only MCERTS accredited companies will be employed for monitoring. However, the relevant MCERTS standard is not currently available for the pollutants to be measured such as hydrogen.	Y

Reference*	Guidance	Applicant's Proposals	Compliant Y/N/FC/NA**
	You must use a laboratory accredited for the required analysis method by the United Kingdom Accreditation Service (UKAS) to carry out analysis for your monitoring. You should also refer to the JRC reference report on monitoring for IED installations.		
8.5 Monitoring process performance	You should identify the main requirements for monitoring process operations where these ultimately impact on environmental performance. This includes: • energy consumption per kg of hydrogen product • water consumption per kg of hydrogen product You should monitor energy efficiency in the hydrogen production by measuring energy consumption per kg of hydrogen produced to calculate overall energy consumption.	Monitoring would be built into the hydrogen generation process and would include energy use, water use, hydrogen production along with a consideration of efficiency in how much is used per tonne of hydrogen.	Y
	You should monitor overall water use by quality of water and purpose of use by carrying out a water balance across the installation. This is to: • identify opportunities for reduction in water use, where technically and economically feasible • consider other environmental impacts, such as energy efficiency Requirements for process performance monitoring which relate to environmental performance, either continuous or periodic, may also be a condition of the permit. For example, frequency of operations leading to additional emissions.	Demineralised water only will be used from the main power station supply. This will be monitored to the hydrogen generation plant to manage the usage of water.	Y

Reference*	Guidance	Applicant's Proposals	Compliant Y/N/FC/NA**
9. Unplanned emissions and accidents			
	You should design your plant to: • inherently avoid leaks by good design practice • ensure the plant is operated and maintained to appropriate industry standards You should propose a risk-based leak detection and repair (LDAR) programme that is appropriate for the fluids and their composition. This should use available industry best practice to minimise releases, including from: • joints • flanges • seals • glands You should include how you will use the principles of LDAR to eliminate or reduce fugitive emissions of hydrogen due to its global warming potential. Your hazard assessment and mitigation for the plant must consider the risks of accidental releases to the environment.	The hydrogen generation plant is intrinsically designed to be airtight and avoid leaks given the explosion and fire potential of hydrogen. Equipment upon installation and periodically thereafter will be pressure tested to ensure the process and pipework is competent and that there are no leaks. All equipment will be part of the planned preventative maintenance programme and be maintained in accordance with the manufacturer's recommendations. In addition, the containers will include a hydrogen sensor which would alarm in the event of hydrogen release. The use of LDAR principles to eliminate or reduce fugitive emissions of hydrogen will be established during the detailed design stage.	FC
10. Noise			
	You should consider sources that have potential for noise and vibration. Hydrogen compression, pumps and fans could be significant sources. Please refer to the guidance on noise and vibration	The major noise source associated with hydrogen generation is compression, which does not occur with the proposed system. All equipment is located within a container and is to be specified as less than 82 dB at 1m and given the distance to residential receptors	Y

Reference*	Guidance	Applicant's Proposals	Compliant Y/N/FC/NA**
	management: environmental permits.	would not have a significant impact.	

* The reference number corresponds with the numbering as set out in the Hydrogen production by electrolysis of water: emerging techniques - GOV.UK

** Y = Yes; N = No; FC = Future compliance; NA = Not applicable

Annex 2: Pre-operational and Improvement Conditions

A) Pre-operational conditions

The following pre-operational conditions have been included in table S1.4 of the varied Permit as a result of this variation Application:

Pre-operational conditions			
Reference	**Operation**	**Pre-operational measures**	**Justification**
29)	Commissioning of each carbon capture plant	**Commissioning plan** At least 3 months prior to the commencement of commissioning of each carbon capture plant, the operator shall submit a written commissioning plan, including timelines for completion, to the Environment Agency for the Environment Agency's written approval. The commissioning plan shall include, but not be limited to: • The timelines for the commissioning and the expected durations of these activities. • The expected emissions to the environment during the different stages of commissioning; risk assessment demonstrating that the environmental risks are not significant throughout all the phases of commissioning; the expected durations of commissioning activities and the actions to be taken to protect the environment and report to the Environment Agency in the event that actual emissions exceed expected emissions. • A Commissioning Monitoring Plan. • A methodology for approval to demonstrate the carbon capture efficiency of the plant. The approved methodology shall be used to demonstrate the carbon capture efficiency of the plant as part of the commissioning activities, and, after the commissioning phase, for process monitoring and reporting purposes in compliance with the conditions of the permit. • A methodology for approval for quantifying total mass of CO_2 emissions during short duration venting that may be required during the start-up sequence of the carbon capture plant and during other than normal operating conditions. The commissioning activities shall be carried out in accordance with the commissioning plan approved by the Environment Agency.	This is a standard pre-operational measure that is included in permits where new equipment is proposed. The purpose of the commissioning plan is to inform us of how the Operator will carry out the commissioning of the plant, what monitoring will be undertaken and what other tests will be undertaken to demonstrate that the built plant can meet the design objectives and the conditions in the permit. Once we have agreed the proposals, the Operator has to carry out the commissioning in accordance with the agreed plan.

Pre-operational conditions			
Reference	**Operation**	**Pre-operational measures**	**Justification**
30)	Commissioning of each carbon capture plant	**Process monitoring methods** Following the completion of the final design of the carbon capture plant and at least 6 months prior to the commencement of commissioning the operator shall submit to the Environment Agency for the Environment Agency's written approval proposed methodologies for the following process monitoring requirements for absorber amine solvent quality as required in table S3.4 of this permit: • percent active amine • carbon dioxide loading (rich amine) • heat stable salts • soluble iron concentration (rich and lean amine) • colour • degradation products	Process monitoring is specified in table S3.4 of the varied Permit and the Operator is required to carry out this monitoring in order to demonstrate that the PCC operates in accordance with the design and the permit conditions. The Operator is required to provide details of the proposed methodologies they will use to determine the solvent quality throughout the process to demonstrate that the PCC is functioning in accordance with its design.
31)	Commissioning of each carbon capture plant	**Carbon capture plant other than normal operating conditions (OTNOC) plan** Following the completion of the final design of the carbon capture plant and prior to the commencement of commissioning of each carbon capture plant, the operator shall submit to the Environment Agency for the Environment Agency's written approval a carbon capture plant OTNOC management plan. The plan shall include: (i) Any potential 'other than normal operating conditions (OTNOC)' for the carbon capture plant, taking into consideration both internal and external causes of OTNOC. (ii) Details of measures to: • minimise the occurrence of OTNOC that are within the operator's control; and • reduce the impact of all OTNOC events. (iii) Proposals for reviewing and optimising capture performance periodically so capture rates are as high as reasonably practicable during these periods. The OTNOC plan shall be included in the EMS.	In relation to Units 1 and 2 which are proposed to be fitted with PCC, operation with PCC would be considered to be the normal operational conditions. However, there will be times when the PCC plant is not available, and this condition requires the Operator to specify the circumstances which would prevent operation of the PCC and to consider how these can be minimised.

Pre-operational conditions			
Reference	**Operation**	**Pre-operational measures**	**Justification**
32)	Commissioning of each carbon capture plant	**Monitoring standards** At least six months prior to (or other date agreed in writing with the Environment Agency) the commencement of commissioning of the carbon capture plant, the operator shall submit a report in writing to the Environment Agency, and obtain the Environment Agency's written approval for it, specifying arrangements for continuous and periodic monitoring of emissions to air from the carbon capture emission point to comply with EN 15259 and Environment Agency guidance notes on monitoring stack emissions measuring locations, techniques and standards for periodic monitoring and for quality assurance of CEMS: Monitoring stack emissions: carbon capture plants with solvent-based abatement - GOV.UK Monitoring stack emissions: techniques and standards for periodic monitoring - GOV.UK Monitoring stack emissions: quality assurance of continuous monitoring - GOV.UK Monitoring stack emissions: measurement locations - GOV.UK The report shall include the following: • Details of monitoring locations, access and working platforms. • Evidence that CEMS are MCERTS certified at the appropriate range. • Evidence that data handling and acquisition systems are MCERTS certified. • Methods and standards for periodic monitoring. Procedures for the quality assurance of CEMS, which includes evidence of completion of CEMS' functional tests and setting up quality assurance level (QAL) 3 checks, prior to completing a QAL2.	This is a standard pre-operational condition that is included in permits where monitoring of emissions to air is required. As the design of the PCC was not finalised at the time the Application was made, this condition requires the Operator to provide the standards to which monitoring will be carried out and the locations where monitoring will take place. The Operator will need to demonstrate that their proposals are in accordance with published guidance to ensure that any monitoring carried out can be considered to be appropriate and, therefore, the results are representative of the emissions.

Pre-operational conditions			
Reference	**Operation**	**Pre-operational measures**	**Justification**
33)	Commissioning of each carbon capture plant	**Carbon capture performance** At least 3 months prior to the commencement of commissioning, the operator shall submit the following methodologies to the Environment Agency for the Environment Agency's written approval: • A methodology to demonstrate the carbon capture efficiency of the plant. The approved methodology shall be used to demonstrate the carbon capture efficiency of the plant as part of the commissioning activities, and, after the commissioning phase, for process monitoring and reporting purposes in compliance with the conditions of the permit. • A methodology for quantifying total mass of CO_2 emissions during short duration venting that may be required during the start-up sequence of the carbon capture plant and during other than normal operating conditions.	Our guidance on emerging techniques for PCC requires that up to 95% of CO_2 is captured in the PCC absorber. This condition is set to require the Operator to provide a methodology that is appropriate to demonstrate what the capture level is.

Pre-operational conditions			
Reference	**Operation**	**Pre-operational measures**	**Justification**
34)	Commissioning of each carbon capture plant	**Storage and containment infrastructure** Following the completion of the final design for the carbon capture plant, and prior to the commencement of commissioning operations, the operator shall submit a report in writing on the containment infrastructure to the Environment Agency for the Environment Agency's written approval. The report shall include information on the detailed design and construction specification of the primary, secondary and tertiary containment infrastructure associated with the carbon capture plant. The report shall demonstrate that the containment systems have been designed and specified by suitably qualified and experienced engineers to comply with the requirements of CIRIA Report 736 – 'Containment systems for the prevention of pollution' 736, addressing the key elements which include: • updating the risk assessment and classification to identify the class of containment required; • developing the specification and design of the primary, secondary and tertiary containment appropriate to the class of containment, taking into account CIRIA 736 guidance on bunding, further containment and transfer systems; • demonstrating that design has taken into account the capacity requirements, including the capacity of the inventory to be contained, allowance for rainfall, firefighting and cooling water provision; and • demonstrating that the isolation and operating philosophy for the secondary and tertiary containment infrastructure prevents accidental emissions to the environment. The operator cannot begin the commissioning operations of the PCC plants, including any associated activities, until it has obtained approval in writing from the Environment Agency to this pre-operational condition.	As the design of the PCC and its associated infrastructure is not finalised, this condition requires the Operator to specify the design and construction for all the infrastructure for storing and containing the solvent, waste solvent and other associated raw materials to demonstrate that this will be carried out in accordance with published standards.

Pre-operational conditions			
Reference	**Operation**	**Pre-operational measures**	**Justification**
35)	Commissioning of each carbon capture plant	**Noise Impact Assessment (NIA)** Following the completion of the final design of the carbon capture plant and at least 6 months prior to the commencement of commissioning, the operator shall submit an updated NIA to the Environment Agency for the Environment Agency's written approval. The revised NIA shall be informed by updated and final noise emissions data provided by equipment manufacturers during the detailed engineering design of the plant, taking into account the detailed noise attenuation measures included in the design according to BAT. The revised NIA shall be carried out by an experienced and suitably qualified person (i.e. a noise consultant with an appropriate qualification accredited by the Institute of Acoustics), in accordance with the procedures given in BS4142:2014 (Rating industrial noise affecting mixed residential and industrial areas) and BS7445: 2003 (Description and measurement of environmental noise).	The design of the PCC was not finalised at the time the Application was made, so this condition requires the Operator to carry out a NIA based on the noise emissions data provided by the manufacturers of the actual equipment to be used and the noise attenuation measures included in the design, to determine the impact of the as-built PCC.
36)	Commissioning of each carbon capture plant	**The leak detection and repair (LDAR) and fugitive emissions minimisation and monitoring plans** Following the completion of the final design of the carbon capture plant and prior to the commencement of commissioning of the carbon capture plant, the operator shall submit to the Environment Agency for the Environment Agency's written approval, the LDAR and fugitive emissions minimisation and monitoring plans for the carbon capture plant, solvent and hydrogen. The LDAR and fugitive emissions monitoring plans shall be included in the EMS.	The design of the PCC was not finalised at the time the Application was made, so this condition requires the Operator to develop a plan for detecting and monitoring fugitive emissions from the storage and use of the solvent and other raw materials.
37)	Commissioning of each carbon capture plant	**CO_2 compression system** Following the completion of the final design of the carbon capture plant and prior to the commencement of commissioning of the carbon capture plant, the operator shall submit to the Environment Agency for assessment and written approval, details of the system to be used to compress CO_2.	As the design of the compression system depends on the operator of the pipeline into which the CO_2 will be discharged for transport to the geological storage site, the Applicant only provided limited details of the compression system with the Application. This condition requires the Operator to provide the details of the compressor once the design is finalised.

Pre-operational conditions			
Reference	**Operation**	**Pre-operational measures**	**Justification**
38)	Commissioning of each carbon capture plant	**CO_2 venting assessment** Following the completion of the final design of the carbon capture plant and at least 12 months prior to the commencement of commissioning, the operator shall submit to the Environment Agency for assessment and the Environment Agency's written approval a report that reviews and updates the outcomes of the CO2 venting emissions to air risk assessment presented in the application EPR/VP3530LS/V022. This report shall include but not be limited to: • Confirmation of the vent location(s) and an updated drawing showing the location and reference of the vents; • Confirmation of the height and diameter of the vents; • Information on how modelling has been used to inform the process design and manage risks associated with CO2 venting. This should include a description of the different potential venting scenarios; • Confirmation that the design is in line with industry best practice, such as that produced by the Energy Institute, or other equivalent guidance; • A description of the operating techniques that will minimise the risks associated with venting CO2 to atmosphere and limit venting scenarios to those considered in their application; • A vent management plan which is in keeping with our published guidance on emerging techniques for post-combustion carbon capture and industry best practice, such as that produced by the Energy Institute, or other equivalent guidance.	An assessment of the venting of CO_2 was provided in response to our information notice, but this is not based on the final design of the PCC. This condition requires the Operator carry out the risk assessment again based on the final design and to submit a vent management plan (based on the final design) that details the measures to be taken to ensure venting is minimised and that any venting that takes place is controlled.
39)	Commissioning of each carbon capture plant	**CO_2 dehydration** Following the completion of the final design of the carbon capture plant and prior to the commencement of commissioning of the carbon capture plant, the operator shall submit to the Environment Agency for the Environment Agency's written approval details of the methodology and substances to be used to dehydrate the captured CO_2.	At the time the Application was made, the design of the PCC was not finalised and the details of the material to be used to dehydrate the captured CO_2 was not known. This condition requires the Operator to provide that information.

