Net Zero Teesside

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4. Proposed Development

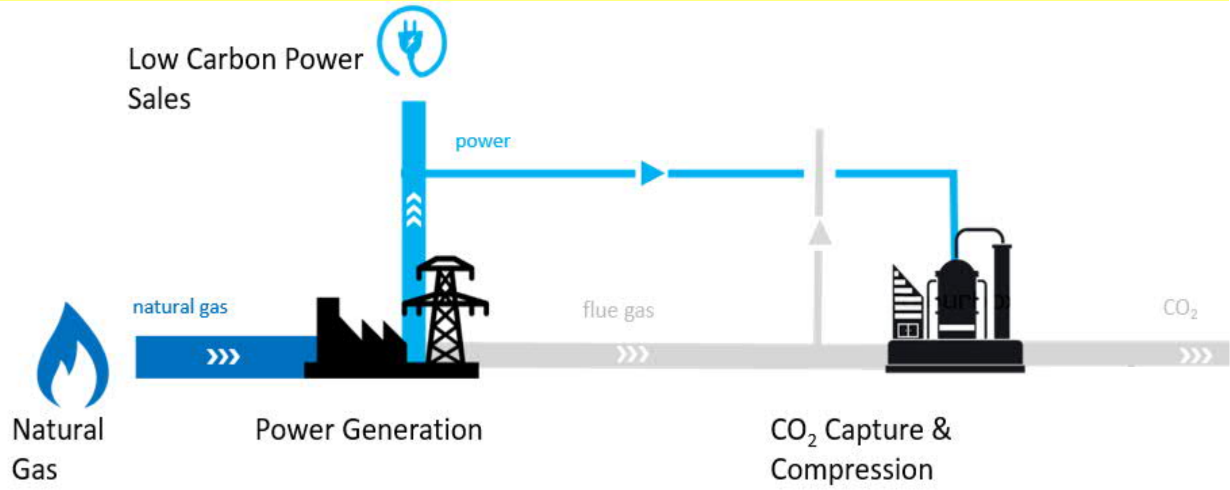
4.1 Introduction

4.1.1 The Proposed Development comprises the construction (including site clearance and remediation), operation (including maintenance) and decommissioning of a Carbon Capture Utilisation and Storage (CCUS) facility comprising a gas-fired power station with a net (abated) electrical output of up to 2.1 GW together with equipment required for the capture and compression of carbon dioxide (CO_2) emissions from the generating station. In addition, there is a need for the provision of supporting infrastructure and connections to facilitate the Proposed Development and to integrate it to a wider industrial carbon capture network in Teesside, the construction of which also forms part of this project. The project also includes high-pressure compression of CO_2 and export for off-shore storage.

4.1.2 Whilst the proposed development is designed for the future collection and sequestration of CO_2 from third-party industrial emitters, the capture and compression of third-party CO_2 emissions will not form part of the DCO application (and is not considered in this Preliminary Environmental Information (PEI) Report) but will be the subject of separate consent applications.

4.1.3 A schematic of the proposed development is shown in Diagram 4.1.

Diagram 4.1: The Proposed Development



4.1.4 The National Infrastructure Plan (NIP, 2014) sets out a vision for the development of infrastructure within the UK and in doing so, reinforces the Government's commitment to investing in infrastructure and improving its quality and performance. In relation to the UK Energy System, the NIP states that strategic investment in gas and low-carbon electricity generation is vital in order to replace ageing energy infrastructure, maintain secure energy supplies and meet legally binding environmental targets.

4.1.5 Given the inherent intermittency of the primary forms of Renewable Energy (On-shore Wind, Off-shore Wind and Solar Photovoltaics'), other sources of generation are required in order to complement Renewables whilst maintaining supply. This is acknowledged by the NIP which reports that 'New gas plant is also needed as a vital backup for less flexible renewable generation and to ensure that the system can meet peak electricity demand' (NIP, 2014). More recently, The National Infrastructure Commission (NIC) have highlighted the role of flexible generation as being playing a vital role alongside a 'highly renewable power system (NIC - Net Zero – Opportunities for the Power Sector, 2020).

4.2 Project Elements

4.2.1 The Proposed Development includes the following elements:

1. A New Build low carbon(clean) gas-fired power station with integrated carbon capture unit, low pressure compression and associated utilities and buildings (**Power and Capture Site**);
2. High Pressure CO_2 Compression facilities (**HP Compressor Station**);
3. High pressure CO_2 export pipeline (**CO_2 Export Pipeline**);
4. Gaseous Phase CO_2 Gathering Network connecting various industrial installations across the Tees Valley (**CO_2 Gathering Network**);
5. Natural gas pipeline to supply the power station to support the clean power development (**Gas Connection Corridor**);
6. Power export lines from the power station to the national transmission system to support the clean power development (**Electrical Connection Corridor**); and
7. **Water Connection Corridors** including:
   - A connection corridor to Northumbrian Water Ltd, for the provision of water for the Proposed Development (**Freshwater Connection Corridor**);
   - An intake within the River Tees, which would be utilised in the event that the Northumbrian Water Ltd connection is not available or there is insufficient capacity, for provision of water for the Proposed Development (**Water Abstraction Corridor**); and
   - Disposal of treated effluent to Tees Bay subject to Environment Agency Permitting requirements (**Water Discharge Corridor**).

4.2.2 The Power, Capture and Compressor facilities together are termed the PCC in this PEI Report. Further details of the Proposed Development are set out in Section 4.3 and Figures 3-2A to E in PEI Report, Volume II.

4.2.3 The design of the Proposed Development, at this stage of the project, incorporates a degree of flexibility in the dimensions and configurations of buildings and structures to allow for the future selection of the preferred technology and contractor.

