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/LP3132FX
The Application reference is:	EPR/LP3132FX/V009
The Applicant / Operator is:	Encyclis Limited
The Installation is located at:	Protos Energy Recovery Facility, Generation Road, Ince

What this document is about

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

It explains how we have considered the Operator's Application, and why we have included the specific conditions in the varied Permit we are issuing to the Operator. 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 Operator'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/LP3132FX/V009. We refer to the application as "the **Application**" in this document in order to be consistent.

The Permit number is EPR/LP3132FX. We refer to the variation to the Permit as "the **varied Permit**" in this document.

The Application was duly made on 24/11/2023.

The Applicant is Encyclis Limited. We refer to Encyclis Limited as "the Operator" in this document.

Encyclis Limited's facility is located at Protos Energy Recovery Facility, Generation Road, Ince. We refer to this as "the **Installation**" in this document.

The Installation comprises a waste incineration facility and a post-combustion amine-based (Monoethanolamine, MEA) carbon capture plant for permanent geological storage. We refer to the waste incineration facility as ''the **Incineration plant**'' and to the carbon capture facility as ''the **CC plant**'' in this document.

The variation

The Operator applied to vary the Permit as follows:

- Inclusion of one new Schedule 1 regulated activity: Section 6.10 Part A(1): Capture of carbon dioxide streams from an installation for the purposes of geological storage. This incorporates two carbon capture lines, and its directly associated activities:
    - Back pressure turbine providing steam/heat for use within the CC plant.
    - Treatment of wastewaters for re-use within the Installation with a capacity of <50 tonnes per day;
    - Compression of captured carbon dioxide (CO_2); and
    - Conditioning of the compressed CO_2, including the use of hydrogen and silica gel to remove oxygen and water respectively.
- Extension of the Installation boundary to include an additional area of land where the CC plant will be located.
- Update to the site layout to incorporate the layout changes associated with the CC plant.
- Update to the provisions for emissions monitoring associated with the installation of the CC plant.

- Addition of one limited hours emergency gas oil generator that will serve the CC plant.
- Relocation of the existing surface water emission points W1 and W2.
- Addition of one new discharge point to water: W3, for surface water run-off from the CC plant.
- Addition of four emission points to air: A5, A6, A7, and A8.
- Addition of two new monitoring points for monitoring flue gas emissions from Incineration plant prior to CC plant: A1a and A2a.

How this document is structured

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Glossary of acronyms used in this document

(Please note that this glossary is standard for our decision documents and therefore not all these acronyms are necessarily used in this document.)

AAD	Ambient Air Directive (2008/50/EC)
APC	Air Pollution Control
AQS	Air Quality Strategy
BAT	Best Available Technique(s)
BAT-AEL	BAT Associated Emission Level
BAT AEEL	BAT Associated Energy Efficiency Level
BREF	Best Available Techniques (BAT) Reference Documents for Waste Incineration
BAT C	BAT conclusions
CC	Carbon capture
CCS	Carbon capture and storage
CEM	Continuous emissions monitor
CHP	Combined heat and power
CO_2	Carbon dioxide
COMEAP	Committee on the Medical Effects of Air Pollutants
CROW	Countryside and rights of way Act 2000
CV	Calorific value
DAA	Directly associated activity – Additional activities necessary to be carried out to allow the principal activity to be carried out
DCC	Direct Contact Cooler
DD	Decision document
EAL	Environmental assessment level
EIAD	Environmental Impact Assessment Directive (85/337/EEC)
ELV	Emission limit value
EMAS	EU Eco Management and Audit Scheme
EMS	Environmental Management System
EPR	Environmental Permitting (England and Wales) Regulations 2016 (SI 2016 No. 1154) as amended
EQS	Environmental Quality Standard
ES	Environmental standard
EWC	European waste catalogue
FGC	Flue gas cleaning

FPP	Fire prevention plan
FSA	Food Standards Agency
GWP	Global Warming Potential
HHRAP	Human Health Risk Assessment Protocol
HPA	Health Protection Agency (now UKHSA – UK Health Security Agency)
HRA	Human Rights Act 1998
HW	Hazardous waste
HWI	Hazardous waste incinerator
IBA	Incinerator Bottom Ash
IED	Industrial Emissions Directive (2010/75/EU)
I-TEF	Toxic Equivalent Factors set out in Annex VI Part 2 of IED
I-TEQ	Toxic Equivalent Quotient calculated using I-TEF
LCV	Lower calorific value – also termed net calorific value
LfD	Landfill Directive (1999/31/EC)
LOI	Loss on Ignition
MBT	Mechanical biological treatment
MEA	Monoethyleneamine
MSW	Municipal Solid Waste
MWI	Municipal waste incinerator
NOx	Oxides of nitrogen (NO plus NO_2 expressed as NO_2)
OTNOC	Other than normal operating conditions
PAH	Polycyclic aromatic hydrocarbons
PC	Process Contribution
PCB	Polychlorinated biphenyls
PCC	Post combustion carbon capture
PEC	Predicted Environmental Concentration
PHE	Public Health England (now UKHSA – UK Health Security Agency)
POP(s)	Persistent organic pollutant(s)
PPS	Public participation statement
PR	Public register
PXDD	Poly-halogenated di-benzo-p-dioxins
PXB	Poly-halogenated biphenyls
PXDF	Poly-halogenated di-benzo furans

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
SPA(s)	Special Protection Area(s)
SS	Sewage sludge
SSSI(s)	Site(s) of Special Scientific Interest
SWMA	Specified waste management activity
TDI	Tolerable daily intake
TEF	Toxic Equivalent Factors
TGN	Technical guidance note
TOC	Total Organic Carbon
UN_ECE	United Nations Environmental Commission for Europe
US EPA	United States Environmental Protection Agency
WFD	Waste Framework Directive (2008/98/EC)
WHO	World Health Organisation
WID	Waste Incineration Directive (2000/76/EC) – now superseded by IED

Links to guidance documents

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.

Name of guidance document	Link
RGN 6: Determinations involving sites of high public interest	RGN 6
CHP Ready Guidance for Combustion and Energy from Waste Power Plants	CHP ready
Risk assessments for your environmental permit	Risk assessments
Guidance to Applicants on Impact Assessment for Group 3 Metals Stack Releases – version 4".	Metals guide
The Incineration of Waste (EPR 5.01)	EPR 5.01
Waste incineration BREF and BAT conclusions	BREF and BAT C
UKHSA: Municipal waste incinerators emissions: impact on health	UKHSA reports
Post-combustion carbon dioxide capture: emerging techniques	PCC guidance

1 Our decision

We have decided to issue the varied Permit to the Operator. This will allow it to continue 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 Regulations (EPR) 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.

2 How we reached our decision

2.1 Receipt of Application

The Application was duly made on 24/11/2023. 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 Operator made no claim for commercial confidentiality. 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, and our statutory Public Participation Statement (PPS).

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. The advertising period ran between 10/01/2024 and 07/02/2024.

We made a copy of the Application and all other documents relevant to our determination available to view on our Citizen Space web-based consultation portal. We also made them available on our public register, so anyone wishing to see these documents could do so and arrange for copies to be made.

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

- Cheshire West and Chester Environmental Protection Department
- Food Standards Agency
- The Health and Safety Executive
- UK Health Security Agency and director of public health
- National air traffic services (NATS)
- Liverpool John Lennon Airport operator
- National Grid

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.

Further details along with a summary of consultation comments and our response to the representations we received can be found in Annex 4. 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 as shown in Table 1 below on 01/03/2024, 30/04/2024, 08/07/2024 and 01/08/2024, and a request for information (RFI) on 20/05/2024. Copies of the information notices were placed on our public register together with the responses on receipt.

Table 1 Request and response dates for information notices and requests		
Request date	**Response date**	**Summary of information**
01/03/2024 Notice No1	01/03/2024 Follow-up response on 02/04/2024	Revised air quality assessment and environmental risk assessment, information on site CO_2 management, waste management, effluent treatment, and management plans.
30/04/2024 Notice No2	24/05/2024	Revised further information on effluent streams and options appraisal for effluent disposal.
20/05/2024 RFI	03/06/2024 and 10/06/2024	Revised Environmental Risk Assessment, revised process flow diagram and clarifications regarding CO_2 venting.
08/07/2024 Notice No3	05/08/2024	Additional information on Best Available Techniques (BAT) assessment for effluent disposal, and additional information on CO_2 venting, emergency diesel generator, monitoring, and chemicals stored and used on site.
01/08/2024 Notice No4	30/08/2024	Information on carbon dioxide conditioning and condensate management.

In addition to our information notices, we received additional information during the determination from the Operator on 16/06/2024: Revised Site Condition Report. We made a copy of this report available to the public in the same way as the responses to our information notices and RFIs.

3 The legal framework

The varied Permit will be granted, under Regulation 20 of the EPR. 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 *waste incineration plant* as described by the IED, *with Post-combustion Carbon Capture (PCC) for geological storage,* 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 7 towards the end of this document.

We consider that the varied Permit 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 because it carries out an activity listed in Part 1 of Schedule 1 to the EPR.

Existing activity:

- Section 5.1 Part A(1)(b) – incineration of non-hazardous waste in a waste incineration plant or waste co-incineration plant with a capacity of 3 tonnes or more per hour.

New activity:

- Section 6.10 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.

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

Existing:

- Electricity generation using a steam turbine
- Emergency generators

New:

- Raw materials storage for CC plant
- Waste amine solvent storage
- Water treatment plant
- Back pressure turbine
- CO_2 compression

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

The IED definition of “waste incineration plants” and “waste co-incineration plants” says that it includes:

“all incineration lines or co-incineration lines, waste reception, storage, on-site pre-treatment facilities, waste, fuel and air supply systems, boilers, facilities for the treatment of waste gases, on-site facilities for treatment or storage of residues and waste water, stacks, devices for controlling incineration or co-incineration operations, recording and monitoring incineration or co-incineration conditions.”

Many activities which would normally be categorised as “directly associated activities” (DAA) for EPR purposes, such as air pollution control plant, including storage and preparation of treatment chemicals e.g. lime slaking, and the ash storage bunker, are therefore included in the listed activity description.

4.1.2 The Site

As part of this variation the site boundary of the Installation has been extended to include additional land to the south-east of the existing site. The Operator submitted a plan which we consider is satisfactory, showing the site of the expanded Installation and its extent. A plan is included in Schedule 7 to the Permit, and the Operator is required to carry on the permitted activities within the site boundary.

Further information on the site is addressed below at 4.2.

4.1.3 What the Installation does

The purpose of the variation is to permit the CC plant and all the associated changes to the Installation. There are no major operational changes to the Incineration plant, therefore operation of the Incineration plant will not be covered in this section.

The activities taking place at the Installation comprise:

- Incineration plant with two waste incineration lines
- Back-pressure turbine for generating low pressure steam for the CC plant
- Incineration flue gas abatement systems
- Incinerator bottom ash quench
- Three emergency gas oil generators
- Water treatment plant with a capacity of <50 tonnes per day, consisting of ultrafiltration and ion exchanger units
- Carbon capture plant
- Carbon capture plant flue gas abatement systems, including water wash and acid wash
- Compression, de-oxygenation, and dehydration systems for CO_2 conditioning before transfer off site

4.1.3.1 Operation of the CC plant

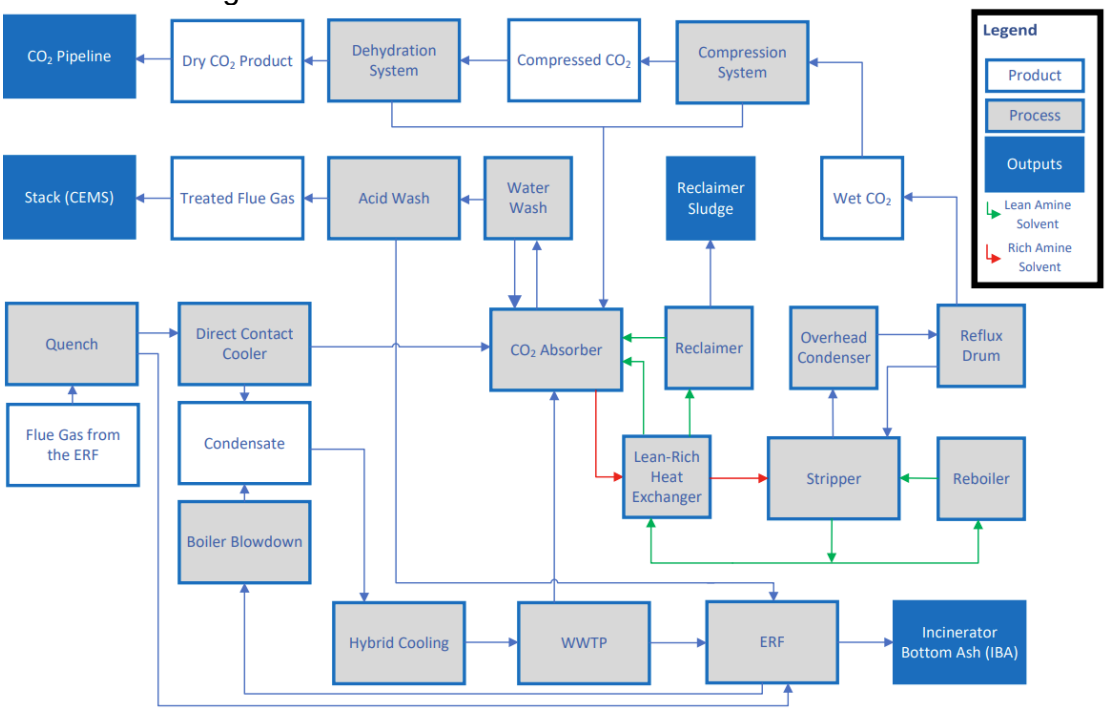
(i) Overview

The process of reducing carbon dioxide emissions from incineration plant can be divided into three main steps which are:

1. Separation of CO_2 from the flue gas stream from the incineration plant;
2. Compression, conditioning, and transportation of the CO_2 (via pipeline or shipping); and
3. Use of the captured CO_2 as a resource for other industries or storage within suitable geological formations (saline aquifers, depleted oil and gas reservoirs).

Step 1 and the compression and conditioning of the CO2 from Step 2 are relevant to the determination of the variation Application and are summarised below:

Overall flow diagram:



Two PCC units are proposed to be installed, one for each of the two Incineration plant lines. 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.

At the Installation the full flue gas flow will be extracted from each line of the Incineration plant using dampers. The dampers will isolate the flue gas from the existing Incineration plant stacks. Individual ducts will be used to send the flue gases from each line of the Incineration plant to the CC plant. Exhaust gases from each line of the Incineration plant will be treated as separate lines in the CC plant.

The CC plant will utilise heat from the waste incineration processes for CO_2 stripping, amine regeneration and flue gas re-heating. Steam produced from the Incineration plant will be extracted for use in the CC plant, expanded to the correct pressure using a back pressure turbine, which will generate sufficient power for the CC plant and export the balance back to the Incineration plant.

The CC plant is designed so that the flue gases from the Incineration plant can either be treated within the CC plant or released to atmosphere through the existing stack without the capture of CO_2, i.e. via a by-pass. Flue gas cleaning of emissions from the Incineration plant will be carried out before the emissions are extracted for treatment in the CC plant to ensure compliance with the ELVs in the existing Permit and the Waste Incineration BREF.

(ii) Flue gas cooling

Flue gas from the Incineration plant will be cooled across the direct contact cooler (DCC) by spraying water into the flue gas stream. Initially, this water will be vapourised and the flue gas cooled by losing the heat required for vaporisation. Eventually the flue gas reaches saturation and cannot hold any more water. The point at which the flue gas becomes saturated is a strong function of the temperature of the gas and the saturation point decreases as the gas is cooled. After the gas has reached this point, it is cooled further by increasing the temperature of the liquid water it passes through. As the gas is cooled and the saturation point reduces, water condenses from the flue gas (referred to as DCC condensate). As such, there is a net increase in the water pumped from the bottom of the DCC compared to that sprayed into the unit.

The quantity of DCC condensate depends on the initial moisture content of the flue gas and the exit temperature of the flue gas. To minimise thermal degradation of the MEA, the exit temperature is required to be around 40°C.

The DCC also functions as a polishing scrubber. As the flue gas condenses, acidic gases within the gas will also condense. The DCC cooling water will be cooled by the CC plant cooling system. The pH of the cooling water circulating in the DCC will be monitored, with sodium hydroxide dosed to maintain a slightly alkaline pH and neutralise any acids condensed from the gas.

(iii) Booster fan

The booster fan increases the pressure of the flue gas to overcome the pressure drop experienced across the CC plant. The booster fan will work in tandem with the induced draft (ID) fan to ensure there is no under-pressure in the ducting between the ID fan and booster fan. The booster fan will be equipped with a variable speed drive to ensure that turndown can be achieved without significant loss of efficiency.

(iv) CO_2 absorption

Cooled flue gas will enter the base of the absorber and flow counter current to the lean amine solution (amine without CO_2) which trickles down and the CO_2 reacts with the lean amine. This reaction is exothermic. To maintain a constant temperature of amine within the absorber, heat is removed by intercooling the amine solution and flue gas within the column. The flue gas will pass through sections of packing within the column, which increases the internal area of the column and increases the rate of reaction.

Following the packing section, the flue gas enters the water wash section of the column. Water will be sprayed in this section for the abatement of emissions of amines, nitrosamines, and nitramines. Nitrosamines and nitramines are formed by degradation of all amines used in the capture process. At the outlet of the water wash, the flue gas will pass through an acid wash. This acid wash will remove ammonia which is generated by degradation of the amine solution within the column.

As flue gas passes across the water wash and acid wash, its temperature decreases, causing water to condense from the flue gas. Water condensed from the water and acid washes will be managed by measuring the level of holdup in the wash, and bleeding water from the cooling water tank back into the absorber, with a percentage blown down to control the build-up of pollutants within the water. Outgoing flue gas will be reheated using hot condensate from the reboiler to aid dispersion of the flue gas as it is released from a stack on top of the absorber tower. A control system will measure the CO_2 content and flowrate at the inlet and outlet of the CC plant allowing for calculation of the mass flowrate of CO_2. The system will then adjust the flow rate of lean amine solution into the absorber based on the CO_2 content of the flue gas.

A lean amine tank will provide a control buffer. If more amine is demanded by the system to absorb more CO_2, then the level in the lean amine tank will drop. If the level drops below a defined value, additional amine will be demanded from the make-up amine tank. A reservoir of rich amine solution will be provided in the base of the absorber tower. The level of holdup in the absorber will be controlled to a constant level by a control valve on the exit line from the base of the absorber, and as such the flow rate into the stripper will vary. The rich amine (amine with CO_2) pumps will be located at the base of the absorber. This will provide a pressure increase in the rich amine tank to overcome the pressure drop in the interlinking pipework, heat exchangers, the hydrostatic pressure to reach the top of the stripper and to match the higher pressure within the stripper.

(v) Amine regeneration

To regenerate the amine solution and release the absorbed CO_2, the temperature of the rich amine solution will be increased. The heated rich amine enters the stripper at the top of the column. The liquid is distributed across the column cross section and falls through a packed section within the column, flowing counter to the high temperature vapour generated in the reboiler. This increases the temperature of the rich amine and liberates the captured CO_2 from the solution. The CO_2 and amine vapour which reaches the top of the tower will be cooled by an overhead condenser, fed from the cooling water circuit. The cooled vapour/CO_2 mixture then passes to a reflux drum, where the gas and liquid fractions are separated. The gas fraction will be passed to the CO_2 compression system. The liquid portion will be returned to the top of the stripper.