Pre-operational conditions			
Reference	**Operation**	**Pre-operational measures**	**Justification**
40)	Commissioning of each carbon capture plant	**CO_2 monitoring** Following the completion of the final design of the carbon capture plant and prior to the commencement of commissioning of the carbon capture plant, the operator shall submit to the Environment Agency for the Environment Agency's written approval: • Details of the locations of monitoring points used to monitor CO2 to determine capture rates; • Details of the monitoring of CO2 quality, including location and methods, prior to storage and dispatch off-site.	At the time the Application was made, the design of the PCC was not finalised so the Applicant had not decided where the CO_2 monitoring locations will be. This condition requires the Operator to provide that information once the design is finalised.
41)	Commissioning of the hydrogen generation plant	**Hydrogen generation plant** Following the completion of the final design of the hydrogen generation plant and prior to the commencement of commissioning of the hydrogen generation plant, the operator shall submit to the Environment Agency for the Environment Agency's written approval, a report that includes: • A review of the final design and proposed operation of the hydrogen generating plant against the emerging techniques guidance: Hydrogen production by electrolysis of water: emerging techniques • An updated site layout plan that shows the location of the hydrogen generating plant and any emission points.	The Applicant provided a review of the proposed hydrogen generation plant against the emerging techniques guidance for hydrogen production by electrolysis. However, the final design of the plant was not yet known and the Applicant committed to meeting the standards required by the guidance but without submitting the final design details. This condition requires the Operator to provide the details once the final design of the plant has been determined.

Pre-operational conditions			
Reference	**Operation**	**Pre-operational measures**	**Justification**
42)	Operation of the carbon capture plant	**Waste management plan** Prior to commencement of operation of the carbon capture plant, the operator shall submit to the Environment Agency for the Environment Agency's written approval a Waste Management Plan for the wastes arising from the operation of the carbon capture plant that includes, but is not limited to: • Details of the waste streams and quantities produced by the carbon capture process; • The hazardous properties associated with the waste streams; • Details of the storage for the waste streams, including segregation, containment and bunding as appropriate; • Details of the fate of the waste streams including disposal or recovery off-site; and • Confirmation that the Waste Management Plan for the wastes from the carbon capture activity has been included in the site's Environmental Management System	The Applicant stated in the Application that until the final design of the PCC is known and the PCC is operated the type and quantity of waste wouldn't be known. This condition requires the Operator to provide a Waste Management Plan with the details of the types, quantities, fates and storage arrangements once the PCC has been commissioned and before it commences operation as some wastes will be produced during commissioning and the Plan can be developed based on this.
43)	Construction of each carbon capture plant	**Decommissioning Plan for the ash pits** Following completion of the final design of the carbon capture plant and prior to commencement of construction, the operator shall submit to the Environment Agency for the Environment Agency's written approval a Decommissioning Plan for ash pits 3, 4, 5 and 6 and details of the ash handling system and management for discharge of ash from Units 1 to 4 to ash pits 1 and 2.	If the PCC is developed, some of the ash pits (used for storage of the ash from the combustion of the biomass fuel prior to removal off-site) will have to be demolished to make space for the PCC to be built. This condition requires the Operator to provide details of the decommissioning of the ash pits and the associated changes to the handling system and management of ash from Units 1 to 4.

Pre-operational conditions			
Reference	**Operation**	**Pre-operational measures**	**Justification**
44)	Commissioning of each carbon capture plant	**Site layout and drainage plans** Following the completion of the final design of the carbon capture plant, the operator shall submit the following plans to the Environment Agency: • The final site layout of the carbon capture plant and its associated infrastructure, including the CO_2 compressor, the hydrogen production plant, the wastewater treatment plant, solvent and other raw material storage and the storage areas for wastes generated by the carbon capture activity. • The site drainage system, taking account of the changes as a result of the installation of the carbon capture plant and its associated infrastructure.	These plans were submitted with the application as an indication of the layout and location of the PCC plant and the associated infrastructure and to indicate the changes required to the drainage system. This condition requires the operator to provide the final versions of these drawings once the final design of the PCC is completed.
45)	Prior to construction of Carbon capture activity AR8	**Confirmation of carbon capture activity AR8** The operator shall confirm in writing to the Environment Agency that it is intending to carry out the carbon capture activity.	The wastewater treatment plant for treating effluent from the flue gas treatment can only be installed if the existing wastewater treatment plant for treating effluent from the FGD plant. In order that both activities are not operated at the same time and to provide the flexibility that the operator requested, we have included this condition so that the operator informs us when they have decided to go ahead with the installation of carbon capture plant, so that the existing activity then ceases.

B) Improvement Conditions

The following improvement conditions have been included in table S1.3 of the varied Permit as a result of this variation Application:

Improvement Conditions			
Reference	**Requirement**	**Date**	**Justification**
IC51D	**Calibration and verification testing** The operator shall submit a written summary report in writing to the Environment Agency to confirm the results of calibration and verification testing show that the performance of the Continuous Emission Monitors for parameters as specified in Table S3.1a comply with the requirements of BS EN 14181, specifically the requirements of QAL1, QAL2 and QAL3. The report shall include the results of calibration and verification testing.	Initial calibration report to be submitted to the Environment Agency within 3 months of completion of commissioning of each carbon capture plant. Full summary evidence compliance report to be submitted within 18 months of completion of commissioning of each carbon capture plant.	This is a standard improvement condition that is included in permits where continuous monitoring is proposed. The Operator is required to carry out checks to demonstrate that the equipment is functioning appropriately.

Improvement Conditions			
Reference	**Requirement**	**Date**	**Justification**
IC52D	**<u>Monitoring location standards</u>** During commissioning, the operator shall carry out tests to assess whether the new air emissions monitoring locations between the absorber and the main stack as provided in accordance with reference PO32 in table S1.4 meet the requirements of BS EN 15259 and supporting Method Implementation Document (MID). A report shall be submitted in writing to the Environment Agency for the Environment Agency's written approval setting out the results and conclusions of the assessment including where necessary proposals for improvements to meet the requirements. Where notified in writing by the Environment Agency that the requirements are not met, the operator shall submit proposals or further proposals for rectifying this in accordance with the time scale in the notification. The proposals shall be implemented in accordance with the Environment Agency's written approval.	Report to be submitted to the Environment Agency within 3 months of completion of commissioning of each carbon capture plant.	This is a standard IC that is included in permits where monitoring air emissions is proposed. This IC is related to the pre-operational measure PO32 which requires the Operator to confirm that the monitoring locations are in accordance with our guidance so are fit for purpose. This IC requires the Operator to demonstrate that the actual monitoring locations meet the required standards.

Improvement Conditions			
Reference	**Requirement**	**Date**	**Justification**
IC53D	**<u>Commissioning</u>** The operator shall submit a report in writing to the Environment Agency for the Environment Agency's written approval on the commissioning of the carbon capture plant. The report shall summarise the environmental performances of the carbon capture plant as set out in the commissioning plan required by pre-operational condition PO29 in table S1.4 of this permit. The report shall include: • A summary of the environmental performance of the carbon capture plants as installed against the design parameters and risk assessments set out in the application and updated in response to the pre-operational conditions in this permit; and • A review of the performances of the carbon capture plant against the conditions of this permit and details of procedures developed during commissioning for achieving and demonstrating compliance with permit conditions and confirmation that the Environmental Management System (EMS) has been updated accordingly.	Within 3 months of the completion of commissioning of each carbon capture plant.	This is a standard improvement condition that is included in permits where new equipment is installed. This IC is related to pre-operational measure PO29 and requires the Operator to provide a summary of the performance of the PCC determined during commissioning.

Improvement Conditions			
Reference	**Requirement**	**Date**	**Justification**
IC54D	**<u>Carbon capture performance</u>** The operator shall submit a report in writing to the Environment Agency for the Environment Agency's written approval detailing the carbon capture efficiency of the Carbon Capture Plant under normal operating conditions (calculated using the methodology as approved in accordance with pre-operational condition PO35 in table S1.4 of this permit) averaged over one year of operation as specified in table S3.3 (performance monitoring) of this permit. Should the carbon capture efficiency during normal operating conditions be reported to be less than the design capture performance specification of 95%, the operator shall carry out an analysis of the issues affecting the performance of the plant with respect to achievement of the 95% carbon capture rate and either: • Submit written proposals for remedial actions designed to improve capture efficiency to the Environment Agency for approval; or • Provide an acceptable justification to the Environment Agency that a 95% capture rate is not reasonably achievable, and that no further remedial action is to be taken. The operator shall implement any proposals identified within the report in accordance with the Environment Agency's written approval and within the approved timescales.	Within 15 months of the completion of commissioning of each carbon capture plant.	Our emerging techniques guidance for PCC requires that PCC plants aim to achieve a capture rate of 95%. This IC requires the Operator to provide evidence that the operational plant can achieve a capture rate of 95% after operation for a 12 month period and, where this is not achieved, to propose measures to improve the capture rate where it is reasonably achievable.

Improvement Conditions			
Reference	**Requirement**	**Date**	**Justification**
IC55D	**Amine solvent degradation** The operator shall submit a report in writing to the Environment Agency for the Environment Agency's written approval on the degradation of absorber solvent quality. The report shall review the findings from the monitoring of absorber solvent quality over 12 months of operation, including but not limited to the monitoring carried out in accordance with table S3.4 of this permit. The report shall include: • An investigation into the reasons for solvent degradation and how degradation affects the performance of the plant over time; • A review of the options for reducing the rate of solvent degradation; and • Proposals for the implementation of any measures identified from the review. The proposals shall be implemented in accordance with Environment Agency's written approval.	Within 15 months of the completion of commissioning of the carbon capture plant.	When the solvent is used in the capture process, its quality degrades due to impurities in the flue gas and the reactions within the absorber. Therefore, the capture rate could reduce. We have set process monitoring in table S3.4 of the varied Permit requiring the Operator to monitor the performance of the solvent and replace it as required. This IC requires the Operator to provide a report that includes a review of the process monitoring data after 12 months of operation to determine the impact on solvent quality and to propose any improvements to the rate of solvent degradation so that the use of fresh solvent is minimised and the PCC operates optimally.
IC56D	**Air emissions risk assessment (Carbon capture plant)** The operator shall submit a report in writing to the Environment Agency for the Environment Agency's written approval. The report must contain an emissions to air risk assessment in line with the Environment Agency's guidance which is based on sampled and monitored emissions data from emission point A1 in table S3.1a. Emissions monitoring data obtained during the first year of operation shall be used to compare the actual emissions with those assumed in the impact assessment submitted with the permit application EPR/VP3530LS/V022 ('Air Emissions Risk Assessment' dated November 2024, 'BECCS Environmental Permit Variation Application Schedule 5 Response: Q4' dated July 2025 and 'Drax Power Station Environmental Permit Variation V022 Schedule 5 Notice Part 5', dated 25/02/2026). For any parameters not included in the original impact assessment, or those showing to be at concentrations higher than those assumed in the impact assessment submitted in the application, unless alternative measures have been submitted to and agreed in writing by the Environment Agency, an assessment shall be made of the impact to human health and	Within 15 months of commencement of operation of each carbon capture plant.	The emission limits and parameters from the PCC that are required to be monitored as specified in table S3.1a are based on predicted emissions. This IC requires the Operator to compare actual monitoring data from 12 months of operation with the predicted emissions and determine if the air emissions risk assessment that was provided with the Application is appropriate. Where parameters or concentrations are different the Operator is required to carry out an air emissions risk assessment based on the actual emissions. Where this revised assessment shows that environmental standards may be exceeded, the Operator is required to propose measures to reduce the emissions to acceptable levels.

Improvement Conditions			
Reference	**Requirement**	**Date**	**Justification**
	habitats of each parameter using the 'Air emissions risk assessment for your environmental permit - GOV.UK (www.gov.uk)' guidance. Where Environmental Assessment Levels (EALs) for emitted substances are not available on the current published EAL list on gov.uk the operator should propose a new EAL. To derive a new EAL, the operator should follow the Environment Agency's published guidance on air emissions risk assessments. Where the updated environmental risk assessment shows a risk of causing exceedances of the EALs, the operator shall propose remedial actions to reduce the emissions of these pollutants to acceptable levels approved in writing by the Environment Agency. The operator must implement the proposals in the report in line with the timescales in accordance with the Environment Agency's written approval.		

Annex 3: Consultation

A) Advertising and Consultation on the Application

The Application has been advertised and consulted upon in accordance with the Environment Agency's Public Participation Statement. The way in which this has been carried out along with the results of our consultation and how we have taken consultation responses into account in reaching our draft decision is summarised in this Annex. Copies of consultation responses have been placed on the Environment Agency public register.

The Application was advertised on the Environment Agency website from 26/05/2023 to 29/06/2023 and in the Yorkshire Post on 01/06/2023. The Application was made available to view digitally on the Environment Public Register.

The following statutory and non-statutory bodies were consulted: -

- Food Standards Agency
- Health and Safety Executive
- UK Health Security Agency
- North Yorkshire Council
- Yorkshire Wildlife Trust

1) Consultation Responses from Statutory and Non-Statutory Bodies

Response Received from North Yorkshire Council	
Brief summary of issues raised:	**Summary of action taken / how this has been covered**
The draft DCO stipulates operating noise limits. The applicant has concluded in the risk assessment that the probability of exposure is low and modelled noise emissions have been found to be insignificant. Due to the restrictions in the draft DCO, advise that there are adverse impacts and that these should be considered in the context of the applicant's assessment.	We did not consider that the noise impact assessment submitted with the application was appropriate and asked for additional information in our schedule 5 notice dated 23/10/2023. We have reviewed the revised noise impact assessment and conclude that the noise from the operation of the PCC and CO_2 compression will not change the current soundscape. The noise from the existing operations is calculated to have a significant adverse effect at nearby receptors. However, there have been no complaints of noise, and the power station has been in operation since the 1970s. This is discussed in section 5.5.2 of this document.

