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Consulting Engineers Limited

Runcorn CC Facility - EP Application

Viridor Runcorn CCS Ltd

Supporting Information

ENGINEERING + CONSULTING

Document approval

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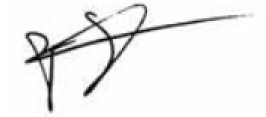
Prepared by:	James Sturman		Lead Consultant	13/12/2023
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Non-technical Summary

An Environmental Permit (EP) (Ref: EPR/RP3638CG now EPR/XP3005LB) was granted by the Environment Agency (EA) for the Runcorn Energy Recovery Facility (ERF) (herein referred to as the Facility) on 26 January 2011. The named Operator on the existing EP is Viridor Energy Limited.

The ERF comprises four incineration lines. Viridor is proposing to install a single Carbon Capture (CC) facility to extract the Carbon Dioxide (CO_2) from the emissions produced by the ERF. The CC facility will be operated by Viridor Runcorn CCS Limited. The CC facility will form part of the North West of England Cluster project. The proposed CC facility is projected to capture approximately 900,000 tonnes of CO_2 per annum from the flue gases for transmission and storage off-shore in the Liverpool bay sub-sea aquifer.

In addition, as this application is submitted on behalf of Viridor Runcorn CCS Ltd, a separate application is being submitted, on behalf of Viridor Energy Limited, to vary the EP for the ERF to be a multi-operator Installation.

As set out within this application, the proposed CC facility will not result in any significant impacts upon the Environment.

This application is submitted as an application for a standalone EP, as the CC facility will be regulated as Schedule 1 Part A(1) in its 'own right', as per EA Guidance titled '*Environmental permits: when and how you are charged*', dated July 2022. This was confirmed by the EA during pre-application discussions.

As demonstrated within this application, the CC facility has been designed in accordance with the requirements of the EA's draft Best Available Techniques (BAT) guidance for post-combustion CO_2 capture. When the draft guidance has been finalised it is understood that it will replace the EA's current guidance[1], which does not currently incorporate energy from waste.

Due to the additional land to be incorporated into the installation boundary, an updated Site Condition Report is also provided.

[1] https://www.gov.uk/guidance/post-combustion-carbon-dioxide-capture-best-available-techniques-bat

Contents

1 Introduction

An Environmental Permit (EP) (Ref: EPR/RP3638CG now EPR/XP3005LB) was granted by the Environment Agency (EA) for the Runcorn Energy Recovery Facility (ERF) (herein referred to as the Facility) on 26 January 2011. The named Operator on the EP is Viridor Energy Ltd. The EP (EPR/XP3005LB) has been varied nine times. The latest variation to the EP was granted by the EA on 26 May 2023.

Within this application, Viridor Runcorn CCS Ltd is applying for an EP for the operation of the proposed carbon capture (CC) facility to capture the carbon dioxide (CO_2) produced by the ERF for off-site transfer and sequestration.

Viridor understands that the EP for the CC facility will be determined as a standalone bespoke EP. Therefore, in addition to this application, a separate application is being submitted, on behalf of Viridor Energy Ltd, to vary the existing EP for the ERF to be a multi-operator Installation.

In October 2021, the Department for Business, Energy and Industrial Strategy (BEIS) announced funding for two regional carbon capture hubs, HyNet in the northwest of England and the East Coast Cluster in the North East.

The ERF comprises four incineration lines. Viridor Runcorn CCS Ltd is proposing to install a single CC facility to extract the CO_2 from the gaseous emissions produced by the ERF. The CC facility will form part of the North West of England Cluster project. The proposed CC facility is projected to capture approximately 900,000 tonnes of CO_2 per annum from the flue gases for transmission and storage off-shore in the Liverpool bay sub-sea aquifer.

A pre-application meeting was held with the Environment Agency, and its representative prior to submission of the application. The minutes from the pre-application meetings are provided in Appendix G.

2 Carbon Capture and Storage Technologies

2.1 Background

In a CC process, CO_2 is extracted from a mixture of gases to create a CO_2 rich stream. The CO_2 captured can then be injected into underground formations (storage), used in the manufacture of a wide range of products, or used as a plant growth enhancer in agriculture. Overall, the process is referred to as carbon capture and storage (CCS). Where the CO_2 can be used as a resource in another process, the process is referred to as carbon capture, usage and storage (CCUS). CCUS can be applied to large scale point sources of carbon including energy intensive industries, power generation, heat production, transport and maritime sectors. The process can be divided into three main steps which are:

1. separation of CO_2 from the gas stream;
2. compression 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).

In the UK and in Europe, residual Municipal Solid Waste (MSW) and Refuse Derived Fuel (RDF) is combusted for power generation, such as at the Facility. These feedstocks contain a mixture of plant and fossil fuel derived materials which are of biogenic and non-biogenic origin respectively. Consequently, coupling of EfW plants with CCS allows for the capture of CO_2 produced from the combustion of both the biogenic and non-biogenic fractions of the waste. This means that waste incineration plants can become net-negative emission plants. Furthermore, for EfW plants in the UK which operate on waste with a low biogenic content, CCS is considered as the sole route for decarbonisation of these systems. There are currently, no operational waste incineration facilities in the UK which have CCS systems installed and operational; however, Viridor understands that other operators of waste incineration facilities are developing projects for the installation of CCS systems.

To date, although CCS systems have been integrated with several large coal plants, only three demonstration scale CCS systems have been operated on flue gases from EfW plants[2].

2.2 CCS technologies

The technologies developed for CC can be divided into four main categories:

1. pre-combustion;
2. post-combustion;
3. oxyfuel combustion; and
4. direct air capture (DAC).

Pre, post and oxyfuel combustion technologies all require a point source of CO_2, such as combustion of fossil fuels or biomass. A point source of combustion is not required for direct air capture systems. Viridor considers that post-combustion capture is the most commercially viable process

[2] Larger plants have been installed on other (e.g. coal) power plants (the largest plant built to date is 3,250 t/day CO_2). The configuration of CCS plants is largely independent of the fuel used in the power plant, although there are differences in contaminants which need to be taken into account. A plant of around 1,200 t/day CO_2 capacity is scheduled for construction on an EfW plant in Norway.

for capture of CO_2 from power generation processes, such as the Runcorn ERF for the following reasons:

- can be retrofitted onto existing power plants and industrial facilities without significant modifications to the existing processes;
- it can be applied to existing facilities, such as the Runcorn ERF, providing a relatively quick and practical means of reducing CO_2 emissions in the near term; and
- It has been demonstrated in various pilot and commercial-scale projects, enhancing its credibility and reliability.

Therefore, post-combustion capture is the process which is discussed in this application for the capture of CO_2 from the Runcorn ERF.

3 The Carbon Capture Facility

The proposed carbon capture process involves using an amine solvent to remove CO_2 from the flue gas, followed by thermal regeneration of the solvent to produce pure CO_2. For the purposes of this application, it has been assumed that the amine solvent is a primary amine - mono-ethanolamine (MEA) solution.

Viridor considers that amine based carbon capture technologies are versatile in handling various CO_2 sources and capacities giving high capture efficiency. Therefore, this makes it suitable for retrofitting into existing heat, power, and industrial plants with minimal disruption. Additionally, it can be integrated with boiler steam cycles and district heating networks to enhance the overall energy efficiency.

The amine carbon capture technology is based on cyclic absorption and desorption (stripping) processes based on the reversible chemical reaction. The CO_2 is absorbed from the flue gas by a circulating aqueous MEA solution. The CO_2 is an acidic gas whereas the MEA is an alkaline solution. After the reaction, the gas is released as a concentrated CO_2 stream through thermal regeneration of the amine solution i.e., applying heat to the solution, in a desorber/stripper column. Hence, the CO_2 capture process is thus driven by thermal energy.

3.1 Integrating the CC process into the Facility

Following treatment of the flue gases within the ERF, and prior to being ducted to the stack from the ERF, the treated flue gas flow from the ERF will be ducted from all four lines of the ERF to the CC facility. The treated flue gases will be collected in a manifold prior to treatment within the CC facility. As the flue gases will be treated prior to the CC facility, the flue gases will be monitored for compliance with the waste incineration ELVs within the EP prior to being ducted to the CC facility. In the event that the CC facility is not available, or not able to abate the CO_2 emissions within the flue gases, the treated flue gases will be ducted to a new emission point from the absorber tower and released to the atmosphere.

The CC facility will utilise heat, in the form of steam, for CO_2 stripping, amine regeneration and flue gas re-heating. The CC facility will also require power to maintain operation.

Line 1 and Line 2 of the Runcorn ERF currently generate heat and steam which is exported to the adjacent Inovyn industrial facility. Due to the contractual arrangements between Inovyn and Viridor, Viridor is not able to supply heat and power for the operation of the CC facility from Line 1 and Line 2. Therefore, the heat and power for the operation of the CC facility will primarily be supplied from Line 3 and Line 4. In the event that there is insufficient steam generated by the ERF to supply heat and generate sufficient power to maintain operation of the CC facility, in some instances, power may be imported from the National Grid.

A CHP Report setting out the arrangements for the export of heat and power from the Runcorn ERF to the CC facility is provided in Appendix B.

Carbon capture is listed as a regulated activity within Section 6.10 of Part 2 of Schedule 1 of the Environmental Permitting Regulations as:

> *(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.*

As explained in section 1, during pre-application discussions with the EA, it was confirmed that the CC facility would require an application for a standalone bespoke EP, with a separate application is being submitted to vary the existing EP for the ERF to be a multi-operator Installation.