4.2.4 In order to ensure a robust assessment of the likely significance of the environmental effects of the Proposed Development, the Environmental Impact Assessment (EIA) is being undertaken adopting the principles of the 'Rochdale Envelope' approach where appropriate. This involves assessing the maximum (or where relevant, minimum) parameters for the elements where flexibility needs to be retained (building dimensions or operational modes for example). Where this approach is being applied to the specific aspects of the EIA, this is confirmed within the relevant chapters of this Preliminary Environmental Information (PEI) Report. Justification for the need to retain flexibility in certain parameters is also outlined in this chapter and in Chapter 6: Alternatives and Design Evolution (PEI Report, Volume I). As such, this PEI Report represents a reasonable worst-case assessment of the potential impacts of the Proposed Development at its current stage of design.

4.2.5 Construction of the Proposed Development is detailed in Chapter 5: Construction Programme and Management (PEI Report, Volume I). At this stage a detailed construction programme is not available as this is normally determined by the Engineering Procurement and Construction (EPC) contractor who has not yet been appointed; however, an indicative programme is presented within Chapter 5 on which the potential environmental effects of the Proposed Development have been assessed.

4.2.6 Following grant of a Development Consent Order (DCO) for the Proposed Development (which at this stage is anticipated around Q1 2022), construction is likely to commence later in 2022, with operation commencing in 2026 at the earliest.

4.2.7 The Power and Capture elements of the Proposed Development are comprised of up to three "trains" of plant, each comprising a single CCGT unit with associated carbon capture. The first train would be constructed, commissioned and operated initially, with the other two trains installed once the first unit is operational. Three alternative programme scenarios are considered in this PEI Report:

i. a single three train constructed from 2022 and becoming operational by 2024; or

ii. all three trains constructed sequentially from 2022 and becoming operational over the period 2024 to 2026; or

iii. the first train operational by 2024, with trains 2 and 3 constructed sequentially commencing in 2028 and all three trains operational by 2031.

4.2.8 It is envisaged that the power station and carbon capture elements of the Proposed Development will have a design life of around 25 years. At the end of the design life, these elements would be assessed for ongoing viability and, if appropriate, be decommissioned as outlined in Section 4.5 below. It is anticipated that decommissioning of the power station and carbon capture elements will most likely commence at some point after 2051.

4.2.9 The CO_2 Gathering Network and CO_2 Export Pipeline have been designed to operate independently of the power generation and carbon capture plant and will have a design life of 40 years. The HP Compressor station has a design life of 25 years and may need refurbishment to continue operations past this.

4.2.10 This chapter is supported by Figures 3-2A to E in PEI Report, Volume II, which show the layout of the Proposed Development.

4.3 Components of the Proposed Development

Power and Capture Site

Overview

4.3.1 The proposed Power and Capture site will be a gas powered power plant with carbon capture. It will comprise up to three Combined Cycle Gas Turbine (CCGT) units each with a nominal power export capacity of 700 MWe abated (i.e. following application of carbon capture and low pressure compression), or 800 MWe (if operating in unabated mode). The proposed power station would therefore have a nett output capacity of up to 2.1 GW (abated) and 2.4 GW (unabated). The maximum power generation will be seasonally dependent; for example, the station will generate a maximum of 840 MWe in unabated mode and 790 MWe in abated mode in the winter when air density is at its highest and the CCGT can produce maximum power. The location of the Power and Capture site is shown on Figure 3-2A (PEI Report, Volume II).

4.3.2 It is expected that the power station will be designed on a modular basis such that each CCGT unit will form part of an integrated power generation and carbon capture train comprising:

- natural gas conditioning equipment;
- a gas turbine;
- a heat recovery steam generator (HRSG);
- a steam turbine;
- selective catalytic reduction (SCR) equipment for the removal of nitrogen oxides (NOx) from the flue gas;
- absorber column for carbon capture;

- CO_2 treatment and low pressure compression
- hybrid cooling cells;
- one auxiliary boiler and/or a diesel generator;
- three stacks for the discharge of emissions to air from the HSRG, absorber column and auxiliary boiler;
- transformers (for the import and export of electricity); and
- ancillary equipment (including air compressors, pumps, chemical storage, fan coolers, water treatment).

4.3.3 The electrical, steam and water circuits within each train and the capture plant will be integrated as far as is technically practicable in order to reduce energy use. For example, steam will be extracted from the HRSG for use in the capture plant and, once used, condensed and returned to the HRSG for re-use.

Power Generation

4.3.4 Natural gas that has been conditioned to the required temperature and pressure will be combusted in the CCGT. The gas turbine selected will be provided with dry low NOx (DLN) burners to minimise the formation of NOx.

4.3.5 Following combustion, the hot product gases enters the gas turbine where they will expand across the blades of the turbine causing it to rotate and drive an electrical generator. The gas turbine exhaust gases are passed through the HRSG to recover the useful heat within them in order to produce steam (at various pressures) to generate further power via a separate steam turbine, and for heating of process streams within the carbon capture unit.

4.3.6 Spent steam from the steam turbine will be cooled and condensed with the condensate returned to the HRSG for reuse. Water used within this steam/water cycle will need to be treated to be of extremely high purity to manage the build-up of residual dissolved solids in pipework arising from the continuous evaporation and condensing of water within the cycle. To further manage this risk, it will be necessary to purge a small amount of the recirculating water (known as boiler blowdown) intermittently. Any blowdown removed from the cycle will need to be made up with fresh demineralised water.

4.3.7 The condensation of steam exiting the steam turbine will be achieved using wet/dry (hybrid) cooling towers in each train which are specifically designed to minimise the formation of visible plumes, although some may occur dependent on the ambient weather conditions.

