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6.0 CONSIDERATION OF ALTERNATIVES

6.1 Background

- 6.1.1 This chapter of the Environmental Statement (ES) sets out the alternatives that have been considered during the evolution of the Proposed Development and design process as presented in **Chapter 4: The Proposed Development and Chapter 5: Construction Programme and Management** (ES Volume I – **Application Document Ref. 6.2**).
- 6.1.2 The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 (the ‘EIA Regulations’) (HMSO, 2017) state that an Environmental Statement (ES) should contain ‘*A description of the reasonable alternatives (for example in terms of development design, technology, location, size and scale) studied by the developer, which are relevant to the proposed project and its specific characteristics, and an indication of the main reasons for selecting the chosen, option, including a comparison of the environmental effects*’ (Regulation 14(2)(e)). This chapter recognises and fulfils this requirement in respect of the Proposed Development.
- 6.1.3 On the matter of alternatives, National Policy Statement (NPS) EN-1 (DECC, 2011) paragraphs 4.4.1 and 4.4.2 state that ‘*This NPS does not contain any general requirement to consider alternatives or to establish whether the proposed project represents the best option. However, applicants are obliged to include in their ES, as a matter of fact, information about the main alternatives they have studied. This should include an indication of the main reasons for the applicant’s choice, taking into account the environmental, social and economic effects and including, where relevant, technical and commercial feasibility.*’
- 6.1.4 In this context, the consideration of alternatives and design evolution has been undertaken with the aim of developing a low carbon dispatchable power station to meet the identified national need for such facilities, while avoiding and/ or reducing adverse environmental effects (following the mitigation hierarchy of avoid, reduce and, if possible, remedy) whilst also maximising its wider benefits, maintaining operational efficiency and cost-effectiveness, and considering other relevant matters such as available land and planning policy.
- 6.1.5 The design, including options for cooling water supply and the location of construction laydown, has evolved through further engineering design work, in response to consultation feedback and with reference to additional surveys and technical studies that have been completed. Detailed design work will proceed once the project moves into the Front End Engineering Design (FEED) stage, which is due to commence in 2021, although any changes that result from the FEED work will remain within the design parameters set by the draft DCO (**Application Document Ref. 2.1**).

6.2 The Need for the Proposed Development

6.2.1 The need for the Proposed Development is set out in **Chapter 7: Legislative Context and Planning Policy (ES Volume I – Application Document Ref. 6.2)** and is in accordance with NPS EN-1 and the Energy White Paper – Powering our Net Zero Future’ (EWP) (HM Government, 2020), and the Clean Growth Strategy (Department for Business, Energy & Industrial Strategy, 2017). The alternative ‘do-nothing’ scenario is described in Section 6.7 including the reasons for the Applicant proceeding with the Proposed Development.

6.3 Alternative Sites

6.3.1 The Keadby Power Station site has been selected by the Applicant for the development of a Low Carbon Gas Generating Station, as opposed to other potentially available sites for the following reasons:

- the Proposed Development Site has excellent links to existing infrastructure including electrical grid and gas, (specifically the National Grid electricity and natural gas transmission networks and low voltage electricity from Northern Powergrid 132kV substation); water (given proximity to both the Stainforth and Keadby Canal and River Trent) and transport (A18 and M180 as well as waterborne options);
- the Proposed Development Site is in close proximity to the Zero Carbon Humber (ZCH) Partnership cluster and discussions with National Grid Carbon (NGC) have determined that the proposed Humber Low Carbon Pipeline (HLCP) can directly connect into the Proposed Development Site to enable the transport of captured carbon dioxide from the Proposed Development to permanent geological storage in the southern North Sea;
- the Proposed PCC Site is a brownfield site which is considered more appropriate to redevelop for large scale power generation than a greenfield one;
- the location of the Proposed PCC Site minimises interference with the Landscape and Creative Conservation Plan for Keadby 2 Power Station and specifically, the Habitat Management Areas secured via Conditions 31-34 inclusive of the Section 36 consent for Keadby 2 Power Station;
- the Proposed PCC Site provides sufficient space to accommodate the required scale of power generation and carbon capture infrastructure (a single high efficiency combined cycle gas turbine (CCGT) unit and a carbon capture plan (CCP)), without encroaching on the exclusion areas for the Keadby Wind Farm turbines to the north and the existing overhead lines to the south and east;
- the Proposed Development Site is located largely within the boundary of the existing Keadby Power Station site (and associated land within the ownership or control of the Applicant); and
- the Proposed PCC Site is located in close proximity to the existing Keadby 1 and proposed Keadby 2 Power Stations (under construction), providing opportunities for synergies and efficiencies for the Proposed Development.