3.2 The carbon capture process

The carbon capture process will consist of the following steps:

- flue gas quenching and scrubbing;
- gas absorption;
- gas desorption/solvent regeneration;
- captured CO_2 conditioning and export; and
- CO_2 dehydration and compression.

An indicative process schematic for the carbon capture process is provided in Figure 1. A larger version is also included in Appendix A:

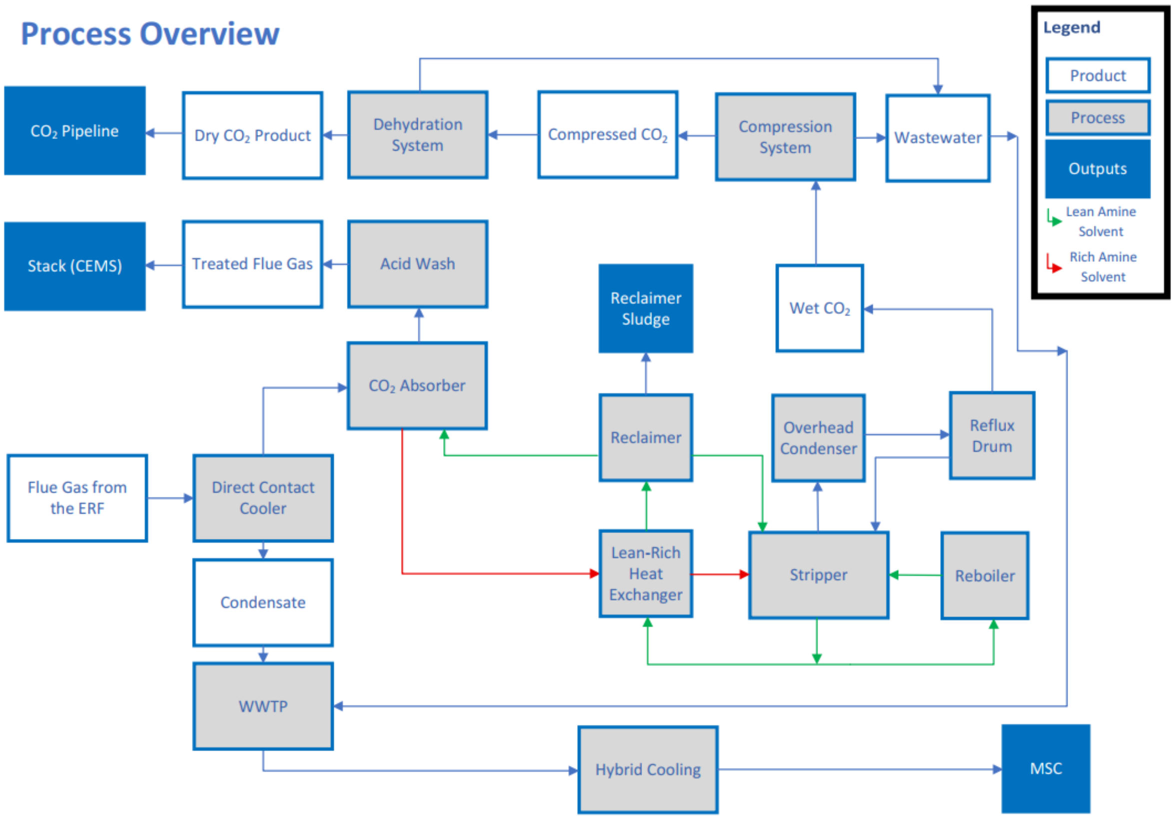

Figure 1 – Indicative process schematic for the carbon capture process

3.2.1 Flue Gas Quenching and Scrubbing

The first step of the CC process is to cool the flue gas in a Direct Contact Cooler (DCC) unit. The purpose of the DCC is to cool/quench the flue gases. In addition, the DCC will include a caustic scrubber to remove acid gases such as SO_2, HCl and HF.

Condensed water/acid gases from the flue gas will exit the DCC as a condensate bleed stream containing absorbed pollutants and will be routed to the wastewater treatment plant to being utilised as make-up water for the hybrid cooling towers, refer to section 3.3.

3.2.2 Gas Absorption

Following flue gas quenching and scrubbing, the flue gas is ducted to a packed bed absorption column where the CO_2 is scrubbed out through contact with the MEA solvent in a counter current flow regime.

The CO_2 in the flue gas is absorbed into the MEA solution, to generate a CO_2 rich amine solution, leaving behind mostly nitrogen and other gases within the treated flue gas. The outlet of the absorber tower includes a water wash step to scrub emissions of amine and degradation products within the treated flue gas will remove entrained mist droplets and solvent vapour prior to release to atmosphere.

Due to the quenching and scrubbing of the flue gases, the temperature of the flue gas entering the absorber column is approximately 35^{o}C. The absorption of CO_2 within the absorber column will release heat which will increase the temperature of the treated flue gas. Therefore, the temperature of the flue gas leaving the absorber column will be approximately 60^{o}C which will aid in the dispersion on it release from the absorber tower.

3.2.3 Gas Desorption/Solvent Regeneration

The CO_2 rich amine solution is drained from the absorber sump and pumped to the stripper to extract the captured CO_2 from the CO_2 rich amine solution and regenerate the amine solution. Heat from the reboiler will raise the temperature of the CO_2 rich amine solution to release the captured CO_2 and produce a hot lean-amine solution which can be recirculated back to the absorber tower.

The released CO_2 and water vapour from the top of the stripper are cooled in a condenser to reduce the temperature of the captured CO_2 to 40°C before being conditioned for export.

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. Reclaiming is required to remove these products and restore the effectiveness of the amine solution.

In this process, a slip stream of the amine is dosed with sodium hydroxide to remove acids. The amine is then passed to a reboiler, where the amine is heated using medium pressure steam until the liquid has boiled off and the vapour is returned to the stripper. The residual sludge will contain the contaminants within the amine solution. Measures will be employed to minimise the volume of reclaimer waste generated. These include reduction of the production of heat stable salts by reduction in incoming pollutants via the DCC, control of temperature within the reboiler to reduce formation of thermal degradation products, and use of a two stage reclamation process to ensure the maximum quantity of solvent is recovered.

The reclaimer will produce a waste, composed of water, amine, thermal degradation products and heat stable salts. The waste will be considered as a hazardous material, as it is likely to be harmful to human health and corrosive. Disposal routes include hazardous landfill and incineration.

3.2.4 Captured CO_2 Conditioning and Export

The CO_2 from the stripper will be saturated with water and traces of oxygen will be present and must be treated prior to release to the CO_2 transport network. Prior to the captured CO2 being compressed it must be conditioned, through dehydration and deoxygenation to produce a CO_2 product which satisfies Hynet’s pipeline transport and export requirements. The CO_2 product will be metered before being transferred to the Hynet pipeline via an above ground installation. The above ground installation is not part of the installation and will be operated by the CO_2 pipeline network provider.

3.2.5 CO_2 Venting

The CC facility is designed to compress and treat the CO_2 for injection into the HyNet CO_2 pipeline. However, there are possible operational scenarios during which it will not be possible to export the CO_2 that has been captured. There are five scenarios that would require CO_2 venting:

1. Venting of out of specification CO_2.
1. Venting of CO_2 due to operational upset.
2. Depressurisation of equipment to perform maintenance or inspections.
3. Plant commissioning.
4. Start-up and shutdown.

The design of the CC facility includes a CO_2 vent header system. In all of the scenarios above, the CO_2 will be collected in the header prior to release to atmosphere CO_2 vent stack, which will located adjacent to the absorber stack and will be the same height (110 m). The release will be a manual rather than an automated process, i.e. will be controlled by the Operator. Dispersion modelling of CO_2 venting has been undertaken and is presented in the Dispersion Modelling Assessment.

Details of each scenario are detailed in the following sections.

3.2.5.1 Out of specification CO_2

CO_2 quality will be analysed by a fiscal meter prior to export to HyNet via the above ground installation. If the product CO_2 does not meet the relevant specifications for it to be transferred to Hygen, it cannot be exported and must be removed from the system via venting. During venting of off-specification CO_2, the CC plant may continue to run until the system produces in-specification CO_2, or until a set time duration of off-specification CO_2 production is reached. This will be confirmed during detailed design.

3.2.5.2 Operational upset

Operational upset could occur due to damage/failure of mechanical equipment, control system faults and operator error. Depending on the cause of the upset and the consequences to plant operation, it may be necessary to vent the CO_2 inventory and fully depressurise the plant or sections of the plant.

3.2.5.3 Depressurisation to perform maintenance or inspections

The CC facility will require either full or partial shutdown at periodic intervals to perform maintenance and plant inspections. This will require venting the CO_2 and controlled depressurisation of the plant or sections of the plant. The venting duration for this scenario is dependent on the stored CO_2 inventory and the rate of depressurisation.

3.2.5.4 Commissioning

Some venting of CO_2 will be required during commissioning as testing of equipment is undertaken prior to full operation of the CC facility. As with venting for inspections, the CC facility (as a whole, or a section) will be depressurised and venting duration for this scenario is dependent on the stored CO_2 inventory and the rate of depressurisation.

3.2.5.5 Start-up and shutdown of the CC facility

On start-up, the CC facility will not be pressurised and CO_2 inventory will be limited. However, there may be occasions due to external factors which require CO_2 to be temporarily vented from the plant before product CO_2 can be directed to downstream transport and storage, particularly if the CO_2 captured during start-up is not up to specification (see section 3.2.5.1).

On plant shutdown, the plant will be depressurised and the CO_2 inventory will be vented from the system. The venting duration is dependent on the stored CO_2 inventory and the rate of depressurisation.