4.3.8 The need for an auxiliary boiler at the power and capture site will be considered in further design studies going forward. If required, the auxiliary boiler would provide heat/steam during commissioning, start-up, shutdown and maintaining carbon capture equipment in a “hot” or “warm” stand-by state when the CCGT is off-line. Exhaust emissions from the auxiliary boiler would be via a dedicated stack. An inline electrical heater would also be used to heat the fuel gas to the gas turbine prior to the availability of steam during start-up.

4.3.9 Emergency diesel generators may need be installed in order to provide a short-term source of electricity, in the event of a simultaneous loss of power generation and external power supply, to provide power for emergency and safety critical equipment until external power can be re-established.

Selective Catalytic Reduction

4.3.10 Combustion of natural gas is highly efficient and, as such, the combustion gases from a typical CCGT plant contain negligible amounts of sulphur dioxide (SO_2) and particulate matter. In addition, the optimisation of combustion within a gas turbine is well understood, such that the emissions of NOx and carbon monoxide (CO) are carefully controlled by design and typically through the implementation of primary control measures such as burner design and staged combustion.

4.3.11 In July 2017, revised Best Available Techniques (BAT) Conclusions for Large Combustion Plants were published, which set out the Achievable Emission Levels (AEL) for combustion plant, including new CCGTs. These AELs may not be achievable, even in high efficiency CCGT plant using, when using primary control measures (such as use of DLN burners) alone.

4.3.12 NOx concentrations in the flue gases also need to be minimised to prevent the degradation of solvent within the carbon capture plant in order to optimise the CO_2 capture efficiency.

4.3.13 Selective Catalytic Reduction (SCR) will therefore be required to control NOx levels entering the carbon capture system. SCR is a secondary abatement technique typically involving either the injection of ammonia or urea into the flue gas to react with any NOx present in the presence of a catalyst. The SCR equipment, using urea injection, will be installed within the HRSG, as is common practice within the power industry.

4.3.14 The level of NOx removal required is the subject of on-going technical studies regarding the capture plant and emission limits that will be required to be met from the generating station and will be partially dependent upon the sensitivity of the carbon capture solvent to NOx. These studies will seek to optimise the operation of a plant in order to maximise efficiency and minimise emissions and waste.

4.3.15 In a conventional CCGT plant, the treated flue gas from the SCR are released from a stack dedicated to each unit. However, in this plant, for each train, the flue gas post SCR will be directed into the carbon capture plant for the removal of carbon dioxide from the gas stream. However, there will still be a stack located between the HRSG and the capture plant for use when the plant is running in unabated mode at times when the carbon capture plant is not operational.

Capture Plant

4.3.16 Each CCGT will be served by a dedicated ‘capture facility’ (as one integrated train). The capture facility will include:

- flue gas pre-treatment, including cooling/scrubbing and flue gas blower;
- CO_2 absorption column (absorber);
- CO_2 removal column (stripper/regenerator); and
- ancillary equipment (including air compressors, pumps, chemical storage, external pipework).

4.3.17 The capture plant will be designed to capture approximately 95% (w/w) of the CO_2 emitted from the generating station, with an average capture rate of around 90% (subject to completion of studies and commercial agreement). At full load, this could equate to a capture of 1.7 to 2 million tonnes of CO_2 per unit (up to 6 million tonnes in total) per year, dependent upon the turbine equipment chosen and the running hours of the plant.

4.3.18 Prior to their introduction into the absorber column, the flue gases from the generating station will be cooled to the required design temperature (approximately 40°C) potentially by using a direct contact cooler/flue gas quencher that contacts the hot flue gases with a fine water spray in a column.

4.3.19 Once cooled, the flue gases from the generating station will be introduced to an absorber column. In the column, the flue gases will be passed through a solvent that will remove the CO_2 from the gas stream. The solvent to be used is the subject of on-going technical studies but is assumed to be an aqueous solution of amines. The alkaline nature of the solvent will mean that it will selectively absorb acidic gases such as CO_2.

4.3.20 Even with the use of SCR technology, it will not be possible to entirely remove NOx or other impurities from the flue gases from the generating station, therefore, some solvent will need to be purged and made-up with fresh solvent.

4.3.21 The CO_2 lean flue gases (treated flue gas) will then exit from the top of the absorber column via a dedicated stack for dispersion to the atmosphere. A flue gas washing unit is usually located as a separate stage within the absorber column to remove entrained solvent from the flue gases prior to release.

4.3.22 CO_2 rich solvent from the absorber will pass from the bottom of the absorber column to a stripper column for regeneration. The stripper column uses heat to release the CO_2 from the solvent. The hot CO_2 lean solvent then leaves the stripper column and is recirculated, likely via a heat exchanger, back to the top of the absorber column.

4.3.23 The CO_2 gas exiting the top of the stripper column will be passed through a condenser to remove water and solvent vapours. The CO_2 stream will then pass to the LP CO_2 conditioning/compressor unit.

CO_2 Conditioning and LP Compressor Unit

4.3.24 The gas CO_2 stream from the capture plant will be saturated with water and will contain traces of oxygen which will need to be reduced in a gas conditioning facility at the emitter sites prior export to the CO_2 gathering network.

4.3.25 The conditioning equipment/processes are the subject of on-going technical studies; however, it is envisaged that the captured CO_2 stream will be cooled and partly compressed before the trace oxygen and water are removed.

4.3.26 Once compressed, treated and metered, the CO_2 stream will be at a pressure between 12 and 20 bar above ambient pressure (barg) and discharged into the CO_2 Gathering Network. At this stage, it is not considered that any on-site storage of compressed CO_2 will be required.

Water Treatment

4.3.27 A water treatment plant (WTP) will be needed to treat the water feed to the plant to remove dissolved solids present and provide make-up water to the steam/water cycle, cooling water system, fire water system and for dilution of make-up solvent within the capture plant. The design of the Proposed Development may include individual WTPs for each train for include for a larger WTP serving the whole generating station.