The reboiler takes the amine which has collected in the base of the stripper. The amine will be heated by the incoming steam, which condenses in the tubes within the reboiler. This causes the CO_2 to outgas, and a portion of the amine solution will boil, and escape through the top of the reboiler as a vapour whereupon it is readmitted to the stripper column below the level of rich amine addition. The lean amine vapour will mix with the incoming rich amine liquid, giving up its heat to release CO_2 from the rich amine liquid and causing the lean vapour to condense, whereupon it will fall back down the column to the reservoir at the bottom.

As the amine solution is recycled, the solvent degrades due to the presence of other gaseous species in the flue gas, such as sulphur dioxide and nitrous oxides. These species react with the amines, and form degradation products, which can be heat stable salts, non-volatile organic compounds, or suspended solids. These products are corrosive and reduce the effectiveness of the solvent for capturing CO_2. Therefore, reclaiming is required to remove these products and restore the effectiveness of the amine solution.

The reclaimer for the CC plant has been designed based on thermal reclamation. In this process, a slip stream of the amine is dosed with sodium hydroxide to remove acids. The amine is then admitted to a reboiler, which heats the amine until the liquid has 'boiled-off'. The remainder is a residual sludge which is consists of water, amine, thermal degradation products and heat stable salts.

(vi) CO_2 compression

Compression of captured CO_2 is necessary to meet the requirements of the HyNet CO_2 cluster. CO_2 compression will be carried out using an electrically driven compressor. Several stages of compression with intercooling between stages will be used to increase the efficiency of compression.

Cooling the gas additionally reduces its ability to hold moisture, and therefore condenses moisture from the gas, reducing the duty on the gas dryer. A cooler located after the compressor is also required to control the outlet temperature of the CO_2 to match the requirements of the HyNet cluster and will also reduce the duty on the gas dryer.

(vii) CO_2 drying

To meet the HyNet moisture requirements of <50 ppm mol of water the compressed CO_2 needs to be dried. This will be done to minimise both the effects of corrosion on the transport pipelines and the formation of hydrates that can block the transmission lines.

The CC plant will use a desiccant dryer, as glycol systems have been prohibited on the HyNet network. Two desiccant drums will be used in this system, with one in operation and one being regenerated.

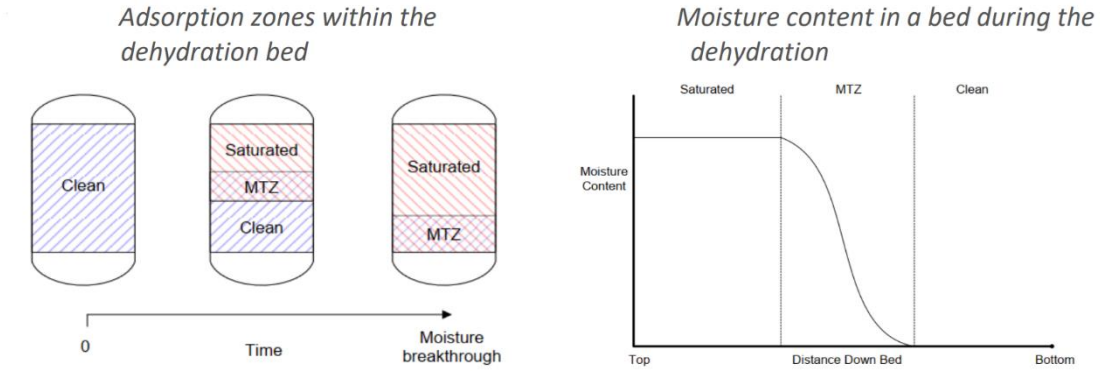
The mechanism of adsorption is as follows.

1. In the volume closest to where the gas is injected into the vessel forms an equilibrium zone. In this zone water in the inlet CO_2 gas is in equilibrium with the water adsorbed into the desiccant. This equilibrium point will be controlled by the pressure and temperature of the vessel.

2. In the volume further from the injection point forms the mass transfer zone (MTZ). This is where the transfer of water from the CO_2 gas into the adsorbent occurs. The size of this zone is determined by the kinetics of the adsorption reaction on the surface of the desiccant, heat and mass

flow limitations (which in turn are a function of temperature and pressure of the vessel) and the velocity of gas flow. When this zone reaches the outlet of the dehydration vessel, the dehydration process should be stopped, and the vessel should be regenerated.

3. The fresh adsorbent zone shrinks as water is adsorbed in the vessel.



Once the bed is saturated, it will be regenerated by thermal swing, in which the bed is heated to a temperature of around 200 – 320°C (temperature depends on type of the desiccant used and operating philosophy) and then flashed with the heated dry product gas. At the end of this phase the vessel will be cooled down with unheated dry gas.

(viii) CO_2 transport off-site

The CC plant is designed to compress and treat the CO_2 for injection into the HyNet CO_2 pipeline. HyNet pipeline will transport the captured CO_2 for storage off-shore in the Liverpool Bay sub-sea depleted oil and gas reservoirs.

If the quality of the CO_2 does not meet pipeline specifications, it cannot be exported and must be vented to atmosphere. Venting can occur in two locations in the process:

1. Upstream of the compressor – in the case that the compressor is not in operation or there is a stop in production of CO_2.

2. Downstream of the CO_2 analyser – in the case that the CO_2 quality does not meet the specification.

In both instances the gases would be released via the CO_2 vent stack. By building in redundancy and reliability into the CCS process, periods of venting will be reduced to a minimum.

(ix) Water, raw material and reagent use

The CC plant will not change the types or quantities of chemicals and raw materials which are currently consumed at the Installation, besides mains water where the consumption will be lower. However, the CC plant will require the following additional consumables, including mains water:

1. Amine solvent, used for capture of CO_2 in the flue gas.
2. Sodium hydroxide, used for acid abatement, regeneration of ion exchange system's filter media, and in the reclaimer to reduce the concentration of heat stable salts.
3. Hydrochloric acid, used for regeneration of ion exchange system's filter media.
4. Sulphuric acid, used in the acid wash.
5. Sodium hypochlorite, used in the cooling water system as to prevent buildup of biological contamination.
6. Mains water, to replace water lost in drying of the product CO_2.
7. Hydrogen for de-oxygenating the captured CO_2.

(x) Water treatment plant

The water treatment plant will include the following treatment steps:

1. Pre-treatment - carbon filtration.
2. Final Treatment/polishing - Reverse osmosis plant to maximise re-use of water in the CC plant.

The main process effluent to be treated at the plant will be the blowdown from the cooling towers. The treatment is needed to maintain the water quality parameters within the cooling towers. In addition to treating the process effluent after the carbon filtration stage, the reverse osmosis plant will also process the boiler blowdown stream from the Incineration plant.

The clean water from the water treatment plant will be returned to the Absorber tower, to be re-used as feedwater for the CC plant. The reject water from the carbon filtration and the reverse osmosis plant will be separately collected and tested before being pumped to the Incineration plant to be re-used in the incinerator bottom ash quench system. On this basis, there will be no discharges of process effluent from the CC plant with all effluents being re-used within the Installation. Overall, the implementation of the CC plant will reduce the mains water consumption of the Installation. The process effluent treatment plant, including pre-treatment, will have a capacity of <50 tonnes per day.

(xi) Energy use

The CC plant will draw heat from the Incineration plant for use in the CC process. High pressure steam will be drawn from the Incineration plant and expanded through a back pressure turbine to the pressure required for the reboiler (3.5 bar). During this process, electrical power will be generated which improves energy efficiency. The remainder of the steam generated from the Incineration plant will be expanded in the existing condensing steam turbine,

generating electrical power. Heat for reheating the flue gas will be drawn from the hot condensate generated in the reboiler. This prevents drawing additional steam and increases the energy efficiency of the facility.

The following components within the CC plant will require heat:

1. The reboiler, which supplies the stripper with heat for amine regeneration and CO_2 separation;

2. The reclaimer, used to clean the amine and remove buildups of pollutants within the solvent; and

3. The flue gas reheater, which heats up the flue gas to aid dispersion.

The expected heat demand of the CC plant is summarised in the table below.

Parameter	Unit	Value
Amine regeneration heat demand	MW	51.8
Amine reclamation heat demand	MW	0.21
Flue gas reheater heat usage	MW	4.36
Total heat usage of the CC plant	**MW**	**56.4**

The new back pressure turbine will provide electrical power for the operation of the CC plant. Any surplus power generated by the back pressure turbine will be exported to the national grid.
The expected electricity demand of the CC plant is summarised in the table below.

Power user	Unit	Value
Booster fan	kW	1,331
Compressor	kW	3,792
Cooling water pump	kW	513
DCC circulation pump	kW	38.8
Rich amine pump	kW	42.0
Lean amine pump	kW	53.2
Dry cooling fans	kW	778.2
Wet/dry cooling fans	kW	204.1

Power user	Unit	Value
Dryer fan	kW	63.9
Dryer electric heater	kW	266.6
Reject CO_2 reheating demand (intermittent)	kW	475.8
Total electricity usage of the CC plant	**MW**	**7.08**

4.1.4 Key Issues in the Determination

The key issues arising during determination of the Application were emissions to air and their impact on human health and the environment, and process effluent management. We therefore describe how we determined these issues in greater detail in the body of this document.

4.2 The site and its protection

4.2.1 Site setting, layout and history

As part of this variation to incorporate a CC plant at the permitted site, the site boundary of the Installation has been extended to include additional land to the south-east of the existing site.

The CC plant will be located on land at Ince Marshes, Cheshire, within the Protos development area, on a plot currently named “Ecology Area E”. The site lies north of Marsh Lane. Ince Bio Power plant and the Incineration plant are located to the west. The area of land where the CC plant will be located currently comprises an ecological mitigation area for the wider Protos Park.
The Site and surrounding was undeveloped until 1990 when the CF Fertilisers facility was constructed on the adjacent plot to the Site. The surrounding land use is commercial/industrial with multiple off-site developments relating to energy and industrial process works.

The CF Fertilisers and Encirc manufacturing facilities are located to the south of the CC plant. It is the Operator’s understanding that these facilities are subject to the Control of Major Accident Hazards (COMAH) 2015 Regulations. However, the CF Fertiliser facility is currently not operational and has been mothballed, with the intention of the manufacturing facility being decommissioned and demolished.

The earthworks drawings for the attenuation ponds indicate that they vary in depth from -1.2m AOD (Above Ordnance Datum) to -2.8m AOD, with the surrounding ground being relatively flat at around 4.5m AOD.

4.2.2 Proposed site design: potentially polluting substances and prevention measures

The detailed design of the CC plant has not yet been finalised, but the Operator has committed to incorporating all relevant pollution prevention measures into the design and operation of the CC plant. These include, but are not limited to, the following commitments:

Storage and transfer of chemicals.

Facilities for the handling and storage of chemicals will be designed in accordance with EA Pollution Prevention Guidance titled 'Pollution prevention for businesses' and 'Oil storage regulations for businesses'.

All chemicals will be stored in appropriate storage facilities incorporating the use of suitable secondary (including acid and alkali resistant coatings, where appropriate) and tertiary containment measures. All vessels which contain fluids which are capable of harming people or the environment, e.g. oils and chemicals, will be provided with an impermeable secondary containment (bund).

Vessel-filling connections will be clearly marked with the fluid type and, where more than one vessel is provided, the connecting vessel will also be identified. Vessel-filling connections will be provided with drip trays or bunds to collect any drips or spillages during unloading operations. Any vessel vents will have suitable traps and/or scrubbers fitted.

Tanker off-loading of chemicals will take place within areas where the drainage is contained with the appropriate capacity to contain a spill during delivery. Adequate quantities of spillage absorbent materials will be made available at easily accessible locations, where chemicals are stored. A site drainage plan, including the location of process and surface water drainage will be made available on-site following completion of detailed design. Transfer of concentrated and dilute chemicals will be carried out at the lowest practical pressure. Where practical, concentrated chemicals will be transferred via vacuum. Reclaimer waste will be transferred to sealed tankers and off-loaded via a standard hose connection. Air displaced from the tanker will be vented back into the sealed storage tank.

In the event of a fire, contaminated water used for fighting fires will be collected through the wastewater drainage system. Site drainage for external areas will be fitted with a manual shut off valve and will contain any firefighting water. Additional storage will be available from the site kerbing.

Bunds.

Bunds will meet the requirements set out below.

- Bund capacities will be a minimum of 110% of the vessel volume. If more than one vessel is in the bund, the capacity will be 110% of the

largest single vessel or 25% of the aggregate of the vessel volumes, whichever is the larger, except where the tanks are hydraulically linked in which case they will be treated as if they were a single tank.

- The bund will slope to a sump to allow the contents of the bund (or rainwater if outdoors) to be pumped out.

Under Article 22(2) of the IED the Operator is required to provide a baseline report containing at least the information set out in paragraphs (a) and (b) of the Article before starting operation.

The Operator has not submitted a baseline report. We have therefore set pre-operational conditions (PO14 and POM9) requiring the Operator to provide this information prior to the commencement of operations.

The baseline report is an important reference document in the assessment of contamination that might arise during the operational lifetime of the Installation and at cessation of activities at the Installation

4.2.3 Closure and decommissioning

The Operator will have to include the operation of the CC plant in the EMS and this requirement is covered by IC16.

At the definitive cessation of all activities, the Operator has to satisfy us that the necessary measures have been taken so that the site ceases to pose a risk to soil or groundwater, taking into account both the baseline conditions and the site's current or approved future use. To do this, the Operator will apply to us for surrender of the permit, which we will not grant unless and until we are satisfied that these requirements have been met.

4.3 Operation of the Installation – general issues

4.3.1 Administrative issues

The Operator is the sole Operator of the Installation.

We are satisfied that the Operator is the person who will have control over the operation of the Installation after the issuing of the varied Permit; and that the Operator will be able to operate the Installation so as to comply with the conditions included in the varied Permit.

4.3.2 Management

The Operator has stated in the Application that they will implement an Environmental Management System (EMS) that will be certified under ISO14001. The Environment Agency recognises that certification of the EMS cannot take place until the Installation is operational. An improvement condition (IC1) is included requiring the Operator to report progress towards gaining accreditation of its EMS.

We are satisfied that appropriate management systems and management structures will be in place for this Installation, and that sufficient resources are available to the Operator to ensure compliance with all the Permit conditions.

4.3.3 Site security

Having considered the information submitted in the Application, we are satisfied that appropriate infrastructure and procedures will be in place to ensure that the site remains secure.

4.3.4 Accident management

The Operator has not submitted an Accident Management Plan. However, having considered the other information submitted in the Application, we are satisfied that appropriate measures will be in place to ensure that accidents that may cause pollution are prevented but that, if they should occur, their consequences are minimised. An Accident Management Plan forms part of the Environmental Management System. The EMS is a live document and will be updated to include the carbon capture plant when required. Permit condition 1.1 and IC16 require this.

4.3.5 Off-site conditions

We do not consider that any off-site conditions are necessary.

4.3.6 Operating techniques

We have specified that the Operator must operate the CC plant in accordance with the following documents contained in the Application:

Description	Parts Included	Justification
Variation application EPR/ LP3132FX/V009	Application documents including: Application Forms C2 and C3 and referenced supporting document: Noise impact assessment, Report No. 103036 Version 3, 11/09/2023	These documents contain key operating techniques that will ensure environmental risk is managed on site.
Response to first Schedule 5 Notice dated 30/01/2024	Response to questions: 2, 6, 8, 9, and 13 Supporting Information (Rev 6), 28/02/2024 Appendix B - Carbon Capture During Start Up and Shut-Down	
Response to first Schedule 5 Notice follow-up questions dated 21/03/2024	Response to questions: 1, 4, and 8	
Response to third Schedule 5 Notice dated 08/07/2024	Response to questions: 1, 2, 3, 6, 7, and 8	
Response to fourth Schedule 5 Notice dated 31/07/2024	Response to questions: 1, 2, 3, and 4	

The details set out above describe the techniques that will be used for the operation of the CC plant that have been assessed by us as being in accordance with our emerging guidance; they form part of the Permit through Permit condition 2.3.1 and table S1.2 in the Permit Schedules.

The documents referenced in the table above are in addition to those already specified in table S1.2 of the Permit and these, together with those already included in the Permit, list the techniques that the Operator must comply with.

We have also specified the following limits and controls on the use of raw materials and fuels in the CC plant:

Raw Material or Fuel	Specifications	Justification
Monoethanolamine (MEA)	Diethanolamine (DEA) not exceeding 0.2% content (unless otherwise agreed with the Environment Agency).	DEA is a known secondary amine contaminant in the production of MEA, due to the higher likelihood of degradation product formation from secondary amines in this process we have set a specification for the maximum amount of DEA present that we understand is achievable.

The raw materials in the table above are in addition to those already specified in table S2.1 of the Permit.

4.3.7 Energy efficiency

(i) Consideration of energy efficiency

We have considered the issue of energy efficiency in the following ways:

1. The use of energy within, and generated by, the Installation which are normal aspects of all EPR permit determinations.

2. The extent to which the Installation meets the requirements of Article 50(5) of the IED, which requires *"the heat generated* during the incineration and co-incineration process is *recovered as far as practicable through the generation of heat, steam or power*".

(ii) Use of energy within the Installation

Energy usage with the Incineration plant will be mostly unchanged from that set out in the original application. The Application details energy efficiency measures for the carbon capture plant as summarised below:

1. Process monitoring to include monitoring of energy efficiency.

2. Maximum temperature experienced by the amine solvent will be limited to prevent solvent degradation and increase efficiency of the process. This will be controlled by limiting the temperature of the supplied steam to the CC plant.

3. Heat for reheating the flue gas will be drawn from the hot condensate generated in the reboiler. This will prevent drawing additional steam from the turbine and increases the energy efficiency of the facility.

(iii) Generation of energy within the Installation - Compliance with Article 50(5) of the IED

Article 50(5) of the IED requires that *"the heat generated during the incineration and co-incineration process is recovered as far as practicable*".

Energy generation efficiency was calculated for both when the carbon capture plant is not operating and for when it is in operation.

a) When the carbon capture plant is not operating
Steam from the boiler will pass to the currently permitted condensing turbine to generate electricity. Gross electrical efficiency was calculated at 33.1%.

b) When the carbon capture plant is operating
Part of the steam will go to the condensing turbine but some of the steam will go to a new back pressure turbine to supply heat to the carbon capture plant. The Operator calculated the efficiency of each separately which is in line with examples from the incineration BREF. Gross electrical efficiency for the energy produced by the condensing turbine and gross energy efficiency for the heat produced from the back pressure turbine were calculated as shown below:

Gross electrical efficiency: 30.5%
Gross energy efficiency: 88.4%

The BAT AEEL for gross electrical efficiency is 20-35%
The BAT AEEL for gross energy efficiency is 72-91.

The values calculated by the Operator are near the top of the efficiency range both in fully condensing mode and when the back pressure turbine is providing heat to the CC plant.

In accordance with BAT 2, table S3.3 of the Permit requires the gross electrical efficiency and gross energy efficiency to be measured by carrying out a performance test at full load.

Guidance note EPR 5.01 and Chapter IV of the IED both require that, as well as maximising the primary use of heat to generate electricity; waste heat should be recovered as far as practicable.

The CC plant will require heat and is considered to be a potential heat user for the ERF. The export of heat to the CC plant via the new back pressure turbine will have gross electrical efficiency and gross energy efficiency more than BAT-AEELs and a primary energy saving (PES) of more than 10%.

The Operator has proposed the installation of the new back pressure turbine for steam generation as the most economic and efficient option for supplying steam to the CC plant. This is primarily due to the cost of lost electrical generation whilst the Incineration plant condensing turbine modification works would be carried out. We accept the Operator's proposal, but we consider that the requirement in the Permit to regularly review viability of Combined Heat and Power (CHP) implementation for the condensing turbine is still relevant and therefore the condition remains in the varied Permit.