3.3 Wastewater treatment plant

The design of the wastewater treatment plant is subject to detailed design. However, at this stage it is anticipated that it will include the following treatment steps:

1. Primary treatment – clarification and sedimentation to precipitate out most of the metals present within the condensate;
2. Secondary treatment (polishing) – ultra-filtration and carbon filter absorption.

The resultant sludge will be dewatered with the treated effluent being suitable for re-use as cooling water within the hybrid cooling system. As the water treatment plant is treating the condensate generated by the CC facility for re-use it is not classified as a regulated activity for the purposes of the Environmental Permitting Regulations.

3.4 Cooling systems

Cooling water will be required to cool the incoming flue gas, the lean amine, the water wash flow water and product CO_2. Hybrid coolers will be used in conjunction with dry cooling, providing better thermodynamic performance.

The use of both cooling technologies allows for re-use of the condensate from the DCC, following treatment within the water treatment plant, within the hybrid cooling towers.

The blowdown from the hybrid cooling towers will subsequently be discharged to the Manchester Ship Canal (MSC).

3.5 Drainage and domestic effluent treatment

Uncontaminated surface water run-off, collected from building roofs and areas of hardstanding within the CC facility will be collected in a dedicated surface water drainage systems, prior to discharge off-site into the Runcorn and Weston Canal. A penstock valve will be installed on the surface water drainage system to enable the surface water system to be isolated to prevent discharges to surface water in the event of an incident, such as a chemical spill or a fire.

3.6 Efficiency of the CC process

When it is in operation, the CC process is designed to capture approximately 95% of the carbon dioxide generated by the Runcorn ERF.

During periods of start-up, shutdown instability of the ERF, the CC facility will not capture CO_2 as there will not be sufficient heat and power required to operate the CC facility.

When the ERF has completed the start-up sequencing and it is in stable operation, the flue gases will be diverted to the CC facility and the CO_2 capture process will be commenced.

4 Additional information

4.1 Raw materials and reagents

4.1.1 Types and amounts of raw materials

The CC facility will require raw materials and reagents which are not currently stored and utilised at the Runcorn ERF. Therefore, the implementation of the CC facility will require additional raw materials to be stored and utilised within the installation boundary.

The main raw materials anticipated to be stored and utilised within the CC facility are provided in Table 1. The quantities and storage capacities should be considered indicative prior to completion of detailed design of the Facility. Information on the potential environmental impact of the raw materials is included in Table 2.

Table 1: Types and amounts of primary raw materials

Schedule 1 Activity	Material	Estimated storage capacity (tonnes)	Estimated annual consumption (tpa)	Description
Section 6.10	MEA solution (Holding tank)	900	60	Reagent for the capture of CO2 within the absorber tower
	MEA solution (Process storage tank)	60		
	MEA solution (Process storage tank)	60		
	Sodium hydroxide (NaOH)	50	400	Used within the alkali wash and the Reclaimer
	Water treatment chemicals	<10	<50	Corrosion inhibitor, Antiscalant and Biocide

Table 2: Primary raw materials and their effect on the environment

Product	Chemical Composition	Estimated annual consumption (tpa)	Relative impact (%)			Impact Potential	Comments
			Air	Land	Water		
MEA solution	C_2H_7NO	60	100	0	0	Low	Reagent for the capture of CO_2 within the absorber tower. Some MEA solution will be lost from the system vie the flue gases or as a residue and will require replenishment within the CC process.
Sodium hydroxide	NaOH	400	0	0	100	Low	Used in the caustic wash within the DCC for removal of acid gases.
Water treatment chemicals		<10	0	0	100	Low	Dosed into the water treatment process

Various other materials may be used in small quantities for the operation and maintenance of the CC facility. These could include, but not be limited to, the following:

1. hydraulic oils and silicone-based oils, greases, insulants;
2. isolation media within electrical switchgear; and
3. fire-extinguishing agents.

These will be supplied to standard specifications offered by main suppliers. All chemicals will be handled in accordance with COSHH Regulations as part of quality assurance procedures and full product data sheets will be available on-site.

Periodic reviews of all materials used will be made in the light of new products and developments. Any significant change of material, where it may have an impact on the environment, will not be made without first assessing the impact.

Viridor maintains a detailed inventory of raw materials used at the Runcorn ERF, and this will be extended to include the chemicals associated with the CC facility.

As part of its IMS, Viridor has existing procedures for the regular review of the development in new raw materials and reagent for the Runcorn ERF, and these will also be applied to the raw materials and reagents utilised in the CC facility.

4.1.2 Reagent storage and handling

A range of chemical substances and hazardous materials required for the operation of the CC facility will be delivered to the Facility via road, as follows:

- MEA amine solution;
- Sodium hydroxide; and
- Water treatment chemicals for the hybrid cooling towers.

Chemical unloading area at the CC facility will be undertaken within a dedicated chemical storage and handling area. The chemical storage and handling area will be designed in accordance with Environment Agency Pollution Prevention Guidance titled '*Pollution prevention for businesses*'.

The chemical storage and handling area will be constructed in accordance with the requirements of CIRIA 736 and in accordance with recognised standard '*Eurocode 2 – Design of Concrete Structures – Part 3: Liquid retaining and containment structures*'. Sealed construction joints (water stop joints) will be installed between each concrete slab to ensure the integrity of the hardstanding, reducing the risk for contamination of the underlying ground/groundwater.

Quality assurance checks will be undertaken during construction to confirm the integrity of the hardstanding (and drainage systems). A regular preventative maintenance scheme will ensure the integrity of the tanker offloading area is maintained throughout the lifetime of the Facility. Preventative maintenance will include for periodically emptying any sumps in the tanker unloading area and undertaking visual inspections of the concrete or other material from which the sumps are constructed.

The exact arrangements are subject to detailed design but sumps/contained drainage will be provided as required within the chemical storage and handling area. Periodic visual inspections of the hardstanding will be undertaken. In the event that the visual inspection identifies that the integrity of the sumps or hardstanding has been compromised, additional leak tests and material thickness checks would be undertaken.

Should it be identified that damage to the containment systems associated with the unloading area has occurred repairs will be undertaken to ensure that this integrity is maintained. These measures will ensure that any chemicals which are stored and handled at the CC facility are not able to contaminate the underlying ground/groundwater in the event of a leak/spill.

Adequate quantities of spillage absorbent materials will be made available at easily accessible location(s), where chemicals are either stored or unloaded. These may be in the form of 'spill kits'. The drainage plan for the Runcorn ERF will be extended to include the CC facility, including the location of process and surface water drainage and will be made available on-site following commissioning of the drainage systems.

As per the existing management arrangements, any spillage that has the potential to cause pollution or be released to the environment will be reported to the site management and recorded in accordance with Viridor's existing spill response and reporting procedures. Where deemed appropriate, the relevant regulatory authorities (EA / Health and Safety Executive) will be informed as specified as required. The effectiveness of the emergency response procedures is subject to periodic Management Review and is revised and updated as appropriate following any major incidents.

In the event of a fire, contaminated water used for fighting fires will be collected in the drainage systems. The drainage systems for CC facility will be fitted with a manual shut off valve and will contain any firefighting water. Additional storage will be available from the site kerbing.

4.1.2.1 MEA storage and containment

MEA amine solution will be delivered to the CC facility in sealed tankers and off-loaded to an MEA storage tank via a standard hose connection. The MEA solution will be stored within the tank in a dedicated storage area, with secondary containment. The MEA storage tank itself will be well-designed and the bund will be designed to provide containment for to 110% of the tank's capacity; therefore, minimising the risk of any fugitive emissions from leaks whilst the MEA solution is stored within the tank. Good design of pipework and regular preventative maintenance will allow for the safe transfer of MEA into the CC process.

The delivery of MEA solution will be supervised by site operatives trained in unloading practices. Regular inspection of the unloading equipment will be undertaken. Spillages will be prevented by good operating procedures such as high tank level alarms or trips. In addition, unloading activities will only be undertaken in dedicated areas with impermeable surfacing and contained drainage. These measures will ensure that fugitive emissions of MEA solution are contained.

4.1.2.2 Water treatment chemicals for the hybrid cooling towers

Water treatment chemicals for the hybrid cooling towers (corrosion inhibitors, scale inhibitors, dispersants, and biocides) will be delivered and stored within Integrated Bulk Containers (IBCs). Subject to detailed design, the secondary containment facilities for the water treatment chemicals be designed to will have capacity to contain whichever is the greater of 110% of a single IBC or 25% of the total volume of chemicals being stored.

The unloading and transfer of the IBC's to the storage facilities will be undertaken within the dedicated chemical storage and handling area.

4.1.2.3 Additional raw materials

Various maintenance materials (oils, greases, insulants, antifreezes, welding and firefighting gases Additional raw materials will be stored in accordance with best practice and relevant pollution prevention guidance. All liquid chemicals and raw materials will be stored in controlled areas, with secondary containment facilities.

4.2 Emissions

4.2.1 Emissions to air

The cooling and quenching of the flue gas within DCC will abate the residual heavy metals which are in the particulate phase from the flue gas and also abate acid gases, and the wash step in the absorber tower will also abate amines and their degradation products from the treated flue gas prior to release to atmosphere.

However, the removal of CO and water vapour will reduce the overall volume of flue gas exiting the CC process compared to the input volume flue gas. Whilst the mass of pollutants, for some pollutants, will remain unchanged (such as oxides of nitrogen, NOx), the concentrations of pollutants will increase as the total mass will remain constant, but the volume of gas will decrease. Therefore, whilst removing CO_2 from the flue gas, the CC process will have a concentrating effect on the concentrations of some pollutants within the flue gases. This concentrating effect for the emissions from the CC process has been allowed for within the air quality modelling undertaken to support this application.