4.3.28 Water treatment is assumed to be required for process effluent discharged to Tees Bay.

CO_2 Gathering Network

4.3.29 The UK Government published its Clean Growth Strategy in October 2017 which included CCUS as part of the strategy for decarbonisation. Net Zero Teesside (as the Teesside Collective) has been actively engaged in the development of industrial CCS solutions for some time in the area identified for the Proposed Development.

4.3.30 It is intended that the Proposed Development facilitates future third-party industrial carbon capture connections to the off-shore storage site. The technical evaluation of this is ongoing and is likely to require the use of a low pressure CO_2 Gathering Network in the surrounding area to allow different users to connect CO_2 streams into the CO_2 Gathering Network.

4.3.31 The capture and compression of CO_2 from third-party industrial emitters will not form part of the DCO application and is not considered in this PEI Report but will be the subject of separate consent applications.

4.3.32 The CO_2 Gathering Network will predominantly use an existing above ground pipe network route running along existing pipe racks and using existing culverts and overbridges, however it may be necessary to install the pipe below ground if pipe racks are not available. It is initially proposed to have a design capacity of the order of 6 million tonnes of CO_2 a year. The CO_2 gathering network, together with CO_2 captured from the power station will pass to the high pressure Compressor Station for export.

4.3.33 The CO_2 gathering network is proposed to start in Billingham, pass through the Seal Sands industrial area and across the River Tees to the South Bank prior to collecting CO_2 from other emitters before entering the HP Compressor Station at the PCC. The CO_2 Gathering network will need to cross the River Tees. The crossing of the Tees is proposed to be using trenchless technologies or through an existing tunnel. This PEI Report has assessed use of trenchless technologies as the worst-case scenario, which may include either horizontal direct drilling or an auger bored tunnel.

4.3.34 The potential routeing of the CO_2 Gathering Network Figure 3-2E (PEI Report, Volume II).

CO_2 Export Pipeline

4.3.35 CO_2 export is expected to include an on-shore HP Compressor Station located adjacent to the Power and Capture plant, and the commencement of an export pipeline to the off-shore elements of the NZT development. The offshore elements will be separately consented and do not form part of the Proposed Development – including the off-shore portion of the CO_2 Export Pipeline, the CO_2 store itself and CO_2 injection wells into the store and the associated off-shore infrastructure (either platform or subsea or combination thereof) (see Section 4.6).

High Pressure Compressor Station

4.3.36 The HP Compressor Station is the collection point for CO_2 from the low pressure CO_2 Gathering Network and Power and Capture plant.

4.3.37 The Compressor Station will consist of inlet metering, dehydration and compression facilities. CO_2 will compressed from a pressure of around 12 barg at the inlet to a pressure between 120 to 160 barg (‘dense phase’) prior to introduction into the CO_2 Export Pipeline.

4.3.38 The HP Compressor Station will be located on land adjacent to Coatham Dunes to minimise the on-shore length of the high-pressure CO_2 Export Pipeline. The exact orientation is currently being studied as well as the integration with the Power and Capture plant. The location of the Compressor Station is shown on Figure 3-2A (PEI Report, Volume II).

4.3.39 The design life of the Compressor Station is longer than the power and capture elements of the Proposed Development. Power for the Compressor Station (30 MWe for one CCGT train operational and 80 MWe when three trains are operational) will therefore be supplied from the National Grid, rather than the CCGT plant.

CO_2 Export Pipeline

4.3.40 It is proposed that the conditioned and compressed CO_2 will be transported off-shore via a new pipeline that will direct the dense phase fluid to the subsurface storage site. The storage site will be located in an underground storage reservoir beneath the North Sea located approximately 150 km to the east-southeast of the Proposed Development.

4.3.41 The on-shore section of the CO_2 Export Pipeline will have a diameter of up to 800 millimetres (mm) and will be installed below ground, with the depth increasing for areas below key receptors or infrastructure.

4.3.42 The route corridor considered for the on-shore section of the CO_2 Export Pipeline to be consented by the DCO is shown in Figure 3-2A in PEI Report, Volume II.

4.3.43 The part of the CO_2 Export Pipeline covered by the DCO will start within the PCC boundary at the HP Compressor Station and pass under the private road to South Gare, under Coatham Dunes and Sands to MLWS. To facilitate this, the pipeline will need to cross parts of the Teesmouth and Cleveland Coast SPA/Ramsar and the Teesmouth and Cleveland Coast SSSI.

4.3.44 In order to minimise disturbance and impacts to the international designated sites, if feasible, the pipe will be installed using trenchless technologies techniques commencing from within the HP Compressor Site. However, the use of open cut techniques through the dunes and sands will also be assessed in order to confirm the selection of the most appropriate technique which will have no residual effects on the international designations. Open cut methods may also be required due to the potential presence of unexploded ordnance from World War II in the coastal area. Trenchless technologies will be used to continue pipeline installation from the foreshore onward.

4.3.45 The off-shore works associated with construction and operation of the CO_2 pipeline beyond MHWS and operation of the off-shore storage facility will be consented through a separate off-shore consent via a separate Marine Licence (ML) application to the Marine Management Organisation (MMO) supported by a separate EIA (see Section 4.6)[1]. Environmental effects from the construction and operation of the off-shore elements of the development will be considered as part of the cumulative impact assessment that will form part of the ES for the Proposed Development (see also Chapter 24: Cumulative and Combined Effects in the PEI Report).

Other Connections

Gas (Fuel) Connection

4.3.46 Natural gas will be used as the fuel for the operation of the CCGT. Subject to agreement with National Gas Grid (NGG), natural gas will be supplied via a tie-in to the HP gas transmission network in the area. It is currently anticipated that this will be on the north bank of the Tees at Seal Sands and will require a crossing of the Tees. The route corridor being considered for connection to the high-pressure transmission system is shown in Figure 3-2B in PEI Report, Volume II.