6.4 Alternative Technologies and Fuels

- 6.4.1 The UK Government is currently developing its policy and investment framework to support low carbon technologies. Various low carbon solutions are being developed in the UK for dispatchable generating stations including fuel switching to hydrogen, but the most mature low carbon technology for large scale dispatchable power generation at the time of developing the Proposed Development is a post-combustion CCP.
- 6.4.2 Within the EIA Scoping Report (**Appendix 1A** (ES Volume II – **Application Document Ref. 6.3**)), the Applicant confirmed that two alternative low carbon technology pathways were initially under consideration for the Proposed Development:
- firing of the Low Carbon Gas Generating Station using natural gas supplied by National Grid Gas with post-combustion capture of the carbon dioxide emitted from the process. In this case, the carbon dioxide would be sent into the ZCH Partnership cluster network pipeline (now notified to PINS as the 'Humber Low Carbon Pipeline') for end usage and long-term storage; and
 - hydrogen-firing of the Low Carbon Gas Generating Station, with hydrogen generation and associated carbon capture carried out off-site by others.
- 6.4.3 Following issue of the EIA Scoping Report, the Applicant decided that its preferred low carbon technology option would be a low carbon enabled Gas Generating Station equipped with CCP equipment. One reason for this decision was that the location of the Proposed Development would allow for connection into the emerging proposals for the ZCH Cluster carbon dioxide pipeline, which at that time, had progressed further than the alternative hydrogen option. In addition, at that time there was no guaranteed or adequate supply of sufficient volumes of hydrogen to fuel the generating station. For these reasons, the alternative low carbon pathway initially considered (hydrogen-firing) was discounted.
- 6.4.4 A number of solvent licensors offer carbon capture systems, each having developed carbon capture solvents to optimise performance, in terms of carbon capture efficiency, minimising energy cost of solvent recovery and minimising environmental emissions. Many, but not all, solvents are based on amine solutions and amine-based carbon capture has therefore been included within the Proposed Development design considerations in order to minimise technology risks. The selection of the preferred licensor will be informed by an assessment of Best Available Techniques (BAT).
- 6.4.5 The final decision has not yet been made on the choice of vendor for the generating station or licensor for the CCP equipment and solvent provider and will not be made until the detailed design stage of the project. Therefore, the design of the Proposed Development at this stage 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. In order to provide a robust assessment of the likely significant environmental effects of the Proposed Development, the EIA has been undertaken adopting the

principles of the 'Rochdale Envelope' approach (Advice Note 9, PINS 2018) where appropriate. This involves assessing the maximum (or where relevant, minimum) parameters for the elements where flexibility needs to be retained (emissions performance, building dimensions or operational modes for example). As such, this ES represents a reasonable worst-case assessment of the potential impacts of the Proposed Development at its current stage of design.

6.5 Alternative Design Options and Design Evolution

6.5.1 As part of the on-going design process, consideration has been given to a range of design options. Decisions taken regarding the concept design of the Proposed Development have, where relevant and possible, been informed by environmental appraisal and assessment work and by consultation with stakeholders.

6.5.2 A number of aspects of design have been determined. These are outlined below with reference to the relevant Work No. provided in Schedule 1 of the Draft DCO (**Application Document Ref. 2.1**) and shown in the Works Plans provided in **Application Document Ref. 4.3**:

- a single CCGT unit (**Work 1A**) and integrated CCP (**Work 1C**) would be installed in defined Work areas in the Proposed PCC Site, north of the existing overhead power lines, whilst auxiliary plant, buildings and facilities would be located south of the overhead lines. The Applicant would not build the CCGT without the CCP as the Applicant is fully committed to building a generating station which has a clear route to decarbonisation;
- the Applicant will work collaboratively with NGC to facilitate installation and operation of a carbon dioxide above ground installation (AGI) (**Work 7B**) to connect the Proposed Development's carbon dioxide compression equipment to the HLCP (**Work 7A**);
- there will be no bulk carbon dioxide storage within the Proposed Development Site;
- once operational, in certain temporary scenarios (e.g. during CCP outages) it may be necessary to run the CCGT (**Work 1A**) without carbon capture (**Work 1C**). The CCGT configuration will therefore allow the CCGT to run independently of the CCP with emissions exiting via the HRSG stack rather than via the CCP absorber stack;
- hybrid cooling (**Work 1C**) will be used for the cooling of the CCGT and carbon capture equipment, rather than once-through cooling or using air cooled condensers, as this option was ranked the highest in a BAT options assessment undertaken. The assessment included consideration of overall cooling duty, water consumption, water source and treatment, parasitic energy load and capital costs. The BAT assessment accompanying the Environmental Permit Application provides further justification for the selected option;