Emissions to air from the Absorber tower for the CC facility will be in accordance with the emission limits provided in Table 3.

Table 3: Proposed emission limits from the Absorber tower

Parameter	Units	Continuous (daily average)	Periodic
Ammonia (NH_3)	mg/Nm^3	15	
MEA	mg/Nm^3		10
DMA	mg/Nm^3		0.25
Total nitrosamines and nitramines (expressed as NDMA)	ug/Nm^3		0.2
Formaldehyde	mg/Nm^3		5

4.2.2 Emissions to sewer

Following consultation with the sewerage undertaker (United Utilities), it has been identified that the local sewerage system only has capacity for the discharge of up to 50m^3 of trade effluent. As this is in excess of the total volume of process effluent generated by the CC facility, it is not proposed to discharge process effluent to sewer. However, this will be subject to review during detailed design.

Therefore, for the purposes of this application, the only effluent from the CC facility which will be discharged to sewer is domestic effluent to sewer.

4.2.3 Emissions to water

Where practicable process effluent generated from the CC facility will be re-used within process, in particular the condensate from the DCC will be re-used as feedwater within the hybrid cooling towers. Blowdown from the hybrid cooling towers will be discharged to the Runcorn and Weston Canal following treatment in the on-site water treatment plant.

Emissions to water from the CC facility will typically be in accordance with the emission limits provided in Table 4.

Table 4: Hybrid cooling tower blowdown composition

Composition	Unit	Average (long term) Composition	Maximum (Short term) Composition
Mercury - (Hg)	mg/l	0.00066	0.00162
Antimony - (Sb)	mg/l	0.00014	0.00021
Arsenic - (As)	mg/l	0.00013	0.00021
Cadmium - (Cd)	mg/l	0.00021	0.00039
Chromium - (Cr)	mg/l	0.00264	0.00764
Cobalt - (Co)	mg/l	0.00008	0.00017
Copper - (Cu)	mg/l	0.00130	0.00355
Lead - (Pb)	mg/l	0.00184	0.00502
Manganese - (Mn)	mg/l	0.00075	0.00194
Nickel - (Ni)	mg/l	0.00256	0.00812
Thallium - (Th)	mg/l	0.00018	0.00023
Vanadium - (V)	mg/l	0.00011	0.00014
Ammonia (NH_3)	mg/l	0.04856	0.20086
Flow rate	m^3/hr	38.9	56.3
Temperature	°C	20	20

As demonstrated with the H1 assessment tool, the impact of these emissions will have an insignificant impact upon the MSC.

Uncontaminated surface water run-off, collected from building roofs and areas of hardstanding within the CC facility will be collected in the surface water drainage systems, prior to discharge off-site into the Runcorn and Weston Canal.

4.2.4 Noise

A noise assessment has been completed to assess the impact of noise from the CC facilities, refer to Appendix E. As explained within the noise assessment:

> *Nosie emissions from the CCS facility will be controlled through the application of noise control measures/techniques which have been described. Due to technical and spatial constraints, it is not feasible to incorporate additional noise control techniques.*
>
> *For 99.6% of the year noise emissions from operation of the CCS facility would result in negligible impact at all noise sensitive receptors (NSRs) and for all time periods (daytime, evening and nighttime). For the remaining 0.4% of the year (11 hours), noise emissions would be higher, and a moderate adverse impact would likely result at two NSRs.*
>
> *However, as this moderate impact would only occur for 11 hours in a year, and would be limited to the daytime period only, not affecting sleep, it is considered that, on balance and over the entire year period, the overall impact would be negligible.*

Consequently, when considering the entire year period, noise emissions from operation of the CCS facility would result in negligible impact at all NSRs and for all time periods.

Taking this into consideration, the operation of the CC facility is not expected to result in unacceptable noise impacts.

4.2.5 Odour

Under normal operation, the CC facility is not anticipated to result in additional odour impacts with suitable measures being incorporated into the design of the CC facility to mitigate any potential for odours, refer to the Environmental Risk Assessment provided in Appendix C.

Therefore, this application has not considered any change in odour associated with the operation of the CC facility.

4.3 Monitoring

4.3.1 Emissions Monitoring

4.3.1.1 Emissions Monitoring and Compliance for the Runcorn ERF

Whilst this will not form part of the EP/Operating Techniques for the ERF, due to the requirement for the flue gases from the ERF being diverted to the CC facility, it will require changes to the arrangements for monitoring of the flue gases.

Four separate CEMS systems are currently installed within the existing stack to monitor emissions from the Runcorn ERF and determine compliance with the emission limit values (ELVs) in the existing EP.

As the flue gases from the Runcorn ERF will be diverted to the CC facility prior to the stack, four new Continuous Emissions Monitoring Systems (CEMS) which will be installed in each of the flues/ducts between each line of the Runcorn ERF and the CC facility to demonstrate compliance with the existing ELVs stated in the EP prior to further treatment within the CC facility. In addition to the duty CEMS, standby CEMS will also be installed in accordance with the existing arrangements.

The CEMS system will be designed to monitor the following regulated pollutants:

- Particulates;
- Total organic carbon;
- Hydrogen chloride;
- Hydrogen fluoride;
- Carbon monoxide;
- Sulphur dioxide;
- Oxides of nitrogen (NO and NO_2 expressed as NO_2); and
- Nitrous oxide.

In addition, the oxygen and water vapour content, temperature and pressure of the flue gases will be monitored so that the emission concentrations can be reported at the reference conditions required by the Industrial Emissions Directive (IED). Whilst it is not a requirement of the Waste Incineration BREF, or the IED, Viridor will also undertake continuous monitoring of the total carbon dioxide within the flue gas, and also continuous extractive monitoring of the flue gas to determine the proportion of the total carbon dioxide which is released from the combustion of the biogenic fraction of the waste within the Runcorn ERF.

In addition to the CEMS, facilities will also be incorporated into the flue to enable the periodic monitoring of the following regulated pollutants:

- Cadmium & thallium, and its compounds;
- Mercury, and its compounds;
- Group 3 heavy metals;
- Dioxins and furans; and
- Polyaromatic hydrocarbons.

As per the requirements of the EP for the ERF (Ref: EPR/RP3638CG), Viridor Energy Ltd will be responsible for all operational, maintenance and reporting requirements associated with the reporting of emissions from the ERF. The responsibilities for monitoring of emissions for compliance with the ELVs for the ERF will be presented within the application for the multi-operator installation.

4.3.1.2 Emissions Monitoring and Compliance for the CC facility

Viridor proposes to undertake monitoring of the resultant flue gases from the CC facility prior to release to atmosphere. The proposed monitoring systems for the CC facility include for the continuous monitoring of emissions of ammonia. CEMS systems are not currently available to monitor the concentrations of the pollutants/by-products formed during reactions with species present in the flue gases within the flue gas it is proposed to undertake periodic monitoring of all other pollutants. Taking this into consideration Viridor proposes to undertake periodic monitoring for the following species following treatment of the flue gas within the CC process and prior to release to the atmosphere:

- aldehydes;
- primary amines, such as MEA;
- secondary amines, such as di-ethanolamine (DEA) and dimethylamine (DMA);
- nitramines; and
- nitrosamines.

In addition, the monitoring of regulated pollutants from the CC facility, Viridor will also install a CEMS to undertake continuous monitoring of emissions of carbon dioxide from the CC facility prior to release to atmosphere. The CEMS system will be used to confirm the efficiency of the operation of the absorber.

4.3.1.3 Emissions monitoring arrangements

The location of the sampling and measurement points will be determined during the detailed design process. The measurement locations will be designed in accordance with EA guidance *Monitoring stack emissions: measurement locations* and the Biogenic CEMS Technical Specification which Viridor understands is being prepared by Department for Energy Scurity Net Zero (DESNZ)

All periodic monitoring will be undertaken by MCERTS accredited stack monitoring organisations. The flue gas sampling techniques and the sampling platforms will be designed to comply with the following EA guidance (formerly referred to as the ‘M1’ and ‘M2’ Guidance Notes):

- Monitoring stack emissions: measurement locations;
- Monitoring stack emissions: environmental permits;

- Monitoring stack emissions: techniques and standards for periodic monitoring; and
- Monitoring stack emissions: guidance for selecting a monitoring approach.

Calibration of the CEMS systems will be carried out at regular intervals as recommended by the manufacturer and, where appropriate, in accordance with the requirements of BS EN 14181 and the BS EN 15267-3. Regular servicing and maintenance will be carried out under a service contract with the equipment supplier. Therefore, the installation and functioning of the CEMS systems for the Runcorn ERF will be subject to the controls and annual surveillance tests as set out in point 1 of Part 6 of Annex VI, as per the existing CEMS for the Runcorn ERF.

Apart from ammonia, the monitoring parameters and specific monitoring methods for the pollutants from the CC process are not listed within EA guidance *Monitoring stack emissions: techniques and standards for periodic monitoring*. Therefore, following completion of detailed design, Viridor would propose that a pre-operational condition is incorporated into the EP which requires the details of the proposed arrangements for periodic monitoring of emissions from the CC facility.

The UK Government and the EA have not published guidance on 'acceptable' emissions concentrations for pollutants from CC technologies. Therefore, Viridor would propose to apply ELVs which are consistent with the emission concentrations used within the Air Quality Assessments, refer to Appendix D, on the basis that the emissions from the CC facility will be no worse than those assumed within the modelling. Viridor understands that this approach is consistent with ELVs which have been incorporated into other Environmental Permits for other post combustion carbon capture facilities which have previously been granted by the EA.

4.3.2 Emission to Water

The flow rate and temperature of the discharge to water from the hybrid cooling towers will be continuously monitored by a MCERTS accredited monitoring system.