(iv) Choice of Cooling System for CC plant

Cooling at the CC plant will be carried out by a mixture of dry air coolers and hybrid wet-dry cooling towers. Hybrid wet-dry cooling towers will provide a closer approach to the ambient air temperature, hence lower cooling water temperatures and lower flowrates are required. However, these towers require a top-up to replace water which evaporates as part of the cooling process. To balance this demand against water supply, the wet-dry towers will be used in combination with dry cooling towers, minimising electricity requirements and water discharge.

We agree that the Operator's choice of cooling systems for the CC plant is in accordance with the standards set out in PCC emerging techniques guidance.

(v) Permit conditions concerning energy efficiency

Conditions have not changed from the original permit other than a requirement to measure gross energy efficiency has been added to table S3.3.

4.3.8 Efficient use of raw materials

Having considered the information submitted in the Application, we are satisfied that the appropriate measures will be in place to ensure that the Operator will make efficient use of raw materials and water.

4.3.9 Avoidance, recovery or disposal with minimal environmental impact of wastes produced by the permitted activities

Addition of the CC plant will mean new wastes will be produced in addition to wastes from the Incineration plant. This requirement addresses wastes produced at the Installation and does not apply to the waste being treated there. The new waste streams the Installation will produce are:

- residual sludge from amine solvent reclaimer,
- acid wash blowdown,

- flue gas quench blowdown,
- ultra-filtration (UF) effluent, and
- ion exchange (IEX) effluent.

The Operator is proposing that flue gas quench blowdown, the UF effluent, and the IEX effluent will be mixed with IBA prior to transfer off-site as part of the IBA residue. All three effluents will be sampled to determine hazardous status prior to being mixed together or with the IBA.

Residual sludge from amine solvent reclaimer and acid wash blowdown will be taken offsite for either further treatment and recovery or disposal.

IBA will normally be classified as non-hazardous waste. However, IBA is classified on the European List of Wastes as a “mirror entry”, which means IBA is a hazardous waste if it possesses a hazardous property relating to the content of dangerous substances. Monitoring of IBA at the Installation will be carried out in accordance with the requirements of Article 53(3) of IED. Classification of IBA for its subsequent use or disposal is controlled by other legislation and so is not duplicated within the varied Permit.

Table S3.4 requires the Operator to carry out an ongoing programme of monitoring of IBA. We have also added pre-operational condition POM4 for the Operator to submit an effluent monitoring procedure to us for approval to ensure that any hazardous effluents are not mixed with the IBA.

Having considered the information submitted in the Application, we are satisfied that the waste hierarchy referred to in Article 4 of the Waste Framework Directive (WFD) will be applied to the generation of waste and that any waste generated will be treated in accordance with that Article.

We are satisfied that waste from the Installation that cannot be recovered will be disposed of using a method that minimises any impact on the environment. Standard condition 1.4.1 will ensure that this position is maintained.

5 Minimising the Installation’s environmental impact

Regulated activities can present different types of risk to the environment, these include odour, 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 (GWP) 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 for geological storage activity using amine solvents, the principal emissions are:

- to air;
- noise; and

- venting of the captured CO_2.

We have not considered the emissions from the existing activities, other than from abnormal operation of the Incineration plant, 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 Installation on human health and the environment and what measures we are requiring to ensure a high level of protection.

5.1 Assessment Methodology

5.1.1 Application of Environment Agency guidance 'risk assessments for your environmental permit'

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 guidance 'Air emissions risk assessment for your environmental permit' 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 methodology 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 – these techniques are expensive but normally lead to a lower prediction of PC.

5.1.2 Use of Air Dispersion Modelling

For incineration applications, we normally require applicants to submit a full air dispersion model as part of their application. For this variation Application we are not considering the emissions to air from the Incinerator stacks as, during normal operation, the emissions will be discharged through the CC plant's stacks. The Operator has provided full air dispersion modelling in relation to the

emissions to air from the CC plant. 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) for air emissions. ES are described in our web guide 'Air emissions risk assessment for your environmental permit'.

Our web guide sets out the relevant ES as:

- Air Quality Standards Regulations 2010 Limit Values
- Air Quality Standards Regulations 2010 Target Values
- UK Air Quality Strategy Objectives
- Environmental Assessment Levels

Where a Limit Value exists, the relevant standard is the Limit Value. Where a Limit Value does not exist, target values, UK Air Quality Strategy (AQS) Objectives or Environmental Assessment Levels (EALs) are used. Our web guide sets out EALs which have been derived to provide a similar level of protection to human health and the environment as the limit values, target values and AQS objectives. In a very small number of cases, e.g. for emissions of lead, the AQS objective is more stringent that the Limit Value. In such cases, we use the AQS objective for our assessment.

Target values, AQS objectives and EALs do not have the same legal status as Limit Values, and there is no explicit requirement to impose stricter conditions than BAT in order to comply with them. However, they are a standard for harm and any significant contribution to a breach is likely to be unacceptable.

PCs are screened out as **Insignificant** if:

- the **long-term** PC is less than **1%** of the relevant ES; and
- the **short-term** PC is less than **10%** of the relevant ES.

The **long term** 1% PC 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 human health and the environment.

The **short term** 10% PC 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 human health and the environment.

Where an emission is screened out in this way, we would normally consider the applicant's proposals for the prevention and control of the emission to be BAT. 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 AAD limit value is identified, we may require the applicant to go beyond what would normally be considered BAT for the Installation 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.

This is not the end of the risk assessment, because we also take into account local factors (for example, particularly sensitive receptors nearby such as a SSSIs, SACs or SPAs). These additional factors may also lead us to include more stringent conditions than BAT.

If, as a result of reviewing 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.

5.2 Assessment of Impact on Air Quality

The Operator's assessment of the impact of air quality is set out in Appendix A: Dispersion Modelling Assessment of the Application. The assessment comprises:

- Dispersion modelling of emissions to air from the operation of the Incineration plant and CC plant.
- A study of the impact of emissions on nearby protected conservation areas.
- A study of the potential impact of visible plumes from the CC plant.
- A study of the potential impact at ground level and at elevated working platforms from CO_2 venting.
- A study of the predicted impact on air quality associated with the identified plausible abnormal emissions from the Incineration plant.

Of these, the dispersion modelling and assessment of emissions to air from the already permitted incinerator stack are not relevant to the Application as they do not form part of this variation. To assess impact from the CC plant's absorber tower stacks A5 and A6, the standard emissions associated with waste incineration were modelled in addition to emissions associated with carbon capture i.e. amine solvent and its degradation product.

This section of the decision document deals primarily with the dispersion modelling of emissions to air from the CC plant's absorber stacks and their impact on local air quality. The impact on conservation sites is considered in section 5.4. The impact during abnormal operation of the Incinerator plant is considered in section 5.5. The impact from CO_2 venting is considered in section 5.6.

The Operator has assessed the Installation's potential emissions to air against the relevant air quality standards, and the potential impact upon local conservation and habitat sites and human health. These assessments predict the potential effects on local air quality from the CC plant's stack emissions using the air dispersion model software ADMS 6.0 dispersion model, which is a commonly used computer model for regulatory dispersion modelling. The model used 5 years of meteorological data collected from the weather station at Liverpool Airport between 2018 and 2022. Liverpool Airport is located approximately 6.5 km to the north-east of the Facility. We consider this meteorological site to be reasonably representative. The effect of the terrain surrounding the site upon plume dispersion was considered in the dispersion modelling.

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

- First, they assumed that for incineration plant emissions via the CC stacks, the ELVs in the Permit would be the maximum permitted by Article 15(3), Article 46(2) and Annex VI of the IED. These substances are:

    - Oxides of nitrogen (NO_x), expressed as NO_2
    - Total dust
    - Carbon monoxide (CO)
    - Sulphur dioxide (SO_2)
    - Hydrogen chloride (HCl)
    - Hydrogen fluoride (HF)
    - Metals (cadmium, thallium, mercury, antimony, arsenic, lead, chromium, cobalt, copper, manganese, nickel and vanadium)
    - Polychlorinated dibenzo-para-dioxins and polychlorinated dibenzo furans (referred to as dioxins and furans)
    - Gaseous and vaporous organic substances, expressed as benzene
    - Ammonia (NH_3)

- Second, they assumed that the Installation operates continuously at the relevant long-term or short-term ELVs, i.e. the maximum permitted emission rate (metals are considered further in section 5.2.3 of this decision document).

- Third, the model also considered emissions of pollutants not covered by Annex VI of IED, specifically, polycyclic aromatic hydrocarbons (PAH) and polychlorinated biphenyls (PCBs). Emission rates used in the modelling have been drawn from data in the Waste Incineration BREF and are considered further in section 5.2.2.

- Fourth, for emissions from the CC plant associated with the carbon capture process, the following substances were modelled:

    - MEA
    - Nitrosamines from MEA
    - Nitramines from MEA
    - Diethanolamine (DEA) –secondary amine
    - Nitrosamines from DEA
    - Nitramines from DEA
    - Dimethylamine (DMA) –secondary amine
    - Nitrosamines from DMA
    - Nitramines from DMA
    - Aldehydes (as formaldehyde)
    - CO_2 from the vent stack

The following assumptions were made for the amine emissions from the CC plant's stacks:

- Emissions of DEA and DMA in total assumed to be 5% of the MEA emissions with a 50/50 split of each.
- No nitrosamines from MEA emitted.
- Total nitramines assumed to be 0.1 µg/Nm^3 apportioned as per the amine concentration – i.e. 95% from MEA, with 2.5% from DEA and DMA.
- Total nitrosamines assumed to be 0.1 µg/m^3 apportioned equally across DEA and DMA.
- It is assumed that the mass release rate of pollutants from the Incineration plant at the ELVs is released via the CC plant with no allowance for any additional abatement of emissions which would occur within the CC plant.

We are in agreement with this approach. The assumptions underpinning the model have been checked and are a reasonable worst-case.

The Operator considered background pollutant concentrations from diffusion tubes and automatic monitoring data presented in the Cheshire West and Chester Council Annual Status Report, air quality networks spread across the UK and Defra background maps. We consider the Operator's chosen background pollution values to be reasonably representative.

As well as predicting the maximum ground level concentration of the pollutants within the modelling domain, the Operator has modelled several discrete receptor locations to represent human and ecological exposure.

The Operator's use of the dispersion models, selection of input data, use of background data and the assumptions made, have been reviewed by our modelling specialists to establish the robustness of the Operator's air impact assessment. The output from the model has then been used to inform further assessment of human health impacts and impact on protected conservation

areas. Our audit takes account of modelling uncertainties. We make reasonable worst case assumptions and use the uncertainties (minimum 140%) in analysing the likelihood of exceeding any particular standard.

Our review of the Operator's assessment leads us to agree with their conclusions. We have also audited the air quality and human health impact assessment and, although we do not necessarily agree with the Operator's exact numerical predictions, we agree with the Operator's conclusions, provided that the source terms from the proposed facility are reasonably representative.

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

5.2.1 Assessment of Air Dispersion Modelling Outputs

The Operator's modelling predictions are summarised in the tables below.

The Operator's modelling predicted peak ground level exposure to pollutants in ambient air and at discreet receptors. The tables below show their peak predicted ground level concentrations.

As part of our checks, we carry out sensitivity analysis of the data provided and conduct our own check modelling to ensure that the applicant's modelling predictions are reliable.

Whilst we have used the Operator's modelling predictions in the tables below, we have made our own simple verification calculation of the percentage PC and predicted environmental concentration (PEC). These are the numbers shown in the tables below and so may be very slightly different to those shown in the Application. Any such minor discrepancies do not materially impact on our conclusions.

Pollutant	ES		Back-ground	Process Contribution (PC)		Predicted Environmental Concentration (PEC)	
	µg/m^3	Reference period	µg/m^3	µg/m^3	% of EAL	µg/m^3	% of EAL
NO_2	40	Annual Mean	19.7	0.78	1.95	20.5	51.2
	200	99.79th %ile of 1-hour means	39.4	21.64	10.8	61.0	30.5
PM_{10}	40	Annual Mean	14.4	0.03	0.08	14.4	36.1
	50	90.41st %ile of 24-hour means	28.8	0.12	0.24	28.9	57.8

Pollutant	ES		Back-ground	Process Contribution (PC)		Predicted Environmental Concentration (PEC)	
	µg/m³	Reference period	µg/m³	µg/m³	% of EAL	µg/m³	% of EAL
$PM_{2.5}$	20	Annual Mean	9.6	0.03	0.2	9.6	48.2
SO_2	266	99.9th %ile of 15-min means	13.2	46.41	17.45	59.6	22.4
	350	99.73rd %ile of 1-hour means	13.2	29.08	8.31	42.3	12.1
	125	99.18th %ile of 24-hour means	13.2	1.85	1.5	15.1	12.0
HCl	750	1-hour average	1.4	21.01	2.80	22.4	2.99
HF	16	Monthly mean	2.4	0.007	0.04	2.4	15.0
	160	1-hour mean	4.7	1.4	0.88	6.10	3.8
CO	10000	Maximum daily running 8 hour mean	712	35.1	0.35	747	7.5
	30000	1-hour mean	712	52.6	0.18	765	2.5
TOC*	5	Annual mean	1.1	0.06	1.20	1.16	23.20
	30	Daily mean	2.2	0.78	2.60	2.98	9.93
PAH**	0.00025	Annual mean	0.00009	0.00000124	0.50	0.00009	36.5
NH_3	180	Annual mean	4.9	0.09	0.05	4.99	2.77
	2500	1-hour mean	9.8	5.26	0.21	15.06	0.6
PCBs	0.2	Annual mean	0.0001	0.00003	0.02	0.00013	0.07
	6	1-hour mean	0.0003	0.00175	0.03	0.00205	0.03
Amines (as MEA)	400	1-hour mean	0	1.51	0.38	1.51	0.38
	100	24-hour mean	0	0.34	0.34	0.34	0.34
Total nitrosami	0.0002	Annual mean	0	0.000001	0.5	0.000001	0.5

Pollutant	ES		Back-ground	Process Contribution (PC)		Predicted Environmental Concentration (PEC)	
	µg/m³	Reference period	µg/m³	µg/m³	% of EAL	µg/m³	% of EAL
nes (as NDMA)							
Total nitrosamines + nitramines (as NDMA)	0.0002	Annual mean	0	0.000003	1.5	0.000003	1.5
Aldehydes (as formaldehyde)	100	30-minute mean	4.74	1.47	1.47	6.21	6.21
	5	Annual mean	2.37	0.03	0.60	2.40	48.0

* as benzene
** as benzo(a)pyrene

Pollutant	ES		Back-ground	Process Contribution		Predicted Environmental Concentration	
	ng/m³	Reference period	ng/m³	ng/m³	% of EAL	ng/m³	% of EAL
Cd	5	Annual mean	0.43	0.12	2.4	0.55	11.0
	30	24 hour mean (short term)	0.86	1.57	5.2	2.43	8.1
Hg	600	1 hour mean	38	7.01	1.17	45.0	7.50
	60	24 hour mean (long term)	19	0.83	1.38	38.8	64.7
Sb	5000	Annual mean	3.6	1.86	0.04	5.46	0.11
	150000	1 hour mean	7.2	105.21	0.07	112.41	0.075
Pb	250	Annual mean	11	1.86	0.74	12.86	5.14
Cu	50	24 hour mean (long term)	26	23.49	46.98	49.49	98.98
Mn	150	Annual mean	6.9	1.86	1.24	8.76	5.84
	1500000	1 hour mean	13.8	105.21	0.007	119.01	0.008
V	1000	24 hr average (short term)	6.2	23.49	2.35	29.69	2.97

Pollutant	ES		Back-ground	Process Contribution		Predicted Environmental Concentration	
	ng/m^3	Reference period	ng/m^3	ng/m^3	% of EAL	ng/m^3	% of EAL
As	6	Annual mean	1	1.86	31.0	2.86	47.7
Cr (II)(III)	2000	24 hour mean (long term)	22	23.49	1.17	45.49	2.275
Cr (VI)	0.25	Annual mean	2.20	1.86	744	4.06	1624
Ni	20	Annual mean	3.6	1.86	9.30	5.46	27.3
	700	1 hour mean	7.2	105.21	15.03	112.41	16.1

(i) Screening out emissions which are insignificant

From the tables above the following emissions can be screened out as insignificant in that the PC is < 1% of the long term ES and <10% of the short term ES. These are:

- PM_{10}
- $PM_{2.5}$
- HCl
- HF
- CO
- PAH
- NH_3
- PCBs
- Amines
- Total nitrosamines (as NDMA)
- Aldehydes (as formaldehyde)
- Sb, Pb, V

Therefore, we consider the Operator's proposals for preventing and minimising the emissions of these substances to be BAT for the Installation, where Waste Incineration (WI) BAT applies and in accordance with PCC emerging techniques guidance, for emissions arising solely from the CC process. This conclusion is based on the detailed audit referred to below.

(ii) Emissions unlikely to give rise to significant pollution

Also from the tables above the following emissions (which were not screened out as insignificant) have been assessed as being unlikely to give rise to significant pollution in that the PEC is less than 100% (taking expected modelling uncertainties into account) of both the long term and short term ES.

- NO_2
- SO_2
- TOC (as benzene)
- Total nitrosamines and nitramines (as NDMA)
- Cd, Hg, Cu, Mn, As, Cr (II)(III), Ni

For these emissions, we have carefully scrutinised the Operator's proposals to ensure that they are applying BAT, where WI BAT applies, and our emerging techniques guidance, for emissions arising solely from the CC process, to prevent and minimise emissions of these substances. This is reported in section 6 of this document.

(iii) Emissions requiring further assessment

From the tables above the following emissions are considered to have the potential to give rise to significant pollution in that the Predicted Environmental Concentration exceeds 100% of the long term or short term ES.

- Cr (VI)

We have interrogated the uncertainty and significance of the Operator's numerical predictions for annual emissions of Cr (VI). Following step 2 of the guidance Waste incinerators: guidance on impact assessment for group 3 metals, annual Cr (VI) emissions show insignificant PC and therefore can be screened out. Further details are in section 5.2.3

In any case, with respect to these pollutants, we have carefully scrutinised the Operator's proposals to ensure that they are applying the Best Available Techniques to prevent and minimise emissions of these substances. This is reported in section 6 of this document.

We have also carefully considered whether additional measures are required above what would normally be considered BAT in order to prevent significant pollution. Consideration of additional measures to address the pollution risk from these substances is set out in section 5.2.4.

5.2.2 Consideration of key pollutants

In this section, reference to BAT is applicable for emissions arising from the waste incineration process. Where we consider emissions arising solely from the CC process, we are considering these in accordance with PCC emerging techniques guidance.

(i) Nitrogen dioxide (NO_2)

The impact on air quality from NO_2 emissions has been assessed against the ES of 40 $\mu g/m^3$ as a long term annual average and 200 $\mu g/m^3$ as a short term hourly average.

The model assumes a 70% NO_X to NO_2 conversion for the long term and 35% for the short term assessment in line with Environment Agency guidance on the use of air dispersion modelling.

The above tables show that the maximum long term PC is greater than 1% of the ES and therefore cannot be screened out as insignificant. However, from the table above, the emission is not expected to result in the ES being exceeded. The maximum short term PC is greater than 10% of the ES and therefore cannot be screened out as insignificant. However, it is not expected to result in the ES being exceeded.