- the main construction and operational access to the Proposed Development Site will be to the south of Keadby Common, with access via North Pilfrey bridge from the A18 (**Work 8A**):
 - the selection of the A18 for the construction access was based on its accepted use for Keadby 2 Power Station construction and the benefits for local villages including Keadby and Althorpe of avoiding HGV traffic entering the village. Alternatives such as construction traffic routing via Ealand and Bonnyhale Road were also discounted for these reasons; and
 - the selection of the A18 for the operational access was based on its suitability along with the findings of public consultation (the DCO Stage 2 statutory consultation) since the reduction in traffic in the villages was a benefit valued by respondents.

6.5.3 The preferred concept design for the proposed Mabey Bridge replacement has been informed by initial feasibility work. The selection of the preferred option shown in **Application Document Ref. 4.16** (a composite weathering steel beam deck with integral piled foundation) over the alternative option initially under consideration (a precast prestressed beam deck integral with the piled abutment) has been informed by environmental considerations. It was determined that for the preferred option, piling could take place behind the existing bankseats, providing environmental benefits in these not having to be removed prior to construction, minimising impacts on Hatfield Waste Drain, a designated local wildlife site. An additional environmental benefit of the preferred option relates to the ability to maintain slightly higher soffit levels than the existing Mabey Bridge soffit levels, thus minimising flood risk by providing additional clearance for water to be conveyed within Hatfield Waste Drain.

6.5.4 A number of options remain under consideration for certain aspects of the Proposed Development, so options have been included and assessed within this ES including:

- the choice of cooling water supply (**Work 4**) which is subject to ongoing technical studies and stakeholder dialogue. The size and location of the hybrid cooling towers for the CCGT and CCP would be the same for either water supply option, which would comprise:
 - abstraction from the Stainforth and Keadby Canal (**Work 4A**), provided that sufficient additional abstraction from the canal is available; or otherwise
 - abstraction from the River Trent (**Work 4B**).
- the absorber tower could comprise either a single tower or two smaller towers and the towers could vary in shape but would remain within the parameters of the Rochdale Envelope assessed (Refer to Table 4-1 in **Chapter 4: The Proposed Development (ES Volume I – Application Document Ref. 6.2)**);
- the Proposed Development is likely to use generated power to supply the CCP auxiliary plant and equipment. An alternative option may also be used, with low voltage supply from the existing Northern Powergrid 132kV

Substation on Chapel Lane (**Work 3B**). The cables would be routed either north via the route of the emergency access road, or south-west across land to the south of the existing 400kV National Grid Substation;

- final stack heights and locations may change but would remain within the Work Areas shown on the Work Plans (**Application Document Ref 4.3**) and parameters of the Rochdale Envelope assessed (refer to Table 4-1 in **Chapter 4: The Proposed Development** (ES Volume I – **Application Document Ref. 6.2**);
- the final treatment and disposal option for sanitary and domestic effluent, which may either be conveyed to the existing foul sewer, subject to the agreement of the sewerage undertaker, or if this option is not feasible for the lifetime of the Proposed Development, treated in a package treatment plant and discharged to the Water Connection Corridor (**Work No. 5**);
- the need or otherwise for certain buildings and/ or enclosures; and
- the preferred surface water drainage strategy and discharge point.

6.5.5 The Rochdale Envelope approach has been applied to address these options and each has been evaluated in terms of environmental effects, constructability and land ownership. The approach taken has been described within each topic specific chapter (**Chapters 8-18** of ES Volume I – **Application Document Ref. 6.2**).

6.6 Alternative Layouts and Temporary Construction Laydown Areas

6.6.1 Two alternative locations within the wider Keadby Power Station Site boundary were considered for the Proposed Development (refer to Figure 2A in **Appendix 1A: EIA Scoping Report** (ES Volume II – **Application Document Ref. 6.3**). Option 2 was presented which encompassed the Keadby 2 Power Station laydown area, which has been allocated for future carbon capture readiness (CCR) and included consideration of the CCP being co-located in this area or on the former tank farm. This option was discounted for various environmental and technical reasons including contiguous space availability, presence of existing infrastructure, to avoid having to relocate the Keadby 2 Power Station CCR space and to allow this area to temporarily be used for maintenance works for Keadby 2 Power Station and the Proposed Development in the future.