In addition, periodic monitoring of emissions to water will be undertaken for Group 3 metals and ammonia. The frequency of the periodic monitoring will be subject to agreement with the EA.

4.3.3 Process monitoring

The design of the CC facility incorporates a number of measures to monitoring and control the process, in particular in relation to the following:

- Foaming;
- Corrosion;
- Amine Solvent Efficiency/Quality and Degradation;
- Maximum Solvent Temperature; and
- Solvent Loss.

The measures are summarised in sections 4.3.3.1 to 4.3.3.5.

4.3.3.1 Foaming

Foaming can result in number of operational problems amine to the CO_2 capture process including decreased capture efficiency and amine solvent loss and is typically caused by suspended solids within the amine solvent; amine degradation products; condensation of organics and hydrocarbons within the flue gas; and impurities within the solvent solution.

Foaming can occur in any part of the CC system but is most common to occur in the absorber tower and/or the stripper.

To enable foaming to be detected, the absorber and stripper columns will be fitted with a pressure differential monitor which will be recorded in the DCS for the CC facility and will enable foaming to be detected and reported in the control room.

The following measures have been incorporated into the design of the CC facility to control and minimise foaming:

- The flue gas will be scrubbed in the DCC.
- Regular amine solvent reclaiming to remove the build-up of degradation products within the solvent.
- Filtration of the amine solvent (Rich and Lean) to remove particulates/suspended solids.
- Regulating the temperature change between the inlet flue gas temperature and the lean amine temperature to the absorber to between 5 – 10°C.
- By dosing an antifoam agent, if required.

4.3.3.2 Corrosion

Corrosion will occurs as result of the circulation of amine degradation products within the CC system, and in particular the solvent containing heat stable salts. Corrosion is exacerbated from elevated temperatures and a high acid gas content within the treated flue gas, and be most significant within the stripper and in both the lean amine and rich amine the heat exchangers.

Corrosion coupons/probes will be installed in the Reboiler and the heat exchangers to detect corrosion within the system. Furthermore, preventative maintenance arrangements will include for regular visual inspections of these areas

The following measures have been incorporated into the design of the CC facility to control and minimise corrosion:

- Controlling the amine stripper/reboiler temperature to be between 110 - 126 °C.
- Operating high temperature heat exchangers (lean/rich exchanger) at suitable operating pressure to prevent captured acid gas break-out.
- Regular solvent reclaiming to remove built up degradation products.
- Operating at optimum lean and rich acid gas loading.
- Limiting liquid pipeline velocities to no more than 1 - 1.5 m/s.
- The addition of a suitable corrosion inhibitor agent, if required.

4.3.3.3 Amine Solvent Efficiency/Quality and Degradation

Amine solvent degradation occurs as a result of a build-up in amine degradation products within the solvent, or as result of solvent oxidation when the amine solvent is being stored. Amine degradation by-products in CCS circulation can result in number of operational amine solvent degradation can result in a number of issues with the CC process, including decreased capture efficiency for the solvent; foaming; and corrosion.

To monitor the quality of the amine solvent, daily checks will be undertaken on the amine solvent for parameters such as colour: pH; conductivity; and acid gas loading. In addition, periodically samples will be sent to an accredited laboratory for detailed analysis to monitor heat stable salts and amine degradation products within the solvent.

The following measures have been incorporated into the design of the CC facility to maintain solvent efficiency/quality and prevent amine degradation:

- Nitrogen tank blanketing of the amine storage tank(s) to prevent solvent oxidation when the amine solvent is being stored.
- Regular bleeding and replacement of the amine solvent (up to 3% of solvent sent to Reclaimer) to prevent the build-up of amine degradation products in the CC process. This will also help with minimising the cumulation of corrosion products which can act as catalyst for the solvent degradation.
- Controlling the amine stripper/reboiler temperature to be between 110 - 126°C to prevent amine degradation.
- Wash stage within the (DCC) to reduce/minimise the contaminants introduced into the CC process.

4.3.3.4 Maximum Solvent Temperature

The temperature of the amine solvent will be controlled to prevent flue gas condensation in the absorber and minimise solvent degradation in the stripper.

The temperature of the amine solvent will be recoded at the inlet of the Absorber and the outlet of the stripper and be recorded in the DCS in control room with fluctuations in the temperature being detected and reported in the control room.

The following measures have been incorporated into the design of the CC facility to maintain a stable temperature for the amine solvent:

- varying the operating pressure within the stripper to maintain the solvent regeneration temperature between approximately 110 - 125°C; and
- varying the flowrate of the cooling fluid within the lean amine cooler based on the inlet flue gas temperature feedback to regulate the temperature change between the inlet flue gas temperature and the lean amine temperature to the absorber to between 5 – 10°C.

4.3.3.5 Solvent Loss

Amine solvent is volatile, and some of the solvent will be loss from the absorber and stripper through carryover/evaporation. Solvent make-up usage will be monitored to identify the solvent loss through carryover/evaporation, and from the periodic monitoring of emissions of amine and amine degradation products from the absorber tower.

Solvent loss will be controlled by the following measures:

- Incorporating a wash water stage(s) at the top of the absorber column, and monitoring and controlling the wash water temperature through intercooling; and
- high efficiency demisters at top of absorber and stripper columns.

4.4 Heat demand and energy efficiency

The CC facility will have the following demand for heat and power:

- Heat: Steam at 4 bara and 144°C and with the condensate being returned from the CC facility at 4 bara and 27°C to Lines 3 and 4. The net heat requirement of the CC facility would be at 131.1 MWth, with the condensate being returned from the CC facility to Lines 3 and 4.
- Power: 14.1 MWe of electrical power

To satisfy the heat and power demand for the CC facility, high pressure steam we be bled from the Phase 2 and supplied to a new back pressure steam turbine generator within the CC facility. This will reduce the electrical output of Lines 3 and 4 turbine from 51.2 MWe to 5.7 MWe. However, an average total electrical generation of Phase 2 turbine and the back pressure turbine would be approximately 26.9 MWe (5.7 MWe from the existing fully condensing steam turbine and 21.2 MWe from the new back pressure steam turbine in the CC facility).

The energy efficiency of the CC facility has been considered within the CHP Report, refer to Appendix B.

4.5 Cooling technology

Cooling of the flue gas is undertaken within the DCC unit quench and scrub the incoming flue gases. The European Commission has published BAT Guidance for industrial cooling systems, referred to as the 'Industrial Cooling Systems BREF'. The Industrial Cooling Systems BREF identifies three recognised techniques for the provision of cooling which are considered to be appropriate the CC facility:

- Air Cooled Condenser (ACC);
- Once-Through Cooling (OTC); and
- Evaporative Cooling, through conventional cooling towers or hybrid systems.

Water cooling can be achieved through OTC systems or by a recirculating water supply, otherwise referred to as evaporative cooling. Both OTC and evaporative cooling systems require significant quantities of water, and a receiving watercourse for the off-site discharge of cooling water. In addition, OTC systems require a source of water abstraction, as mains water is not considered to be an economically viable option due to the large quantities of water required as the cooling medium.

The main advantage of the water-based systems, as opposed to air cooled systems, is that they provide improved cooling and are less susceptible to condenser efficiency fluctuations with seasonal changes in the air temperature. During summer periods, ACC's can have insufficient condensing power and subsequently reduce the efficiency of the cooling system requiring additional cooling capacity. Furthermore, a significant number of ACC's would be required to provide the cooling demand of the DCC, increasing the noise impacts associated with the CC facility. On this basis, ACC's are not considered to represent BAT for the DCC.

The Weaver Navigation Channel (approximately 200m) and the Manchester Ship Canal (approximately 400m) are located to the west of the CC facility. Viridor understands that the Weaver Navigation Channel and the Manchester Ship Canal are in hydrological continuity. Therefore, these two water bodies are a potential significant source of water which could be utilised in an OTC or evaporative cooling system.

The water that is recovered in the DCC can either be re-used within an evaporative cooling system or will require discharge to the aquatic environment. Due to the option of being able to reuse the condensed water from the flue gas within the evaporative cooling system they are considered to represent BAT for cooling purposes.

It should be noted that the design of the CC facility will also include some small ACC units to provide supplementary cooling capacity to the overall CC process.

4.6 Wastes and residues

The anticipated waste generated by the CC facility is minimal, and it will be responsibly managed through permitted third-party waste companies to ensure its proper recycling/disposal.

Implementing solvent-specific management techniques will guarantee minimal waste production and maximise capture performance, this meets the indicative BAT requirements.

Waste from the solvent reclaimer will essentially be comprised of heat-stable salts and corrosive products. This waste stream will be stored locally within the reclaimer, with the specific storage arrangements/volume to be determined in the FEED stage. On-site treatment is not proposed, and this waste will be stored and transported off-site for appropriate disposal.

All waste produced at the CC facility will adhere to the waste hierarchy and, when required, will be handled, and disposed of by permitted waste operators.

5 Post combustion capture technologies

The main types of post-combustion capture technologies currently being promoted by technology providers of CC systems:

1. chemical absorption;
2. adsorption;
3. membrane separation;
4. chemical-looping combustion;
5. calcium-looping; and
6. cryogenic separation

For the purposes of this application, the available technologies have been considered.

5.1 Chemical absorption

In chemical absorption, a liquid sorbent, typically an amine-based solvent, is used to separate the CO_2 from the flue gas. The sorbent is then regenerated through a stripping or regeneration process by heating and/or depressurisation. The energy for regeneration is supplied by steam.

Chemical absorption using amine solvents is a well-established and proven technology having been implemented for a number of years in the oil and gas industry for the removal of CO_2 from raw natural gas.