2) Consultation Responses from Members of the Public and Community Organisations

We received 10 responses from members of the public and other community organisations.

a) Representations from Community and Other Organisations

Representations were received from the following 7 community and other organisations:

- The Association of Independent Meat Suppliers
- Mitsubishi Heavy Industries
- University of Sheffield
- BSI Group
- Just Transition Wakefield
- Stop Burning Trees Coalition (2 responses)
- The LifeScape Project

Brief summary of issues raised:	**Summary of action taken / how this has been covered**
Disclosure	
Failure to disclose information on the chemicals present in the capture unit and the way they will be managed hampers the public's ability to respond.	We did not agree with the Applicant's assessment of the emissions from the PCC and asked for further information to be provided in our information notice dated 27/07/2023. Additional information regarding the substances present in the absorber column and the emission of those substances and their breakdown products was provided in their response dated 29/11/2024. We have asked for information regarding the handling and storage of the solvents in our information notices dated 23/10/2023 and 11/07/2024 and this was provided in the Applicant's responses dated 31/03/2024 and 10/10/2024. We are satisfied that the Operator will have appropriate measures in place to store and handle the solvents without causing pollution of the environment or harm to human health. See section 5.5.3 of this document.
The lack of information on the solvent prevents effective independent assessment of the impact of emissions and concern that the assessment is not sufficiently robust as it fails to identify all effects of the emissions.	We did not consider that that the Applicant had provided sufficient information regarding the emissions of amines and their breakdown products from the absorber column. Therefore, we requested further information. Additional information regarding the substances present in the absorber column and the emission of those substances and their breakdown products was provided in their responses dated 29/11/2024 and 27/01/2025 to our information notice together with a revised impact assessment. We consulted on the revised impact assessment on 04/02/2025 and placed a copy of the impact assessment on the public register. See section 5.1 of this document.
Withholding information is at variance with relevant regulatory requirements: 'But to the extent that information relates to emissions, the regulator must determine to include it on the public register.'	Information regarding emissions has not been withheld from the public register. A copy of the revised air impact assessment that includes all emissions from the absorber column based on the assumption that all substances in the absorber column are emitted was provided in response to our information notice. This was placed on the public

Brief summary of issues raised:	Summary of action taken / how this has been covered
	register and no claim for confidentiality was received for any of this information.
Appendix F does not contain the words 'The amines used in the MHI capture plant are:' The black box under the text: 'The amines emitted to air from the MHI capture plant are:' is presumably covering the name of the third emitted amine.	Although the commercial confidentiality claim requested that the text after 'The amines used in the MHI capture plant are:' should be redacted and withheld from the public register, this text was in fact redacted as well as the names of the solvents. The redacted text in the 'black box' under the text 'The amines emitted to air from the MHI capture plant are:' is the name of one of the solvents but the Applicant has stated that it is not emitted. Therefore, as the Applicant had claimed it was not emitted, we agreed that the name could be withheld from the public register as it would not be an emission.
It is factually incorrect to state in the Applicant's letter that the 'CIC information does not relate to emissions from the plant'. All amines and other components could be emissions. Therefore, the Applicant has failed to disclose the name of one of the solvents that is going to be unavoidably emitted.	We did not agree with the Applicant's assessment of what the emissions are from the carbon capture plant as they had not provided any evidence to support their assessment. In our information notice dated 27/07/2023, we asked the Applicant to provide details of all the substances emitted from the carbon capture plant on the basis that everything in the absorber column would be emitted. The Applicant provided this information on 29/11/2024. This was placed on the public register and no claim for confidentiality was received for any of this information.
Concerns were raised that there should be full disclosure of the solvent as it impacts on emissions and efficiency. This means there is a lack of information regarding where this solvent lies on the balance between energy efficiency and formation of nitrosamines and no comparison can be made between the proposed operational scenario and the tests from which the performance information has been derived.	We did not agree with the Applicant's emissions profile and the assessment of these emissions to air. We requested a revised emissions profile and its assessment in our information notice dated 27/07/2023, which was received on 29/11/2024. We are satisfied that the emissions profile is a better representation of the emissions from the process and the emissions also include the components of the solvent. The Applicant has compared the KS21 solvent against MEA (which is considered the base case solvent for carbon capture as it is the most understood) in terms of its energy efficiency, water use and emissions. This is described in section 4.2 and Annex 1 of this document. We are satisfied that the Applicant has considered the solvent choice in accordance with our PCC emerging techniques guidance which we consider to be BAT for this sector. We have set a requirement for monitoring of emissions and performance in tables S3.1a and S3.4 and we have set IC56D in table S1.3 that requires the Operator to carry out an air emissions risk assessment based on 12 months

Brief summary of issues raised:	Summary of action taken / how this has been covered
	of monitoring data to confirm the predicted emissions.
Request for full disclosure of the solvent performance information and the details of the tests to show the basis for the impact assessments.	The Applicant provided information regarding the solvent performance, tests and emissions, as follows: • Sections 2.4 and 2.5 of Second Stage Information Report V2.0 received 12/05/2023 • Response to information notice No. 1 on 29/11/2024 – Appendix C Specification of Emissions for Control by Emission Limits • Response to information notice No.2 on 31/03/2024 – Appendix G Reclaiming Campaign and Appendix H KS-21 Final Test Report All the above were placed on the public register.
It is expected that all data from relevant trials would have been made available as the exact chemicals present are important in understanding the release and dispersion processes and impacts.	We did not agree with the Applicant's assessment of emissions from the capture plant and requested further information in our notice dated 27/07/2023. The Applicant provided additional information on 29/11/2024 which included information on how the emissions to air from the absorber column have been determined.
Emissions	
Reasonable attention has not been given to the fact that the amine capture solvent in the plant becomes a complex mixture of chemicals with time due to secondary reactions and a failure to identify what is possibly known about this.	We did not agree with the Applicant's assessment of the emissions from the capture plant and requested further information in our notice dated 27/07/2023. We requested that the Applicant assume all amines and their breakdown products present in the absorber column are emitted unless the Applicant could demonstrate with data from relevant pilot plant studies that any substances would not be emitted. The Applicant provided amended information in response to our notice on 29/11/2024 – see section 5.2 in the main body of this document.
Lack of information on what is present due to inadequate testing. The trials are for such short operating periods as to be meaningless and the Applicant refers to a 'further suite of tests but the analysis has not been concluded'. It gives the appearance that information is being withheld.	In our second information notice dated 23/10/2023 we asked the Applicant to provide the results of the second suite of tests as referred to in the Application as not yet being available. The Applicant provided a copy of their final test report in response to our notice on 31/03/2024 and this was placed on the public register.
The table of emissions from the combustion activity only (table 7 in section 2.7 of the Supplemental Information Provision report) does not include amines even though biomass combustion can	There are no changes to the monitoring requirements in relation to the emissions from the combustion of biomass in table S3.1 of the existing Permit (specified in tables S3.1a and S3.1b of the varied Permit) as a result of this Application.

Brief summary of issues raised:	Summary of action taken / how this has been covered
produce amines.	
Concerns and queries regarding whether the Applicant has considered the impact of sulphur on the solvent, how sulphur in the flue gas will be managed and how it will be ensured that only low sulphur fuel is used.	Based on information that the supplier of the KS21 has provided, the Applicant is aware that sulphur dioxide and sulphur trioxide can react with the solvent to generate substances in the absorber tower that could impact the regeneration of the solvent and reduce its efficacy. The Applicant is proposing to treat the flue gas in a quencher tower before it enters the carbon capture plant which will include the use of a wash with an alkali solution which will reduce the sulphur in the flue gas (see section 4.2.1 of this document) and the gas/gas heater used to cool the flue gas before it enters the absorber tower will also mitigate the formation of sulphur trioxide mist. The alkali dosing in the quencher tower can be adjusted to match the levels of sulphur in the flue gas. The current Permit requires the Operator to only accept fuel pellets with a sulphur content not exceeding 0.3% sulphur w/w. This will not change as a result of this variation.
Will conditions for the reaction of the solvent with NOx be specified in the Permit?	The statement: 'Oxides of Nitrogen (NOx), specifically Nitrogen Dioxide, can react in specific conditions with amines to form nitrosamine and nitramine reaction products' in the Application is a statement of fact and does not require the conditions to be specified nor any permit conditions to be included.
Concerns were raised regarding the lack of pilot trial data, particularly that based on burning woody biomass, to show the solvent behaviour in the nitrosamine formation and how solvent choice minimises risks to human health.	A pilot trial was conducted in 2021 and 2022 at Drax. Details of this trial were submitted on 31/03/2024 in response to our schedule 5 notice No2 dated 23/10/2023 and the response was placed on the public register. The pilot trial data has determined what additional controls are required for an 'at scale' operation to maximise the capture rate and reduce the likelihood of nitrosamine formation due to impurities. This has resulted in the Applicant proposing to treat the flue gas prior to entry to the absorber tower and to include both water and acid washes at the top of the water tower to reduce emissions.
Concern that a solvent that is expected to result in a nitrosamine that may be one of the most toxic can be considered 'best' for protection of human health and the environment.	As carbon capture is a new and emerging technology, there are no BAT standards other than those set out in our emerging techniques guidance. Therefore, we determine whether the techniques are BAT, through the risk assessments that the Applicant carries out. Based on the Applicant's assessment of emissions to air, we consider that the Applicant will have measures in place to ensure protection of the environment and human health.

Brief summary of issues raised:	Summary of action taken / how this has been covered
Concerns over dioxins emissions from the biomass combustion which have not been acknowledged or modelled and that there is no management plan as required by section 3b of form Part C3 as no limits are set for dioxins.	Dioxins from the combustion of biomass will only arise where the biomass comprises wood that has been treated with chlorinated organic compounds or chipboard. Only virgin biomass is burnt so there is no biomass which may include chlorinated organic compounds. We have not previously required the operator to model dioxins and as the carbon capture plant does not alter the emissions from the burning of biomass other than by removing CO_2, we do not consider that dioxins are a relevant pollutant in relation to this Application that requires assessment so a management plan for emisisons of dioxins is not required.
Concern regarding the acid wash system: • Will the operation be allowed to operate without an acid wash? • Will the applicant be required to model emissions without the acid wash being operational? • Should two acid wash systems be installed for when one is not available? • Is it considered acceptable to operate without the acid wash even for a short period?	The Applicant has designed the plant to include an acid wash and this forms part of the operating techniques through table S1.2 of the varied Permit. Any operation without the acid wash being available would constitute abnormal operations.
Concern regarding the removal of FGD as there will be impurities in the flue gas which cause higher levels of nitrosamines.	Should the Applicant decide to proceed with the fitting of the PCC plant, the FGD and other infrastructure will have to be removed to make space for the PCC plant. The FGD and its infrastructure is required for the burning of coal which is currently not undertaken. As described in section 4.2 of this document, the Applicant is proposing to install a quencher tower to treat flue gases prior to entry into the absorber column. An alkali water wash will be used which will reduce the sulphur in the flue gases as well as other pollutants such as ammonia and particulates. We are satisfied that the Applicant will have measures in place to treat the flue gas such that emissions of pollutants from the absorber column will be minimised.
Concern that there is poor understanding of the chemistry of nitrosamines from woody biomass and that this uncertainty could lead to higher than expected emissions or compounds with increased toxicity.	Additional information was submitted in response to our information notice No. 1 with details of how the substances that could potentially be emitted were determined (Appendix C Specification of Emissions for Control by Emission Limits received on 29/11/2024). The Air Impact Risk Assessment has been based on these substances and these are required to be monitored as specified in table S3.1 of the varied permit. As this assessment is based on predicted emissions, we have set

Brief summary of issues raised:	Summary of action taken / how this has been covered
	an improvement condition IC56D which requires the Operator to carry out a further Air Emissions Risk Assessment based on actual monitored substances and concentrations. Where this risk assessment shows that there may be exceedances of the EALs, the Operator is required to propose measures to reduce emissions to acceptable levels.
Concern that emissions are not able to be assessed independently	The Application and all additional information submitted in response to our requests for information and information notices has been placed on the public register and is available for review. As we did not agree that the Applicant had fully considered all the emissions from the absorber column, we requested this information together with a revised air impact assessment in our notice dated 23/07/2023. The information was received on 29/11/2024. We consulted on the revised impact assessment on 04/02/2025 and placed a copy of the impact assessment on the public register.
If atmospheric nitrosamine formation is not well understood is the list of substances in the application the expected worst-case?	We did not agree with the Applicant's assessment of emissions to air and requested a revised assessment in our information notice dated 27/03/2023 and this was submitted on 29/11/2024. We have reviewed the revised air dispersion modelling including the assessment of atmospheric nitrosamine formation and we are satisfied that the Applicant's assessment is worst case (see sections 5.1, 5.2 and 5.3).
It is recognised that ammonia may be a pre-cursor to nitrosamine formation. What assumptions have been made about atmospheric nitrosamine formation from amines reacting with ammonia and are these assumptions worst case?	Ammonia does not react with amines in the atmosphere to form nitrosamines. Amines can react with hydroxyl radicals in the atmosphere to form amino radicals which can further react with nitrogen dioxide (NO_2) or nitrogen oxide (NO) to form nitramines and nitrosamines. There is extensive literature on the atmospheric chemistry of amines and formation of nitrosamines and nitramines. This research body had informed the atmospheric chemistry used for amine dispersion modelling. The reaction scheme used in the ADMS amines module is based on the general reaction scheme proposed by *Lindley et al* and adapted by *Nielsen et al*. (C. R. C. Lindley, J. G. Calvert and J. H. Shaw, Rate Studies of the Reactions of the $(CH_3)_2N$ Radical with O_2, NO, and NO_2, *Chemical Physics Letters*, 1979, **67**, 57-62. C. J. Nielsen, H. Herrmann and C. Weller, Atmospheric chemistry and environmental impact of the use of amines in carbon capture and storage (CCS), *Chemical Society Reviews*, 2012, **41**, 6684-6704). This scheme is described in reports published alongside our evidence review for guidance on emerging techniques for post-combustion

Brief summary of issues raised:	Summary of action taken / how this has been covered
	carbon capture: Post-combustion carbon dioxide capture: emerging techniques - GOV.UK Whether stable nitrosamines are formed depends on the amines present. The Applicant has set out in the revised air impact assessment submitted on 29/11/2024 in response to our information notice dated 27/07/2023, which nitrosamines could be formed in the atmosphere and how they may be formed. We have reviewed the air impact assessment and consider that in the context of the uncertainties regarding the chemistry module, the Applicant has considered the worst case.
The plant releases pollutants other than amines for which reports suggest there is no safe level, such as for NOx and PM. Explain why the proposal is consistent with the urgent need to reduce air pollution.	There will be no change to the BAT AELs and emission limits for the pollutants, including NOx and PM, generated by the current operations as a result of the variation Application. These have previously been assessed, and the emission limits have been set in order to ensure protection of the environment in accordance with our guidance and process.
Concern that other emissions from the combustion of wood have not been considered: • Burning wood can create nitrosamines and there is no evidence of the plant's current nitrosamine emissions. The applicant should be required to measure these and assess the impact of these with those from the proposal. • No consideration of dioxins or heavy metals has been included and there should be a Human Health Risk Assessment for and continuous monitoring of dioxins.	Dioxins and heavy metals assessments and a Human Health Risk Assessment are requirements for burning waste wood as part of the waste incineration sector. The BAT Conclusions for the combustion sector, which the permitted activity falls under, do not require nitrosamines or dioxins to be measured. There is no change to the emissions from the combustion of biomass as a result of this variation Application and the Operator is required to comply with the BAT AELs and ELVs set in the existing Permit.
Will the EA require the applicant to confirm the half-life degradation of all nitrosamines to be <1 day and if not, is it considered that there is possibility of formation of nitrosamines with a longer half-life in some conditions?	We did not agree with the Applicant's assessment of emissions to air and requested a revised assessment in our information notice dated 27/03/2023 and this was submitted on 29/11/2024. In the revised assessment, the Applicant used the reaction rates based on those in the guidance from CERC, May 2024, 'Improving post carbon capture air quality risk assessment techniques' which is in accordance with our recommendations for modelling amine emissions. We have reviewed the reaction rates used (referred to as