[1] Land between MHWS and MLWS is covered by both the DCO and Marine Licensing regimes

4.3.47 The Gas Connection will be placed below ground using a combination of open-cut and trenchless technologies, depending on the constraints or crossings required. The gas pipeline will connect to an new Above Ground Installation (AGI) on the NGG and a gas receiving station will be required on the PCC.

4.3.48 The Gas Connection will need to cross the River Tees. The preferred construction option for crossing the River Tees is currently being assessed, but is likely to be using trenchless technologies.

Electrical Connection

4.3.49 The existing electrical infrastructure in the area comprises 275 kilovolt (kV) and 400 kV overhead lines as well as lower voltage underground cables that serve, amongst others, three substations.

4.3.50 In order to export electricity from the Proposed Development, engagement is ongoing with National Grid to identify the preferred connection option. It is anticipated that the Proposed Development will require a direct connection to the 400 kV system, due to its total electrical generation capacity.

4.3.51 A 400 kV overhead line runs approximately north-west/south-east approximately 5 km south-west of the PCC, at its nearest point (Lackenby Substation). The Lackenby Substation steps down the voltage to 275 kV along an overhead line that runs north-east to a point approximately 1 km south of the PCC at Todd Point Sub-station.

4.3.52 The size, timing and location of the connection to the NETS will be determined in consultation with National Grid. At this stage several options are under consideration and the potential route corridors being considered are shown in Figure 3-2C in PEI Report, Volume II. Should routeing of the Electrical Connection from the PCC to Lackenby Substation, need to pass to the east and south of the Wilton International Site, the connection will be undergrounded to minimise impacts on residential and ecological receptors.

Water Connections

4.3.53 Water will be required to provide cooling for the Power and Capture site. Process water will also be required in order to provide make-up to the steam/water cycle of the Power and Capture plant. There will also be a requirement for water for domestic and sanitary use.

4.3.54 The preferred source of water is from the existing Northumbrian Water Ltd. feed to the former SSI Steelworks subject to sufficient capacity being available. In the event that this is not available or there is insufficient capacity, the Applicant is also examining the potential for utilising the existing intake from the former SSI Steelworks to supply water to the Proposed Development. It is likely that works would be required in order to upgrade parts of the existing abstraction infrastructure (e.g. to comply with the Eels (England and Wales) Regulations 2009). If reuse is not possible, replacement of the infrastructure is being assessed as a worst-case, along the same or a similar route within the Abstraction Corridor.

4.3.55 Wastewater disposal could be via Northumbrian Water's wastewater treatment facilities and outfall. In the event that this is not feasible or there is insufficient capacity to treat all wastewater, the Applicant is examining the potential for the reuse of existing assets for the discharge of treated effluent to Tees Bay using an existing outfall for discharge of water from the former Steelworks.

4.3.56 If reuse of this outfall is possible, it may require upgrading or replacing within the Water Corridors. As replacement represents the worst-case option, both this and refurbishment are assessed in this PEI Report.

4.3.57 As part of refurbishment and/or replacement works within the Water Corridors, various ancillary works may be required.

4.3.58 Discharge of domestic/sanitary effluent, would be to the local sewerage system.

4.3.59 The location of the Water Connections is shown on Figure 3-2D in PEI Report, Volume II.

Chemical Storage

4.3.60 A number of chemicals will be required to be stored and used on the PCC (refer to section 4.3.5). Some of these materials will be classed as hazardous. Where any substance could pose a risk to the environment through its uncontrolled release (e.g. surface water drains), the substance will be stored within appropriate containment facilities including impermeable concrete surfaces and appropriately designed and sized bunds.

4.3.61 The inventory of materials to be stored on the PCC will be developed through the design process. However, where storage of hazardous materials, individually or in-combination exceeds the relevant thresholds, separate permissions will need to be sought from the HSE and local planning authority as appropriate for their storage, under the Hazardous Substance Consent and COMAH regimes. All chemical storage will be regulated by the Environment Agency through an environmental permit that will be required for the operation of the generating station and associated carbon capture and compression equipment.

Design Parameters

4.3.62 The design of the Proposed Development is iterative and may change as the EIA process progresses. However, the design parameters defined within the DCO will be retained in order to allow construction of the Consented Development to progress from Q3 2022. The evolution of the Proposed Development to date is outlined in Chapter 6: Alternatives and Design Evolution.

4.3.63 A number of the design aspects and features of the Proposed Development cannot be confirmed until the EPC construction contractor has been appointed. For example, the building sizes may vary depending on the contractor selected and their specific configuration and selection of plant. Focussed use of the Rochdale Envelope approach has therefore been adopted to define appropriate parameters for use in the EIA.

4.3.64 Table 4.1 sets out the maximum dimensions for the layout of the Proposed Development which have been used for the basis of the various technical assessments. Maximum parameters have been devised to enable the EIA to progress in the absence of the final design information and to enable the compilation of a robust assessment based on a reasonable and appropriate worst-case option.

4.3.65 Existing ground levels at the proposed location of the PCC are approximately 4 to 13 m AOD. Ground elevations post site clearance and remediation and final finished floor levels are the subject of on-going studies and will be confirmed in the EIA to accompany the DCO application.

Table 4-1. Maximum Design Parameters (per CCGT Train)

Component	Dimensions(m)		
	Length	**Width**	**Height**
Gas Turbine Hall	76	76	30
HSRG	63	28	50
Steam Turbine Hall	64	54	30
Absorber	35	25	62
Stack		6.5 m inner diameter	80 – 120 m above ground level

4.3.66 Further information on limits of deviation will be provided in the draft DCO and described in the final ES.

4.4 Proposed Development Operation

Operational Modes

4.4.1 The power plant is designed to be able to operate in either baseload or dispatchable mode in the future.

4.4.2 Baseload power refers to generation that generally runs continuously throughout the year and the plant is operated at stable power output levels. Dispatchable generation refers to operation on demand and dispatched according to market needs.