(ii) Particulate matter PM_{10} and $PM_{2.5}$

The impact on air quality from particulate emissions has been assessed against the ES for PM_{10} (particles of 10 microns and smaller) and $PM_{2.5}$ (particles of 2.5 microns and smaller). For PM_{10}, the ES are a long term annual average of 40 $\mu g/m^3$ and a short term daily average of 50 $\mu g/m^3$. For $PM_{2.5}$ the ES of 20 $\mu g/m^3$ as a long-term annual average was used, having changed from 25 $\mu g/m^3$ in 2020.

The Operator's predicted impact of the Installation against these ES is shown in the tables above. The assessment assumes that **all** particulate emissions are present as PM_{10} for the PM_{10} assessment and that **all** particulate emissions are present as $PM_{2.5}$ for the $PM_{2.5}$ assessment.

The above assessment is considered to represent a worst case assessment in that:

- It assumes that the plant emits particulates continuously at the IED Annex VI limit for total dust, whereas actual emissions from similar plant are normally lower.
- It assumes all particulates emitted are below either 10 microns (PM_{10}) or 2.5 microns ($PM_{2.5}$), when some are expected to be larger.
- It assumes there would be no additional abatement of particulate emissions within the CC plant.

We have reviewed the Operator's particulate matter impact assessment and are satisfied in the robustness of the Operator's conclusions.

The above table shows that the predicted PC for emissions of PM_{10} is below 1% of the long term ES and below 10% of the short term ES and so can be screened out as insignificant. Therefore, we consider the Operator's proposals for preventing and minimising the emissions of particulates to be BAT for the Installation.

The above table also shows that the predicted PC for emissions of $PM_{2.5}$ is also below 1% of the ES. Therefore, the Environment Agency concludes that particulate emissions from the installation, including emissions of PM_{10} or $PM_{2.5}$, will not give rise to significant pollution.

There is currently no emission limit prescribed nor any continuous emissions monitor for particulate matter specifically in the PM_{10} or $PM_{2.5}$ fraction. Whilst we are confident that current monitoring techniques will capture the fine particle fraction ($PM_{2.5}$) for inclusion in the measurement of total particulate matter, an improvement condition (IC2) in the Permit requires a full analysis of particle size distribution in the flue gas, and hence determine the ratio of fine to coarse particles and this remains in the varied Permit. In the light of current knowledge and available data however we are satisfied that the health of the public would not be put at risk by such emissions, as explained in section 5.3.3.

(iii) Acid gases, sulphur dioxide (SO_2), hydrogen chloride (HCl) and hydrogen fluoride (HF)

From the tables above, emissions of HCl and HF can be screened out as insignificant in that the process contribution is <10% of the short term ES. The ES for HCl is 750 $\mu g/m^3$, this is an hourly short term average, there is no long term ES for HCl. HF has 2 assessment criteria – a 1-hr ES of 160 $\mu g/m^3$ and a monthly ES of 16 $\mu g/m^3$ – the process contribution is <1% of the monthly ES and so the emission screens out as insignificant if the monthly ES is interpreted as representing a long term ES.

There is no long term EAL for SO_2 for the protection of human health. Protection of ecological receptors from SO_2 for which there is a long term ES is considered in section 5.4. There are three short term ES, hourly of 350 $\mu g/m^3$, 15 – minute of 266 $\mu g/m^3$ and daily of 125 $\mu g/m^3$.

From the above table, whilst SO_2 emissions cannot be screened out as insignificant, the Operator's modelling shows that the Installation is unlikely to result in a breach of the ES. The Operator is required to prevent, minimise and control SO_2 emissions using BAT, this is considered further in Section 6. We are satisfied that SO_2 emissions will not result in significant pollution.

(iv) Emissions to air of carbon monoxide (CO), Volatile Organic Compounds (VOCs), Polycyclic Aromatic Hydrocarbons (PAHs), Polychlorinated Biphenyls (PCBs), Dioxins and ammonia (NH_3)

The above tables show that for CO emissions, the maximum long term PC is less than 1% of the ES and the maximum short term PC is less than 10% of the ES and so can be screened out as insignificant. Therefore, we consider the Operator's proposals for preventing and minimising the emissions of CO to be BAT for the Installation.

The Operator has used the ES for benzene for their assessment of the impact of VOC. Our guidance: ''Air emissions risk assessment for your environmental permit'' advises applicants to treat VOCs that cannot be identified as 100% benzene in the risk assessment. However, butadiene has the lowest ES (other than PAH, PCBs, dioxins and furans) so we have checked the modelling against the ES for butadiene, and, using butadiene as the ES does not affect the conclusions.

The above tables show that for emissions of VOCs (expressed as TOC), the maximum long term PC is marginally greater than 1% of the ES and therefore cannot be screened out as insignificant. However, the emission is not expected to result in the ES being exceeded. The maximum short term PC for VOCs is less than 10% of the ES and so can be screened out as insignificant. Therefore, we consider the Operator's proposals for preventing and minimising the emissions of VOCs to be BAT for the Installation.

The above tables show that for PAH and PCB emissions, the maximum long term PC is less than 1% of the ES and the maximum short term PC is less than 10% of the ES for PCBs and so can be screened out as insignificant. Therefore, we consider the Operator's proposals for preventing and minimising the emissions of these substances to be BAT for the Installation.

The impact from VOCs was based on the emission limit set in the Permit for total organic carbon.

The Operator has also used the ES for benzo[a]pyrene (BaP) for their assessment of the impact of PAH. We agree that the use of the BaP ES is sufficiently precautionary.

There is no ES for dioxins and furans as the principal exposure route for these substances is by ingestion and the risk to human health is through the accumulation of these substances in the body over an extended period of time. This issue is considered in more detail in section 5.3.

The ammonia emission is based on a release concentration of 15 mg/m^3 from the incineration plant. We are satisfied that this level of emission is consistent with the operation of a well controlled SNCR NO_x abatement system. Ammonia emissions from the carbon capture process were modelled at 0.662 g/s, although actual emissions are expected to be lower due to the use of the multi-stage wash.

Whilst all emissions cannot be screened out as insignificant, the Operator's modelling shows that the installation is unlikely to result in a breach of the ES. The Operator is required to prevent, minimise and control PAH and VOC emissions using BAT, this is considered further in Section 6. We are satisfied that PAH and VOC emissions will not result in significant pollution.

(v) Amines, nitrosamines, nitramines and aldehydes

The above tables show that for Total amines (as MEA), Total nitrosamines (as NDMA) and Aldehydes (as formaldehyde) emissions, the maximum long term PC is less than 1% of the ES and the maximum short term PC is less than 10% of the ES and so can be screened out as insignificant. Therefore, we consider the Operator's proposals for preventing and minimising the emissions of these substances to be BAT for the Installation.

The above tables show that for Total nitrosamines and nitramines (as NDMA), the maximum long term PC is greater than 1% of the ES and therefore cannot

be screened out as insignificant. However, the emission is not expected to result in the ES being exceeded. The Operator used an EAL of 0.0003 $\mu g/m^3$ but we used a lower EAL of 0.0002 $\mu g/m^3$ in our checks and this did not change the conclusions.

The Environment Agency Risk Assessment Guidance includes Environmental Assessment Levels for MEA (a primary amine) and NDMA (a stable nitrosamine). Amines, nitrosamine and nitramines are not routinely monitored in the UK, therefore in the absence of data the Operator assumed background concentrations to be zero.

Total emissions of nitrosamines and nitramines were modelled as a sum of direct emissions and indirect emissions from the Installation.

Directly-emitted amines have the potential to react in the atmosphere to form amine degradation products – nitramines and nitrosamines. The nitrosamines and nitramines that form in the atmosphere in this way are referred to as indirect emissions.

The primary amine emitted by the CC plant will be MEA. However, the Operator has assumed that trace amounts of both DEA and DMA would also be emitted. The nitrosamines formed from primary amines such as MEA are unstable, forming isomers known as imines within a few seconds. Imines are not reactive nor significantly harmful to human health. Therefore, any directly emitted nitrosamines will be formed from secondary amines formed within the absorber tower. The Operator has assumed that the secondary amines emitted will be equal concentrations of DMA and DEA, and the indirectly emitted nitrosamines will be consequently equal concentrations of NDMA (formed from DMA) and n-nitrosodiethanolamine (NDELA, formed from DEA).

The Operator used the ADMS 6 amine chemistry module to calculate concentrations of amines, nitramines and nitrosamines based on the release rate of pollutants and a number of user-defined parameters. The Operator considered that the main model scenario, in which there are direct emissions of amines, nitrosamines and nitramines, and the amine chemistry is enabled, is the most realistic scenario.

The Operator carried out sensitivity analysis to determine the impact if various parameters were changed. It was concluded that:

- The concentration of amines is not sensitive to any of the parameters. This is because the large majority of the amine remains unreacted in all scenarios.
- Varying the amine chemistry reaction parameters leads to a range of 79% - 111% of the main model result for nitrosamines and 44% - 550% of the main model result for nitramines. The nitramine results are considerably more sensitive because the majority are formed from MEA.

The Operator concludes that, even under the worst case assumptions, the PEC of total nitrosamines and nitramines would remain well below the EAL and no significant effects would occur.

We are satisfied that the Operator's amine chemistry model incorporates several conservative assumptions based on the proposed emission parameters and the available knowledge at the time of the assessment. We agree with the Operator's conclusion that emissions of nitrosamines and nitramines, both direct and indirect, are unlikely to result in an exceedance of the available ESs. We have included IC16 in the Permit for the Operator to review the CC plant's performance during commissioning and IC19 to validate the air emissions risk assessment submitted with the application with data from first year of operation of the CC plant.

Whilst all emissions cannot be screened out as insignificant, the Operator's modelling shows that the Installation is unlikely to result in a breach of the ES.

(vi) Summary

For the above emissions to air, for those emissions that have not screened out as insignificant, we have carefully scrutinised the Operators' proposals to ensure that they are applying the BAT and emerging technique guidance to prevent and minimise emissions of these substances. This is reported in section 6 of this document. Therefore, we consider the Operator's proposals for preventing and minimising emissions to be BAT for the Installation and in accordance with PCC emerging techniques guidance for the CC plant. Dioxins and furans are considered further in section 5.3.2.

5.2.3 Assessment of Emission of Metals

The Operator has assessed the impact of metal emissions to air, as previously described.

There are three sets of BAT AELs for metal emissions from incinerators:

- An emission limit value of 0.02 mg/m^3 for mercury and its compounds (formerly WID group 1 metals).
- An aggregate emission limit value of 0.02 mg/m^3 for cadmium and thallium and their compounds (formerly WID group 2 metals).
- An aggregate emission limit of 0.3 mg/m^3 for antimony, arsenic, lead, chromium, cobalt, copper, manganese, nickel and vanadium and their compounds (formerly WID group 3 metals).

In addition, the UK is a Party to the Heavy Metals Protocol within the framework of the UN-ECE Convention on long-range trans-boundary air pollution. Compliance with the IED Annex VI emission limits for metals along with the Application of BAT also ensures that these requirements are met.

In section 5.2.1 above, the following emissions of metals were screened out as insignificant:

- Antimony
- Lead
- Vanadium

Also in section 5.2.1, the following emissions of metals whilst not screened out as insignificant were assessed as being unlikely to give rise to significant pollution:

- Cadmium
- Mercury
- Copper
- Manganese
- Arsenic
- Chromium (II)(III)
- Nickel

This left emissions of Chromium (VI) requiring further assessment. For all other metals, the Operator has concluded that exceedances of the EAL for all metals are not likely to occur.

Where the BREF sets an aggregate limit, the Operator's assessment assumes that each metal is emitted individually at the relevant aggregate emission limit value. This is a something which can never actually occur in practice as it would inevitably result in a breach of the said limit, and so represents a very much worst case scenario.

For Chromium (VI) the Operator used representative emissions data from other municipal waste incinerators using our guidance note "Waste incinerators: guidance on impact assessment for group 3 metals – version 4". Measurement of Chromium (VI) at the levels anticipated at the stack emission points is expected to be difficult, with the likely levels being below the level of detection by the most advanced methods. As mentioned above in section 5.2.2, we have interrogated the uncertainty and significance of the Operator's numerical predictions for annual emissions of Chromium (VI). Following step 2 of the guidance ''Waste incinerators: guidance on impact assessment for group 3 metals'', annual Chromium (VI) emissions show insignificant PC and therefore can be screened out.

Based on the above, the following emissions of metals were screened out as insignificant:

- Chromium (VI)

The Environment Agency's experience of regulating incineration plant is that emissions of metals are in any event below the BAT AELs which are lower than the Annex VI limits set in IED, and that the above assessment is an over prediction of the likely impact.

The Installation has been assessed as meeting BAT for control of metal emissions to air from the incineration activity. See section 6 of this document.

5.2.4 Consideration of Local Factors

(i) Impact on Air Quality Management Areas (AQMAs)

Cheshire West and Cheshire Council (CWACC) has declared one AQMA with respect to SO_2, 15-Minute Mean in the vicinity of the Installation. It is located as follows:

- Thornton le Moors AQMA No. 4 (SO_2, 15-Minute Mean) approximately 2.8km south-west of the EfW Facility.

From the Operator's model, the process contribution at all points within the AQMA is predicted to be below 1% of the ES and can be considered insignificant. Therefore, even though the background is already above the ES, the contribution from the Installation is negligible.

The Operator is required to prevent, minimise and control emissions using the best available techniques; this is considered further in Section 6.

5.3 Human health risk assessment for incineration plant emissions

5.3.1 Our role in preventing harm to human health

Health impacts from carbon capture plant emissions have been considered above where we have assessed the impact from amines and other substances against relevant ESs. The rest of the section below is further consideration of health impacts from incineration plant emissions.

The Environment Agency has a statutory role to protect the environment and human health from all processes and activities it regulates. We assessed the effects on human health for this application in the following ways:

i) Applying Statutory Controls

The plant will be regulated under EPR. The EPR include the requirements of relevant EU Directives, notably, the IED, the WFD, and ADD.

The main conditions in an EfW permit are based on the requirements of the IED. Specific conditions have been introduced to specifically ensure compliance with the requirements of Chapter IV of the IED. The aim of the IED is to prevent or, where that is not practicable, to reduce emissions to air, water and land and prevent the generation of waste, in order to achieve a high level of protection of the environment taken as a whole. IED achieves this aim by setting operational conditions, technical requirements and emission limit values to meet the requirements set out in Articles 11 and 18 of the IED. These requirements may in some circumstances dictate tighter emission limits and controls than those set out in the BAT conclusions (BAT-C) or Chapter IV of IED on waste incineration and co-incineration plants. The assessment of BAT for this installation is detailed in section 6 of this document.

ii) Environmental Impact Assessment

Industrial activities can give rise to odour, noise and vibration, accidents, fugitive emissions to air and water, releases to air (including the impact on Photochemical Ozone Creation Potential (POCP)), discharges to ground or groundwater, GWP and the generation of waste. For an installation of this kind, the principal environmental effects are through emissions to air, although we also consider all of the other impacts listed. Section 5.1 and 5.2 above explain how we have approached the critical issue of assessing the likely impact of the emissions to air from the Installation on human health and the environment and any measures we are requiring to ensure a high level of protection.

iii) Expert Scientific Opinion

There is a significant amount of literature on whether there are links between operation of incineration plants and effects on health. We have not referenced them here, but we have included information on one of the most recent studies that was commissioned by the UK Health Security Agency (UKHSA), previously Public Health England (PHE). The overall weight of the evidence is that there is not a significant impact on human health.

UKHSA review research undertaken to examine suggested links between emissions from municipal waste incinerators and effects on health. UKHSA's risk assessment is that modern, well run and regulated municipal waste incinerators are not a significant risk to public health. While it is not possible to rule out adverse health effects from these incinerators completely, any potential effect for people living close by is likely to be very small.

UKHSA keep literature on health effects under review and would inform us if there were any changes to the above position. Similarly, we would consult UKHSA if new evidence was provided to us.

In 2012 the UK Small Area Health Statistics Unit (SAHSU) at Imperial College was commissioned by PHE to carry out a study to extend the evidence base and to provide further information to the public about any potential reproductive and infant health risks from municipal waste incineration (MWIs).

A number of papers have been published by SAHSU since 2012 which show no effect on birth outcomes. One paper in the study looked at exposure to emissions from MWIs in the UK and concluded that exposure was low. Subsequent papers found no increased risk of a range of birth outcomes (including stillbirth and infant mortality) in relation to exposure to PM_{10} emissions and proximity to MWIs, and no association with MWIs opening on changes in risks of infant mortality or sex ratio.

The final part of the study, published on 21/06/19, found no evidence of increased risk of congenital anomalies from exposure to MWI chimney emissions, but a small potential increase in risk of congenital anomalies for children born within ten kilometres of MWIs. The paper does not demonstrate a causal effect, and it acknowledges that the observed results may well be down

to not fully adjusting the study for factors such as other sources of pollution around MWIs or deprivation.

UKHSA have stated that 'While the conclusions of the study state that a causal effect cannot be excluded, the study does not demonstrate a causal association and makes clear that the results may well reflect incomplete control for confounding i.e. insufficiently accounting for other factors that can cause congenital anomalies, including other sources of local pollution. This possible explanation is supported by the fact no increased risk of congenital anomalies was observed as a result of exposure to emissions from an incinerator.'

Following this study, UKHSA have further stated that their position remains that modern, well run and regulated municipal waste incinerators are not a significant risk to public health.

We agree with the view stated by the UKHSA. We ensure that permits contain conditions which require the installation to be well-run and regulate the installation to ensure compliance with such permit conditions.

iv) Health Risk Models

Comparing the results of air dispersion modelling as part of the Environmental Impact assessment against European and national air quality standards effectively makes a health risk assessment for those pollutants for which a standard has been derived. These air quality standards have been developed primarily to protect human health via known intake mechanisms, such as inhalation and ingestion. Some pollutants, such as dioxins, furans and dioxin like PCBs, have human health impacts at lower ingestion levels than lend themselves to setting an air quality standard to control against. For these pollutants, a different human health risk model is required which better reflects the level of dioxin intake.

Models are available to predict the dioxin, furan and dioxin like PCBs intake for comparison with the Tolerable Daily Intake (TDI) recommended by the Committee on Toxicity of Chemicals in Food, Consumer Products and the Environment, known as COT. These include the HHRAP model.

HHRAP has been developed by the US EPA to calculate the human body intake of a range of carcinogenic pollutants and to determine the mathematical quantitative risk in probabilistic terms. In the UK, in common with other European countries, we consider a threshold dose below which the likelihood of an adverse effect is regarded as being very low or effectively zero.

The TDI is the amount of a substance that can be ingested daily over a lifetime without appreciable health risk. It is expressed in relation to bodyweight to allow for different body size, such as for adults and children of different ages. In the UK, the COT has set a TDI for dioxins, furans and dioxin like PCBs of 2 picograms WHO-TEQ/kg-body weight/day (a picogram is a millionth of a millionth (10^{-12}) of a gram).

In addition to an assessment of risk from dioxins, furans and dioxin like PCBs, the HHRAP model enables a risk assessment from human intake of a range of heavy metals. In principle, the respective ES for these metals are protective of human health. It is not therefore necessary to model the human body intake.

The Committee on the Medical Effects of Air Pollution (COMEAP) developed a methodology based on the results of time series epidemiological studies which allows calculation of the public health impact of exposure to the classical air pollutants (NO_2, SO_2 and particulates) in terms of the numbers of "deaths brought forward" and the "number of hospital admissions for respiratory disease brought forward or additional". Defra reviewed this methodology and concluded that the use of the COMEAP methodology is not generally recommended for modelling the human health impacts of individual installations.