Brief summary of issues raised:	Summary of action taken / how this has been covered
	'k factors') and have carried out sensitivity analysis using different k factors and agree with the Applicants conclusions. See section 5.2 of this document.
Concern that fugitive emissions have not been considered, including: • Pests • Dust • Litter • Noise • Amines • CO_2	The changes proposed in the variation Application will not result in the emissions of pests, dust or litter. A Noise Impact Assessment has been carried out in accordance with relevant guidance which we have reviewed. See section 5.5.2. The Applicant has provided information regarding the storage of amines and CO_2 and we consider that it is unlikely that there will be impacts on air, land or water from fugitive emissions. See section 5.5.3.
Concern that there is no consideration of deposition of amines on aquatic environments or on drinking water sources, as a worst-case study in Norway based on conversion of MEA to nitrosamines showed that deposition would exceed toxicity limits for aquatic organisms and safety limits for drinking water. Also concern that some amines are persistent in the environment and that nitrosamines and nitramines can accumulate and cause danger to human health so it is unclear how air dispersion modelling can fully assess impacts.	The 2010 Norwegian reference cited is based on a theoretical conversion factor of 2% for MEA to nitrosamines with extrapolation to concentrations of nitrosamines and nitramines in drinking water sources. We are not aware of evidence to support the theoretical conversion of this primary amine to stable nitrosamines or the basis of the deposition rates used in this study. We focus our impact assessment requirements on the primary risk of impacts to human health which is exposure by the inhalation route. We set limits in permits to prevent risk of significant impact on air quality. This minimises emission to air which also reduces potential risks from deposition to land and water. We require applicants to assess emissions to air using air dispersion modelling of direct and indirect emissions of nitrosamines and nitramines. Indirect emissions are chemical transformations of amines in atmospheric reactions post-emission. We consider the methodology to be conservative i.e. likely to over-estimate concentrations of amines, nitrosamines and nitramines in ambient air. In the UK we do not have limits for amines, nitrosamines and nitramines in drinking water, and there are no discharges of these substances to water that require assessment and inclusion in the varied Permit. As noted in our recently published report on environmental impacts of emerging carbon capture technologies (Environmental impacts of emerging carbon capture technologies for industrial decarbonisation - GOV.UK), we are aware that there is a theoretical risk of impacts from deposition of these substances to land and water. We are therefore taking various actions to investigate the potential risk of emissions from amine-based carbon capture on both air and water quality. This includes observation of an ongoing project in Norway led by the Norwegian Research Institute for Water and the Environment (NIVA) (Future

Brief summary of issues raised:	Summary of action taken / how this has been covered
	Drinking Water Levels of Nitrosamines and Nitramines near a CO2 Capture Plant (FuNitr) | NIVA) which aims to develop methodologies to predict deposition of nitrosamines and nitramines from air to water and impacts on future drinking water levels. We will publish the findings from our research projects and continue to liaise with government, industry and academia to disseminate findings and recommendations for further work. The findings from our research projects (and other sources) will provide evidence to support our decisions going forward, for example in permit application determinations and permit reviews.
The Non-technical summary says that emissions to air should not have any significant impact on human health or ecological receptors, but it does not say that it will not have any significant impacts. Therefore, explain why the public should be satisfied by the uncertainty in this statement?	We are satisfied that the Applicant has assessed the impacts of emissions to air in accordance with our air emissions risk assessment guidance and our recommendations in relation to amine emission modelling and that appropriate human health and ecological receptors have been included. We have carried out check modelling and sensitivity analysis to determine whether changes to the model input parameters affect the conclusions and have determined that they do not. Details of the air emissions risk assessment are included in sections 5.1, 5.2 and 5.3 of this document.
Solvent selection	
Although carbon capture technology using amines is the correct choice to retro-fit, there is no evidence in the Application that the KS21 solvent is the right one. A key omission is any mention of the reclaiming or cleaning process for the solvent to demonstrate a stable solvent can be maintained indefinitely.	In our second information notice dated 23/10/2023 we asked the Applicant to provide a revised justification for the use of the KS21 solvent and to provide a review of the effectiveness of the solvent reclamation process. The Applicant provided this information in their response dated 31/03/2024 and the information was placed on the public register. An assessment of the solvent choice and whether it is in accordance with the emerging techniques guidance is set out in Annex 1 to this document.
Will the applicant be required to provide data relating to other solvents to demonstrate the chosen solvent is the best on the market based on nitrosamine formation and toxicity and environmental impact? What information is available to show no better solvent is available?	The Applicant provided additional information regarding the solvent selection in the response dated 31/03/2024 to our second information notice dated 23/10/2023. This information determined that it was not feasible to use a non-amine based solvent to capture the CO_2 as the technology was not sufficiently developed to be applied to a large-scale process. The Applicant provided data on environmental impact, energy use and water and cooling demand for two proprietary solvents compared with the base case of the primary amine MEA. These two were then compared as part of the pre-FEED study and the KS21 solvent was chosen on the basis that it used less solvent per tonne of

Brief summary of issues raised:	Summary of action taken / how this has been covered
	CO_2 captured and required less steam and power. Solvent types and published performance figures are described in the UKCCSRC document: Evidence Review of emerging techniques for Carbon Dioxide Capture Using Amine-Based and Hot Potassium Carbonate Technologies under the IED for the UK. We are satisfied that the Applicant has considered the selection of the solvent in accordance with our guidance.
Air dispersion modelling	
There are no details of sensitivity analysis and it is considered that AQMAU should not do this on behalf of the Applicant and that all evidence to support the conclusions should be disclosed.	We did not agree that the Applicant had provided an air impact assessment that considered all emissions. We requested a revised assessment in our information notice dated 27/03/2023 and a revised assessment was received on 29/11/2024. The revised air impact assessment includes sensitivity analysis, and the revised assessment was placed on the public register, and we consulted on it on 04/02/2025. We audit the air impact assessment and carry out our sensitivity analysis to determine whether the applicant's proposals represent the worst case. The internal report of the audit provided to the permitting officer by our modelling specialists is for internal use to assist the permitting officer in their decision. Whilst this is not placed on the public register, the results of our audit are included in the decision document, which is consulted on. In this case, the results of the audit are discussed in sections 5.2 and 5.3 of this document and we have consulted on it in our 'minded to' consultation between 27/05/2026 and 24/06/2026.
The Environment Agency guidance requires an applicant to submit air dispersion model input files and a separate annex with all the input parameters. It is not possible to fully comment if some files are missing. Provide a table of input parameters in an easily readable format.	We have received the model input files and have accepted that, although not presented as a single table, the information relating to the input parameters has been provided. However, as we did not consider that the air impact assessment was representative of the potential emissions from the use of the KS21 solvent to capture CO_2, we requested an amended air impact assessment and associated modelling in our information notice dated 27/07/2023. The Applicant provided an amended air impact assessment on 29/11/2024 and this, together with the model input files, have been placed on the public register. In addition, we have consulted the public and the relevant statutory consultees again on this revised air impact assessment.
Concerns regarding the weakness of the	Details of the models used by the Applicant are set out in

Brief summary of issues raised:	Summary of action taken / how this has been covered
various models used to estimate emissions.	section 5.1.3 of this document. In the revised modelling submitted on 29/11/2024 in response to our information notice dated 27/07/2023 the Applicant considered the modelling uncertainty and provided information regarding the uncertainty range for long and short term predictions which accounts for variation in the emissions. We have checked the model sensitivities and uncertainties during our audit and are satisfied that the models used are appropriate for the assessment undertaken and that any uncertainties have been taken into account.
Concern that the weather data used in the modelling is not representative of future weather conditions and query how the Environment Agency takes account of these changes.	For dispersion modelling we expect 5 years of meteorological data to be used that is generally less than 10 years old. Climate change is assumed to be less than the inter year variation in the data and so is not expected to affect the predictions significantly.
Concerns raised about the uncertainty of inputs to the model and the model itself and in particular the weather data used and that no sensitivity analysis on weather data was carried out by the Applicant. Request that if EA do sensitivity analysis, the results should be published.	We did not agree with the Applicant's assessment of emissions to air and requested a revised assessment in our information notice dated 27/07/2023, which was received on 29/11/2024. We audited the Applicant's dispersion modelling. As part of the audit, we checked that the modelling parameters and weather data used by the Applicant were appropriate and we are satisfied that they were. Based on the Applicant's modelling, and our review of it, we are satisfied that there will not be a significant impact in air quality. See sections 5.2 and 5.3 of this decision document for further details. For dispersion modelling we expect 5 years of meteorological data to be used that is generally less than 10 years old. Climate change is assumed to be less than the inter year variation in the data and so is not expected to affect the predictions significantly. The internal report of the audit provided to the permitting officer by our modelling specialists is for internal use to assist the permitting officer in their decision. Whilst this is not placed on the public register, the results of our audit are included in the decision document, which is consulted on.
Concerns were raised about the uncertainties in the model: • the range of the predicted results, the upper range of which may change the conclusions • measurement uncertainty of emissions	We did not agree with the Applicant's assessment of emissions to air and requested a revised assessment in our information notice dated 27/07/2023, which was received on 29/11/2024. In this revised modelling the Applicant considered the modelling uncertainty and provided information regarding the uncertainty range for long and short term predictions. They concluded that even using the upper limit of the range, the overall conclusions would not change.

Brief summary of issues raised:	Summary of action taken / how this has been covered
	We expect the ELVs to be used in modelling-based assessments without the measurement uncertainties (confidence intervals, CIs) added or subtracted. The reason is that CIs are required for reporting actual emission concentrations to the regulator. They are a measure of monitoring uncertainty such that once subtracted there would be no reasonable doubt of an offence if the regulator seeks to take enforcement action. The ELVs are based on the emissions the plant is capable of meeting. Modelling for permit applications is different in that the aim is the assessment of risk to human health and ecological sites of emission scenarios from the site at the permit limits (i.e. the future facility). Assuming that the site will operate continuously at the ELVs will represent a facility operating at the most likely upper-end of the uncertainty range in relation to mass pollutant emissions. Modelled predictions already include an uncertainty when compared to observed ambient concentrations. This uncertainty range already includes measurement uncertainties, thus adding a CI (i.e. error/bias) value to the mass pollutant emissions, would increase the uncertainty in the resultant modelled predictions even further. We audited the Applicant's modelling and we are satisfied that the Applicant has considered uncertainty in accordance with our guidance.
Concerns were raised about the limited sensitivity analysis carried out and that the Applicant has not modelled the non-BECCS units alone	We did not agree with the Applicant's assessment of emissions to air and requested a revised assessment in our information notice dated 27/07/2023, which was received on 29/11/2024. We audited the Applicant's revised assessment which included sensitivity analysis and different operating scenarios including operations without BECCS (baseline). Based on our audit we asked for clarification of the most likely operating scenarios and requested in our fourth schedule 5 notice that the Applicant provide modelling of the amines likely to result in the highest concentrations of nitramines and nitrosamines. This modelling was provided on 31/07/2025. We audited this modelling and agreed with the Applicant's conclusions. See sections 5.2 and 5.3 of this decision document for further details.
Confusion over which model version has been used and about its validation.	We did not agree with the Applicant's assessment of emissions to air and requested a revised assessment in our information notice dated 27/07/2023, which was received on 29/11/2024. In the revised modelling, the Applicant stated that they had used ADMS version 6.0.0.1. This is a commonly used

Brief summary of issues raised:	Summary of action taken / how this has been covered
	computer model and is validated against available measured data obtained from real world situations, field campaigns and wind tunnel experiment.
No consideration given to calm conditions on the model impacts.	Low wind speeds are particularly important when plume buoyancy and momentum are low. In these situations, the plume will be more localised within the site boundary. This is unlikely to be the case at Drax due to the height of the stack and the type of emissions. Therefore, we do not consider it necessary to include the 'calm' module in the modelling.
Unclear what uncertainties have been considered with respect to modelling parameters such as surface roughness, buildings	We did not agree with the Applicant's assessment of emissions to air and requested a revised assessment in our information notice dated 27/07/2023, which was received on 29/11/2024. In the revised modelling, the Applicant considered surface roughness (agricultural areas with low vegetation) and used an alternative (parkland and open suburbia) in their sensitivity analysis. In addition, the effect of buildings on dispersion was considered and only those buildings with a height of 86m or more were included in the assessment. These are the cooling towers. All other buildings would not affect dispersion as they are too low. We audited the Applicant's modelling and were satisfied with the modelling parameters used.
ADMLC guidelines for modelling – should use these, if not why not?	Applicants must follow the Environment Agency modelling guidance, available at Environmental permitting: air dispersion modelling reports - GOV.UK. The Environment Agency is a member of the Atmospheric Dispersion Modelling Liaison Committee (ADMLC) and we led the development of the ADMLC Guidelines (2021). These are a supplement to the online guidance.
Concern that the ADMS chemistry module is not validated and the models for nitrosamines are not mature enough to assess environmental concentrations and the predictions are not an adequate basis for the protection of human health.	Currently, the ADMS chemistry module is the only commercially available modelling software to evaluate the potential impacts from amine degradation products. The amines chemistry module is based on established science considering published research on mechanisms of formation of toxic compounds. Although the model chemistry has not been validated with real world measurements at this stage, the underlying dispersion model has been validated and is a well accepted dispersion model. It should be possible to validate the model chemistry in future when there are suitable operational plant and suitably sensitive monitoring techniques. The amines chemistry scheme is incorporated into ADMS air dispersion modelling algorithms which are continually validated against real world situations, field campaigns

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	and wind tunnel experiments. Therefore, including the estimation of nitrosamines in assessments provides a comprehensive picture for decision-making. Applicants must assess the totality of all/any nitrosamines and nitramines against the NDMA environmental standard of 0.2 ng/m^3. This standard based on the toxicological evidence available at Appendix C: summary of toxicological evidence for MEA and NDMA - GOV.UK provides additional conservatism to assessments. There are limitations in measuring nitrosamines in ambient air at these levels. We continue to follow the development of standardised measurement techniques.
Concerns regarding the source of ozone concentrations required for the ADMS modelling of amine chemistry and the impact of changing weather patterns due to climate change could have on ozone concentrations.	We did not agree with the Applicant's emissions profile and the assessment of these emissions to air. We requested a revised emissions profile and its assessment in our information notice dated 27/07/2023, which was received on 29/11/2024. The revised impact assessment includes details of the background ozone concentrations for each meteorological year and the location where they are recorded. Climate change is assumed to be less than the inter year variation in the meteorological data and so is not expected to affect the predictions significantly. We have reviewed the impact assessment and are satisfied that the Applicant has included appropriate ozone concentrations.
The peak nitrosamine concentration extends outside the area shown. Will the Applicant be required to provide a contour map for the full area of impact?	We did not agree that the Applicant had provided an air impact assessment that considered all emissions. We requested a revised assessment in our information notice dated 27/07/2023 and a revised assessment was received on 29/11/2024. The revised air impact assessment includes isopleths (contour maps) showing the full extent of the PCs for pollutants.
Concern was raised regarding the basis on which the EALs for MEA and NDMA were derived, specifically due to the lack of evidence from trials and the Excess Life-time Cancer Risk (ELCR) used.	The EALs were set based on the methodology that was consulted on in 2012. In the first version of the methodology published in 2012 we used a default ELCR of 1 in 1,000,000 for substances with sufficient data from human studies. However, following a further review of this methodology, we now apply a default ELCR of 1 in 100,000. Therefore, to determine the EALs for MEA and NDMA we used an ELCR of 1 in 100,000. This approach is derived from relevant human studies and is considered representative of a minimal risk to human health. This view was subsequently reiterated by the Department for Environment, Food and Rural Affairs in 2014 and is representative of government thinking as to