4.4.3 A power station running in both baseload and dispatchable modes is:

- responsive to seasonal demand fluctuation;
- responsive to daily demand fluctuation (flexible power);

- able to cope with renewables intermittency (in particular wind) by replacing the electricity supplied by renewables at time of low renewable generation capacity; and
- able to adapt to changing market in the future (increase in renewables capacity anticipated).

4.4.4 It is anticipated that on commissioning, the plant will operate in baseload mode with continuous operation with carbon capture for several years. Continuous and stable CO_2 production and export is essential during this period to minimise changes to injection rates to the offshore underground storage reservoir.

4.4.5 After a period of base-load operation, and after CO_2 within the gathering network has stabilised, there is the opportunity for the CCGT plant to operate in dispatchable mode, i.e. being able to export power in the day-ahead market to match the anticipated intermittency of renewable power in the future power market. Operating in dispatchable mode could involve between 40 and 80 start-up/shutdown cycles per year.

Hours of Operation

4.4.6 The facility will be designed to operate 24 hours per day, 7 days per week with programmed offline periods for maintenance.

Staff

4.4.7 It is anticipated that during the operational phase, the Proposed Development will generate approximately 100 full-time permanent jobs Operations staffing will be on a shift basis to be spread over a 24-hour period.

4.4.8 Temporary and contractor employees associated with maintenance activities will also be employed at the site as required.

Process Inputs

4.4.9 The Proposed Development will use various raw materials during operation. Except for water, these will be delivered to the facility in bulk transportation vehicles. Storage capacity on site will be set to reflect the process requirements and delivery capability.

4.4.10 The Proposed Development will also use a number of chemicals during operation. These are anticipated to include:

- water treatment chemicals (including sodium hypochlorite, hydrochloric/sulphuric acid, sodium hydroxide, sodium hypochlorite, carbohydrazide (or alternative oxygen scavenger), urea and trisodium phosphate);
- distillate fuel;
- urea for NOx control;

- nitrogen (natural gas system and other equipment purge);
- cleaning chemicals;
- acetylene (metal cutting);
- inert fire-fighting gases;
- lubricating oils;
- hydrogen for generator cooling and deoxygenation of product CO_2 stream; and
- carbon dioxide for purging of electrical generators for maintenance purposes.

4.4.11 In order to reduce the risks of contamination to processes and surface water, all liquid chemicals stored on site will be kept in bunded controlled areas with a volume of 110% of storage capacity.

Maintenance

4.4.12 The objective of plant maintenance is to ensure the Power, Capture and Compressor elements of the site and the Connections operate safely and reliably.

4.4.13 Routine maintenance will be planned and scheduled via the maintenance management system with major overhauls occurring approximately once every five years on each unit. These maintenance activities will require additional contractors to work on-site. The contractors will access the Site via the main entrance.

4.4.14 Inspection and Maintenance activities are one of a number of key criteria for determining the PCC footprint and layout. The maintenance strategy to be adopted will use established methods such as Risk Based Inspection (RBI) and Reliability Centred Maintenance (RCM) to support the required facility availability. Therefore, to support the maintenance strategy for the PCC facilities each major equipment item will have appropriate access and laydown areas and the road scheme for the PCC will enable free movement for cranes and heavy lifting equipment.

4.4.15 Pipeline inspection plans will be prepared and if required, PIG launching and receiving facilities for intelligent pigging operations will be considered.

4.4.16 It is anticipated that an integrated Operations and Maintenance (O&M) team will have responsibility for daily operations, including troubleshooting and effecting minor repairs on the PCC. Major O&M interventions (turn-arounds, turbine overhauls, etc) are likely to be outsourced and major equipment items serviced by original equipment manufacturers.

4.4.17 It is intended that major maintenance activities be harmonised around the longest or most constrained outages. For example, it is likely that maintenance of the CO_2 compressors will be aligned with shutdowns of the CO_2 emitter facilities and/or a single Power/Capture train.

Hazard Prevention and Emergency Planning

4.4.18 The Applicant aims to protect human health by safely and responsibly managing activities on site. A Health and Safety Plan covering the works, commissioning and operation of the Proposed Development will be prepared by the Operator. For design and construction, a competent and adequately resourced Construction (Design and Management) (CDM) Coordinator and Principal Contractor will be appointed. The Applicant will ensure that its own staff, its designers and contractors follow the Approved Code of Practice (ACoP) laid down by the CDM Regulations 2015.

4.4.19 Written procedures clearly describing responsibilities, actions and communication channels will be available for operational personnel dealing with emergencies. Procedures will be externally audited and contingency plans written in preparation for any unexpected complications.

4.4.20 Depending on the volumes of hazardous materials stored on Site, a Hazardous Substances Consent and if necessary, a lower tier COMAH licence will be obtained. This will introduce additional hazard prevention and emergency planning procedures.

4.4.21 As set out in Chapter 22: Major Accidents and Natural Disasters (PEI Report, Volume I), CO_2 is not harmful to human health at low concentrations, it is not flammable and will not support combustion. As the concentration of CO_2 in air rises, the hazardous effects on people and the environment increase, however, compared with other materials conveyed via major pipelines in the UK, such as natural gas and ethylene, the risks of harm (e.g. of asphyxiation or cooling) are relatively low. The key risk relates to its potential to act as an asphyxiant gas at low lying locations should it displace air from these locations due to its density being higher than that of air.