Our recommended approach is therefore the use of the methodology set out in our guidance for comparison for most pollutants (including metals) and dioxin intake modelling using the HHRAP model as described above for dioxins, furans and dioxin like PCBs. Where an alternative approach is adopted for dioxins, we check the predictions ourselves.

v) Consultations

As part of our normal procedures for the determination of a permit application, we consult with Local Authorities, Local Authority Directors of Public Health, FSA and UKHSA. We also consult the local communities who may raise health related issues. All issues raised by these consultations are considered in determining the Application as described in Annex 4 of this document.

5.3.2 Assessment of Intake of Dioxins, Furans and Dioxin like PCBs

For dioxins, furans and dioxin like PCBs, the principal exposure route is through ingestion, usually through the food chain, and the main risk to health is through accumulation in the body over the lifetime of the receptor.

The human health risk assessment calculates the dose of dioxins and furans that would be received by local receptors if their food and water were sourced from the locality where the deposition of dioxins, furans and dioxin like PCBs is predicted to be the highest. This is then assessed against the Tolerable Daily Intake (TDI) levels established by the COT of 2 picograms WHO-TEQ / kg body weight/ day.

The results of the Operator's assessment of dioxin intake are detailed in the table below (worst case results for each category are shown). The results showed that the predicted daily intake of dioxins, furans and dioxin like PCBs at all receptors, resulting from emissions from the proposed facility, were significantly below the recommended TDI levels. The predicted maximum contribution as presented in the below table is 3.2% of the TDI for an adult, and 4.56% of the TDI for a child, both modelled at agricultural maximum point of impact. Since their predictions are below the TDI the Operator concluded: *'The*

impact of emissions of dioxins and dioxin-like PCBs from the Proposed Facility on human health is not predicted to be significant.'' We have interrogated the Operator's assessment and agree with their conclusion.

Receptor	Adult (pg I-TEQ kg-BW^{-1}d^{-1})	Adult (%age TDI)	Child (pg I-TEQ kg-BW^{-1}d^{-1})	Child (%age TDI)
Point of maximum impact - agricultural	0.064	3.2%	0.091	4.56%

Calculated maximum daily intake of dioxins over a lifetime by local receptors resulting from the operation of the proposed facility (WHO-TEQ/ kg-BW/day)

In 2010, the FSA studied the levels of chlorinated, brominated and mixed (chlorinated-brominated) dioxins and dioxin-like PCBs in fish, shellfish, meat and eggs consumed in the UK. It asked COT to consider the results and to advise on whether the measured levels of these PXDDs, PXDFs and PXBs indicated a health concern ('X' means a halogen). COT issued a statement in December 2010 and concluded that "The major contribution to the total dioxin toxic activity in the foods measured came from chlorinated compounds. Brominated compounds made a much smaller contribution, and mixed halogenated compounds contributed even less (1% or less of TDI). Measured levels of PXDDs, PXDFs and dioxin-like PXBs do not indicate a health concern". COT recognised the lack of quantified TEFs for these compounds but said that "even if the TEFs for PXDDs, PXDFs and dioxin-like PXBs were up to four fold higher than assumed, their contribution to the total TEQ in the diet would still be small. Thus, further research on PXDDs, PXDFs and dioxin-like PXBs is not considered a priority."

In the light of this statement, we assess the impact of chlorinated compounds as representing the impact of all chlorinated, brominated and mixed dioxins / furans and dioxin like PCBs.

5.3.3 Particulates smaller than 2.5 microns

The Operator will be required to monitor particulate emissions using the method set out in Table S3.1 of Schedule 3 of the varied Permit. This method requires that the filter efficiency must be at least 99.5 % on a test aerosol with a mean particle diameter of 0.3 µm, at the maximum flow rate anticipated. The filter efficiency for larger particles will be at least as high as this. This means that particulate monitoring data effectively captures everything above 0.3 µm and much of what is smaller. It is not expected that particles smaller than 0.3 µm will contribute significantly to the mass release rate / concentration of particulates because of their very small mass, even if present. This means that emissions monitoring data can be relied upon to measure the true mass emission rate of particulates.

Nano-particles are considered to refer to those particulates less than 0.1 µm in diameter ($PM_{0.1}$). Questions are often raised about the effect of nano-particles on human health, in particular on children's health, because of their high surface to volume ratio, making them more reactive, and their very small size, giving

them the potential to penetrate cell walls of living organisms. The small size also means there will be a larger number of small particles for a given mass concentration. However, the UKHSA statement (referenced below) says that due to the small effects of incinerators on local concentration of particles, it is highly unlikely that there will be detectable effects of any particular incinerator on local infant mortality.

The UKHSA addresses the issue of the health effects of particulates in their September 2009 statement 'The Impact on Health of Emissions to Air from Municipal Incinerators'. It refers to the coefficients linking PM_{10} and $PM_{2.5}$ with effects on health derived by COMEAP and goes on to say that if these coefficients are applied to small increases in concentrations produced, locally, by incinerators; the estimated effects on health are likely to be small. UKHSA note that the coefficients that allow the use of number concentrations in impact calculations have not yet been defined because the national experts have not judged that the evidence is sufficient to do so. This is an area being kept under review by COMEAP.

In December 2010, COMEAP published a report on The Mortality Effects of Long-Term Exposure to Particulate Air Pollution in the United Kingdom. It says that "a policy which aims to reduce the annual average concentration of $PM_{2.5}$ by 1 $\mu g/m^3$ would result in an increase in life expectancy of 20 days for people born in 2008." However, "The Committee stresses the need for careful interpretation of these metrics to avoid incorrect inferences being drawn – they are valid representations of population aggregate or average effects, but they can be misleading when interpreted as reflecting the experience of individuals."

UKHSA also point out that in 2007 incinerators contributed 0.02% to ambient ground level PM_{10} levels compared with 18% for road traffic and 22% for industry in general. UKHSA noted that in a sample collected in a day at a typical urban area the proportion of $PM_{0.1}$ is around 5-10% of PM_{10}. It goes on to say that PM_{10} includes and exceeds $PM_{2.5}$ which in turn includes and exceeds $PM_{0.1}$. The National Atmospheric Emissions Inventory (NAEI) figures show that in 2016 municipal waste incineration contributed 0.03% to ambient ground level PM_{10} levels and 0.05% to ambient ground level $PM_{2.5}$ levels. The 2016 data also shows that road traffic contributed to 5.35% of PM_{10} and 4.96% of $PM_{2.5}$ and that domestic wood burning contributed 22.4% to PM_{10} and 34.3% of $PM_{2.5}$ levels.

This is consistent with the assessment of this Application which shows emissions of PM_{10} to air to be insignificant.

A 2016 paper by Jones and Harrison concluded that 'ultrafine particles (<100nm) in flue gases from incinerators are broadly similar to those in urban air and that after dispersion with ambient air ultrafine particle concentrations are typically indistinguishable from those that would occur in the absence of the incinerator.

We take the view, based on the foregoing evidence, that techniques which control the release of particulates to levels which will not cause harm to human

health will also control the release of fine particulate matter to a level which will not cause harm to human health.

5.3.4 Assessment of Health Effects from the Installation

Our assessment of health impacts is summarised below

i. We have applied the relevant requirements of the Environmental legislation in imposing the permit conditions. We are satisfied that compliance with these conditions will ensure protection of the environment and human health.

ii. In carrying out air dispersion modelling as part of the environmental impact assessment and comparing the PC and PEC with the ES, the Operator has effectively made a health risk assessment for many pollutants. The ES have been developed primarily to protect human health. The Operator's assessment of the impact from PM_{10}, $PM_{2.5}$, HCl, HF, CO, PAH, NH_3, PCBs, Amines, Total nitrosamines (as NDMA), Aldehydes (as formaldehyde), Sb, Pb, and V have all indicated that the Installation emissions screen out as insignificant; where the impact of emissions of NO_2, SO_2, TOC (as benzene), Total nitrosamines and nitramines (as NDMA), Cd, Hg, Cu, Mn, As, Cr (II)(III), and Ni have not been screened out as insignificant, the assessment still shows that the PEC are well within the ES. Following step 2 of the guidance ''Waste incinerators: guidance on impact assessment for group 3 metals'', annual Cr (VI) emissions show insignificant PC and therefore can be screened out.

iii. We have assessed the health effects from the operation of this installation in relation to the above (sections 5.3.1 to 5.3.3).

iv. We have reviewed the methodology employed by the Operator to carry out the health impact assessment.

As a result of our checks and sensitivity analysis, we found that although we do not necessarily agree with the Operator's exact numerical predictions, we agree with the Operator's conclusions provided that the source terms from the proposed facility are reasonably representative.

Regarding human health receptors, our checks indicate that PCs are either below 1% and 10% of the ES or PECs are below the ES for both normal and abnormal operations. Regarding the HHRA, our checks indicate that dioxin, furan and dioxin-like PCB intakes are below 10% of the COT TDI and are unlikely to result in risk to health, including abnormal operations. This criterion is based on the UKHSA advice:

- If total exposure, including the PC results in an exceedance of the COT TDI, as long as the PC from the facility is less than 10% it would be unlikely to result in a significant risk.

- A total exposure, including the PC from dioxins, furans and dioxin-like PCBs is without appreciable health risk if the total exposure is below the TDI.

Overall, taking into account the conservative nature of the impact assessment (i.e. that it is based upon an individual exposed for a life-time to the effects of the highest predicted relevant airborne concentrations and consuming mostly locally grown food), it was concluded that the operation of the proposed facility will not pose a significant risk to human health.

v. In relation to the emissions from the incinerator, we agree with the conclusion reached by UKHSA that modern, well run and regulated municipal waste incinerators are not a significant risk to public health. While it is not possible to rule out adverse health effects from these incinerators completely, any potential effect for people living close by is likely to be very small.

vi. UKHSA and the Local Authority Director of Public Health were consulted on the Application. The UKHSA concluded that they had no significant concerns regarding the risk to the health of humans from the Installation. The Local Authority Director of Public Health did not provide a response. The Food Standards Agency was also consulted during the permit determination process but did not provide a response to our consultation. Details of the response provided by UKHSA to the consultation on this Application can be found in Annex 4.

We are therefore satisfied that the Operator's conclusions presented above are reliable and we conclude that the potential emissions of pollutants including dioxins, furans and metals from the proposed facility are unlikely to have a significant impact on human health.

5.4 Impact on protected conservation areas (SPAs, SACs, Ramsar sites and SSSIs and local nature sites)

5.4.1 Sites Considered

The following Special Areas of Conservation (SAC), Special Protection Areas (SPA) and Ramsar sites are located within 10 km of the Installation:

- Mersey Estuary (SAC, SPA and Ramsar site), approximately 0.6km to the north at the nearest point
- Midland Meres and Mosses Ramsar (Phase 1) – Hatch Mere, approximately 9.0km to the southeast at the nearest point
- Midland Meres and Mosses Ramsar (Phase 1) – Flaxmere Moss, approximately 9.5km to the southeast at the nearest point
- Midland Meres and Mosses Ramsar (Phase 2) – Linmere Moss, approximately 9.7km to the southeast at the nearest point

The following Sites of Special Scientific Interest (SSSI) are located within 2 km of the Installation:

- Mersey Estuary SSSI, approximately 0.6km to the north at the nearest point

The following local nature sites (ancient woodlands, local wildlife sites and national and local nature reserves) are located within 2 km of the Installation:

- Frodsham and Helsby and Ince Marshes, surrounding the facility
- Station Road Railway Site, approximately 1.4km to the southwest at the nearest point

5.4.2 Habitats Assessment

The Operator's habitats assessment was reviewed by our technical specialists for air dispersion modelling and assessment and specialists for, habitats and conservation who agreed with the assessment's conclusions, that there would be no likely significant effect on the interest features of the protected sites.

Mersey Estuary SAC, SPA, Ramsar site, and SSSI:

Pollutant	ES / EAL (µg/m³)	Back-ground (µg/m³)	Process Contribution (PC) (µg/m³)	PC as % of ES	Predicted Environmental Concentration (PEC) (µg/m³)	PEC as % ES
Direct Impacts[2]						
NO_x Annual	30	15.5	0.497	1.66	16.47	54.90
NO_x Daily Mean	200[1]	31.1	7.655	3.83	38.755	19.38
SO_2	20	6.6	0.111	0.55	6.711	33.56
Ammonia	3	4.90	0.042	1.38	5.87	195.66
HF Weekly Mean	0.5	2.35	0.015	2.96	2.365	473
HF Daily Mean	5	4.7	0.043	0.85	4.743	94.86
Deposition Impacts[2]						
N Deposition (kg N/ha/yr)	10-20	24.3	0.283	1.42-2.83	24.58	122.92-245.83%
Acidification (Keq/ha/yr)	4.856-5.071	1.9	0.043	0.84-0.88	1.943	38.31-40.01%

(1) For detailed assessments where the ozone is below the AOT40 critical level and sulphur dioxide is below the lower critical level of 10 micrograms per cubic metre.
(2) Direct impact units are µg/m³ and deposition impact units are kg N/ha/yr or Keq/ha/yr.

The table above shows that at the Mersey Estuary SAC, SPA, Ramsar site, and SSSI the PCs are <10% for all short term environmental standards and <1% for SO_2, and acidification long term environmental standards. Hence, we can conclude that impacts from these pollutants are insignificant.

PCs are >1% for NOx, ammonia and nitrogen deposition long term environmental standards and therefore cannot be screened out as insignificant.

There is predicted to be a slight decrease in the peak concentration of oxides of nitrogen and ammonia impact from the proposed facility compared to the permitted facility, but the impact from nitrogen deposition is slightly increased owing to the additional contribution from amine solvent and its degradation products.

After further analysis NOx was screened out since the PECs fall well below 100% of the significance thresholds (51.21%) allowing significant headroom.

The Operator states that whilst the peak impact of ammonia and nitrogen deposition from the proposed facility cannot be screened out as 'insignificant', this is based on conservative modelling assumptions including that the Incineration plant and CC plant will continually operate at the ELVs for the entire year. In practice both the Incineration plant and the CC plant will be offline for maintenance on occasions, so are unlikely to operate for a full year at full load, and the CC plant includes a multi-stage water and acid wash which will reduce emissions of amines and ammonia. Also, ammonia from the Installation is unlikely to continually be emitted at the ELV. Therefore, the impacts predicted for ammonia emissions and nutrient nitrogen from the CC plant are expected to be significantly lower than presented in the above table. When availability and interannual variability in weather conditions is accounted for, the ammonia concentration is likely to be less than the critical level, and the degree of change between the existing and varied site would be <1% of the critical load for both ammonia and nitrogen deposition.

The Operator states that based on the context presented above, it is unlikely that impacts upon the Mersey Estuary or functionally linked land as a result of ammonia emissions and nitrogen deposition would exceed 1% of the Critical Level or load.

We have done our own assessment, and we agree with the Operator's conclusions that there should be no adverse effect on the protected habitat site from the proposed development and it is not likely to damage any of the flora, fauna or geological or physiological features which are of special interest. Background levels in the environment are already exceeding thresholds at the Mersey Estuary at maximums of 15.9 kgN/ha/yr (minimum critical load 10 kgN/ha/yr); and whilst Natural England resources have indicated that saltmarshes in particular have been heavily damaged (as of the last condition assessment in 2023) – this damage has been attributed to excessive vehicle use and grazing, and not as a result of air emissions. An audit of the Operator's air quality assessment was carried out by our internal modelling specialists (AQMAU). They have acknowledged the slight increases in nutrient nitrogen at Mersey Estuary in comparison to the permitted site. However, they believe the degree of change to be insignificant (<1% of the critical load) where the background levels exceed the critical load. As the degree of change is so small; the saltmarsh subject to significant emissions is regularly inundated by the sea and this variation has been applied for to achieve an environmental

improvement (reduction in carbon emissions), we have concluded there should be no adverse effect.

Midland Meres and Mosses Ramsar (Phase 1 and Phase 2)

(I) Screening out emissions which are insignificant

For all three protected habitats considered below as part of Midland Meres and Mosses Ramsar sites, the PCs are <10% for all short term environmental standards and <1% for NOx, SO_2, and ammonia long term environmental standards. Hence, we can conclude that impacts from these pollutants are insignificant.

(II) Hatch Mere (Phase 1):

Pollutant	ES / EAL (µg/m³)	Back-ground (µg/m³)	Process Contribution (PC) (µg/m³)	PC as % of ES	Predicted Environmental Concentration (PEC) (µg/m³)	PEC as % ES
Direct Impacts[3]						
NO_x Annual	30	8.2	0.099	0.33	-	-
NO_x Daily Mean	200[2]	16.4	1.02	0.51	-	-
SO_2	10 (1)	3.0	0.022	0.22	-	-
Ammonia	1 (1)	2.7	0.0084	0.84	-	-
HF Weekly Mean	0.5	2.35	0.00205	0.41	-	-
HF Daily Mean	5	4.7	0.0055	0.11	-	-
Deposition Impacts[3]						
N Deposition (kg N/ha/yr)	5-15	26.6	0.057	0.38-1.14	26.657	177.7-533.1
Acidification (Keq/ha/yr)	-	-	-	-	-	-

(1) The lichen and bryophyte sensitivity standards for ammonia and sulphur dioxide have been assigned for this assessment as the presence of these features has been recorded in the site Management Plan for at least one of the sections of the site.
(2) For detailed assessments where the ozone is below the AOT40 critical level and sulphur dioxide is below the lower critical level of 10 micrograms per cubic metre.
(3) Direct impact units are µg/m³ and deposition impact units are kg N/ha/yr or Keq/ha/yr.

The Hatch Mere is not sensitive to acidification.

The table above shows that at the Hatch Mere, PC is >1% of the nitrogen deposition long term environmental standard and therefore cannot be screened out as insignificant.

(III) Flaxmere Moss (Phase 1):

Pollutant	ES / EAL (µg/m³)	Back-ground (µg/m³)	Process Contribution (PC) (µg/m³)	PC as % of ES	Predicted Environmental Concentration (PEC) (µg/m³)	PEC as % ES
Direct Impacts[3]						
NO_x Annual	30	8.2	0.096	0.32	-	-
NO_x Daily Mean	200[2]	16.4	0.86	0.43	-	-
SO_2	10 (1)	2.6	0.021	0.21	-	-
Ammonia	1 (1)	2.7	0.0079	0.79	-	-
HF Weekly Mean	0.5	2.35	0.0018	0.36	-	-
HF Daily Mean	5	4.7	0.0045	0.09	-	-
Deposition Impacts[3]						
N Deposition (kg N/ha/yr)	5-15	26.4	0.054	0.36-1.08	26.454	176.36-529.08
Acidification (Keq/ha/yr)	0.552	1.9	0.008	1.48	1.908	345.69

(1) The lichen and bryophyte sensitivity standards for ammonia and sulphur dioxide have been assigned for this assessment as the presence of these features has been recorded in the site Management Plan for at least one of the sections of the site.
(2) For detailed assessments where the ozone is below the AOT40 critical level and sulphur dioxide is below the lower critical level of 10 micrograms per cubic metre.
(3) Direct impact units are µg/m³ and deposition impact units are kg N/ha/yr or Keq/ha/yr.

The table above shows that at the Flaxmere Moss, the PCs are >1% for acidification and nitrogen deposition long term environmental standards and therefore cannot be screened out as insignificant.