A challenge of using amine-based solvent is amine degradation, resulting in solvent loss, equipment corrosion and generation of volatile degradation compounds. Furthermore, amine emissions can degrade into nitrosamines and nitramines, which if the process is not appropriately managed can result in elevated concentrations of these pollutants.

Viridor considers that chemical absorption is a proven technology on a commercial scale and represents BAT for the capture of carbon emissions from the Facility.

5.2 Adsorption

In an adsorption system, a solid sorbent is used to separate the CO_2 from the flue gas by binding the CO_2 onto its surface. Typical sorbents include molecular sieves, activated carbon, zeolites, calcium oxides, hydrotalcites and lithium zirconate. Chemical adsorption is considered to be mature technologies and is widely used in industries for the separation of gases.

Although the energy usage of adsorption systems is significantly lower, currently within the industry it is considered unlikely that solid adsorbent technology will be competitive against established liquid absorption systems due to the complexity of large-scale solids handling systems. In addition, although some of the solid sorbents being considered can be regenerated like liquid amines, over time as the efficiency of capture reduces, these substances will be classified as hazardous waste and would require specialist waste treatment prior to disposal.

Due to the nature and potential quantities of hazardous waste which would be produced by an absorption system, Viridor does not currently consider that adsorption is a suitable technology for the CC facility.

5.3 Membrane separation

Membrane separation can be used for selective separation of CO_2 from flue gases and from air. Therefore, membrane separation systems are considered to be versatile as they can be used for CO_2 removal in both pre and post combustion capture systems. Membrane separation has also been used to separate other gases such as O_2 from N_2.

The main operational problems associated with membrane separation include:

1. low fluxes;
2. fouling of the membranes from the particulates entrained in the flue gas stream; and
3. low stability on exposure to high temperature and pressure.

As the use of separating agents and phase changes are not needed in membrane systems, it has been projected that membrane separation technologies will have lower capital and operating costs compared to other separation technologies. However, although membrane technologies have been commercialised for gas separation processes such as air separation and natural gas sweetening, CO_2 separation membranes are currently considered to be at pilot scale, with several types of membranes being trialled at power plants in Europe.

Due to the unproven nature of membrane separation systems, Viridor does not currently consider that membrane separation is a suitable technology for the CC facility.

5.4 Chemical-looping combustion

Chemical looping combustion (CLC) is an indirect combustion process in which fuel is combusted without direct contact with air. Unlike oxyfuel combustion, a solid metal oxide is used as an O_2 carrier instead of pure O_2. CLC technologies are currently under development and there are no facilities operating at a scale to enable Viridor to consider that they are a proven technology.

Due to the unproven nature of CLC technologies, Viridor does not currently consider that they are a suitable technology for the CC facility.

5.5 Calcium-looping

Calcium-looping utilises the reversible chemical reaction between calcium oxide (CaO) and CO_2 in order to capture CO_2 from gas streams. The chemical reaction is then reversed into CaO and CO_2 in a calciner. CO_2 capture in a carbonator occurs at a temperature of around 650°C and calcination reaction occurs at a temperature of 950°C.

The high temperatures required for the adoption of calcium-looping would require a very high energy input, and/or potentially significant re-design of the existing waste incineration process to be implemented at the Facility.

Viridor understands that calcium looping has been proposed as a key route for decarbonisation of both the power generation and the cement sector and there is a small-scale demonstration project in Italy. However, due to the unproven nature of the calcium-looping technology on a commercial scale, Viridor does not currently consider that it is a suitable technology for the CC facility.

5.6 Cryogenic separation

Cryogenic distillation is a gas separation process using distillation at very low temperature and high pressure based on the different boiling points of the components within the flue gases. For CO_2 separation, flue gases containing CO_2 are cooled to the de-sublimation temperature (- 100°C to

- 135°C), the solidified CO_2 is separated from other light gases and then compressed at a high pressure. Whilst cryogenic distillation can recover up to 95% of the CO_2 in the flue gas, as distillation is conducted at extremely low temperature and high pressure the energy demand to capture the CO_2 is very high and would require the installation of a separate power station to supply the heat and power required to operate the cryogenic separation system.

Due to the very high energy demands for cryogenic distillation, Viridor does not currently consider that it is a suitable technology for the CC facility.

6 Installation boundary

As presented in the layout and installation boundary drawings provided in Appendix A, Viridor is proposing to install the CC facility on land to the west/north-west of the Runcorn ERF. This area of land is not within the existing installation boundary. Therefore, in applying for this EP Viridor Runcorn CCS Limited is proposing to extend the installation boundary to incorporate this additional area of land.

Therefore, the site condition report has been updated to include for the additional land to be incorporated into the installation boundary. The updated site condition report is provided in Appendix F.

7 Management arrangements

Viridor's integrated management systems which apply to all of its businesses, including Viridor Energy Limited and Viridor Runcorn CCS Limited, will be extended to incorporate the CC facility. The following technical guidance will be followed when developing and implementing the EMS:

- BS EN ISO 14001:2015; and
- Environment Agency guidance to 'Develop a management system: environmental permits'.

Following construction of the CC facility, the EMS will be extended to incorporate the operation of the CC facility. The EMS will include the relevant Viridor policies, procedure, protocols and other documentation required for compliance with both the EP and operational requirements. All documents and records relating to the EMS will be made available to the EA upon request.

The EMS will clearly define the management structure as well as setting out the roles and responsibilities of all staff. The EMS will also include:

- An Environmental Policy;
- Health and Safety Procedures; and
- An operational guidance manual which will include process plant operating procedures for both standard and emergency conditions.

The Construction (Design and Management) Regulations will apply during the construction and commissioning period. In addition, management will undertake inspections and reviews for quality control, performance measurements, and staff appraisals.

7.1 Scope and structure

The scope of the EMS will cover three key areas:

- the design and development of the CC facility and its integration into the operation of the ERF;
- the operation of the CC facility and its integration into the operation of the ERF; and
- the incineration of waste and the carbon capture process.

Where applicable, documented procedures will detail specifically how each activity will be controlled. These will be contained in an Environmental Procedures Manual and identified related documents.

The site EMS will contain procedures for accident management that comply with the EA's requirements. This will be in the form of an accident management plan that will be developed for the Facility.

7.2 General requirements

The structure of the EMS documentation will include, but not be limited to, the following:

- an environmental policy;
- identification of potential environmental impacts;
- documented procedures to control operations that may have an adverse impact on the environment;
- ensuring adequate responsibility, authority and resources to management necessary to support the EMS;

- defined procedures for identifying, reviewing and prioritising items of plant and equipment for which preventative maintenance regimes are appropriate;
- establishing preventative maintenance programmes (and associated auditing) to cover all plant and equipment whose failure could lead to environmental impacts (including infrastructure such as pipework, drainage, bunds etc);
- documented procedures for monitoring relevant emissions or environmental impacts;
- establishing performance indicators to measure the effectiveness of the procedures;
- monitoring, measuring and analysing the procedures for effectiveness; and
- implementing actions as required based on the results of auditing to ensure continual improvements of the processes.

Where applicable, documented procedures will detail specifically how each activity will be controlled. These will be contained in an Environmental Procedures Manual or similar and identified related documents.

7.3 Site operations

The overall Site will operate as an Energy Recovery Facility with carbon capture, with the main activity being undertaken the incineration of non-hazardous waste to recover energy and the subsequent capture of carbon dioxide.

All permitted activities will take place within the Installation Boundary, as provided within Appendix A.

Steps will be taken to prevent or minimise risks to the environment from each activity/process – these are described within the Environmental Risk Assessment (presented in Appendix C). The environmental risks will be expanded on and incorporated into the final EMS document upon completion of detailed design of the CC faiclity.

7.4 Site plan(s)

Following completion of detailed design, the EMS will include for detailed plan(s) of the site which highlight where permitted activities are undertaken. The plan(s) will also show the location of the following, in accordance with EA guidance '*Develop a management system: environmental permits*':

- buildings and any other main constructions such as security fences;
- storage facilities for hazardous materials (oil or fuel tanks), chemical stores, waste materials;
- the location of items for use in accidents and emergencies, such as spill kits;
- entrances and exits for use by emergency services;
- any points designed to control pollution (e.g., containment facilities or penstock valves);
- effluent or water discharge points;
- areas vulnerable to pollution such as watercourses, adjacent industrial premises etc;
- drainage facilities; and
- utilities supplies (water, gas, electric) including stop taps, isolating valves, routes etc.

Preliminary site plans (including emissions points and installation boundary drawings) are presented within Appendix A.

7.5 Storage of waste and other residues/wastes

Upon completion of detailed design of the site, a waste/wastes/residues storage plan will be incorporated into the EMS, in accordance with the requirements of EA guidance '*Develop a management system: environmental permits*'.

7.6 Site and equipment maintenance plan

Upon completion of detailed design of the site, a site equipment and maintenance plan will be incorporated into the EMS, in accordance with the requirements of EA guidance '*Develop a management system: environmental permits*'. Preliminary information in relation to this plan is set out as follows:

- Plant and machinery (including any mobile plant) will be maintained in accordance with the manufacturers or supplier's recommendations. A preventative maintenance regime will be put in place.
- Records will be kept of any maintenance carried out on plant and machinery.

7.7 Personnel

Viridor will ensure that sufficient numbers of staff, in various grades, are provided to manage, operate and maintain the site on a continuous basis, seven days per week throughout the year.