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	what constitutes minimal risk. This is broadly consistent with the derivation of limit and target values under the Ambient Air Directive. The toxicological evidence that was used to derive the EALs for MEA and NDMA is summarised in Appendix C to the consultation outcome published in 2021.
Concerns were raised that NDMA is not the most toxic nitrosamine so the Applicant's use of the NDMA EAL for N-ethyl-N- (2-hydroxyethyl)nitrosamine, which the Applicant says is released, is neither precautionary or conservative as it is functionally related to N-nitrosodiethylamine, which the Norwegian Institute of Public Health says is 3 times more toxic than NDMA.	We agree that N-nitrosodiethylamine (NDEA) has a higher oral route toxicity than N-nitrosodimethylamine (NDMA). The Norwegian Institute of Public Health (NIPH) report entitled 'New knowledge on health effects of amines and their derivatives associated with CO_2 capture' published in 2024, refers to a comparison of Tumourigenic Dose 50 (TD50) data from the Carcinogenic Potency Database. The ratio of the reported TD50 values for NDEA and NDMA is around three and a half. We are however assessing risks from emissions to air, and the main exposure route is inhalation rather than ingestion. The long-term EAL for NDMA is 0.2 ng/m^3 and is based on an inhalation study by Klein et al. (1991). It is always preferable to derive a long-term EAL based on an inhalation study rather than rely on route-to-route extrapolation because it depends on an understanding of both the toxicokinetics of the chemical and the critical target organs for toxicity. However, such data is not always available. As part of our work to develop further Environmental Assessment Levels, we have recently asked a contractor to review the available data on NDEA. They found no suitable inhalation studies on which to base any subsequent guideline, and, therefore, they proposed an approach based on route-to-route extrapolation from oral data to an equivalent level in air. Many authoritative bodies rely on drinking water and dietary studies to derive a suitable benchmark dose for the carcinogenicity of nitrosamines including NDEA and NDMA. The European Food Safety Authority (EFSA) carried out a 'Risk assessment for nitrosamines in food', published in 2023. They derived a benchmark dose (BMDL10) of 0.01 mg/kg bw/day for NDEA. Applying route-to-route extrapolation to derive an equivalent level in air, assuming comparable route to route absorption, gives an indicative air guideline for NDEA which is higher than the current long-term EAL for NDMA. Our work on this is in progress, however our preliminary findings support our position that NDMA has the highest inhalation route toxicity for nitrosamines that we are aware of. We therefore apply our derived EAL for NDMA for worst-case assessment of other nitrosamines for which we

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	do not have derived EALs and consider this to be a precautionary approach.
Concern that incorrect statement has been made regarding the formation of stable nitrosamines from MEA as studies have shown that MEA under the influence of NOx can form stable nitrosamines therefore, request an explanation how the pathway from MEA to nitrosamine is simulated.	The air quality impact assessment includes assessment of emissions to air of both MEA and diethanolamine (DEA). This is described in the Air Emissions Risk Assessment submitted November 2024 in response to question 1 of the Schedule 5 Notice dated 27/07/2023. DEA is a known breakdown product of MEA in the presence of NOx (Effects of NOx in the flue gas degradation of MEA - ScienceDirect) and could be formed in the post-combustion carbon capture absorber. DEA has the potential to react with NOx in the absorber or in the emission plume to form the stable nitrosamine nitrosodiethanolamine (NDEA). MEA is a primary amine and does not directly form stable nitrosamines. The air emissions assessment takes this information into account: • MEA is assessed as a direct release to air only and no assessment of unstable MEA n-amines is performed. • DEA is assessed as the breakdown product of MEA, both as the amine and as the stable nitrosamine NDEA. • NDEA emissions are assessed as both direct releases (from formation in the absorber) and as indirect releases. • The indirect emission of NDEA is modelled using the ADMS amines air dispersion model to predict atmospheric formation of NDEA post-release of DEA. • The assessment takes a conservative approach and models release of DEA at a similar rate to the parent MEA.
Concerns regarding background monitoring locations for NOx/NO_2	We did not agree with the Applicant's emissions profile and the assessment of these emissions to air. We requested a revised emissions profile and its assessment in our information notice dated 27/07/2023, which was received on 29/11/2024. In the revised impact assessment, the Applicant used data from different locations and determined that the Hull Freetown AURN was the most conservative. We carried out sensitivity analysis including using a third alternative background monitoring location which was at the same elevation as the site and concluded that the differences in background concentrations did not alter the conclusions. We are satisfied that the background data

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	used is representative of the worst case.
Concerns were raised about mixing of the emissions in the flues as the gases will be emitted at different temperatures and flow rates and no evidence that complete mixing in all weathers will take place. The EA should require modelling of individual flues.	Bringing flues together is a common design practice that can improve dispersion. A stack containing multiple flues, or multiple stacks close together, enhance buoyancy and plume rise. Whether exhausts mix depends on site-specific factors such as their proximity and the conditions at release. In this case, the applicant has explained how the individual flues were combined and provided the calculation method used to derive the source parameters. Given the exhaust configuration, operating conditions and turbulent flow regime, it is reasonable to expect the exhausts to mix at discharge. Modelling the emissions as a single source is therefore appropriate for the purposes of dispersion modelling.
Concerns were raised regarding the uncertainty of deposition modelling: • whether deposition estimated in a Norwegian study is appropriate for amines in Yorkshire; • whether deposition uncertainties of a factor of 10 should be modelled as worst case assumption; • whether greater uncertainty should be applied to assessing deposition for amines, nitrosamine and nitramines; • what the impact would be if the deposition velocities used significantly underestimate actual deposition.	The Air Quality Technical Advisory Group (AQTAG) is an inter-agency group that provide technical advice on assessing air pollution impacts from regulated sites on protected nature sites. The AQTAG06 technical document is the technical guidance that reflects the methodology. The pollutants' deposition velocities are deemed precautionary in the UK for regulatory purposes. The applicant followed AQTAG06 to estimate impacts from pollutants deposition at ecological sites. Amines, nitrosamines and nitramines are large groups of chemical substances with differing characteristics and behaviour. Applicants must estimate their contribution to nitrogen deposition based on the case-specific circumstances. The applicant assumed the ammonia deposition flux for amines. This is a conservative assumption based on the ratio of nitrogen in the molecules compared to ammonia, following the AQTAG06 method.
Cumulative impacts	
Combined impacts of Drax and Keadby 3 have not been modelled or considered.	The Applicant has considered the combined impact of the emissions to air with those from Keadby 3. However, we did not agree with the air impact assessment provided and requested a revised impact in our notice dated 23/07/2023 which was submitted on 29/11/2024. Our guidance requires applicants to consider cumulative impacts with other operations and the background centration where the PC is greater than 1% or 10% of the long and short term environmental standards (where PCs are not insignificant – see section 5.1.2). In the revised modelling, the Applicant has determined that the PCs for amines and their breakdown products are insignificant, so they are not required to determine cumulative impacts.

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	We have previously considered the cumulative impact of emissions from Keadby 3 and Drax as part of the determination of the Keadby 3 variation. Our conclusion is that there will not be a cumulative impact due to the distance between the sites, the location of Keadby being to the southeast of Drax and the prevailing winds being towards the northeast.
Concern about the inter-relation with other carbon capture proposals as the application is submitted as a stand-alone application and no consideration will be given to cumulative effects on human and ecological health. These other proposals include gas fired power stations, energy from waste plants and hydrogen production with carbon capture in Yorkshire and Humber areas.	In our risk assessment guidance for emissions to air, applicants are required to include the emissions from other emitters as well as the background concentrations of pollutants in the local area where their process contributions do not screen out as insignificant. We have previously considered the cumulative impact of emissions from Keadby 3 and Drax as part of the determination of the Keadby 3 variation. Our conclusion is that there will not be a cumulative impact due to the distance between the sites, the location of Keadby being to the southeast of Drax and the prevailing winds being towards the northeast.
Should background nitrosamine concentrations be provided and if not, will cumulative impacts be a risk to human health?	There is currently no monitoring carried out for nitrosamines in the background, so we consider that the background concentration is zero. We have previously considered the cumulative impact of emissions from Keadby 3 and Drax as part of the determination of the Keadby 3 variation. Our conclusion is that there will not be a cumulative impact due to the distance between the sites, the location of Keadby being to the southeast of Drax and the prevailing winds being towards the northeast.
Concerns were raised about cumulative impact: • No assessment of cumulative short term air quality was made. • Emissions from Keadby 3 project alone could reach up to 54% of the EAL so when combined with emissions from Drax, the cumulative risk of breaching EALs increases significantly. • Not considered that increased air pollutants from other sources will increase the reaction rate of nitrosamine production. • Other emitters could impact local background nitrosamine concentrations	We did not agree with the Applicant's assessment of emissions to air and requested a revised assessment in our information notice dated 27/07/2023, which was received on 29/11/2024. The Applicant did not carry out modelling of cumulative impacts in the revised modelling as the results of the modelling were insignificant and this is in accordance with our guidance. We have previously considered the cumulative impact of emissions from Keadby 3 and Drax as part of the determination of the Keadby 3 variation. Our conclusion is that there will not be a cumulative impact due to the distance between the sites, the location of Keadby being to the southeast of Drax and the prevailing winds being towards the northeast. We have not considered the cumulative impact of other proposals (such as the Kirk Sandall energy from waste plant) as they are not located where the maximum impacts

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	from Drax are predicted to be so the plumes from the facilities won't overlap. We are satisfied that no cumulative assessment is required.
The risk from cumulative impact of emissions is further increased due to the EA's decision to relax the NDMA EAL determination by a factor of 10.	We do not consider that there will be a cumulative impact of emissions from Drax and Keadby 3 due to the distance between the sites, the location of Keadby being to the southeast of Drax and the prevailing winds being towards the northeast. In relation to the EAL for NDMA, details of the derivation of the EAL are included in the response to the consultation dated September 2021, available here: Environmental assessment levels (EALs) used in air emissions risk assessments - GOV.UK
Keadby 3 is only 22 km away from Drax, so does the EA agree with the research in 2022 by Imperial College and the Norwegian Institute for Public Health that building another PCC plant within a distance of 100-200km downwind of an existing PCC will endanger human health?	Drax is not downwind of Keadby 3 as Keadby 3 is to the south-east and the prevailing wind is to the north-east. Therefore, we do not consider that there will be a cumulative impact. In addition, the predicted emissions from Drax are orders of magnitude lower than those assessed in the research referenced.
Habitats	
Concern that not all sensitive ecological sites have been considered.	The Applicant has included SPA, SAC, Ramsar and SSSIs within 15 km and non-statutory sites such as local nature reserves, local wildlife sites and ancient woodlands within 2 km of the site in the air impact assessment. This is in accordance with our guidance and we are satisfied that all relevant ecological receptors have been considered.
Concern regarding impact at ecological receptors (Thorne Moor SAC/SPA/SSSI, Lower Derwent Valley SAC and Skipworth Common SSSI) as acid deposition exceeds the 1% significance screening criterion where the critical load is already exceeded.	We did not agree that the Applicant had provided an air impact assessment that considered all emissions. We requested a revised assessment in our first information notice dated 27/07/2023 received on 29/11/2024 and in our fourth information notice dated 27/05/2025 received on 31/07/2025. Based on these revised impact assessments, the Applicant determined that there were exceedances of the acid deposition critical loads at the Thorne Moor SAC/SPA/SSSI, Skipworth Common SSSI and South Cliffe Common SSSI (an additional receptor requested in our fourth information notice). The Applicant concluded that the results of the modelling are an over-estimate of the contribution of emissions from the PCC plant as the sulphur in the flue gas would be removed in the quencher prior to entering the PCC plant and the Core Scenario was a worst case, with the plant not likely to be operated in this manner.

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	We reviewed the modelling and agreed with the Applicant's conclusions and consider that it is unlikely that emissions from the PCC will contribute to an exceedance of the critical loads. We consulted with Natural England who agreed with our assessment. See section 5.3 of this document.
Concern regarding the impact of acid deposition on nightjars at the Thorne Moor SPA.	Information on APIS indicates that the interest features at the Thorne Moor SPA are not sensitive to acid deposition.
The Applicant's figures show NOx levels that are close to the 1% significance threshold at some ecological receptors. Given the uncertainties, will a Habitats Regulations Assessment of potential impacts at all sites that could have levels in excess of 1% be required?	We did not agree that the Applicant had provided an air impact assessment that considered all emissions. We requested a revised assessment in our first information notice dated 27/07/2023 received on 29/11/2024 and in our fourth information notice dated 27/05/2025 received on 31/07/2025. The Applicant has included predictions of process concentrations of NOx at all ecological receptors, and they are all less than 1% of the environmental standard for annual mean NOx and less than 10% of the environmental standard for daily mean NOx. See section 5.3 of this document. A Habitats Regulations assessment has been carried out in accordance with our guidance.
Concern regarding deposition of amines adding to the total nitrogen deposition and request consideration of the harm from this on ecological sites.	The Applicant has included amine emission contributions in the estimation of nutrient nitrogen deposition and has assessed the impacts at ecological receptors. See section 5.3 above. We are satisfied that the methodology used is in line with the current approach.
Concern that the applicant's air quality predictions are not sufficiently precautionary for compliance with the Habitats Directive and that all sources of uncertainty should be listed and quantified.	We are satisfied that the Applicant has carried out the air emissions risk assessment in accordance with our guidance and recommendations and advice for assessment of impacts from amine-based carbon capture. We have completed relevant Habitat Regulations and Countryside Rights of Way Act assessments and consulted with Natural England as necessary in accordance with our internal guidance and procedures. See section 5.3 of this document.
Concern regarding the impact on the River Ouse, Humber Estuary Ramsar/SAC/SPA/SSSI and River Derwent SAC as the Applicant states the Ouse and Derwent have high acid buffering capacity, but that this does not mean they won't be impacted by acid pollution.	The Applicant has considered all of these sites, with the exception of the River Ouse, in their air emissions risk assessment as ecological receptors. The River Ouse is not a designated habitats or wildlife site. The Applicant stated that the River Derwent is not sensitive to acid or nutrient nitrogen deposition and that the Humber Estuary is not sensitive to acid deposition. We have checked the Applicant's assessment, including

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	the sites considered, and have checked their sensitivity to deposition impacts using APIS. We are satisfied that the Applicant has considered the appropriate sites and impacts.
Concern regarding the assessment of deposition on non-statutory habitats sites as the EA's screening criteria are not sufficient to show adequate protection so request that evidence is provided to show that it is sufficient.	Protection of conservation sites is set out in different legislation depending on the designation of the site. Different types of sites have different levels of protection which are proportionate to the legislation and different critical levels and loads are set to protect the most vulnerable habitat types. For non-statutory sites protection is under the Environment Act 1995 and we determine whether the emissions alone (without considering background concentrations) could cause significant pollution. The Applicant has considered all habitat sites in the air emissions risk assessment and has determined that all emissions at the non-statutory sites are less than 1% and <10% of the long- and short-term critical levels and <1% of the critical loads. Since the criteria to assess significance is <100% of the critical levels and loads, the Applicant considers that deposition on the non-statutory sites is insignificant. We have checked the Applicant's assessment, including the sites considered, and have checked their sensitivity to deposition impacts using APIS. We are satisfied that the Applicant has considered the appropriate sites and impacts.
Issues regarding protected species were raised: • the impact on bryophytes, lichens and other species, including those present in rivers, has not been determined • request for surveys and analysis of impacts on these sites • detail of assessments carried out to ensure these species are not harmed by air pollution or loss of habitat.	We are satisfied that the Applicant has carried out the air emissions risk assessment in accordance with our guidance and recommendations and advice for assessment of impacts from amine-based carbon capture. The Applicant's modelling showed that for all parameters at all of the non-statutory sites the predicted PCs were <1% or <10% of the relevant long- or short-term ES and concluded that the impact would be insignificant. We have reviewed the modelling and agree with the Applicant's conclusions. See section 5.3 of this document. There is no change to the discharge to surface water as a result of the Application so assessment of impact on river ecosystems and species is not required.
Concern whether the aims of the legislation and Core Guidance for the Environment Agency to protect the environment, enhance biodiversity and achieve government policy targets will be met in the assessment of all ecological sites.	All relevant ecological sites including statutory and non-statutory sites have been included in the assessment of emissions to air. We are satisfied that the Applicant has carried out the assessment in accordance with our guidance and we have completed our review in accordance with our internal procedures and guidance which will ensure that all legal requirements and duties