(IV) – Linmere Moss (Phase 2):

Pollutant	ES / EAL (µg/m³)	Back-ground (µg/m³)	Process Contribution (PC) (µg/m³)	PC as % of ES	Predicted Environmental Concentration (PEC) (µg/m³)	PEC as % ES
Direct Impacts[3]						
NO_x Annual	30	7.7	0.078	0.26	-	-
NO_x Daily Mean	200[2]	15.4	0.78	0.39	-	-
SO_2	10 (1)	2.8	0.017	0.17	-	-
Ammonia	1 (1)	2.9	0.0064	0.64	-	-
HF Weekly Mean	0.5	2.35	0.0017	0.34	-	-
HF	5	4.7	0.0045	0.09	-	-

Pollutant	ES / EAL (µg/m³)	Back-ground (µg/m³)	Process Contribution (PC) (µg/m³)	PC as % of ES	Predicted Environmental Concentration (PEC) (µg/m³)	PEC as % ES
Daily Mean						
Deposition Impacts[3]						
N Deposition (kg N/ha/yr)	15-25	25.4	0.044	0.17-0.29	-	-
Acidification (Keq/ha/yr)	0.552	1.9	0.006	1.2	1.906	345.4

(1) The lichen and bryophyte sensitivity standards for ammonia and sulphur dioxide have been assigned for this assessment as the presence of these features has been recorded in the site Management Plan for at least one of the sections of the site.
(2) For detailed assessments where the ozone is below the AOT40 critical level and sulphur dioxide is below the lower critical level of 10 micrograms per cubic metre.
(3) Direct impact units are µg/m³ and deposition impact units are kg N/ha/yr or Keq/ha/yr.

The table above shows that at the Linmere Moss, the PC is <1% of the nitrogen deposition long term environmental standards. Hence, we can conclude that impact from nitrogen deposition is insignificant.

PC is >1% of the acidification long term environmental standards and therefore cannot be screened out as insignificant.

(V) Emissions unlikely to give rise to significant pollution

The Operator states that the peak impact of nitrogen deposition and acidification from the proposed facility cannot be screened out as 'insignificant' at all Midland Meres and Mosses Ramsar sites. However, this is based on conservative modelling assumptions including that the Incineration plant and CC plant will continually operate at the ELVs for the entire year. In practice both the Incineration plant and the CC plant will be offline for maintenance on occasions, so are unlikely to operate for a full year at full load, and the CC plant includes a multi-stage water and acid wash which will reduce emissions of pollutants contributing to nitrogen deposition and acidification and ammonia from the Installation is unlikely to continually be emitted at the ELV.

The Operator states that when availability and interannual variability in weather conditions is accounted for, it is unlikely that impact upon the Midland Meres and Mosses Ramsar sites as result of nitrogen deposition and acidification would exceed 1% of the Critical Load.

We have done our own assessment, and we agree with the Operator's conclusions that there should be no adverse effect on the protected habitat site from the proposed development.

5.4.3 SSSI Assessment

There are no other Sites of Special Scientific Interest (SSSI) within 2 km of the proposed Installation, besides Mersey Estuary that has already been considered in the section above. The Operator's assessment of SSSIs was reviewed by our technical specialists for air dispersion modelling and specialists for habitats and conservation, who agreed with the assessment's conclusions, that the proposal does not damage the special features of the SSSI.

5.4.4 Assessment of local nature sites

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. The Environment Act 1995 provides more generalised protection for flora and fauna rather than for specifically named conservation designations. 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 Operator is using BAT to control emissions.

Frodsham and Helsby and Ince Marshes (LWS):

Pollutant	ES / EAL (µg/m³)	Back-ground (µg/m³)	Process Contribution (PC) (µg/m³)	PC as % of ES
Direct Impacts[2]				
NO_x Annual	30	16.9	1.1	3.72
NO_x Daily Mean	200[1]	33.8	14.06	7.03
SO_2	20	6.8	0.248	1.24
Ammonia	3	4.9	0.093	3.1
HF Weekly Mean	0.5	2.35	0.078	5.69
HF Daily Mean	5	4.7	0.028	1.57
Deposition Impacts[2]				
N Deposition (kg N/ha/yr)	10-20	24.28	0.635	3.17-6.35
Acidification (Keq/ha/yr)	5.071	1.93	0.096	1.89

(1) For detailed assessments where the ozone is below the AOT40 critical level and sulphur dioxide is below the lower critical level of 10 micrograms per cubic metre.
(2) Direct impact units are µg/m³ and deposition impact units are kg N/ha/yr or Keq/ha/yr.

Station Road Railway Site (LWS):

Pollutant	ES / EAL (µg/m³)	Back-ground (µg/m³)	Process Contribution (PC) (µg/m³)	PC as % of ES
Direct Impacts[2]				
NO_x Annual	30	16.5	0.254	0.85
NO_x Daily Mean	200[1]	33.0	4.79	2.39
SO_2	20	3.7	0.056	0.28
Ammonia	3	3.8	0.021	0.71
HF Weekly Mean	0.5	2.35	0.011	2.27
HF Daily Mean	5	4.7	0.027	0.53
Deposition Impacts[2]				
N Deposition (kg N/ha/yr)	10-20	23.79	0.635	0.72-1.45
Acidification (Keq/ha/yr)	5.071	1.85	0.022	0.43

(1) For detailed assessments where the ozone is below the AOT40 critical level and sulphur dioxide is below the lower critical level of 10 micrograms per cubic metre.
(2) Direct impact units are µg/m³ and deposition impact units are kg N/ha/yr or Keq/ha/yr.

The two tables above show that the PCs at the two local wildlife sites are below the critical levels or loads. We are satisfied that the Installation will not cause significant pollution at any of the other conservation sites. The Operator is required to prevent, minimise and control emissions using BAT, this is considered further in Section 6.

5.5 Impact of abnormal operations

Article 50(4)(c) of the IED requires that waste incineration and co-incineration plants shall operate an automatic system to prevent waste feed whenever any of the continuous emission monitors show that an ELV is exceeded due to disturbances or failures of the purification devices. Notwithstanding this, Article 46(6) allows for the continued incineration and co-incineration of waste under such conditions provided that this period does not (in any circumstances) exceed 4 hours uninterrupted continuous operation or the cumulative period of operation does not exceed 60 hours in a calendar year. This is a recognition that the emissions during transient states (e.g. start-up and shut-down) are higher than during steady-state operation, and the overall environmental impact of continued operation with a limited exceedance of an ELV may be less than that of a partial shut-down and re-start.

For incineration plant, IED sets backstop limits for particulates, CO and TOC which must continue to be met during abnormal operation. The CO and TOC limits are the same as for normal operation and are intended to ensure that good combustion conditions are maintained. The backstop limit for particulates is 150 mg/m^3 (as a half hourly average) which is five times the limit in normal operation.

Article 45(1)(f) requires that the permit shall specify the maximum permissible period of any technically unavoidable stoppages, disturbances, or failures of the purification devices or the measurement devices, during which the concentrations in the discharges into the air may exceed the prescribed emission limit values. The time limit set in the current Permit is 4 hours, which is the maximum period prescribed by Article 46(6) of the IED. We have decided that this time limit should remain in the varied Permit.

These abnormal operations are limited to no more than a period of 4 hours continuous operation and no more than 60 hours aggregated operation in any calendar year. This is less than 1% of total operating hours and so abnormal operating conditions are not expected to have any significant long term environmental impact unless the background conditions were already close to, or exceeding, an ES. For the most part therefore consideration of abnormal operations is limited to consideration of its impact on short term ESs.

The CC plant is designed to treat flue gas during normal operation and emissions will leave the Installation through Absorber stacks A5 and A6, therefore assessment of emissions from the Incinerator stacks A1 and A2 during normal operation is not required. The CC plant will be bypassed during abnormal operation of the Incineration plant and flue gas will be emitted through stacks A1 and A2. As there have been minor changes to the stack parameters for A1 and A2, abnormal operation scenarios had to be re-assessed.

In making an assessment of abnormal operations at the incineration plant the following worst case scenario has been assumed:

- Dioxin emissions of 100x normal
- NO_x emissions of 500 mg/m^3 (1.25x normal)
- Particulate emissions of 150 mg/m^3 (5x normal)
- Metal emissions, including mercury, are 30 times those of normal operation
- SO_2 emissions of 450 mg/m^3 (2.25x normal)
- HCl emissions of 900 mg/m^3 (15x normal)
- HF emissions of 400 mg/m3 (5x normal)
- PCBs (100 x normal)

This is a worst case scenario in that these abnormal conditions include a number of different equipment failures, not all of which will necessarily result in an adverse impact on the environment (e.g. a failure of a monitoring instrument does not necessarily mean that the incinerator or abatement plant is malfunctioning). This analysis assumes that any failure of any equipment results in all the negative impacts set out above occurring simultaneously.

The result of the Operator's short-term environmental impact assessment is summarised in the table below.

Pollutant	ES		Back-ground	Process Contribution (PC)		Predicted Environmental Concentration (PEC)	
	µg/m^3		µg/m^3	µg/m^3	% of EAL	µg/m^3	% of EAL
NO_2	200	99.79th %ile of 1 hour means	39.4	15.44	7.72	54.84	27.4
PM_{10}	50	90.41st %ile of 24 hour means	28.8	0.42	0.84	29.22	58.4
SO_2	266	99.9th ile of 15-min means	13.2	53.56	20.14	66.76	25.1
SO_2	350	99.73rd %ile of 1 hour means	13.2	38.08	10.88	51.28	14.7
SO_2	125	99.18th %ile of 24 hour means	13.2	3.42	2.74	16.62	13.3
HCl	750	1 hour mean	1.42	166.59	22.21	168.0	22.40
HF	160	1 hour mean	4.7	3.71	2.32	8.41	5.3
PCBs	6	1 hour mean	0.258	92.71	1.55	92.97	1.55

Pollutant	ES		Back-ground	Process Contribution (PC)		Predicted Environmental Concentration (PEC)	
	ng/m^3		ng/m^3	ng/m^3	% of EAL	ng/m^3	% of EAL
Hg	600	1 hour mean	38	111.25	18.54	149.25	24.88
Sb	150000	1 hour mean	7.2	63.97	0.04	71.17	0.047
Cd	30	24 hour mean (short term)	0.86	2.41	8.03	3.27	10.90
Mn	1500000	1 hour mean	13.8	333.74	0.02	347.54	0.023
V	1000	24 hour mean (short term)	12.4	1.44	0.14	13.84	1.384
Ni (worst case)	700	1 hour mean	7.2	1223.72	174.82	1230.92	175.85
Ni (2nd highest)	700	1 hour mean	7.2	750.92	107.27	758.12	108.30
Ni (3rd highest)	700	1 hour mean	7.2	294.8	42.11	302.0	43.14
Ni (mean)	700	1 hour mean	7.2	83.44	11.92	90.64	12.95

From the table above the emissions of the following substances can still be considered insignificant, in that the PC is still <10% of the short-term ES:

- NO_2
- PM_{10}
- HF
- PCBs
- Sb, Cd, Mn, V

Also, from the table above emissions of the following substances (which were not screened out as insignificant) have been assessed as being unlikely to give rise to significant pollution in that the predicted environmental concentration is less than 100% of the short term ES:

- SO_2
- HCl
- Hg

For Ni, the highest PEC is greater than the short term ES. We should therefore consider whether additional measures are required. Using the second and third highest Ni emission concentrations, the 1-hour Ni PCs are 107% and 42% respectively, and the PECs are 108% and 43% respectively of the ES. This is based on the worst-case scenario that during abnormal operation, Ni is emitted at a concentration of 30 times the maximum monitored Ni concentration from

guidance: ‘’Waste incinerators: guidance on impact assessment for group 3 metals stack’’, compared to the typical assumption of 5 times the BAT-AEL (0.3 mg/Nm^3). This is a conservative assumption. If the top two outlier results were excluded and assuming that both lines of the Incineration plant operate at the 3rd highest monitored concentration from the aforementioned guidance the predicted PEC for Ni would be 43.14%. We consider that this is a more representative result than the highest value as presented in the table above.

We are therefore satisfied that it is not necessary to further constrain the conditions and duration of the periods of abnormal operation of the incineration plant beyond those permitted under Chapter IV of the IED.

We have not assessed the impact of abnormal operations against long term ESs for the reasons set out above. Except that if dioxin emissions were at 10 ng/m^3 for the maximum period of abnormal operation, this would result in an increase of approximately 68% in the TDI reported in section 5.3.2. In these circumstances the TDI would be 0.108 pg(WHO-TEQ/ kg-BW/day), which is 7.65% of the COT TDI. At this level, emissions of dioxins will still not pose a risk to human health.

5.6 Other Emissions

5.6.1 Impact of abnormal venting of carbon dioxide (CO_2)

The release of the captured highly concentrated CO_2 under pressure from the installation has the potential to cause harm to human health. It is recognised that venting to atmosphere of concentrated CO_2 may be required during operation of the CC plant. For this reason, the Operator was required to provide an assessment of the impact of the vented concentrated CO_2 on harm to health at nearby sensitive receptors.

The Operator provided an assessment which presented a number of operational scenarios under which CO_2 may be vented to atmosphere. The Operator’s assessment of the acute impacts of CO_2 venting is set out in Section 11 of the Dispersion Modelling Assessment dated March 2024 of the Application.

The Operator assessed the Installation’s potential emissions to air against the relevant air quality standards (UK HSE Workplace Exposure Limit (WEL)), and the potential acute impacts upon human health. These assessments predict the potential effects on human health from the Installation’s CO_2 vent using the ADMS modelling software version 6.

Environment Agency air quality specialists have audited the Operator’s assessment and are satisfied that the concentrations of CO_2 are likely to be below the Operator’s proposed lowest assessment criteria at sensitive human receptor locations. Therefore, we are satisfied that that there is no significant risk to human health.

A pre-operational measure POM6 has been included in the varied Permit requiring the Operator to provide an updated assessment for approval to confirm venting conditions before commissioning of the CC plant. Also included in this condition is a requirement for the Operator to submit to the Environment Agency for approval a management plan detailing operating techniques to minimise potential CO_2 phase changes, solid effects and dense gas behaviour when venting CO_2 atmosphere. This is included because the Operator's assessment assumes that CO_2 releases are (fully expanded) gas with no phase change and we, therefore, require the Operator to have plans in place to minimise the CO_2 phase changes, dense gas behaviour or incidents that could occur during the proposed venting operation.

5.6.2 Process effluent management

All process effluents generated by the CC plant will be treated and re-used within the Installation or tankered off-site for recovery or disposal. Therefore, there will be no discharges of process effluent to water or sewer.

Uncontaminated surface water run-off from the CC plant will be discharged via an on-site drainage system, at emission point W3. The surface water drainage systems will be fitted with a penstock valve to isolate the drainage systems in the event of an environmental incident/chemical spill. Surface water discharge points W1 and W2 have been relocated to accommodate the CC plant, but this has no material impact on the environmental risk posed by the facility.

6 Application of Best Available Techniques

6.1 Scope of Consideration

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

- are in accordance with the emerging techniques, or equivalent, for the carbon capture sector;
- are in accordance with Common Waste Water (CWW) and Waste Gas Treatment/Management Systems in the Chemical Sector BAT for the new waste water treatment plant;
- will continue to meet BAT for the incineration sector.

6.2 Post- combustion Carbon Dioxide Capture Emerging Techniques

We have reviewed the Application against the emerging techniques guidance for capture of CO_2: Post-combustion carbon dioxide capture: emerging techniques - GOV.UK (www.gov.uk).

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

6.3 Consideration of CWW BAT

We have reviewed the Application against the Common Waste Water and Waste Gas Treatment/Management Systems in the Chemical Sector (CWW) BAT. We have only considered CWW BAT for the new waste water treatment plant.

The Operator's response to each technique is set out in Annex 1B of this decision document together with our assessment of whether the Operator will be compliant with the relevant BAT.

6.4 Consideration of Waste Incineration BAT

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

6.4.1 Energy Efficiency

We have not re-visited the use of energy within the waste incineration 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 can affect the efficiency.

Energy efficiency is considered in detail in section 4.3.7 of this document.

We are satisfied that the operation of the Installation with the two PCC units fitted will still meet the BAT AEELs for incineration of waste.

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 incineration units following the deployment of PCC and abatement measures used to meet these limits will still be in place. Therefore, the limits already specified in table S3.1 of the Permit will remain in the varied Permit. In addition, the Operator is proposing to monitor emissions from the incineration plant at points before the carbon capture plant meaning no further correction for water, oxygen content or reduction in volume due to the removal of the CO_2 will be required. Therefore, the BAT AELs and ELVs for the incineration emissions remain as specified in the current Permit.

The Operator has provided information regarding where monitoring will take place to demonstrate compliance with the ELVs and BAT AELs from the waste incineration plant both with and without CO_2 capture (see section 6.9) 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 waste incineration.

6.4.3 BAT and emissions control

The prime function of flue gas treatment is to reduce the concentration of pollutants in the exhaust gas as far as practicable. The techniques which are described as BAT individually are targeted to remove specific pollutants, but the BREF notes that there is benefit from considering the Flue Gas Cleaning System (FGC) system as a whole unit. Individual units often interact, providing a primary abatement for some pollutants and an additional effect on others.

The Operator has stated that emission control measure at the Incineration plant have not changed with this Application. This includes a SNCR system, a semi-dry lime acid gas abatement system, and bag filters. The emission control measures at the Incineration plant will control emissions of pollutants going into the CC plant to ensure that there is not significant degradation of amine solution or creation of aerosols as well as ensuring that the BAT AELs and ELVs as specified in the Permit will be complied with. We are satisfied that the current controls on emissions will ensure compliance in accordance with BAT.

6.4.4 BAT and global warming potential

Our assessment of global warming and BAT options for the incineration plant remains unchanged from that assessed for application EPR/LP3132FX/A001.

6.5 Other Emissions to the Environment

6.5.1 Emissions to water and sewer

All process effluents generated by the CC plant will be treated and re-used within the Installation or tankered off-site for recovery or disposal. Therefore, there will be no discharges of process effluent to water or sewer.

Based upon the information in the Application we are satisfied that appropriate measures will be in place to prevent and /or minimise emissions to water and sewer.

6.5.2 Fugitive emissions

The IED specifies that plants must be able to demonstrate that the plant is designed in such a way as to prevent the unauthorised and accidental release of polluting substances into soil, surface water and groundwater. In addition storage requirements for waste and for contaminated water under Article 46(5) of the IED must be arranged.

The Operator has provided information regarding the storage and bunding of the raw materials that will be required for the operation of the CC plant. This is described in detail in section 4.2.2 of this document.

The Operator has stated that there will be no fugitive or point source emissions to air from the water treatment plant.

Based upon the information in the Application we are satisfied that appropriate measures will be in place to prevent and /or minimise fugitive emissions.

6.5.3 Noise and vibration

This application is to vary the existing permit to allow operation of a CC plant at the Installation. The CC plant will add additional noise sources at the Installation.

Based upon the information in the Application we are satisfied that the appropriate measures will be in place to prevent or where that is not practicable to minimise noise and vibration and to prevent pollution from noise and vibration outside the site.

The Application contained a noise impact assessment which identified local noise-sensitive receptors, potential sources of noise from the proposed plant and noise attenuation measures. Measurements were taken of the prevailing ambient noise levels to produce a baseline noise survey and an assessment was carried out in accordance with BS 4142:2014 to compare the predicted plant rating noise levels with the established background levels.

The Operator’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.

We audited the Operator’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.

6.6 Setting ELVs and other Permit conditions

6.6.1 Translating BAT into Permit conditions

Article 14(3) of the IED states that BAT-C shall be the reference for permit conditions. Article 15(3) further requires that under normal operating conditions; emissions do not exceed the emission levels associated with the BAT as laid down in the decisions on BAT-C.

BAT-C for waste incineration or co-incineration were published on 03/12/2019.

The use of BAT AELs and IED Chapter IV emission limits for air dispersion modelling sets the worst case scenario. If this shows emissions are insignificant then we have accepted that the applicant's proposals are BAT, and that there is no justification to reduce ELVs below the BAT AELs and Chapter IV limits.