It is anticipated that the key environmental management responsibilities will be allocated as described below:

- The 'Site' or 'General' Manager will have overall responsibility for management of the Site and compliance with all aspects of the EP. The Site Manager will have extensive experience relevant to their responsibilities.
- The 'Operations' Manager(s) will have day-to-day responsibility for the Site to ensure that it is operated in accordance with the EP and that the environmental impact of operations is minimised. In this context, they will be responsible for designing and implementing operating procedures which incorporate environmental aspects.
- The 'Engineering' or 'Maintenance' Manager will be responsible for the management of maintenance activities, for maintenance planning and for ensuring that the Site continues to operate in accordance with its design.
- The Environment, Health and Safety (EHS) manager will be responsible for environmental and health and safety at the Site, including compliance with the EP.

The majority of employees would be skilled operatives (electricians/fitters) or technical engineers (control and plant). In addition to the above, roles could include security officers, technicians, administrators, site operatives, etc.

7.8 Competence, training and awareness

Viridor will ensure that any persons performing tasks for it, or on its behalf, which have the potential to cause significant environmental impact, are competent on the basis of appropriate education and training or experience.

Systems to assess competence and provide training for relevant staff will be provided. These may cover, but not be limited to, the following:

- awareness and importance of regulatory implications of the EP for the activities and operations undertaken at the site;
- awareness of potential environmental effects from operation under normal and abnormal circumstances (e.g., periods of shutdown);
- awareness of the need to report any significant deviations from the EP;
- prevention of accidental emissions and action to be taken when accidental emissions occur and
- roles and responsibilities in achieving conformity with the requirements of the EMS.

Skills, competencies and training requirements for staff will be documented and recorded as part of the internal management systems at the site. Viridor will comply with industry standards or codes of practice for training, where they exist. The EMS will contain an archiving procedure to ensure all training is recorded and all associated records are retained.

7.8.1 Competence

Viridor will identify the minimum competencies required for each role. These will then be applied to the recruitment process to ensure that key roles and responsibilities are satisfied. Particular attention will be paid to potential candidate’s experience, qualifications, knowledge and skills.

7.8.2 Induction and awareness

Staff induction programmes are location and job role specific and will include, as a minimum, the induction of:

- the Environmental Policy;
- the requirements of the EP;
- the Health and Safety Policy and Procedures; and
- the EMS Awareness Training.

Staff will have access to the IMS via internal computer systems and will be required to understand any sections of the IMS relevant to the activities they carry out.

7.8.3 Training

Viridor will be required to train staff during the commissioning of the CC facility and prior to it becoming operational. Line Managers will be required to identify and monitor staff training needs as part of the appraisal system. The training needs of employees will be addressed using on-the-job training, mentoring, internal training and external training courses/events. As stated above, records of training will be documented and recorded, with industry standards or codes of practice for training complied with where relevant. Training records will be maintained onsite. The operation of the site will comply with industry standards or codes of practice for training where they exist.

For any contractors working on-site, potential environmental risks will be identified, and where relevant instructions provided to the contractors.

7.9 Accident management

The existing accident plan will be extended to include for written procedures and forms for recording, handling, investigating, communicating and reporting actual or potential non-compliance (e.g. complaints) with operating procedures/emission limits associated with the operation of the CC facility. Any incidents will be investigated thoroughly and documented, with the regulatory authorities informed if the incident is significant. Near misses will be reported and suitable corrective action/mitigation measures implemented and followed up.

For each potential accident or incident, the following will be identified:

- the likelihood of the accident happening;
- the consequences of the accident happening;
- proposed measures to be taken to avoid the accident happening; and
- proposed measures to be taken to minimise the impact if the accident does happen.

A list of substances stored at the site, and storage facilities, will also be incorporated into the accident management plan (either linked to part of the wider EMS or listed specifically within the accident management plan itself).

7.10 Climate change and flood risk

The potential impacts of climate change (including flood risk) have been and will continue to be considered in the context of the design and operation of the Site. The accident management and contingency plans presented will be reviewed and updated to take into any additional climate change or flood risk considerations associated with the operation of the CC facility.

7.11 Keeping records

All records are already required to be retained in accordance with the relevant timescales indicated within the EP. The EMS will be extended to include the records associated with the CC facility.

The records that will be kept will include, but not be limited to, the following:

- the EP for the site;
- other legal requirements for the site;
- environmental risk assessments;
- environmental management plans;
- EMS plans;
- operating procedures;
- staff competence and training (such as qualifications, courses attended);
- emissions and any monitoring undertaken as required by the EP;
- compliance checks, findings of investigation and actions taken;
- complaints made, findings of investigation and actions taken;
- audits of management system, findings (reports) and actions taken;
- management reviews and changes made to the management system;
- where applicable, certification audit reports and any actions carried out;
- records to show that the duty of care requirements are being met.

Furthermore, the Site Condition Report will be kept with the EMS and records will be maintained of any updates to the Site Condition Report as required by the operation of the CC facility.

7.12 Review of management systems

The IMS is reviewed and updated regularly in response to changing internal and external factors, with records kept on any checks carried out and updates made. As a minimum, the IMS is reviewed once per year.

7.13 Contingency

The existing contingency plan will be extended to include the operation of the CC facility. This will incorporating measures and procedures for the following scenarios in order to minimise environmental risk associated with the operation of the CC facility:

- breakdown scenarios;
- enforced shutdowns;
- planned shutdowns;
- any other abnormal operation (e.g. due to flooding or extreme weather).

7.14 Contact information for the public

A notice board is already displayed or near the entrance for the Site which tells the public key information about the site.

7.15 Complaints

A complaints procedure is already in place and will be extended to include any complaints associated with the operation of the CC facility.

7.16 Operating and maintenance procedures

In addition to the EMS described above, an operating and maintenance (O&M) manual(s) or similar will be developed for the CC facility. It is assumed that the O&M procedures will include, but not be limited to the following aspects:

- comprehensive description of each component at the CC facility including operating hours and design details;
- as-built drawings of the CC facility;
- maintenance and service plans;
- staffing and staff responsibilities;
- raw materials storage and handling procedures;
- copies of any guaranties/warranties/certificates; and
- health and safety procedures.

8 BAT Guidance Review

8.1 Post-combustion CO_2 Capture BAT Guidance

The EA latest published Best Available Techniques (BAT) guidance for post-combustion CO_2 capture[3] is dated 2022 and applies to combustion plants. During pre-application discussions with the EA it was identified that the guidance is being updated to include energy from waste facilities, and a draft version of the guidance was provided. Sections 8.1.1 to 8.1.14 explain how the design of the CC facility complies with the requirements of the draft guidance.

8.1.1 Power plant selection and integration with the PCC plant

The primary purpose of the ERF is to treat waste, and it needs to be able to be operated continuously. The CC facility has been designed to fully integrate with this design basis and is able to operate continuously, and allow for turndown of the ERF – the CC facility will operate at 35% load of all four lines of the ERF.

Prior to the implementation of the CC facility, the thermal efficiency of the ERF has already been maximised with the export of heat from Line 1 and Line 2, with the export of heat to Innovyn.

The CHP Report contained in Appendix B, demonstrates that Line 1 and Line 2 of the ERF is in accordance with the gross energy efficiency requirements of the BAT AEELs; and Line 3 and Line 4 of the ERF is in accordance with the gross electrical efficiency requirements of the BAT AEELs.

Furthermore, as presented in the CHP Report, the heat and power required for the operation of the CC facility will typically be supplied from the ERF. High pressure steam will be drawn from the ERF 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.

8.1.2 PCC plant design and operation

In normal operation, the CC facility has been designed to typically capture approximately 95% of the CO_2 in the flue gas from the ERF.

8.1.3 Solvent selection

As explained in section 3, it is proposed to use an MEA based solvent within the CC process. Viridor understands that MEA is proven solvent for the capture of CO_2, and information on how it reacts in the atmosphere and any subsequent degradation products are recognised by regulatory authorities.

8.1.4 Features to control and minimise atmospheric and other emissions

The Runcorn ERF includes a flue gas cleaning system to control and minimise emissions from the combustion of waste prior to the flue gases being passed to the CC facility. The flue gas cleaning systems include:

- an SNCR system to abate NOx;

[3] EA (2022) Post-combustion carbon dioxide capture: best available techniques (BAT) – available at https://www.gov.uk/guidance/post-combustion-carbon-dioxide-capture-best-available-techniques-bat

- a dry lime system to abate acid gases; and
- bag filters to abate particulates.

The flue gas treatment and monitoring systems will ensure that emissions of these pollutants are not passed to the CC process resulting in the significant degradation of the amine solvent or the creation of aerosols.

The design of the CC facility includes the following steps to minimise emissions released to atmosphere from the process:

- a caustic wash within the DCC for removal of acid gases; and
- a water wash prior to release to atmosphere from the absorber column for the abatement of amines, ammonia and other basic species.

The stack height for the CC facility has been optimised. Detailed dispersion modelling has been carried out which shows that the temperature of the release has a significant effect on the level of dispersion of emissions. The stack height proposed (110 m) is 5 m taller than the existing ERF. The dispersion modelling has shown that the impact on air quality of the CC facility is not significant.

8.1.5 Process and emissions monitoring

As detailed within section 4.3.2 the CC facility will include a series of measures to monitor the process and emissions to air.

As detailed in Section 4.3.1.1, four new CEMS will be installed in each of the flues/ducts between each line of the Runcorn ERF and the CC facility to demonstrate compliance with the existing ELVs stated in the EP prior to further treatment within the CC facility.

A range of methods of monitoring the process will be carried out as set out in section 4.3.2. Where appropriate monitoring will meet the MCERTS standards, and external laboratories utilised to undertake monitoring/analysis will be UKAS accredited.