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	that apply to us will have been addressed.
Monitoring	
Will information on aspects such as CEMs be required before determining the application, and will it be consulted on if it is provided at a later stage?	As the technology is a first-of-a-kind at this scale, there are some aspects of equipment and testing methods that are not yet available. In these circumstances and where the Applicant has committed to using the appropriate equipment and methods, we will set pre-operational conditions in the varied Permit that require the Operator to provide the information prior to operation of the plant (see table S1.4 in the varied Permit). If the pre-operational measure is not complied with or we do not agree with the Operator's proposals, the Operator will not be able to commence operation of the plant.
Levels of current emissions (nitrosamines) are below sensitivity of existing monitors. If more sensitive monitors are not available, request that modelling assumes emissions are at the maximum level that may go undetected with existing monitoring equipment.	During the determination of this Application guidance on monitoring of stack emissions from carbon capture plants was published Link. For monitoring of nitrosamines, the guidance references the National Physical Laboratory report on monitoring methods for nitrosamines. The limit of detection used in this study was 0.001 mg/m^3 which is below the emission limit set for total amines in table S3.1a of the varied Permit.
Will continuous monitoring of amines be required even if CEMs are not available?	Monitoring of amines is required to be carried out monthly. There are currently no continuous monitoring methods for amines. This may change in the future as CEMs will be designed based on periodic monitoring. The Applicant has stated that where CEMs are available they will monitor continuously.
Concerns were raised regarding background nitrosamine levels: • Will the Applicant be required to monitor background nitrosamine levels? • There is no data on ambient levels of amines and nitrosamines, but this does not mean that there are no existing emissions in the area or naturally occurring emissions. • Without knowing background levels it is impossible to determine cumulative impacts.	Currently there are no monitoring methods for carrying out background monitoring of nitrosamines. We have identified in our recently published report on environmental impacts of emerging carbon capture technologies (Environmental impacts of emerging carbon capture technologies for industrial decarbonisation - GOV.UK) that this is an area that requires action. We have an ongoing research project to identify potential ambient air monitoring techniques for amines and breakdown products On this basis, we have not required the Applicant to monitor background nitrosamine levels.
Will the operator be required to carry out detailed checks on nitrosamine levels to determine if the modelling predictions have been exceeded?	Emission limits set in the varied Permit for total nitrosamines are based on the Applicant's modelled concentrations. The operator is required to monitor emissions of nitrosamines to demonstrate compliance with

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	the limits. In addition, we have set IC56D in table S1.3 of the varied Permit which requires the Operator to provide a revised air emissions risk assessment based on 12 months of monitoring data to confirm whether actual concentrations of emissions are in accordance with the predicted concentrations.
Unaware of any British Standard for monitoring or standards or technology for continuous monitoring	We have developed methods for the periodic monitoring of amines and nitrosamines which was published in March 2025. Monitoring stack emissions: carbon capture plants with solvent-based abatement - GOV.UK Due to the presence of water droplets in the flue gases isokinetic sampling is required and, as a result, there are currently no continuous monitoring methods for amines and nitrosamines. However, development of periodic standards will lead to development of continuous monitoring methods.
Concern that monitoring limits based on modelling will not provide protection of human health due to the uncertainties in the modelling and the lack of validation of the chemical transformation dispersion modelling.	As the degradation of amines in the atmosphere is dependent on the concentration of amines that are emitted, we have set an emission limit for total amines in the varied Permit (table S3.1a) based on the modelling carried out by the Applicant. We have reviewed the modelling and carried out sensitivity analysis to check the sensitivity of the uncertainties in the model and consider that the impact of emissions will be insignificant on human health. See section 5.2 of this document.
Emission rates and stack parameters	
What evidence is there that the flue gases will mix perfectly given that the applicant's model assumes perfect mixing of flue gases but the BECCS and non-BECCS emissions have different temperatures? Will the plant be required to operate with a flue gas temperature as modelled?	The current Permit requires the Operator to monitor stack temperature continuously and this will not change as a result of this Application. There are standard conditions requiring the Operator to provide an annual review of monitoring, a review of the performance of the plant, including the carbon capture plant, and to propose any improvements to reduce impact on the environment. In addition, we have included an improvement condition that requires the Operator to re-visit the assumptions made in the Application following commissioning of the carbon capture plant. These conditions will ensure that should the temperature in the flue gas not be in accordance with that used in the modelling, revised assessments will be provided.
Concern was raised regarding the much lower amine emission rate (0.36 g/s) compared to that for Keadby 3 (5.9 g/s)	We did not agree with the Applicant's assessment of emissions to air, in particular regarding the proposed emissions, and requested a revised assessment in our

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even though the generating power of Drax is significantly higher than that for Keadby 3, and how this can be BAT.	information notice dated 27/07/2023, which was received on 29/11/2024. The revised assessment is based on a different emissions profile and the emission rate for primary amines is 2.22 g/s and for secondary and tertiary amines is 1.33 g/s. The difference in the emission rates results from a number of factors. The solvent proposed at Keadby 3 and Drax are different meaning their emission profiles will be different, and the stack parameters such as temperature and diameter will also be different so these will account for the differences in the emission rates. As part of our assessment of the air impact assessment, we check whether we agree with the emission rates used in the modelling. For Drax we were able to replicate the emission rates. As there is no specific BAT for carbon capture, we assess the proposal against the PCC carbon dioxide capture: emerging techniques guidance – see section 6 and Annex 1 of this document.
The EA should regulate emission rates, temperature (stack) and flow velocity so they are no less or no worse than those modelled.	We have set ELVs based on the Applicant's modelling in table S3.1a of the permit and have set monitoring including for gas flow and temperature. The stack parameters used in the modelling have been included in the operating techniques (table S1.2). We have set IC56D in table S1.3 of the varied Permit that requires the Operator to review the air dispersion modelling after 12 months of operation to confirm that the actual operating conditions are in accordance with those predicted. Where this is not the case, the Operator will be required to assess the impact of the actual emissions and propose and measures for reducing emissions where required.
Other concerns	
There is a shortage of CO_2 and the UK Food and Drink Sector has struggled to source CO_2 of both food grade and technical grade. Regardless of the grade of CO_2 that Drax will produce there is a market for this gas. Drax's proposal to build a pipeline and store the CO_2 in perpetuity has a cost associated with it whereas using the CO_2 would provide a revenue stream and create jobs.	Drax are not proposing to build a pipeline, but rather they are proposing to capture the CO_2 from their combustion plant and to discharge it into the pipeline and storage developed by third parties. We can only consider the information submitted in the application. As the proposal is to capture CO_2 for long term geological storage, our determination can only be based on this proposal.
We support the permit application from Drax. We are supporting the development of standards for carbon capture and are working with industry to further progress	No response required.

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innovation in this field.	
We note the application is novel and complex and that the final design is not yet complete. We ask that every stage of the staged permitting process is open to public consultation.	The Application was submitted in stages and once all the stages had been submitted, we 'duly made' the Application. All the information submitted was placed on the public register and was included in the consultation. In addition, a second consultation on the revised air impact assessment was carried out. We also consulted on our draft decision. See section 2 of this document. All responses to our notices and requests for information have been placed on the public register.
Request that permitting details are open to amendment to allow for ongoing research from other CCS installations.	Where there is no final design for elements of the process we have included pre-operational conditions in the varied Permit that require the Operator to provide details of the design and to validate any assessments. It is likely that these designs will be based on knowledge at the time and will have to be based on our guidance, which is updated as new information regarding the sector is obtained. All the information provided regarding the operation of the CC plant submitted with the Application, responses to pre-operational and improvement conditions and monitoring data have been or will be placed (when operational, should we decide to issue the variation) on the public register and will be available for anyone to view.
Real-world experience has not informed the application.	There are no operational carbon capture plants on power stations burning biomass. The Applicant has based their proposals on a system and process provided by a manufacturer that has experience of the use of their process in pilot studies. The Operator will be required to validate the assumptions made regarding the impacts of the operations through pre-operational and improvement conditions and to carry out monitoring to determine actual emissions. Where the actual operation shows different emissions to those assumed in the Application, the Operator would be expected to propose measures to reduce the emissions.
Will an explanation of 'X and Y' as stated in section 2.4.2 of the Supplemental Information Provision report be requested?	We requested the information for the dates of the trials at the site in our information notice dated 23/10/2023. The Applicant provided the response on 31/03/2024 as follows: *'The test dates for the pilot were:* • *KS-1: 29/09/2020 – 01/07/2021* • *KS-21: 12/07/2021 - 06/12/2022'*
For start-up and shut down it states the parameters will not be available until final design, the timescale for which has	We have included a number of pre-operational conditions which the Operator needs to comply with before the plant can be operated. These relate to confirmation of the final

Brief summary of issues raised:	Summary of action taken / how this has been covered
passed. When will this data be available and when will the permit conditions be considered and will they be open to public comment?	design and commissioning of the pant which will establish the performance parameters of the plant including what is considered to be stable operation. The draft varied Permit together with this document have been made available for public consideration as part of our 'minded to' consultation from 27/05/2026 to 24/06/2026.
Concerns regarding the capture rate and that the actual rate will be much lower if it is only recorded during stable operating conditions; that the claim for 95% capture rate cannot be relied on as no evidence of this having been achieved; that the reports of capture rate should be publicly available; and whether 95% capture rate will be a permit condition.	As this plant is a 'first of its kind' for the scale of the operation, there is limited data available to confirm what the capture rate should be. Our emerging techniques guidance requires operators to design their plant to capture 95% of the CO_2 from the flue gas, but it acknowledges that the capture rate may fluctuate. Whilst we have not set a condition in the varied Permit that specifically requires the capture rate to be 95%, we have set conditions that require the rate to be monitored and reported. The Operator is required to continuously monitor CO_2 capture rate and report the average capture rate each year both during normal operation and at start up and shut down. These reports will be made available on the public register. As this is novel technology, we have included an improvement condition (IC54D) in table S1.3 of the varied Permit that requires the Operator to report the average capture rate after 12 months of operation and to carry out an investigation where the average capture rate is less 95% to determine why this is the case and to propose remedial measures to improve the capture rate where appropriate. This will also confirm whether the capture rate is in accordance with the design parameters.
Concern that the Applicant is claiming that the proposal will mean 'negative carbon emissions across the supply chain' and request that the carbon accounting system is updated to account for all supply chain emissions.	This is not relevant to the determination of the Application and is outside our remit. Therefore, this is not considered further in our determination.
Concern that the capture plant can be switched off to increase power to the grid which will have an impact on reported capture rate.	There is no legal obligation on operators of carbon capture plant to capture CO_2 all the time and therefore it is possible that the flue gases will be diverted away from the capture plant and emitted. The Operator is required to report the number of hours of operation of the carbon capture plant each year and condition 4.2.2 of the varied Permit requires the Operator to report on the operation and functioning of the carbon capture plant each year.
Concerns that Drax Power Limited could not be considered to be a competent operator in accordance with the Regulations and Core guidance given that	We consider an operator not to be competent to hold an environmental permit if it: • Has an inadequate management system.

Brief summary of issues raised:	Summary of action taken / how this has been covered
OFGEM were investigating the company in relation to Renewables Obligation and fined them as a subsidiary had breached its electricity generating licence and that there have been issues regarding misleading statements in the press and fines regarding air quality at pellet processing plants in the USA.	• Demonstrates inadequate technical competence. • Has a record of poor behaviour or non-compliance with previous regulatory requirements. Or, • Has inadequate financial competence. We do not consider that the issues raised would lead us to consider Drax Power Limited to not be a competent operator. The offences referred to are not ones included in the list of 'relevant offences' which we consider when determining if an operator is competent in relation to holding an environmental permit. Therefore, the issues raised are not relevant to this determination.
The operator has not considered the wastes that will be produced by the PCC and has no plan for the management of these wastes.	As the proposal is a first-of-a-kind and there is no similar plant operating at scale, it is not possible for the Applicant to be precise regarding the waste types that will be generated at the site, but a list of wastes is included in the Application together with proposals for managing them. A pre-operational condition (PO42) has been included in table S1.4 in the varied Permit that requires the Operator to confirm that a plan for the management of wastes from the carbon capture process has been included in their Environmental management System.
Concern that not all risks have been considered, specifically in relation to associated infrastructure and changes to the current process.	Additional information regarding treatment of wastewater, storage of the solvent, noise impacts and impacts and management of fugitive emissions was provided in response to our two information notices dated 23/10/2023 and 11/07/2024. We are satisfied that the Applicant has considered the impacts of emissions and will have appropriate plans in place to manage the risks. Where the Applicant has not finalised the design of any measures, we have included pre-operational or improvement conditions in the varied Permit requiring the Operator to finalise these before operation of the plant or with our agreement.
Can a proposal without comparable data be a 'mature and well understood technology' as stated by the Applicant?	Although the solvent-based capture of carbon dioxide is understood and is a 'mature' technology, this is in relation to coal fired power stations. The capture technology has not been used to capture CO_2 from biomass fuelled power stations, so this is less understood. However, for the purpose of the determination of this Application, we consider whether the Applicant's proposals are in accordance with our guidance and base our assessment on the information provided in the Application and in response to any requests for further information.
Concern that risks to human health are being determined based on emission limits that cannot be monitored for and query	We did not agree that the Applicant had provided an air impact assessment that considered all emissions. We requested a revised assessment in our information notice