4.4.22 Guidance and best practise information for carbon capture technology and transport via pipeline is available from the Health and Safety Executive (HSE). The HSE does not currently provide Land Use Planning (LUP) advice for CO_2 capture, transport or storage, and the status of the project relating to the Control of Major Accident Hazards (COMAH) Regulations has not yet been confirmed. However, the HSE is a statutory consultee for all Nationally Significant Infrastructure Projects (NSIPs), such as the Proposed Development therefore consultation with the HSE will be ongoing throughout the design and planning process.

4.4.23 CO_2 is not currently defined as a dangerous substance under The Control of Major Accident Hazards Regulations 2015 (COMAH). The Pipeline Safety Regulations 1996 do not consider an on-shore high pressure CO_2 pipeline as a Major Accident Hazard Pipeline (MAHP). However, given the volume of CO_2 to be exported, the CO_2 pipeline will be designed, installed and operated as if it were a MAHP, and the high-pressure CO_2 were to be classified as a 'dangerous fluid'. A Major Accident Prevention Document (MAPD) will be produced during the design process and the Health and Safety Executive (HSE) will be consulted. The HP Compressor Station and the CO_2 Export Pipeline have been located to maximise the distance to residential properties and to minimise the length of the on-shore part of the CO_2 Export Pipeline.

External Lighting

4.4.24 Prior to the commissioning of the Proposed Development a detailed lighting scheme will be submitted to RCBC for approval. The external lighting scheme will be designed in accordance with relevant standards, such as the Guidance Notes for the Reduction of Obtrusive Light (2020) published by the Institute of Lighting Engineers and/or Chartered Institution Building Services Engineers (CIBSE) requirements, as appropriate.

4.4.25 The external lighting scheme will be designed to provide safe working conditions in all areas of the Site whilst reducing light pollution and the visual impact on the local environment. This is likely to be achieved using luminaires that eliminate the upward escape of light.

Environmental Management

4.4.26 The Proposed Development will comply with the 2010 Industrial Emissions Directive (IED) (Directive 2010/75/EU) under its Environmental Permit so that any impacts of emissions to air, soil, surface and groundwater, to the environment and human health will be minimised and avoided where possible.

4.4.27 The Site will be operated in line with appropriate standards and the operator will implement and maintain an Environment Management System (EMS) which will be certified to International Standards Organisation (ISO) 14001. The EMS will outline requirements and procedures required to ensure that the Site is operating to the appropriate standard.

4.4.28 Sampling and analysis of pollutants will be undertaken where required including monitoring of exhaust emissions levels using a Continuous Emissions Monitoring System (CEMS) prior to discharge from the stacks, in accordance with the Environmental Permit.

Heavy Good Vehicle Movements

4.4.29 The site will be accessed from the A1085 via the former SSI Steelworks entrance. Operational and Construction traffic movements are detailed within the Transport Assessment (TA) (Appendix 16A , PEI Report, Volume III). In summary it is anticipated that during the operational phase of the Proposed Development, total Heavy Goods Vehicle (HGV) movements at the PCC will be around 40 in and 40 out per day. These figures include movements associated with delivery of consumables and removal of waste products.

4.4.30 The air quality, noise and transport assessments (Chapters 8, 11 and 16 respectively in PEI Report, Volume I) consider the worst-case traffic profile relevant to that topic.

4.4.31 Construction traffic movements are described in Chapter 5: Construction Programme and Management (PEI Report, Volume I).

4.5 Decommissioning

4.5.1 The power generation and carbon capture elements of the Proposed Development are expected to have a design life of approximately 25 years. At the end of its design life it is expected that these elements of the Proposed Development may have some residual life remaining and the operational life may be extended. The design life of the CO_2 Gathering Network, the HP Compressor Station and the CO_2 Export Pipeline is anticipated to be longer as they could operate independently of the power generation elements of the Proposed Development.

4.5.2 At the end of its operating life, it is anticipated that all above-ground equipment associated with the Proposed Development will be decommissioned and removed from the Site. Prior to removing the plant and equipment, all residues and operating chemicals will be cleaned out from the plant and disposed of in an appropriate manner.

4.5.3 The bulk of the plant and equipment will have some limited residual value as scrap or recyclable materials, and the construction contractor will be encouraged to use materials that could be recycled.

4.5.4 Prohibited materials such as asbestos, polychlorinated biphenyls (PCBs), ozone depleting substances and carcinogenic materials will not be allowed within the design of the Proposed Development. Other materials recognised to pose a risk to health, but which are not prohibited, will be subject to a detailed risk assessment.

4.5.5 Prevention of contamination is a specific requirement of the Environmental Permit for the operation of the Proposed Development and therefore it is being designed such that it will not create any new areas of ground contamination or pathways to receptors as a result of construction or operation. Once the plant and equipment have been removed to ground level, it is expected that the hardstanding and sealed concrete areas will be left in place. Any areas of the Proposed Development that are below ground level will be backfilled to ground level to leave a levelled area.

4.5.6 A Decommissioning Plan (including Decommissioning Environmental Management Plan (DEMP)) will be produced and agreed with the Environment Agency as part of the Environmental Permitting and site surrender process. The DEMP will consider in detail all potential environmental risks and contain guidance on how risks can be removed, mitigated or managed. This will include details of how surface water drainage should be managed on the PCC during decommissioning and demolition.

4.5.7 The Decommissioning Plan will include an outline programme of works. It is anticipated that it would take up to a year to decommission the PCC, with demolition following thereafter, taking approximately two years to complete.

4.5.8 During decommissioning and demolition there will be a requirement for the provision of office accommodation and welfare facilities.

4.5.9 Any demolition contractor would have a legal obligation to consider decommissioning and demolition under the CDM Regulations 2015, or the equivalent prevailing legislation at that time.