8.1.6 Unplanned emissions to the environment

A vent stack with a common header is included in the design to ensure adequate and safe dispersion of rejected CO_2 from the CC facility as detailed in 3.2.5.

8.1.7 Capture level, including during flexible operation

As detailed within section 3.2.5, the CC process is designed to capture approximately 95% of the carbon dioxide generated by the Runcorn ERF.

During periods of start-up and shutdown of the ERF, the CC facility will not capture CO_2 as there will not be sufficient heat and power required to operate the CC facility.

When the ERF has completed the start-up sequencing and it is in stable operation, the flue gases will be diverted to the CC facility and the CO_2 capture process will be commenced.

8.1.8 CO_2 Compression

Detailed CO2 compression design will be developed by the EPC contractor during the FEED and design stages of the project. At this stage, it is assumed that the compressor will be of a 3-stage design with intercoolers and liquid knockout drums/vessels.

8.1.9 Noise

A Noise Assessment is provided in Appendix E. As concluded in the noise assessment '*noise emissions from operation of the CCS facility would result in negligible impact at all NSRs and for all time periods*'.

8.1.10 Odour

Under normal operation, the CC facility is not anticipated to result in additional odour impacts. Therefore, this application has not considered any change in odour associated with the operation of the CC facility.

8.1.11 Planned and emergency venting of CO_2

Venting of CO_2 will occur in the following scenarios:

- Venting of out of specification product CO_2;
- Temporary venting of CO_2 due to operational upset;
- Depressurisation of equipment to perform maintenance and/or inspections;
- Plant commissioning; and
- Start-up and shutdown.

Details of the arrangement for venting of CO_2 are provided in section 3.2.5.

8.1.12 Cooling

Cooling provision within the DCC will be provided through the use of hybrid evaporative condensers., with supplementary cooling provision to the CC process will be provided by air cooled condensers. An assessment of technology options for the provision of cooling to the CC facility is provided in section 4.5.

The hybrid evaporative condensers require a make-up/feedwater, and the condensate which condenses in the DCC can be re-used for this purpose, reducing the volume of effluent generated and requiring discharge from the CC facility.

8.1.13 Discharges to water

Surface water run-off from building roofs and areas of vehicle movement within the CC facility will be discharged to water as 'uncontaminated surface water run-off'. A penstock valve will be installed on the surface water drainage system to enable the surface water system to be isolated to prevent discharges to surface water in the event of an incident, such as a chemical spill or a fire.

The condensate from the direct contact coolers will be treated prior to use within the hybrid evaporative condensers. Therefore, the only discharge of process effluent from the CC facility will be the blowdown from the hybrid evaporative condensers which is discharged to the MSC. Modelling of the impact of the discharge has been undertaken which has shown that the impact of the discharge on the MSC is not significant.

8.1.14 Climate change adaption

Climate change is likely to result in higher temperatures and more frequent and higher intensity of storm events, resulting in more frequent and severe flooding events. The design of the CC facility is currently being addressed, and it is expected that adaptation to potentially changing climate change impacts will need to be considered within the design, and will include, but not be limited to the following:

- Increased ambient temperatures – the CC facility is designed to operate within a range of ambient temperatures which will include allowances for projected increases in ambient temperatures as a result of climate change.
- Increased flood events – it is assumed that the development platform for the CC facility will be set at a height which is above the flood level. It should be noted that the site is located within Flood Zone 1 and is protected from flooding due to the flood defences provided by the MSC and the River Mersey.

Any additional climate change mitigation measures incorporated into the design of the Facility will be presented within in the Climate Change chapter of the planning application. The planning application is currently being developed, and will be submitted to the planning authority in due course.

8.2 BAT review for the water treatment plant

Whilst the water treatment plant is not regulated as a schedule 1 'installation activity' as it is treating the condensate generated by the CC facility for re-use. However, to demonstrate that it represents BAT, the design and operation of the water treatment plant has been considered in relation to the "Common Waste Water and Waste Gas Treatment/Management Systems in the Chemical Sector", dated May 2016. Whilst this is not directly applicable to the CC facility, it is considered to be the most appropriate BREF to determine whether the water treatment plant represents BAT.

Table 5: BAT Review for Water Treatment Plan

#	BAT Requirement	How met or reference
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 has already been implemented by Viridor for the ERF. The IMS will be extended to include the operation of the CC facility, refer to section 7. On this basis, Viridor considers that the water treatment plant is in accordance with BAT 1.
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 IMS for the CC facility when it is operational. On this basis, Viridor considers that the water treatment plant is in accordance with BAT 2.
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, Viridor considers that the water treatment plant is in accordance with BAT 3.
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 hybrid cooling towers prior to discharge to the Manchester Ship Canal. Viridor proposes to undertake monitoring of the effluent prior to discharge to the Manchester Ship Canal, refer to section 4.3.2.

#	BAT Requirement	How met or reference
		Therefore, Viridor considers that the water treatment plant is in accordance with BAT 4.
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. Therefore, Viridor considers that the requirements of BAT 5 are not applicable.
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. Therefore, Viridor considers that the requirements of BAT 6 are not applicable.
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, to enhance the reuse of waste water within the production process and to recover and reuse raw materials.	The design of the process effluent treatment plan has been designed to maximise the re-use of water and reduce the consumption of main water within the CC facility. On this basis, Viridor considers that the design of the water treatment plant is in accordance with BAT 7.
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.	As explained in sections 3.5 and 4.2.3, surface water run-off from the CC facility will be collected separately to condensate from the DCC. On this basis, Viridor considers that the drainage design for the CC facility is in accordance with BAT 9.
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).	A process water tank to collect DCC condensate prior treatment within the wastewater treatment plant is included within the design to provided provide buffer storage. On this basis, Viridor considers that the design of the water balance for the CC facility is in accordance with BAT 9.

#	BAT Requirement	How met or reference
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 ERF 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. On this basis, Viridor considers that the design of the water balance for the CC facility is in accordance with BAT 10.
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.	As explained in section 3.3, the water treatment plant has been designed with a two stage wastewater treatment plant to ensure that the wastewater is suitably treated to enable re-use within the CC facility prior to discharge to the Manchester Ship Canal. On this basis, Viridor considers that the design of the water treatment plant is in accordance with BAT 11.
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.	As set out in section 3.3, the design of the wastewater treatment plant includes chemical conditioning and stabilisation as required by the BREF. On this basis, Viridor considers that the design of the water treatment plant is in accordance with BAT 12.
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.	Viridor can confirm that it has an existing a waste management plan as part of its IMS. The design of the water treatment plant will enable waste water generated by the CC facility to be re-used prior to discharge to the Manchester Ship Canal. On this basis, Viridor considers that the design of the water treatment plant is in accordance with BAT 13.
14	In order to reduce the volume of waste water sludge requiring further treatment or disposal, and to reduce its potential environmental impact,	As set out in section 3.3, the design of the wastewater treatment plant includes chemical conditioning and stabilisation as required by the BREF.

#	BAT Requirement	How met or reference
	BAT is to use one or a combination of the techniques as set out within the BREF.	On this basis, Viridor considers that the design of the water treatment plant is in accordance with BAT 14.
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. Therefore, Viridor considers that the requirements of BAT 15 are not applicable.
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. Therefore, Viridor considers that the requirements of BAT 16 are not applicable.
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. Therefore, Viridor considers that the requirements of BAT 17 are not applicable.
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. Therefore, Viridor considers that the requirements of BAT 18 are not applicable.
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. Therefore, Viridor considers that the requirements of BAT 19 are not applicable.

#	BAT Requirement	How met or reference
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.	Viridor can confirm that it already has an odour management plan as part of the IMS for the ERF. This will be extended to include the operation of the CC facility, which will include the water treatment plant. On this basis, Viridor considers that the operation of the water treatment plant is in accordance with BAT 20.
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. Therefore, Viridor considers that the requirements of BAT 21 are not applicable.
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 part of the environmental management system (see BAT 1), that includes all of the elements set out in the BREF.	Viridor can confirm that it already has a noise management plan as part of the IMS for the ERF. This will be extended to include the operation of the CC facility, which will include the water treatment plant. On this basis, Viridor considers that the operation of the water treatment plant is in accordance with BAT 22.
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 EP application, refer to Appendix E. As concluded within the noise assessment, the noise impacts associated with the implementation of the CC facility will be ‘not significant’. On this basis, Viridor considers that the design of the water treatment plant is in accordance with BAT 23.

9 Pre-operational & Improvement conditions

9.1 Pre-commencement conditions

Prior to commencement of commissioning of the CC facility, Viridor would propose to provide the EA with a written commissioning plan for the CC facility, including timelines for completion, for approval by the EA.

The commissioning plan shall include the expected emissions to the environment during the different stages of commissioning, the expected durations of commissioning activities and the actions to be taken to protect the environment and report to the EA in the event that actual emissions exceed expected emissions. Commissioning shall be carried out in accordance with the commissioning plan as approved.

9.2 Post commissioning conditions

Following commissioning of the CC facility, Viridor would propose to submit written reports to the EA setting out the following:

- the performance and optimisation of the CC facility; and
- the commissioning of the CC facility, summarising the environmental performance of the Facility as installed against the design parameters set out in the EP application.

A Plans and Drawings

A.1 Site Location Plan

A.2 Site Layout Drawing

A.3 Installation Boundary – ERF activity

A.4 Installation Boundary – CC facility

A.5 Emissions Points Drawing

A.6 New additional land

A.7 CCS Process Overview

B CHP Report

C Environmental Risk Assessment

D Air Quality Assessments

D.1 Air Quality Assessment

D.2 Dioxins Pathway Assessment

E Noise Assessment

F Updated Site Condition Report

G Minutes from pre-application meetings

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