Below we consider whether, for those emissions not screened out as insignificant, different conditions are required as a result of consideration of local or other factors, so that no significant pollution is caused (Article 11(c)) or to comply with environmental quality standards (EQS) (Article 18).

(i) Local factors

We have considered the location when assessing BAT, including proximity of human and ecological receptors, and one declared AQMA in Cheshire. We are satisfied that the BAT measures described will ensure a high level of protection for the environment and human health.

(ii) National and European ESs

We have assessed emissions against National and European environmental quality standards, determining that the Installation can comply without requiring stricter conditions than BAT.

(iii) Global Warming

CO_2 is an inevitable product of the combustion of waste. The amount of CO_2 produced by the incineration plant will be essentially determined by the quantity and characteristics of waste being incinerated, which are already subject to conditions in the Permit. It is therefore inappropriate to set an ELV for emissions from the incineration plant for CO_2, which could do no more than recognise what is going to be emitted. The gas is not therefore targeted as a key pollutant under Annex II of the IED, which lists the main polluting substances that are to be considered when setting ELVs in permits.

We have therefore not considered setting equivalent parameters or technical measures for CO_2. However, provided energy is recovered efficiently (see section 4.3.7 above), there are no additional equivalent technical measures (beyond those relating to the quantity and characteristics of the waste) for the incineration plant that can be imposed that do not run counter to the primary

purpose of the plant, which is the destruction of waste. Controls in the form of restrictions on the volume and type of waste that can be accepted at the Installation and Permit conditions relating to energy efficiency effectively apply equivalent technical measures to limit CO_2 emissions.

There is no legal requirement for an operator to use a carbon capture plant to abate their CO_2 emissions. However, where an operator proposes to install one, there are measures we can require to ensure its performance is maximised. Our current guidance states that operators should design carbon capture plants to achieve a CO_2 capture rate of at least 95% during normal operating conditions and we have set this as an equivalent measure in the varied Permit through IC17.

(iv) Commissioning

We have set pre-operational condition POM3 for the Operator to produce commissioning plans for commissioning of the CC plant. The plan must be reviewed and approved by the Environment Agency before commissioning can begin.

Improvement conditions IC3 and IC16 require collection of data throughout the commissioning process and submission of a summary report of the environmental performance during commissioning to demonstrate that the plant performs in accordance with the Permit conditions. The Operator must demonstrate that design parameters assessed within the Applications EPR/LP3132FX/A001 to EPR/LP3132FX/V009 and updated in response to the pre-operational conditions in this permit have been met.

6.7 Monitoring

6.7.1 Monitoring during normal operations

We have decided that monitoring should be carried out for the parameters listed in Schedule 3 using the methods and to the frequencies specified in those tables. These monitoring requirements have been imposed in order to demonstrate compliance with ELVs and to enable correction of measured concentration of substances to the appropriate reference conditions. In addition, monitoring will enable the gathering of information about the performance of the SNCR system; establishing of data on the release of dioxin-like PCBs and PAHs from the incineration process, the delivery of the requirements of Chapter IV of the IED for monitoring of residues and temperature in the combustion chamber, and provide data regarding the quantity of CO_2 captured in order for the Operator to determine the capture rate of the CC plant.

For emissions to air, the methods for continuous and periodic monitoring are required to be in accordance with our guidance for monitoring of stack emissions to air where methods are available.

Based on the information in the Application and the requirements set in the conditions of the varied Permit we are satisfied that the Operator's techniques, personnel and equipment will have either MCERTS certification or MCERTS accreditation as appropriate.

6.8 Reporting

We have specified the reporting requirements in Schedule 4 of the varied Permit either to meet the reporting requirements set out in the IED, or to ensure data is reported to enable timely review by us to ensure compliance with the Permit conditions and to monitor the efficiency of material use, energy recovery at the Installation and the efficiency of the CC plant in capturing CO_2.

7 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.

7.1 The EPR 2016 and related Directives

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

7.1.1 Schedules 1 and 7 to the EPR 2016 – **IED Directive**

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 planning application
- The decision of the Cheshire West and Chester Council to grant planning permission on 03/09/2024.
- The response of the Environment Agency to the local planning authority in its role as consultee to the planning process.

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

7.1.2 Schedule 9 to the EPR 2016 – **Waste Framework Directive**

As the Installation involves the treatment of waste, it is carrying out a *waste operation* for the purposes of the EPR 2016, and the requirements of Schedule 9 therefore apply. This means that we must exercise our functions so as to ensure implementation of certain articles of the WFD.

We must exercise our relevant functions for the purposes of ensuring that the waste hierarchy referred to in Article 4 of the Waste Framework Directive is applied to the generation of waste and that any waste generated is treated in accordance with Article 4 of the Waste Framework Directive. (See also section 4.3.9)

The conditions of the varied Permit ensure that waste generation from the facility is minimised. Where the production of waste cannot be prevented it will be recovered wherever possible or otherwise disposed of in a manner that minimises its impact on the environment. This is in accordance with Article 4.

We must also exercise our relevant functions for the purposes of implementing Article 13 of the Waste Framework Directive; ensuring that the requirements in the second paragraph of Article 23(1) of the Waste Framework Directive are met; and ensuring compliance with Articles 18(2)(b), 18(2)(c), 23(3), 23(4) and 35(1) of the Waste Framework Directive.

Article 13 relates to the protection of human health and the environment. These objectives are addressed elsewhere in this document.

Article 23(1) requires the varied Permit to specify:

(a) the types and quantities of waste that may be treated;
(b) for each type of operation permitted, the technical and any other requirements relevant to the site concerned;
(c) the safety and precautionary measures to be taken;
(d) the method to be used for each type of operation;
(e) such monitoring and control operations as may be necessary;
(f) such closure and after-care provisions as may be necessary.

These are all covered by permit conditions.

The permit does not allow the mixing of hazardous waste so Article 18(2) is not relevant.

We consider that the intended method of waste treatment is acceptable from the point of view of environmental protection so Article 23(3) does not apply.

Energy efficiency is dealt with elsewhere in this document but we consider the conditions of the permit ensure that the recovery of energy take place with a high level of energy efficiency in accordance with Article 23(4).

Article 35(1) relates to record keeping and its requirements are delivered through permit conditions.

7.1.3 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 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.

7.1.4 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 has been consulted upon in line with this statement, This satisfies the requirements of the Public Participation Directive.

The way in which this has been done is set out in Section 2. A summary of the responses received to our consultations and our consideration of them is set out in Annex 2.

7.2 National primary legislation

7.2.1 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 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 Permit.

(iv) Section 6(6) (Fisheries)

We have a duty to maintain, improve and develop fisheries of salmon, trout, eels, lampreys, smelt and freshwater fish.

We consider that no additional or different conditions are appropriate for this Permit.

(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 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 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 Permit.

7.2.2 **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.

7.2.3 **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.

7.2.4 **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.

7.2.5 **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 Installation.

7.2.6 **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 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 5.4 of this document. A copy of the full Appendix 4 Assessment can be found on the public register.

7.2.7 **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 permit application determination and, consider that no different or additional conditions are required in the permit.

7.2.8 **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 Permit are required.

7.2.9 **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.

We have done so and consider that no different or additional conditions in the Permit are required. There is no National Park which could be affected by the Installation.

7.2.10 **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.

7.3 National secondary legislation

7.3.1 **Conservation of Habitats and Species Regulations 2017**

We assessed the Application in accordance with our guidance and 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.

We consulted Natural England on the appropriate assessment, and they agreed with our conclusion, that the operation of the Installation would not have adverse effects on the interest features of European sites.

The Habitats Regulations Assessment is summarised in greater detail in section 5.4 of this document. A copy of the Habitats Regulations Assessment 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 permit in terms of these duties but concluded that we should not.

7.4 Other relevant legal requirements

7.4.1 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 section 2.2 of this document. The way in which we have taken account of the representations we have received is set out in Annex 4. Our public consultation duties are also set out in the EP Regulations, and our statutory Public Participation Statement, which implement the requirements of the Public Participation Directive.

Annexes

Annex 1A: Compliance with guidance: Post-combustion carbon dioxide capture (PCC) emerging techniques

Reference*	Guidance	Operator's Proposals	Compliant Y/N
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 plant and of the supply of heat for the associated PCC plant.	The CC plant is being retro-fitted to a permitted waste incineration plant. The Operator has considered the energy efficiency, heat utilisation and electrical output penalty for the Incineration plant in the selection of the PCC system and the Application states that the thermal efficiency of the Incineration plant and CC plant will be maximised. The Operator has stated that the gross net electrical output of the Installation reduces by 13.8 MWe with the operation of the CC plant, which results in a gross electrical efficiency drop from 33.1% to 30.5 %, and gross energy efficiency of 88.4%. This puts gross electrical efficiency of the Installation in the middle but gross energy efficacy at the higher end of the BAT AEELs for waste incineration plant as set out in the WI BAT Conclusions.	Y
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 primary purpose of the Installation is to treat waste. Therefore, it needs to be able to be operated continuously. The Operator states that the CC plant has been designed so that the Incineration plant can operate independently and efficiently during periods of power only mode.	Y

Reference*	Guidance	Operator's Proposals	Compliant Y/N
	CHP plants and EfW plant are not expected to be dispatchable, but some variation in output is likely. However, they may not be able to meet the requirements for good quality CHP over periods when electrical output is constrained. The design of the plant may be changed to help variable operation, possibly with a slight impact on full load thermal efficiency. Where you plan to install CO_2 capture onto a CHP plant, you must design the plant so that it can operate efficiently during periods of power only mode. The primary purpose of an EfW plant is to treat waste. Therefore, they need to operate continuously. The PCC plant design and operation must be compatible with this.		
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	The Operator states that the heat and electricity for the CC plant will be supplied from the Incineration plant. High pressure steam will be drawn from the Incineration plant and expanded through a back pressure turbine to the pressure required for the reboiler. Heat for reheating the flue gas will be drawn from the hot condensate generated in the reboiler. The waste incinerator does not currently supply heat for district heating, so this has not been considered further.	Y

Reference*	Guidance	Operator's Proposals	Compliant Y/N
	should consider using heat pumps or other plant to reduce the amount of steam required to meet that heat demand.		
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 Operator has stated that the CC plant has been designed for a minimum CO_2 capture rate of 95% under normal operation.	Y
	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 Operator has stated that CO_2 will be conditioned and compressed so that it can be delivered at the parameters required by the CO_2 transport network provider. The Operator states that to remove oxygen, the captured CO_2 will be dosed with hydrogen in the presence of a catalyst. The water that will form in this process will be removed in the silica gel dryers.	Y
	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 confirm this using: • atmospheric dispersion and reaction modelling tools • specific site parameters which will define plant-specific ELVs	The Operator 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. Relevant ELVs are set in the varied Permit.	Y

Reference*	Guidance	Operator's Proposals	Compliant Y/N
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 Operator proposes to use a monoethanolamine (MEA), a primary amine, based solvent due to the low formation rate of degradation products and high availability of information on the solvent properties.	Y
	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	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

Reference*	Guidance	Operator's Proposals	Compliant Y/N
	• formation of further additional substances in the atmosphere from emissions from the PCC system		
	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 Operator states that the amine solvent will be recycled via thermal reclamation. The reclaimer waste will be transferred off-site for recovery or disposal at a suitably licensed waste treatment facility.	Y
	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 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.	The Operator proposes to use a monoethanolamine (MEA), a primary amine, based solvent. There is high availability of information on the solvent properties and performance in public domain.	Y
3.3 Features to control and minimise atmospheric and other emissions			
3.3.1 Flue gas cleaning	SOx and HCl 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.	The Operator states that the Incinerator plant includes a SNCR system, a semi-dry lime acid gas abatement system, and bag filters. They state that this will control emissions of pollutants going into the CC plant to ensure that there is not significant degradation of the amine solution or creation of aerosols. The CC plant will include a water wash and an acid wash which will ensure effective removal of amines, ammonia and other basic species emissions to very low levels.	Y

Reference*	Guidance	Operator's Proposals	Compliant Y/N
	SOx levels in the existing flue gases from an amine PCC plant will be expected to be at extremely low levels.	Demisters will be included in the absorber column to remove sulphur trioxide droplets and fine particulates as they can cause significant amine emissions. The temperature in the solvent stripping process will be controlled and solvent residence time in the absorber sump will be limited.	
	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 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.		
	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		

Reference*	Guidance	Operator's Proposals	Compliant Y/N
	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 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.		
	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.	The Operator proposes to use a monoethanolamine (MEA), a primary amine, based solvent. There is high availability of information on the solvent properties and performance in public domain. The Operator states that the Incinerator plant includes a SNCR system, a semi-dry lime acid gas abatement system, and bag filters. This will control emissions of pollutants going into the CC plant to ensure that there is not significant degradation of amine solution or creation of aerosols.	Y
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.	The Operator states that the temperature in the solvent stripping process will be controlled and solvent residence time in the absorber sump will be limited.	Y

Reference*	Guidance	Operator's Proposals	Compliant Y/N
	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 result in degradation.		
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.		
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).	The Operator states that the CC plant includes a water wash and an acid wash which will ensure effective removal of amines, ammonia and other basic species emissions to very low levels.	Y
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 m^3 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 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 NH_3 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		

Reference*	Guidance	Operator's Proposals	Compliant Y/N
	• 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.	The Operator states that the CC plant will include demisters in the absorber column to remove sulphur trioxide droplets and fine particulates.	Y
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 Operator states that the stack height for the CC plant has been optimised. Detailed dispersion modelling showed that the temperature of the release has a significant effect on the level of dispersion of emissions, therefore the temperature of the emissions from the CC plant have been increased by including flue gas reheating. The stack height proposed (105 m) is taller than the existing Incinerator plant stacks and the highest which would be installed without significant civils works.	Y
3.4 Process and emissions monitoring			
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.	A continuous emissions monitoring system (CEMS) will be located at both the outlet of the Incinerator stacks (upstream of the CC plant) and at the outlet of the CC plant. The CEMS at the outlet of the Incinerator will monitor for all the parameters listed in the existing EP. This will be used to demonstrate compliance with the EP requirements and to control the system to minimise the formation of solvent degradation products. The proportion of biogenic CO_2 will also be monitored at the outlet of the Incinerator, in compliance with the	Y

Reference*	Guidance	Operator's Proposals	Compliant Y/N
	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.	requirements of the Waste Industrial Carbon Capture contract. A range of methods for monitoring the process will be carried out, this will be used to show that resources are being used efficiently. These methods will include energy and resource efficiency, capture efficiency, and verification that the CO_2 is suitable for safe transport and storage. A monitoring plan for the commissioning phase and routine operation will be developed. Where appropriate monitoring will meet the MCERTS standards, and any lab used will be UKAS accredited.	
	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.	The Operator states that a monitoring plan for the commissioning phase and routine operation will be developed before commencement of commissioning of the CC plant.	Y
	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.	CEMS is included at the outlet of the Incinerator and will be included at the outlet of the CC plant. This will be used to demonstrate compliance with the EP requirements and to control the system to minimise the formation of solvent degradation products.	Y
	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 quality of the solvent will be monitored within the absorber column. Amine loading will be kept constant to ensure process stability and to reduce the formation of degradation products. This will be achieved by varying the solvent flow rates based on the measurement of the incoming gas, particularly concentration of CO_2 and flue gas flow rate.	Y POM5 is included in the Permit to confirm methodology for amine solvent monitoring. IC18 is included

Reference*	Guidance	Operator's Proposals	Compliant Y/N
			in the Permit to review how solvent degradation effects the performance of the plant over time and to review the options for reducing the rate of solvent degradation.
3.4.2 Point source emissions to air	You must include monitoring to demonstrate compliance with: • IED Chapter IV • 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	CEMS is included at the outlet of the Incinerator and will be included at the outlet of the CC plant. This will be used to demonstrate compliance with the EP requirements. To demonstrate compliance with WI BREF BAT AELs, monitoring will be done at monitoring points located between the incineration plant and the CC plant. In addition to this, monitoring of the flue gases at Absorber stacks prior to release to atmosphere will be as follows: • Continuous monitoring: ammonia • Periodic monitoring: primary amines, secondary amines, nitrosamines, nitramines, and aldehydes.	Y POM8 is included in the Permit to address changes to monitoring locations before commissioning of the CC plant.
	Emission sampling point must also comply with M1 sampling requirements for stack emission monitoring.	The Operator has confirmed that the sampling locations have been designed to meet BS EN 15259 clause 6.2 and 6.3.	Y

Reference*	Guidance	Operator's Proposals	Compliant Y/N
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 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	The design of the CC plant will incorporate aspects of process monitoring, these will include the quality of the solvent within the absorber column. Solvent quality will be measured by several methods: – gas chromatography to determine the composition of the solvent; – visual inspection of the solvent to determine solvent colour, which is a key indicator of the presence of degradation products; – periodic sampling of both the rich and lean solvent; and – measurement of the solvent density to determine amine loading and the presence of degradation products, heavy metals and soluble iron, using Coriolis type flowmeters in conjunction with chromatography. Water condensed from the water and acid washes will be managed by measuring the level of holdup in the wash, and bleeding water from the cooling water tank back into the absorber, with a percentage blown down to control the build-up of pollutants within the water.	Y
3.4.4 Monitoring of CO_2	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 CC plant control system will measure the CO_2 content at the inlet and outlet of the CC plant as well as the inlet and outlet flowrate, allowing for calculation of the mass flowrate and capture rate of CO_2. A CO_2 analyser will continuously monitor to assess the quality of the CO_2	Y IC17 is included in the Permit to confirm that the CC plant is operating at the designed capture rate. Requirements for monitoring

Reference*	Guidance	Operator's Proposals	Compliant Y/N
			and reporting CO_2 vented to the environment are included in the Permit.
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 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.	Where appropriate monitoring will meet the MCERTS standards, and any lab used will be UKAS accredited.	Y
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 Operator has stated that a leak detection and repair programme will be developed.	Y
3.6 Capture level, including during	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	The Operator has stated that the CC plant has been designed for a minimum CO_2 capture rate of 95% under normal operation and will operate continuously when the Incineration plant is in steady state normal operation.	Y

Reference*	Guidance	Operator's Proposals	Compliant Y/N
flexible operation	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.		
	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 Operator has stated that whilst consideration will be given to capturing CO_2 during start-up and shut-down of the Incineration plant, due to a lack of available heat and electricity for stable operation of the CC plant it is unlikely that the capture plant will be put into service prior to stable operation of the Incineration plant. In addition, the Incineration plant combusts a different fuel during start up and shutdown events, which produces a flue gas for which the CC plant will not be designed or optimised. Incineration plants tend to operate continuously with fairly infrequent shut-downs.	
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 Operator has stated that detailed CO_2 compression design will be developed by a contractor during the FEED and design stages of the project. The compressor will be of multistage design and will include intercooling to increase efficiency.	Y
3.8 Noise and odour 14.2	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.	The Operator submitted a noise assessment with the Permit variation Application and concluded that noise impact from the varied installation can be considered 'not significant'.	Y

Reference*	Guidance	Operator's Proposals	Compliant Y/N
	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 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 Operator has stated that an odour management plan will be implemented as part of the environmental management system for the Incineration plant and the CC plant.	Y
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 • pressurised capture process – smaller volumes of gases	The Operator is not using this capture process.	NA

Reference*	Guidance	Operator's Proposals	Compliant Y/N
	• 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	The Operator has stated that cooling will be carried out by a mixture of dry air coolers and hybrid wet-dry cooling towers to minimise electricity requirements and water discharge.	Y
	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	The incineration plant uses an air cooled condenser system so no opportunities to share cooling water	Y