Brief summary of issues raised:	Summary of action taken / how this has been covered
whether limits that can be enforced will be required.	dated 27/07/2023 and a revised assessment was received on 29/11/2024. Based on this assessment, the limits that have been assessed are at levels that are above the limit of detection that can be achieved by current monitoring methods. The modelled emission limits have been included in the varied Permit, and the Operator will be required to monitor to demonstrate compliance.
Will limits on OTNOC be included in the permit to ensure that operation without the carbon capture plant does not become the normal operating condition?	There is no legal requirement for operators to install carbon capture so we cannot enforce its use. However, operation of Units 1 and 2 with carbon capture will be the normal operating conditions for these units. We have included a pre-operational condition PO31 in table S1.4 of the varied Permit, that requires the Operator to provide an OTNOC Plan. The Operator is required to report the number of events and number of hours the PCC is not available each year through table S4.3 and condition 4.2.2 of the varied Permit.
What is the source of heat used in the regenerator and does this maximise energy efficiency?	All heat, steam and power for the PCC is provided from the existing power station (see section 4.2.3 above). Steam is tapped off from the turbines for use in the PCC and provides the heat to the regenerator. We have reviewed the Applicant's use of heat, steam and power at the site and agree that even with the operation of the PCC and its energy penalty, the site as a whole has an energy efficiency just below the lower limit of the BAT AEELs as set out in the LCP BAT conclusions, although there is no efficiency specified for biomass plants with PCC (see section 6.4.1 above).
How will the determination of the Application ensure a high level of protection of the environment as a whole given that there have been issues with deforestation, air pollution from the pellet plants and the use of biomass to generate power not being sustainable which have resulted in environmental impact?	Whether the use of biomass to generate power is sustainable and whether the production of the wood pellets in a different country have resulted in environmental pollution are not matters for the Environment Agency as they are outside our remit. The variation Application relates to the operation of the carbon capture plant, and we can only base our determination on the assessment of the impacts on the environment from this activity.
Given the controversial nature of Drax, will the application be considered to be of high public interest?	The Application is considered to be of high public interest.
Section 2 of Part C3 not completed so unable to comment without list of emissions and their locations.	We requested an updated plan showing the emission points at the site and a list of emission points being added and removed in our second information notice dated 23/10/2023. A response was received on 31/03/2024. The

Brief summary of issues raised:	Summary of action taken / how this has been covered
	request and the response were placed on the public register, and we are satisfied that all emission points are identified.
The Applicant has not completed Appendix 4 of the Part C6 form so it is difficult to make meaningful comments.	There is no change to the discharge or the location of the discharge as a result of this Application so it was not considered critical to the determination that Appendix 4 was completed as the answers would have been 'no change'.
Disagree that the Application is a minor technical variation as ticked in 2a of the Part C2 form.	We have not considered the Application to be a minor technical variation, and our determination has been carried out on the basis that the Application is a substantial variation.
Concern that the Applicant has only referred to nitrosamines as 'potentially toxic' so has not appreciated the likely significant toxicity of the nitrosamines, so this calls in to question the Applicant's competency.	We did not agree with the Applicant's assessment of emissions to air and requested a revised assessment in our information notice dated 27/07/2023, which was received on 29/11/2024 and derivation of EALs was received on 27/01/2025. We are satisfied that the Applicant has considered the toxicity of the emissions as they have assessed the predicted concentrations against published, draft and their own derived EALs which take into account the effects on human health. We consulted on the revised air impact assessment on 04/02/2025 including with the UKHSA who agree with the Applicant that the emissions will not have an adverse impact on human health.
Concern that the documents provided in relation to a summary of the Environmental Management System (EMS) are not a summary and request that this is provided so meaningful consultation comments can be provided.	As the Applicant already holds a permit we have previously assessed the EMS and are satisfied that it is in accordance with our guidance. Any changes to operations and management of emissions as a result of this Application will have to be included in the EMS.
Part C2 shows there is no discharge to sewer, but concern that if there is an increase in loading on the sewer system due to extra staff that increases nitrogen and phosphorous should be considered.	Discharge of sewage from the toilets, showers and canteen at the site is not regulated under this Permit and so is not considered further as it is not relevant to the determination of this Application.
Concern whether the documents referred to in the application forms are the same or different versions of the same document and that if they are different, that they are not available to allow meaningful public comment.	The references are to the same supporting document. This and all documents submitted as part of the variation Application or in response to our information notices have been placed on the public register.
Concern that the proposals will worsen air quality and will risk water pollution as the	We have reviewed the risk assessments provided by the Applicant including that regarding the emissions to air,

Brief summary of issues raised:	Summary of action taken / how this has been covered
risks from nitrosamines cannot be adequately controlled using unvalidated modelling and undisclosed emissions.	there is no change to the emissions to water as a result of this variation Application and the Applicant provided a revised emissions profile in response to our first information notice which we have placed on the public register. We are satisfied that the proposed PCC will operate without impacting air quality or causing pollution of water. See section 5 of this document.
Concern there will be harm to human health and that the plant will not be compliant with Articles 2 and 8 of the Human Rights Act as there are alternative means to generate electricity without emitting carbon.	We have reviewed the Applicant's proposals and are satisfied that the operation of the PCC will not cause harm to human health. In following our procedures for the determination of this Application, we consider that our decision is compatible with our duties under the Human Rights Act 1998. We make our decision on the merits of applications presented to us and it is outside our remit to comment on alternative proposals to the one included in the application.
Concerns about explosion risk and whether these have been minimised and whether emergency procedures have been updated and published for consultation.	The risk from explosion was included in the Environmental Risk Assessment which was submitted in response to our 'not duly made' request regarding stage 1 of the application. This was included in the consultation on the application. A safety data sheet was received in response to our second information notice and has been placed on the public register. The safety data sheet for the solvent states that the substance is not explosive. The Applicant will be required to update any emergency procedures which are part of their environmental management system and, therefore, are not published on the public register.
Query regarding how 'costs and benefits' have been taken into account in assessing: • the harm to human health from increased air pollution • the environmental cost of the continued use of biomass • the level of abatement required due to the costs to human health and the environment	In general terms the environmental damage costs would be relevant to the formulation of strategic decisions as a way of approximating impacts. They can also be relevant to comparing the costs of different technologies in terms of assessment of BAT in relation to our emerging techniques guidance. However, they are not a replacement for a detailed assessment of environmental impact based on detailed air quality modelling. We have based our decision on such an assessment and are satisfied that there will not a significant environmental impact, as set out in section 5 of this decision document. We have not made any assessment in relation to the use of biomass as a fuel as this is not material to the variation Application to which this document refers.
Concern that the engineering design has optimised heat and electrical demand to ensure the units are energy and resource efficient, but has not focused on	The Applicant is required to design the plant in accordance with our emerging techniques guidance (or to an equivalent standard that has the same level of environmental protection) and, in doing so, the

Brief summary of issues raised:	Summary of action taken / how this has been covered
minimising risks to human health and the environment.	environment and human health are protected. In order to demonstrate that the proposed design does not harm human health and protects the environment the Applicant is required to provide environmental risk assessments. We have reviewed the proposals in the Application and the environmental risk assessments, and we satisfied that the site will operate without causing significant impacts to human health or the environment. Details are set out in section 5 of this document.
Request for the missing link in section 2 of the Non-technical summary to the proposed approach to the staged application so can comment.	The information referenced where the link was not included is to the covering letter of the application submitted on 22/08/2022 and which was included in the consultation on the application in 2023.

b) Representations from Individual Members of the Public

A total of 2 responses were received from individual members of the public. A drop-in event was attended by 10 persons, who were a mixture of local residents and community and other organisations.

Brief summary of issues raised:	Summary of action taken / how this has been covered
Unable to comment on the technical data but consider biomass to be the most environmentally friendly means of power generation as it is not reliant on unsuitable minerals or result in products which can't be recycled. Managed woodland is essential and the scale is vast so it will generate local jobs. Woodland will enable absorption of carbon and carbon capture will store the carbon released through burning.	No action required.
If CCS is to be deployed, use coal or gas as fuel source and not biofuel, as: • Coal and gas are more efficient as emit less CO_2 when burnt • Using wood felled in southern America, cut into pellets, coated in plastic and transported across the Atlantic is environmental madness.	The variation is for the addition of the carbon capture activity to the Permit and does not include proposals for a change in fuel. We have to make our decision based on the application submitted and the use of different fuel is not part of the determination of this Variation application.
CCS is an unproven technology and carries risks: • Potential leakage of CO_2 from the subsurface reservoir	We are not the regulator of the geological storage of carbon dioxide and therefore, we cannot comment on the issues raised. The North Sea Transition Authority is the regulator

Brief summary of issues raised:	Summary of action taken / how this has been covered
• Potential for inducing earthquakes.	responsible for the licensing of offshore geological storage of CO^2.

B) Consultation on the information notice response

The responses received on 29/11/2024 and 27/01/2025 to the first information notice regarding the air impact assessment and derivation of EALs have been consulted upon in accordance with the Environment Agency's PPS. The way in which this has been carried out along with the results of our consultation and how we have taken consultation responses into account in reaching our draft decision is summarised in this Annex. Copies of consultation responses have been placed on the Environment Agency public register.

The responses to the information notice were advertised on the Environment Agency website from 04/02/2025 to 04/03/2025. The information was made available to view digitally on the Environment Public Register.

The following statutory and non-statutory bodies were consulted: -

- UK Health Security Agency

1) Consultation Responses from Statutory and Non-Statutory Bodies

Response received from UK Health Security Agency	
Brief summary of issues raised:	**Summary of action taken / how this has been covered**
The Environment Agency should satisfy themselves that the modelling of the core scenario is protective of the modelling of the three operating scenarios that are only partially presented.	We requested additional assessment in our schedule 5 notice No4 dated 27/05/2025 of two scenarios considered in the sensitivity analysis as our audit of the air quality assessment identified that the core scenario was not the worst case. We asked the Applicant to provide an assessment of impacts of methylethylamine and N-dimethylethylenediamine (the amines predicted to form the greatest quantities of nitrosamines and nitramines respectively) for the following scenarios which are considered to be the most likely operating scenarios: • Both BECCS units operating continuously; and • Both BECCS units operating continuously and Units 3 and 4 (non-BECCS) operating for 4000 hours per year. The Applicant provided the revised modelling and assessment on 31/07/2025. The modelling showed that the emissions of methylethylamine are unlikely to exceed the NDMA EAL for any of the scenarios and that

Response received from UK Health Security Agency	
Brief summary of issues raised:	**Summary of action taken / how this has been covered**
	emissions of N-dimethylethylenediamine are unlikely to exceed the NDMA for the operation of both BECCS and Units 3 and 4 operating for 4000 hours per year. However, predicted emissions of N-dimethylethylenediamine for the BECCS only scenario showed exceedance of the NDMA EAL. The Applicant concluded that emissions of N-dimethylethylenediamine will not be at the emission limit value for total secondary and tertiary amines, but rather make up 8% of it. In addition, the Applicant stated that it is unlikely that Units 1 and 2 with the carbon capture plant will operate continuously throughout the year. We have reviewed the assessment and, based on the conservative nature of the modelling and the likely operating scenarios, we agree with the Applicant's conclusions. See section 5.2 for more details.
The hourly process contribution of Ethylmethylamine should be provided to allow a comparison to the proposed 1-hour operator-derived EAL for the short-term exposure.	We requested this information in our schedule 5 notice No4 dated 27/05/2025. The Applicant provided the amended EAL for short term 1-hour Ethylmethylamine in their response dated 20/06/2025. The Applicant provided updated tables with the assessment of PCs against the correct EALs. This revised assessment has not changed the conclusions. The EAL previously provided was a typographical error.
It would be prudent to ensure consideration of whether there are other nearby installations or proposed or future installations that would also result in nitrosamine and/or nitramine emissions or formation in the atmosphere to ensure appropriate health protection in the local community.	For the assessment of the application for a carbon capture activity at the Keadby power station, we considered the impact of emissions to air from Keadby and the proposed carbon capture plant at Drax. We determined that given the location of the two sites and the prevailing wind direction, there would not be a cumulative impact on receptors from the operation of both sites.
It is noted that the Applicant does not provide a description and assessment of the water courses in the proximity to the site (i.e. surface water, groundwater and abstractions) within the documents provided for the above variation. The Environment Agency should satisfy themselves that a suitable assessment and mitigations are in place to prevent risks to human health via exposure to controlled waters.	As described in section 4.2.1 the CC plant operates as a 'closed loop' system where no process or wastewater that has come in to contact with the amine solvent or breakdown products is discharged to surface water or sewer. Wastewater from the reclaimer unit which will contain amines and breakdown products will be stored as hazardous waste and will be sent off-site for appropriate disposal. The Applicant has assessed the storage of the raw solvent in accordance with Storage BRef from 2006 and has confirmed that the storage will be in accordance with

Response received from UK Health Security Agency	
Brief summary of issues raised:	**Summary of action taken / how this has been covered**
	BAT. We have set a pre-operational condition PO34 in table S1.4 of the varied Permit that requires the Operator to confirm that the final design of the storage for the solvent is in accordance with the BRef. We consider that impacts on groundwater and surface water from the storage of the solvent and waste from the CC plant have been assessed and are determined to be negligible. There is no change to the emissions to surface water, and the impact of these emissions has been assessed in previous permit applications.
The Fire Prevention Plan is not included within the permit variation documents provided. The Environment Agency should satisfy themselves that a Fire Prevention Plan is produced by the Applicant and that it is in line with the approach recommended in the relevant Environmental Permit sector guidance.	A Fire Prevention Plan is not required as the application does not involve the storing or treating of combustible waste. Therefore, no further action is required.

2) Consultation Responses from Members of the Public and Community Organisations

a) Representations from Community and Other Organisations

Representations were received from the following community and other organisations:

- Just Transition Wakefield

Brief summary of issues raised:	Summary of action taken / how this has been covered
The conclusion that the impacts are insignificant are based not on a genuine, well-informed risk assessment, but on a very thin knowledge base.	We have reviewed the Applicant's risk assessments and consider that these have been carried out in accordance with our relevant guidance and are based on the worst case and the information that is available now. We have included a number of pre-operational and improvement conditions as described in the main body of this document that require the Operator to confirm the actual operating techniques and emissions and to confirm the assumptions used in the risk assessments.
As there is a lot of uncertainty and this is novel unproven technology, request that conditions are set on a precautionary	Monitoring of pollutants arising from the PCC activity has been specified in table S3.1a and performance monitoring is specified in table S3.4 of the varied Permit.

Brief summary of issues raised:	Summary of action taken / how this has been covered
principle with vigorous stack and environmental monitoring.	In addition, the Operator is required to validate the assumptions made in their risk assessments through pre-operational and improvement conditions set out in tables S1.3 and S1.4.
As the cluster develops there needs to be a way to assess cumulative impacts and new methods should be developed independently.	The modelling that is carried out in accordance with our air dispersion modelling guidance (Environmental permitting: air dispersion modelling reports) is very conservative. The guidance requires that where the PCs do not screen out as insignificant (refer to section 5.1.2 of this document for explanation), the applicant has to consider the PEC (PC plus background concentration of the pollutant) against the relevant standard including emissions from other proposed and operating sites in the local area. This determines a cumulative impact. We have also modelled cumulative air emissions impacts for the Tees and Humber Clusters (The cumulative air quality impacts of net zero technologies) and have an ongoing research project modelling cumulative impacts for water discharges from net zero technology deployment in these clusters. The cumulative water quality modelling includes impacts from deposition of reaction products associated with emissions to air from amine-based carbon capture. The recommendations from these studies will also help us identify background ambient air and environmental monitoring programme requirements for the clusters.

b) Representations from Individual Members of the Public

A total of 5 responses were received from individual members of the public. Some of the responses covered matters that had been raised during the consultation on the Application and these have been addressed in Part A of this Appendix.