4.5.10 Decommissioning activities will be conducted in accordance with the appropriate guidance and legislation at the time of the Proposed Developments closure. All decommissioning activities will be undertaken in accordance with the waste hierarchy. Materials and waste produced during decommissioning and demolition will be stored in segregated areas to maximise reuse and recycling. All materials that cannot be reused or recycled will be removed from the Site and transferred to suitably permitted waste recovery/disposal facilities. It is anticipated that a large proportion of the materials resulting from demolition will be recycled and a record will be kept in order to demonstrate that the maximum level of recycling and reuse has been achieved.

4.5.11 Upon completion of the decommissioning programme, including any remediation works that might be required, the Environment Agency will be invited to witness a post-decommissioning inspection by site staff. All records from the decommissioning process will be made available for inspection by the Environment Agency and other relevant statutory bodies, in accordance with the Environmental Permit requirements.

4.5.12 In the light of the control measures set out above that would form part of the proposed DEMP, decommissioning is not anticipated to present any significant environmental impacts beyond those assessed for the construction phase of the Proposed Development and are not assessed separately in this PEI Report.

4.6 Elements of the Proposed Development Consented under a Deemed Marine Licence

Marine Licensing

4.6.1 In England, the Marine and Coastal Access Act (2009) (MCAA) provides that a ML is required for certain ‘licensable activities’ within the UK Marine Area (Section 42, MCAA). These activities include deposits, removals and construction/’alteration’ works (Section 66, MCAA).

4.6.2 Whether issued via a ‘standalone’ Marine Licence Application (MLA) or a licence ‘deemed’ within the body of the DCO i.e. a Deemed Marine Licence (DML), the MMO is the body responsible for issuing, revoking and enforcing a Marine Licence.

4.6.3 Several aspects of the Proposed Development are likely to require a ML from the MMO. It is the Applicant’s intention to secure the ML via a DML.

CO_2 Export Pipeline – On-shore Section

4.6.4 The on-shore section of the CO_2 Export Pipeline includes a portion of the corridor which is below MHWS and above MLWS. Construction works are subject to ongoing design refinement but are likely to be using trenchless technologies. This would be to avoid impact on the most sensitive features of the surrounding environment.

Water Intake Refurbishment and/or Replacement

4.6.5 Pending the condition of the existing intake infrastructure, works may be required below MHWS in the River Tees.

Outfall Tunnel Refurbishment and/or Replacement

4.6.6 Pending the condition of the existing outfall infrastructure, works may be required below MHWS at Coatham Sands within the wider Tees Bay to refurbish or replace the existing discharge. Works are subject to ongoing design refinement but are likely to include a combination of open-cut trenching techniques and trenchless technologies to reach a suitable discharge point within the Tees Bay whilst minimising impact to the surrounding environment. At the outfall head, the emplacement of a suitable discharge head would also be required via a jack-up barge or similar.

Tees Crossings

4.6.7 The CO_2 Gathering Network and the natural gas connection both require a crossing underneath the River Tees using pipelines or a bored tunnel which is below MWHS.

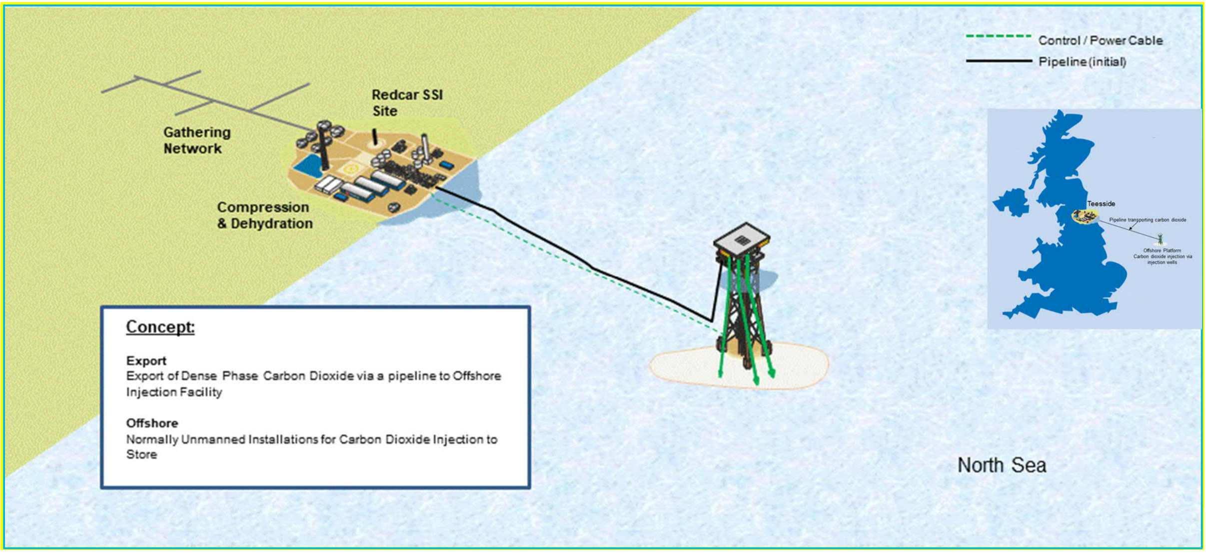
4.7 Off-shore Elements Consented under a Separate Marine Licence

4.7.1 The following parts of the Proposed Development will be located off-shore below MHWS and consented under a separate ML, supported by a separate EIA (see Diagram 4.2):

- installation of the continuation of the CO_2 Export Pipeline from below MLWS to the geological storage facility, located beneath the North Sea approximately 150 km to the east south-east of Teesside; and
- the construction of either a sub-sea injection system or an un-manned platform for the injection of exported CO_2 using a well or wells drilled into the underground storage reservoir over 1,000 m below sea level. The injection wells will be drilled and completed using a jack-up drilling rig.

Net Zero Teesside

Diagram 4.2 Offshore Elements of the NZT Project



4.8 References

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