Reference*	Guidance	Operator's Proposals	Compliant Y/N
	specific water discharge temperature limits may be an issue for direct cooling.		
	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	Outgoing flue gas will be reheated using hot condensate from the reboiler to aid dispersion of the flue gas	Y
	Lean and rich solvent storage may also help you achieve satisfactory PCC performance during periods of high cooling demand.	The Operator has stated that cooling will be carried out by a mixture of dry air coolers and hybrid wet-dry cooling towers to minimise electricity requirements and water discharge and has not considered the use of lean and rich solvent storage.	N/A
	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.	The Operator has stated that cooling will be carried out by a mixture of dry air coolers and hybrid wet-dry cooling towers to minimise electricity requirements and water discharge.	Y
5. Discharge to water	For discharges to water, you should refer to the 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'.	The Operator has stated that there will be no discharges of process effluent to water from the CC plant, with all process effluents being treated prior to re-use within the Incineration plant or the CC plant or transferred off-site for recovery or disposal at a suitably licensed waste treatment facility. The only discharges to water from the CC plant will be uncontaminated surface water run-off.	Y
***** The reference number corresponds with the numbering as set out in the Post-combustion carbon dioxide capture: emerging techniques - GOV.UK (www.gov.uk)			

Annex 1B: Compliance with CWW BAT Conclusions for the waste water treatment plant

BAT conclusion	BAT requirement	Applicants Proposals	Compliant Y/N
1	In order to improve the overall environmental performance, BAT is to implement and adhere to an environmental management system (EMS) that incorporates all of the features as set out in the BREF.	An IMS (integrated management system) incorporating environmental management is being established by Encyclis for the Installation. The IMS will be extended to include the operation of the CC plant.	Y
2	In order to facilitate the reduction of emissions to water and air and the reduction of water usage, BAT is to establish and to maintain an inventory of waste water and waste gas streams, as part of the environmental management system (see BAT 1), that incorporates all of the techniques set out in the BREF.	An inventory of waste water and waste gas streams will be developed a part of the design process for the water treatment plant. This will be reviewed and updated throughout the design process, and maintained as part of the EMS for the CC plant when it is operational.	Y
3	For relevant emissions to water as identified by the inventory of waste water streams (see BAT 2), BAT is to monitor key process parameters (including continuous monitoring of waste water flow, pH and temperature) at key locations (e.g. influent to pretreatment and influent to final treatment).	At each waste water generation, and/or treatment step, the key process parameters will be monitored. On this basis,	Y
4	BAT is to monitor emissions to water in accordance with EN standards with at least the minimum frequency given below. If EN standards are not available, BAT is to use ISO, national or other international standards that ensure the provision of data of an equivalent scientific quality.	There are no emissions to water from the water treatment plant, as the treated effluent is re-used within the Installation.	NA
5	BAT is to periodically monitor diffuse VOC emissions to air from relevant sources by using an appropriate combination of the techniques I – III or, where large amounts of VOC are handled, all of the techniques I – III.	There are no diffuse emissions to air from the water treatment plant.	NA
6	BAT is to periodically monitor odour emissions from relevant sources in accordance with EN standards.	There are no diffuse emissions to air from the water treatment plant.	NA
7	In order to reduce the usage of water and the generation of waste water, BAT is to reduce the volume and/or pollutant load of waste water streams,	The process effluent treatment plant has been designed to maximise the re-use of water, to reduce water usage	Y

BAT conclusion	BAT requirement	Applicants Proposals	Compliant Y/N
	to enhance the reuse of waste water within the production process and to recover and reuse raw materials.	and result in the CC plant having no discharges to water. On this basis,	
8	In order to prevent the contamination of uncontaminated water and to reduce emissions to water, BAT is to segregate uncontaminated waste water streams from waste water streams that require treatment.	Surface water run-off from the CC plant will be collected separately to condensate from the DCC.	Y
9	In order to prevent uncontrolled emissions to water, BAT is to provide an appropriate buffer storage capacity for waste water incurred during other than normal operating conditions based on a risk assessment (taking into account e.g. the nature of the pollutant, the effects on further treatment, and the receiving environment), and to take appropriate further measures (e.g. control, treat, reuse).	There will be no process effluent discharge from the facility as all waste water streams will be re-used within the Installation. To accommodate changes in operating conditions a process water tank will be provided to provide buffer storage.	Y
10	In order to reduce emissions to water, BAT is to use an integrated waste water management and treatment strategy that includes an appropriate combination of the techniques set out the BREF in the priority order given.	The Incineration plant is designed to minimise the concentrations of pollutants which are contained within the flue gases, and subsequently precipitated out of the flue gases within the DCC. The philosophy of re-using waste water streams within the Installation is in line with the BAT requirements.	Y
11	In order to reduce emissions to water, BAT is to pretreat waste water that contains pollutants that cannot be dealt with adequately during final waste water treatment by using appropriate techniques.	There are no process effluent emissions to water, with all treated effluents being re-used within the Installation.	NA
12	In order to reduce emissions to water, BAT is to use an appropriate combination of final waste water treatment techniques as set out within the BREF.	There are no process effluent emissions to water, with all treated effluents being re-used within the Installation.	NA
13	In order to prevent or, where this is not practicable, to reduce the quantity of waste being sent for disposal, BAT is to set up and implement a waste management plan as part of the environmental management system (see BAT 1) that, in order of priority, ensures that waste is prevented, prepared for reuse, recycled or otherwise recovered.	Encyclis can confirm that it will set up and implement a waste management plan as part of the environmental management system for the Facility. The design of the water treatment plant enables all waste water generated by the CC plant to be re-used, and the overall installation to be a ‘zero discharge’ facility.	Y

BAT conclusion	BAT requirement	Applicants Proposals	Compliant Y/N
14	In order to reduce the volume of waste water sludge requiring further treatment or disposal, and to reduce its potential environmental impact, BAT is to use one or a combination of the techniques as set out within the BREF.	The water treatment plant will not generate a sludge requiring further treatment of disposal.	NA
15	In order to facilitate the recovery of compounds and the reduction of emissions to air, BAT is to enclose the emission sources and to treat the emissions, where possible.	There are no fugitive or point source emissions to air from the water treatment plant.	NA
16	In order to reduce emissions to air, BAT is to use an integrated waste gas management and treatment strategy that includes process-integrated and waste gas treatment techniques.	There are no fugitive or point source emissions to air from the water treatment plant.	NA
17	In order to prevent emissions to air from flares, BAT is to use flaring only for safety reasons or non-routine operational conditions (e.g. start-ups, shutdowns) by using one or both of the techniques set out in the BREF.	There are no fugitive or point source emissions to air from the water treatment plant.	NA
18	In order to reduce emissions to air from flares when flaring is unavoidable, BAT is to use one or both of the techniques set out in the BREF.	There are no fugitive or point source emissions to air from the water treatment plant.	NA
19	In order to prevent or, where that is not practicable, to reduce diffuse VOC emissions to air, BAT is to use a combination of the techniques set out in the BREF.	There are no fugitive or point source emissions to air from the water treatment plant.	NA
20	In order to prevent or, where that is not practicable, to reduce odour emissions, BAT is to set up, implement and regularly review an odour management plan, as part of the environmental management system (see BAT 1), that includes all of the elements set out in the BREF.	The Operator will set up and implement an odour management plan as part of the environmental management system for the Incineration plant and the CC plant, which will include the water treatment plant.	Y
21	In order to prevent or, where that is not practicable, to reduce odour emissions from waste water collection and treatment and from sludge treatment, BAT is to use one or a combination of the techniques set out in the BREF.	The effluent treated within the water treatment plant will not contain putrescible contaminants. Therefore, the water treatment plant will not result in odours.	NA
22	In order to prevent or, where that is not practicable, to reduce noise emissions, BAT is to set up and implement a noise management plan, as	The Operator will set up and implement a noise management plan as part of the environmental	Y

BAT conclusion	BAT requirement	Applicants Proposals	Compliant Y/N
	part of the environmental management system (see BAT 1), that includes all of the elements set out in the BREF.	management system for the Incinerator plant and the CC plant, which will include the water treatment plant.	
23	In order to prevent or, where that is not practicable, to reduce noise emissions, BAT is to use one or a combination of the techniques set out in the BREF.	A noise assessment has been submitted with the application, (Appendix E of the Support document, Noise assessment, Report No. 103036 Version 3). As concluded within the noise assessment, the noise impacts associated with the implementation of the CC plant will be 'not significant'.	Y

Annex 2: Pre-Operational Conditions

Based on the information in the Application, we consider that we do need to impose pre-operational measures for operation of the CC plant. These conditions are set out below and 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 CC plant.

Table S1.4B Pre-operational measures for future development		
Reference	**Operation**	**Pre-operational measures**
POM1	Commissioning of the carbon capture plant	**Storage and secondary containment** At least 3 months prior to the commencement of commissioning of the carbon capture plant, the Operator shall submit a written report to the Environment Agency for assessment and written approval. The report must contain: • Detailed design for all containment structures which contain relevant hazardous substances including tanks and pipework as well as secondary and tertiary containment where required. The Operator must implement the proposals in the report as agreed with the Environment Agency's written approval.
POM2	Commissioning of the carbon capture plant	**Pollution prevention measures** At least 3 months prior to the commencement of commissioning of the carbon capture plant, the Operator shall submit a written plan to the Environment Agency for assessment and written approval. The plan must contain: • Pollution prevention measures including inspection and maintenance plans and procedures around the storage and use of all chemicals identified as relevant hazardous substances in the Stage 1-3 assessment of the Site Condition Report. The Operator must implement the proposals in the report as agreed with the Environment Agency's written approval.
POM3	Commissioning of the carbon capture plant	**Commissioning plan** At least 3 months prior to the commencement of commissioning of the carbon capture plant, the Operator shall submit a written commissioning plan, including timelines for completion, for assessment and written approval by the Environment Agency. The commissioning plan shall include, but not be limited to:

Table S1.4B Pre-operational measures for future development		
Reference	**Operation**	**Pre-operational measures**
		• 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.
POM4	Commissioning of the carbon capture plant	**<u>Process effluent monitoring</u>** At least 3 months prior to the commencement of commissioning of the carbon capture plant, the operator shall submit a written procedure to the Environment Agency for approval. The written procedure shall include: • A plan for routine effluent sampling and monitoring to confirm the hazard status of each individual effluent stream (flue gas quench blowdown, ultra filtration effluent and ion exchange effluent) that is proposed to be mixed with incinerator bottom ash (IBA). • Details of how an effluent stream will be separately disposed of (without mixing with the IBA) if monitoring results show it is hazardous. The Operator must implement the proposals in the procedure as agreed with the Environment Agency's written approval.

Table S1.4B Pre-operational measures for future development		
Reference	**Operation**	**Pre-operational measures**
		Effluents shall not be added to the IBA until written approval has been provided by the Environment Agency.
POM5	Commissioning of the carbon capture plant	**Process monitoring methods** Following the completion of the final design of the installation and at least 6 months prior to the commencement of commissioning of the carbon capture plant, the Operator shall submit to the Environment Agency for assessment and written approval proposed methodologies for the following process monitoring requirements for absorber amine solvent quality as required in table S3.3 of this permit: • Percent active amine (MEA). • Carbon dioxide loading (rich amine). • Heat stable salts. • Soluble iron concentration (rich and lean amine). • Colour.
POM6	Commissioning of the carbon capture plant	**CO_2 assessment** Following the completion of the final design of the installation and at least 12 months prior to the commencement of commissioning of the carbon capture plant, the Operator shall submit to the Environment Agency for assessment and written approval: • A report that validates the assumptions used in the CO_2 venting emissions to air risk assessment presented in the application EPR/LP3132FX/V009. • If any of the input parameters to the CO_2 venting assessment are different to those assumed in the assessment submitted in variation V009, the Operator shall submit an updated assessment of the impact of CO_2 emissions on human health from the short duration venting that may be required during the start-up sequence of the carbon capture plant, during other than normal operating conditions and plant commissioning. The assessment shall be carried out in accordance with environmental risk assessment methodology set out in Environment Agency guidance https://www.gov.uk/guidance/air-emissions-risk-assessment-for-your-environmental-permit and Environmental permitting: air dispersion modelling reports - GOV.UK (www.gov.uk). The assessment must show that CO_2 concentrations at locations of public exposure are below the levels at which onset of symptoms and effects are reported. • A management plan detailing operating techniques to minimise potential CO_2 phase changes, solid effects

Table S1.4B Pre-operational measures for future development		
Reference	**Operation**	**Pre-operational measures**
		and dense gas behaviour when venting CO_2 to atmosphere. The Operator must implement the proposals in the plan in line with the Environment Agency's written approval.
POM7	Commissioning of the 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 the carbon capture plant, the Operator shall submit to the Environment Agency for assessment and written approval a post combustion carbon capture (PCC) 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.
POM8	Commissioning of the carbon capture plant	**Monitoring standards** At least six months before (or other date agreed in writing with the Environment Agency) the commencement of commissioning of the carbon capture plant, the Operator shall submit a written report 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 Installation's emission points to comply with EN 15259 and Environment Agency guidance notes on monitoring stack emissions measuring locations, techniques and standards for periodic monitoring and TGN M20 for quality assurance of CEMS. The report shall include the following: • Details of monitoring locations, access and working platforms.

Table S1.4B Pre-operational measures for future development		
Reference	**Operation**	**Pre-operational measures**
		• 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.
POM9	Commissioning of the carbon capture plant	**Site condition report** Prior to the commencement of commissioning of the carbon capture plant, the Operator shall update the Site Condition Report (to cover the whole Installation), supplementary to that already provided in response to PO7 and PO14 to provide adequate information to meet the information requirements of Article 22(2) of the IED.

Annex 3: Improvement Conditions

Based in the information in the Application we consider that we need to set additional improvement conditions. These conditions are set out below - justifications for these is provided in the relevant section of the decision document. We are using these conditions to require the Operator to provide the Environment Agency with details that need to be established or confirmed during and/or after commissioning of the Incineration plant and/or CC plant.

Table S1.3 Improvement programme requirements		
Reference	**Requirement**	**Date**
IC8b	The Operator shall submit a written summary report to the Environment Agency to confirm the results of calibration and verification testing that the performance of Continuous Emission Monitors for parameters as specified in Table S3.1 and Table S3.1(a) complies 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 the carbon capture plant. Full summary evidence compliance report to be submitted within 18 months of completion of commissioning of the carbon capture plant.
IC15	**Monitoring standards** During commissioning, the operator shall carry out tests to assess whether the air monitoring location(s) meet the requirements of BS EN 15259 and supporting Method Implementation Document (MID). A written report shall be submitted for approval setting out the results and conclusions of the assessment including where necessary proposals for improvements to meet the requirements. The report shall specify the design of the ports for PM10 and PM2.5 sampling. 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 Agency within 3 months of completion of commissioning of the carbon capture plant.

Table S1.3 Improvement programme requirements		
Reference	**Requirement**	**Date**
IC16	**Commissioning of the carbon capture plant** The Operator shall submit a written report to the Environment Agency for assessment and written approval on the commissioning of carbon capture plant. The report shall summarise the environmental performance of the plant as set out in the commissioning plan required by pre operational condition POM3 in table S1.4B of this permit. The report shall include: • a summary of the environmental performance of the carbon capture plant as installed against the design parameters and risk assessments set out in the application EPR/LP3132FX/V009 and updated in response to the pre-operational conditions in this permit; • a review of the performance 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 confirm that the Environmental Management System (EMS) has been updated accordingly.	Within 6 months of the completion of commissioning of the carbon capture plant.
IC17	**Carbon capture efficiency** The Operator shall submit a written report to the Environment Agency for assessment and 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 POM3 in table S1.4B of this permit) averaged over one year of operation as specified in table S3.3 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 to the Environment Agency for approval designed to improve capture efficiency, or; • provide a written justification to the Environment Agency that a 95% capture rate is not reasonably achievable and that no further remedial action is to be taken.	Within 15 months of the completion of commissioning of the carbon capture plant.
IC18	**Amine solvent degradation** The Operator shall submit a written report to the Environment Agency for assessment and written approval on the degradation of absorber solvent quality. The report shall review the findings from the monitoring of absorber	Within 15 months from the completion of commissioning of the carbon capture plant.

Table S1.3 Improvement programme requirements		
Reference	**Requirement**	**Date**
	solvent quality over 12 months of operation, including but not limited to, the monitoring carried out in accordance with table S3.3 of this permit. The report shall include: • an investigation into the reasons for solvent degradation and how degradation effects 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.	
IC19	**Air emissions risk assessment (Carbon capture plant)** The Operator shall submit a written report to the Environment Agency for technical assessment and written approval. The report must contain an emissions to air risk assessment in line with Environment Agency's guidance which is based on sampled and monitored emissions data from emission points A5 and A6 in table S3.1. 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/LP3132FX/V009. For those 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, an assessment shall be made of the impact to human health and 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.	Within 15 months of commencement of operation of the carbon capture plant.
IC20	**Commencement of bi-annual monitoring** The Operator shall submit a written report to the Environment Agency for assessment and written approval with reference to the monitoring requirements set in table S3.1 of this permit for emissions from the absorber tower stacks (points A5 and A6). The report must contain:	After at least 12 months of operation and then at least 3 months prior to the proposed start of bi-annual monitoring at A5 and A6.

Table S1.3 Improvement programme requirements		
Reference	**Requirement**	**Date**
	• the results of tests carried out for species to be considered for bi-annual monitoring • assessment of the results and conclusions of the assessment • proposals to change monitoring to bi-annual The proposals shall be implemented in accordance with the Environment Agency's written approval.	

Annex 4: Consultation Reponses

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 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 10/01/2024 to 07/02/2024. The Application was made available to view on the Environment Agency's Public Register.

The following statutory and non-statutory bodies were consulted:

- Cheshire West and Chester Environmental Protection Department
- Food Standards Agency
- The Health and Safety Executive
- UK Health Security Agency
- National air traffic services (NATS)
- Liverpool John Lennon Airport operator
- National Grid

1) Consultation Responses from Statutory and Non-Statutory Bodies

No concerns were raised by the consulted statutory and non-statutory bodies.

Response Received from UK Health Security Agency (18/02/2024)	
Brief summary of issues raised:	**Summary of action taken / how this has been covered**
Based on the information contained in the application supplied to us, UKHSA has no significant concerns regarding the risk to the health of the local population from the installation.	No action required.

Response Received from National air traffic services (NATS) (11/01/2024)	
Brief summary of issues raised:	**Summary of action taken / how this has been covered**
NATS anticipates no impact and has no comments to make on the Application.	No action required.

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

No consultation responses were received from members of public or community organisations during consultation period.

3) Representations from local MP, councillors and parish/town community councils

No responses received.

4) Representations from community and other organisations

Representation was received from UKWIN on 30/08/2024. The issues raised are listed below:

Brief summary of issues raised:	Summary of action taken / how this has been covered
Potential cumulative impacts on human health from amines and their degradation products, due to proximity of multiple PCC plants, based on the Sustainable operation of post-combustion capture plants (SCOPE) report: ''Human Health hazard assessment strategy for amine emissions around PCC facilities'', issued on 09.11.2022.	We have carried out a review of the air impact assessment submitted with the Application. The assessment predicts worst case scenario against current EALs. We consider this to be protective of human health. The Operator considered in-combination effects in their dispersion modelling assessment. We have audited the Operator's assessment and agree with their conclusions. For more details on how we made our decision regarding air quality and risk to human health, please see section 5 of this document. The emissions from the Protos energy recovery facility have been modelled and are multiple magnitudes lower than those assessed in the report referenced by UKWIN.
SHPI status of the Installation.	We have followed our internal process to determine if the Installation meets the requirements to be considered as a site of high public interest. We have concluded that at this point the site does not need SHPI status.