Brief summary of issues raised:	Summary of action taken / how this has been covered
Background NOx concentrations are variable so using an average does not account for the variations in topography and meteorological conditions	The background maps provided by Defra and the devolved authorities are updated periodically to take account of monitoring data and meteorological conditions. Data is available for a 1km by 1km grid. Therefore, variability of concentrations over time and across an area are taken into account.
The emission rates provided by Drax in the DCO are markedly lower than those for Keadby 3 which would not be expected since the generating capacity of Drax is	The figures quoted refer to the PCs rather than the emission rates. PCs are based on a number of factors including the emission rate of a pollutant which itself depends on the concentration of the pollutant, the flow

Brief summary of issues raised:	Summary of action taken / how this has been covered
much higher than that for Keadby.	rate, temperature and velocity of the flue gas, and the diameter of the stack at the point of emission. In addition, the PC is affected by the height of the stack. Therefore, as these are different for both sites, the PCs are expected to be different. As the exit temperature and the height of the stack at Drax are much higher than those for Keadby, lower PCs would be expected as there would be better buoyancy and dispersion of the pollutants.

C) Consultation with the Health and Safety Executive on the CO_2 Venting Risk Assessment

We consulted the Health and Safety Executive on the response received on 12/09/2025 to our fourth information notice dated 27/05/2025 regarding the CO_2 venting risk assessment on 27/10/2025.

We did not receive a response.

D) Advertising and Consultation on the Draft Decision

This section reports on the outcome of the public consultation on our draft decision carried out between 27/05/2026 and 24/06/2026.

In some cases, the issues raised in the consultation were the same as those raised previously and already reported in section A of this Annex and so have not been repeated in this section.

Also, some of the consultation responses received were on matters which are outside the scope of the Environment Agency's powers under the Environmental Permitting Regulations, such as concerns regarding the sustainability of the use of wood as a fuel. Our position on these matters is as described previously.

1) Consultation Responses from Statutory and Non-Statutory Bodies

No responses received.

2) Consultation Responses from Community Organisations and Members of the Public

We received 5 responses from community organisations and members of the public.

a) Representations from Community and Other Organisations

Representations were received from Stop Burning Trees Coalition, who raised the following issues:

Brief summary of issues raised:	Summary of action taken / how this has been covered
The variation should not be issued because of the precautionary principle	The United Kingdom Interdepartmental Liaison Group on Risk Assessment (UK-ILGRA) state in their paper "The Precautionary Principle: Policy and Application" that the precautionary principle should be invoked when there is good reason to believe that harmful effects may occur and the level of scientific uncertainty about the consequences or likelihood of the risk is such that the best available scientific advice cannot assess the risk with sufficient confidence to inform decision making. Although there is uncertainty regarding the actual impacts from the proposal on the environment and people given that this is 'first-of-a-kind' technology, we do not consider that the risks cannot be assessed. We are satisfied that the conditions in the varied Permit – such as the improvement, pre-operational, emissions monitoring and process monitoring conditions – will provide sufficient control on the operation of the PCC to prevent or minimise pollution.
Concern that real-world' emission rates are not validated, and results show exceedance of N-dimethylethylenediamine which are dismissed on the basis that the substance is not emitted at the limit and continuous operation is unrealistic.	We have reviewed the modelling and have concluded that we are satisfied that the Applicant's modelling is worst case. This is explained in section 5.2 above. As the technology is novel and there is no real-world data available from which to determine the concentrations of substances, we have included an improvement condition in table S1.3 of the varied Permit for the Operator to confirm the concentrations of substances emitted once the PCC has been operational for 12 months. This condition requires them to re-assess the impact and propose measures to reduce emissions where the results show a risk of exceedance of the EALs.
Concerns permit conditions are not specific to substances.	We have not set limits for specific substances as the assessment is based on: • Each substance being emitted as total amines, nitrosamines or nitramines; and • The predicted percentage of each substance likely to be emitted within the total amines, nitrosamines or nitramines emitted. We have specified emission limits for total amines, nitrosamines and nitramines and monitoring of each substances emitted. The Operator has to demonstrate compliance with the limits for total amines, nitrosamines and nitramines by adding up the emissions of each amine, nitrosamine or nitramine, which should be below the total limits. Therefore, there is no requirement to set an emission limit for each substance.

Brief summary of issues raised:	Summary of action taken / how this has been covered
Concern that emission limits are based on modelled emissions and these will only be checked against actual emissions after the plant has operated for 12 months.	As there are no similar operational sites, we have to base our determination on what the Applicant has proposed as the substances and concentrations emitted. Whilst we have set an IC to require the Operator to use actual data to determine if they are in accordance with predicted results, this is not the only measure specified in the varied Permit that requires the Operator to determine emissions. We have also set a pre-operational condition, 29, in table S1.4 of the varied Permit, regarding commissioning of the PCC. This requires a Monitoring Plan and proposals for actions to be taken in the event actual emissions exceed expected emissions. Improvement condition IC53D requires a report to be submitted regarding the commissioning that includes a review of the performance of the PCC against the design parameters and the conditions in the varied Permit. Where the commissioning cannot demonstrate that the Permit conditions can be complied with, we will not be able to provide written approval to the pre-operational and improvement conditions, and the PCC will not be able to operate.
Concern that NDMA is used as proxy despite an incomplete evidence base regarding NDEA which is not precautionary and that the gap in evidence should weigh against the granting of the permit.	As explained previously in Annex A to this decision document we agreed that NDEA has a higher oral toxicity and explained why the EAL for NDMA is precautionary based on inhalation. The route-to-route extrapolation to derive an inhalation EAL in the absence of relevant studies is an accepted methodology. The Applicant has based their assessment of impacts using NDMA as a proxy EAL on the basis that this is the most precautionary EAL. We agree with this approach, and the UKHSA did not comment on the use on the use of NDMA as the most precautionary EAL.
Concern that the first-of-a-kind plant is permitted ahead of research such as that for deposition of amines, nitrosamines and nitramines to water.	As described in Annex A to this document, we consider the impacts of emissions to air on human health through the inhalation exposure route. We have set limits in the varied Permit based on the assessment provided by the Applicant to prevent significant impact on air quality. These limits also minimise the impacts from deposition on land and water. Therefore, we consider that these assessments and limits are protective of human health including in relation to theoretical effects from deposition on water.
Concern that critical loads are exceeded and the conclusion of insignificance is only reached through comparison with baseline	As explained previously in this decision document we are satisfied that the Applicant has assessed the impact of emissions appropriately and in accordance with our

Brief summary of issues raised:	Summary of action taken / how this has been covered
and conservatism arguments.	guidance and we agree with the Applicant's conclusions.
It is unclear why Natural England's position regarding acid deposition impacts was reversed.	The Applicant submitted revised modelling based on actual monitoring data for sulphur dioxide. This is described in section 5.1.4 of this document.
Concern regarding the dismissal of cumulative impacts based on wind direction, given the concerns in the research from Imperial College and the Norwegian Institute of Public Health and the development of the Humber Cluster.	As explained previously in this decision document we are satisfied that there won't be any cumulative impacts due to the location of this site in relation to other projects and the concentrations of substances being orders of magnitude lower than those used in the research.
Concerns regarding the energy penalty stated is not inline with previous R&D trials.	We have previously considered this (see section 6.4.1) and are satisfied that the operation of Units 1-4 with two PCC units fitted will still meet the BAT AEELs for LCPs burning solid biomass
The variation to the permit is justified by the supposed capture of CO2, yet the permit does not require it.	We have a statutory duty to determine the application submitted. As stated, there is no legal obligation to capture CO_2. We are satisfied that, should the Operator decide to install the PCC, the conditions of the varied Permit will ensure a high level of protection is provided for the environment and human health. We are satisfied that the permit conditions and limits will achieve this, and that the Applicant has provided sufficient information to demonstrate their capability and commitment to comply with the permit conditions.

b) Representations from Individual Members of the Public

A total of four responses were received from individual members of the public. These raised many of the same issues as previously addressed. Only those issues additional to those already considered are listed below:

Brief summary of issues raised:	Summary of action taken / how this has been covered
Concern regarding cooling water use in data centres	This is not relevant to the variation application subject to this decision and, therefore, is not considered further. Use of water for the PCC is described in section 4.2.2 and emissions to water are described in section 5.5.1 of this document.
Support for the PCC as it will provide further opportunities for jobs and training in the area.	No response required.

Brief summary of issues raised:	Summary of action taken / how this has been covered
Concern regarding the restriction in table S2.1 regarding the biomass fuel and that the supply chain is inconsistent with condition 1.3 regarding efficient use of raw materials	The Application related to the installation of PCC plant and was not related to the fuel used for the generation of power. Therefore, consideration of the fuel was not material to the determination of the Application, other than in relation to how combustion-derived pollutants in the flue gas may influence amine degradation.
Concern regarding pre-operational measure 36 which is not conclusive regarding reporting of fugitive amine degradation products.	Under this pre-operational measure, the Operator is required to submit a plan for the monitoring and minimisation of fugitive emissions from the amine infrastructure (such as the storage tanks) and other raw materials used in the PCC. This plan will be part of the EMS and regulated through condition 1.1 of the varied Permit and any monitoring will be placed on the public register.
Energy use, capture rate and quantity of CO_2 not captured should be published less than six months after the end of each year.	Condition 4.2.2 of the varied Permit requires the Operator to submit a report, which includes the performance parameters specified in table S4.3, by the end of January each year. This report is placed on the public register. Therefore, the information is available within a month of the end of each year.
Concern regarding acceptance of the operator's claims that there is a performance guarantee from the supplier.	The Conditions in the varied Permit have been set based on the information in the Application and the Application was made on the basis of the performance provided by the supplier of the PCC plant. We have set a pre-operational condition, 29, in table S1.4 of the varied Permit regarding commissioning of the PCC. This requires a Monitoring Plan and proposals for actions to be taken in the event actual emissions exceed expected emissions. Improvement condition IC53D requires a report to be submitted regarding the commissioning that includes a review of the performance of the PCC against the design parameters and the conditions in the varied Permit. Where the commissioning cannot demonstrate that the Permit conditions can be complied with, we will not be able to provide written approval to the pre-operational and improvement conditions, and the PCC will not be able to operate.
Concern that risks from fugitive emissions of amine degradation products are downplayed and that there is no equipment available to monitor them beneath the plume.	There are no fugitive emissions of amine degradation products as these are formed in the PCC plant and are released as point source emissions from the main stack. The impacts of these emissions have been assessed as described in sections 5.1, 5.2 and 5.3 of this document. Section 5.5.3 of this document assesses the impacts of fugitive emissions specifically from the storage of the raw and used solvent.

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The solvent is proprietary and may be subject to commercial confidentiality meaning that this might prevent sufficient assessment.	As described in section 2.1 of this document, the Applicant has claimed commercial confidentiality on the solvent and this claim has been accepted. The names of the substances in the solvent have been redacted from the relevant documents on the public register. The Applicant has provided the information to the Environment Agency in unredacted versions of the documents and the assessment of emissions is based on the substances in the solvent and the degradation products generated from their use.
Concern that the timing of the consultation may be of benefit to the Applicant.	The timing of this consultation has not been discussed with the Applicant. The timing is based only on the timing of when the determination of the Application was completed.
The final permit should contain stronger, clearer and enforceable conditions regarding: • Air emissions • Solvent-related pollutants • Wastewater • Hazardous waste • Ecological receptors • Abnormal operations • Carbon capture performance • CO_2 venting • Public reporting	The varied Permit contains standard permit conditions which, in our view, will ensure a high level of protection is provided for the environment and human health. We are satisfied that the permit conditions and limits will achieve this, and that the Applicant has provided sufficient information to demonstrate their capability and commitment to comply with the Permit conditions. We have addressed many of the concerns raised about specific issues in the responses below. It is important to recognise that permit conditions are designed to function cohesively within the broader context of the Permit. Reading them in isolation may not provide a complete understanding of how they work together. It is important to read the varied Permit in its entirety to fully understand the interconnections between various conditions.
Request that where assessment is based on assumptions, likely operating scenarios and claims regarding emissions, these are converted into binding permit conditions.	There are a number of conditions in the varied Permit that control the operations based on the information provided by the Applicant such as condition 1.1.1 regarding the environmental management system and table S1.2 which is referenced by condition 2.3.1 and includes operating techniques. The Operator has to comply with all the conditions in the varied Permit.
The final permit should contain specific controls through clear monitoring, trigger thresholds, emission limits for substances produced by the carbon capture plants, and automatic review or restrictions if the impacts are greater than predicted.	Emission limits and monitoring requirements relating to the emissions from the PCC plant are specified in table S3.1a of the varied Permit. The Operator is required by conditions 3.1.1, 3.1.2 and 3.5.1 to meet these limits and carry out the specified monitoring. Condition 4.3.1 requires the Operator to notify the Environment Agency in the event of an incident, accident, breakdown or malfunction of equipment or breach of an emission limit. Condition 4.3.1(c) requires the Operator to shut down the plant if there is a breach of a permit

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	condition that poses an immediate danger to human health or threatens to cause an immediate significant impact on the environment.
The permit should require public reporting and prompt reporting of exceedances, abnormal operations, CO_2 venting and solvent degradation issues.	A number of conditions in the varied Permit require reporting or notifications and condition 4.2.1 requires them to be sent to the Environment Agency. Conditions 4.2.2 and 4.2.3 require reports on the performance of the activities over the previous year, including the performance parameters, and the monitoring data to be submitted to the Environment Agency. All of these reports and notifications are required to be placed on the public register.
CO_2 venting should not be treated as routine, should be reported publicly and counted against performance expectations.	Venting of captured CO_2 may be required to ensure safety of the system as the captured CO_2 is compressed. The Applicant has provided an assessment of the impacts of venting of the whole inventory of CO_2 at the site as part of the Application and this is described in section 5.4 of this document. Table S3.4 includes a requirement to monitor carbon capture performance, the mass of CO_2 vented and the duration of the event. Condition 4.2.2 and 4.2.3 require reports on the performance and monitoring of the activities to be provided each year. These reports are placed on the public register.
The permit should include enforceable performance requirements.	Condition 3.5.1(c) of the varied Permit requires the Operator to monitor the performance requirements specified in table S3.4. The Operator is required to comply with all the conditions in the varied Permit, including these.
The permit should require clear identification, tracking and handling of hazardous wastes including where they sent and how they are disposed of.	Pre-operational measure 42 specified in table S1.4 of the varied Permit requires the Operator to submit a Waste Management Plan to the Environment Agency for approval that details the waste type and quantities to be produced by the PCC process, details of the storage requirements and the fate of the wastes when removed form the site. Once this Plan is approved, it will form part of the Environmental Management System (EMS) for the site, and the Operator is required to operate in accordance with the EMS to comply with condition 1.1 of the varied Permit. In addition, the Operator is required to comply with other legislation in addition to the requirements of the EPR 2016 in relation to the consigning of hazardous waste for disposal off-site. This includes a requirement to ensure waste is appropriately described and tested so that the transport off-site and the facility receiving the waste

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	understands what the waste is and how it has to be stored, handled and disposed of.
The permit should control other than normal operating conditions and set clear limits for these conditions.	Operation of the PCC, once it is constructed, is considered to be normal operations for Units 1 and 2. We have set a pre-operational measure, 31, in table S1.4 of the varied Permit requiring the Operator to provide an OTNOC Plan that includes the potential OTNOC, the measures to minimise OTNOC events and duration and the proposal for reviewing and optimising performance so that capture rates are as high as possible during OTNOC. Once approved, this plan will be included in the EMS and the Operator will be required to comply with this plan through condition 1.1.