6.6.2 Figure 2A of the EIA Scoping Report (**Appendix 1A** (ES Volume II – **Application Document Ref. 6.3**)) shows that an area was previously included in the Proposed Development Site boundary to the south-west of the Proposed PCC Site for 'construction laydown and biodiversity'. This area is currently unused and vegetated, with mounds and spoil heaps which are anticipated to contain Pulverised Fuel Ash (PFA) associated with historic coal-fired power use. Over time, semi-natural habitat has become established on this disturbed ground associated with the former Keadby Ash Tip.

6.6.3 In view of the value of this land for biodiversity (refer to **Chapter 11: Biodiversity and Nature Conservation** in ES Volume I – **Application Document Ref. 6.2**),

the Applicant has chosen to maximise use of existing land of lower biodiversity value that may be suitable for temporary laydown under their control, supplemented by additional land that is currently used as farmland, to be leased from the landowner. These areas are illustrated on **Figure 5.1** (ES Volume III – **Application Document Ref 6.4**).

6.6.4 A long list of potential laydown land parcels (both within the Applicant's control and third party land) were subject to desk based appraisal. It was concluded that in order to achieve the necessary laydown area requirements, whilst mitigating significant environmental effects (e.g. avoiding land of high value for biodiversity and known archaeological features), third party land in close proximity to the Proposed PCC Site that would be suitable for temporary laydown would be required. Final areas for laydown include:

- Area 1 – an unused parcel of land adjacent to the A18 junction improvement and Mabey Bridge replacement;
- Area 2a and 2b south of the existing access road within agricultural land;
- Area 2c – north of the existing access road and south of the Stainforth and Keadby Canal on land owned by the Applicant and including land which is in part already in use as temporary laydown for Keadby 2 Power Station construction;
- Area 3a and 3b – land within and adjacent to the Proposed PCC Site including land in use as temporary laydown for Keadby 2 Power Station construction; and
- Area 3 – within the Proposed PCC site.

6.6.5 These areas are described in **Chapter 3: The Site and Surrounding Areas** (ES Volume I – **Application Document Ref. 6.2**) and have been assessed the relevant topic specific chapters of this ES (**Chapters 8-18** (ES Volume I – **Application Document Ref. 6.2**)).

6.7 The Do-Nothing Alternative

6.7.1 It is considered that a 'do nothing' scenario is not appropriate given the established national need for new low carbon dispatchable energy generation to meet the UK's Net Zero targets (refer to **Chapter 7: Legislative Context and Planning Policy Framework** (ES Volume I – **Application Document Ref. 6.2**)).

6.7.2 A 'do nothing' alternative would mean that a first of a kind gas-fired power station with carbon capture would not be developed, meaning that dispatchable low carbon generating plant would not be available to support the increased deployment of renewables onto the UK transmission system.

6.7.3 Another key disadvantage of a 'do nothing' scenario would be the lack of additional investment in the local economy since the Proposed Development would not be developed.

6.7.4 For these reasons the do nothing scenario is not considered appropriate, although it has been assessed as part of the baseline conditions in the EIA

presented in the topic specific chapters of this ES (**Chapters 8-18** of ES Volume I – **Application Document Ref. 6.2**).

6.8 Conclusions

6.8.1 The Proposed PCC site was identified as being the most suitable for the following key reasons:

- absence of major structures requiring demolition, treatment and removal on the Proposed PCC Site;
- sufficient space is available within the Proposed PCC Site to accommodate the power generation and carbon capture equipment, without encroaching on the exclusion areas for the Keadby Wind Farm turbines to the north and the existing overhead lines to the south and east;
- the Proposed PCC Site enables connections to be developed to existing electrical, gas and, in the future, carbon dioxide pipeline infrastructure;
- adequate supplies of cooling water can be provided via the nearby Stainforth and Keadby Canal or River Trent, whilst existing infrastructure for discharge of the treated effluent into the River Trent can also be utilised; and
- use of the Proposed PCC Site minimises interference with the Landscape and Creative Conservation Plan for Keadby 2 Power Station. It also avoids areas of highest biodiversity value within the wider Keadby Power Station site.

6.8.2 The form and approach to the Proposed Development has been identified as above, taking into account potential environmental effects, alongside other factors such as technical and commercial feasibility. The design and associated connection routings have continued to evolve following consultation to inform the final Rochdale Envelope that has been assessed and included in this ES submitted as part of the DCO Application.

6.9 References

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